

## **MANHOLES**

### **MANHOLE ROOFS**

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#### **1. DESIGN OF MANHOLE ROOFS**

##### **Manholes Not More Than 4 Ft.-6 In. Wide**

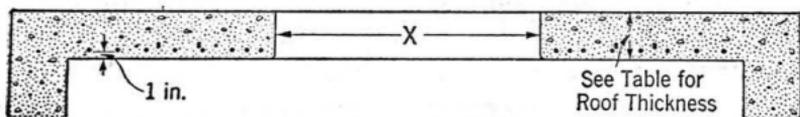
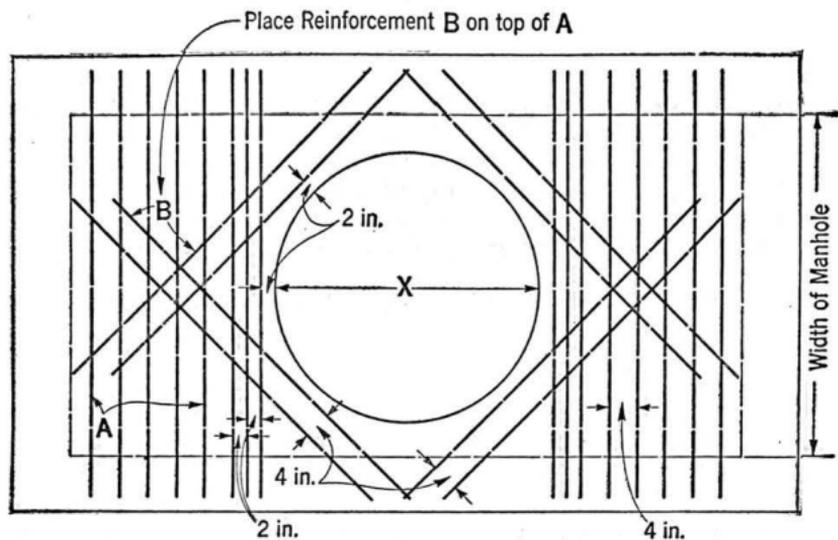
1.01 The designs of reinforced concrete roofs for manholes not more than 4 ft.-6 in. wide are identical as to reinforcing and vary only in thickness according to the width of the manhole. The following table gives the required thickness for the roofs:

<u>*Width of Manhole</u>	<u>Roof Thickness</u>
3 ft.-6 in.	6 in.
4 ft.-0 in.	7 in.
4 ft.-6 in.	7-1/2 in.

\* For fractional widths use next greater thickness.

1.02 The following illustration shows the arrangement of the reinforcement consisting of 1/2-inch round deformed bars. An alternative design is included to provide for the use of 6000-pound or larger steel strand as a substitute for bar reinforcing. Recovered strand in good physical condition and having the galvanizing reasonably intact is satisfactory for this latter use.

