SECTION 14

CHUTE SPILLWAYS

1. INTRODUCTION

Definitions. Chute spillways are defined as open channels with steep slopes, in which flow has supercritical velocities. They usually consist of an inlet, vertical curve section, channel, and outlet. The major part of the drop in water surface takes place in a channel. Flow passes through the inlet and down a paved, steeply sloped channel to the floor of the outlet. (See ES-78, page 2.143.) Various designs and proportions are in use. Further research and systematic evaluations of experience with existing structures will lead to continued improvement in design and proportions. However, confidence can be placed in the design principles contained herein, for they are conservative when available information does not permit them to be stated precisely.

The word "chute" will be used to mean chute spillway.

Component Parts. As mentioned before, a chute is generally composed of four component parts, namely:

a. Inlet
b. Vertical curve section
c. Paved, steeply sloped channel
d. Outlet

In most instances, these component parts are structurally independent. Five types of inlets are in common use, three of which are treated in this section. The five types are:

a. Straight inlet (See ES-82, page 2.13.)
b. Box inlet (See ES-90, ES-91, ES-92, and ES-93, pages 2.31, 2.55, 2.79, and 2.95.)
c. Side-channel inlet (See ES-85, page 2.113.)
d. Culvert inlet (See Fig. 1a, page 1.2.)
e. Drop inlet or box-culvert inlet (See Fig. 1b, page 1.2.)

Culverts and drop inlets will be considered in the Engineering Handbook sections on Culverts and Drop Inlets. Figures 1a and 1b are schematic drawings. No inference concerning the proper proportioning of such inlets is to be made from these drawings.

Material. Reinforced concrete is by far the most widely used material for chute construction, and has proved to be satisfactory from the standpoints of long life and low construction and maintenance costs. This section considers only chutes constructed of reinforced concrete.

Purposes. Chutes are used for the following purposes:

a. To control the gradient in either natural or constructed channels.
b. To serve as reservoir spillways for flood-control and water-conservation structures, and sediment-collecting structures.

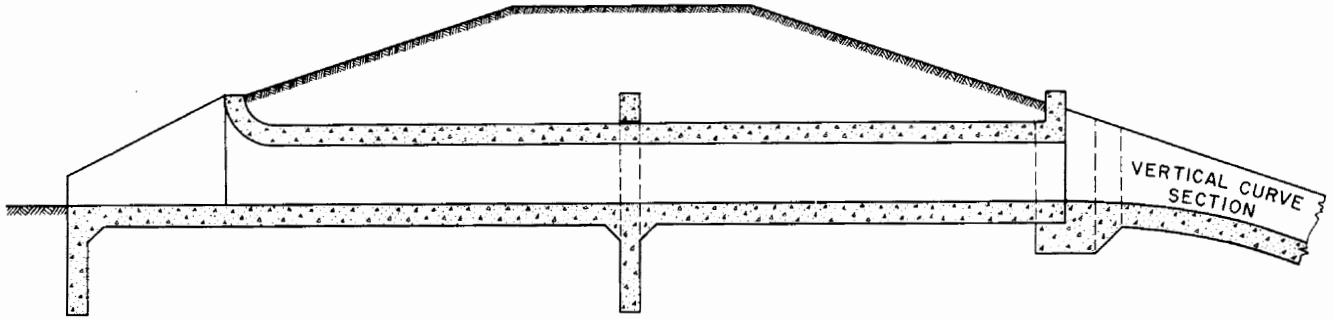


FIGURE - 1a

CULVERT INLET

(NON-PRESSURE FLOW)

SECTION ALONG CENTER-LINE

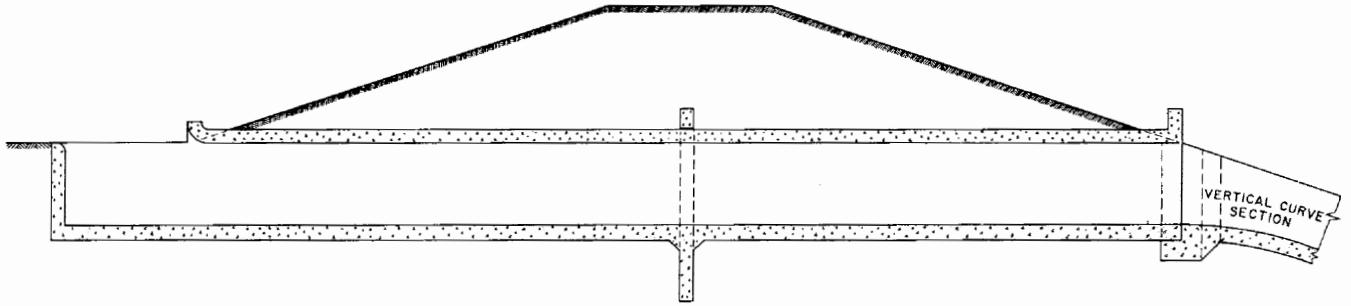


FIGURE - 1b

BOX-CULVERT INLET

(NON-PRESSURE FLOW)

SECTION ALONG CENTER-LINE

Methods of determining discharges and hydrographs from watersheds are discussed in the Engineering Handbook, Section 4, Hydrology. Determination of the rate of runoff or the hydrograph of runoff into the reservoir associated with the chute should be related to:

a. Expected life of the structure, which depends on the quality and type of material used.

b. Type and amount of damage that would result from various runoff rates through the chute that are greater than its capacity.

c. Probability or frequency of partial or complete failure as a result of the lack of spillway capacity.

The capacity-cost relationship of a chute is such that increasing the capacity of a chute causes a smaller rate of increase in the cost for concrete. Thus, insurance against failure because of a lack of capacity can be obtained for a relatively small increase in the total cost of the structure. The initial cost of a chute is usually much lower than the cost of replacing a chute that has failed completely.

The discharge the spillway is expected to convey is determined from hydrologic data and possibly reservoir routing and economic considerations. This discharge Q_r is the design discharge. Throughout the Chute Spillway Section, Q_r will be the symbol used to designate design discharge and the symbol q_r will be used to designate the design discharge per foot width of chute. When routing is considered, the design discharge is dependent in part on the relationship of the discharge head over the crest of the spillway itself. See Engineering Handbook, Section 5, Hydraulics, for methods of routing floods through reservoirs.