

CONDUIT AND MANHOLES

MATERIAL TABLES

Contents	Page
1. General	1
2. Material for Laying Conduit	2
Mortar Bandage Joints	2
Troweled or Plastered Joints	5
3. Material for Duct Protection	6
4. Material for Concrete Manholes	7
Rectangular Manholes	7
Types V and Modified V Manholes	13
5. Material for Brick Manholes	18

1. GENERAL

1.01 The tables contained in this section will be of assistance in determining the quantities of different materials required to construct underground conduit and manholes. In these tables no allowance has been made for waste.

1.02 For convenience in using the material tables, the following table of fractional equivalents is given.

TABLE OF FRACTIONAL EQUIVALENTS

Decimal	Fraction
.125	$\frac{1}{8}$
.250	$\frac{1}{4}$
.375	$\frac{3}{8}$
.500	$\frac{1}{2}$
.625	$\frac{5}{8}$
.750	$\frac{3}{4}$
.875	$\frac{7}{8}$

1.03 The following quantities are used in the tables of materials required for conduit and manhole construction.

Brickwork	
Mortar to lay 1000 Brick	.7 Cu. Yds. (Approximately 19 Cu. Ft.)
Number of Brick per square ft. of wall	8 in. thick = 14 Brick
	12 in. thick = 21 Brick
	16 in. thick = 28 Brick
Mortar	
The quantities required to make one cubic yard of mortar are as follows:	
Mixture	
1	3
Cement	Sa..d
9.56 Bags (approx. 9½ Bags)	1.06 Cu. Yds. (approx. 28½ Cu. Ft.)

APPROXIMATE QUANTITIES OF MATERIALS PER CUBIC YARD OF CONCRETE

Class of Concrete		Class 1 Concrete Water - Cement Ratio = 6		Class 2 Concrete Water - Cement Ratio = 7½		
		1A & 1C	1B & 1D	2A	2B	2C & 2D
Using gravel for coarse aggregate	Cement (sacks)	6½	6¼	4¾	5½	4½
	Water (gallons)	30½	28½	26½	32	25¾
	Sand (pounds)	1420	1440	1510	1440	1290
	Sand (cubic yards)	.59	.60	.63	.60	.54
	Gravel (pounds)	1750	1780	1860	1770	2130
	Gravel (cubic yards)	.65	.67	.70	.66	.80
Using stone for coarse aggregate	Cement (sacks)	7	6¾	5¼	6	5
	Water (gallons)	33¼	31	29½	35	28
	Sand (pounds)	1510	1570	1620	1540	1420
	Sand (cubic yards)	.63	.65	.68	.64	.59
	Stone (pounds)	1530	1560	1640	1560	1910
	Stone (cubic yards)	.57	.58	.61	.58	.71

The cement and aggregates used in all concrete shall be as specified in G45.110.1 and G45.120.1 respectively.

As outlined in G45.140.1, classes of concrete 1A, 1B, 2A, 2B, and 2C are prepared with normal Portland cement and classes 1C, 1D and 2D are prepared with high early strength Portland cement. The recommended uses for different classes of concrete are also shown in G45.140.1.

2. MATERIAL FOR LAYING CONDUIT

Mortar Bandage Joints

2.01 The following table shows the sizes of mortar bandages required for the various units of Clay Conduit. It also shows the dimensions of the material needed for the mortar

bandages. The materials are furnished in suitable containers, each enclosing the necessary cut pieces of cheesecloth, felt, and tape to make 250 complete bandages of the size specified.

DIMENSIONS OF MATERIALS FOR MORTAR BANDAGES

Size of Conduit Unit		Size of Finished Bandage Inches	Cheesecloth				Waterproof Paper		Tying Tapes
No. of Ducts	Length		Outside Wrapper		Reinforcing Strip		Width Inches	Length Inches	Length Inches
			Width Inches	Length Inches	Width Inches	Length Inches			
1	All Lengths	5×25	15	25	5	25	5	15	33
2	All Lengths	5×32	15	32	5	32	5	22	40
3 4	6 inches	5×42	15	42	5	42	5	32	50
6	6 inches	5×51	15	51	5	51	5	41	60
8 9	6 inches	5×61	15	61	5	61	5	51	70
3 4	Over 6 inches	7×42	20	42	7	42	7	32	50
6	Over 6 inches	7×51	20	51	7	51	7	41	60
8 9	Over 6 inches	7×61	20	61	7	61	7	51	70

2.02 The following table indicates the quantities of materials required for a carton containing 250 mortar bandages.

QUANTITIES OF MATERIALS FOR A CARTON CONTAINING 250 MORTAR BANDAGES

Size of Conduit Unit		Size of Finished Bandage Inches	Mortar							
No. of Ducts	Length		1:1 Mixture Normal Cement				1:1½ Mixture High Early Strength Cement			
			Cement Bags	Sand Cu. Yds.	Inert Filler Lbs.	Water Gals.	Cement Bags	Sand Cu. Yds.	Inert Filler Lbs.	Water Gals.
1	All Lengths	5×25	4.5	0.15	40	30	4.0	0.20	20	25
2	All Lengths	5×32	5.5	0.20	50	40	5.0	0.30	25	30
3 4	6 Inches	5×42	7.5	0.30	50	55	7.0	0.40	35	45
6	6 Inches	5×51	9.5	0.35	70	65	8.5	0.45	40	50
8 9	6 Inches	5×61	11.0	0.40	90	80	10.0	0.55	45	55
3 4	Over 6 Inches	7×42	10.5	0.40	100	75	9.5	0.55	45	60
6	Over 6 Inches	7×51	13.0	0.50	120	90	11.5	0.65	55	70
8 9	Over 6 Inches	7×61	15.5	0.55	145	110	14.0	0.80	65	85

2.03 The following table indicates the quantities of materials required for mortar bandage joints when laying 100 trench feet of various Clay Conduit formations.

