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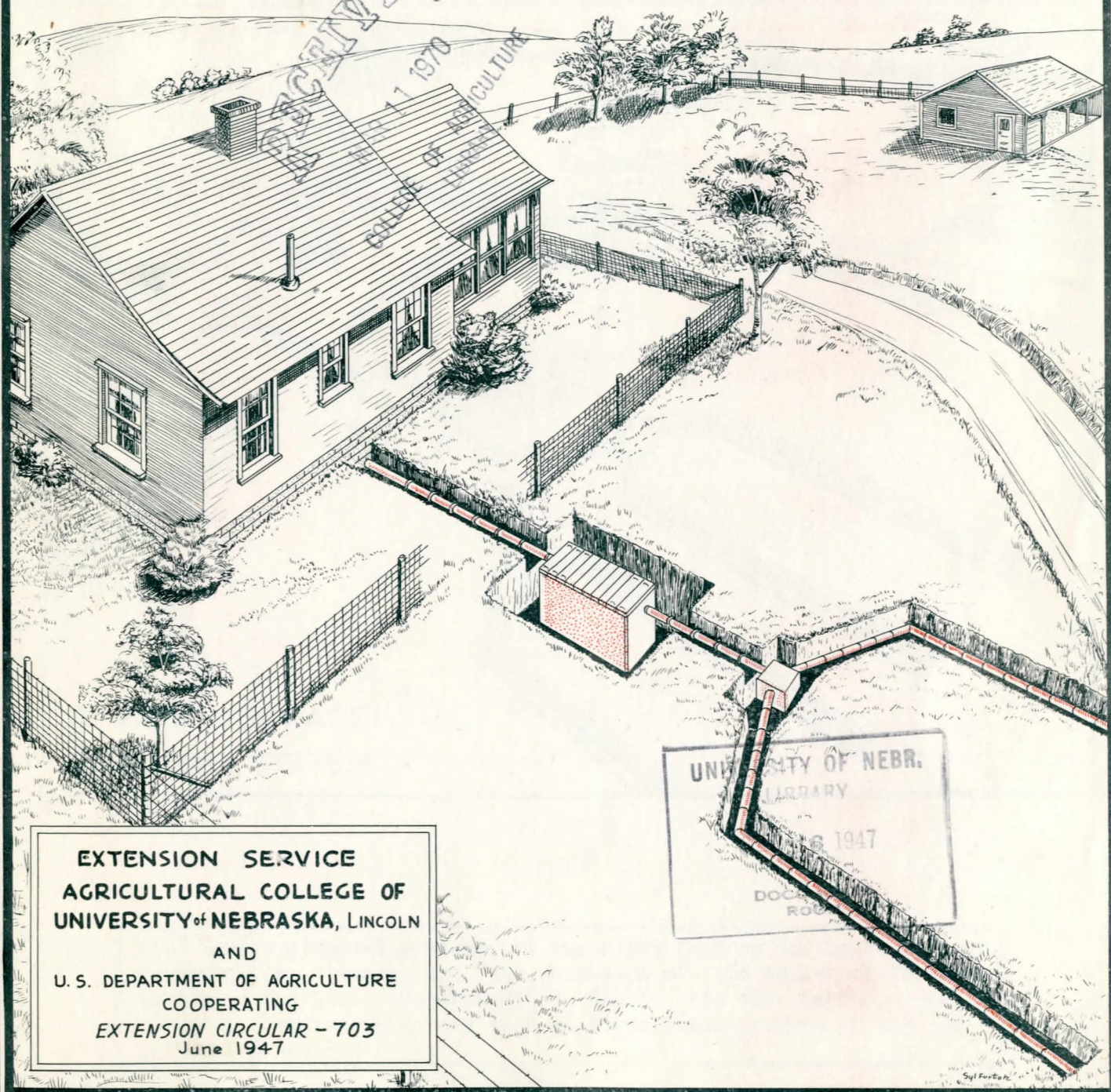
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Farm SEWAGE DISPOSAL