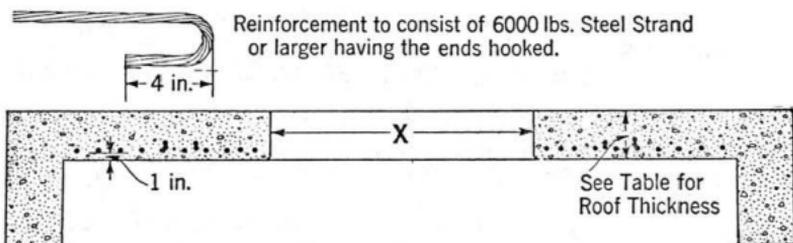
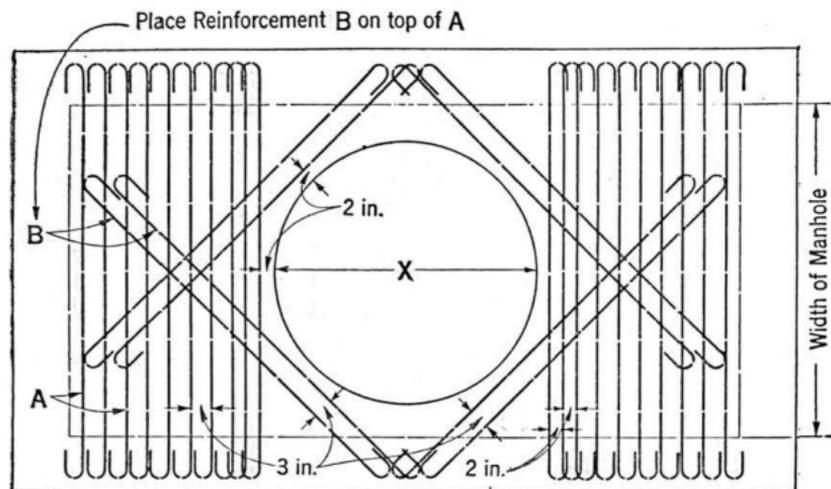
DESIGN OF CONCRETE ROOFS  
FOR MANHOLES NOT MORE THAN 4 FT.-6 IN. WIDE



X = Diameter of opening in bottom of frame.

Reinforcement to consist of 1/2 in. round deformed bars.

**DESIGN OF CONCRETE ROOFS  
FOR MANHOLES NOT MORE THAN 4 FT.-6 IN. WIDE**  
Alternative Design



$X$  = Diameter of opening in bottom of frame.

**Rectangular Manholes Over 4 Ft.-6 In. Wide**

1.03 The roofs for rectangular manholes more than 4 ft.-6 in. wide vary in thickness and reinforcement according to the width of the manhole. The following table shows the required roof thickness and size and spacing for the reinforcement for these manholes.

## DESIGN OF CONCRETE ROOFS

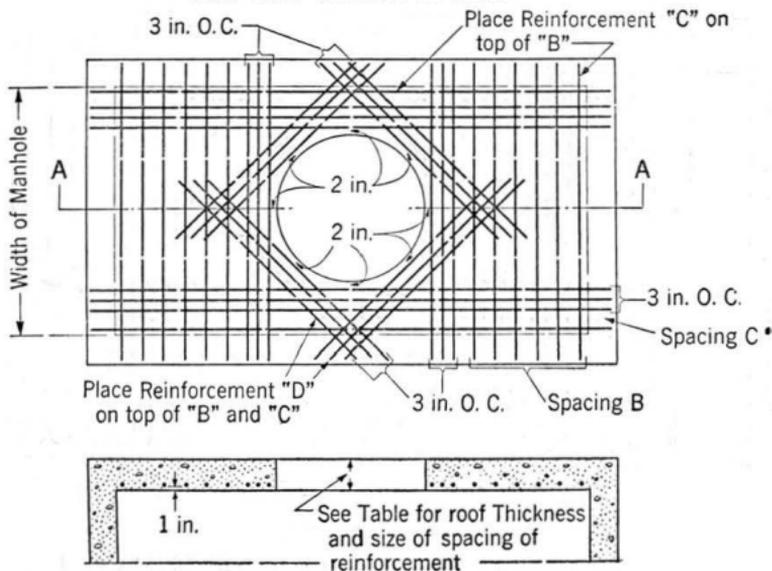
Thickness of Roof and Reinforcement  
Required for Rectangular Manholes  
More Than 4 ft. - 6 in. Wide

Width * of Manholes	Thickness of Roof (Inches)	Reinforcement Required using round deformed bars		
		Size (Inches)	Spacing B (Inches)	Spacing C ** (Inches)
5 ft. - 0 in.	8	$\frac{5}{8}$	$5\frac{1}{2}$	6
5 ft. - 6 in.	$8\frac{1}{2}$	$\frac{5}{8}$	5	6
6 ft. - 0 in.	$9\frac{1}{2}$	$\frac{5}{8}$	$4\frac{1}{2}$	6
6 ft. - 6 in.	10	$\frac{5}{8}$	4	6
7 ft. - 0 in.	$10\frac{1}{2}$	$\frac{5}{8}$	4	6
7 ft. - 6 in.	11	$\frac{5}{8}$	4	6
8 ft. - 0 in.	$11\frac{1}{2}$	$\frac{3}{4}$	$5\frac{1}{2}$	6
8 ft. - 6 in.	12	$\frac{3}{4}$	5	6