MATERIAL FOR LAYING MULTIPLE CLAY CONDUIT

Mortar Bandage Joints
Length of Conduit Units-3 Feet

Per 100 Trench Feet								
No. Ducts M.C.C. *	Cheesecloth Paper and Tying Tapes		Mortar					
	Number of Cartons	Size of Finished Bandage (Inches)	1-1 Mixture Normal Portland Cement			1-1½ Mixture High Early Strength Portland Cement		
			Cement Bags	Sand Lbs.	Inert Filler Lbs.	Cement Bags	Sand Lbs.	Inert Filler Lbs.
4	0.13	7 x 42	1.4	127	13.2	1.3	174	5.9
6	0.13	7 x 51	1.7	158	15.9	1.5	206	7.3
8	0.13	7 x 61	2.0	174	19.1	1.8	253	8.6
9	0.13	7 x 61	2.0	174	19.1	1.8	253	8.6
10	0.13	7 x 42	3.1	285	29.1	2.8	380	13.2
	0.13	7 x 51						
12	0.26	7 x 51	3.4	316	31.8	3.0	412	14.6
15	0.13	7 x 51	3.7	332	35.0	3.3	459	15.9
	0.13	7 x 61						
16	0.26	7 x 61	4.0	348	38.2	3.6	506	17.2
18	0.26	7 x 61	4.0	348	38.2	3.6	506	17.2
18 (Alternative)	0.40	7 x 51	5.1	474	47.7	4.5	618	21.9
20	0.26	7 x 42	6.2	570	58.2	5.6	760	26.4
	0.26	7 x 51						
24	0.40	7 x 61	6.0	522	57.3	5.4	756	25.8
24 (Alternative)	0.53	7 x 51	6.8	632	63.6	6.0	824	29.2
28	0.26	7 x 51	7.4	664	70.0	6.6	918	31.8
	0.26	7 x 61						
32	0.53	7 x 61	8.0	696	76.4	7.2	1012	34.4
36	0.79	7 x 51	10.2	948	95.4	9.0	1236	43.8
40	0.53	7 x 51	10.8	980	101.8	9.6	1230	46.4
	0.26	7 x 61						

*The Standard Conduit Formations on which these Tables are Based are shown in G40.070.1

Troweled or Plastered Joints

2.04 The amounts of material required to make troweled or plastered joints per 100 trench feet of various conduit formations are shown in the following table.

MATERIAL FOR LAYING MULTIPLE CLAY CONDUIT

Troweled or Plastered Joints
Length of Conduit Units - 3 Feet

No Ducts M.C.C.*	Per 100 Trench Feet			Cheesecloth Yards
	Mortar			
	Mixture Volume Cubic Yards	1 Cement Bags	3 Sand Cubic Yards	
4	.15	1.55	.15	9.5
6	.20	1.80	.20	11.5
8	.20	2.00	.20	13.5
9	.20	2.00	.20	13.5
10	.35	3.35	.35	21.5
12	.38	3.65	.40	23.0
15	.40	3.80	.42	25.0
16	.45	4.00	.45	27.0
18	.45	4.00	.45	27.0
18 (Alternative)	.55	5.45	.60	35.0
20	.65	6.40	.70	42.5
24	.65	6.05	.65	40.0
24 (Alternative)	.70	6.90	.75	46.5
28	.80	7.65	.85	50.0
32	.85	8.05	.90	53.5
36	1.05	10.05	1.15	69.5
40	1.10	10.90	1.20	73.0

*The standard conduit formations on which these tables are based are shown in G40.070.1.

3. MATERIAL FOR DUCT PROTECTION

3.01 The following table shows the quantities of concrete required for the different methods of providing concrete protection per 100 trench feet of the various conduit formations.

CUBIC YARDS OF CONCRETE REQUIRED FOR PROTECTION OF MULTIPLE CLAY CONDUIT

No. Ducts M.C.C. *	Per 100 Trench Feet			
	Cubic Yards of Concrete			
	Method 1 Top and Base	Method 1B Base Only	Method 2 Top Only	Method 3 Complete Encasement
4	2.7	1.7	.9	4.1
6	2.7	1.7	.9	4.7
8	2.7	1.7	.9	5.3
9	3.4	2.2	1.2	5.4
10	2.7	1.7	.9	6.2
12	3.4	2.2	1.2	6.2
12 (Alternative)	4.4	2.7	1.7	6.4
15	3.4	2.2	1.2	6.9
16	4.4	2.7	1.7	7.0
18	3.4	2.2	1.2	7.5
18 (Alternative)	3.4	2.2	1.2	7.7
20	4.4	2.7	1.7	7.8
24	4.1	2.6	1.6	8.4
24 (Alternative)	4.4	2.7	1.7	8.5
28	4.4	2.7	1.7	9.1
32	4.4	2.7	1.7	9.7
36	4.4	2.7	1.7	10.6
40	4.4	2.7	1.7	11.2

* The Standard Conduit Formations on which These Tables are Based are shown in G40.070.1.

4. MATERIAL FOR CONCRETE MANHOLES

Rectangular Manholes

4.01 The following charts indicate the quantities of concrete required for constructing rectangular concrete manholes of various sizes, headrooms, and wall thicknesses. The charts can also be readily employed for computing the amount of concrete required for manholes with lengths different than those shown in the charts. For example, it is desired to determine the amount of concrete needed to construct a manhole 4 feet wide by 11 feet-6 inches long with 15 feet of headroom and with 10 inch walls. From the charts, a manhole 4 feet wide by 10 feet-6 inches long of the desired headroom and wall thickness requires 17.1 cu. yds. of concrete. A manhole 4 feet wide by 9 feet-6 inches long of similar headroom and wall thickness requires 14.4 cu. yds. By adding the difference between the two amounts (2.7 cu. yds.) to the first amount, 19.8 cu. yds. is found to be the quantity of concrete required.

