EC703 Farm Sewage Disposal

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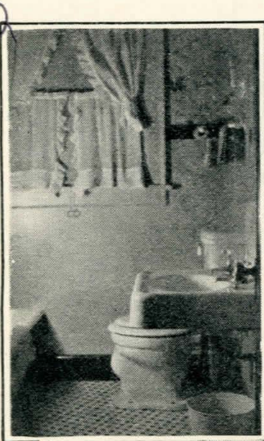
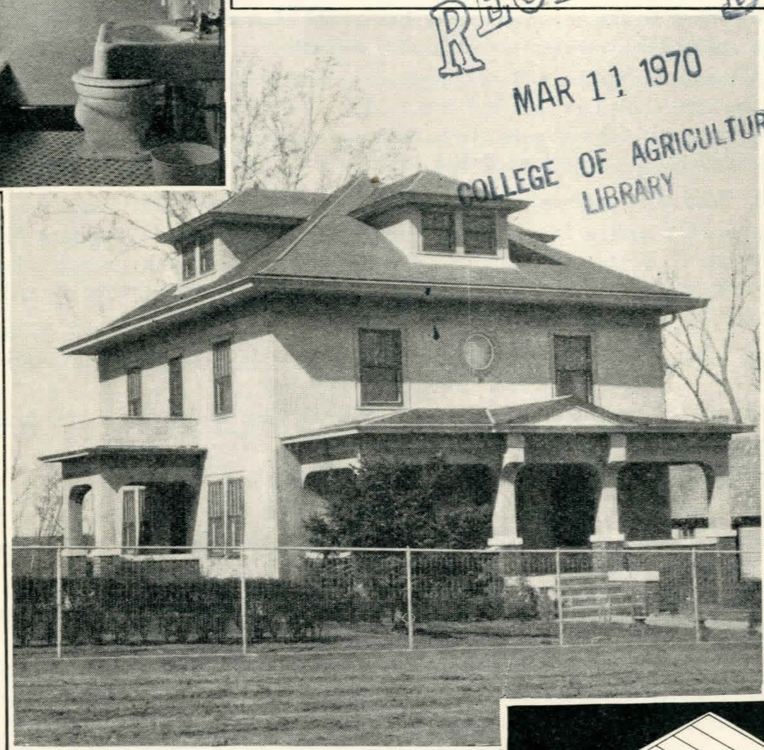
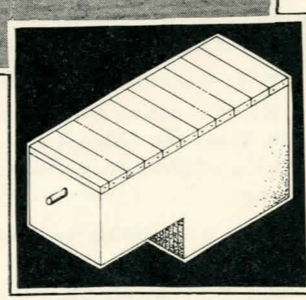




A Nebraska Modern Farm Home



The University of Nebraska Agricultural College Extension Service and United States Department of Agriculture Cooperating. W. H. Brokaw, Director, Lincoln

Farm Sewage Disposal

BY PAUL R. HOFF AND H. J. YOUNG

Questions and Answers

1. What is the difference between a septic tank and a cess pool?

A cess pool is a cistern having porous sides and no bottom into which the wastes from the homes are emptied, and from which the liquid seeps into the ground. A septic tank is a water-tight receptacle into which the wastes from the home are emptied and later dissolved or decomposed and finally carried into the soil.

2. What is the maximum size household that can be served by the size septic tank recommended in this bulletin?

A maximum household of 12 persons can be served by a septic tank of the size shown in this bulletin. However, for smaller families it is not practical to build a smaller tank as a certain capacity is necessary for successful operation of the tank.

3. Why is it necessary that a septic tank be water-tight?

Since the action in a septic tank requires from 48 to 72 hours for completion, no seepage should take place from the tank proper, also varying water depths will cause the scum to be disturbed, thus retarding the action in the tank.

4. What is the maximum water depth that is practical in a septic tank?

Studies of septic tank operation indicate that a depth of 4½ feet is necessary for satisfactory operation.

5. How often is it necessary to clean a septic tank?

A septic tank should be inspected at least every five years, and cleaned if more than 1½ feet of sludge has accumulated in the bottom of the large chamber.

