HYDRAULIC STRUCTURES

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Section B

Submitted to

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Question #01

a) Define reservoir also explain which type of reservoir will be more economical and why?

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 the reservoirs are artifical and made by humans while on the other hand lakes are naturally occuring bodies of water.

Reservoirs are great because they provide a supply of water, when

naturally occuring bodies of water like lakes or rivers, run dry.

Economical Type Of Reservoir

The most economical type of reservoir is Valley Dammed Reservoir because of the following reasons;

1. Benefit To Cost Ratio

Generally speaking the benefit to cost ratio of valley-dam reservoir is high as compared to other types of

reservoirs.

If for a populated township we had to design a water supply scheme and let's say we require 30 service reservoirs but contrary to this we construct a single valley dam reservoir which will be more economical and then no need for providing so many service reservoirs.

2. Storage Capacity

The valley dam reservoir may takes years to built, but once it is built, the water pools in the valley and it has a large storage capacity of water as compare to other types of reservoirs.

3. **Less Maintance**

Valley dam reservoir is functional for a large period of time without maintance as compare to the other types of reservoirs.

b) Which type of Embankment dam you will suggest in a hilly area and Why?

Ans The type of embankment that I will suggest in a hilly area is Rockfill Embankment because of the following reasons;

1 **Availability Of Material**

As rock fill embankment

consist of 50% of material as rocks. As rocks are easily available in hilly areas as compared to clay or sand which are not or rarely available in hilly areas. By using rocks in embankments in hilly areas also saves transportation charges and hence it becomes economical also.

2. Stability Of Embankment

Rockfill embankment are also known as gravity structure which are easy to build and rigid structures or gravity structures are self supported by their weights.

In hilly areas, the ground is rock type material and cannot bear the earth fill embankment, because there are more changes of sliding

of embankment whenever earthfill embankment is constructed over rocky ground surface.

3. Strength Of Embankment

The strength of rockfill embankment is more as compared to earthfill embankment. As there are more rains in hilly areas and rockfill embankment is tightly bounded and doesnot allow the water to pass through as compare to earthfill embankment in which water may penetrate during heavy floods.

Question # 02

List down different types of spillways, also mention which type of spillway will be more efficent in a condition where freezing point of water is less then -10°C in winters & why?

Ans)

Types Of Spillway

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

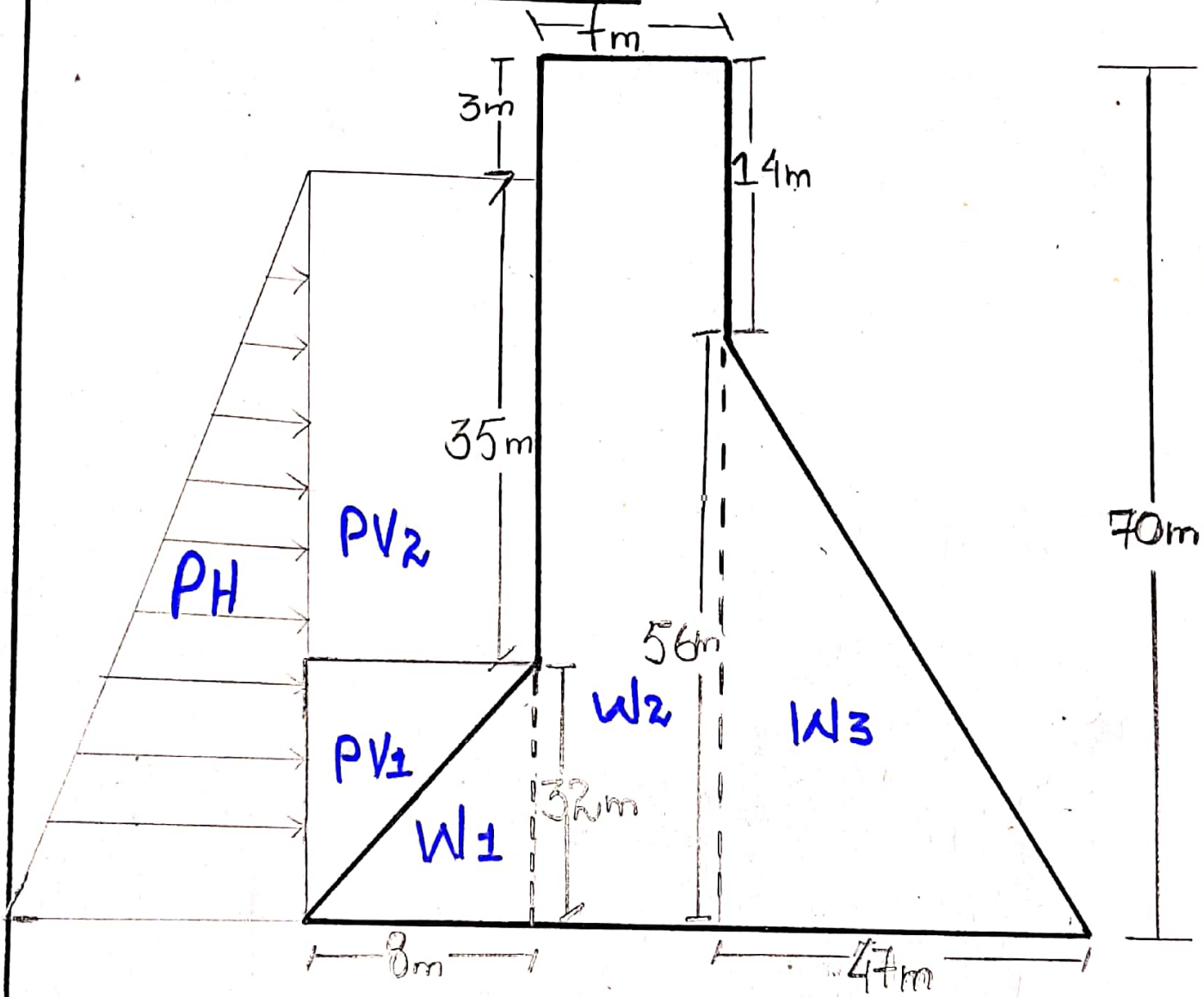
The type of spillway that I will suggest for