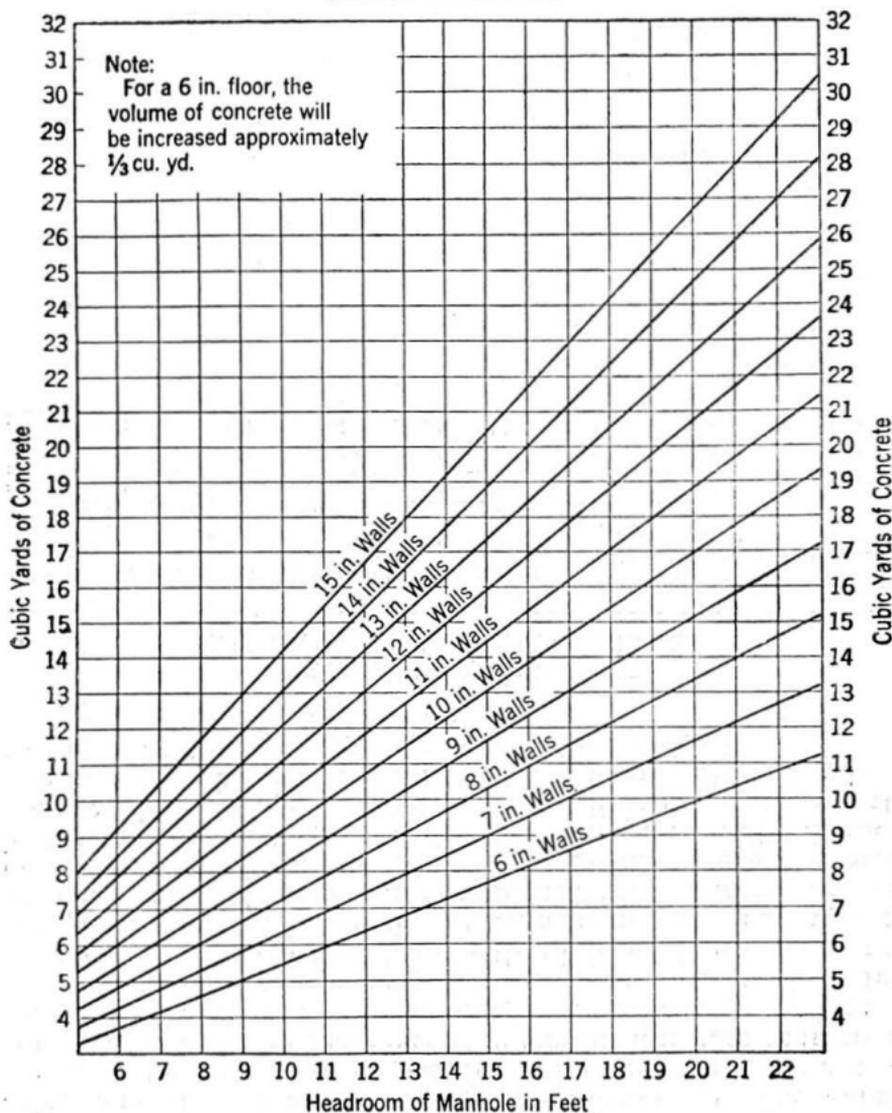
CUBIC YARDS OF CONCRETE
REQUIRED FOR CONCRETE MANHOLES

Type	Width	Length	Head room	Cubic yards of concrete	Wall thickness	Floor thickness	Roof thickness
A	3 ft. - 6 in.	7 ft. - 0 in.	5 ft. - 6 in.	3.3	6 in.	4 in.	6 in.
B	3 ft. - 6 in.	6 ft. - 6 in.	5 ft. - 0 in.	2.9	6 in.	4 in.	6 in.
X	3 ft. - 0 in.	4 ft. - 0 in.	3 ft. - 6 in.	1.5	6 in.	4 in.	6 in.
Y	3 ft. - 0 in.	5 ft. - 6 in.	4 ft. - 0 in.	2.1	6 in.	4 in.	6 in.

CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

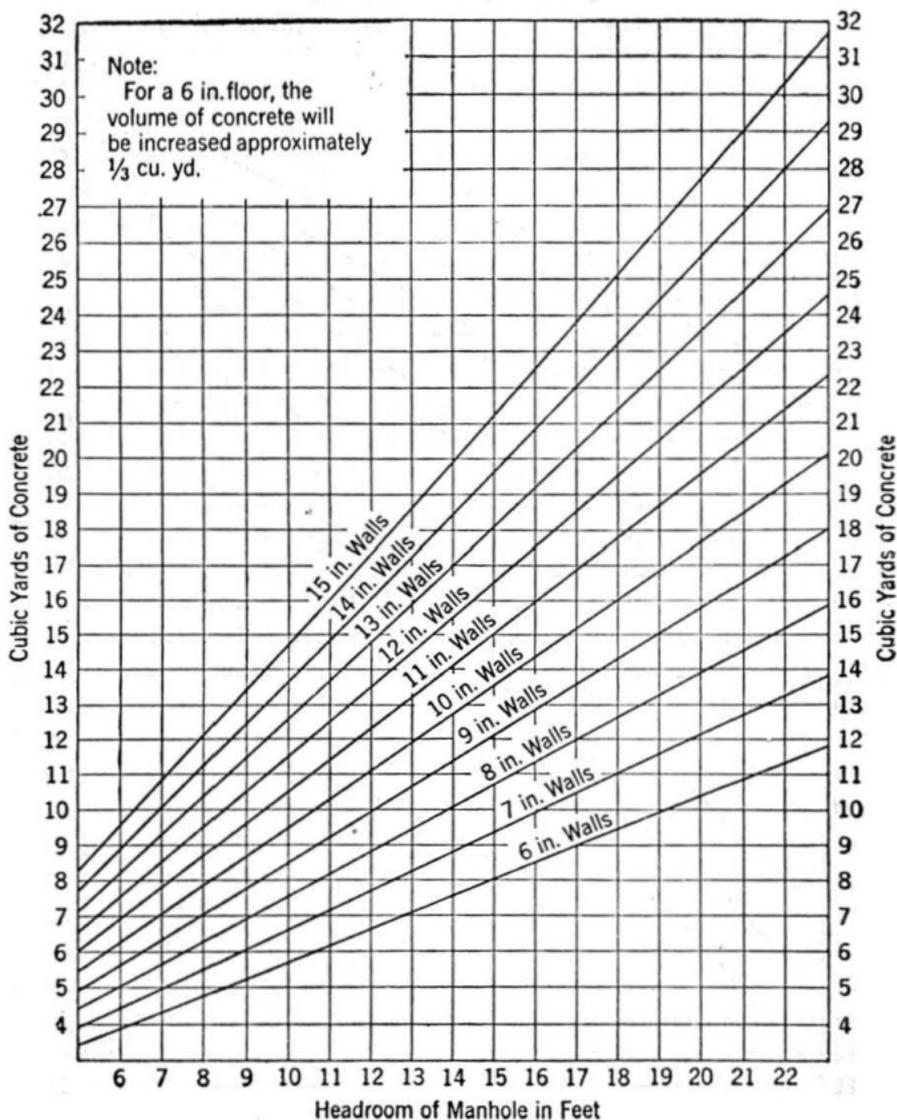
3 Ft.-6 In. Wide x 7 Ft.-6 In. Long

6 In. Roof and 4 In. Floor



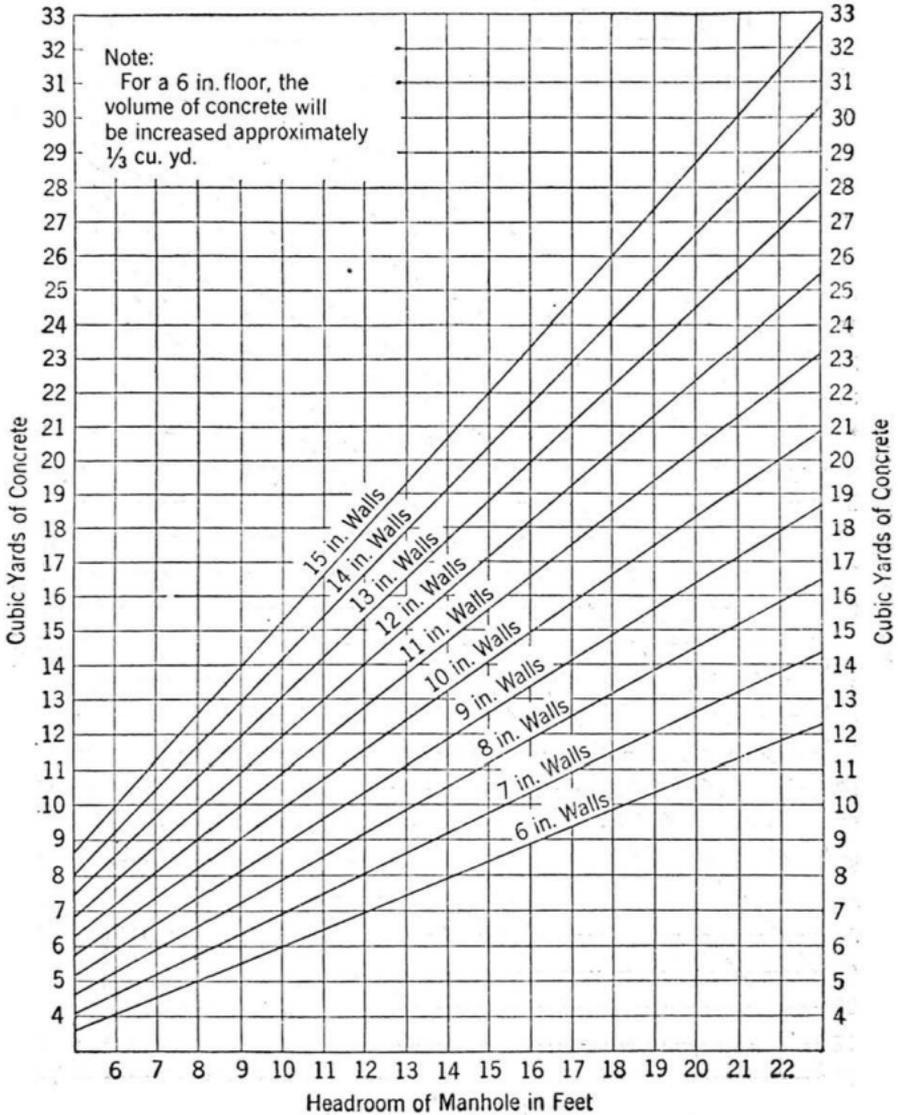
CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

3 Ft. - 6 In. Wide x 8 Ft. - 0 In. Long
6 In. Roof and 4 In. Floor



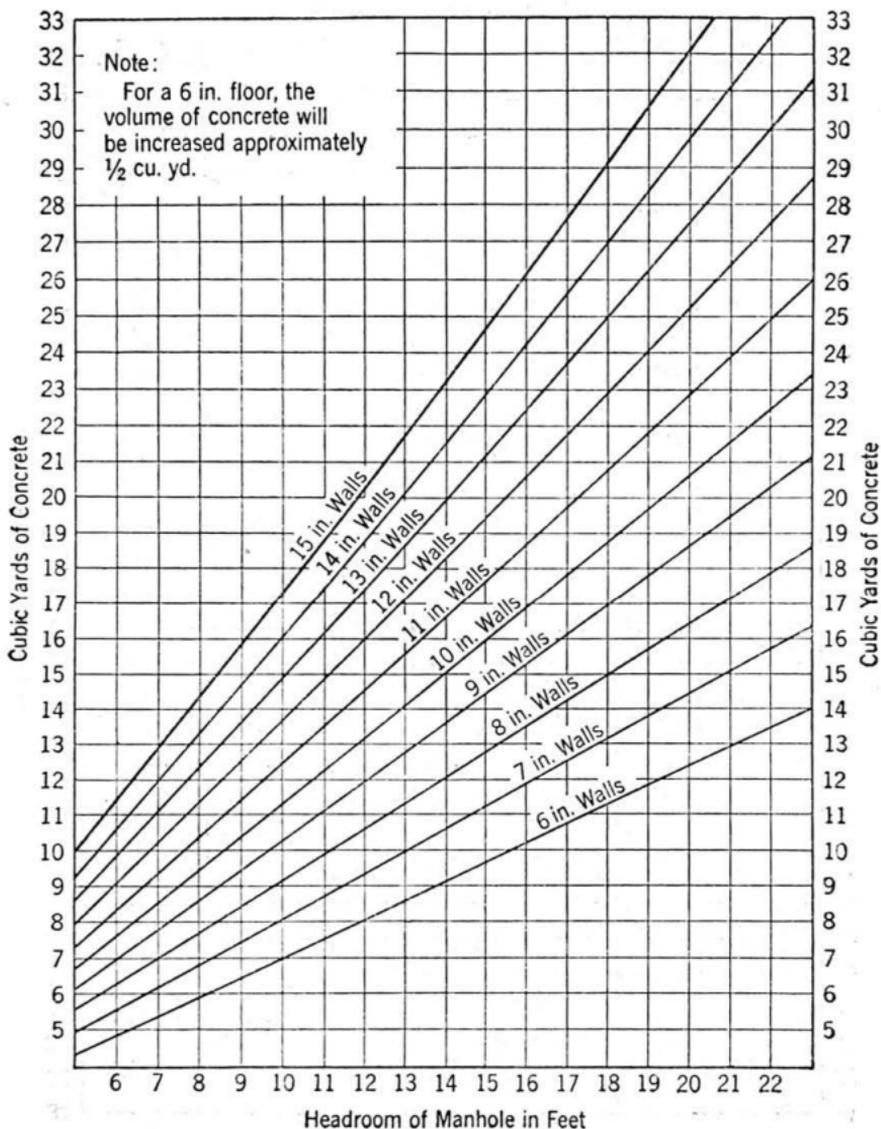
CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

