

CONDUIT AND MANHOLES

REPAIRING BROKEN ENDS OF

CLAY CONDUIT

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1. GENERAL

1.01 This section describes a method of repairing Clay Conduit by replacing the broken out portions of the conduit with a patching material the strength of which is practically equivalent to the original material. Two methods are described; one, the preferred method where proper curing conditions can be obtained, consisting in the use of ordinary cement mortar, and the other involving the use of a commercial material known as Hydro-Tite. The latter is prescribed for use in making patches where there is not sufficient time available for cement mortar to harden, or where it would not be convenient to protect cement mortar patches against freezing. Hydro-Tite patches, when carefully made, will withstand ordinary handling, but will not, however, resist severe shocks as well as patches made with cement mortar. For this reason Hydro-Tite patching should not be employed except under unusual circumstances, as discussed in 6.03.

1.02 The procedures described below apply to the repair of all breaks extending back more than 1-1/2 inches from the end of the conduit. Smaller breaks occurring at the ends of the conduit need not be repaired.

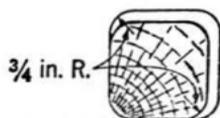
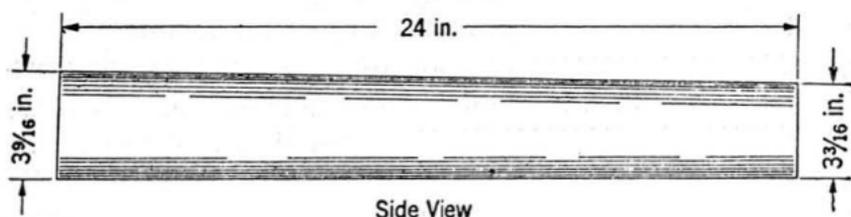
2. FORMS AND MANDRELS

2.01 The method of making the patches consists in filling with cement mortar or Hydro-Tite the space between a mandrel placed in the bore of the conduit and a sheet metal form secured to the outside of the conduit.

2.02 The form consists of a piece of 22-gauge galvanized sheet steel or tin plate which can be bent to conform to the shape of the conduit and is of sufficient size to cover the break.

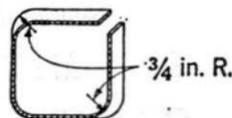
2.03 The mandrels can be made locally of wood or galvanized sheet steel. The wooden mandrels should be formed of hard wood such as maple, and treated with paraffin or varnish to minimize water absorption. The cross-section of the mandrel conforms to the bore of the duct with the corners rounded to a $\frac{3}{4}$ inch radius. The mandrel is 24 inches in length and is tapered from $3\text{-}\frac{9}{16}$ inches square at the large end to $3\text{-}\frac{3}{16}$ inches square at the small end. The steel mandrels should be open along one edge, thereby allowing two of the sides to be bent slightly outward so the mandrel can be firmly engaged in the bore of the conduit. For repairing breaks in conduit having minimum size bores and unusually long breaks, it may be necessary to plane the surfaces of the wooden mandrels slightly so that they can be inserted far enough into the bores to cover the break.

MANDREL FOR REPAIRING CLAY CONDUIT



Cross - Section of
Wooden Mandrel

Make of hard wood and treat
with paraffin or varnish.
Plane all surfaces smooth
except for ends.