- \* For fractional widths use next greater thickness
- \*\* May not be required. See illustration, paragraph 1.05

**1.04** The following illustration shows the arrangement of the reinforcement for the roofs of rectangular manholes more than 4 ft.-6 in. wide and with one opening in the roof.

DESIGN OF CONCRETE ROOFS  
FOR RECTANGULAR MANHOLES MORE THAN 4 FT. - 6 IN WIDE  
WITH ONE OPENING IN ROOF

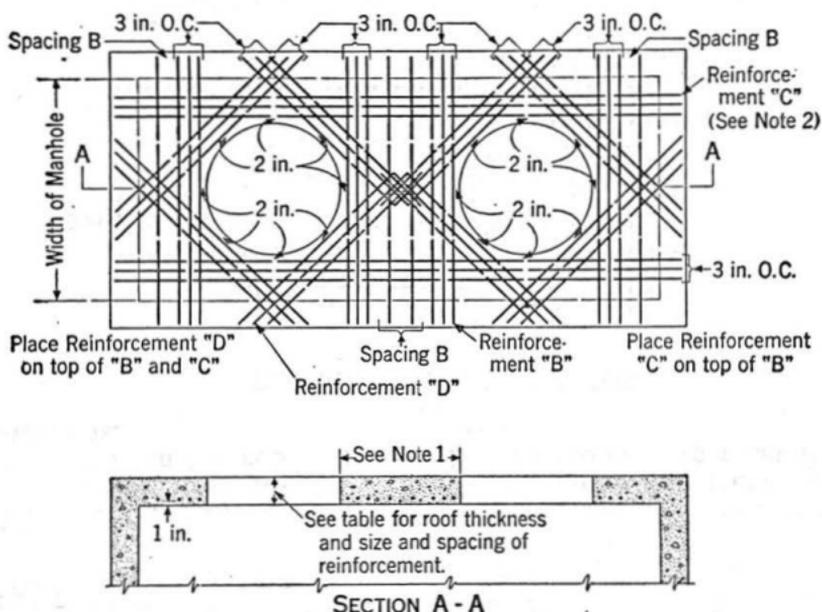


- \* May not be required.

## SECTION A-A

1.05 The following illustration shows the arrangement of the reinforcement for the roofs of rectangular manholes more than 4 ft.-6 in. wide and with two or more openings in the roof. The distance along the length of the manhole roof between the openings should be equal to at least one-half the width of the manhole. This distance is required for the proper distribution of the street traffic load transmitted to the roof through the frame and cover. If it is not practicable to obtain this distance between the openings, the inspector or supervisor should be consulted regarding requirements for a steel beam between the openings, as described in 1.09.

**DESIGN OF CONCRETE ROOFS  
FOR RECTANGULAR MANHOLES MORE THAN 4 FT. - 6 IN. WIDE  
AND WITH 2 OR MORE OPENINGS IN ROOF**



Note 1: The minimum distance between the openings in the roof should be  $\frac{1}{2}$  the width of the manhole. Otherwise steel beam may be required in roof.

Note 2: For manholes wider than shown above, additional bars for reinforcement "C" may be required. See table following paragraph 1.03 for spacing (Spacing C).