6. How do gases formed in the decomposition of the sewage in the tank escape?

Part of the gases escape through the absorption system but the greater portion enters the top of the inlet "T" and escape into the open air through the vent on the roof of the house.

7. Is the effluent from a septic tank pure water?

No, it contains many impurities, although it may appear clear.

8. Does the effluent from a septic tank contain disease germs?

This effluent may contain disease germs if they are present in the sewage.

9. Is it advisable to empty effluent into a land drainage system or open ditch?

No, effluent should never be emptied where persons or stock will come in contact with it.

10. Is it advisable to empty large quantities of lye water, antiseptics, etc. into a septic tank?

Any antiseptic material entering the tank kills the bacteria which cause septic tank action. Quantities of these materials used under average home conditions are not harmful.

11. Should wash water from the milk house be emptied into the septic tank?

Yes, if it does not contain excessive amounts of antiseptics material, in which case the wash water should be carried directly to the absorption system.

12. What kind of tiles or sewer pipe should be used between the house and septic tank?

Any standard bell tile or sewer pipe, or soil pipe should be used. All joints should be cemented or otherwise sealed to prevent seepage.

13. Is gravel under the absorption tile necessary?

Yes, it is essential in heavy clay soils, but is often omitted in lighter or sandy soils.

14. Is there any danger of the absorption tile freezing during cold winter weather?

Absorption tile properly laid will not freeze, except if it comes to the surface or is exposed at the end.

15. Will the open end of an absorption tile line freeze?

Yes, as the cold wind and air blown back into the tile will lower the temperature below the freezing point.

16. Are there other types of absorption systems than lines of drain tile?

In installations on level ground, where the septic tank is placed deep enough to include the basement floor drain, it may be necessary to use an absorption chamber, which resembles in construction only the ordinary cess pool, or it may consist of several holes, about one foot in diameter, drilled down to a gravel layer. Into systems of these types nothing but effluent from a septic tank should be emptied. Since the effluent from a septic tank may contain disease germs, it should never be allowed to seep into the water vein.

17. What is the purpose of the baffle board?

The baffle board holds the scum away from the overflow to the second chamber and retains all solids in the first chamber.

18. How may sand-gravel be tested to determine whether it contains too much silt and clay to make a good concrete?

The common test is as follows: Place exactly two inches of the sand-gravel to be tested in a quart glass fruit jar filled about ¾ full

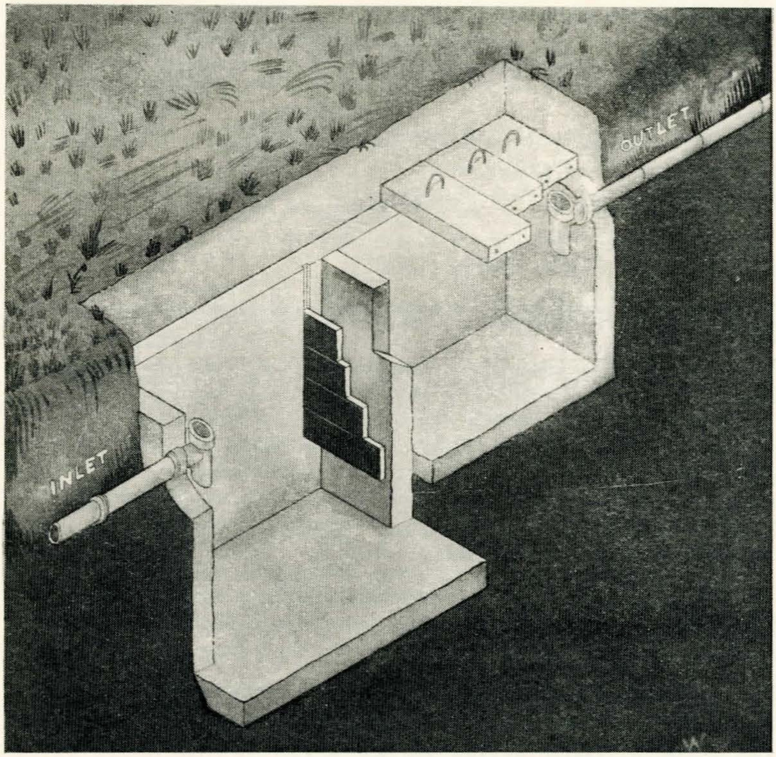
with water. Shake contents for 1 minute, after which allow to settle 1 hour. If at the end of the hour ⅛ inch or more of silt and clay is deposited on the sand-gravel it is an indication that the material is not suitable for making a good concrete.

