HYDRAULIC STRUCTURES

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Section A

Submitted to

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Q:1 (a)

Define reservoir, also explain which type of reservoir will be more ecnomical and why?

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 artificial 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.

Ecnomical Type of Reservoir:-

The most ecnomical type of reservoir is **Valley-dammed Reservoir**

Benifit To cost ratio:-

In term of benefit to cost ratio the most ecnomical type of reservoir is valley-dammed reservoir because it is created in valleys between mountains and usually there is an existing lake or body of water and the mountains sides are used as the walls of the reservoir to hold the water.

Large storage capacity:-

The valley-dammed reservoir may takes years to built, but onces it is built, the water pools in the valley and it has a large storage capacity of water as compare to other types of reservoir. Also this type of reservoir is functional for a large period of time without maintance as compare to other types of reservoirs.

Q:1 (b)

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

Ans The type of Embankment dam, I will suggest in a hilly area is Rock fill embankment.

Rock Fill Embankment:-

The designation "rock fill embankment" is appropriate where over 50% of the fill material may be classified as rock fill.

Reasons For Selection of Rock-fill Embankment in hilly area:-

(i) **Availability of Material:-**

As in rock-fill embankment the fill material is rock-fill, which is easily available in hilly areas and can be easily used, and saves the transportation charges and makes the embankment more economical.

Strength of Embankment:-

In hilly areas rock-fill embankment are more suitable because they have high strength as compare to earth-fill embankment.

Bearing Capacity:-

As in hilly areas, the ground surface is of rock material and it cannot bear the earthfill embankment, because there is more chances of sliding of embankment when earth-fill embankment is made on rocky surface. So it is perferable to use rock-fill embankment in hilly areas.

Q:2

List down different types of spillways.

Different types of spillways are as follows;

(1) Straight Drop spillway.

(2) Ogee spillway.

(3) Shaft spillway.

(4) Chute spillway.

(5) Side Channel spillway.

(6) Siphon spillway.

(7) Labyrinth spillway.

Q:2

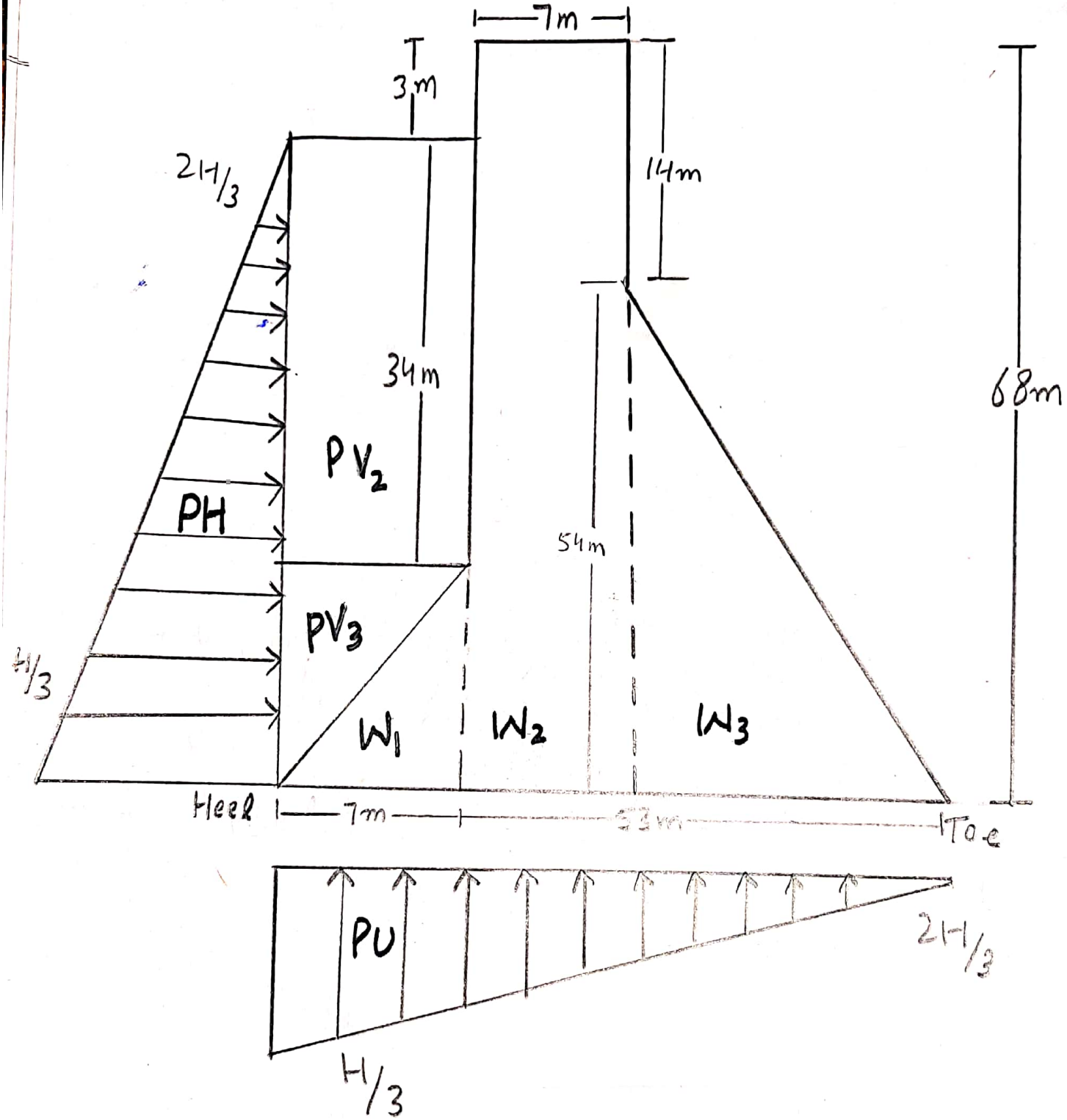
Which type of spillway will be more efficent in a condition where freezing point of water is less than -10 degree centigrade in winters and why?

