

SOIL CONSERVATION SERVICE
KENTUCKY

STANDARD AND SPECIFICATIONS
FOR
GRADE STABILIZATION STRUCTURE

(410)

- Definition -

A structure to control the grade and head cutting in natural or artificial channels.

- Scope -

This standard applies to all types of grade stabilization structures. They may be a combination of earth embankments and mechanical spillways and may be full-flow or detention-type structures. This standard also applies to channel side-inlet structures installed to lower the water from a field elevation, a surface drain, or a waterway to deeper outlet channel. It does not apply to structures designed to control the rate of flow or to regulate the water level in channels (587).

- Purpose -

To stabilize the grade and control erosion in natural or artificial channels, to prevent the formation or advance of gullies, and to enhance environmental quality and reduce pollution hazards.

- Conditions Where Practice Applies -

In areas where the concentration and flow velocity of water require structures to stabilize the grade in channels or to control gully erosion. Special attention shall be given to maintaining or improving habitat for fish and wildlife where applicable.

- Design Criteria -

Structures

Grade stabilization structures of materials such as concrete, masonry, steel, aluminum and treated wood shall be designed in accordance with the principles outlined in Sections 5, 6, 11, and 14 of the National Engineering Handbook or Chapter 6 and 11 of the Engineering Field Manual. The structure must be designed for stability after installation. The crest of the inlet must be set at an elevation that stabilizes upstream head cutting.

Embankments

1. Embankments for all class (a) structures with mechanical pipe spillways shall meet the Standards and Specifications for Pond (378). The minimum principal spillway capacity shall be for a two-year frequency, 24 hour storm runoff. The mechanical spillway, regardless of size, may be considered in the design of the emergency spillway.

2. The design of embankments for all structures exceeding the limitations in 1 above; either in dimension or hazard, shall be based on requirement of Technical Release No 60 (TR-60) when the product of height times storage exceeds 3,000.
3. Simple structures with island type construction shall have fill sideslopes and top width that will provide a stable structure for local conditions.

Full-Flow Open Structures

Drop, chute, and box inlet drop spillways shall be designed according to the principles set forth in the Engineering Field Manual, the National Engineering Handbook, and other applicable SCS publications and reports. The minimum capacity shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 1, less any reduction because of detention.

Fabricated aluminum drop toewall structures with vertical drop of 4 feet or less and aluminum drop spillways with vertical drop of 6 feet or less may be used if flows are intermittent, downstream grades are stable, and tail water is at or near the crest of the weir at design flow.

Table 1 - Minimum Capacity of Full-Flow Structures

Maximum Drainage Area (acres)	Vertical Drop (ft)	Minimum Design Capacity 24-hr Storm	
		Principal Spillway (yr)	Total (yr)
225	5 or less	10	10*
450	10 or less	10	25

* Island Type Structures shall have a total capacity of a 25-yr frequency, 24-hr duration storm.

Riprap Chute

A grade stabilization structure constructed of rock riprap and limited to channels having a contributing drainage area of 150 acres or less.

Capacity - Chutes shall have the capacity to carry the peak runoff expected from a 10-year frequency, 24-hr storm duration, except for island type structures which shall have a total capacity (chute and emergency spillway) of a 25-year frequency, 24-hour storm duration.

Velocity - The velocity used for design shall not exceed 7.5 feet per second for erosion resistant soils and 6.5 feet per second for easily erodible soils.

Design Dimensions - The chute dimensions will be selected from the attached "Riprap Chute Design Charts".

The entrance apron shall have a minimum length of 10 feet. The exit apron shall be located at or below the elevation of a stable grade of the outlet channel and have a minimum length of 3 feet. The minimum depth of the riprap shall be 18 inches.

Bedding -Chutes shall have a bedding of at least 3 inches placed under the riprap and should have a uniform layer of bedding material spread over the entire surface of the chute to fill the voids. Geotextiles (filter fabric) may be substituted for bedding under the riprap.

Gradation - Rock riprap should meet one of the following requirements:

By Weight

<u>Maximum Weight (lbs.)</u>	<u>Min. - Max. Weight of Stone (lbs.)</u>	<u>Weight Range of 75% of Stone (lbs.)</u>
150	6-150	40-150

By Gradation

<u>Size (inches)</u>	<u>% Passing (by wt.)</u>
18	100
12	70 - 85
9	65 - 85
6	45 - 65
3	10 - 30
1 1/2	0 - 10

Bedding material should not be smaller than Ky. No. 2, Coarse Aggregate. The grading requirements for Ky. No. 2 Stone is as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
3 1/2	100
2 1/2	70 - 85
1 1/2	0 - 10

Side Inlet Drainage Structures - The design criteria for minimum capacity of open-weir or pipe structures used to lower surface water from field elevations or lateral channels into deeper open channels are shown in table 2. The minimum principal spillway capacity shall equal the design drainage curve runoff for all conditions.

