Specifications
402-A
October 24, 1913
Superseding Specifications
C-33-A
C-52-A

THE WESTERN UNION TELEGRAPH COMPANY

SPECIFICATIONS FOR

UNDERGROUND CONSTRUCTION

TABLE OF CONTENTS

Section 1
GENERAL

1. **Outline.** These specifications, together with the drawings, cover general instructions for planning underground conduit systems, for laying the conduit and for building manholes.

2. The instructions cover various types of conduit construction with either multiple or single vitrified clay duct or creosoted wood duct, and manhole construction of either brick or concrete. The choice of materials to be used will depend largely on the question of supply and cost in place, as discussed in Sections 4 and 6 of these specifications.

3. Iron pipe shall be used only for avoiding obstructions and for vertical runs in terminating laterals on poles or buildings.

4. **Plans.** A careful survey shall be made of the proposed route and plans prepared giving the following information relative to the conduit system:

(a.) Conduit:

Location
Number of ducts
Type of duct material
Method of laying

(b.) Manholes:
- Location
- Type
- Dimensions
- Material, brick or concrete
- Reinforcing material for roofs
- Type and size of manhole frame and cover

(c.) Laterals or Subsidiaries:
- Location
- Number of ducts
- Material and type of construction
- Diameter and length of pipe for vertical runs, when necessary.

The plans shall also give the location of all foreign underground structures in the near vicinity, as well as all other essential details which can be determined in advance of actual construction work.

5. While the work is in progress, the plans shall be supplemented with whatever further information can be obtained regarding the depth of ducts below the street surface, location of manholes, location and nature of obstructions and special construc-

tion, changes from original plans, etc., so that on completion of the work, the plans will form an accurate record of the entire underground construction.

6. **Material.** Unless otherwise specified herein, all material used and all methods followed shall conform to standard specifications of the Telegraph Company.

7. **Ordinances.** In planning and building an underground system, it is important that all ordinances and regulations, which in any way affect the work or methods of performing it, shall be kept in mind and complied with.

8. **Permits.** Before any work is started, all necessary permits shall be obtained from the city or other proper authorities. The permits, when necessary, should state the approximate location of the work.

9. **Closing Streets.** No street shall be closed until the requisite permission has been obtained and the Fire Department has first been notified that such is to be done.

10. **Distribution of Material.** All material shall be placed along the line of work, so that it will be readily available and still not interfere with the work. In all cases, the material shall be distributed so as to avoid loss or damage to it, and so that it will interfere with traffic as little as practicable.

11. Cement shall always be placed on planks, and covered with a suitable tarpaulin.

12. Creosoted material shall not be placed on lawns or in similar locations where it will injure grass or shrubbery.

13. **Fire Hydrants.** Fire hydrants must be accessible at all times. If necessary, a bridge strong enough to support a fire engine shall be built over the trench in front of the hydrant.

14. No material shall be placed in front of a fire hydrant or less than ten (10) feet from either side of it.

15. **Maintaining Traffic.** Public traffic shall be interfered with as little as possible.

16. The length of trench that may be opened at any one time shall be within the requirements of the municipal ordinances or regulations. When necessary, proper bridges shall be built at street crossings.

17. Bridges shall be built wherever excavations unduly inconvenience the occupants of buildings along the line of work.

18. Whenever the work interferes with the street or surface drainage, temporary drainage shall be provided.

19. **Avoiding Accidents.** Openings, construction, or excavated material shall at all times be protected by suitable means of preventing accidents, such as fences, barricades, or red flags.

20. Red lights shall be used at night to indicate the location of all openings and Company's property. Temporary crossings and bridges shall be designated by white or green lights.

21. Watchmen shall be provided whenever necessary or when directed by the proper authorities.

22. **Property of Other Companies.** Property of other companies shall not be interfered with, unless permission has been obtained from them.

23. Gas or water pipes, sewers, drains or other structures which become exposed shall be properly supported and protected from injury. When necessary, underpinning shall be made permanent and left in the trench.

24. **Damage to Foreign Structures.** Damage to foreign pipes, drains, or other structures shall be temporarily repaired and immediately reported to the proper authorities. No permanent repairs shall be made without the consent of the owners.

25. **Blasting.** Blasting, when required, shall be done only by a person specially authorized to use explosives. All explosives shall be handled in accordance with standard specifications for this work and all local ordinances or requirements shall be complied with.

26. Only moderate charges of explosives shall be used. Where necessary, every

reasonable precaution, such as covering the blast with heavy timbers chained together, etc., shall be taken to protect life and property.

27. **Route.** When there are two or more available routes for a conduit system, the route decided upon should preferably be the one which will permit the shortest cables, due consideration being given to the character of the streets in which the work is to be done, the rock excavation or obstacles which will be encountered, and the liability of subsequent disturbances by work on other underground structures.

28. **Test Holes.** Unless the location and character of obstructions in the line of the proposed conduit can be ascertained from reliable information or records, test holes shall be dug as indicated in Figure 1.

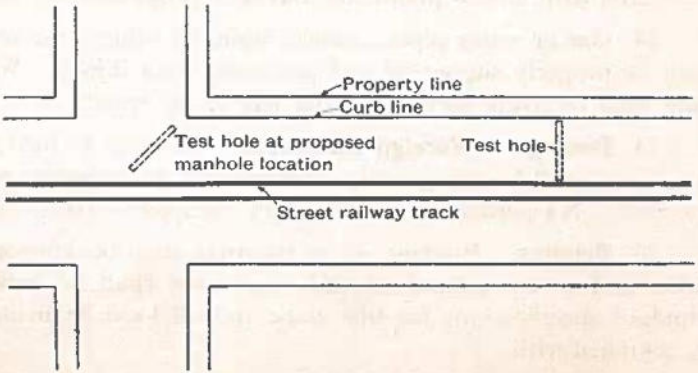


Figure 1—General Location of Test Holes

29. One hole shall be at the end of each block, and others at such intermediate points as may be deemed necessary. The test holes shall be as narrow as possible and long and deep enough to locate any obstructions.

30. **Location of Conduit.** Decision as to location of the conduit shall be based on the information obtained through the records, survey of the streets, test holes, etc. Car tracks and other surface obstructions as well as pipes and other underground structures shall be avoided.

31. As a rule, conduits should not be located in the middle of the street, on account of the possibility of interference from street railways and sewer work, nor close to the curb line, on account of the greater exposure to surface drainage and interference with present or future sewer catch basins.

32. It is highly important to have the conduit located so that foreign pipes will neither enter the manholes nor require them to be constructed with other than standard shape and size. Introducing curves in the conduit or changing the section length between manholes will often bring about the desired result.

33. When impracticable to avoid foreign pipes by suitably locating the manhole, the foreign pipes shall be deflected if possible. Gas pipes should never enter a manhole.

34. **Alignment of Conduit.** As far as possible, the conduit shall follow a straight

line between manholes. Curves should be avoided, particularly two (2) or more curves in the same section.

35. When curves are unavoidable, they shall be not less than twenty-five (25) feet in radius. The maximum length of sections containing such curves should in general be shorter than that of straight sections, the limiting lengths to depend on the number and character of bends and the type of duct.

36. For a section containing a right angle bend with a twenty-five (25) foot radius, the distance between manholes shall not exceed three hundred (300) feet.

37. In cases where it is necessary to lay conduit with a curvature of less than twenty-five (25) feet radius, the curve should be constructed with either short lengths of clay duct or wrought iron pipe.

38. **Separation from Electric Light or Power Conduit.** The telegraph conduit and manholes should not be near electric light or power conduit. In all cases the ducts of the two systems shall be separated by at least six (6) inches of concrete or twelve (12) inches of earth.

39. **Joint Subway.** Subways intended for carrying both electric light or power wires and telegraph or telephone wires shall have the ducts for the two systems separated by at least six (6) inches of concrete or twelve (12) inches of earth and shall be provided with separate manholes.

40. Combination manholes, which have separate compartments for the telegraph cables and the electric light or power wires or cables, will be accepted as substitutes for separate manholes, provided there is a fireproof barrier or partition wall at least six (6) inches in thickness, extending from floor to ceiling and entirely separating the two compartments. There must be no opening of any kind between the compartments and each compartment shall have a separate opening with separate frame and cover.

41. Ducts intended for carrying telegraph or telephone wires passing through electric light or power manholes and vice versa shall be surrounded by at least six (6) inches of concrete continuous from wall to wall, and iron plates or wooden battens shall be placed on the top and sides to prevent the concrete from being knocked off the duct.

42. In all other respects joint subways shall be constructed in accordance with the provisions of these specifications.

43. **Crossings Under Railroads.** Crossings under a railroad or street railway shall not be started until the railway company has been notified.

44. Tile conduit shall be laid with a clearance of twenty-four (24) inches between the top of the conduit structure and the bottom of the ties. If this clearance cannot be obtained, three (3) inch iron pipe shall be used.

45. **Crossing Brooks or Streams.** Crossing of brooks or streams shall in general be beneath rather than above the bed of the stream, in order to avoid danger from freshets, but if permanent bridges or culverts are available and ample provision is made for flood conditions, it is permissible to cross on such bridges or culverts.

46. If the crossing is made beneath the bed of the stream, the ducts should preferably be laid so they will drain into the manholes, using deeper manholes if necessary.

47. Tile conduit should not be used for crossing bridges, unless the bridge is constructed of masonry with a ballasted road bed. As a general rule, the crossing should be made with creosoted wood duct or iron pipe, placed on the bridge at the side of the roadway, or suspended from the under side of the bridge structure. Special instructions shall be obtained as to the method of construction to be employed at such crossings.

Section 2

TRENCH

48. **Size of Trench.** The trench shall be six (6) inches wider than the conduit. The depth should, in general, be enough to provide a minimum cover of twenty-four (24) inches above the conduit protection. Where the conduit is to be laid under grass plots or sidewalks, or under boulevards on which heavy traffic is prohibited, the minimum cover may be decreased to eighteen (18) inches, on approval of the proper authority.

49. Where an unimproved street is to be paved in the near future, the new grade of pavement shall be ascertained, and the conduit laid accordingly. If the grade of the unimproved street is considerably below the proper grade, the conduit may, if thought desirable, be laid with the top of the protecting concrete just below the surface of the unimproved street, provided, however, that a sufficient quantity of surplus dirt be placed over the conduit and well tamped so as to maintain a protective covering at least eighteen (18) inches in depth above the conduit.

50. **Surface Materials.** All paving material which can be used again shall be put aside and saved. No more pavement shall be removed than necessary.

51. In parkways and lawns, the sod and top soil shall be saved so that it can be replaced. When directed, the excavated earth shall be placed on canvas or burlap so as not to damage the grass.

52. **Excavation.** The trench shall be excavated to the proper width and depth and the excavated earth piled on the street. One side of the trench shall be kept clear to give access for placing concrete and laying ducts. The dirt on the other side shall be trimmed back two (2) feet to provide working room.

53. **Shoring.** When necessary, the sides of the trench shall be braced or supported with suitable planks, to prevent caving.

54. **Grading.** When possible, the trench shall be opened the entire length between adjacent manholes before the ducts are laid. This will show the nature and location of all obstructions, after which the final line and grade of conduit shall be established.

55. The trench shall be graded so that it will have a fall of at least three (3) inches and preferably five (5) inches in one hundred (100) feet towards the lowest manhole, or from the middle of the section towards both manholes.

56. The bottom of the trench shall be leveled, and graded evenly, so as to be free from traps or depressions in which water can accumulate or remain. Excavations below the bottom line of the trench shall be refilled with good earth, well rammed.

57. Wherever possible, the incoming and outgoing ducts of the main run at any manhole should enter the manhole walls at the same level.

58. **Water in Trench.** After grading, the trench shall be kept free from water by draining, pumping or bailing. Springs shall be permanently drained, if possible. Where this cannot be done, the conduit shall be completely encased in concrete, steel reinforcement being used if necessary.

59. **Refilling.** In refilling the trench, the better part of the material excavated shall be used next to the ducts. Stones shall not be placed next to the ducts. Large stones which are permitted to be replaced in the trench shall be placed with the flat side vertical, to minimize the liability of settling.

60. The refilled earth shall be thoroughly tamped with two (2) tampers to each shoveller. More tampers shall be used if necessary or if required by the municipal authorities.

61. When permitted by the municipal regulations, the trench may be flushed during the operation of refilling. After being refilled it shall be allowed to settle thoroughly before the pavement is replaced.

62. All tamping, rolling, puddling and flushing shall be done with proper tools in a manner to prevent, as far as possible, future settlement and so as not to damage the conduit or to injure work in progress in the trench.

63. **Temporary Paving.** Whenever it is necessary, in order to prevent inconvenience to the public or interference with traffic, the trench shall be temporarily resurfaced to the satisfaction of the municipal authorities, until such time as the pavement can be permanently replaced.

64. **Permanent Paving.** All pavements, curbstones and foreign structures shall be replaced in as good condition as they were found when the work started, and so as to satisfy the proper authorities.