3 Ft. - 6 In. Wide x 8 Ft. - 6 In. Long
6 In. Roof and 4 In. Floor



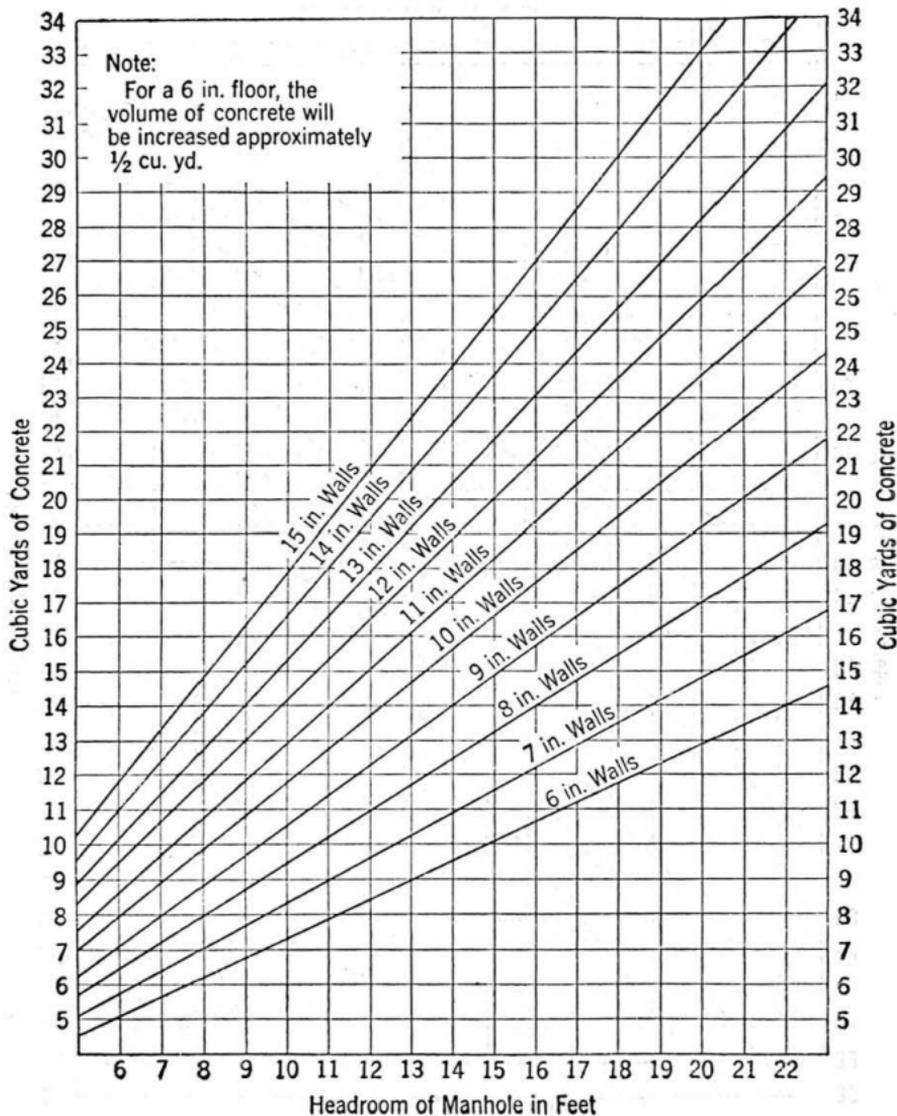
CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

4 Ft. - 0 In. Wide x 9 Ft. - 6 In. Long
7 In. Roof and 4 In. Floor



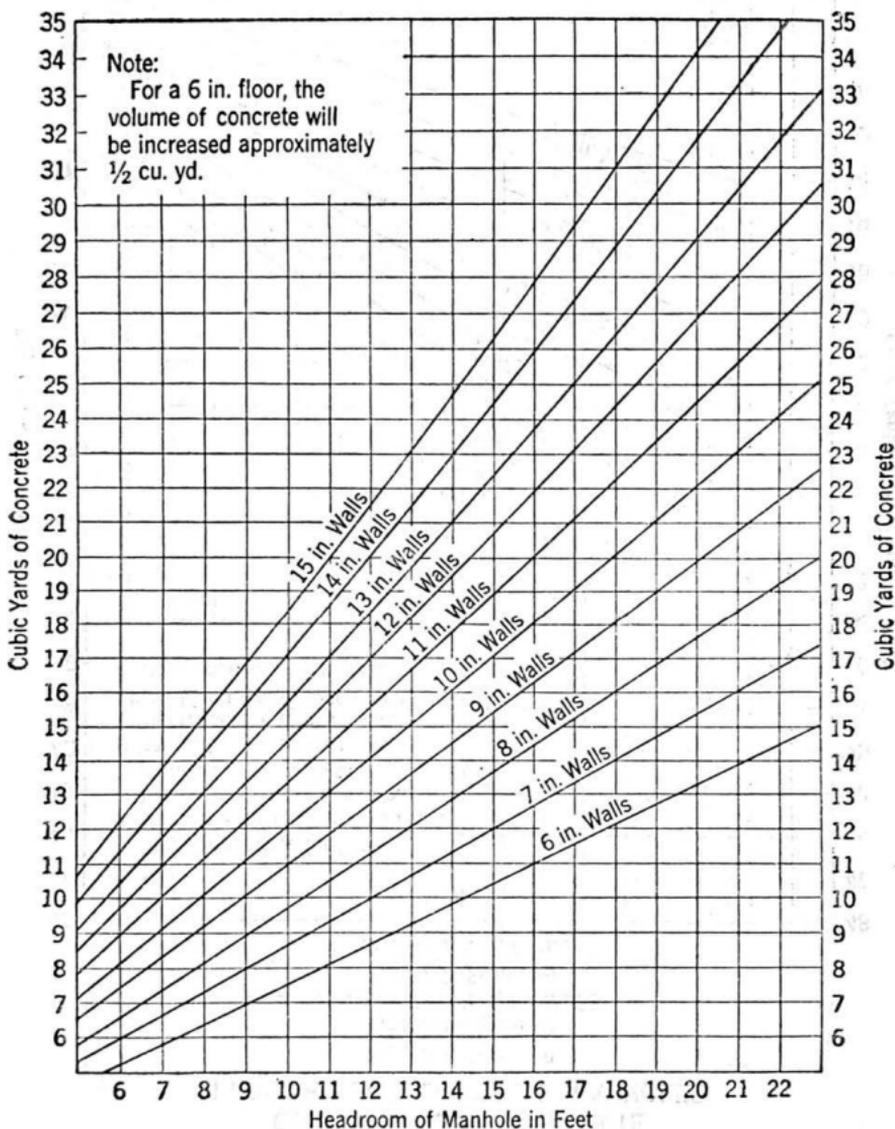
CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