19. Will the size of the tank recommended in this bulletin be satisfactory for school house, community buildings, hotels, etc.?

All installations of this type require special design. Information concrning such installations may be secured by using the questionnaire on the back of this bulletin.

20. How may more specific information be obtained concerning septic tank installations?

The county extension agent in your county has a supply of blueprints and other information covering septic tank construction and installation. The Agricultural College Extension Service, University of Nebraska, Lincoln, can furnish complete information also.



Septic Tanks for Sewage Disposal

The present day modern home in rural districts requires running water and the convenient plumbing that goes with it. Convenient kitchens and sanitary bathrooms are just as necessary to farm people as to their city neighbors, and for thousands of farm people much of the drudgery of farm life has been lifted by the installation of modern plumbing equipment. Along with the convenience of running water comes the problem of disposing of the wastes of the bathroom and kitchen; the installation of a satisfactory sewage disposal system. To be satisfactory, a sewage disposal system must do the work for which

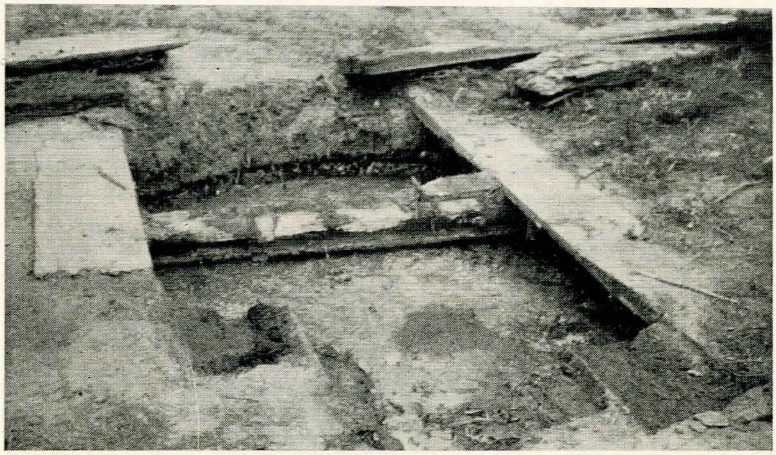


Figure No. 1. A cess pool is unsightly, may contaminate the water supply and is a general menace to the health of the family.

it is designed, it must need very little attention, and it must not be a menace to the health of the family or community. Cess pools, Figure No. 1, open ditches and open tile ends do not come up to these requirements and should not be considered when planning a farm sewage disposal system. Health authorities everywhere condemn their use and at best they are usually unsatisfactory.

The sanitary disposal of all sewage from the home can be accomplished safely and at reasonable cost through a septic tank and a carefully laid out absorption system. Sewage disposal systems of this type have been in use many years and have been proven to be safe and practical where it is impossible to connect to a municipal sanitary sewer.

Action of Septic Tank

A septic tank is an underground reservoir into which all wastes are emptied. In a septic tank all sewage is decomposed by bacteria which feed upon it. This decomposition is often likened to a slow burning process which results in the formaton of three substances: an ash or mineral deposit in the bottom of the tank commonly called "sludge"; gases; and a liquid called "effluent" which contains the dissolved sewage. The bacteria that accomplish this action are a variety that grow in the absence of free oxygen and are known as "anaerobic" bacteria. They derive oxygen by breaking down the sewage, thus causing the desired decomposition. In a septic tank that is in operation a scum of greases and bacteria soon forms on the surface of the water in the tank keeping air away from the liquid below, thus creating a favorable condition for the anaerobic bacteria to work. It is important that this scum form and it should never be disturbed, except when the tank is cleaned.

