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Figure 108.9	Standard SS-6 Inlet
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Figure 108.13	Interception Capacity of Type DI-1 Inlet
Figure 108.14	Typical Area Inlet Depression & Concrete Apron

## SECTION 108 - INLETS

### 108.1 INLET LOCATIONS

Inlets shall be provided at locations and intervals, and shall have a minimum inflow capacity such that maximum flooding depths set forth in Figure 108.1 are not exceeded for the major or minor storm. Inlets shall be provided at all sump locations to prevent ponding of water. **It is recommended that inlets be provided at street intersections upstream of pedestrian crosswalks.** Gutter flow capacity for Greene County standard streets is shown in Figure 108.2.

### 108.2 INLET INTERCEPTION CAPACITIES

Inlet capacities shall be determined in accordance with Federal Highway Administration HEC-12 (Reference 108.1) or HEC-22 (Reference 108.4). The gutter slope to be used for design of curb opening inlets located on vertical curves shall be the average gutter slope for a distance of twenty

feet (20') upstream of the inlet. Variables for use in standard curb opening inlet computations are defined in Figures 108.3 and 108.4.

Figures 108.5 and 108.6 show capacity charts for standard type SS-5 and SS-6 curb opening inlets on grades and in sumps.

Nomographs and methods presented in the Neenah Inlet Grate Capacities report (Reference 108.2) may also be used where applicable.

The use of commercial software utilizing the methods of HEC-12 or HEC-22 is acceptable.

#### 108.2.1 Clogging Factors

The inlet capacities determined as required in this section should be reduced as follows, in order to account for partial blockage of the inlet with debris (Reference 108.3):

<u>INLET TYPE &amp; LOCATION</u>	<u>CLOGGING FACTOR</u>
Standard (Type SS-5 & SS-6) Curb Opening Inlets	
on grades	0.9
in sumps	0.8
Open-side Drop Inlet (Type DI-1)	
in sumps	0.9
(not used on grades)	---
Grated Inlets	
on grades	0.6
in sumps	0.5

Inlet lengths or areas shall be increased as required to account for clogging.

### **108.3 INTERCEPTION AND BYPASS FLOW**

It is generally not practical for inlets on slopes to intercept one hundred percent (100%) of the flow in gutters. Inlets must intercept sufficient flow to comply with street flooding depth requirements. Bypass flows shall be considered at each downstream inlet, until all flow has entered approved storm sewers or drainageways.

### **108.4 STANDARD INLET TYPES**

#### 108.4.1 Curb Opening Inlets

The standard curb opening used in Springfield and Greene County has been very successful. However, there has been a considerable amount of confusion over inlet nomenclature. The

common designations used (SS-5, SS-6, etc.) are based upon the page number on which the standard inlets appeared in the City of Springfield Design Standards. It is the intention of these standards to maintain commonly used terms while clarifying inconsistencies and confusion. The following standard curb inlet designations are recommended for use in Greene County:

A. SS-5 Inlet

The standard SS-5 curb opening inlet shall refer to a shallow standard four foot by eight foot (4' x 8') curb opening inlet with a seven foot (7') long opening, located over a storm drain with a riser pipe connecting the inlet with the storm drain pipe. The type SS-5 inlet is shown in Figure 108.7. Riser pipe capacities for use with SS-5 inlets are shown in Figure 108.8.

B. SS-6 Inlet

SS-6 inlet shall refer to a full depth standard four foot by eight foot (4' x 8') curb opening inlet with a seven foot (7') long opening, which can also serve as a junction structure. The type SS-6 inlet is shown in Figure 108.9. Precast SS-6 inlets may be provided with a six inch (6") precast top, known as a SS-6 top, or an eighteen inch (18") deep precast top, known as a SS-8 top (Figure 108.10). The largest diameter pipe which can enter the short side of a SS-6 inlet is thirty inches (30").

C. SS-6S Inlet

SS-6S inlet shall refer to a 'short' SS-6 inlet, i.e. a full depth inlet with a four foot by four foot (4' x 4') exterior dimension and a three foot (3') long opening, which can also serve as a junction structure. SS-6S inlets are intended for use in sumps serving small areas.

D. SS-6G Inlet

SS-6G inlet shall refer to a SS-6 inlet modified to include a grate in the gutter. Grates used for SS-6G inlets shall be Deeter 2048L, Neenah R3076, or equal. Grates may not extend outward from the curb any further than the width of the standard gutter, which is two feet (2'). Vanes shall be oriented in the direction of gutter flow. The type SS-6G inlet is shown in Figure 108.11.

E. Double Curb Inlets

Where necessary to meet allowable flooding depth criteria, two (2) curb opening inlets may be placed side by side. An opening shall be provided in the common walls between the inlets to provide flow from one inlet to the other. The opening shall be a minimum of eighteen inches (18") high and shall extend the entire interior width of the inlet box.

F. Construction Requirements

Curb opening inlets may be constructed of either pre-cast or cast-in-place concrete. Cast-in-place concrete construction shall meet the requirements of Chapter VII of the City of Springfield

Technical Specifications for Public Works Construction. Reinforcement shall be as shown in the standard details included in this section.

#### G. Special Inlet Box Designs

Where necessary to accommodate large diameter pipes, curb opening inlets may be specially designed. Details of concrete dimensions and reinforcement shall be included in the drawings.

#### 108.4.2 Area Inlets

##### A. Open-Side Drop Inlets, Type DI-1

Open side drop inlets are intended for use in locations where open drainage channels, ditches, or swales terminate and flow enters the storm drain system, and flows range from ten (10) to one hundred (100) cubic feet per second. These inlets are preferred in order to minimize the risk of persons being swept into an open storm drain entrance.

The standard type DI-1 inlet is shown in Figure 108.12. This inlet has a four foot by four foot (4' x 4') exterior dimension and a maximum capacity of about eighteen (18) cfs per opening at a maximum allowable depth of two feet (2'). The designer must stipulate on the drawing the number of open sides to be provided, i.e., 'Type DI-1 w/2 sides open', etc. Interception capacity data for standard DI-1 inlets are shown in Figure 108.13.

Where additional capacity is needed, larger inlet structures can be used, provided dimensions are detailed on the drawings and interception capacity calculations are submitted. The maximum allowable opening height is six inches (6"). For greater opening heights, a horizontal bar shall be placed across the opening at maximum six inches (6") intervals.

##### B. Grated Area Inlets

Grated area inlets may be provided in parking lots and lawn areas. The maximum ponding depth over grated inlets shall be eighteen inches (18") for the major (100-year) storm. Concrete dimensions and reinforcement requirements for the inlet structure and the type of grate and frame to be used shall be specified on the drawings. Gratings shall be bicycle safe.

It is recommended that a two inch (2") depression be provided for area inlets in paved parking areas in order to minimize standing water. It is also recommended that a reinforced concrete paving apron be provided for two feet (2') around the inlet in order to prevent pavement failure, and subsequent water ponding around the inlet (see Figure 108.14).

## **108.5 TYPES OF INLETS ALLOWED**

### 108.5.1 Public Streets

#### A. Curb Opening Inlets

Standard curb opening inlets are required for use in public streets with curb and gutter. Curb openings are not permitted, except in situations where the drainage area is one-half (1/2) acre or less, and there is not sufficient grade to permit installation of a storm drain pipe.