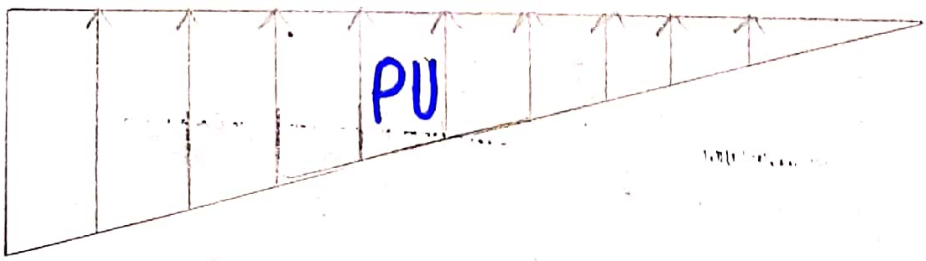
Regions where temperature in winters fall upto -10°C is Chute Spillway because of the following reasons;

1. The slope of the chute spillway is very steep and the water flows and doesnot freezes due to steep slope and the kinetic energy, increases the temperature of water.

2. The water flows from chute spillway with high pressure and will be in super-critical condition. Hence the energy of water is dissipated through dissipators provided provided in chute spillway. Once the energy is dissipated then the water doesnot freezes and dam structure will not be in danger.

Question #3





Assumptions

- Unit weight of concrete, $\gamma_d = 24\ kN/m^3$
- Unit weight of water, $\gamma_w = 10\ kN/m^3$
- $q = 1400$

Forces	Forces Calculation	FV (k.N)	FH	Lever Arm	(FxLA) Resisting Moment Mr	Overturning Moment Mo
W_1	$\frac{1}{2}$x8x32x24	3072		54+8/3 =56.67	3072x56.6 =174090.2	
W_2	7x70x24	11760		47+7/2 =50.5	11760x50.5 =593880	
W_3	$\frac{1}{2}$x47x56x24	31584		47x2/3 =31.33	31584x31.3 =989526.7	
PV_1	$\frac{1}{2}$x8x32x10	1280		54+8x2/3 =59.33	1280x59.3 =75942.40	
PV_2	35x8x10	2800		54+8/2 = 58	2800x58 =162400	
PU	$\frac{1}{2}$x62x67x10	-20770		62x2/3 =41.33		20770x41.3 =858424.1
PH	$-\frac{67^2}{2}$x10		-22445	67/3 =22.3		22445x22.3 =501196.85
	Σ	29726	22445		1995839.36	1359620.95

Eccentricity Of The Resultant Force

$$e = \frac{B}{2} - \bar{x}$$

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

$$\bar{x} = \frac{1995839.36 - 1359620.95}{29726}$$

$$\boxed{\bar{x} = 21.4}$$

So,

$$e = \frac{B}{2} - \bar{x}$$

$$e = \frac{62}{2} - 21.4$$

$$\boxed{e = 9.6\,m}$$

Factor Of Safety Against Tension

Condition

$$e < \frac{B}{6}$$

$$e < \frac{62}{6}$$

$$\boxed{9.6 < 10.3}$$ OK

→ So dam structure is safe in tension

Stresses

Condition

$$\gamma_{heel} > 0$$

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

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

$$\gamma_{toe} = \frac{29726}{62}\left(1 + \frac{6(9.6)}{2}\right)$$

$$\boxed{\gamma_{toe} = 924.9 \text{ kN/m}^2}$$

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

$$= \frac{29726}{62}\left(1 - \frac{6(9.6)}{62}\right)$$

$$\boxed{\gamma_{heel} = 34.03}$$

So,

$\gamma_{heel} > 0$ OK

→ Dam structure is safe in bearing the stresses

Factor Of Safety Against Overturning

Condition 1

$$\frac{\Sigma Mr}{\Sigma Mo} > 2$$

$$= \frac{1995839.36}{1359620.95}$$

$$= \boxed{1.46 \not> 2}$$

So, The condition is not safe and there are chances for dam to overturn.

Condition 2

$$\Sigma M_r > \Sigma M_o$$

$$1995839.36 > 1359620.95$$

Ok! Safe

Factor Of Safety Against Sliding

Condition

$$\mu \times \Sigma F_v + B \times q_r / \Sigma F_H > 1$$

$$\frac{0.75 \times 29726 + 62 \times 1400}{22445}$$

$$4.86$$

So,

$4.86 > 1$ hence dam structure will resist sliding.