A septic tank installation is not complete without an adequate, well installed absorption system. An absorption system consists of two or

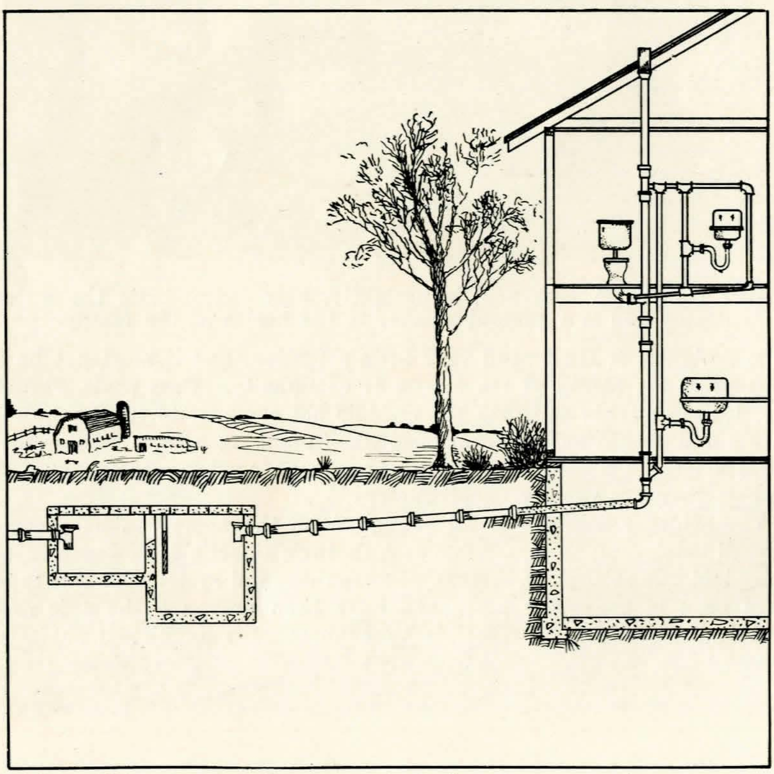


Figure No. 2. Installaton not including basement floor drain.

more lines of drain tile laid in the ground, into which the effluent from the septic tank empties. As this liquid seeps into the soil from the tile the dissolved sewage is again worked on by the soil bacteria. This final bacterial action completes the breaking down of the sewage, thus making the treatment of all wastes from the home by the septic tank and absorption sysem, a sanitary and efficient means of sewage disposal.

Locating the Septic Tank

The first step in the installation of a septic tank is to locate the site. Due to differences in soil, topography, location of the well, and other conditions, locating the site for a septic tank is a separate problem with each home. A septic tank and absorption system should always be located below the well so that the flow of ground water will never be from the absorption system towards the well. When possible it should be placed on the side of the house nearest the bathroom and kitchen, the distance from the house being determined by the grade