#### B. Grated Inlets

In general, the use of grated inlets will not be permitted in streets, since these generally require adjustment when streets are re-paved.

Where conditions are such that curb inlets cannot intercept the required rate of flow necessary to control street flooding depth or to provide diversion of flow to detention, sedimentation, or infiltration basins, combination grate and curb opening inlets (Type SS-6G) may be used provided that the width of the grate is no greater than the gutter width. "Trench inlets" with vaned grates may be specified with approval of the Stormwater Engineer and the Highway Administrator. Use of trench inlets will be permitted only when there is no practical alternative.

Other types of inlets will not be permitted unless approved by the Stormwater Engineer and the Highway Administrator.

### 108.5.2 Outside of Public Right-of-Way

The type of inlets specified outside of public right-of-way is left to the discretion of the designer provided the following criteria are met:

- 1) Maximum flooding depths for the major or minor storm as set forth in Figure 108.1 are not exceeded.
- 2) General safety requirements set forth in Section 108.5 are met.

## **108.6 GENERAL SAFETY REQUIREMENTS**

All inlet openings shall:

- 1) Provide for the safety of the public from being swept into the storm drainage system. The maximum allowable opening for standard curb opening inlets and open side drop inlets shall not exceed six inches (6") in height. The maximum bar spacing for grated inlets shall be six inches (6"). Where the height of the opening exceeds six inches (6"), a three-quarters inch (3/4") diameter galvanized steel bar, or other approved restriction shall be provided horizontally across the opening at mid-height, or at maximum intervals of six inches (6").

The maximum open spacing between bars for grated inlets shall be six inches (6") in any direction.

2) Be sufficiently small to prevent entry of debris which would clog the storm drainage system.

3) Be sized and oriented to provide for safety of pedestrians, bicyclists, etc.

## **108.7 REFERENCES**

1. "Drainage of Highway Pavements", Frank L. Johnson and Fred F. M. Chang, Hydraulic Engineering Circular No. 12, U.S. Department of Transportation, Federal Highway Administration, March 1984.
2. Inlet Grate Capacities for Gutter Flow and Pondered Water, Jack M. Meyer, et al, Neenah Foundry Company, Neenah, Wisconsin, 1987.
3. A Practical Approach to Designing Storm Sewer Systems. Dr. Ronald L. Rossmiller. Course notes for ASCE seminar of the same title.
4. "Urban Drainage Design Manual", S.A. Brown, S.M. Stein, and J.C. Warner, Hydraulic Engineering Circular No.22, U.S. Department of Transportation, Federal Highway Administration, November 1996.

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# ALLOWABLE FLOODING DEPTHS FOR STREETS AND PARKING LOTS

## A. PUBLIC AND PRIVATE STREETS

### 1. MINOR/CONVENIENCE STORM: 2 year storm

#### On grades:

Local streets: No crown overtopping

Collector streets: No overtopping, center 10' of street

Secondary arterials: Two - 10' lanes must remain open;  
(T = 7.5' for 36'-wide street)

Arterial streets : Flow limited to width of gutter (T=2')

#### In sumps:

Local streets: Depth shall not exceed top of curb

Collector streets: Depth shall not exceed top of curb

Secondary arterials: Two - 10' lanes must remain open;  
(Maximum spread, T = 7.5')

Arterial streets: Flow limited to width of gutter (T=2')

### 2. MAJOR/EMERGENCY STORM

#### On grades:

All classifications:    Limit 25-year storm to top of curb  
                                    Limit 100-year storm to right-of-way  
                                    Maximum depth, 100-year storm = 18" at face of curb.

#### In sumps:

All classifications:    Limit 25-year storm to right-of-way  
                                    Maximum depth, 100-year storm = 18" at face of curb.

## B. PARKING LOTS & PRIVATE DRIVES

### 1. MINOR/CONVENIENCE STORM - no requirements.

### 2. MAJOR/EMERGENCY STORM - depth shall be limited to 18" measured from the top of the grate or from the bottom of a vertical inlet opening.

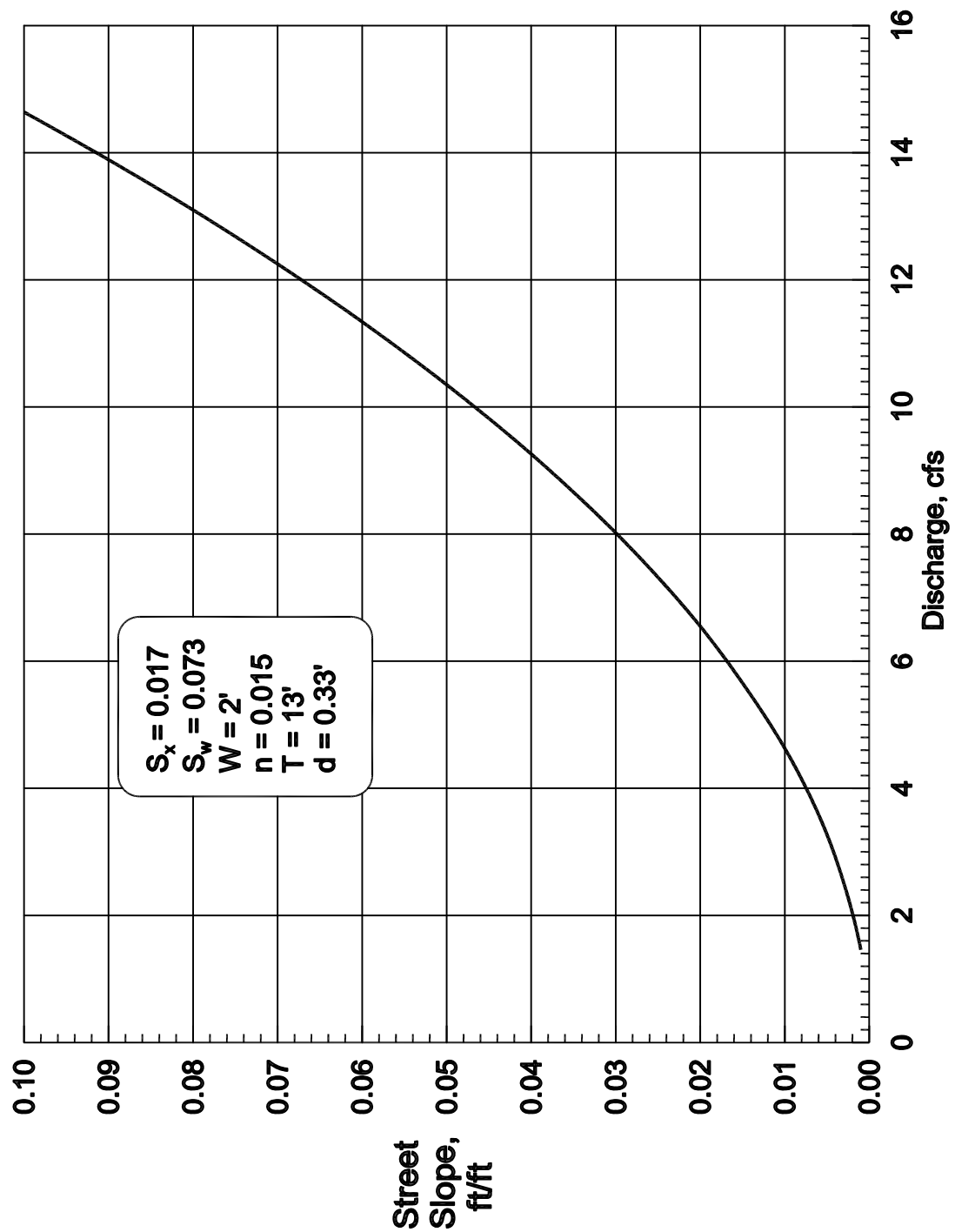
m:\data\wp51\storm2\swregs\section 108 figure 108-1.wpd