**Type V-1 and Modified Type V-1 Manholes**

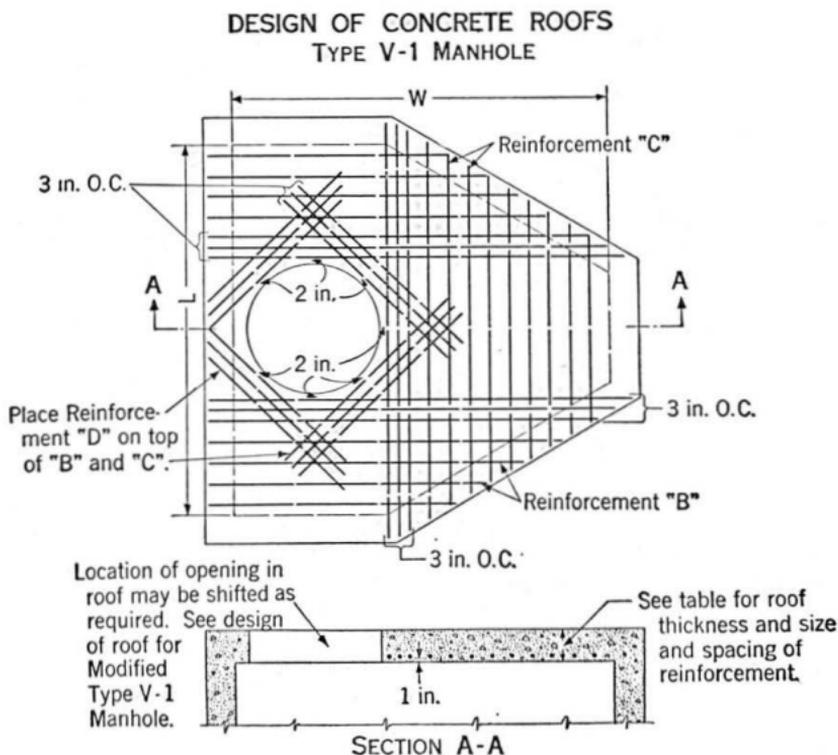
1.06 The designs of roofs for Type V-1 and Modified Type V-1 manholes which have one opening in the roof provide for two-way reinforcement. The following table shows the required roof thickness and the size and spacing of the reinforcing for these manholes.

**DESIGN OF CONCRETE ROOFS**  
**THICKNESS OF ROOF AND REINFORCEMENT REQUIRED FOR**  
**TYPE V-1 MANHOLES AND MODIFIED TYPE V-1 MANHOLES**

* Distance L or W whichever is greater	Thickness of Roof (Inches)	Reinforcement using Round Deformed Bars	
		Size	Spacing B and C
8 ft.-0 in.	11	¾ in.	5½ in.
9 ft.-0 in.	11½	¾ in.	5½ in.
10 ft.-0 in.	12	¾ in.	5 in.
11 ft.-0 in.	12½	¾ in.	5 in.
12 ft.-0 in.	13	¾ in.	4½ in.

\* For Fractional Distances L or W, use next greater thickness.

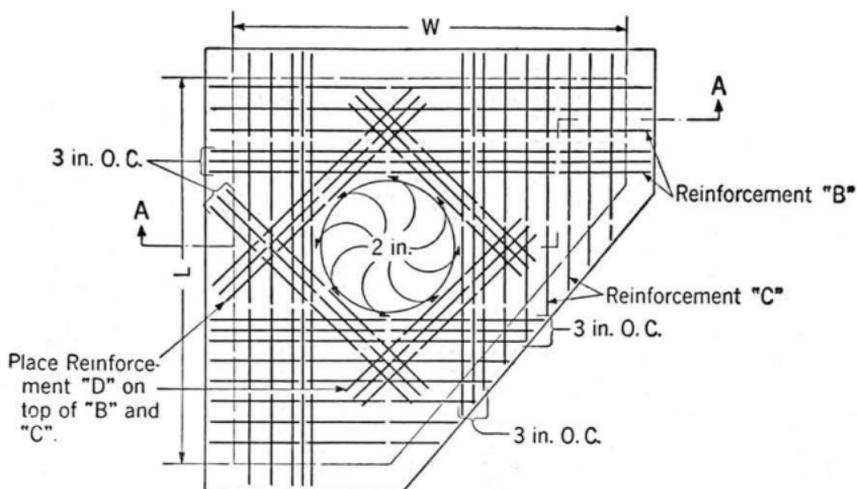
1.07 The following illustration shows the arrangement of the reinforcing for the Type V-1 manhole. The location of the opening in the roof can be shifted as required to meet field conditions.