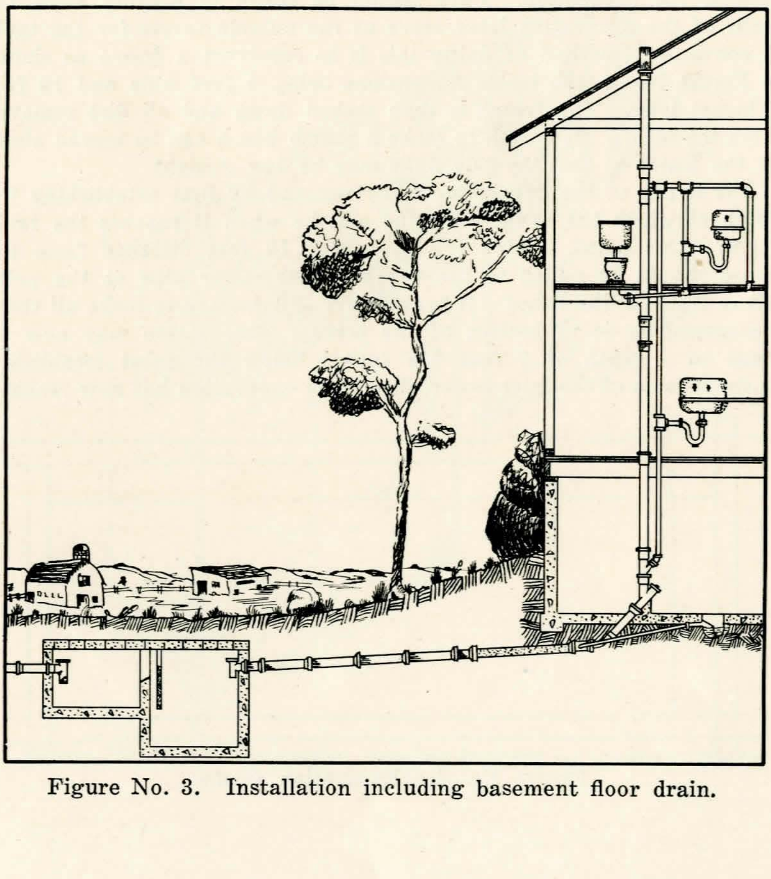


Figure No. 3. Installation including basement floor drain.

of the ground surrounding it. To obtain best results a septic tank should be placed at a depth which will bring the tile of the absorption system to a depth of 18 to 25 inches below ground surface. This is illustrated in Figure No. 2 which shows the tank located so as to give the proper depth for the absorption system. In locations where the fall is more gradual, distances from the house will be greater. In some homes it is desired to carry all wastes, including the drain from the basement floor, Figure 3, to the septic tank while in other homes, Figure No. 2, no basement floor drain is provided. Each of these general conditions also influences the depth and distance from the house at which a septic tank must be located. Another important consideration is that an open space, free from trees, must be provided for the absorption system, as tree roots may enter the tile and stop the flow of effluent.

The Excavation

After selecting the site for the septic tank, we may next consider making the excavation. Care should be taken in digging since the walls of the excavation later serve as the outside forms for the tank. A convenient method of doing this is to construct a frame as shown in Figure No. 4, the inside dimensions being 4 feet wide and 10 feet 6 inches long. The frame is then staked down and all dirt removed from the inside. It is well to make a plumb which can be moved about on the frame so that the side walls may be dug straight.

The depth of the excavation is determined by first establishing the depth at which the sewer pipe line will be when it reaches the tank. To find this point, 1 inch fall for every 12 feet distance from the house should be added to the depth of the sewer pipe at the point where it leaves the house. It proves very satisfactory to make all these measurements as of bottom of the trench. Excavation may now be made to a depth of 2 feet 6½ inches below the point established as the bottom of the inlet sewer pipe. The excavation has now reached

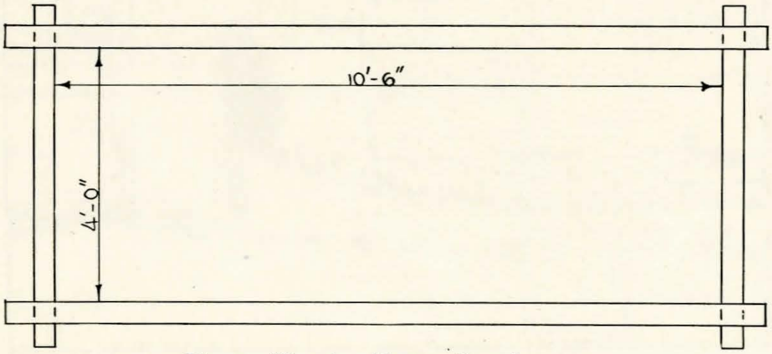


Figure No. 4. Excavation frame.

the depth required for the second or small chamber of the tank. To complete the excavation measure 6 feet from the inlet end of the tank or the end nearest the house and dig this portion 2 feet deeper for the large chamber. The bottom of the excavation for both chambers should be level and smooth.

Forms

The forms used in the construction of the tank are very easily built as only an inside form is used, Figure No. 5. This consists of two boxes without top or bottom, each being the inside form of the corresponding chamber of the septic tank. No outside form is necessary as the sides of the excavation are used for that purpose.

The county extension agent in a number of counties in Nebraska maintains a set of septic tank forms for use of the people in the county. These forms are of the knock-down variety and can be used in the construction of a large number of tanks.