## *GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS*

ALLOWABLE FLOODING DEPTHS FOR  
STREETS AND PARKING LOTS

**FIGURE 108.1**

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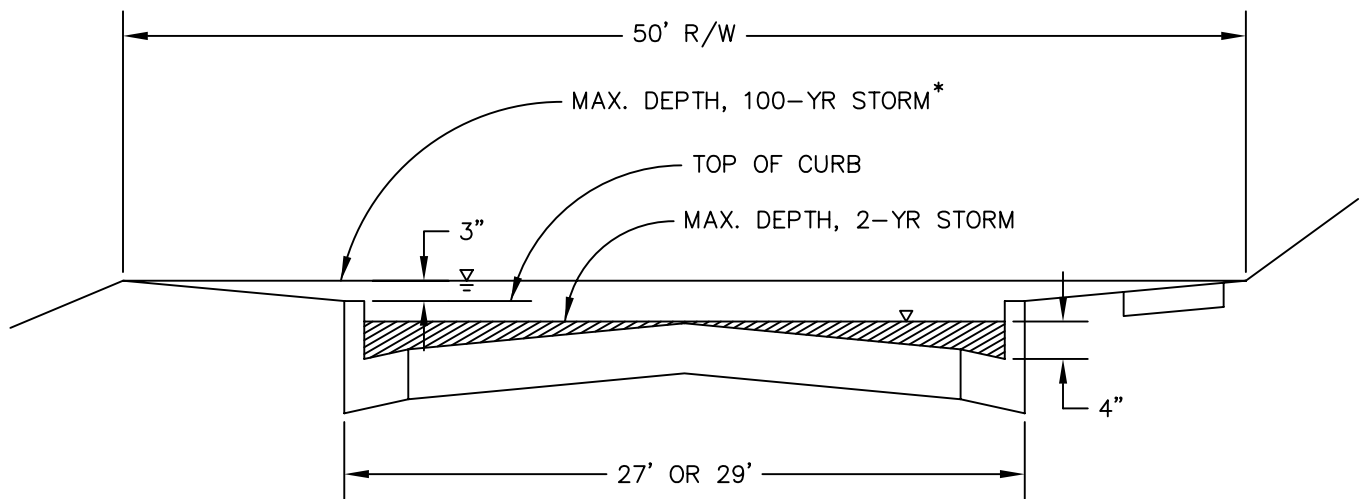
## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

INLETS  
GUTTER CAPACITY FOR  
STANDARD 27' STREET

FIGURE 108.2

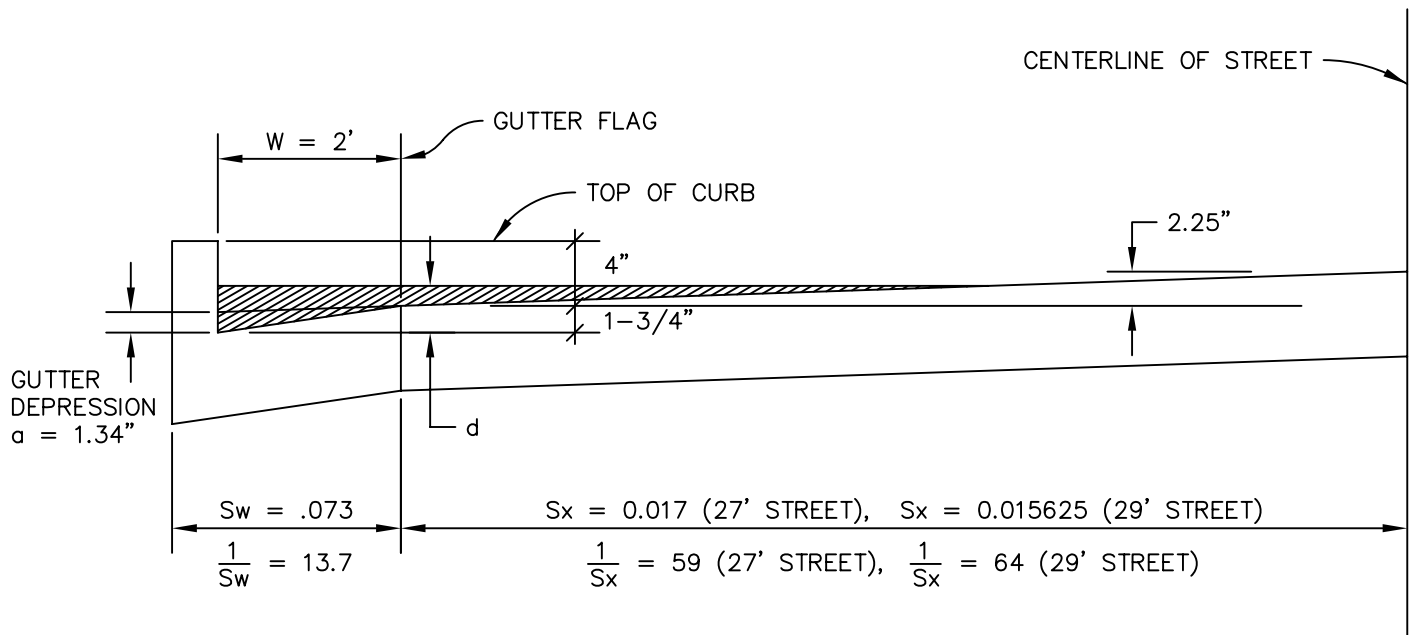
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\* IN SUMPS, KEEP  $Q_{25}$  IN R/W; MAX. DEPTH FOR  $Q_{100}$  IS 18" AT GUTTER (12" OVER TOP OF CURB)

