BELL SYSTEM PRACTICES
Outside Plant Construction and Maintenance

SECTION G43.410.1
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AT&T Co Standard

MANHOLES
REPAIRING

Part **Page**

1. GENERAL

1.01 Most manhole repairs consist of stopping water leaks in the floors or walls of frequently entered manholes to minimize pumping delays and expense. Depending on the contour of the terrain, the pumping of one manhole may, on occasion require the removal of water from several adjacent manholes in the run. The volume of water to be handled under such circumstances may make it advisable to exclude water from certain of the manholes.

1.02 Water entering through the conduit may be stopped by plugging the duct entrances as described in G55.150. It may be found, however, that water is also entering around duct entrances, through construction joints, porous sections of concrete and at other points which will require repairing before

all water can be excluded. This section outlines methods which may be employed in effecting repairs of this nature.

1.03 Upon completion of any work in which patching materials come in direct contact with the hands, wash the hands thoroughly and apply a light coating of vaseline or oil to the skin to counteract the drying action of the materials.

2. TOOLS AND MATERIALS

2.01 The following tools and materials will be required for the repair of cracks or porous areas in concrete:

Cement, as specified in G45.110.1.

Plaster Sand, as specified in G45.120.1.

Waterplug, a quick-setting powdered material.

Calcium Chloride Solution—(Standard Solution). Prepare by dissolving 5 pounds of commercial calcium chloride (chloride of lime) in 1-1/2 gallons of water. Calcium chloride may be obtained in the form of white crystals at hardware or drug stores. It should be kept in an air-tight container to prevent absorption of moisture.

Strip Oakum or Lead Wool: Used for caulking purposes. Obtainable at hardware stores.

Cold Chisel: 3/4 inch.

Hammer: 1-1/4 pound or any medium-weight hammer.

Trowel: Small triangular mason's trowel.

Basin or Bowl: For mixing small batches of Waterplug or cement and calcium chloride solution.

Wire Brush: For removing slime, dirt, grease, etc., from surfaces to be patched.

Vaseline or Oil: For application to hands after handling cement.

2.02 For patching small areas or where the flow of water to be stopped is severe, the use of Waterplug is recommended. For larger areas, quick-setting cement mortar may be used efficiently and economically. Where extensive patching is required, it may be advantageous to use both materials. At no time, however, should the two materials be combined in one mixture.

3. PREPARING THE PATCHING MATERIALS

Waterplug

3.01 Place a small quantity of Waterplug in the mixing pan and add to it sufficient water to form a cake or pat about the consistency of putty. If the cake is too wet to handle

add dry Waterplug to bring it to the desired consistency. Stir just enough to have the cake mildly saturated throughout. Depending on the temperature of the mixing water the material will begin to set in 2 or 3 minutes; consequently do not mix more than can be applied within that time. Do not use warm water as this will hasten the set and do not attempt to soften Waterplug by adding water to material which has become too stiff to use.

Quick-Setting Cement Mortar

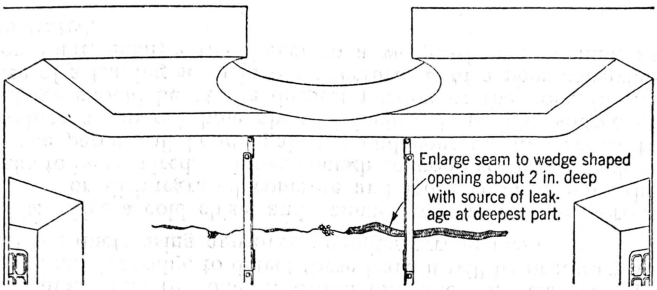
3.02 Quick-setting cement mortar is prepared by mixing portland cement with a solution of calcium chloride as specified in 2.01. The action of the calcium chloride solution is to accelerate the setting of the cement. The time required for the initial set depends somewhat on the brand of cement used, its freshness, and the strength of the calcium chloride solution. For this reason it is best to mix one or more trial batches of mortar and observe the handling characteristics of the mix before proceeding to apply it to the surface to be treated. If the mixture as prepared hardens too rapidly to permit it to be applied properly, discard the batch and mix a fresh batch using a portion of the standard calcium chloride solution diluted slightly by the addition of water. If the material sets too slowly for the intended purpose, the difficulty may lie in the cement. If it is certain that the cement being used is fresh, it may be advisable to try a different brand.

4. TREATMENT OF WALLS

(a) Preparation for Patching

4.01 Water entering through the walls of concrete manholes will usually be found issuing from construction joints or honeycombed areas in concrete which is otherwise sound and can be readily repaired. There may also be some points of weakness around the entering ducts and between the individual units of conduit. Dowel pin holes will also require plugging. Generally, to detect these leaks it will be necessary to seal the ducts using approved plugging arrangements.