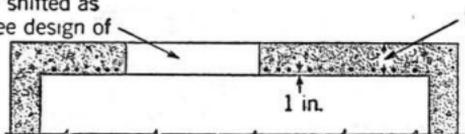
Note: - If distance L is greater than W, place reinforcement "C" on top of "B". If distance L is less than W, place reinforcement "B" on top of "C".

1.08 The following illustration shows the arrangement of the reinforcing for the Modified Type V-1 manhole. The location of the opening in the roof can be shifted as required to meet field conditions.

DESIGN OF CONCRETE ROOFS  
MODIFIED TYPE V-1 MANHOLE



Location of opening in roof may be shifted as required. See design of roof for Type V-1 Manhole.



See table for roof thickness and size and spacing of reinforcement.

SECTION A - A

Note: If distance  $L$  is greater than  $W$ , place reinforcement "C" on top of "B". If distance  $L$  is less than  $W$ , place reinforcement "B" on top of "C".

### Types V-2 and V-3, Modified Type V-2, and Center Rack Manholes

1.09 Manholes which have two openings in close proximity in the roof require steel beams cast in the roof slab to sustain the street traffic loads transmitted through the frames and covers. Steel beams are also indicated when the distance between the manhole walls would require a reinforced concrete roof of excessive thickness. The following table shows the roof thicknesses and beam sizes for manholes with various distances between the walls which will support the beam. The steel beams to be used are known as Wide Flange Sections, with nominal sizes and weights per foot for ordering purposes as shown in the table. Also shown are the actual dimensions of the beams for detailing the bending instructions for reinforcing bars, clamps, etc.

#### DESIGN OF CONCRETE ROOFS

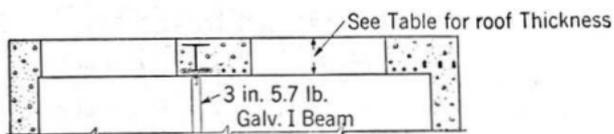
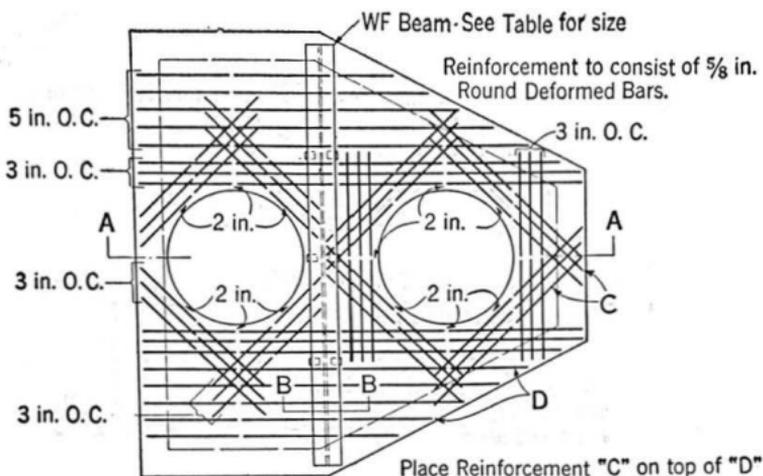
For Types V-2 and V-3, Modified Type V-2, Center Rack, and other Manholes requiring Steel Beams in Roofs