4 Ft. - 0 In. Wide x 10 Ft. - 0 In. Long
7 In. Roof and 4 In. Floor



CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

4 Ft. - 0 In. Wide x 10 Ft. - 6 In. Long
7 In. Roof and 4 In. Floor



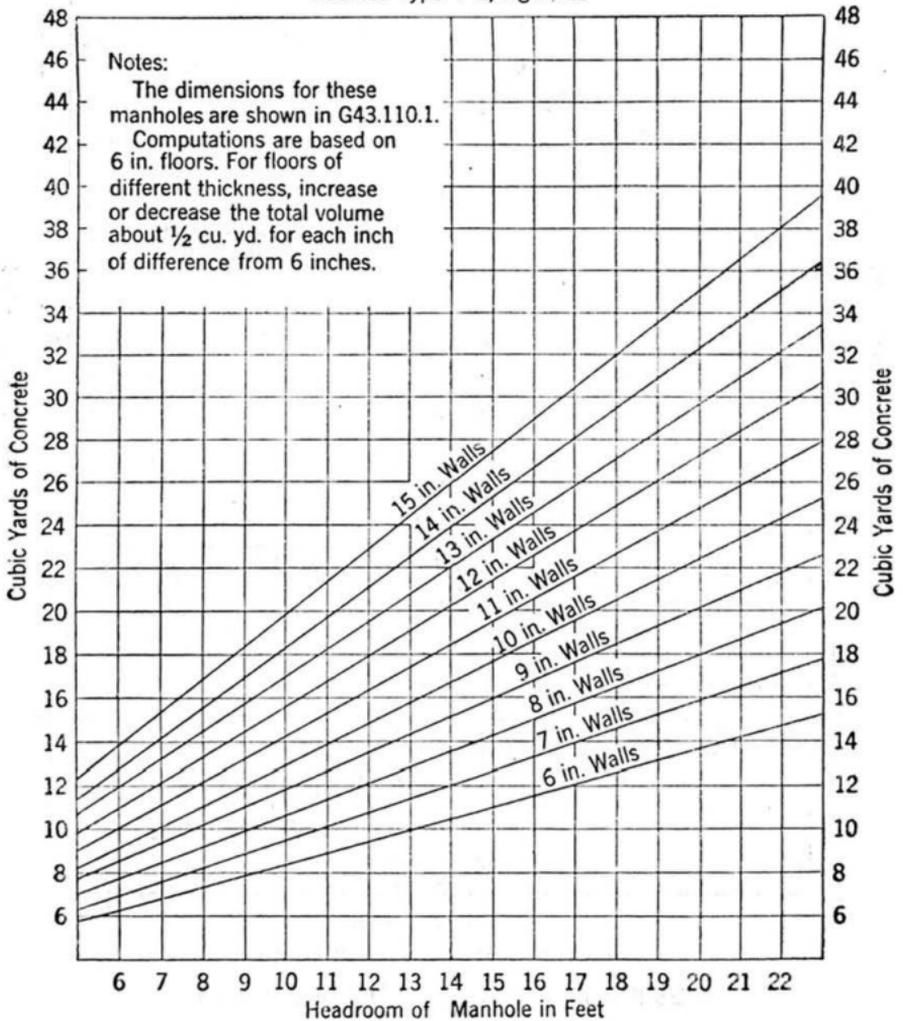
Types V and Modified V Manholes

4.02 The following charts indicate the approximate quantities of concrete required to construct types V and Modified V manholes of the dimensions shown in G43.110.1.

The quantities shown on the charts will be correct to within about 1/2 cu. yd. for the shallower manholes and to within about 1 cu. yd. for the deeper manholes.

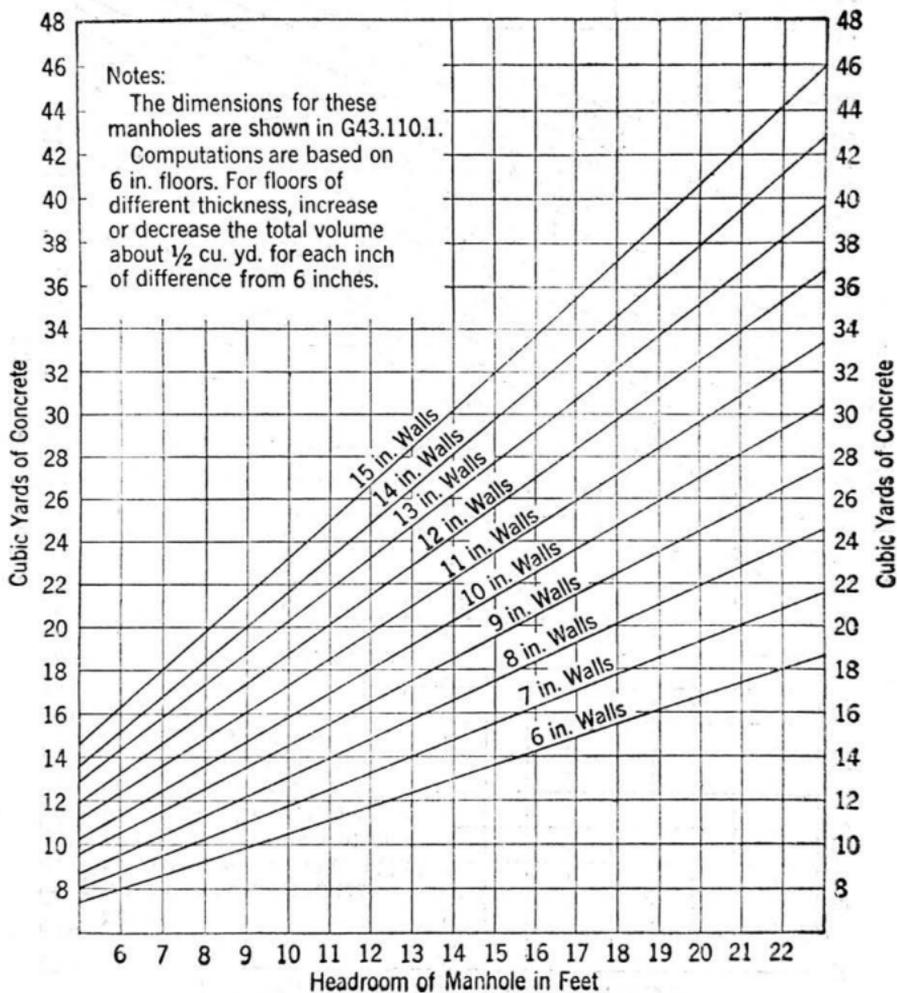
**APPROXIMATE NUMBER OF
CUBIC YARDS OF CONCRETE
REQUIRED FOR CONCRETE MANHOLES**

- Type V-1, Figure 18
- Type V-1, Figure 19
- Modified Type V-1, Figure 22
- Type V-2, Figure 25
- Modified Type V-2, Figure 29