4.02 Use a cold chisel and hammer to chip out the porous or disintegrated concrete and loose stone around the leaks to be repaired. Remove enough concrete so that the edges of the patch will bond against sound concrete and so as to produce a tapered hole about 2 inches deep. The source of leakage should be at the deepest portion of the hole. In the case of a leaking seam in the structure, as at a poor construction joint, enlarge the defect to a wedge-shaped opening as illustrated.



4.03 After the point of leakage has been cleared of unsound material it may be found desirable in cases of excessive flow of water to reduce the flow by caulking oakum or lead wool into the bottom of the opening before patching. Ordinarily, however, a little practice in handling Waterplug or quick-setting mortar will enable the operator to seal most leaks without recourse to caulking.

(b) Plugging Holes

4.04 Holes may be plugged with either Waterplug or quick-setting mortar, although if water is running from the hole, the use of Waterplug is usually more satisfactory. If water is running from a fairly large hole, apply Waterplug first to the upper portion of the space to be filled, leaving a small opening at the bottom through which water can flow to avoid building up pressure until the Waterplug first applied has set. After a few minutes, mix a small quantity of Waterplug and shape it in the hand in the form of a conical plug. When a sudden warm feeling and dry appearance comes over the plug apply it to the opening from below. Force the material well into the opening and exert pressure against the plug for a full minute or longer until the flow of water has stopped. After a few minutes the surface can be smoothed off with a sharp trowel or chisel to conform with the remainder of the seal. When using quick-setting mortar similar procedures should be followed.

(c) Sealing Large Areas

4.05 If water is entering over quite a large surface, as a honeycombed area, the following method of treatment should be employed:

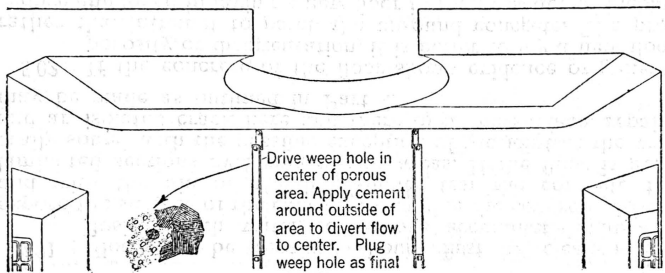
(1) Provide a weep hole near the center of the area by cutting deeply into the concrete or enlarging a hole which already exists at that point.

(2) Beginning near the outer edge of the area apply overlapping patches of quick-setting mortar or Waterplug around the area to divert the flow of water toward the center.

(3) Apply successive patches, continually narrowing the limits of flow.

(4) After all but the center weep hole has been sealed and the flow is confined to this point, the patch should be left undisturbed for a few minutes to allow it to attain strength.

(5) When ready to make the final seal, a conical shaped plug of patching material should be forced into the weep hole and held in place as described under 4.04.



4.06 If the leak is not stopped completely at the first attempt, cut out enough of the first patch to provide another opening of suitable shape for patching and apply a second wedge of material.

4.07 Patched areas one foot square or larger should be finished by plastering with a 1/2 inch layer of mortar for patching as specified in G45.160.1 before the patch has taken its final set.

(d) Duct Entrances

4.08 Dowel pin holes should be sealed by plugging with wooden dowels, oakum or lead wool after which they should be finished over with Waterplug.

4.09 Spaces between individual units of conduit should be enlarged if practicable and sealed with Waterplug as described under 4(a) and 4(b) where practicable. If the spaces between adjoining duct walls are too small to employ this treatment, caulk first with oakum or lead wool and then seal with Waterplug.

4.10 If water is entering through cracks in the conduit walls, the concrete adjacent to the wall of the duct should be chipped away until the crack is exposed on the outside. Waterplug should then be placed over the crack on the outside of the tile, bonding to the tile and extending to sound concrete in the wall.

4.11 If the conduit wall is broken, the break should be built up with Waterplug extending to sound concrete in the manhole wall and finishing off flush with the interior of the duct wall to replace the broken portion.

5. TREATMENT OF FLOORS

5.01 Floors to be repaired should first be cleaned and flushed with water to remove accumulated silt and expose the surface of the concrete. Examine the concrete closely and with the aid of a light hammer test the concrete for laminated sections overlying porous areas. If the floor is generally sound with the possible exception of the joint at the wall and an isolated crack here and there over the surface, repairs may be made as outlined in Part 4.

5.02 If the concrete of the floor shows evidence of general porosity or disintegration, it is better to lay a new floor rather than attempt to patch the unsound concrete. The procedure employed in laying a new floor in the presence of incoming water is outlined in the following paragraphs.