65. **Removing Surplus Material.** From time to time as the work progresses the surplus earth shall be removed from the streets so as not to obstruct traffic. All surplus material remaining after the work has been finished shall be removed.

Section 3

CONCRETE AND MORTAR

Materials

66. **Quantities.** Concrete and mortar shall be made up only in such quantities as are required for immediate use. In no case shall it be used after the cement has begun to set.

67. **Cement.** The cement used shall be a first-class Portland cement, of a brand approved by the Telegraph Company and conforming to the requirements of this Company's Specifications for Cement.

68. **Sand.** Sand shall be clean and coarse or a mixture of coarse and fine grains with the coarse grains predominating. It shall be free from clay, loam, mica, sticks, and other deleterious matter.

69. **Broken Stone.** The broken or crushed stone shall be of limestone, granite or trap rock, clean, hard, sound and free from clay, dust or dirt.

70. It shall be of such size that it will pass through a screen having a three-

fourths (¾) inch mesh and be retained on a screen having a one-fourth (¼) inch mesh. The requirements as to the size of the stone may be modified slightly to meet the material available locally.

71. **Screened Gravel.** The gravel shall be composed of clean pebbles free from sticks and other foreign matter, and containing no clay or other material adhering to the pebbles in such quantity that it cannot be removed by washing.

72. It shall be of such size that it will pass through a screen having a three-fourths (¾) inch mesh and be retained on a screen having a one-fourth (¼) inch mesh. The screenings may be used as part of the sand.

73. **Water.** The water used for the concrete and mortar shall be free from oil, acid, strong alkalies and vegetable matter.

Mortar

74. **Proportions.** Mortar shall be composed of:

One (1) part cement
Three (3) parts sand.

75. **Mixing.** The cement and sand shall first be mixed dry, to a uniform color. Water shall then be added and the mixture turned again until it forms a uniform paste of the proper consistency.

76. **Proportions.** For trench work and manhole floors, concrete shall be composed of:

One (1) part cement
Four (4) parts sand
Eight (8) parts broken stone or screened gravel.

77. For manhole walls and roofs, concrete shall be composed of:

One (1) part cement
Two and one-half (2½) parts sand
Five (5) parts broken stone or screened gravel.

78. **Mixing.** Machine mixed concrete is preferable to concrete mixed by hand. When machine mixing is used, care shall be taken that the machine is adjusted to give the proper proportions of materials. The concrete should be neither too wet nor too dry.

79. When mixing by hand, the cement and sand shall first be mixed dry and then the stone or gravel added. The whole shall then be thoroughly mixed until a uniform color is obtained. Water shall next be added and the mixture turned until it is thoroughly mixed and uniform.

80. **Placing Concrete.** Concrete shall be mixed as near as possible to the place

where it is to be used. If necessary, it shall be hauled to place in wheelbarrows. It should not be hauled too far, however, as this will tend to separate its ingredients.

81. The concrete shall be placed immediately after mixing. It shall be spread evenly and rammed until water collects at the surface.

82. When placing concrete on top of the ducts, care shall be taken not to damage the cement collars nor disturb the alignment of the ducts.

83. **Joining Concrete or Masonry.** If work on concrete or masonry is interrupted for an hour or more, the surface of the material where the joint is to be made shall be washed with a thin mixture of cement and water.

Section 4
LAYING CONDUIT
General

84. **Choice of Materials.** The choice of materials depends largely upon their relative costs. In making comparisons, the cost of installation should always be included.

85. Under most conditions, multiple clay duct will be the most economical. Where greater flexibility is required, on account of foreign pipes or conduit systems, single duct will often be preferable.

86. Creosoted wood ducts will be found desirable where concrete work is difficult or expensive, as, for example, when suitable materials are not available locally or when the soil is so wet that expensive pumping is necessary. On account of its being laid easily and without foundation, creosoted wood is often well suited for trunk conduit construction in rural districts, where a considerable length of trench can be opened at a time and where there is small likelihood of subsequent disturbance from foreign excavations.

87. Iron pipe construction shall be avoided wherever possible, on account of its high cost and the danger from electrolysis. Its chief use will be in avoiding obstructions which cannot be overcome by construction of clay duct or creosoted wood.

88. **Conduit Cross Sections.** Standard cross sections for conduit are shown in Figure 2. These cross sections give the most economical arrangement for the ducts and also permit of the best arrangement of the cables in the manholes.

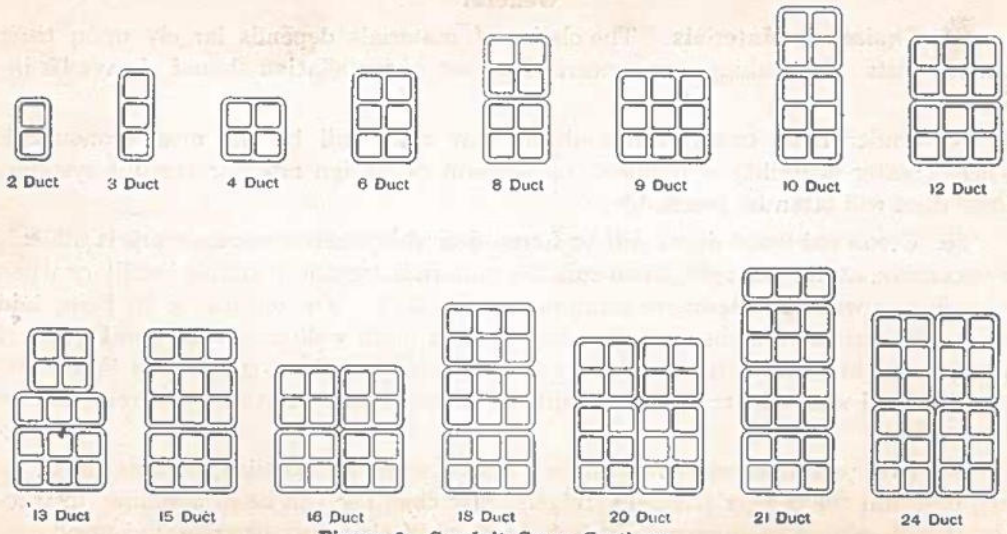


Figure 2—Conduit Cross Sections

89. Under certain conditions, such as obstructions limiting the vertical location of the subway or caving in of the sides of the trench necessitating shoring, a wider and shallower formation will prove more economical than the standard cross sections. When such conditions are met with, the matter should be investigated so as to determine the most economical arrangement of the conduit cross sections for the particular case.

90. The conduit cross sections for single clay duct shall in general be the same as those specified for multiple clay duct.

91. **Cleaning Bores.** Care shall be taken that all ducts have clean bores before they are laid. If necessary the bores of all ducts shall be cleaned or scraped.

92. **Foreign Pipes in Trench.** Gas and water pipes shall always be excluded from the concrete protection of conduits, if possible.

93. Foreign pipes that cannot be excluded from the conduit structure shall be surrounded with broken stone or sand, so as to permit the pipes being withdrawn without disturbing the conduit (Figure 3).

94. Sufficient space for calking shall be left between the conduit structure and joints in cast iron pipes. Conduit crossing a cast iron pipe line, near a joint, should cross back of the bell.

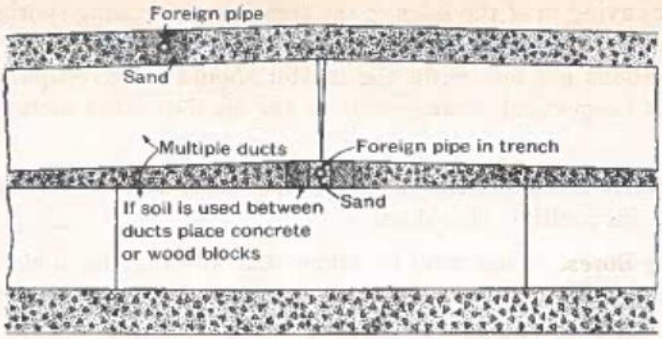


Figure 3—Method of Avoiding Foreign Pipes in Trench

95. **Conduit Through Rock.** When conduit is laid through rock, a two (2) inch cushion of sand shall be laid under the conduit structure.

96. **Plugging Ducts.** When the work is left at night or other times, the ducts

shall be firmly stopped with wooden plugs, care being taken that no obstructions remain in the ducts. Completed runs between manholes shall be plugged whenever there is danger of the ducts being flooded.

97. The wooden plugs shall be in accordance with Figure 4, or an approved equivalent. Unless they have been previously soaked in oil or otherwise treated to exclude water, the plugs shall be well soaked in water, and covered with burlap or cheesecloth, before being used.

98. **Changes in Type of Conduit.** Where a change is made, out in a section, from tile conduit to wood or iron pipe, the two types of duct shall be joined with conduit castings, as shown in Figure 5. The joints between the ducts and castings shall be surrounded with concrete or mortar.

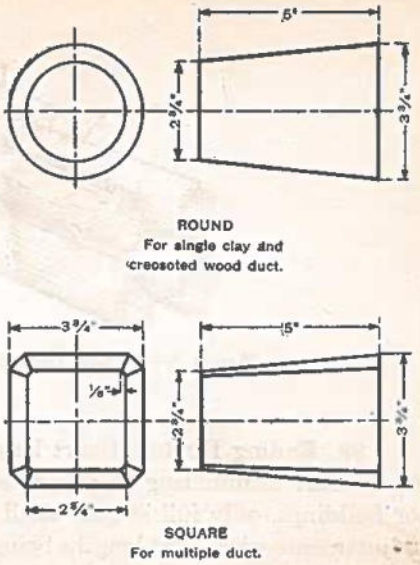


Figure 4—Conduit Plugs

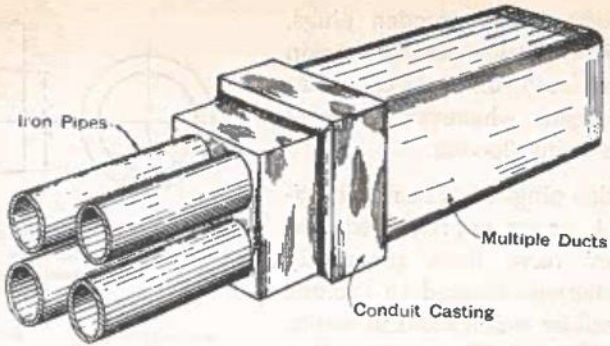


Figure 5—Joining Different Types of Conduit with Conduit Casting

99. **Ending Ducts.** Short lengths of duct shall be used for adjusting the length of conduit terminating in manholes or buildings. At the entrance to the manholes or buildings, only full lengths shall be used in the bottom tier of ducts, any necessary adjustments with short lengths being made further out in the section.

Multiple Vitrified Clay Duct

100. **Methods of Laying.** Multiple duct tile shall be laid according to one of the following methods:

Method No. 1—Top and Bottom Protection.
Method No. 2—Inverted Channel Concrete Protection.
Method No. 3—Complete Encasement in Concrete.

101. Method No. 1, Top and Bottom Protection, shall be considered standard for all conduits whose cross section contains more than one (1) section of multiple tile. It may also be used for conduits containing but a single section of multiple tile where Method No. 2 construction is impracticable.

102. Method No. 2, Inverted Channel Concrete Protection, shall be considered as the preferable method for conduits containing but a single section of multiple duct. This method consists of laying the tile directly on the bottom of the trench and therefore it shall not be used when the soil is not firm enough to keep the ducts in alignment until the concrete on top of the ducts has taken a permanent set.

103. Method No. 3, Complete Encasement in Concrete, shall be used only when quicksand or other unstable ground makes it necessary to provide an artificial support for the ducts.

Method No. 1—Top and Bottom Protection

104. The method of laying multiple duct with top and bottom protection is shown in Figure 6.

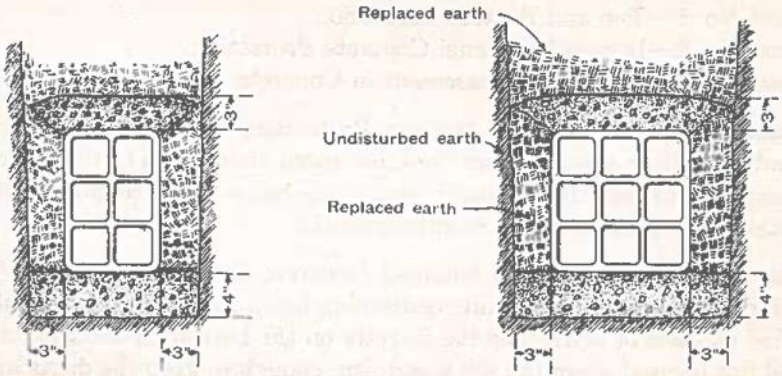


Figure 6—Multiple Duct Tile—Method No. 1

105. **Foundation.** The ducts shall be laid on a concrete base four (4) inches thick and extending three (3) inches on each side of the ducts.

106. On two (2) and three (3) duct runs, creosoted timber may be used instead

of concrete for the foundation, provided it is cheaper, and that there is little likelihood of interference from foreign excavations. The creosoted plank shall be one and one-half (1½) inches in thickness and as wide as the conduit.