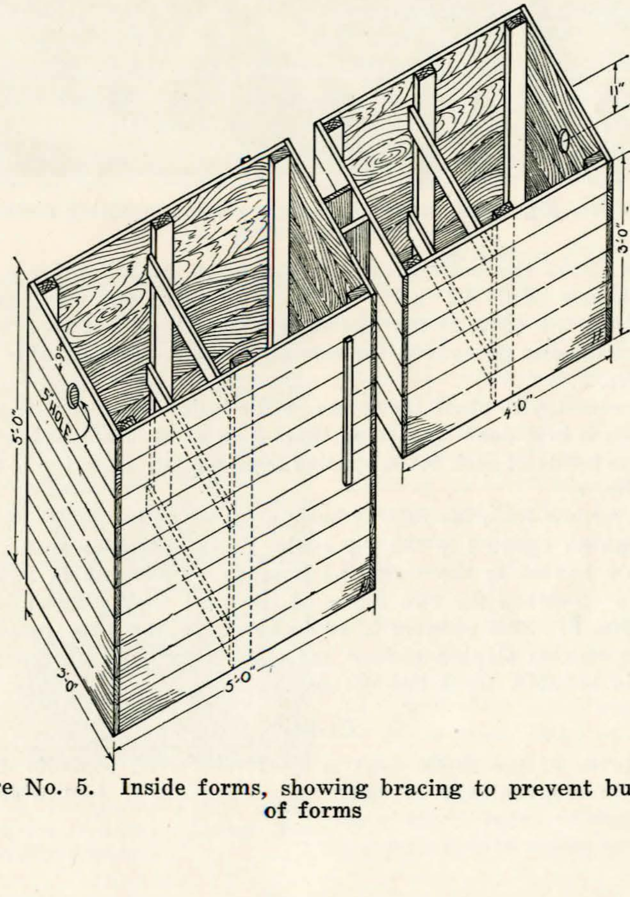


Figure No. 5. Inside forms, showing bracing to prevent bulging of forms

When lowering the forms in place, preparatory to placing the concrete, keep in mind that they are suspended from the surface of the ground, rather than resting on the bottom of the excavation. Usually a 1" x 4" piece at each corner of each form is sufficient to hold the weight of the forms, these being nailed to 2" x 4" pieces running across the top of the excavation, Figure No. 6. The forms are hung

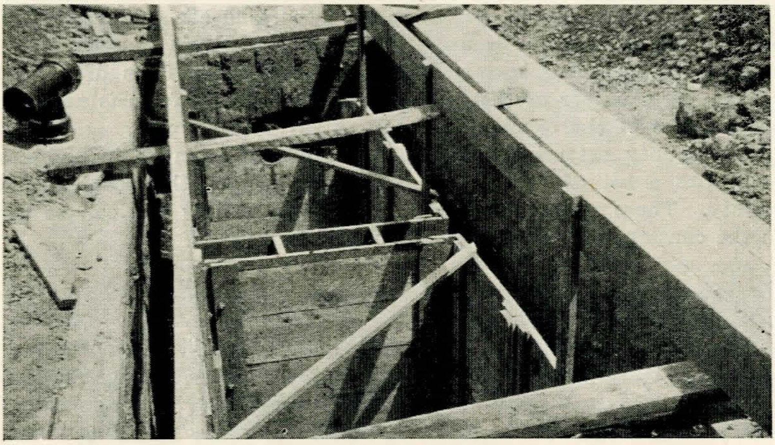


Figure No. 6. Forms suspended in excavation, showing method of hanging forms.

6 inches above the bottom of the excavation, to allow for a 6 inch floor. A pair of 2" x 2" x 2½' cleats are nailed; one on each side 6 inches from the edge, at the discharge end of the large form to make the perpendicular grooves in the side of the tank for the baffle boards, Figure No. 5.

It is necessary to brace the forms on the inside to prevent them bulging. This is best done by placing three 2" x 4" braces, lengthways and crossways inside of each form, spacing them equally from top to bottom, Figure No. 7.

The overflow from the first or large chamber to the smaller chamber is through an opening in the top center of the partition wall. This is commonly known as the weir and is made by slipping in two pieces of 2" x 6" between the two forms at the time they are put in place. Figure No. 5. This opening is 18 inches wide and 12¼ inches deep, with the bottom sloping toward the small chamber. No concrete is placed in between these two pieces.