Distance* between Walls Supporting Beam	Thickness of Roof  (Inches)	Steel Beam Details - Wide Flange (WF) Sections			
		Nominal Size WF Section  (Inches)	Weight per Foot  (Pounds)	Actual Dimensions for Detailing	
				Depth of Section (Inches)	Width of Flange (Inches)
6 ft.-0 in.	10	8 × 8	31	8	8
7 ft.-0 in.	10½	8 × 8	35	8⅛	8⅛
8 ft.-0 in.	10½	8 × 8	40	8¼	8⅛
9 ft.-0 in.	11	8 × 8	48	8½	8⅛
10 ft.-0 in.	11	8 × 8	58	8¾	8¼
11 ft.-0 in.	11½	8 × 8	67	9	8⅝
12 ft.-0 in.	12½	10 × 10	66	10⅜	10⅛
13 ft.-0 in.	13	10 × 10	77	10⅝	10¼
14 ft.-0 in.	13	10 × 10	89	10⅞	10⅝

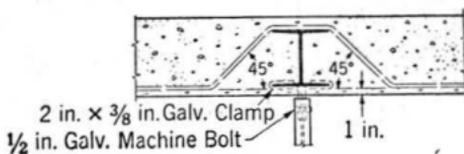
\* For fractional distances, use next larger beam

1.10 The following figure shows a typical steel beam and reinforcement arrangement for the roof of a Type V-2 manhole.

DESIGN OF CONCRETE ROOFS  
TYPE V-2 MANHOLE



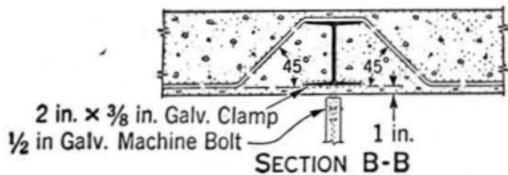
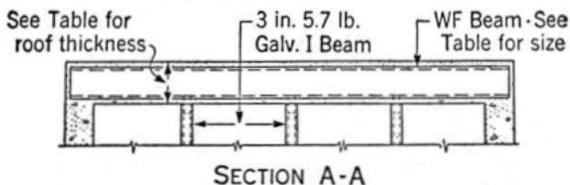
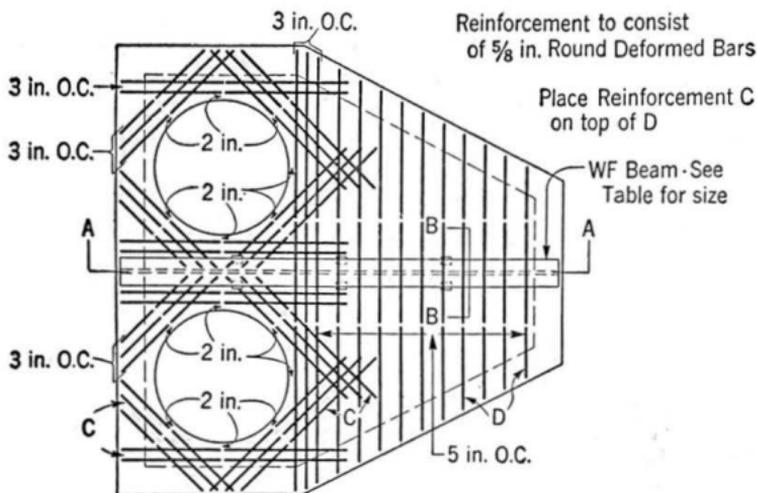
SECTION A-A