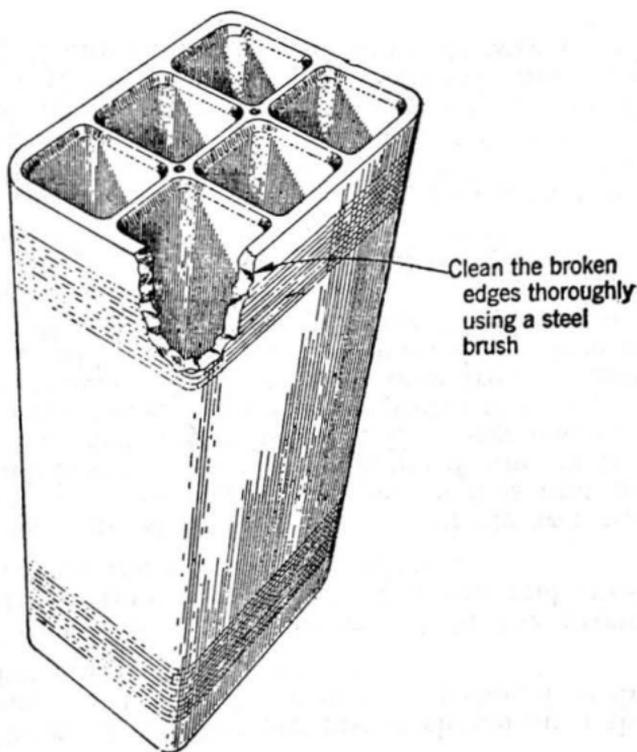
Cross - Section of
Steel Mandrel

Make of 18 ga. galvanized
sheet steel.

3. PREPARING CONDUIT FOR PATCHING WITH MORTAR

3.01 Segregate all broken conduit in a convenient store yard or vacant lot where there is sufficient room to store the repaired conduit while the mortar is being cured and where the necessary tools and equipment for doing the work can be maintained.

3.02 Stand on end the conduit sections to be repaired. Clean the broken edges thoroughly of all foreign material and loose or cracked particles of conduit, using a steel brush.



4. PREPARING CEMENT MORTAR

4.01 In preparing the cement mortar, use either normal portland cement or high early strength portland cement as specified in G45.110.1. The high early strength cement produces a somewhat higher quality of mortar which is easier to work into the forms and possesses the advantage of allowing the conduit to be handled sooner because of its rapid hardening qualities.

4.02 The sand used for the mortar should meet the requirements of G45.120.1 except that it should be fine enough to pass through a No. 14 sieve.

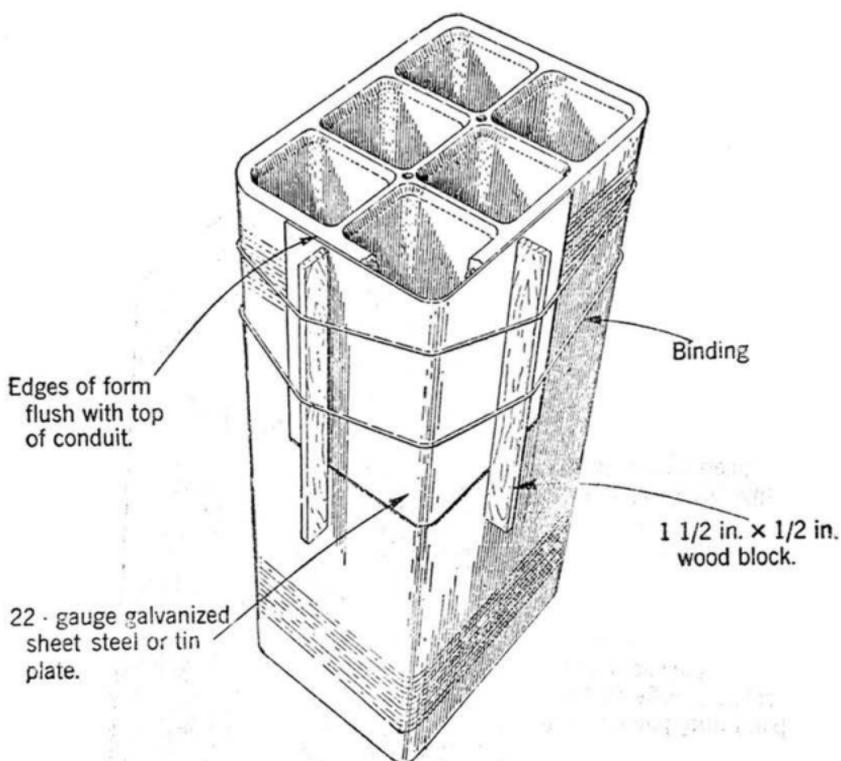
4.03 The mortar should be mixed in the proportions of 1:1-1/2 (one part of cement to one and one-half parts sand). Measure the materials by volume.