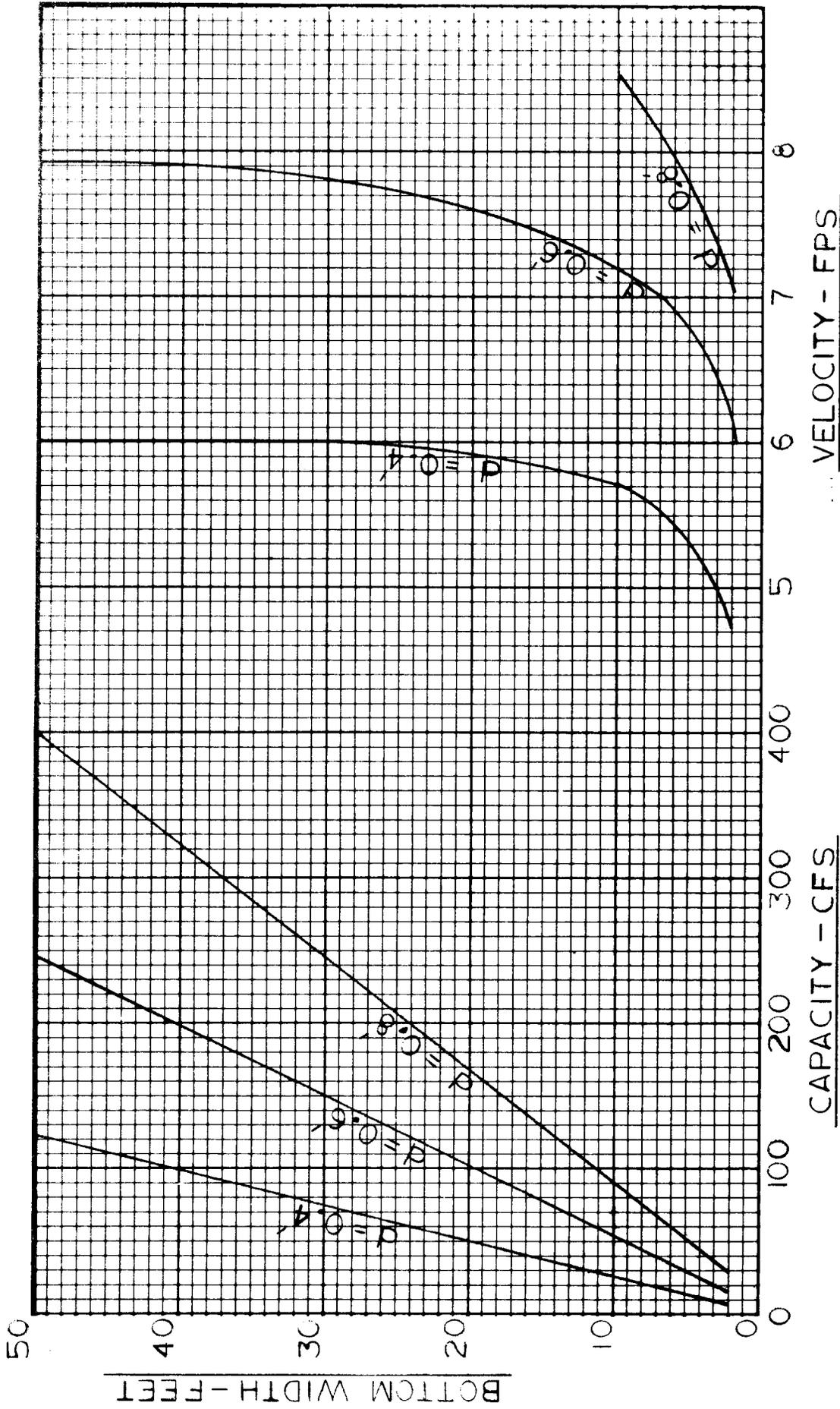
Table 2. - Criteria for determining minimum capacity of side-inlet, open-weir, or pipe-drop-drainage structure.