6. REPLACEMENT OF FLOORS

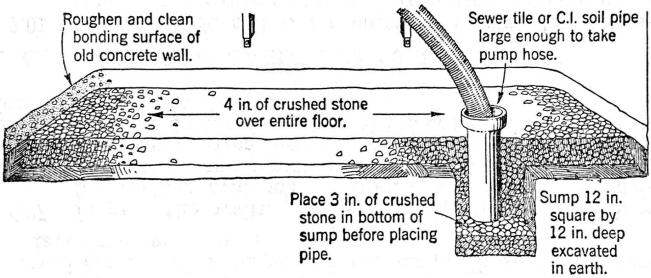
6.01 Where a reduction in the headroom of the manhole in the order of about 8 or 10 inches will not affect the utility of the manhole, the new floor may be laid directly over the old concrete, otherwise the old floor should be broken up and removed.

6.02 The first operation in the construction of the new floor is to excavate a temporary sump about 12 inches square and 12 inches deep. If the old floor is torn out, sufficient earth should be removed throughout the entire area of the floor to secure the required headroom in the manhole plus 8 or 10 inches needed for installing a drain and the new floor as outlined below.

6.03 Place a layer of about 3 inches of crushed stone in the bottom of the sump and upon this set a section of cast iron soil pipe or sewer tile of inside diameter large enough to accommodate the intake hose of a pump and a length sufficient to bring its top about one inch below the grade of the finished floor. Fill in around the pipe with crushed stone and cover the remainder of the floor with about a 4-inch layer of stone to form a drain to the sump. Tamp the stone slightly around the sump in order to hold the pipe firmly in position. Insert the pump hose in the sump and start the pump.

Note: Construction of the permanent sump installed for maintenance purposes follows the procedures outlined in G43.122.1 covering manhole floor construction.

6.04 Using a cold chisel and hammer roughen the portion of the walls which is to bond with the new floor. Scour thoroughly with a wire brush and water and paint the bonding surface with a slush of cement and water mixed to the consistency of thick paint.



6.05 Over the layer of crushed stone construct a floor of the design recommended in G43.122.1 relating to floor construction as determined by the type of manhole and the soil conditions. Use Class 1D concrete as specified in G45.140.1. During the laying of the floor and for some time after its completion the water level in the sump should be kept below that of the drainage stone under the new concrete in order to avoid washing the cement paste away from the aggregate. The new floor should not be subjected to ground water pressure until it has attained sufficient strength to withstand the load. Pressure may be avoided by leaving the sump unsealed and either continuing pumping operations or allowing the manhole to fill with water to the ground water level.

6.06 After allowing the floor concrete to set for about 24 hours, the sump should be sealed as follows:

(a) Remove all water from the manhole and keep the pump in operation with the pump hose as deep as possible in the sump.

(b) Mix a batch of quick-setting mortar or Waterplug in the quantity needed, as indicated below.

(c) Remove the pump hose and place crushed stone in the sump to a level about 3 to 4 inches below the finished grade of the floor.

(d) Place in the sump quick-setting mortar or Waterplug in the amount required to fill the sump to floor level. Compact the mortar firmly by tamping to form a dense mass well bonded with the wall of the sump. Finish off the surface level with the new floor.

6.07 Inspect the walls, duct entrances, and finished floor for further evidence of leakage and make any additional repairs necessary. Small leaks may be readily detected by dusting dry cement over suspected areas. Evidence of leakage will be indicated by the darkening of the cement due to absorption of water from the leak.

7. CORROSION OF CABLE RACKS AND HOOKS

7.01 Contaminated soil water entering a manhole is occasionally the cause of rapid corrosion of manhole hardware. When this condition exists, an effort should be made to locate the source of pollution and have it diverted to proper channels, if practicable. Sewage, waste from industrial plants and brackish water in the vicinity of swamps are examples of possible sources of contamination.

7.02 If correction by the above means is impracticable, steps should be taken to exclude the water from the manhole. All leaks in the floor and walls and at the conduit entrances should be repaired as indicated in the preceding paragraphs. All ducts should be sealed in accordance with the provisions of G55.150.

7.03 When neither of the above methods is practicable, consideration should be given to substituting M Cable Racks and Hooks for the usual galvanized steel hardware. Attachment of cable racks to the walls should be made with M Machine Bolts. In order to prevent galvanic action between cable sheath and the M-type hardware (copper-nickel alloy), the cable should be separated from contact with the racks and hooks. This can be done by applying a lead Strap Cable Tag to

the cable at each hook position with the wide portion of the tag separating the cable from the hook and rack.

8. DISINTEGRATION OF CONCRETE DUE TO ACTION OF SOIL WATER

8.01 In concrete manholes, particularly where the structure contains honeycomb, poorly made construction joints or other porous areas, contaminated soil water from sources such as those mentioned in 7.01 may attack the concrete. Reactions between the cement and the materials in the absorbed water have a disruptive effect which may result initially in a spalling of the surface. In advanced stages, evidence of general disintegration of the concrete to a considerable depth may be observed. If the water can be excluded from the manhole as suggested in 7.01 and 7.02, and the disintegration has not progressed too far, repairs made as described in other parts of this section will generally be adequate. If these measures are impracticable, consideration should be given to rebuilding the manhole with concrete made of sulphate resisting cement.