4.04 The sand should not be excessively wet nor entirely dry when measured. For mixing it is best to use only water which is suitable for drinking, but if other water is known to be satisfactory it can be used. Use only enough water to make a mortar which is sufficiently plastic to be readily tamped into place between the forms. Use only freshly mixed mortar. Any mortar which shows signs of hardening before it is placed should be discarded. **Do not attempt to rework such mortar with additional water or cement.**

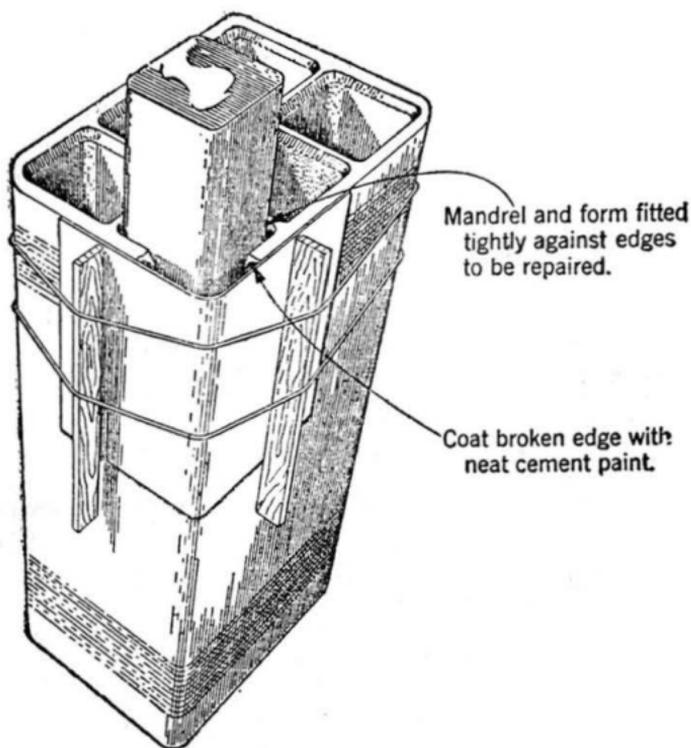
5. APPLYING CEMENT MORTAR PATCH

5.01 Apply a thin coat of oil or grease to the form and mandrel in order to make it easy to remove them after the mortar has set. Care must be taken that an excessive amount of grease is not used as the bond between the cement mortar and the broken edge of the conduit would be seriously weakened if any of the grease found its way to this surface.

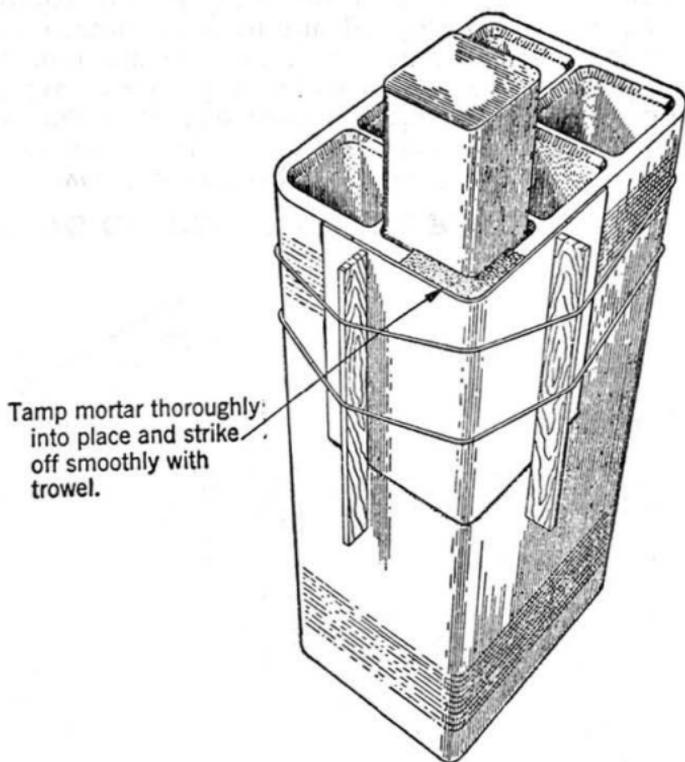
5.02 Dampen the edges of the broken portions of the conduit thoroughly with water. Secure the form to the surface of the conduit by means of two ties of cord or other suitable binding with the upper edge flush with the end of the conduit. In order to hold the sheet metal tightly against the surface of the conduit, wedge 1-1/2-inch x 1/2-inch wooden blocks under the ties and locate them so that they will press the form against the edges of the break.



