Channel Types and Structures

A. Introduction

The flow of water in an open channel is a common event in Iowa, whether in a natural channel or an artificial channel. Its movement is a difficult problem when everything is considered, especially with the variability of natural channels. However, in many cases the major features can be expressed in terms of only a few variables, whose behavior can be described adequately by a simple theory. The principal forces at work are those of inertia, gravity, and viscosity, each of which plays an important role.

B. Channel Types

Where open channel concepts are given approval by the Jurisdictional Engineer, the following design criteria should be used. The governing criteria for the selection of the channel type are based on the hydraulic carrying capacity of the channel from the area runoff.

1. Type I Channel:

a. Width at top of channel = 15 feet or less.

b. Minimum radius of curvature at centerline:
   1) Slopes greater than 3 feet/mile - 400 feet radius
   2) Slopes less than 3 feet/mile - 300 feet radius
   3) Curve protected with rip rap 75 feet radius

c. Maximum side slope = 1 vertical to 3 horizontal.

d. Minimum channel bottom = 4 feet.

e. For maximum velocity, see Section 2F-2, Tables 2F-2.03 and 2F-2.04.

f. Invert protection maybe required such as a concrete lined channel (cunette).

2. Type II Channel:

a. Width at top of channel = 15 feet to 35 feet.

b. Minimum radius of curvature at centerline:
   1) Slopes greater than 3 feet/mile - 600 feet radius
   2) Slopes less than 3 feet/mile - 500 feet radius
   3) Curve protected with rip rap - 100 feet radius

c. Maximum side slope = 1 vertical to 4 horizontal.

d. Minimum channel bottom = 6 feet.

e. For maximum velocity, see Section 2F-2, Tables 2F-2.03 and 2F-2.04.

f. Invert protection may be required such as a concrete lined channel (cunette).

3. Type III Channel:

a. Width at top of channel = 35 feet or greater.

b. Minimum radius of curvature at centerline:
   1) Slopes greater than 3 feet/mile - 700 feet radius
   2) Slopes less than 3 feet/mile - 600 feet radius
   3) Curve protected with rip rap - 200 feet radius

c. Paved concrete channel (cunette) required. Minimum width is 6 feet.

d. Maximum paved or rip rap side slope invert = 1/1 at depth established for 2 year frequency. If nets, meshes, or geo-grids are used adjacent to a paved channel bottom (no paved or rip rap side slope invert) the adjacent sideslope will not exceed 4% and have a minimum width of 2 feet on each side of the paved channel bottom.

e. Maximum side slope floodway = 1 vertical to 4 horizontal.

f. Maximum velocity in floodway = See Section 2F-2, Tables 2F-2.03 and 2F-2.04.

C. Drop Structures for Open Channel Flow

1. The use of channel drops is required when the channel would otherwise be too steep for design conditions. All drops should be designed to protect the upstream and downstream channel from erosion. Drop structure analysis may be required to determine the length of hydraulic jump and adequate erosion control measures.

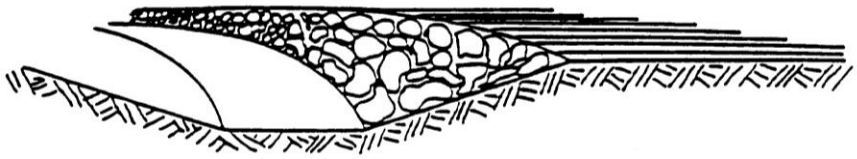
2. Vertical drops should be constructed of concrete or gabions (see Figure 2F-1.02 for example).

3. Sloped drops should be constructed of concrete, gabions, or rip rap. Rip rap drops should have a minimum of 6 inches thick gravel base and may require grouting. Engineering fabric under rip rap may be required depending on soil conditions.

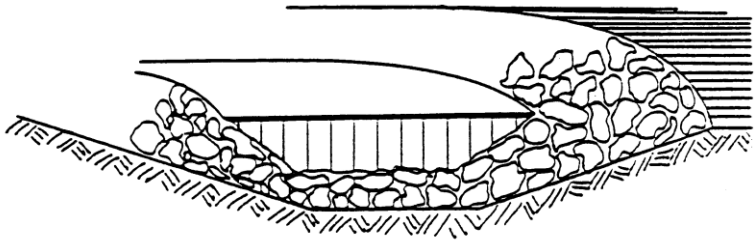
4. At drop structures, both the channel bottom and banks should be protected from erosion.

Figure 2F-1.01: Sample Channel Cross-Sections

TYPE 1 CHANNEL



TYPE 2 CHANNEL



TYPE 3 CHANNEL

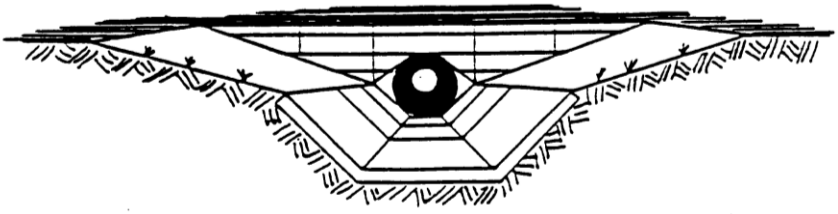


Figure 2F-1.02: Example Drop Structure for Open Channel Flow