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Soil-Water Conservation Engineering and Structures

Presented By-

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Chute spillway

- Chute spillway is a spillway whose discharge is conveyed from the upper reach of the channel or a reservoir to the downstream channel level through an open channel placed along a dam, abutment, or through a saddle. Chute structures are useful for gully head control and they could be used for drops upto 5 to 6 m.
- Chute spillways are constructed at the gully head to convey the discharge from upstream area of gully into the gully through a concrete or masonry open channel, when drop height exceeds the economic limit of drop structures. Chute spillway has more advantage than a drop spillway, when a large runoff volume is required to be discharged from the area. Flow in a chute spillway is at super-critical velocities.



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- It is permanent type gully control structures in which the excess runoff are passed through chute spillway. This type of structure is recommended for G-3 type of gully where the gully depth is more than 3 meter.

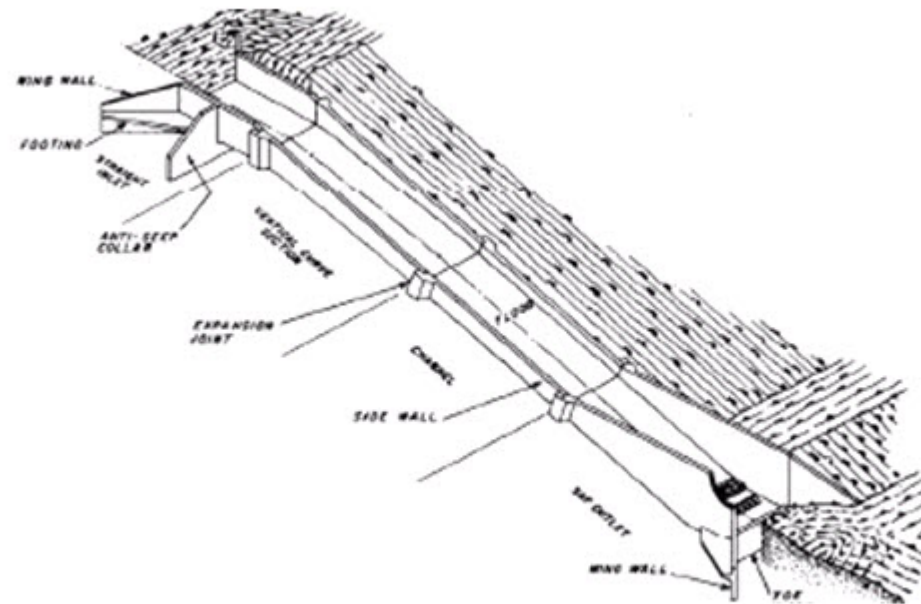


Fig. 13.5. Chute structures. (Source: SCS, 1984)



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Uses of chute spillway:-

- (i) to control gully head;
- (ii) to convey the runoff from upstream areas into the gully, very smoothly without erosion;
- (iii) as a structure for flood prevention, water conservation and collection of sediments and
- (iv) for controlling the gradient of natural or artificial channels.

Adaptability:-

The chute spillways are suitable for following conditions:

- (i) For high overfalls, where a full flow structure is required.
- (ii) Where site conditions are not suitable for constructing drop spillway.
- (iii) This spillway can also be constructed in combination of check dams and other detention type structures.



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Components of Chute Spillway

The chute spillway consists of the following three design components :

Inlet or Entrance Channel: The most common type of inlets used in chute spillways are the straight inlet, box type inlet and sometimes side channel inlet also. The box type inlet is generally used in a situation when straight type inlet is not sufficient to carry the runoff at the desired drop.