107. When conduit is laid through solid rock, the concrete or plank foundation may be omitted and the ducts laid directly on a two (2) inch cushion of sand.

108. **Laying Ducts.** If possible, the ducts shall be laid before the concrete foundation has taken its initial set. If the concrete has already set, a thin layer of mortar shall be placed under the ducts.

109. In laying two (2) or three (3) duct tile on creosoted plank foundation, a layer of mortar shall be placed between the plank and the ducts, so as to completely close the joints between all ducts.

110. When building a conduit of two (2) or more sections of tile, a layer of mortar shall be placed between each tier of ducts. The duct sections shall be laid so as to break joints, both horizontally and vertically.

111. **Making Joints.** Adjacent sections of tile shall be carefully butted and centered. At least two (2) dowel pins shall be used at each joint.

112. Each joint shall be covered with a strip of wet cheesecloth, nine (9) inches wide and long enough to overlap four (4) inches at the top. The joint shall be plastered with a one-half (½) inch layer of mortar (Figure 7).

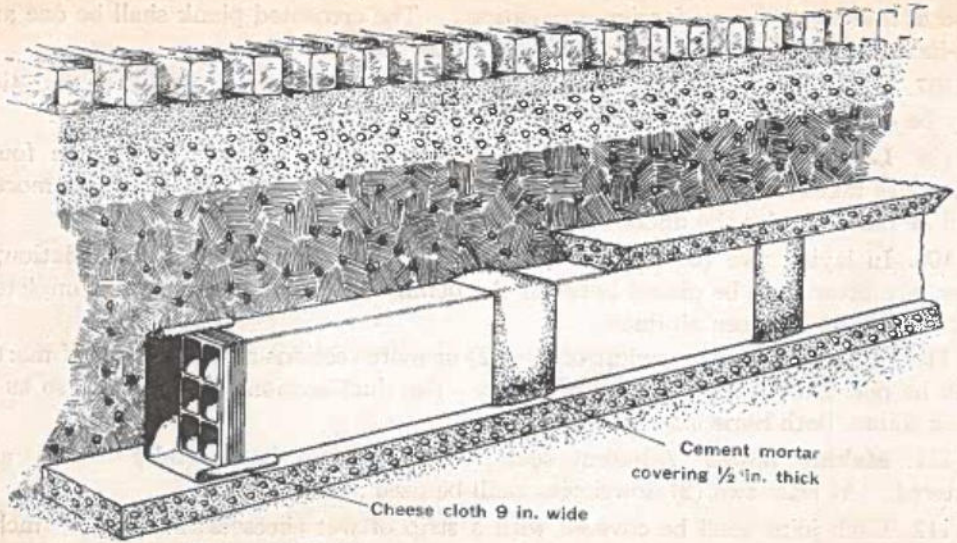


Figure 7—Multiple Duct Tile—Method of Making Joints

113. A convenient way of using the cheesecloth strips is to roll or fold up each strip separately and then bind several pieces in a bundle so that they can be pulled out from the bundle, one at a time. By having one of these bundles in a pail of water, the man who lowers the tiles into the trench can pick out a piece of cheesecloth from the bundle and lay it on the tile to be lowered into the trench. In this way, the cloth will lie flat and not curl up.

114. **Filling and Placing Top Protection.** The sides of the trench shall be filled with earth, well tamped, as shown in Figure 6. This earth shall be banked against the sides of the trench so as to provide a form for the concrete protection and avoid the use of flash boards or other devices for limiting the width of the protection.

115. A three (3) inch layer of concrete shall then be placed on top of the ducts. The concrete shall be well tamped, care being taken not to disturb the ducts.

116. Where creosoted timber is cheaper than concrete, creosoted wood planks, one and one-half (1½) inches thick and of a width equal to the top tier of ducts, may be used instead of concrete as a top protection for the ducts.

Method No. 2—Inverted Channel Concrete Protection

117. In this method of laying, the multiple duct tile is laid on the bottom of the trench and provided with a concrete protection as shown in Figure 8.

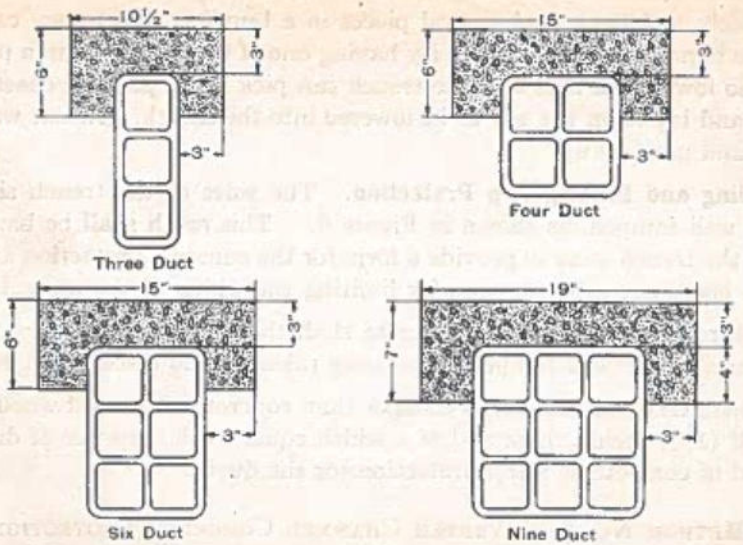


Figure 8—Multiple Duct Tile—Method No. 2

118. **Laying Ducts.** The duct shall be laid directly on the trench bottom, a slight excavation being made in the bottom of the trench where the joints will come.

119. A layer of cement mortar shall be placed under the joints, and the joints made as specified for Method No. 1.

120. **Filling and Placing Top Protection.** The sides of the trench shall be filled with earth, well rammed, to within four (4) inches of the top, for a nine (9) duct conduit and to within three (3) inches of the top for conduits containing less than nine (9) ducts.

121. Wet concrete shall then be placed on the conduit in the form and of the dimensions shown in Figure 8.

122. If possible, with this type of construction, the trench shall not be refilled until the concrete has taken its "final" set. Otherwise it shall be refilled immediately after the concrete has been placed and before it has taken its "initial" set.

Method No. 3—Complete Encasement in Concrete

123. Complete encasement in concrete shall be used only when a good foundation for the conduit cannot be obtained.

124. The ducts shall be laid the same as specified for Method No. 1 and then surrounded with three (3) inches of concrete on sides and top.

125. Where necessary, the concrete shall be reinforced with guy strand or its equivalent.

Mandrel Test

126. After refilling, but before the trench is permanently repaired, amandrel, as shown in Figure 9, shall be drawn through two ducts of each tile, from manhole to manhole. These two ducts shall be on diagonally opposite corners of the tile.

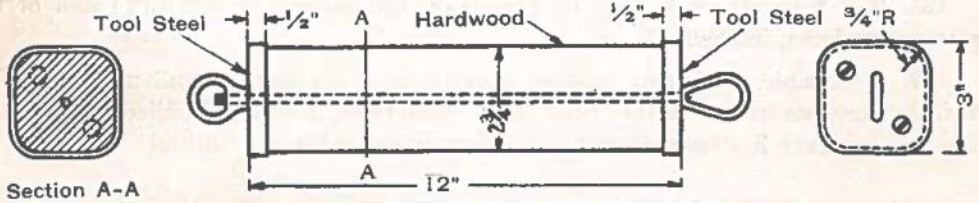


Figure 9—Test Mandrel for Multiple Duct Tile

127. Tiles through which the mandrel cannot be drawn are defective and shall be repaired at once. After repairs are made the mandrel shall be redrawn through two (2) diagonal ducts of all tiles that have been disturbed.

Single Vitrified Clay Duct

128. **Methods of Laying.** Single duct tile shall be laid according to one of the following methods:

Method No. 4—Top and Bottom Protection.
Method No. 5—Complete Encasement in Concrete.

129. Method No. 4, Top and Bottom Protection, shall be considered standard for conduits constructed of single clay duct.

130. Method No. 5, Complete Encasement in Concrete, shall be used under the same general conditions as Method No. 3 for multiple duct tile.

Method No. 4—Top and Bottom Protection

131. **Foundation.** The ducts shall be laid on a concrete base four inches thick and extending three (3) inches on each side of the ducts (Figure 10).

132. **Laying Ducts.** If possible, the ducts shall be laid *after* the concrete has set. A layer of mortar shall be placed under the ducts and between each tier of ducts. All spaces between the ducts shall be filled with mortar.

133. The ducts shall be laid without shoulders or offsets in the bore, and so as to break joints, both horizontally and vertically.

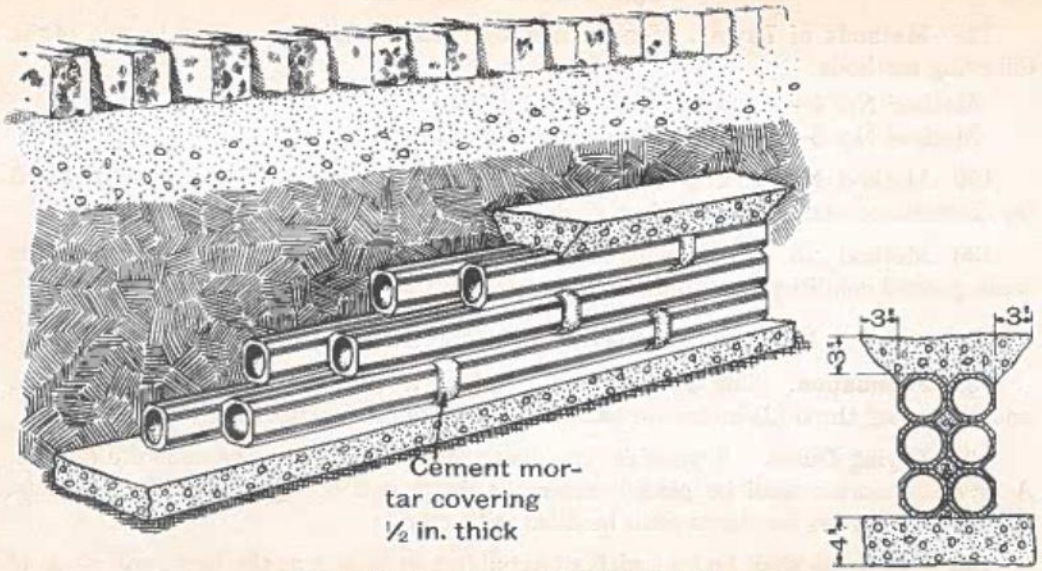


Figure 10—Single Duct Tile—Method No. 4

134. **Mandrel Test.** A mandrel, shown in Figure 11, shall be drawn through each duct as it is laid. Care should be taken that the washers fit the ducts tightly and are renewed whenever necessary.

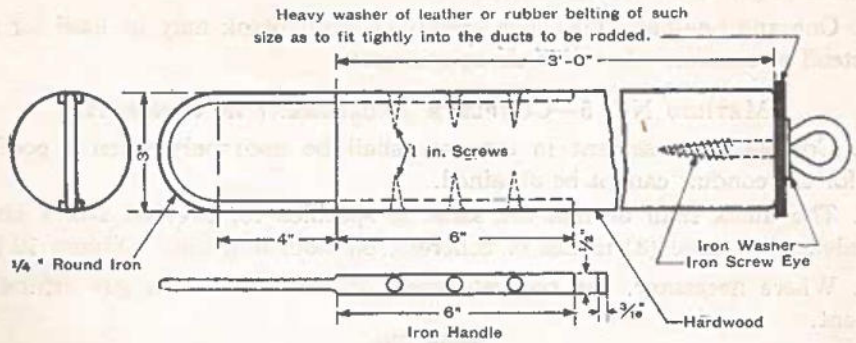


Figure 11—Mandrel for Laying Single Duct Tile

135. **Making Joints.** The outside of each joint shall be plastered with a layer of mortar.

136. **Filling and Placing Top Protection.** The sides of the trench shall be filled with earth, well tamped, both sides of the trench being filled at the same time.

137. A three (3) inch layer of concrete shall then be placed on top of the ducts, as in Method No. 1, for multiple duct tile.

138. One and one-half (1½) inch creosoted wood plank may be used for protection instead of concrete when it is cheaper in cost.

Method No. 5—Complete Encasement in Concrete

139. Complete encasement in concrete shall be used only when a good foundation for the conduit cannot be obtained.

140. The ducts shall be laid the same as specified for Method No. 4 and then surrounded with three (3) inches of concrete, on sides and top. (Figure 12.)

141. Where necessary, the concrete shall be reinforced with guy strand or its equivalent.

Split Tile

142. **General.** Split tile is sometimes required in reconstruction and repair work, but should be laid only by an experienced tile layer.

143. The tile should be split on the job and marked so that the pieces will be put together in the same way in which they were made.