Answer:- The type of spillway which will be more efficient is **Chute spillway;** due to the following reasons;

① **Steep slope:-**
The slope of the chute spillway is very steep and the water flows through it and doesnot freezes due to steep slope and the kinetic energy, increases the temperature of water and prevent the freezing of water on spillway.

② **Energy Dissipation:-**
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 in chute, and water doesnot freeze.

Q: 3



Assumption:-

Unit weight of concrete section, $\gamma_d = 24 kN/m^3$

Unit weight of water, $\gamma_w = 10 kN/m^3$

$\mu = 0.65 - 0.75$, $q = 1400$

Moment Calculation:-

Forces	Forces Calculation	Vertical Forces FV (k.N)	Horizontal Forces FH	Lever Arm L.A	Resisting Moment MR (FV x L.A)	over-turning Moment MO
W_1	$\frac{1}{2} \times 7 \times 31 \times 24$	2604		$53 + 7/3 = 55.3$	144079.3	
W_2	$7 \times 68 \times 24$	11424		$46 + 7/2 = 49.5$	565488	
W_3	$1/2 \times 46 \times 54 \times 24$	29808		$46 \times 2/3 = 30.67$	914211.36	
PV_1	$1/2 \times 7 \times 31 \times 10$	1085		$53 + \frac{2 \times 7}{3} = 57.67$	6257195	
PV_2	$34 \times 7 \times 10$	2380		$53 + 7/2 = 56.5$	134470	
PU	$-\frac{1}{2} \times 60 \times 65 \times 10$	-19500		$60 \times 2/3 = 40$		780000
PH	$-65^2/2 \times 10$		-21125	$65 \times 1/3 = 21.67$		457778.75

$\Sigma FV = 2780$ $\Sigma FH = 21125$ $\Sigma M_R = 1820820.61$ $\Sigma M_O = 1237778.75$

Eccentricity of Resultant Force:

$$e = \frac{B}{2} - \bar{x} \rightarrow (1)$$

Where

$\bar{x}$ = location of resultant force from toe.

$$\bar{x} = \frac{\Sigma M_R - \Sigma M_O}{\Sigma F_V}$$

$$\bar{x} = \frac{1820820.61 - 1237778.75}{27801}$$

$$\bar{x} = 20.97m$$

Put value of $\bar{x}$ in eq (1)

$$\Rightarrow e = \frac{60}{2} - 20.97$$

$$\boxed{e = 9.03m}$$

Factor OF Safety against Tension:-

Conditions;

(1) $e < \frac{B}{6}$

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

$$9.03 < \frac{60}{6}$$

$$9.03 < 10$$

So this condition is safe.

(2) Stress ;

$\gamma_{heel} > 0$

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

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

$$\gamma_{toe} = \frac{27801}{60}\left(1 + \frac{6(9.03)}{60}\right)$$

$$\gamma_{toe} = 881.76\ KN/m^2$$

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

$$\gamma_{heel} = \frac{27801}{60}\left(1 - \frac{6(9.03)}{60}\right)$$

$$\gamma_{heel} = 44.94\ KN/m^2.$$

$\gamma_{heel} > 0$

So, This condition is safe

③ Factor of safety against Overturning:-

$$\frac{\Sigma M_r}{\Sigma M_o} < 2$$

$$\frac{1820820.61}{1237778.75}$$

$$= 1.47 \not> 2$$

So, Not safe.

④

$$\Sigma M_r > \Sigma M_o$$

$$1820820.61 > 1237708.33$$

So this condition is safe.

⑤ Factor of safety (F.O.S) against Sliding:

$$\frac{\mu \times \Sigma F_v + B \times q}{\Sigma F_H} > 1$$

$$\frac{0.75 \times 27801 + 60 \times 1400}{21125}$$

$$= 4.96 > 1$$

So this condition is safe.