15th Oct,
SATURDAY

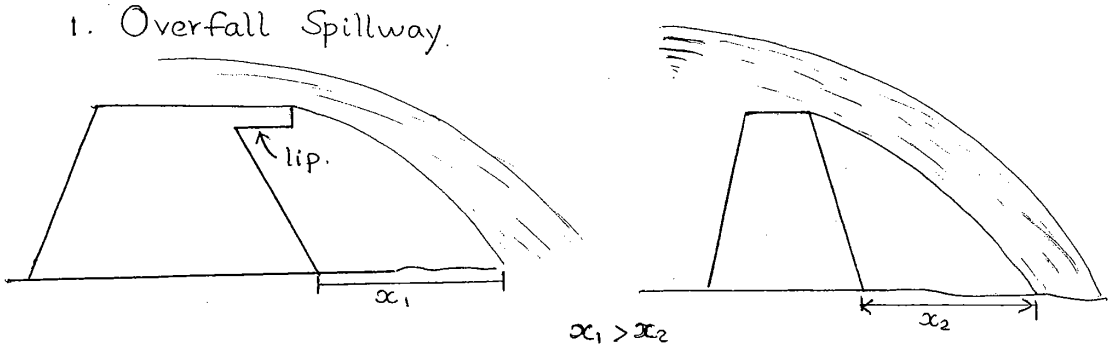
04. SPILLWAYS

Spillways are used to release excess flow entering into the reservoir.

- It is a safety ~~wall~~ valve for the dam.
- It is located along the length of dam or can be seperated.
- It can be provided along rim of a reservoir or in a saddle. or in an abutment of a dam.

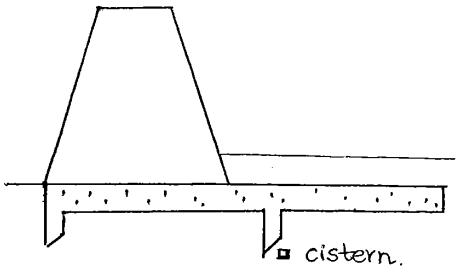
→ Types of Spillways.

1. Overfall Spillway.



In a spillway with lip, jet of water away from spillway.

In a spillway without lip, erosion of soil occurs due to impact of water on soil



Erosion is prevented in an overfall spillway by providing a cistern.

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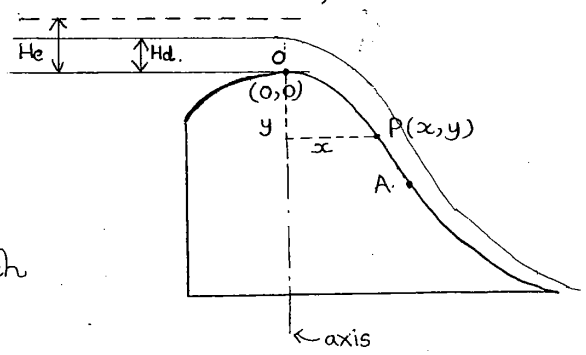
2. Overflow Spillway or Ogee Spillway



H_d = design head.

$H_e = H_d + \frac{V_a^2}{2g}$.

$\frac{V_a^2}{2g}$ → velocity of approach

Case 1: $H = H_d$

- max. discharge,
- jet of water flows along the d/s face.
- atmospheric pressure

Case 2: $H < H_d$

- less discharge
- depressed nappe is formed.
- subject to +ve hydrostatic pressure (> atm. pressure)

Case 3: $H > H_d$

- seperation of flow occurs
- flow loses its contact with surface.
- (-ve) pressure develops.
- water boils, bubbles form. Bubbles are carried by water to a high pressure zone and collapse,
- cavitation occurs

* Equation of d/s profile for OA portion:

$$x^n = K H_d^{(n-1)} y.$$

For u/s vertical, $n = 1.85$ & $K = 2$.

$$\boxed{x^{1.85} = 2 H_d^{0.85} y.}$$

From model studies, it has been observed that

if $H > 33.5\%\ Hd$, -ve pressure $= 0.35\ Hd$ (at axis).

-ve pressure $= 0.5\ Hd$ (at a distance of $0.2\ Hd$ from axis towards u/s)

* **Discharge, $Q = C\ Le\ He^{3/2}$**

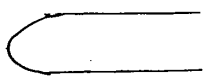
* where Le, effective length $= L - 2(K_p N + K_a) He$.

$L \rightarrow$ clear length of spillway.

L = total length − no. of piers * thickness of each pier.

Le is used to account for end contractions that occurs due to pier, abutments etc.

$K_p \rightarrow$ pier contraction coeffecient = f(shape of pier).



■ cut water nose pier (less energy loss).

■ blund nose pier (more losses).

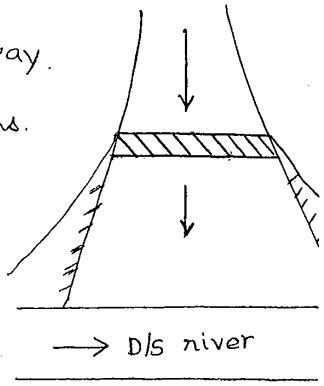
$N \rightarrow$ no. of piers.