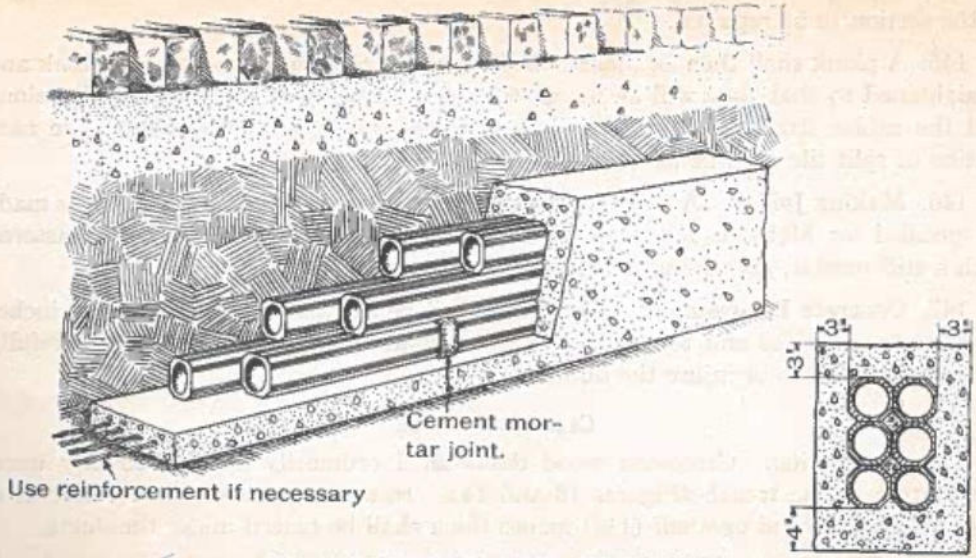


Figure 12—Single Duct Tile—Method No. 5

144. **Laying.** The split tile shall be laid on the concrete base for the entire length of the section to be repaired.

145. A plank shall then be placed on the tile and the cables laid on the plank and straightened so that they will lie flat in the duct. The plank can then be slid along and the cables straightened out until their entire length is in the duct. The next section of split tile shall be laid and handled in the same way.

146. **Making Joints.** A dowel pin shall be placed in each hole and the joints made as specified for Methods No. 1 and No. 4. All horizontal joints shall be plastered with a stiff mortar, care being taken that no mortar enters the ducts.

147. **Concrete Encasement.** The ducts shall be surrounded with three (3) inches of concrete, on sides and top. This concrete shall be placed and tamped carefully so as not to disturb or injure the ducts.

Creosoted Wood

148. **Foundation.** Creosoted wood ducts shall ordinarily be laid directly upon the bottom of the trench (Figures 13 and 14). In sandy or insecure soil, creosoted wood planks one and one-half (1½) inches thick shall be placed under the ducts.

149. **Laying Ducts.** The ducts shall be laid as shown in Figure 14, so as to break joints both horizontally and vertically. All joints shall be tight.

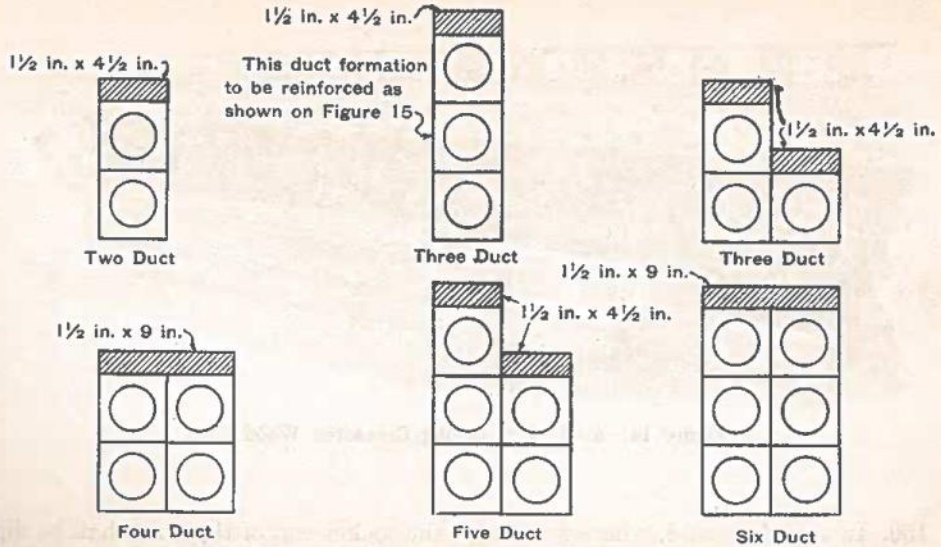


Figure 13—Arrangement of Creosoted Wood Ducts

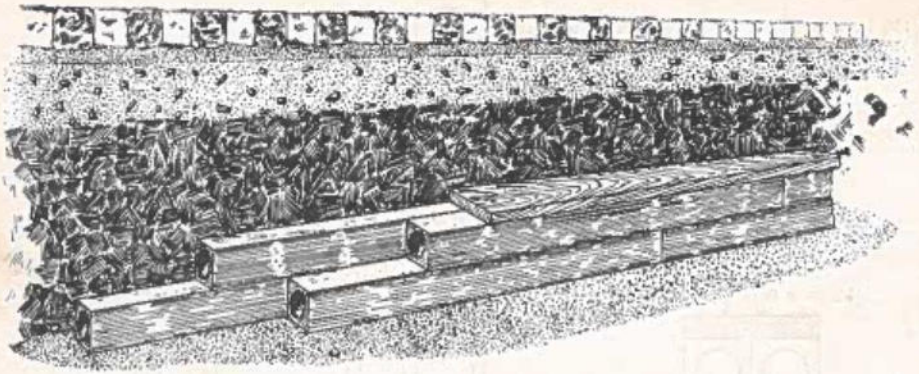


Figure 14—Method of Laying Creosoted Wood Duct

150. In very fine sand, where necessary, the socket end of the duct shall be dipped in hot tar to a depth of one (1) inch, before joining. No tar should be allowed to enter the bore of the duct.

151. When the conduit is one (1) duct wide and more than two (2) ducts high, creosoted ties shall be used to preserve the alignment, as shown in Figure 15.

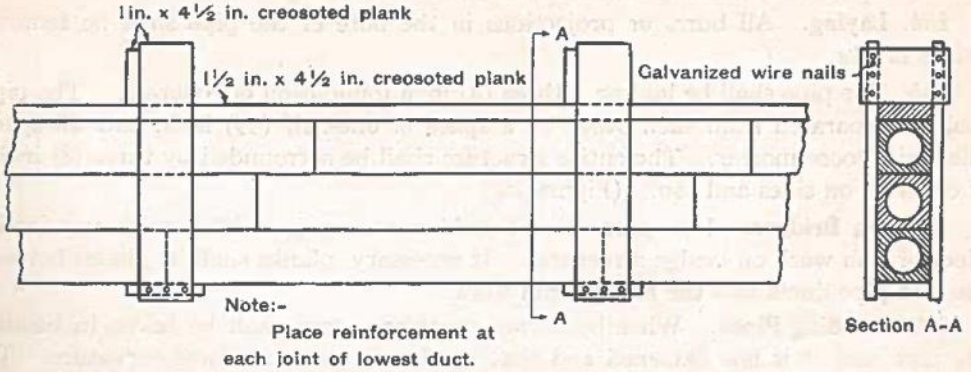


Figure 15—Method of Reinforcing Three-Duct Run of Creosoted Wood

152. **Covering Plank.** Creosoted wood planks, one and one-half (1½) inches thick and of a width equal to the maximum width of the duct structure, shall be placed on top of the ducts, for protection.

Wrought Iron Pipe

153. Three (3) inch iron pipe may be used to avoid obstructions when satisfactory construction cannot be made with clay or creosoted wood duct.

154. **Laying.** All burrs or projections in the bore of the pipe shall be removed before laying.

155. The pipe shall be laid on a three (3) inch foundation of concrete. The pipes shall be separated from each other by a space of one-half (½) inch, and all spaces filled with loose mortar. The entire structure shall be surrounded by three (3) inches of concrete on sides and top. (Figure 16.)

156. **On Bridges.** Iron pipe ducts should not come in contact with any foreign pipes or iron work on bridge structures. If necessary, planks shall be placed between the iron pipe ducts and the foreign iron work.

157. **Bending Pipes.** When bends are necessary, care shall be taken in bending the pipe that it is not flattened and that the bends are of uniform curvature. The radii of the bends should be as large as possible.

158. **Connection with Other Ducts.** Connections between iron pipe and creosoted wood duct shall be made by fitting the iron pipe into the socket end of the wood duct and covering the joint with concrete or mortar. Connections between iron pipe and multiple duct tile shall be made with conduit castings, as hereinbefore specified.

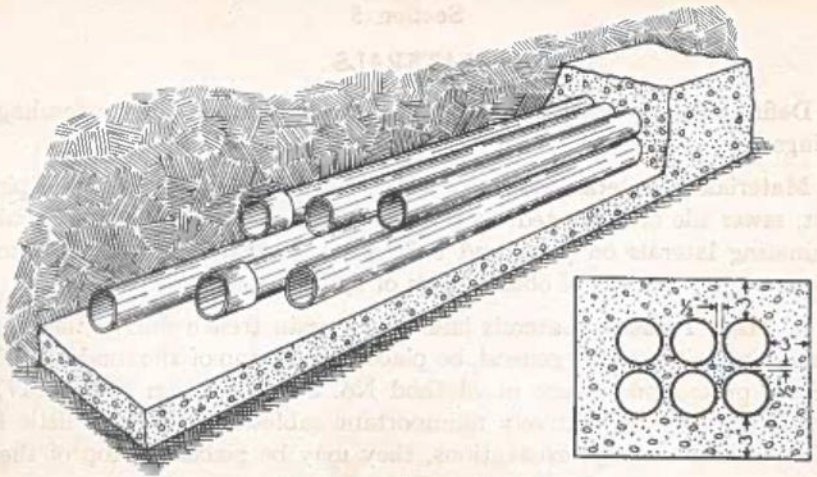


Figure 16—Method of Laying Iron Pipe Ducts

Section 5

LATERALS

159. **Definitions.** Laterals are short branch conduits or pipes extending to poles or buildings.

160. **Materials.** Laterals shall be constructed of either single or multiple vitrified clay duct, sewer tile or creosoted wood duct. Three (3) inch iron pipe shall be used for terminating laterals on poles and buildings. It shall be used in trenches only when necessary on account of obstructions or special conditions.

161. **In Main Trench.** Laterals laid in the main trench during the construction of the main conduit shall, in general, be placed at the top of the conduit and beneath the concrete protection, except in Method No. 3 construction (Figure 17). When laterals will be used for relatively unimportant cables, and there is little likelihood of interference from foreign excavations, they may be placed on top of the concrete protection.

162. If creosoted wood is used for the top protection of the main conduit, the laterals shall be placed under the protection.

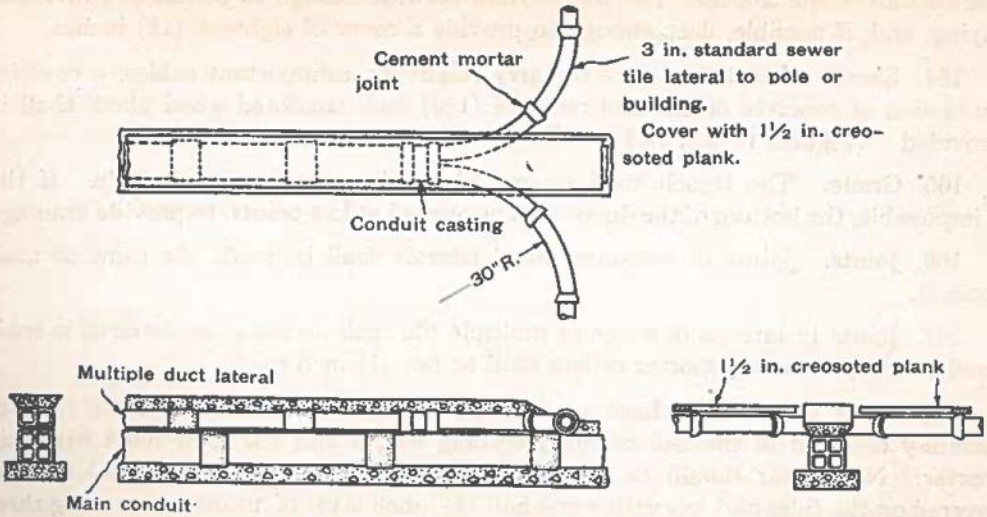


Figure 17—Lateral in Main Trench

163. **In Separate Trench.** Laterals in a separate trench shall be laid directly on the bottom of the trench. The trench shall be wide enough to permit of convenient laying, and, if possible, deep enough to provide a cover of eighteen (18) inches.

164. Except when laterals are to carry relatively unimportant cables, a covering protection of concrete or one and one-half (1½) inch creosoted wood plank shall be provided. (Figures 18 and 19.)

165. **Grade.** The trench shall be graded evenly towards the manhole. If this is impossible, the bottom of the ducts shall be opened at low points, to provide drainage.

166. **Joints.** Joints in creosoted wood laterals shall be made the same as main conduit.

167. Joints in laterals of single or multiple tile shall be made the same as in main conduit except that the mortar collars shall be one (1) inch thick.