### ALLOWABLE FLOODING DEPTHS – LOCAL STREET



$$S_w' = \frac{a}{12W} = 0.055, \quad \frac{1}{S_w'} = 18.2$$

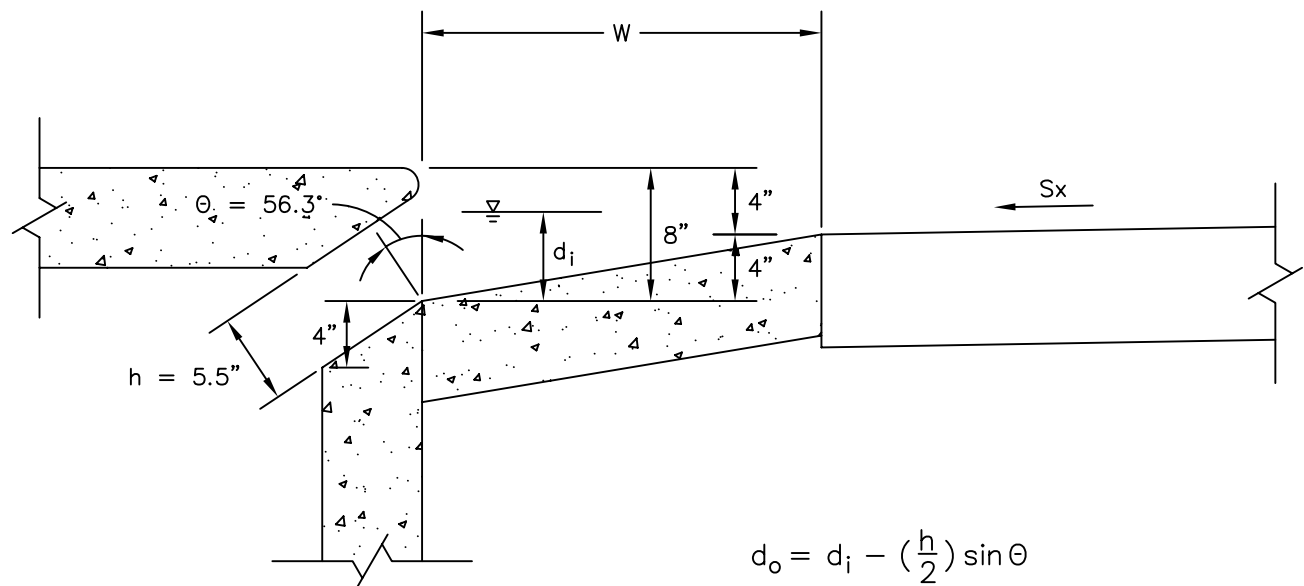
### DEFINITION SKETCH – VARIABLES FOR GUTTER FLOW AND INLET DESIGN

## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

STREET FLOODING DEPTHS, VARIABLE DEFINITIONS

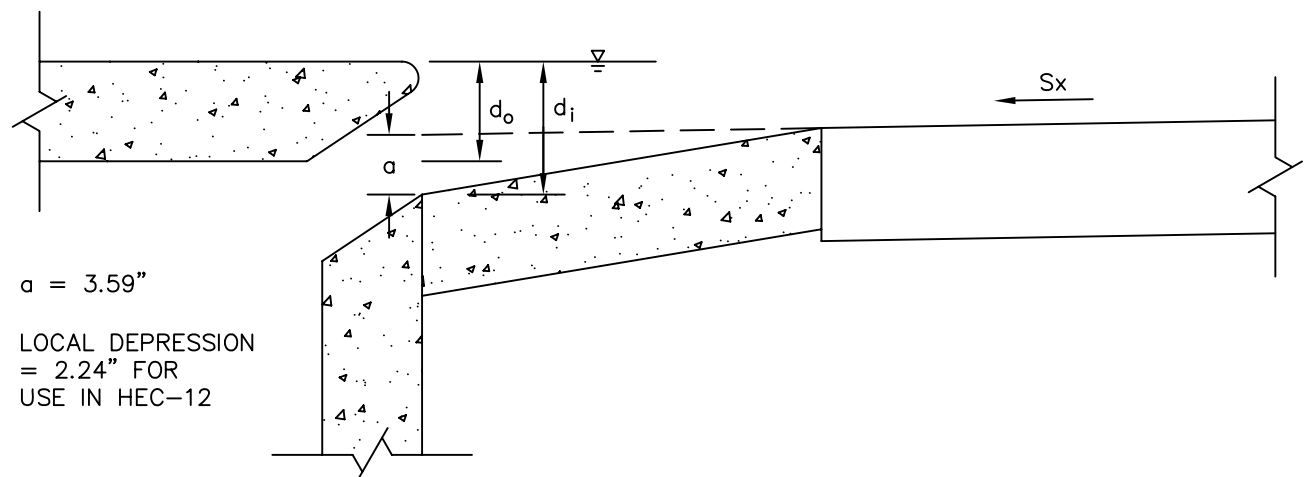
FIGURE 108.3

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$$d_o = d_i - \left(\frac{h}{2}\right) \sin \theta$$

$$d_i = d + 2.24"$$



$$a = 3.59"$$

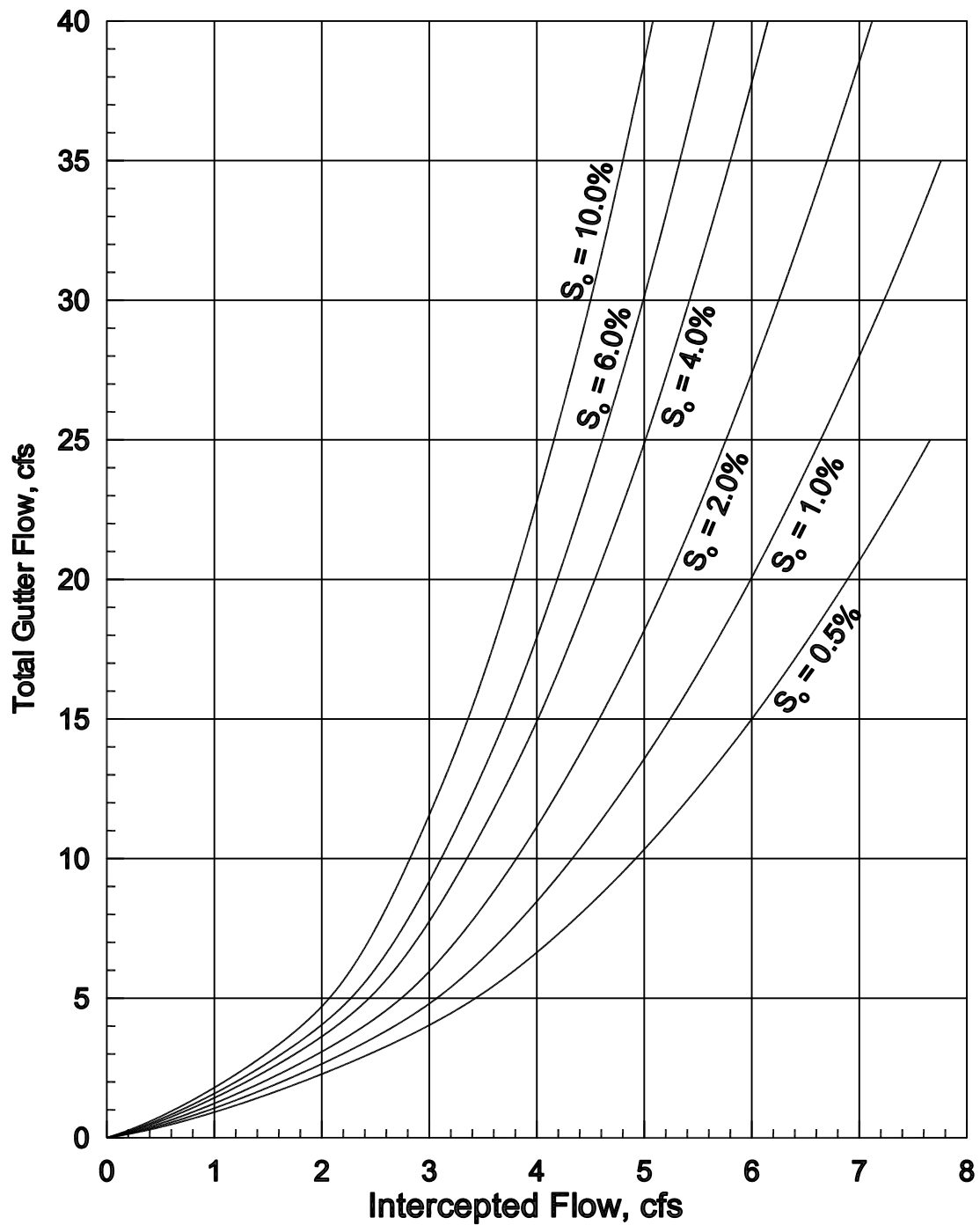
LOCAL DEPRESSION  
= 2.24" FOR  
USE IN HEC-12

## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

STANDARD CURB OPENING INLET – DEFINITION SKETCH

FIGURE 108.4

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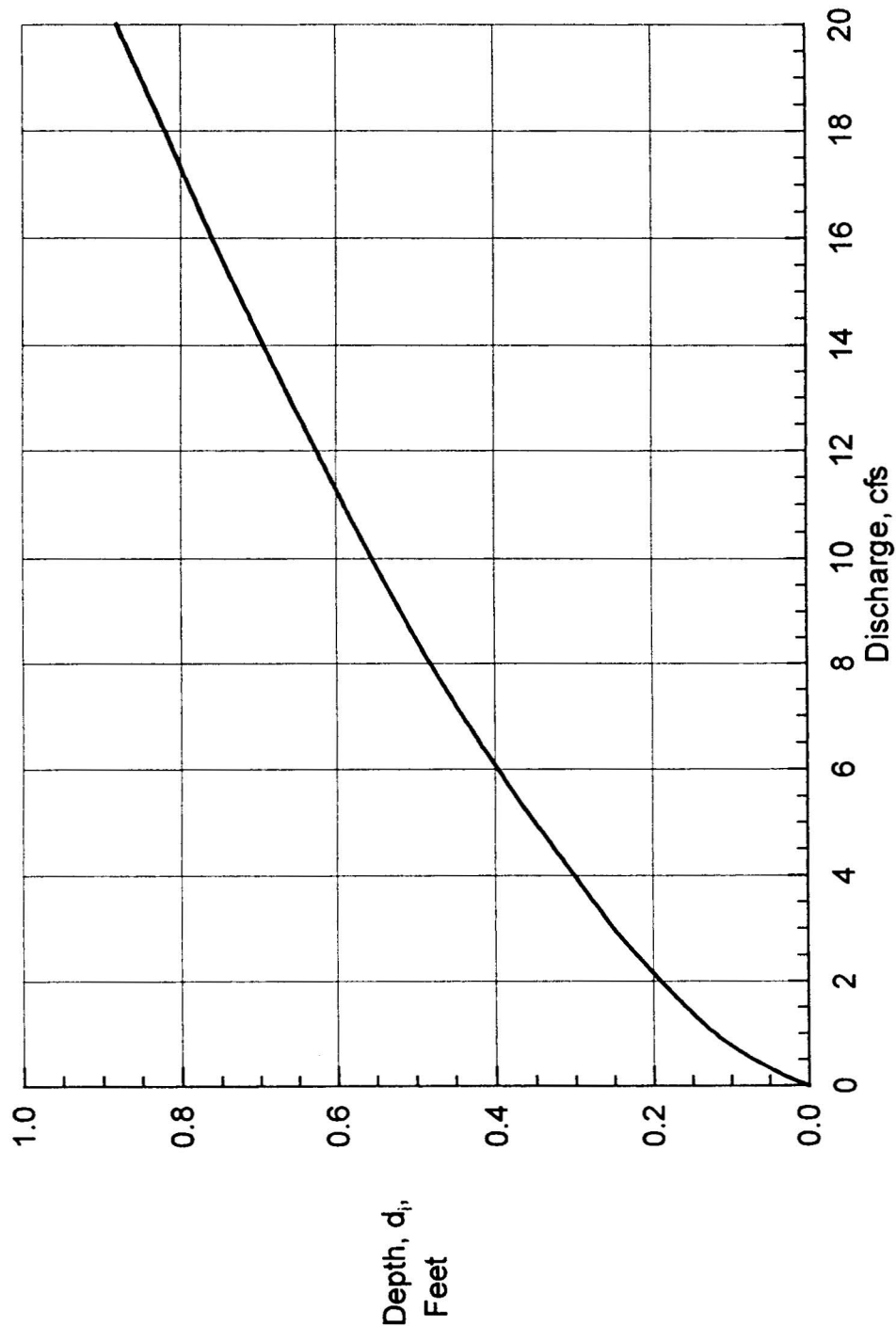


## *GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS*

INLETS  
INTERCEPTION CAPACITY FOR STANDARD  
CURB OPENING INLET, 7' OPENING

**FIGURE 108.5**

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DATE: 04/05/99



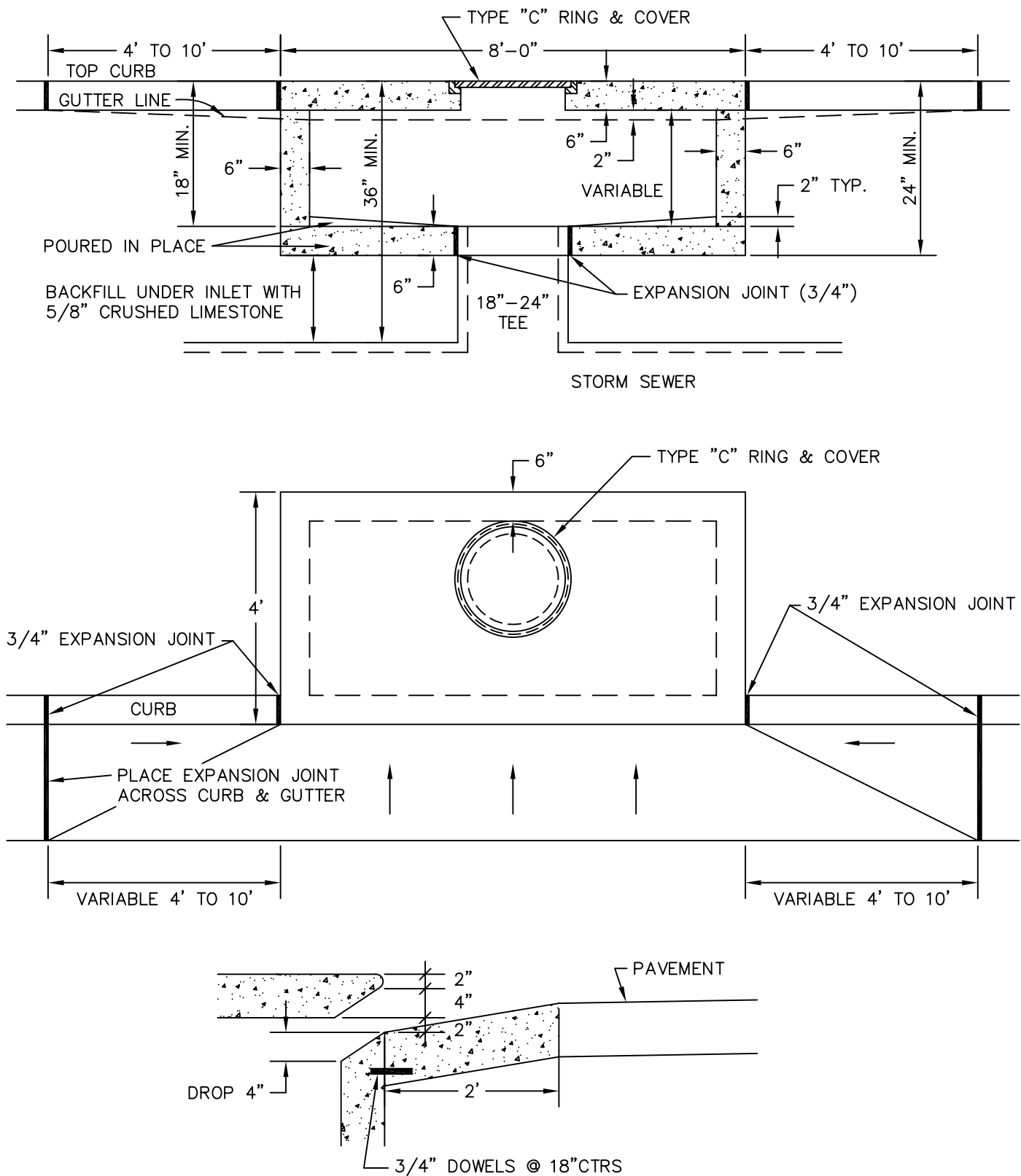
Note: For standard 7' inlet with 2" gutter depression.