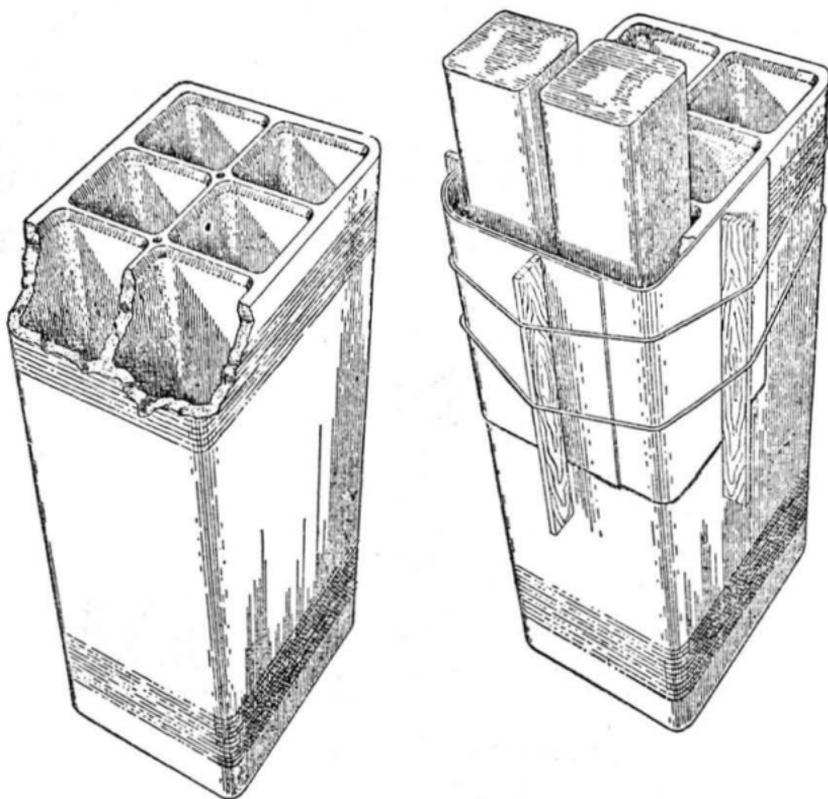
5.03 Insert the mandrel in the bore of the duct to be repaired. Care is to be taken to see that the mandrel is wedged tightly against the surface to be repaired, that the outer form fits closely to the surface of the conduit and that the corners and edges of this form are not distorted.



5.04 Coat the broken edge of the conduit thoroughly with a mixture of neat cement and water of about the consistency of thick paint, using a narrow long-handled brush. The purpose of the coating of rich cement is to increase the bond between the mortar and the clay surface. Follow immediately with the cement mortar, tamping it into the space between the form and the mandrel. When this space is completely filled, strike off smoothly with a trowel the upper surface of the patch.



5.05 If the break to be repaired is in a web, use two or more mandrels, one in each of the bores affected, and if it also involves the outside wall use the metal form in addition to the two mandrels. If the break includes a dowel pin hole essential to the assembling of the conduit, form a new hole by means of an oiled wooden dowel of the same diameter as the original hole. Place the oiled wooden dowel in the mortar after the mortar is tamped in place, and withdraw the dowel just before the forms are removed.