168. Sewer tile shall be lined up before making any joints. Each tile shall be carefully centered in the bell of the preceding length and the joint filled with stiff mortar. No mortar should be allowed to enter the tile. The joint shall then be covered on the sides and top with a one-half (½) inch layer of mortar, extending three (3) inches on each side of the joint. (Figure 19.)

169. **Terminating Laterals on Poles and Buildings.** Laterals shall be terminated

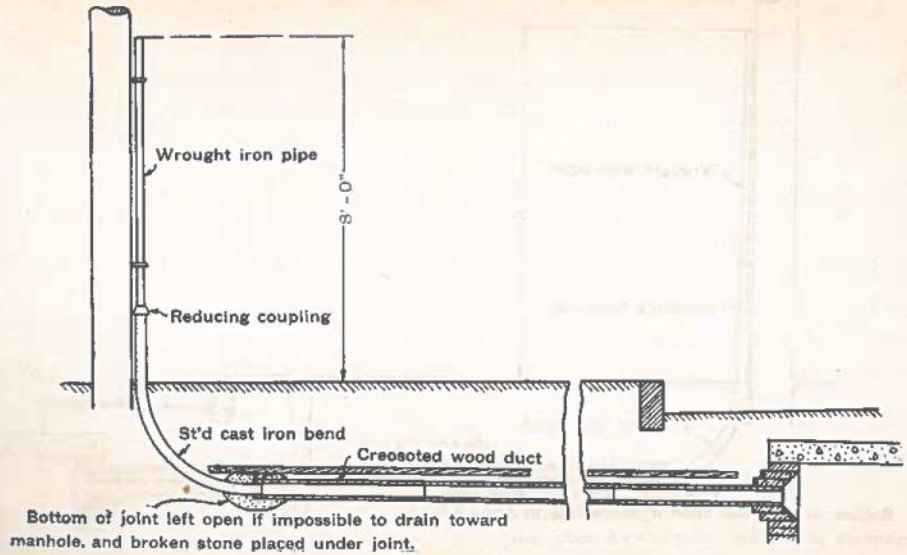


Figure 18—Creosoted Wood Duct Lateral in Separate Trench

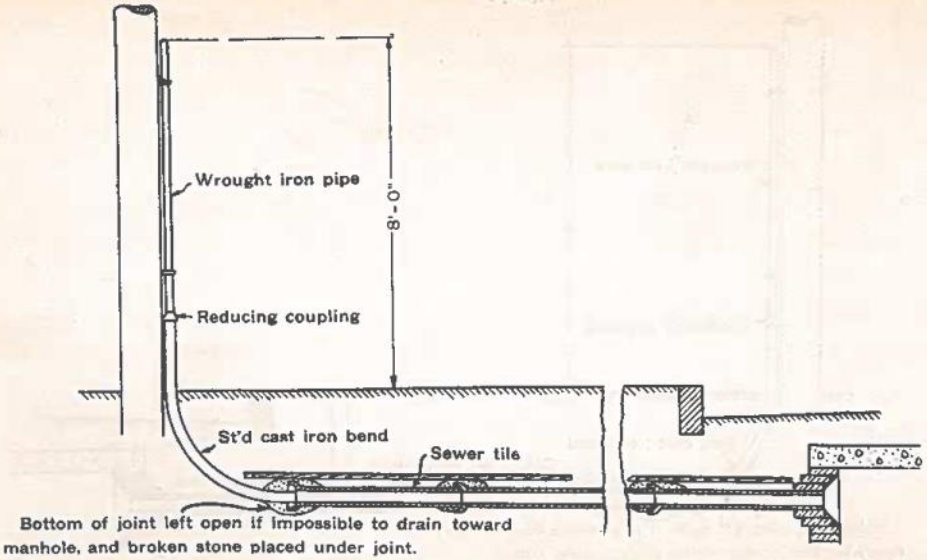


Figure 19—Sewer Tile Lateral in Separate Trench

on poles and buildings as shown in the illustrations. The vertical runs shall be of standard three (3) inch wrought iron pipe, extending approximately eight (8) feet above the ground. The pipe shall be fastened in place by pipe straps or other approved fastenings.

170. **Connections with Other Ducts.** Iron pipe shall be connected to single or multiple clay duct by conduit castings. (Figure 5.)

171. Connections between iron pipe and creosoted duct or sewer tile shall be made by fitting the pipe into the socket end of the duct or tile and plastering with a thick coat of mortar.

172. **Sealing Laterals.** Laterals ending in buildings shall have both ends carefully sealed with oakum and a thin layer of plaster of Paris, to exclude water and gas.

Section 6

MANHOLES

General

173. **Location of Manholes.** In city construction, manholes shall ordinarily be located at present or future street or alley intersections with the conduit run, close to one corner, and at other points where required for distribution or for terminals of aerial leads. In no case, however, shall the distance between manholes exceed seven hundred (700) feet.

174. Through country districts, manholes shall be spaced approximately five hundred and fifty (550) feet apart, if possible. The length of section shall never be more than seven hundred (700) feet.

175. When the route of a conduit changes direction, manholes shall be located, as far as practicable, at bends in the road; they shall not, however, be closer together than is necessary to insure ease in pulling in cables.

176. In order to avoid traps in the conduit in which water might accumulate, manholes shall be located at dips or depressions in the conduit line, whenever such locations will not result in more manholes than would otherwise be required.

177. **Foreign Pipes.** As stated in Paragraphs 32 and 33, foreign pipes shall be excluded from manholes whenever possible.

178. When foreign pipes unavoidably pass through a manhole, the walls shall be arched around them, leaving a space of at least one (1) inch above and at the sides of the pipe. This space shall be filled with oakum and a light film of cement.

179. When necessary, foreign pipes in a manhole shall be supported by iron beams or by brick or concrete piers. (Figure 20.)

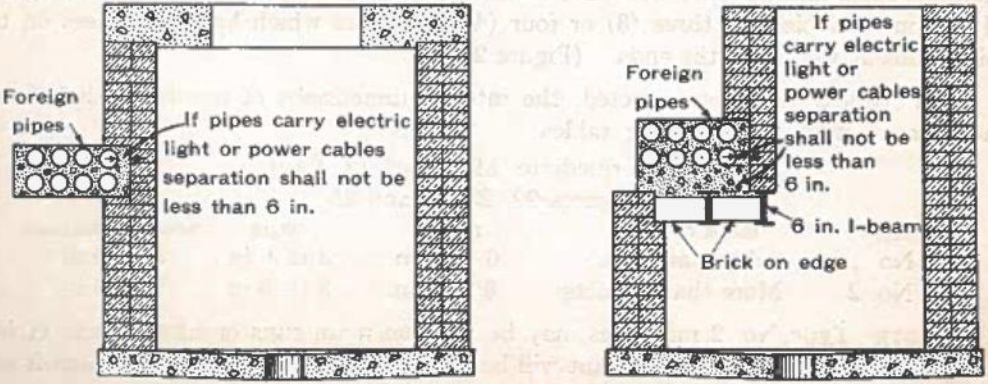


Figure 20—Foreign Pipes in Manholes

180. **Size of Manholes.** The sizes of manholes covered by these specifications apply to all conduit runs of not more than twenty-four (24) ducts. When the number of ducts exceeds twenty-four (24), special instructions shall be obtained from the Division Plant Superintendent as to the size of manholes to be constructed.

181. In these specifications, manholes are designated as "Intermediate" or "Junction" manholes. Intermediate manholes are two (2) way holes in main or branch conduit runs, and have no side duct entrances other than subsidiary or lateral pipes. Junction manholes are three (3) or four (4) way holes which have entrances on the side walls as well as at the ends. (Figure 21.)

182. Unless otherwise directed, the interior dimensions of manholes shall be in accordance with the following tables:

Intermediate Manholes (2 Way)
Figures 22, 23, 24 and 25

Type	Size of Conduit	Length	Width	Minimum Headroom
No. 1	6 ducts and less	6 ft. 0 in.	3 ft. 6 in.	5 ft. 0 in.
No. 2	More than 6 ducts	8 ft. 0 in.	3 ft. 6 in.	5 ft. 6 in.

NOTE: Type No. 2 manholes may be used on main runs of six (6) ducts or less when it is probable that the conduit will be enlarged in the near future or when it will often be necessary to enter the manhole for cable work.