SECTION B-B

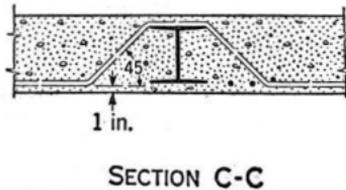
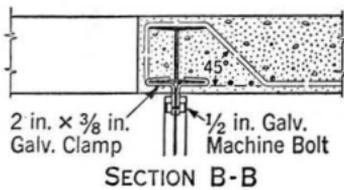
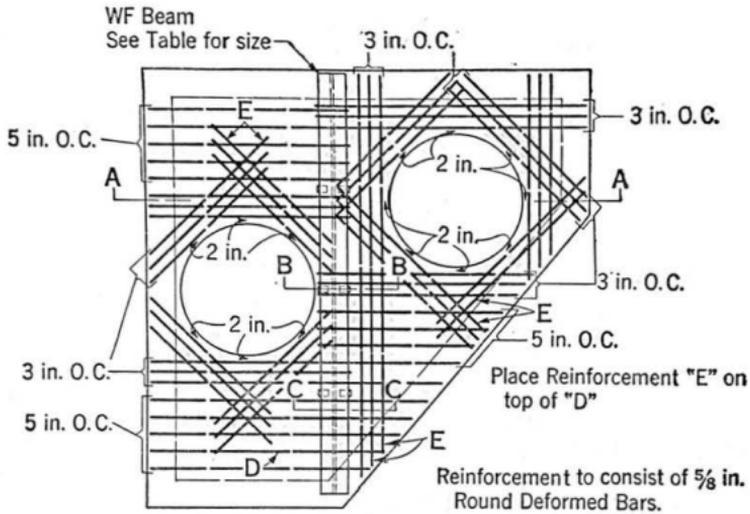
1.11 The following figure illustrates the roof details for a Type V-3 manhole.

DESIGN OF CONCRETE ROOFS  
TYPE V-3 MANHOLE



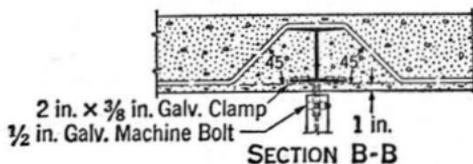
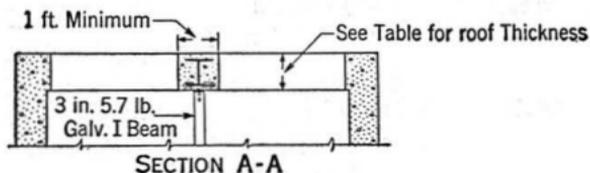
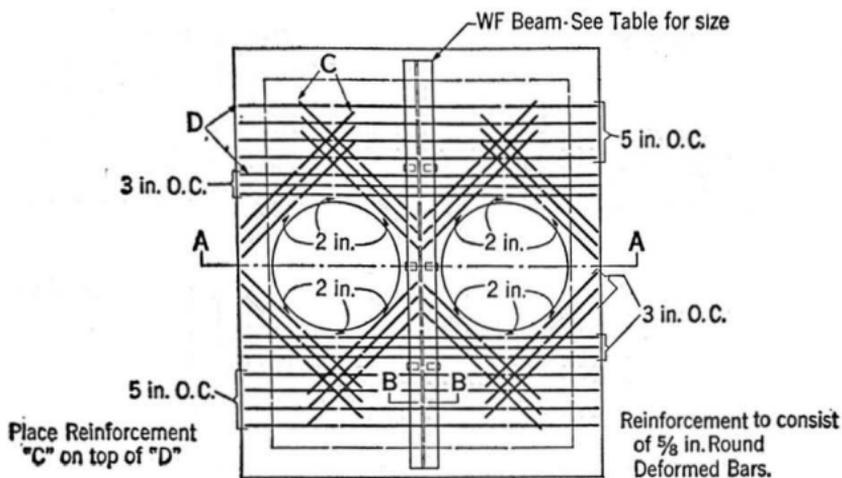
- 1.12 The following figure shows the steel beam and reinforcement arrangement for a Modified Type V-2 manhole.

DESIGN OF CONCRETE ROOFS  
MODIFIED TYPE V-2 MANHOLE



1.13 The following illustration shows the roof details for a Center Rack manhole.

DESIGN OF CONCRETE ROOFS  
 CENTER RACK MANHOLE  
 WITHOUT CENTER WALL



1.14 Very large manholes may require the use of two or more steel beams in the roofs. In such cases, the distance between the manhole wall parallel to the beam and the center of the beam or between the centers of the beams should be limited to 6 ft.-0 in. This distance may be increased provided larger size steel beams and additional rod reinforcement are employed than are shown in the preceding table and roof designs. The inspector or supervisor should be consulted if the detail plans do not provide sufficient information concerning the roof details of large manholes.