# **GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS**

INLETS  
CAPACITY FOR STANDARD 7' CURB OPENING INLET  
IN A SUMP

**FIGURE 108.6**

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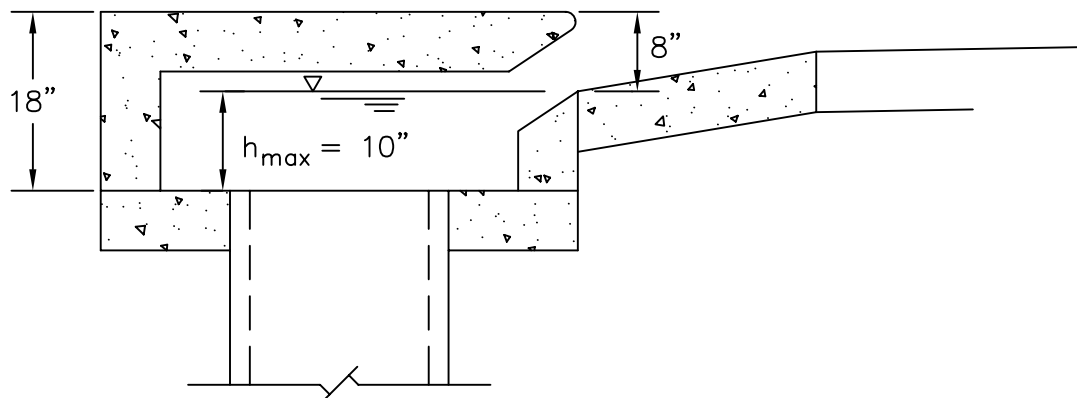


## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

"SS-5" CURB OPENING INLET

FIGURE 108.7

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USE WEIR EQUATION  $Q = C_w L h^{3/2}$

$C_w = 3.0$

$L = \text{Pipe Circumference}$

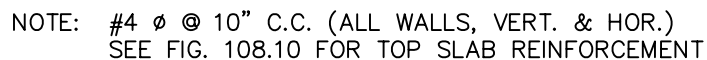
RISER DIAMETER (in.)	$L = \pi D$ (ft.)	$Q_{\max}$ (cfs)
18	4.7	10.7
21	5.5	12.5
24	6.3	14.4

## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

"SS-5" CURB OPENING INLET RISER CAPACITY

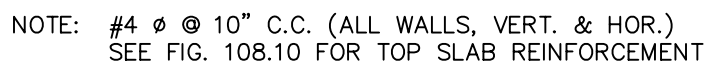
FIGURE 108.8

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6" PRECAST TOP

SECTION B-B



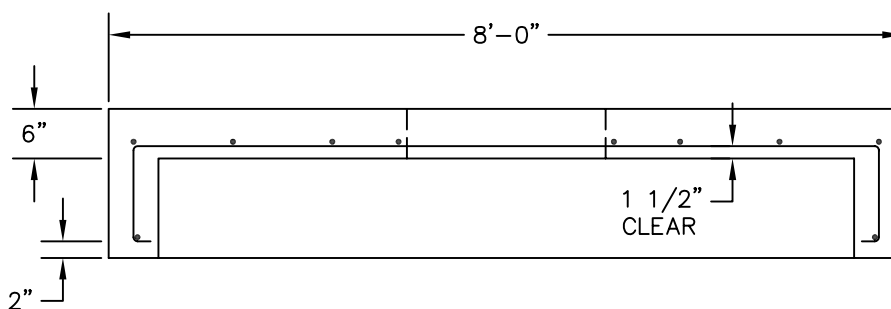
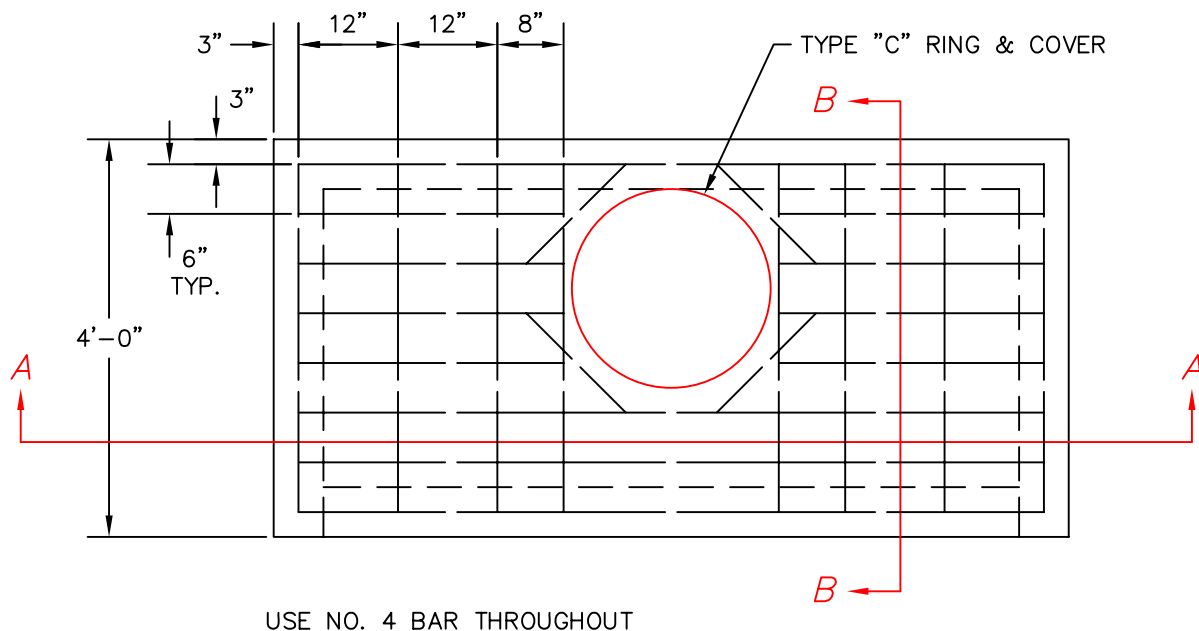
18" PRECAST TOP

# GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

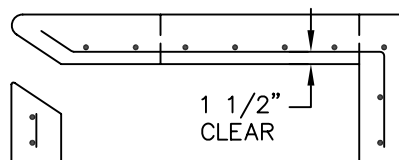
"SS-6" CURB OPENING INLET

FIGURE 108.9

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SECTION A-A



SECTION B-B

NOTE: "SS-8" TOP SHOWN, REINFORCEMENT  
FOR 6" "SS-6" TOP SIMILAR

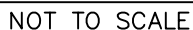
## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

TYPICAL REINFORCEMENT FOR PRECAST TOPS  
FOR CURB OPENING INLETS

FIGURE 108.10

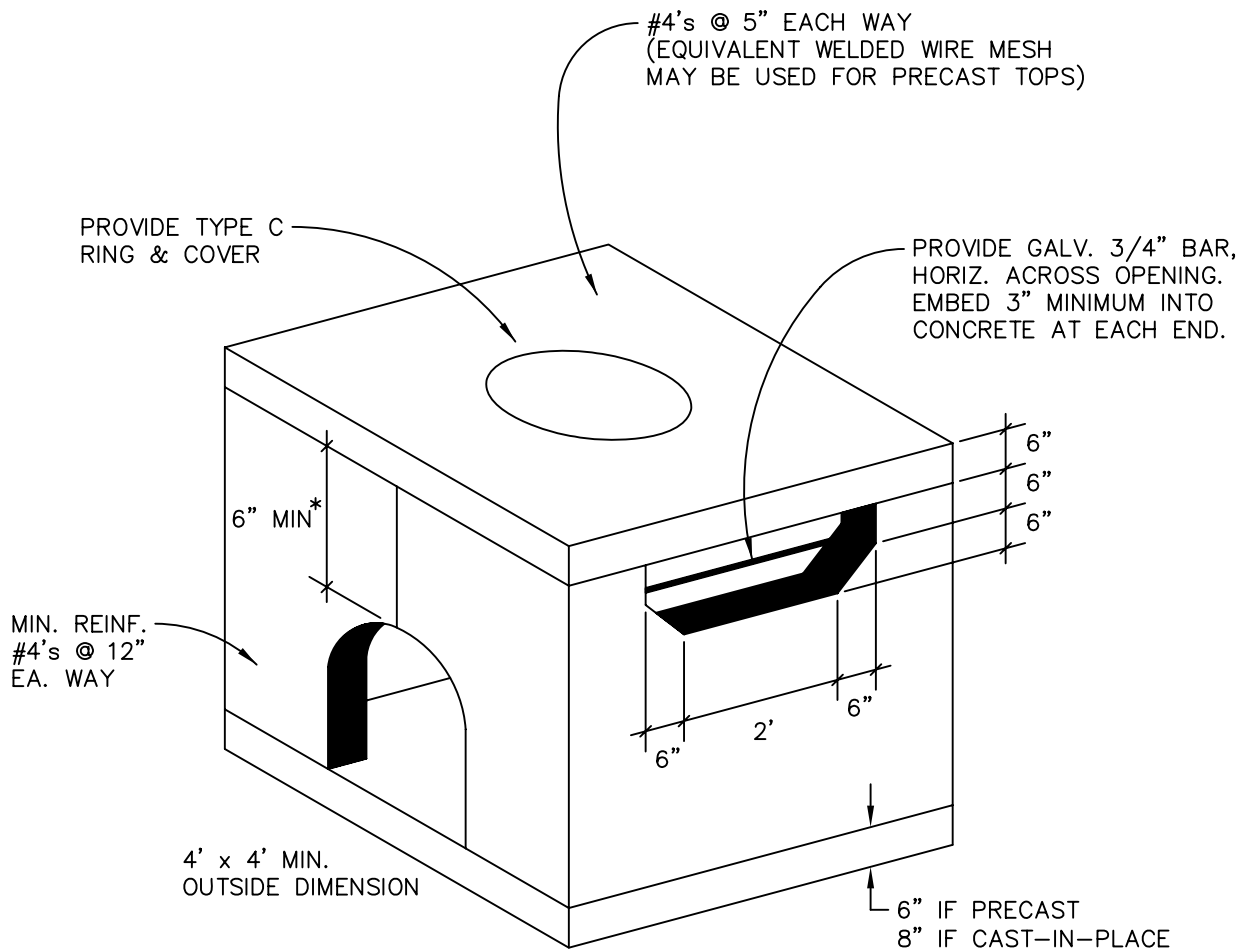
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NOT TO SCALE

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DATE: 04/05/99



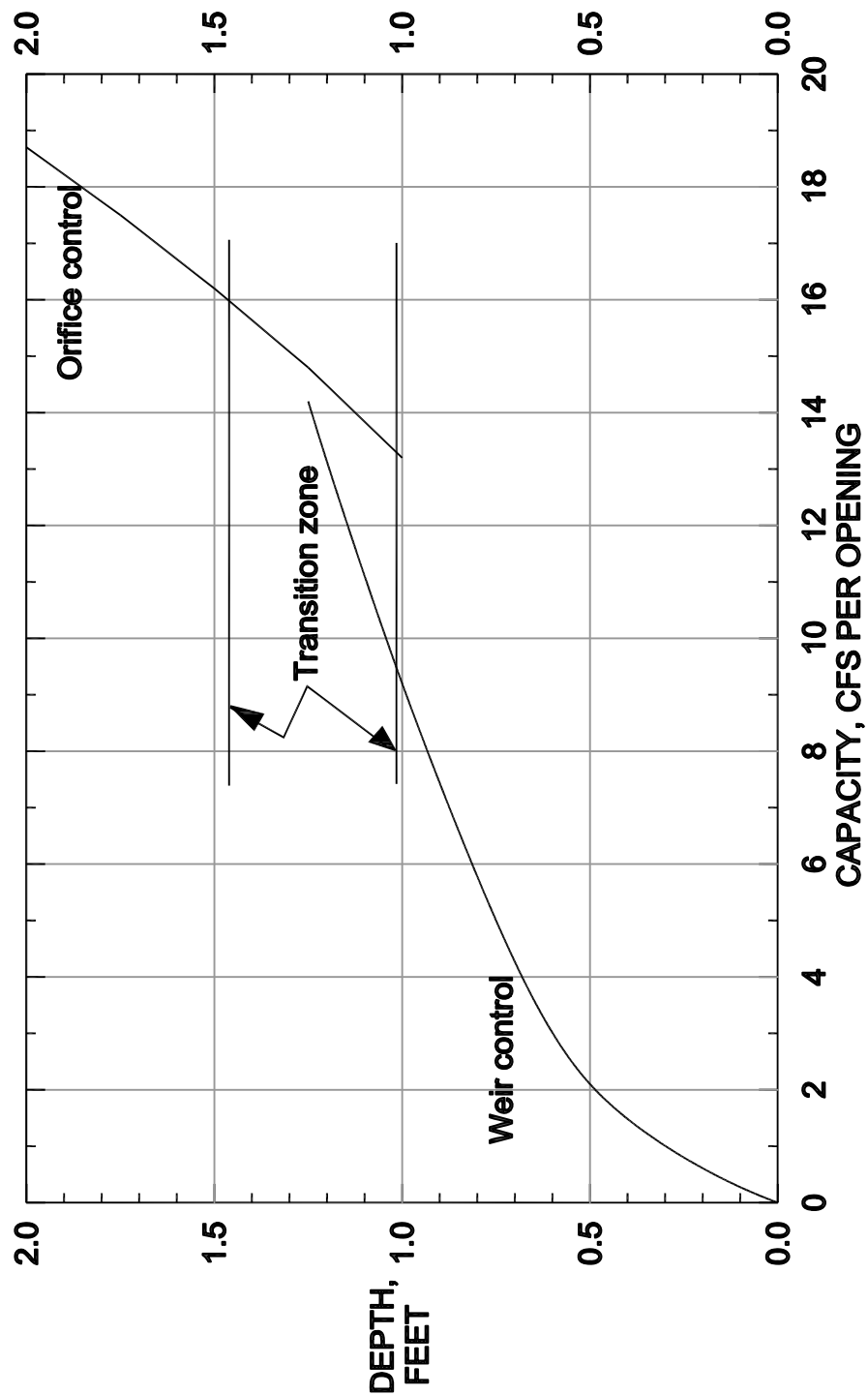
\* LESS CLEARANCE MAY BE ALLOWED PROVIDED ADEQUATE STRUCTURAL PROVISIONS ARE MADE TO PREVENT THE UNIT FROM CRACKING DURING DELIVERY AND INSTALLATION.

## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

STANDARD "DI-1" INLET

FIGURE 108.12

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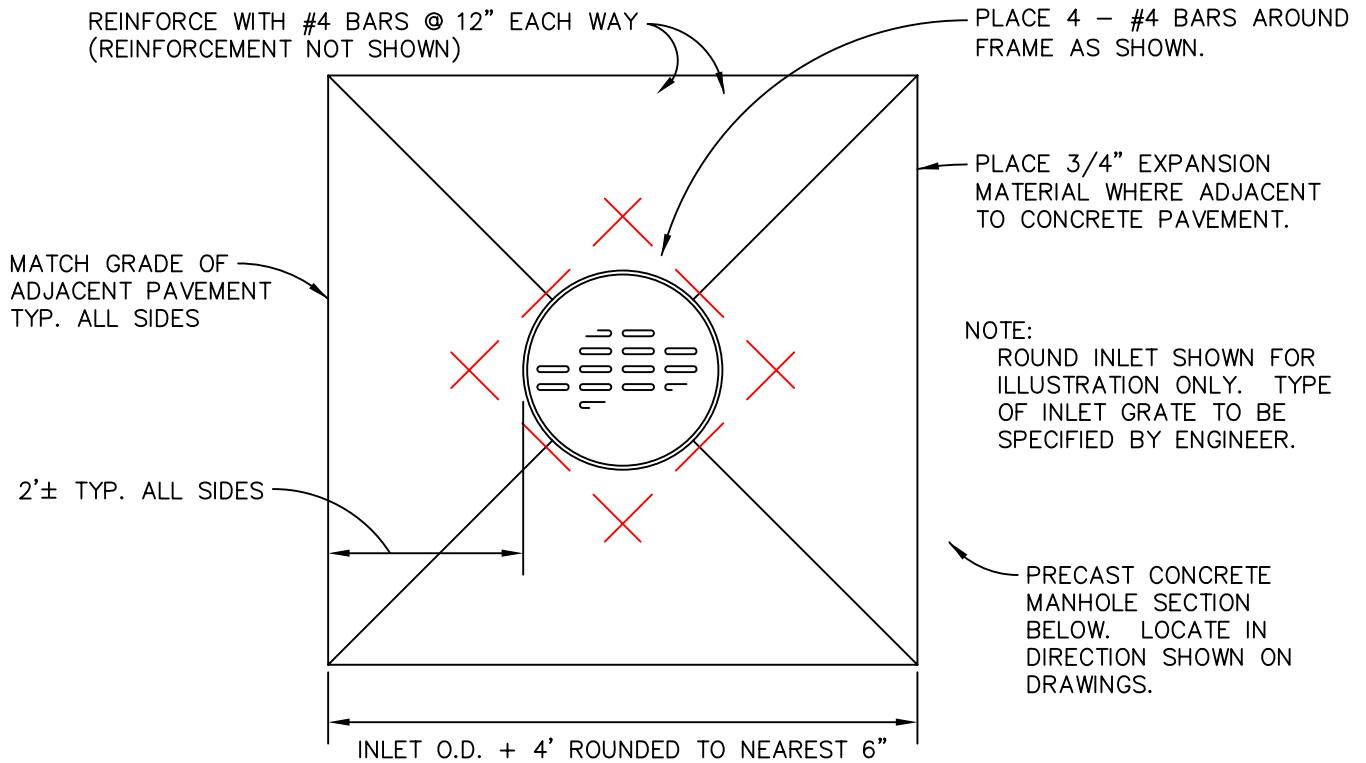
Note: Specify number of openings.  
For 24" basewidth opening inlet only.

## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

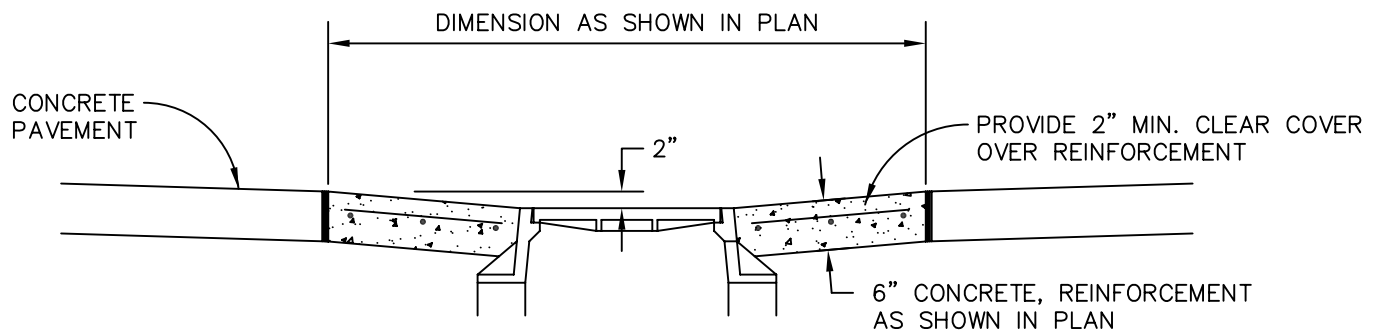
INLETS  
CAPACITY FOR STANDARD  
OPEN SIDE DROP INLET, D1

FIGURE 108.13

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*PLAN VIEW*  
NOT TO SCALE



*SECTION VIEW*  
NOT TO SCALE

## GREENE COUNTY MISSOURI – STORM WATER DESIGN STANDARDS

TYPICAL AREA INLET DEPRESSION & CONCRETE APRON

FIGURE 108.14

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