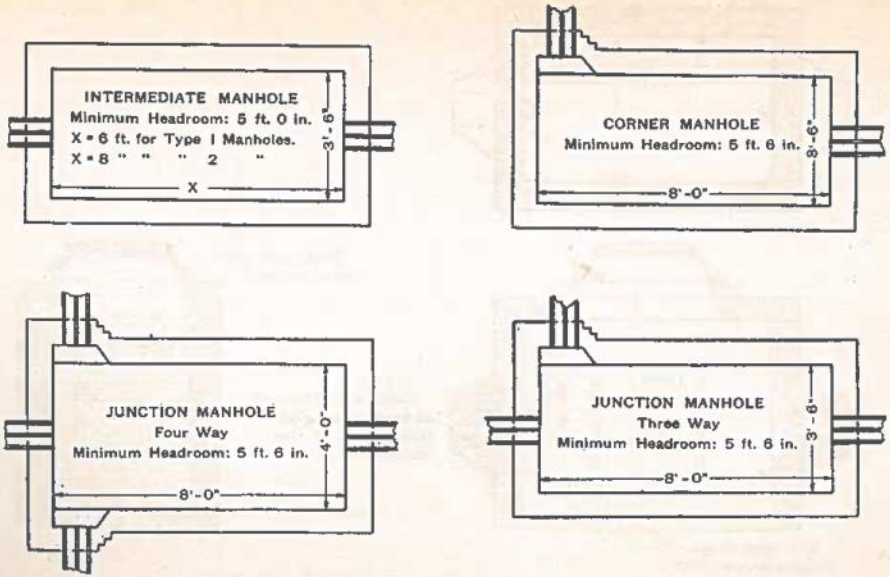


Figure 21—Types of Manholes

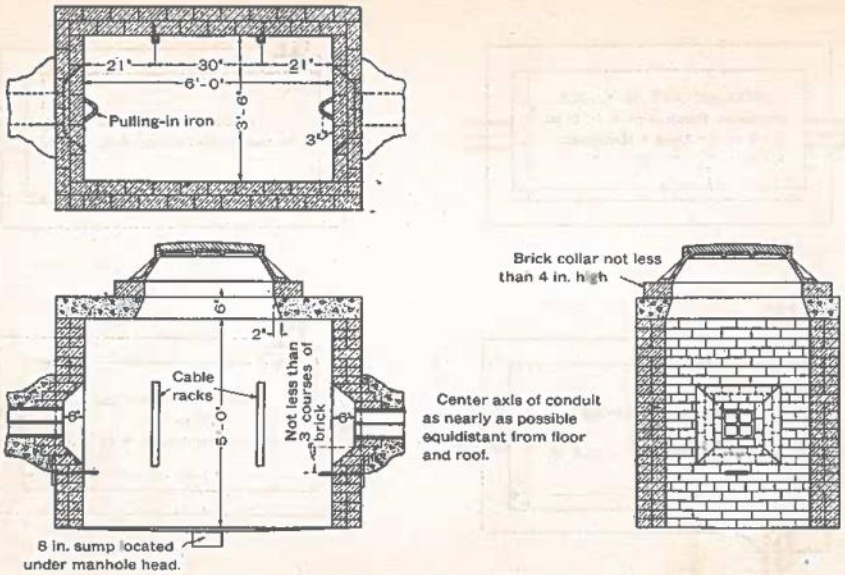


Figure 22—Intermediate Type 1 Brick Manhole

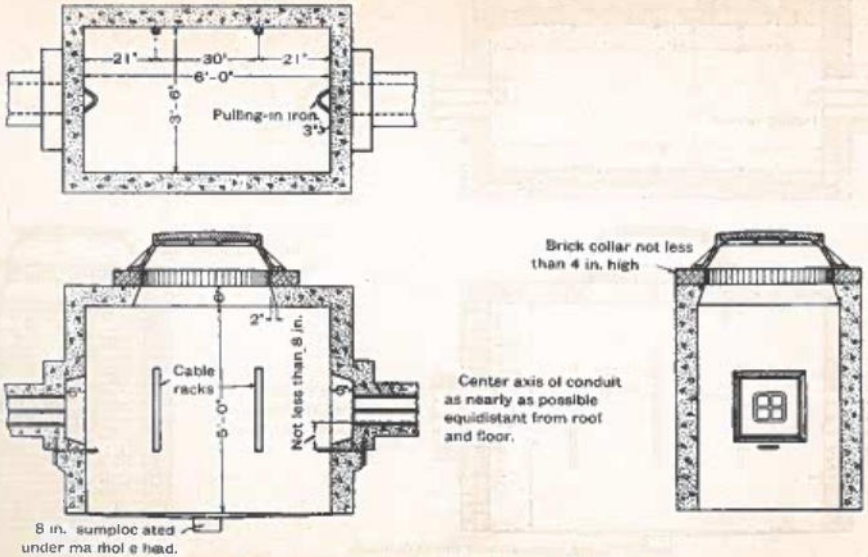


Figure 23—Intermediate Type 1 Concrete Manhole

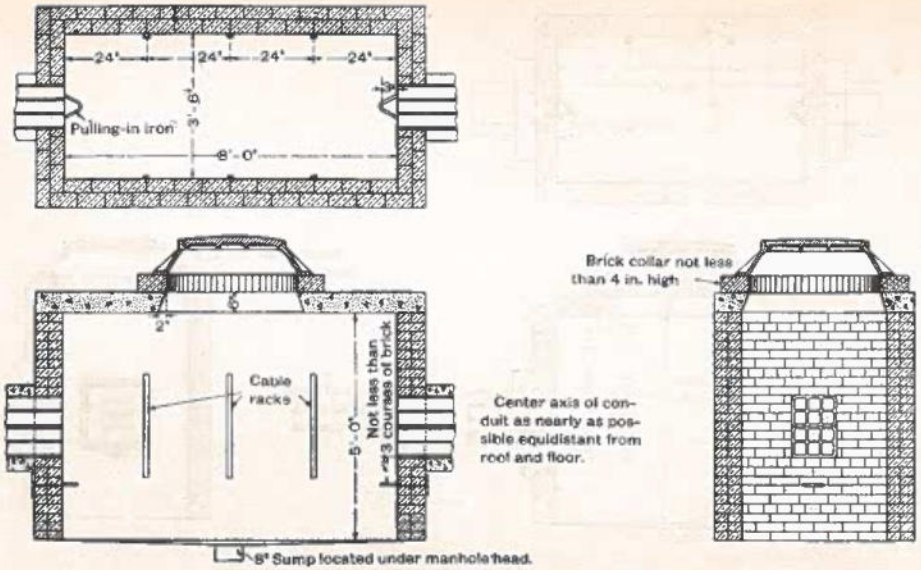


Figure 24—Intermediate Type 2 Brick Manhole

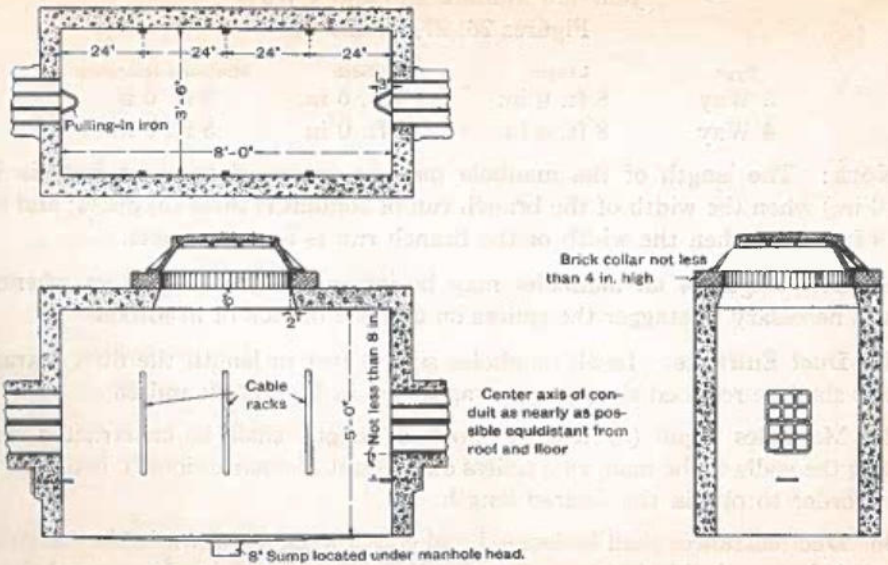


Figure 25—Intermediate Type 2 Concrete Manhole

Junction Manholes (3 and 4 Way)
Figures 26, 27, 28 and 29

Type	Length	Width	Minimum Headroom
3 Way	8 ft. 0 in.	3 ft. 6 in.	5 ft. 6 in.
4 Way	8 ft. 0 in.	4 ft. 0 in.	5 ft. 6 in.

NOTE: The length of the manhole may be increased to eight feet six inches (8 ft. 6 in.) when the width of the branch run of conduit is three (3) ducts; and to nine feet (9 ft. 0 in.) when the width of the branch run is four (4) ducts.

183. The length of all manholes may be increased by one (1) foot whenever it becomes necessary to stagger the splices on account of lack of headroom.

184. **Duct Entrance.** In all manholes six (6) feet in length the duct entrance of the runs shall be recessed six (6) inches as shown in Figures 22 and 23.

185. Manholes eight (8) feet or more in length shall be constructed without recessing the walls of the main run, unless on account of obstructions it becomes necessary in order to obtain the desired length.

186. Duct entrances shall be located and constructed as shown in the illustrations. When it is impracticable for ducts to enter the side walls of junction manholes *above* the level of the main run, they shall be brought into the manhole *below* the main run,

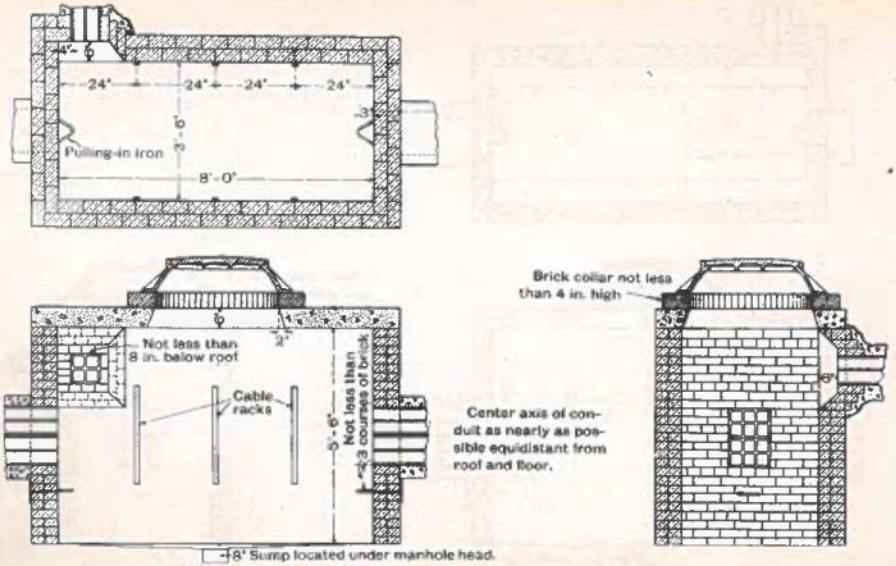


Figure 26—3-Way Junction Brick Manhole

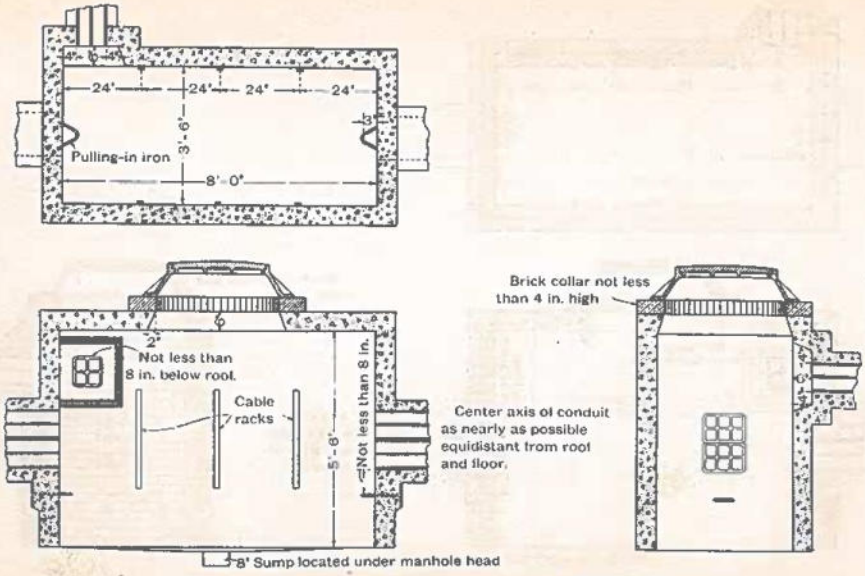


Figure 27—3-Way Junction Concrete Manhole

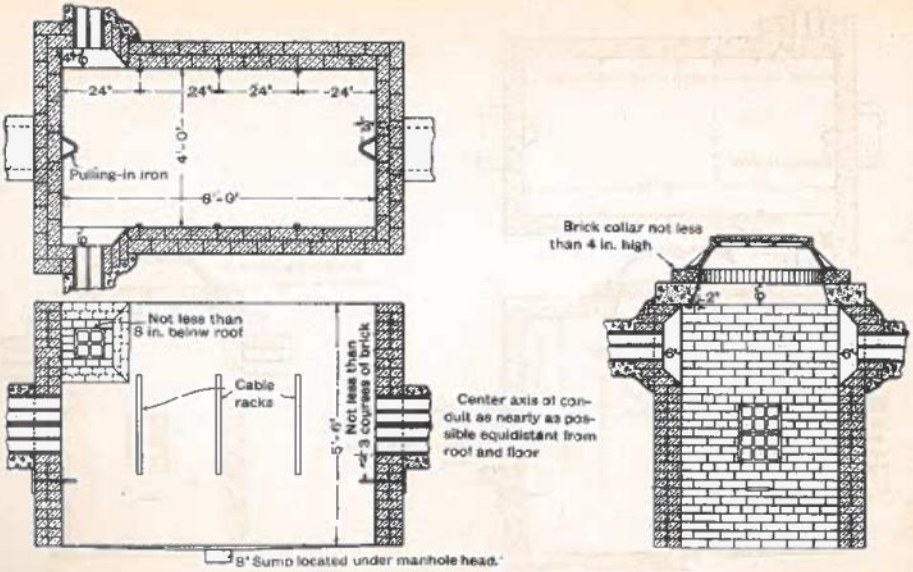


Figure 28—4-Way Junction Brick Manhole

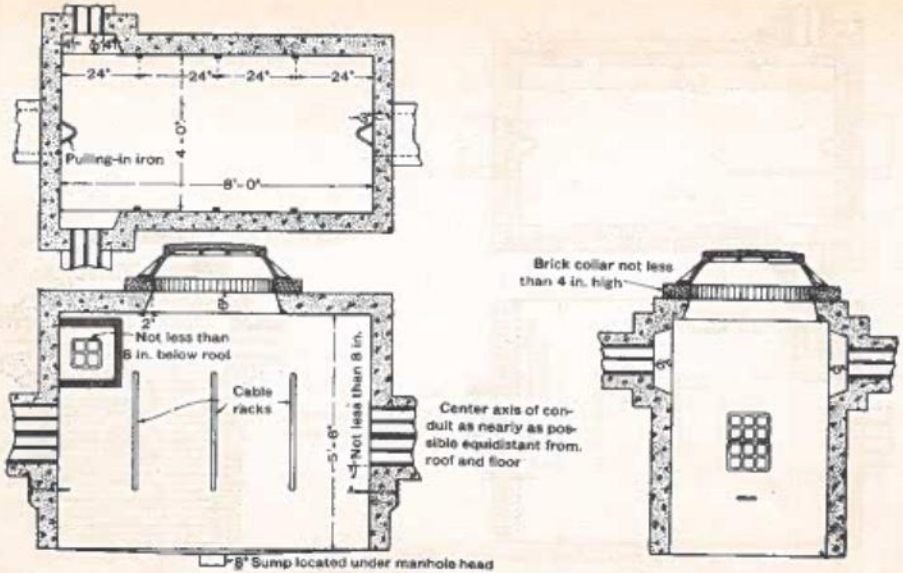


Figure 29—4-Way Junction Concrete Manhole

so as to provide a clearance of not less than four (4) inches between the bottom of the main run and the top of the branch run.

187. **Lateral Pipe Entrances.** Lateral pipes shall be brought into the manholes in the end walls, or else in the side walls as shown in Figure 30.

Materials

188. **General.** Manholes shall be constructed with either brick or concrete walls, and with roofs of either reinforced concrete, or brick laid on a framework of I-beams. The frames and covers shall be of cast iron of the type and dimensions specified in this Company's standard specifications for such materials.

189. **Floors.** Manholes shall, in general, have open bottoms. Artificial floors shall be provided when required on account of soil conditions or municipal regulations and in manholes where cable work will be done at frequent intervals, as, for example, in congested districts of large cities. Artificial floors shall be of either concrete or loose brick, the choice of type to depend on local conditions and on the relative costs of construction.

190. Concrete shall be used wherever floors are to be placed in concrete manholes, and wherever sewer connections are to be provided. Concrete floors shall also be used in all manholes that are built in quicksand or in wet or unstable soil.