Cover

The cover of the septic tank is steel reinforced concrete 4 inches thick. For convenience 10 small slabs each one 1 foot wide and 4

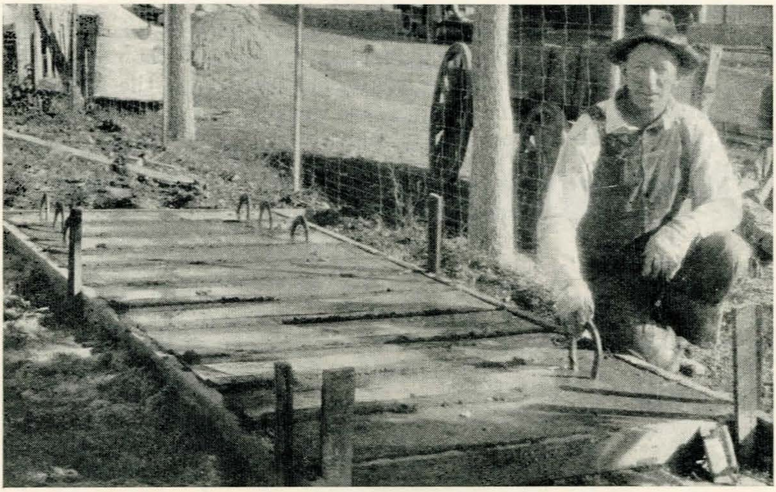


Figure No. 7. Forms for cover slabs.

feet long are used rather than a single large slab. Each slab has two ¼ inch by 4 feet reinforcing rods running lengthways of the slab. Two or three slabs may have a pair of horse shoes or U shaped iron rods, one at either end for handling at times when it is necessary to open the tank. Forms for cover slabs are shown in Figure 7.

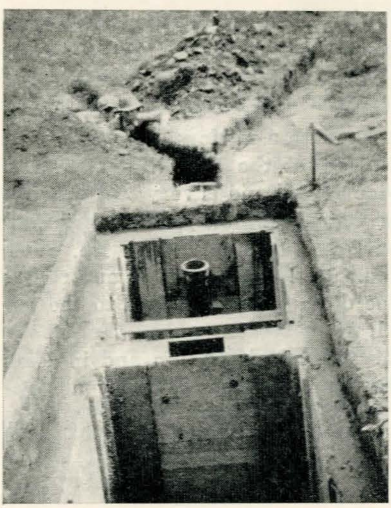


Figure 8. Completed septic tank, forms not removed. Trench for absorption system.

Absorption System

The absorption system consists of two or more lines of 4 inch drain tile, laid 18 to 24 inches under the surface of the soil. The length of the tile lines will vary according to the size of the family and character of the soil, usually allowing 30 to 50 feet of tile per person in the family. Less absorption area will be required in a loose, sandy soil than in a heavy clay, but under no condition should less than 100 feet of tile be installed. For the heavier soils, 150 or more feet of tile should be installed as a minimum. Two or more short lines of tile are more satisfactory than one longer line, because there is less chance of a water-logged condition showing up near the septic tank.

The flow of effluent must be divided so as to give an even distribution for all branches of the absorption system. Without a properly constructed divider box at the junction of the branch tile lines, there is no assurance that the flow of effluent is being divided. Figure No. 9 shows a divider box that equally divides the flow from the tank by means of the steel plate in the center.

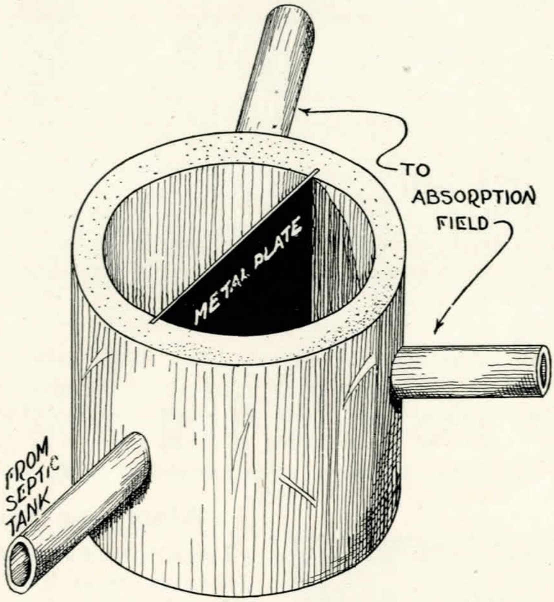


Figure No. 9. Divider Box.