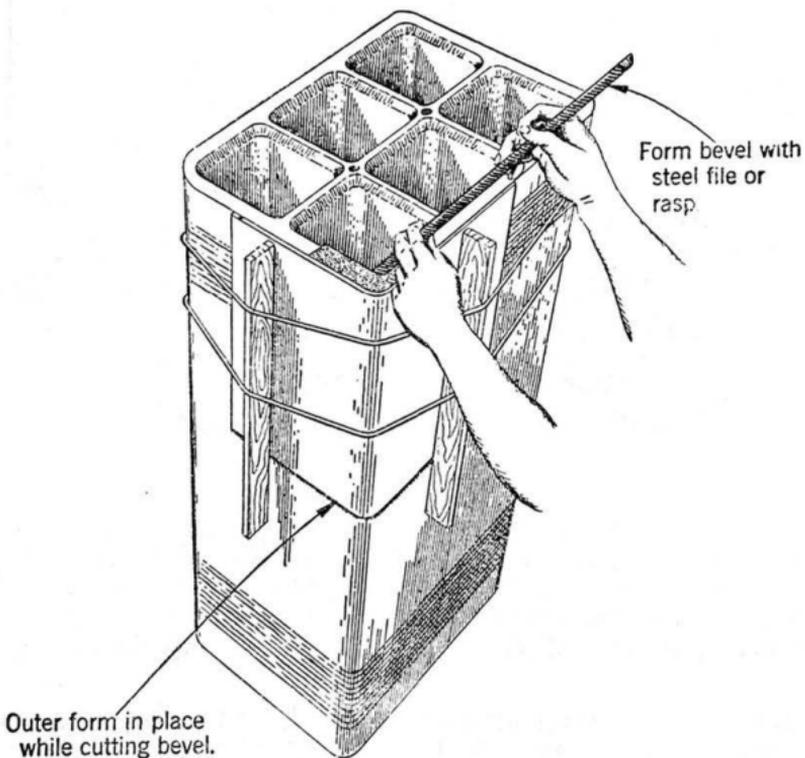


6. CURING CEMENT MORTAR PATCHES

6.01 Cover the end of the conduit with wet burlap, canvas or other suitable wet material to prevent the mortar from drying out. **The proper curing of the mortar is an important factor affecting the success of this method of repairing conduit,** and careful attention should be given to it. If normal portland cement is used the patches should be kept continuously moist for at least seven days. If high early strength cement is used the patches should be kept moist for at least three days.

6.02 At the end of 48 hours if normal portland cement has been used, and 24 hours if high early strength cement has been used, the forms can be removed. Care must be taken not to injure the bond between the mortar and the conduit, however, as the patch will not have attained its full strength at this age. The procedure is as follows:

- (1) Remove the mandrel before the outer form is taken off in order that this form may support the patch while the inside surface is being smoothed and the bevel is being cut.
- (2) After removing the mandrel, scrape smooth any roughness which may be found on the inside surfaces of the patch, and form the bevel with a steel file or rasp.
- (3) Remove the outer form.
- (4) Replace the wet burlap or other material, and continue the curing of the patch for the balance of the full curing period specified above.



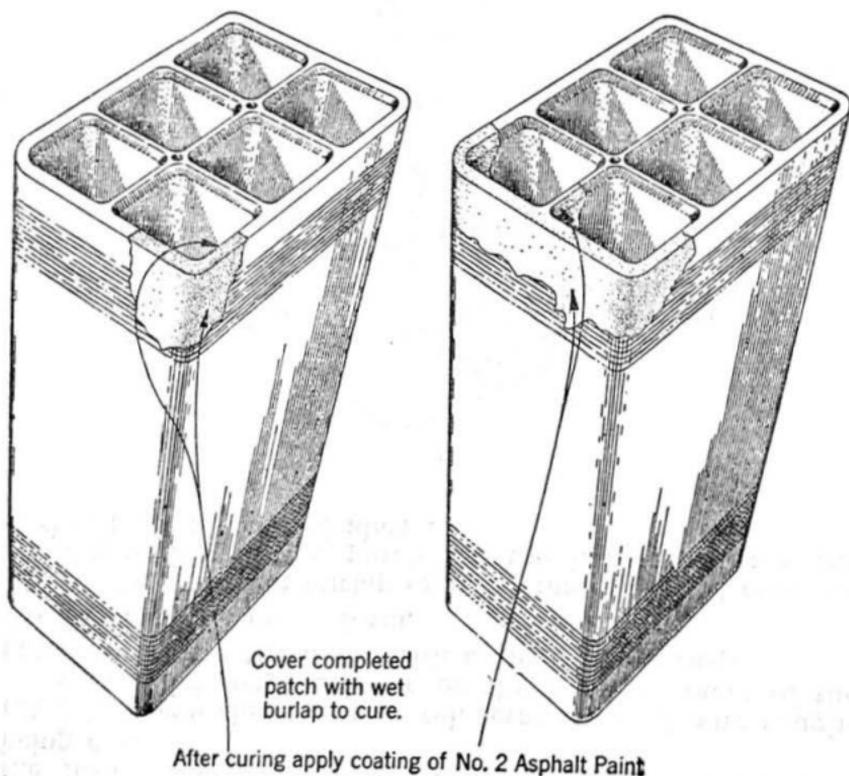
6.03 Conduit should not be repaired with cement mortar in freezing weather unless the work is done where the temperature can be maintained above 50 degrees Fahrenheit during the curing period. If conduit is to be patched when the proper curing conditions for the cement mortar cannot be

