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Section : B

Paper : Hydraulic Structure

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Q NO 1 (a)

Reservoir:-

A natural or artificial place where water is collected and stored for use, especially water for supplying a community, irrigating land, furnishing power etc.

Service reservoir are more economical because it will be of less construction cost. construction cost are less as compared with other reservoirs. It will be entirely man made.

service reservoir are of less time of construction.
service reservoir are take less time on construction.

Q No 1. (b)

Rockfill Embankment dam:-

Rockfill Embankment dam are best and economical in hilly areas.

- Because Rockfill dam are appropriate for construction at location where suitable rock can be near the dam site, and where the foundations will not be subjects to material settelment due to loading or erosion from any seepage through or under the dam.
- It's material are easily available near the dam it cheap and economical since material can be sourced from near the dams location.

- This type of dam also be suitable in areas that cannot present the best condition for deep foundations.

Q No.2. Types of Spillways.

1. Overflow spillway:

→ Also called Ogee shaped (S-shaped) spillways.
→ This type of spillway allows the passage of the flood wave over its crest (which is S-shaped).
→ Widely used on Gravity dams, Arch dams and Buttress dams.

→ Reduce the impact of water at downstream.

→ Reduce scouring.
→ Used for small concrete dams.

2. Chute spillway:

→ Discharge is conveyed from the reservoir to the d/s through an open channel.
→ Profile is influenced by site topography.
→ Used for earth fill dam.

→ Crest of spillway is kept normal to its centre line.

3. Side channel spillway :-

→ It is used when dam is not rigid and it is undesirable to pass flood water over the dam.

→ After passing crossing over the spillway rest water flows parallel to the crest.

4. Saddle spillway :-

→ Constructed when other types of spillways are not favourable.

→ There may be some natural depressions on the periphery of the reservoir basin away from the dam.

5. Emergency spillway :-

→ Rarely used.

→ Extra spillways provided on a project in case of emergency.

→ Used to convey frequently occurring outflow rates.

6. Siphon spillway:-

→ Designed by the principle of siphon.
→ when water rises over FRL then water start spilling.

~~→ when water rises~~
→ There is an air vent for removing the entrapped pressure from the water.

7. Shaft spillway:-

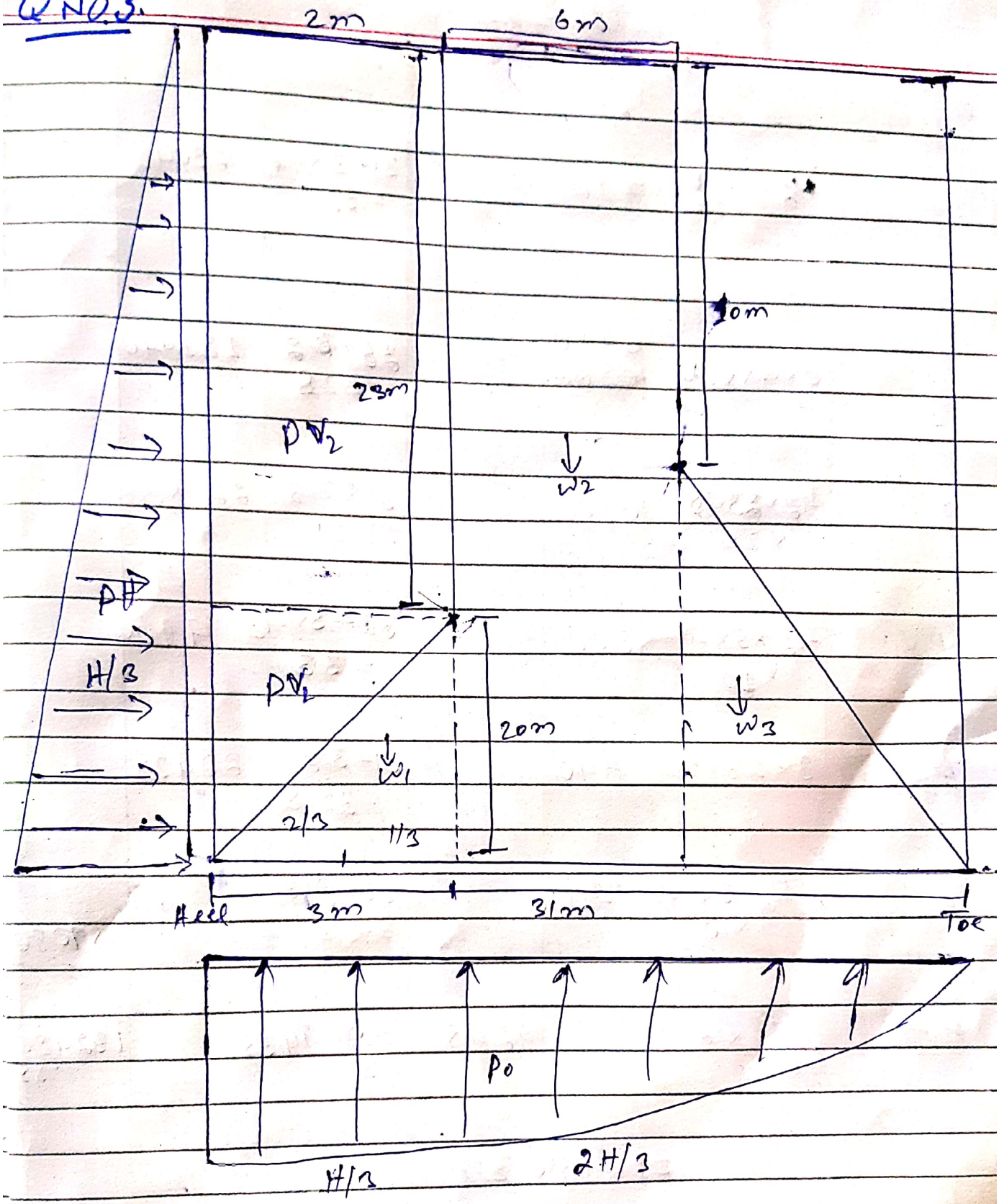
→ The shape is just like a funnel.
→ Water drops through a vertical shaft to a horizontal conduit that conveys the water past the dam.
→ Also called as glory hole spillway.

