Design Criteria for Drop Inlet and Morning Glory Spillways

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These criteria apply to the design of drop inlet and morning glory spillways which may be used as the principal spillway for ponds, irrigation reservoirs, and stabilization structures.

Various types of stabilization structures and the storm frequency for which they should be designed are discussed in UMC Guide 1509 "Types of Stabilization Structures."

The drop inlet and morning glory are usually used in conjunction with an emergency spillway. See UMC Guide 1517 "Emergency Spillways, Part 2-Design."

**Drop Inlet**

**Description:** Common uses of drop inlet spillways are shown in Fig. 1.

- To discharge water from terraces, grass waterways, and diversions into a main drainageway.
- In grade stabilization structures, ponds or irrigation reservoirs.

**Figure 1. Examples of installations using drop inlet or morning glory spillways.**

The drop inlet spillway consists of a vertical riser connected to a sloping conduit. The riser may be of corrugated or smooth metal pipe, or concrete. The conduit may be of corrugated or smooth metal pipe. Reinforced concrete may be used for the conduit in larger structures but is not included in this Guide.

**Adaptability:** The drop inlet spillway is best adapted to overfalls greater than 8 feet and to sites where a good emergency spillway, or adequate detention storage, can be provided. It may also be used as a road culvert, or to lower surface water to a drainage ditch.

**Figure 2. Dimensions of the drop inlet.**
Compared with canopy inlets and hood inlets, the drop inlet requires a smaller depth of water over the entrance to cause full conduit flow.

**Design:** The details needed to design the drop inlet are given in Fig. 2. Note that two different riser diameters are given.

The riser diameters in columns 2 and 3 of the table in Fig. 2 are approximately 1 ½ times the diameter of the conduit. If this diameter riser is used the riser height Z may vary from 2 to 4 times the conduit diameter as long as the upper end of the conduit is at least 2 feet below the top of the riser as indicated in Fig. 2.

The riser diameter in columns 6 and 7 of the table in Fig. 2 are such that the area of the riser will be at least 1 ½ times the area of the conduit. If this diameter riser is used, the riser height Z must be at least 5 times the conduit diameter.

The entrance head, indicated by H on the sketch in Fig. 2, varies with the riser diameter and the type of conduit as indicated in the table. The entrance heads given in Fig. 2 are those required to cause sufficient flow into the riser equal to the discharge capacity for a 50-foot conduit with a 24-foot head. These capacities may be obtained from UMC Guide 1520 "Discharge Capacity Tables for Canopy, Hood, Morning Glory and Drop Inlet Spillways". In practically all installations the spillway capacity will be less than this, so the entrance heads given in Figure 2 should be adequate. If a spillway has less capacity the entrance head will be less. The required entrance head for any installation can be computed by the equation:

\[
H^{3/2} = \frac{Q, \text{ cfs}}{3.1 \left[(3.14 \times \text{Riser Diameter}) - \text{Obstructions, feet}\right]}
\]

The difference in elevation between the top of the riser and the emergency spillway must be equal to and in most cases will exceed the required entrance head.

The conduit should be attached to the riser at the proper angle and at least 6 inches above the base of the riser. Care must be taken that this connection will be durable and watertight. Also be sure that the conduit inlet is not obstructed by the base material.

The capacities of drop inlet spillways with full conduit flow are given in UMC Guide 1520, "Discharge Capacity Tables for Canopy, Hood, Morning Glory, and Drop Inlet Spillways".

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**Morning Glory**

**Description:** Examples of the use of morning glory spillway are shown in Fig. 1.

The morning glory is constructed by forming earth about the pipe to the desired shape of the structure, placing 4 inches of concrete on the shaped earth with the reinforcing mesh located as indicated in Fig. 3.

The dimensions for the construction of the morning glory and the minimum entrance head required to cause the conduit to flow full are given in Fig. 3.

Compared with the drop inlet, the morning glory inlet requires a smaller depth of flow over the entrance to cause the conduit to flow full.

**Design:** If the morning glory is constructed to the dimensions given in Fig. 3, the conduit will flow full when the water surface over the top of the morning glory reaches the depth indicated as "minimum entrance head" in Fig. 3. The difference in elevation between the top of the morning glory and the side spillway must be equal to, and in most installations will exceed the "minimum entrance head."

The capacity of morning glory structures are given in UMC Guide 1520, "Discharge Capacity Tables for Canopy, Hood, Morning Glory and Drop Inlet Spillways."

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**Materials and Construction**

See UMC Guide 1515 "Selecting Materials for and Installing Principal Spillways" and Guide 1546 "Designing and Constructing Earth Embankments" for information on the selection of material and construction of Morning Glory and Drop Inlet Structures.

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