Maximum Drainage Area (acres)	Vertical Drop (ft)	Receiving Channel Depth (ft)	Frequency of minimum design, 24-hour duration storm
			Total Capacity (yr)
150	0 - 5	0 - 10	2
150	5 - 10	10 - 20	10

- Plans and Specifications -

Plans and specifications for the installation of grade stabilization structures shall be in keeping with this standard and shall be approved in accordance with the "Engineering Job Classification Approval Authority". Final plans and specifications should reflect the following items as needed:

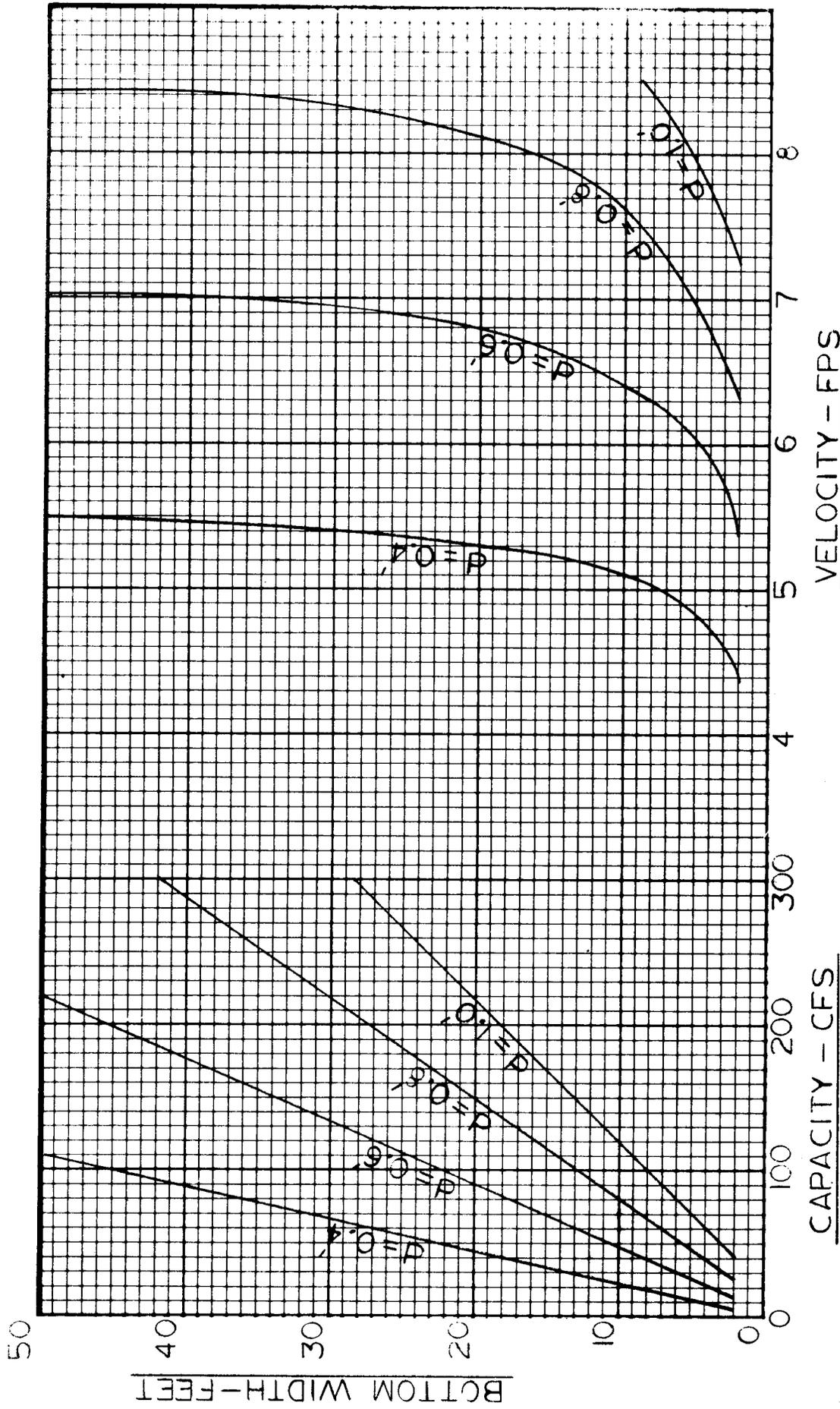
1. Specified materials shall be of a quality capable of providing the stability and durability required to achieve the planned objective with appropriate factors for safety.
2. Specifications for installation of structures, within the scope of TR-60, will be in accordance with the Guide Specifications contained in National Engineering Handbook, Section 20.
3. Measures and construction methods that enhance fish and wildlife values shall be incorporated as needed and practical.
4. Construction operations shall be carried out in such a manner that erosion and air pollution will be minimized and held within legal limits.
5. Fencing shall be specified as required.
6. The completed job shall present a workmanlike finish.
7. Any deviations from this standard shall be approved by the appropriate Soil Conservation Service Engineer.