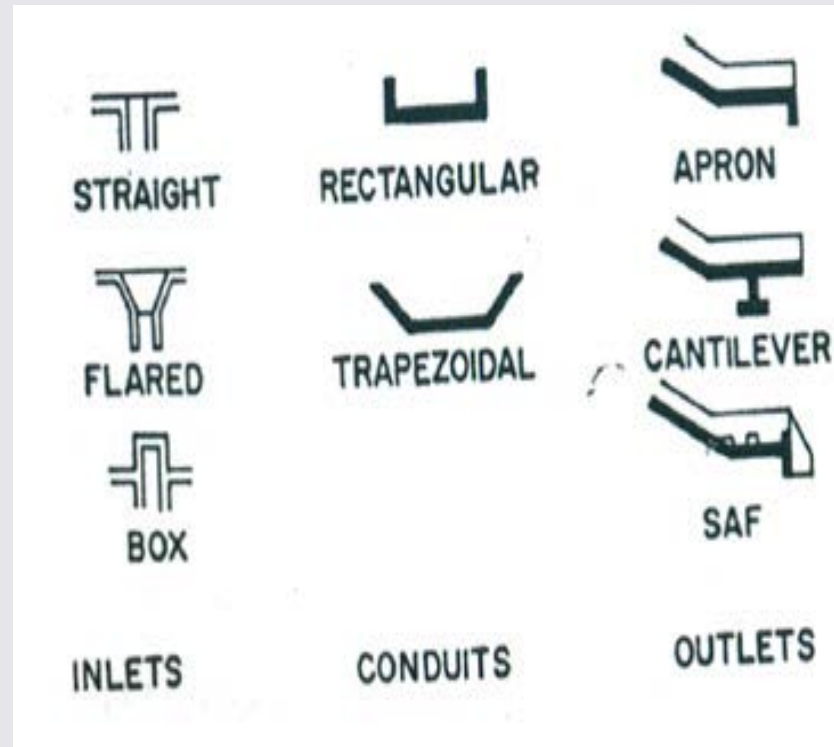
Channel Section or Conduit: In chute spillway, the rectangular type conduits are mostly common. The side walls of conduit confine the flow rate and discharge distribution. The top edge of side walls is constructed in such a way that it may be flushed with the embankment slope. The vertical curve section is continued through the channel in such a manner so that it conveys and guides the discharge to the lower elevation without erosion.



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Outlet: The outlet dissipates the energy of the flowing water and provides non-erosive velocity downstream. Straight apron type outlets are most commonly used in small gully control structures.





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Material for Construction

- A chute spillway usually requires less masonry or concrete than a drop structure of the same capacity and drop.
- To minimize problems of settling and undermining, chute spillways are constructed on foundations on solid ground or on fill that has been carefully compacted under controlled conditions.
- Reinforced concrete, brick, or stone masonry are used for chute construction.



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Energy Dissipaters

- The water flowing over the spillway acquires a lot of kinetic energy by the time it reaches near the toe of the spillway (because of conversion of potential energy into kinetic energy). If arrangements are not made to dissipate this huge kinetic energy of water, and if the velocity of water is not reduced, large scale scour can take place on the downstream side near the toe of the dam and away from it. These arrangements are known as energy dissipation arrangements or energy dissipaters.



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Design Features

- Design of a chute spillway includes the design of the inlet, the channel section and the outlet.
- **Inlet:** The design procedure for inlets is the same as described under drop spillways. The discharge that the spillway is expected to convey is determined from hydrological data. The capacity of a chute spillway is usually controlled by the inlet section. The inlets convey and guide the designed discharge and provide cutoff of flow by piping under and around the chute channel. To calculate the inflow capacity of chute spillway, the following weir formula may be used:

$$Q=1.66LH^{3/2}$$

where, Q = peak discharge rate (m³/s) which is to be handled by the structure; L = Length of crest (m) and H = head above the crest (m).

- **Channel Section:** Design of channel cross-section is similar to the design of open channel, in which bottom width, top width, side slope and depth are determined for a given discharge rate. For this purpose, Manning's formula is used.



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Outlet: The design principle of outlet of chute spillway is similar to the design of outlet of drop structures . The hydraulic jump is used as the means of energy dissipation. In the design of outlets using the hydraulic jump, the sequent-initial depths ratio (y_2/y_1) is important. Here y_1 and y_2 are the flow depths before and after the jump respectively.

In a rectangular channel the depth ratio is: $y_2/y_1 = 1/2((\sqrt{1+8F_1^2})-1)$

where, F_1 = Froude number is given by $v_1/\sqrt{gy_1}$; = the flow velocity before occurrence of hydraulic jump (m/s); g = acceleration due to gravity (m/s^2).