1.15 In certain of the V-type manholes and in the Center Rack manhole, provision is made for the installation of I-beam uprights for the support of cable racks. These uprights are usually secured to the steel roof beams by means of clamps formed of 2 inch x 3/8 inch strap iron galvanized. If the roof beam is not in the proper position for attaching the uprights, concrete inserts may be placed in the roof for the later attachment of angles to which the uprights can be bolted. The bottoms of the uprights may be set in the concrete of the floor or, if it is desired that they be detachable at the bottom, bolted to angles anchored to the floor.

## 2. MANHOLE OPENINGS

### Locations

- 2.01 The manhole opening should be located over the center of the manhole except as noted below:
- (a) For Types L, T and J manholes, locate the opening over the center of the manhole unless such a location would unduly hamper cable placing operations. In this case the inspector or supervisor should consider the advisability of placing the opening at the end of the manhole where the conduit formation enters the side wall.
  - (b) In loading manholes more than 10 feet long, one opening is to be provided for each 8 feet of length or fraction thereof, bearing in mind, however, the provisions of 1.05. The number and location of the openings will be shown on the detail plans.
  - (c) When the manhole opening would normally be located over the center of the manhole, but this position would bring the opening within 3 feet of the rail of a steam or electric railroad, or if other physical obstructions prevent establishing the opening at this point, locate the opening at either end of the manhole.
  - (d) For V-type, modified V-type, and Center Rack manholes, the locations for the openings are as indicated in the respective roof designs.

**Size**

2.02 The size of the manhole opening will be determined by the type and size of the manhole frame called for in the detail plans. The diameter of the opening in the roof should approximate the diameter of the opening in the base of the frame. The table below indicates the proper size of Manhole Opening Form for use with a manhole frame of given size and type.

MANHOLE OPENING FORM  
SIZE OF FORM TO PROVIDE ROOF OPENING  
FOR FRAME OF SPECIFIED TYPE AND SIZE

Manhole Frame		Manhole Opening Form
Type	Size (Inches)	Size (Inches)
A	27	34
A	30	38
B	24	34
B	27	38
B	30	41
SA	27	34
SA	30	38
SB*	27	34
SB <sup>®</sup>	30	38
R	27	28
R	30	31

\* These frames can also be used on openings intended for Type B frames of corresponding nominal sizes.

**3. PLACING CONCRETE AND REINFORCING**

3.01 Concrete of the class specified in G45.140.1 shall be used for roof construction and placed in accordance with G45.150.1.

3.02 If practicable, the roof form should be assembled along with the sections of the wall form in order that the walls and roof may be poured in a continuous operation.

3.03 If it is necessary to stop operations before the roof can be poured, a keyed construction joint of the type specified in G45.150.1 shall be provided.

- 3.04 Place the manhole opening form or forms as determined by the requirements of the particular manhole.
- 3.05 The reinforcing may be placed in either of two ways:
- (a) Place a layer of approximately one inch of concrete over the form and upon this lay the reinforcing as required by the roof design. If the walls of the manhole are reinforced the top horizontal wall reinforcing bar will serve to hold the roof bars in position as discussed in G43.124.1.
  - (b) Place the reinforcement before any concrete is poured on the roof form. It may be supported on the top horizontal bar of the wall reinforcement or on reinforcement chairs or saddles. All overlapping bars should be securely tied by means of 14- or 16-gauge soft annealed iron wire or approved bar ties to prevent displacement during the placing of the concrete.
- 3.06 For manhole roofs requiring steel beams, the beams should be blocked up from the roof form by means of pieces of concrete, bricks or other solid and durable material.
- 3.07 Complete the pouring of the concrete to the depth required by the roof design.