It is very important that the tile be laid to a uniform grade, so that there are no low places or humps to prevent the even flow of water. The following method is one that is widely used and is very satisfactory. First, establish the grade to be used which ordinarily is ½ inch fall in 12 feet. The use of a grade board as shown in Figure No. 10 is very helpful in getting a uniform slope. Both grade boards and stakes are left in the ditch permanently. The ditch bottom is filled to the top of the grade board with coarse gravel.

The gravel fill greatly increases the rate of absorption and in some heavy soils is absolutely necessary to maintain the necessary absorption.

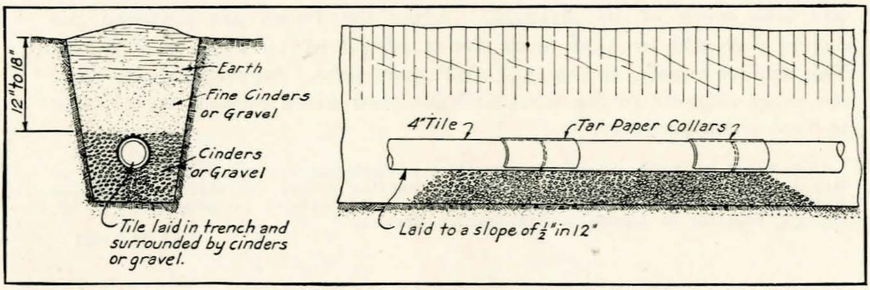


Figure No. 10. Grade board and gravel fill in absorption tile trench. Cutaway view of septic tank in ground, showing tile connections, and all points of construction possible.

The Concrete

Since it is necessary that a septic tank be water-tight, it is necessary to make an impervious concrete. To make a dense, water tight concrete it is essential to use a clean, well graded sand-gravel. By well graded is meant a mixture of sand and gravel in which there is little more sand than is required to fill in the spaces beween the gravel, and contains 40 to 50% sand and 50 to 60% gravel particles. Sand-gravel should always be clean; that is, free from silt, clay, and organic matter.

The concrete should be mixed using not more than 5½ gallons of mixing water with each sack of cement, using such quantities of ordinary moist sand-gravel as may be required to bring the mixture to a jelly, quaky stiffness. A batch of concrete as mixed in the average barrel type mixer consists of ⅓ sack cement (31⅓ pounds), 1¾ gallons water and such quantity of sand-gravel as is required to make a mixture of the proper workability. Note that in mixing, the workability of the mixture is controlled by the amount of sand-gravel added, the amount of water in each batch remaining constant. Allowance in the amount of water added should always be made for very wet or very dry sand-gravel.

As the concrete is placed around the forms it must be well spaded. Thorough spading is accomplished by using a spade or straight hoe, working it up and down along the sides of the forms. This forces all coarse particles back into the mess permitting fine particles to come next to the forms. Spading also assists to work out all air pockets and make a more dense concrete. As a final step in placing concrete in forms many tap the sides of the forms gently with a hammer.

The concrete slabs made for the cover of the tank must be reinforced by placing two ¼ inch steel rods 4 feet long in each slab. These reinforcing rods should be placed 3 inches from the top of the slab.

The last step in making a water-tight concrete is to cure it properly. Concrete that is permitted to dry out rapidly may become porous and

will lose much of its strength. After the forms are removed the concrete should be kept moist for a period of 10 days or 2 weeks. This applies equally to the tank and cover slabs. Since the cover slabs are more exposed to the wind and sun they often require more water to cure them properly.

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Information Regarding Sewage Disposal Systems for Public Buildings

1. Kind of buildings to be served..

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2. Number of persons occupying the building..

3. Average number of gallons of water used per day..........................
   (Give water meter reading for one month if it is available.)

4. Is building located on level or sloping ground?....................................

....

5. Give type of soil..

Name ....

Address ....

Fill Out and Mail to
AGRICULTURAL ENGINEERING DEPT.
COLLEGE OF AGRICULTURE
LINCOLN, NEBRASKA