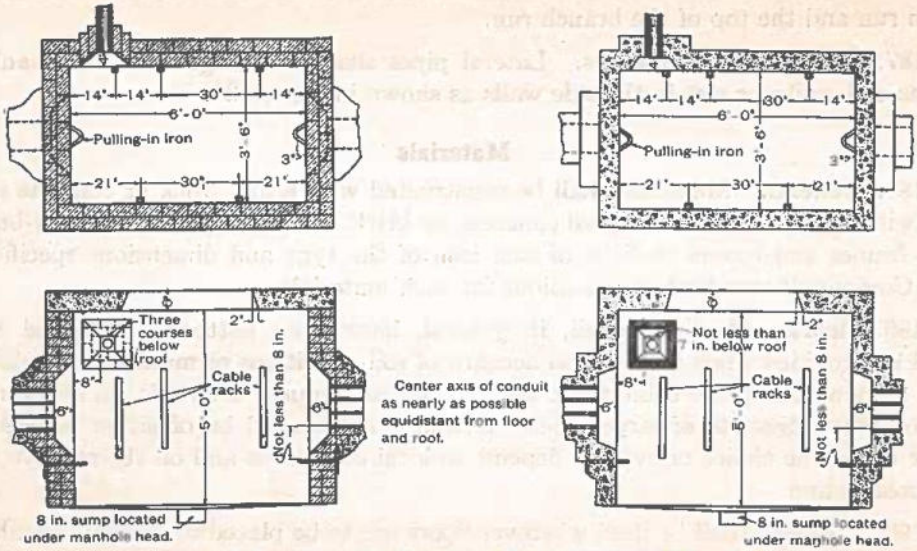


Figure 30—Lateral Pipe Entrances in Intermediate Manholes

191. **Walls.** Manhole walls shall be of either brick or concrete, the choice of material to depend largely on local conditions, such as obstructions, availability of material, cost, and number of manholes to be constructed of similar design.

192. In general, brick walls shall be built in cities where sewer, water and gas pipes or other obstructions necessitate alterations in the design of the manholes. Concrete walls shall usually be built in country districts where obstructions are few and where a number of similar manholes are to be constructed.

193. **Roofs.** Manhole roofs shall preferably be constructed of reinforced concrete. Brick roofs, supported by I-beams, may be built whenever their cost will be less than that of concrete roofs.

194. **Brick.** Bricks shall be hard burned and of a good quality. They shall be of uniform size and free from cracks, flaws, stones and lumps.

195. **Concrete and Mortar.** All concrete and mortar, and the materials of which they are composed, shall be as specified in Section 3.

196. **Roof Reinforcement.** The reinforcement for concrete roofs shall be either one-half (½) inch square twisted or deformed steel bars, or steel strand not lighter than 6,000 pound guy strand. Steel strand, when used, may be scrap guy strand which is free from rust or other serious defects.

197. Steel I-beams for supporting brick roofs shall be standard sections, five (5) and six (6) inches in depth.

Excavation

198. **General.** The excavation shall be large enough to permit the manhole to be conveniently constructed and deep enough to allow for the manhole collar and casting.

199. **Brick Manholes.** The excavation for brick manholes shall leave at least three (3) inches clear space beyond the outside walls.

200. **Concrete Manholes.** The excavation for concrete manholes shall ordinarily be the same size as the outside dimensions of the manhole.

201. When an outside form is necessary, on account of unstable ground, the excavation shall be large enough to permit removal of the outside form, after the concrete has set.

Floors and Foundations

202. **Open Bottom.** In constructing a manhole of the open bottom type, the bottom of the excavation shall be evenly graded and thoroughly tamped.

203. **Concrete Floors.** Concrete floors shall be four (4) inches thick and, where used in connection with brick walls, shall extend not less than two (2) inches

outside of the walls. The concrete shall be well tamped into place. (Figure 31.)

204. **Loose Brick Floors.** Brick floors shall be laid before the walls are constructed and shall extend beyond the outer walls at least two (2) inches. The bricks shall be laid as shown in Figure 32 and the bricks directly under the walls laid in a cement mortar.

205. **Drainage.** Manholes with concrete floors shall be provided with sewer connections only when the manhole must be drained at all times, and the connection to the sewer can be made at comparatively small expense.

206. All sewer connections shall be provided with approved traps and with removable cast iron strainers, set as nearly flush with the floor of the manhole as possible. The floor of the manhole shall drain toward the sewer connection.

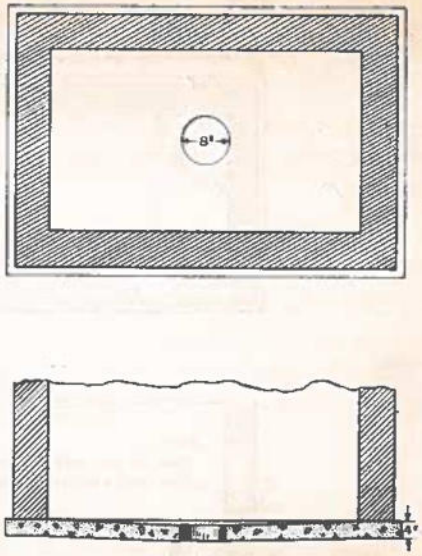


Figure 31—Concrete Floor with Sump

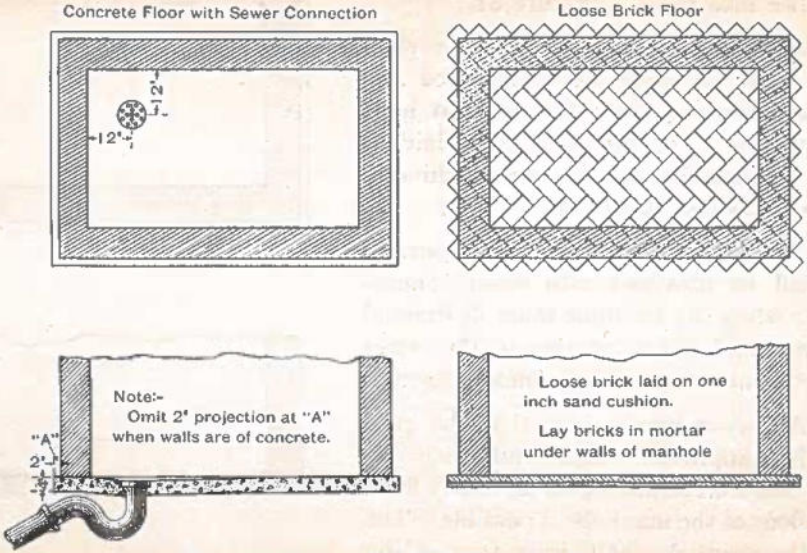


Figure 32—Brick and Concrete Floors, showing Sewer Connection with Concrete Floor

207. All manholes with artificial floors, except those having sewer connections, shall be provided with eight (8) inch sump holes, eight (8) inches deep. These sumps may be formed in the concrete, as shown in Figure 31, or built of sewer tile.

208. Where a manhole is located in gravel or sand, or in other soils through which water can penetrate, the sump hole shall extend through the concrete floor so as to provide natural drainage for the manhole. When located in wet soils or where it is necessary to keep water from entering at the bottom of the manhole, the sump hole shall not extend through the concrete floor but shall have concrete on the bottom as well as the sides.

Brick Walls

209. **Thickness.** Brick manholes shall, in general, be constructed with eight (8) inch walls. When the depth exceeds eight (8) feet, the walls shall be twelve (12) inches thick up to the point eight (8) feet below the surface of the street, and eight (8) inches thick above that point. (Figure 33.)

210. All brick manholes having an inside length *greater* than nine (9) feet shall have walls not less than twelve (12) inches in thickness.

211. **Laying Bricks.** Bricks shall be thoroughly wet just before laying. All joints shall be completely filled with mortar. The mortar shall not exceed one-half (½) inch in thickness at horizontal joints and three-eighths (⅜) inch at vertical joints.

212. The brick work shall be bonded with a layer of headers, every fifth course. When no artificial floor is placed under the walls, the first three (3) courses of brick shall be twelve (12) inches wide. Headers for twelve (12) inch walls shall consist of bricks and bats, laid so that adjacent headers will break joints.

Concrete Walls

213. **Thickness.** Concrete manholes shall, in general, be constructed with six (6) inch walls. When the depth exceeds eight (8) feet, the walls shall be either eight (8) inches thick, non-reinforced, or six (6) inches thick, reinforced, up to the point eight feet below the surface of the street, and six (6) inches thick, non-reinforced, above that point. (Figure 34.)

214. All concrete manholes having an inside length *greater* than nine (9) feet shall be constructed with eight (8) inch non-reinforced or six (6) inch reinforced walls throughout.

215. **Forms or Molds.** All forms shall preferably be

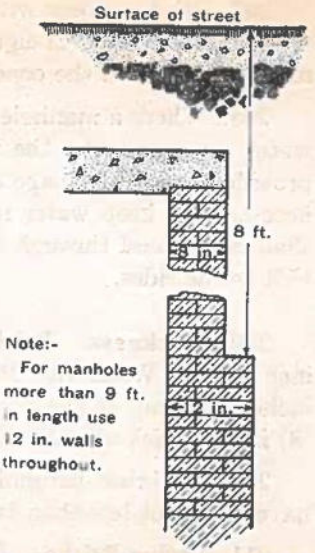


Figure 33—Thickness of Brick Walls

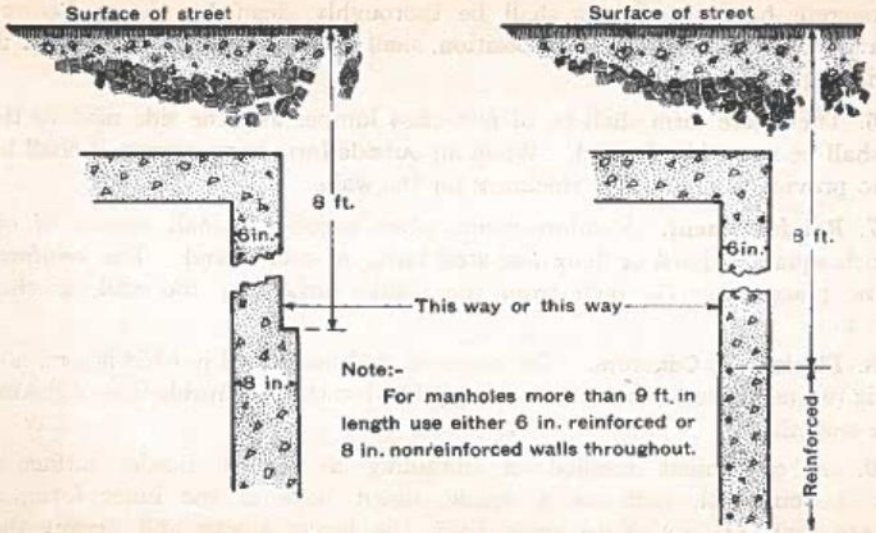


Figure 34—Thickness of Concrete Walls

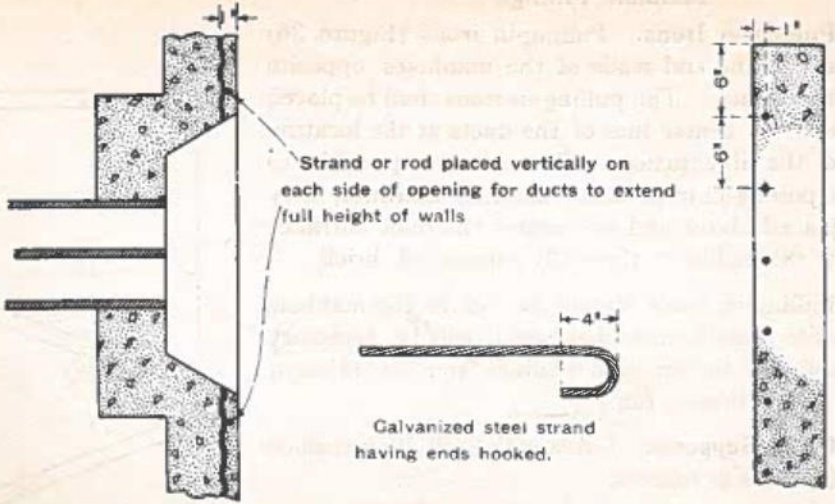
of unseasoned lumber and shall be constructed so as to be readily removed after the concrete has set. Forms shall be thoroughly cleaned and wet before being used and, when placed in proper position, shall be braced so as to prevent moving or springing.

216. The inside form shall be of first-class lumber and the side next to the concrete shall be smoothly dressed. When an outside form is necessary, it shall be built so as to provide the necessary thickness for the walls.

217. **Reinforcement.** Reinforcement, when necessary, shall consist of one-half (½) inch square twisted or deformed steel bars, or steel strand. The reinforcement shall be placed one (1) inch from the inside surface of the wall, as shown in Figure 35.

218. **Placing the Concrete.** The concrete shall be placed in even layers, not more than six (6) inches thick, and rammed or puddled so that the inside face of the manhole will be smooth.

219. A convenient method of obtaining a smooth inside surface is to thrust a thin tool, such as a spade, down next to the inner form, as the walls are built up, so as to press back the larger stones and permit the finer portions to flush against the form. Care should be taken not to pry the forms apart.



Horizontal section through wall at opening for ducts showing location of reinforcing strands.