RIPRAP CHUTE DESIGN

CHUTE SLOPE = 4:1 SIDE SLOPES = 4:1

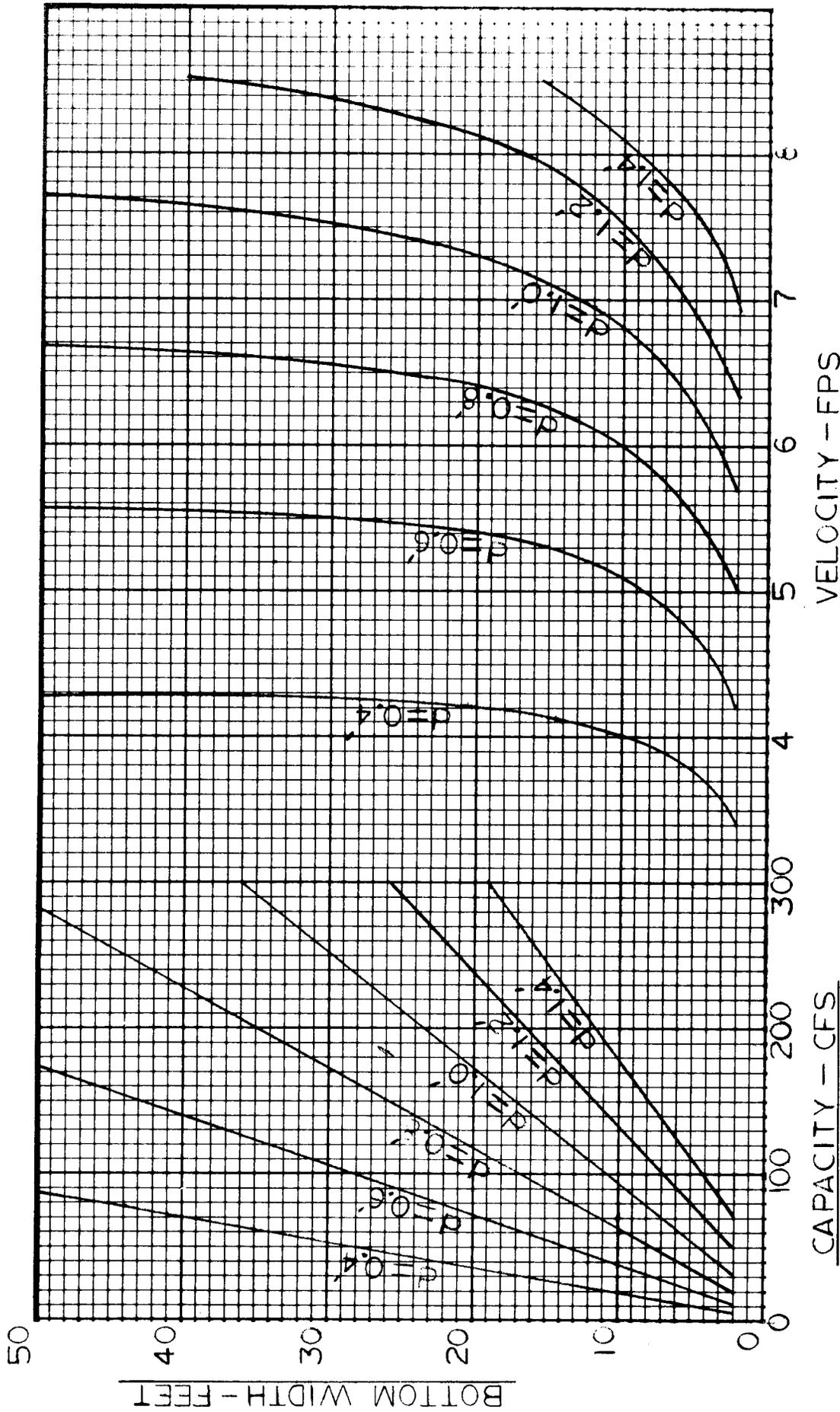
$d =$ CHUTE DEPTH



RIPRAP CHUTE DESIGN

CHUTE SLOPE = 5:1 SIDE SLOPES = 4:1