obtained, such as during freezing weather or when the conduit is to be used within a few hours after making the repairs, the method employing Hydro-Tite for the patches is to be followed.

7. APPLYING PROTECTIVE COATING OF ASPHALT

7.01 Because of the possibility of corrosion of the lead sheath through direct contact with the cement mortar, the surfaces of the patches are to be coated with a protective material. A liquid paint, No. 2 Asphalt Paint, is used for this purpose.

7.02 Apply the paint to the patch with a paint brush after the seven-day moist curing period when normal portland cement has been used or after the three-day moist curing period when high early strength cement has been used. Apply one coat, covering all surfaces of each patch.



8. PREPARING CONDUIT FOR REPAIRING WITH HYDRO-TITE

8.01 The following precautions are to be observed in preparing breaks for repair by the Hydro-Tite method.

- (a) Stand on end the conduit sections to be repaired.
- (b) Clean the broken edges thoroughly of all foreign material and loose or cracked particles of conduit, using a steel brush.
- (c) **Do not wet the broken portions.** In repairing with Hydro-Tite it is important that the broken edges be kept as dry as possible until the patching is completed.

9. APPLYING HYDRO-TITE PATCH

9.01 Hydro-Tite is furnished in the form of a fine black powder which must be reduced to a liquid before it is placed in the forms. Prepare the powdered Hydro-Tite for pouring by melting it slowly over a low fire in a suitable vessel. A kerosene furnace and small paraffin pot or similar equipment may be used for this purpose. Stir thoroughly after the mass becomes fluid in order to remove all lumps. During the melting the material will foam slowly, and the stirring should be continued until all bubbling ceases.

Note: Particular care should be taken to prevent excessive heating of the melt, both because of the tendency of the sulphur in the compound to ignite and of the tendency of the material when too hot to become pasty or sticky in the bottom of the pot. If the mass ignites, it should be thrown away and no attempt made to use it again. If it becomes sticky, additional fresh material may be added and stirred in thoroughly to produce the proper pouring consistency.

9.02 When all lumps and bubbles have disappeared, the melted mass should be removed from the fire and allowed to stand until the surface assumes a smooth, mirror-like appearance. The material is then ready to be poured.

9.03 Warm the broken edges by directing the flame of the furnace against them for a minute or two. **This operation is important in ensuring a good bond between the Hydro-Tite and the conduit.** Insert the oiled mandrel, place the oiled outside form and adjust both forms tightly against the conduit to prevent the loss of any of the fluid material.

9.04 Should the break occur at a point involving a dowel pin hole which is essential in assembling the conduit, form a new hole by inserting an oiled wooden dowel in the

existing hole before the Hydro-Tite is poured. After the patch has cooled the wooden dowel may be removed by driving it out with a steel rod inserted in the dowel pin hole at the opposite end of the conduit.

9.05 Pour the Hydro-Tite in the space between the forms, filling approximately 2/3 of the break. Allow the material to set for a short time to permit shrinkage, and then pour the remainder of the patch.

9.06 As the patching proceeds add more powdered material to the original batch and heat as before. If, during the pouring, it is found that the material is becoming too thick to pour, it may be reheated until it has again reached the proper pouring consistency as indicated by the mirror-like appearance of the surface of the melt. As soon as each patch has cooled, remove the forms and cut the bevel with a steel file or rasp. The conduit is then ready to be installed.