Vertical section through wall showing location of reinforcing strands.

Figure 35—Method of Reinforcing Concrete Walls

Manhole Fittings

220. **Pulling-in Irons.** Pulling-in irons (Figure 36) shall be set in the end walls of the manholes opposite each duct entrance. The pulling-in irons shall be placed in line with the center line of the ducts at the location shown in the illustrations. Where it is impossible to locate the pulling-in irons below the duct entrance, they may be placed above and not nearer the duct entrance than eight (8) inches or three (3) courses of brick.

221. Pulling-in irons should be set in the manhole wall opposite branch runs whenever it will be necessary to pull cable into the junction manhole from the adjacent manhole on the branch run.

222. **Cable Supports.** Cable racks will be furnished in three (3) sizes as follows:

Size	Length	Spacing of Bolt Holes
8 hole	15 inches	13½ inches
14 hole	24 inches	22½ inches
18 hole	30 inches	28½ inches

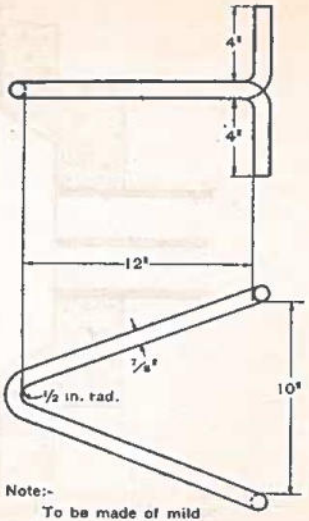


Figure 36—Pulling-in Iron

223. The design of the cable racks is such that one section may be placed vertically above another, the junction of the two sections being secured by one bolt. The additional sections may be added at any time they are required. In general, however, the size of the racks to be provided in any particular case shall be of such length as to carry the total number of cables that will probably enter the manhole.

224. When a conduit contains four (4) ducts or less, cable racks shall be provided on but one side of the manhole. When the number of ducts exceeds four (4), racks shall be provided on both sides of the manhole.

225. Unless otherwise specified, as the walls are built up, one-half (½) inch by six (6) inch galvanized machine bolts shall be installed for supporting the cable racks. If the bolts are not installed at the time the walls are built up, the cable racks shall be supported by means of one-half (½) inch by three (3) inch expansion bolts.

226. The vertical separation of the bolts shall accord with the spacing of bolt holes given above. The location of the bolts shall be such that the racks will have the horizontal separation shown on the illustrations, and be located at a convenient height from the floor of the manhole. Except when the ducts from both directions enter a manhole near the top or bottom, the racks should be on an approximate level with the mean height of the ducts.

227. Cable hooks shall not be installed during the construction of a manhole, but shall be attached as required, when cable is drawn into the ducts.

Manhole Tops

228. **Brick Roofs.** The method of constructing manhole roofs of bricks, supported by steel beams, is shown in Figure 37.

229. **Concrete Roofs.** Manhole roofs of reinforced concrete shall be not less than six (6) inches thick and shall be constructed as shown in Figures 38 and 39. The opening through the roof shall register with the inner edge of the seat of the manhole frame, and, wherever possible, shall be located over the center of the manhole.

230. The platform or form for supporting the concrete top shall closely fit the inside face of the top of the manhole walls, and shall be thoroughly cleaned and wet before the concrete is deposited. The form shall have a smooth upper surface and shall be so constructed and supported as to furnish an unyielding platform for the concrete.

231. Enough concrete shall be mixed in one batch to finish the roof. A one (1) inch layer of concrete shall first be placed and then the reinforcement placed as shown in Figures 38 or 39, and tamped lightly into place. The remaining concrete shall then be placed and tamped well.

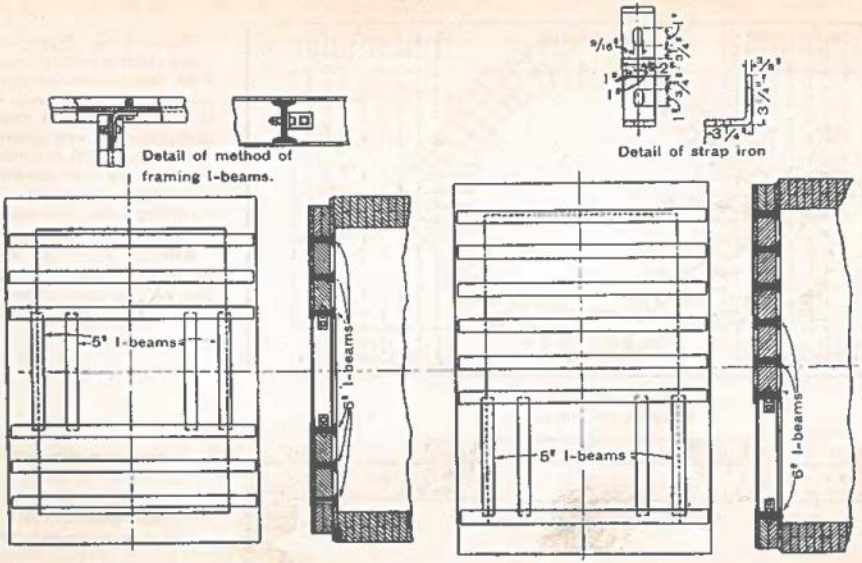
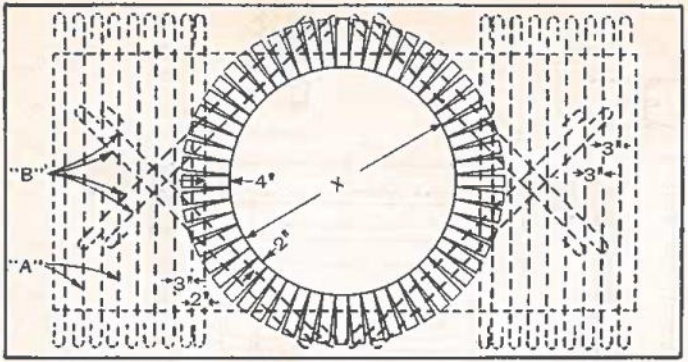


Figure 37—Manhole Roof of Brick



Place 1 in. layer of concrete then reinforcement "A" with the reinforcement "B" on top of "A"; tamp down the reinforcement slightly and place the remaining concrete carefully, tamping it around the reinforcement and edges and continuing the tamping until all the concrete is in place.

Enough concrete must be made in a batch to finish a top in one operation.

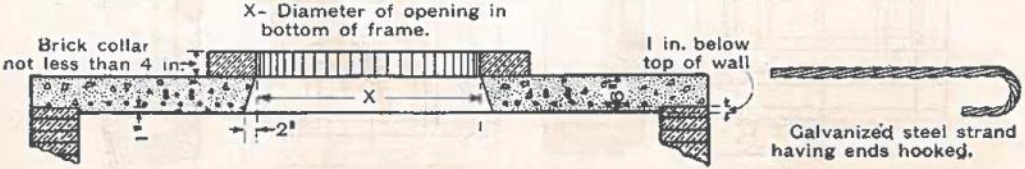
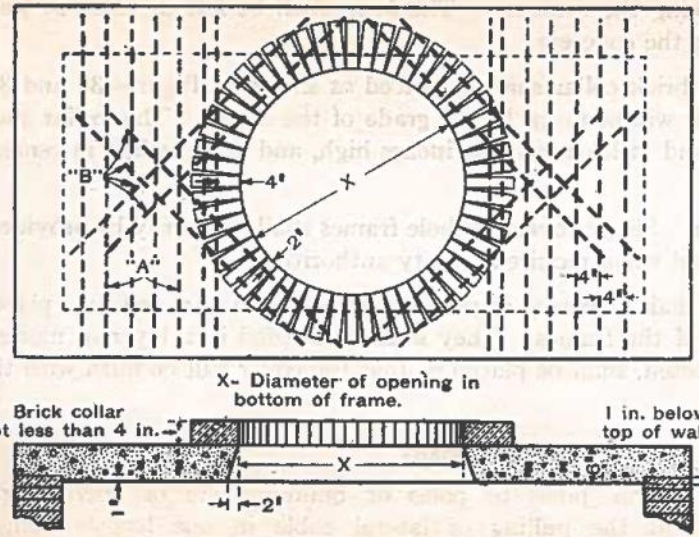


Figure 38—Manhole Roof of Concrete Reinforced with Strand



Place 1 in. layer of concrete then reinforcement "A" with the reinforcement "B" on top of "A"; tamp down the reinforcement slightly and place the remaining concrete carefully, tamping it around the reinforcement and edges and continuing the tamping until all the concrete is in place.

Enough concrete must be made in a batch to finish a top in one operation.

Reinforcement to consist of ½ in. square twisted steel rods or deformed bars.

Figure 39—Manhole Roof of Concrete Reinforced with Rods

232. The frame shall not be placed nor the refilling or paving done within twenty-four (24) hours after placing the concrete. The form shall be left in place at least one (1) week after placing the concrete.

233. **Brick Collar.** A brick collar shall be placed as shown in Figures 38 and 39, so that the manhole cover will conform to the grade of the street. This collar shall be eight (8) inches wide and at least four (4) inches high, and shall be laid in cement mortar.

234. **Frame and Cover.** Single cover manhole frames shall ordinarily be provided. Double covers shall be used when required by city authorities.

235. Manhole frames shall be placed in position by means of bars or hooks placed in the holes in the webs of the frames. They shall be bedded in a layer of mortar, and, unless otherwise directed, shall be placed so that the cover will be flush with the street grade.

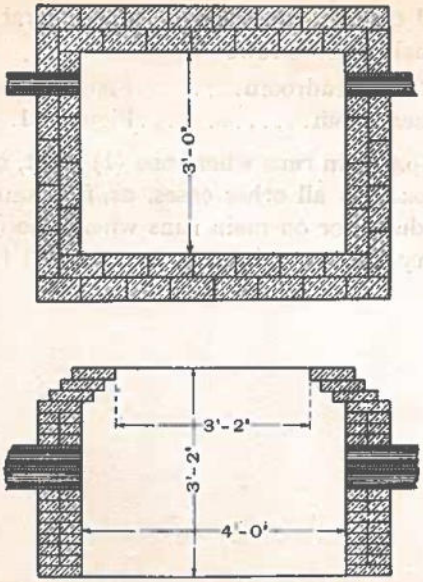
Service Boxes

236. In cases where lateral pipes to poles or buildings are of such length or curvature as to prevent the pulling of lateral cable in one length from a manhole to a pole or building, service boxes shall be located along the lateral run, as directed.

237. Service boxes shall be constructed of brick according to the general specifications for manholes except that the size shall be as follows:

4 ft. long by 3 ft. wide with 3 ft., 2 in. headroom.....Figure 40.
6 ft. long by 3 ft. wide with 4 ft. headroom.....Figure 41.

238. The six (6) foot size shall be built on main runs where one (1) duct, carrying a full sized cable, will enter the service box. In all other cases, as, for example, on subsidiary runs of not more than two (2) ducts, or on main runs where one (1) duct will enter the service box but will not carry a full sized cable, the four (4) foot size shall be built.



Note:-
Bricks in upper layers at corners, to be corbelled in, so that frame completely covers opening.

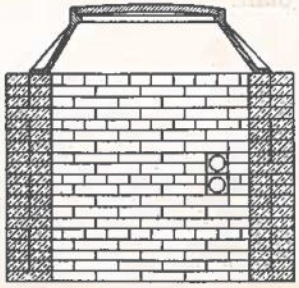


Figure 40—Service Box Four Feet Long

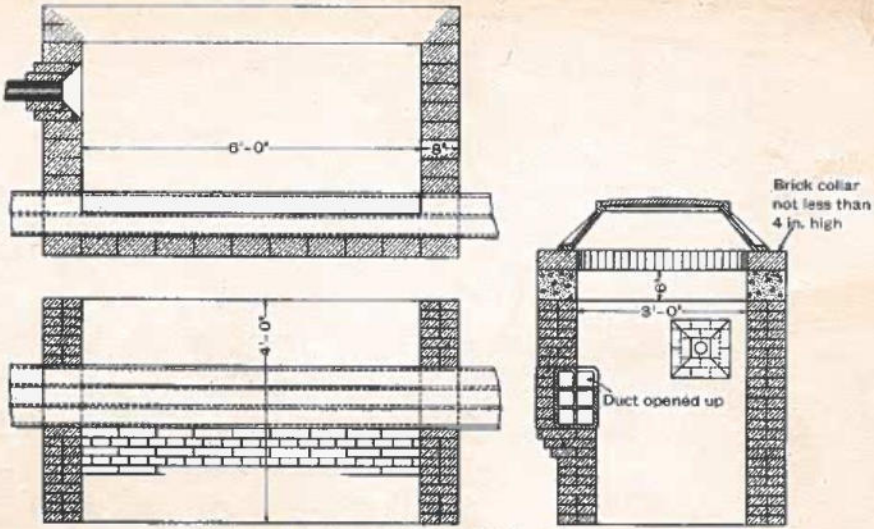


Figure 41—Service Box Six Feet Long