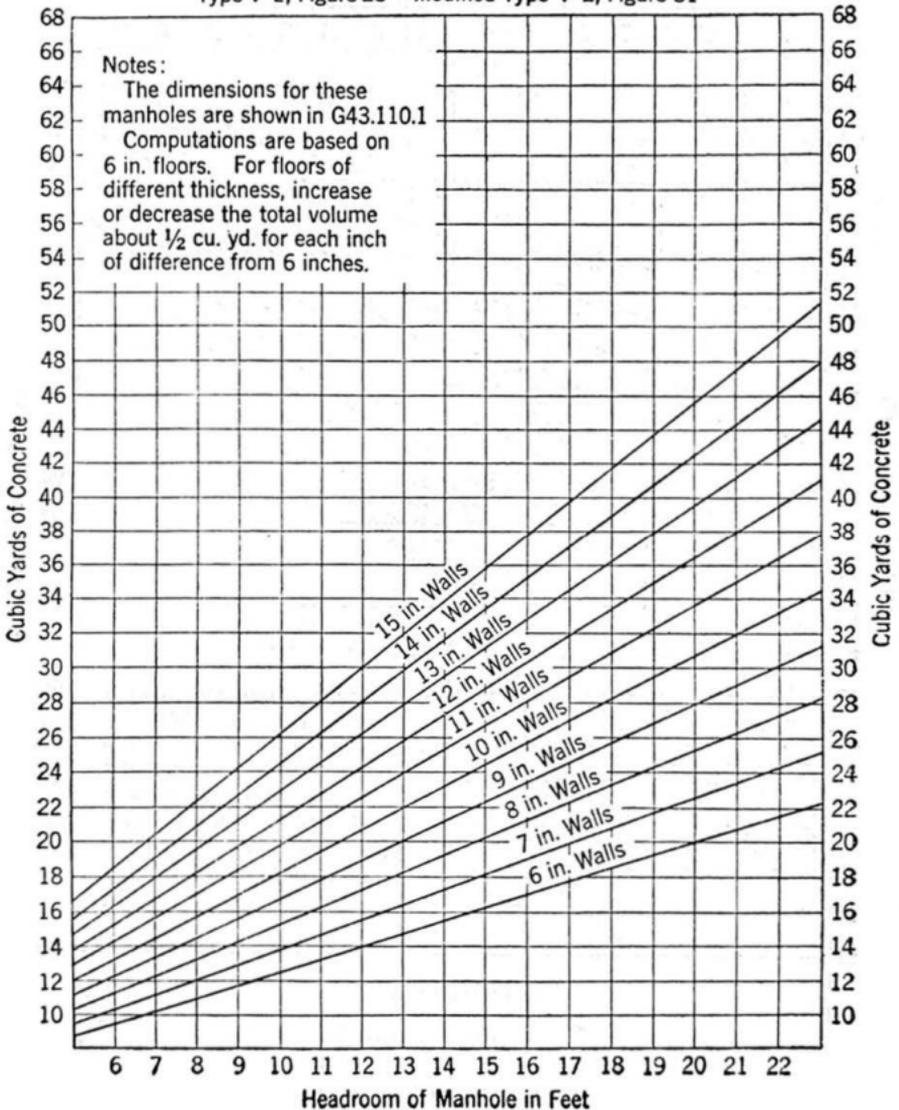
APPROXIMATE NUMBER OF CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

Type V-2, Figure 20
Modified Type V-1, Figure 23
Type V-2, Figure 26
Type V-2, Figure 27
Modified Type V-2, Figure 30
Type V-3, Figure 32



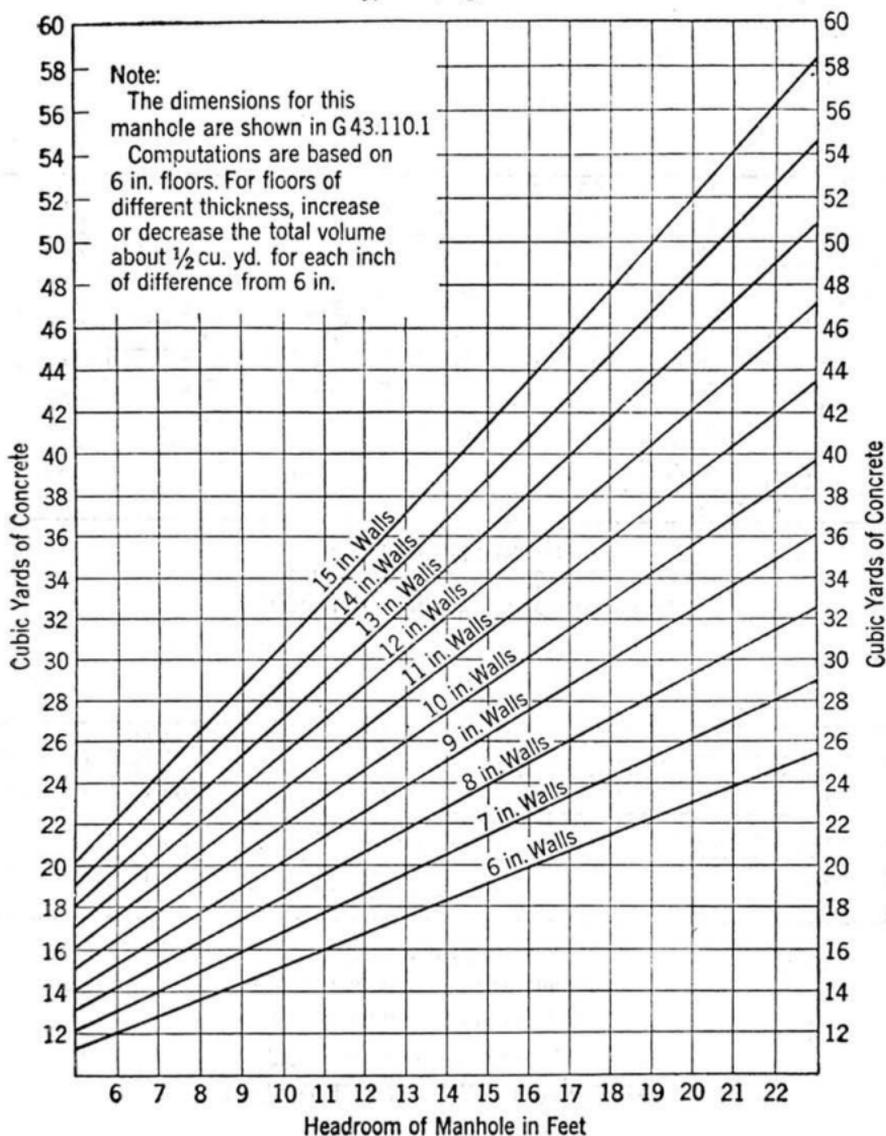
APPROXIMATE NUMBER OF CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

Type V-1, Figure 21 - Modified Type V-1, Figure 24
Type V-2, Figure 28 - Modified Type V-2, Figure 31



APPROXIMATE NUMBER OF CUBIC YARDS OF CONCRETE REQUIRED FOR CONCRETE MANHOLES

Type V-3, Figure 33



5. MATERIAL FOR BRICK MANHOLES

5.01 The amounts of materials required to construct brick manholes of varying sizes are covered in the following tables.

MATERIAL FOR BRICK MANHOLES

3 Ft. - 6 In. Wide x 6 Ft. - 0 In. Long

3 Ft. - 6 In. Wide x 6 Ft. - 6 In. Long

3 Ft. - 6 In. Wide x 7 Ft. - 0 In. Long

4 In. Floor and 6 In. Roof

Length of Manhole	Head-room	Walls				Floor & Roof	
		Mortar			Brick M.	Concrete Cu. Yds.	Reinf. Rods
		Volume Cu. Yds.	Cement Bags	Sand Cu. Yds.			
6 Ft. - 0 In.	5 Ft. - 0 In.	1.1	10.4	1.2	1.56	1.1	20
6 Ft. - 6 In.	5 Ft. - 0 In.	1.2	10.9	1.3	1.63	1.2	22
7 Ft. - 0 In.	5 Ft. - 6 In.	1.3	13.0	1.4	1.94	1.3	24