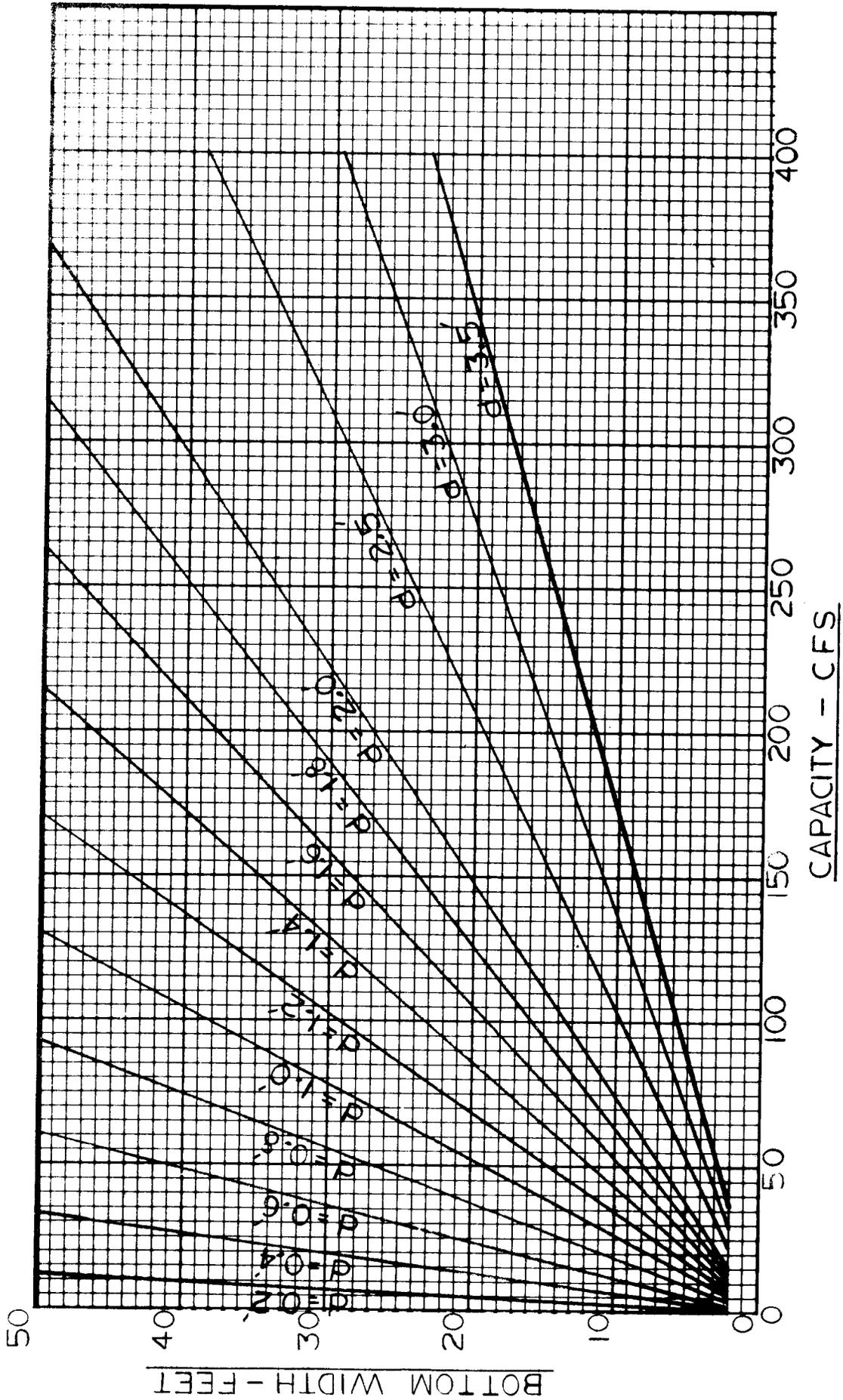
d = CHUTE DEPTH



RIPRAP CHUTE DESIGN

CHUTE SLOPE = 8:1 SIDE SLOPES = 4:1

d CHUTE DEPTH



RIPRAP CHUTE DESIGN

d = CHUTE ENTRANCE DEPTH