$K_a \rightarrow$ abutment contraction coeffecient.

$C \rightarrow$ coeffecient of discharge. (≈ 2.2)

3. Chute / Trough / Open Channel Spillway.

- preferrable for rockfill or earthen dams.
- erodable nature of bed of river.
- abutment of dam.

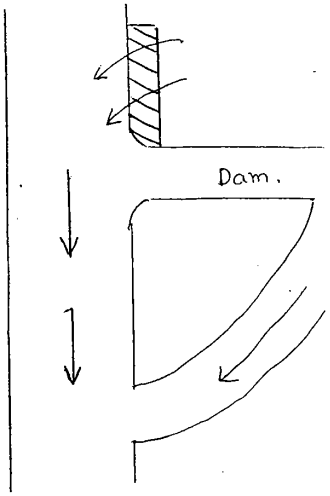


4. Side Channel Spillway

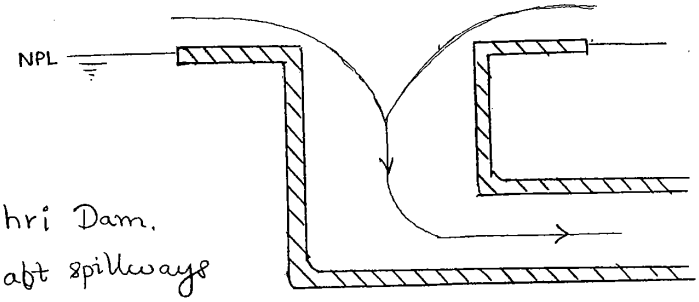
- wherever chute spillway is not possible.

5. Shaft Spillway

- provided in the reservoir
- whenever space is not available for spillway, shaft spillway is preferred.
- It has a shaft connected to a horizontal section embedded in the foundation of a dam, which is then connected to diversion tunnels.

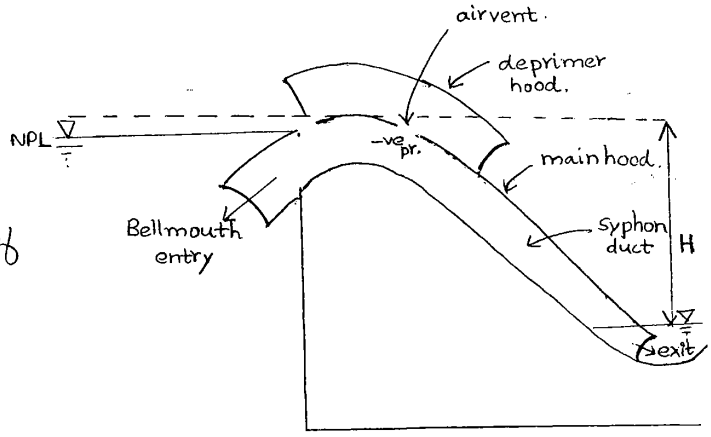


□ side channel spillway.



Eg: Tehri Dam.
(4 shaft spillways
one chute spillway)

6. Syphon Spillway



Bellmouth entry:

To prevent entry of floating matter into the syphon passage.

Deprimer hood:

To prime the passage

Exit:

to prevent entry of air.

* $\boxed{\text{Discharge, } Q = C_d A \sqrt{2gH}}$

where A → length of spillway. ; b → throat depth.

$A = L \times b.$

- used when less space is available.

01. $C_d = 2.4$, $H_d = 2$, $L = 100$ m.

$$Q = C_d L H^{3/2}$$

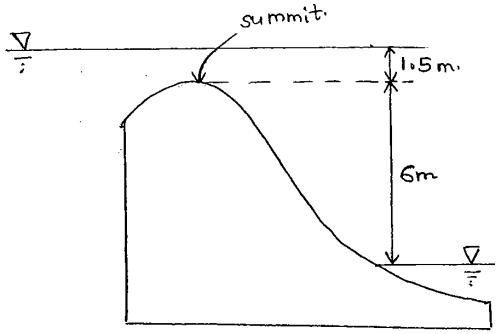
$$= 2.4 \times 100 \times 2^{3/2}$$

$$= 678 \text{ m}^3/\text{s}$$

02. $H = 6 + 1.5 = 7.5$ m.

$A = 4 \times 1 = 4$ m^2.

$C_d = 0.6$



$$Q = C_d A \sqrt{2gH}$$

$$= 0.6 \times 4 \sqrt{2g \times 7.5}$$

$$= 29.11 \text{ m}^3/\text{s}$$

Q. A discharge of 72 m^3/s is to be allowed through syphon spillways of 2m width and 75 cm depth, with working head of 8m. The no. of spillways to be provided will be ___ (Assume $C_d = 0.64$).

$$\text{Discharge, } Q = C_d A \sqrt{2gH}$$

$$= 0.64 \times 2 \times 0.75 \sqrt{2g \times 8}$$

$$= 12.025 \text{ m}^3/\text{s}$$

$$\text{No. of spillways} = \frac{\text{Total discharge}}{\text{Discharge per spillway}} = \frac{72}{12.025} \approx 6 \text{ nos}$$