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 reservoirs rises above the normal pool level, the surplus water falls freely from the crest of the weir and hence it is known as straight drop spillway. or over fall spillway.

This is type of spillway quitely suitable for the regions where the temperature remains down and water quickly changes to the ice due to its greater width the spillway will not be close due to the ice and don't make damages to spillway as well as provide free flow the water cum ice, all other type of spillway are not for the condition mentioned due to its small and narrow width.

Q NO.3.



Forces	Force calculation	FV (KN)	FH	Lever Arm	Mv	Mo
W_1	1/2 x 3 x 20 x 24	720		31 + 3 x 1/3 = 32	23040	
W_2	6 x 45 x 24	6480		25 x 1/2 = 28	181440	
W_3	1/2 x 25 x 35 x 24	10500		31 x 2/3 = 21	220500	
PV_1	1/2 x 3 x 20 x 10	300		31 + 3 x 2/3 = 33	9900	
PV_2	3 x 23 x 10	690		31 + 3/2 = 32.5	22425	
Pu	-1/2 x 34 x 42 x 10	-7140		33 x 2/3 = 22		159080
PH	$\frac{43^2}{2}$ x 10		9245	$\frac{43}{3}$ = 14.33		132480 x .85
		ΣFv = 11550	ΣFH = -9245		ΣMr = 457300	ΣMo = 284500 x .85

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

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

$$\bar{x} = \frac{457305 - 289560.85}{11550}$$

$$\bar{x} = 14.52$$

$$e = \frac{34}{2} - 14.52 = 17 - 14.52 = 2.48$$

Factor of safety for tension

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

$$2.48 < \frac{34}{6}$$

$$\boxed{2.48 < 5.67}$$ OK in tension.

Stress Wheel > 0

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

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

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

$\gamma_{toe} = (339.71)(1+0.48)$

$\gamma_{toe} = (339.71)(1.48)$

$\boxed{\gamma_{toe} = 502.778}$

$\gamma_{heel} > 0.$

$\gamma_{heel} = \frac{1155}{34}\left(1 - \frac{6 \times 2.48}{34}\right)$

$\gamma_{heel} = (339.71)(1-0.44)$

$\gamma_{heel} = (339.71(0.56)$

$\gamma_{heel} = 190.24$ OK (safe)

→ Factors of safety against overturning.

$\frac{\Sigma M_r}{\Sigma M_o} > 2.$

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

1.58 < 2 (Not safe).

$\Sigma M_r > \Sigma M_o$

$457305 > 289560.85$

OK.

→ F.O.S against sliding

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

(0.65 to 0.75
$\mu = 0.7$
$q = 1400$)

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

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

$6.02 > 1$ (OK safe against sliding)