MATERIAL FOR BRICK MANHOLES

3 ft. - 6 in. wide x 8 ft. - 0 in. long

4 in. floor and 6 in. roof

Head room	Walls				Floor and roof	
	Mortar			Brick M.	Concrete cu. yds.	Reinf. rods
	Volume cu. yds.	Cement bags	Sand cu. yds.			
5 ft. - 6 in.	1.4	13.5	1.5	2.02	1.4	26
6 ft. - 0 in.	1.5	14.7	1.6	2.20	1.4	26
6 ft. - 6 in.	1.7	16.6	1.8	2.48	1.6	26
7 ft. - 0 in.	1.9	18.6	2.1	2.77	1.6	26
7 ft. - 6 in.	2.1	20.5	2.3	3.05	1.6	26
8 ft. - 0 in.	2.3	22.3	2.5	3.33	1.6	26
8 ft. - 6 in.	2.5	24.2	2.7	3.62	1.6	26
9 ft. - 0 in.	2.7	26.1	2.9	3.90	1.6	26

MATERIAL FOR BRICK MANHOLES

3 ft. - 6 in. wide x 8 ft. - 6 in. long
4 in. floor and 6 in. roof

Head room	Walls				Floor and roof	
	Mortar			Brick M.	Concrete cu. yds.	Reinf. rods
	Volume cu. yds.	Cement bags	Sand cu. yds.			
5 ft. - 6 in.	1.5	14.0	1.6	2.10	1.5	28
6 ft. - 0 in.	1.6	15.3	1.7	2.28	1.5	28
6 ft. - 6 in.	1.8	17.3	1.9	2.58	1.7	28
7 ft. - 0 in.	2.0	19.2	2.1	2.87	1.7	28
7 ft. - 6 in.	2.2	21.2	2.4	3.17	1.7	28
8 ft. - 0 in.	2.4	23.1	2.6	3.46	1.7	28
8 ft. - 6 in.	2.6	25.1	2.8	3.75	1.7	28
9 ft. - 0 in.	2.8	27.2	3.0	4.05	1.7	28

MATERIAL FOR BRICK MANHOLES

3 Ft. - 6 In. Wide x 9 Ft. - 0 In. Long
4 In. Floor and 6 In. Roof

Head-room	Walls			Floor and Roof		
	Mortar			Brick M.	Concrete Cu. Yds.	Reinf. Rods
	Volume Cu. Yds.	Cement Bags	Sand Cu. Yds.			
5 Ft. - 6 In.	1.5	14.5	1.6	2.17	1.6	30
6 Ft. - 0 In.	1.7	15.9	1.8	2.37	1.6	30
6 Ft. - 6 In.	1.9	17.9	2.0	2.67	1.7	30
7 Ft. - 0 In.	2.1	20.0	2.2	2.98	1.7	30
7 Ft. - 6 In.	2.3	22.0	2.4	3.28	1.7	30
8 Ft. - 0 In.	2.5	24.0	2.7	3.59	1.7	30
8 Ft. - 6 In.	2.7	26.0	2.9	3.89	1.7	30
9 Ft. - 0 In.	2.9	28.1	3.1	4.20	1.7	30

MATERIAL FOR BRICK MANHOLES

4 Ft.-0 In. Wide × 8 Ft.-0 In. Long
4 In. Floor and 7 In. Roof

Head-room	Walls				Floor and Roof	
	Mortar			Brick M.	Concrete Cu. Yds.	Reinf. Rods
	Volume Cu. Yds.	Cement Bags	Sand Cu. Yds.			
5 Ft.-6 In.	1.5	14.0	1.6	2.10	1.7	26
6 Ft.-0 In.	1.6	15.3	1.7	2.28	1.7	26
6 Ft.-6 In.	1.8	17.3	1.9	2.58	1.9	26
7 Ft.-0 In.	2.0	19.2	2.1	2.87	1.9	26
7 Ft.-6 In.	2.2	21.2	2.4	3.17	1.9	26
8 Ft.-0 In.	2.4	23.1	2.6	3.46	1.9	26
8 Ft.-6 In.	2.6	25.1	2.8	3.75	1.9	26
9 Ft.-0 In.	2.8	27.2	3.0	4.05	1.9	26

MATERIAL FOR BRICK MANHOLES

4 Ft.-0 In. Wide × 8 Ft.-6 In. Long
4 In. Floor and 7 In. Roof

Head-room	Walls				Floor and Roof	
	Mortar			Brick M.	Concrete Cu. Yds.	Reinf. Rods
	Volume Cu. Yds.	Cement Bags	Sand Cu. Yds.			
5 Ft.-6 In.	1.5	14.5	1.6	2.17	1.8	28
6 Ft.-0 In.	1.7	15.9	1.8	2.37	1.8	28
6 Ft.-6 In.	1.9	17.9	2.0	2.67	2.0	28
7 Ft.-0 In.	2.1	20.0	2.2	2.98	2.0	28
7 Ft.-6 In.	2.3	22.0	2.4	3.28	2.0	28
8 Ft.-0 In.	2.5	24.0	2.7	3.59	2.0	28
8 Ft.-6 In.	2.7	26.0	2.9	3.89	2.0	28
9 Ft.-0 In.	2.9	28.1	3.1	4.20	2.0	28

MATERIAL FOR BRICK MANHOLES

4 Ft.-0 In. Wide × 9 Ft.-0 In. Long
4 In. Floor and 7 In. Roof

Head-room	Walls				Floor and Roof	
	Mortar			Brick M.	Concrete Cu. Yds.	Reinf. Rods
	Volume Cu. Yds.	Cement Bags	Sand Cu. Yds.			
5 Ft.-6 In.	1.6	15.1	1.7	2.25	1.9	30
6 Ft.-0 In.	1.7	16.4	1.8	2.45	1.9	30
6 Ft.-6 In.	1.9	18.6	2.1	2.77	2.0	30
7 Ft.-0 In.	2.2	20.7	2.3	3.08	2.0	30
7 Ft.-6 In.	2.4	22.8	2.5	3.40	2.0	30
8 Ft.-0 In.	2.6	24.9	2.8	3.71	2.0	30
8 Ft.-6 In.	2.8	27.0	3.0	4.03	2.0	30
9 Ft.-0 In.	3.0	29.1	3.2	4.34	2.0	30