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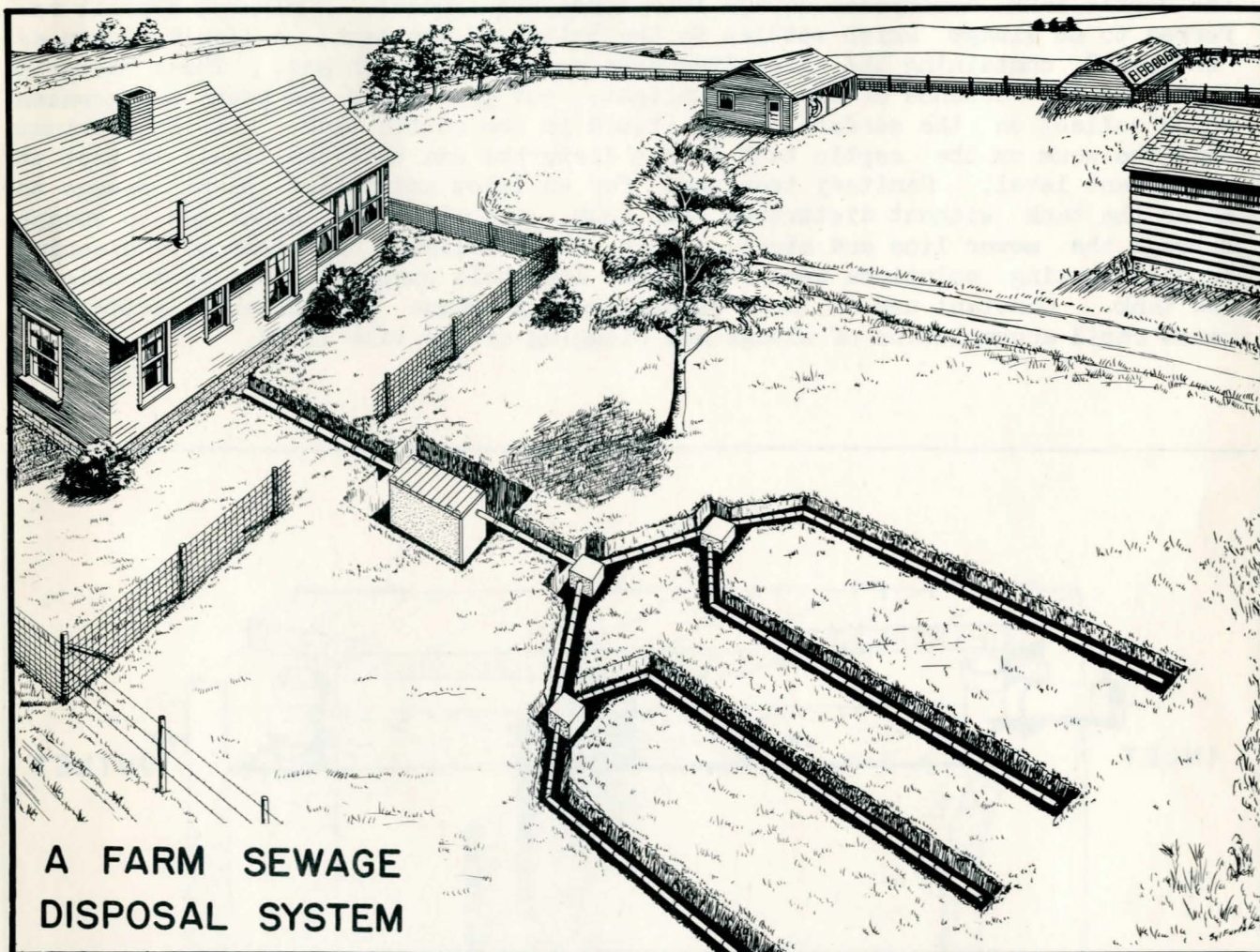
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FARM SEWAGE DISPOSAL

Prepared by

E. A. Olson*

The modern farm home with running water and a bathroom is not complete without a satisfactory sewage disposal system. A sewage disposal system should serve the purpose for which it is intended, require little attention, and it must not be a menace to the health of the family or the community. The practice of disposing of sewage into open fields, ditches or cesspools is condemned by health authorities everywhere. Too often these unsanitary methods are used with little or no thought given to the possibility of contaminating the family water supply.



**A FARM SEWAGE
DISPOSAL SYSTEM**

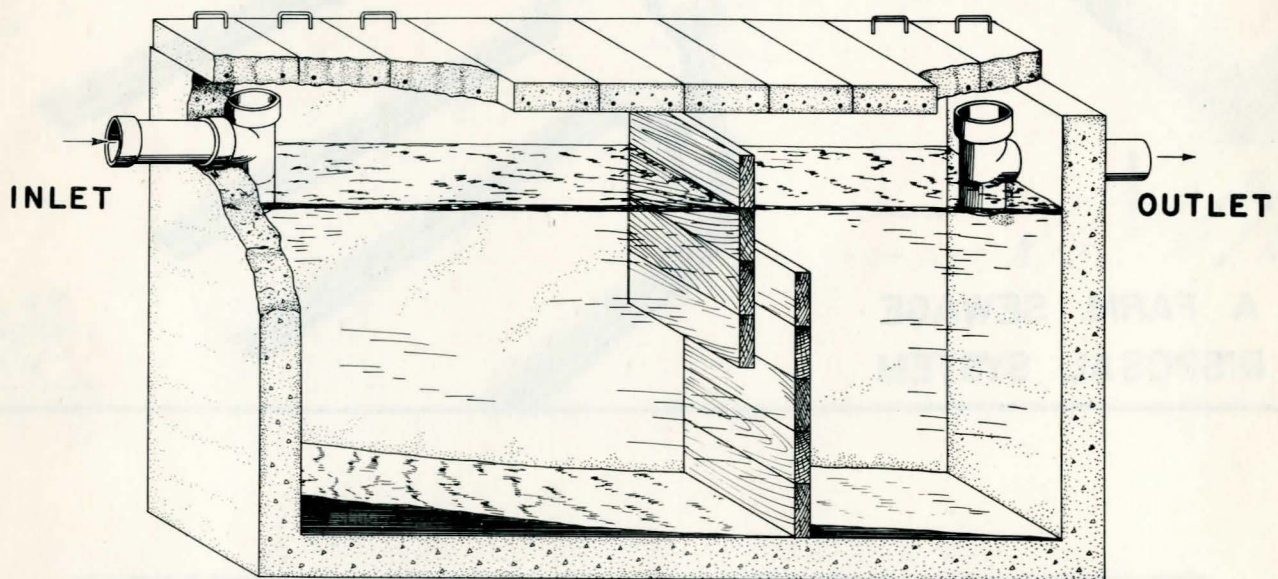
Farm sewage disposal systems are important factors in the control of communicable diseases and the promotion of the health of Nebraska people. The State Department of Health and the Nebraska Health Planning Committee endorses such an educational program of the Agricultural Extension Service.

*The writer wishes to express his appreciation to Professor E. E. Brackett, Chairman, and other members of the Agricultural Engineering Department, for helpful suggestions in preparing this circular.

A cesspool as a means of disposing of sewage is not recommended because it may pollute the water supply. At best its life is relatively short, since the side walls become sealed with fats and greases. Safe and sanitary disposal of sewage from the farm home can be accomplished economically by means of a septic tank with a suitable absorption or disposal field. This type of sewage disposal system has been in use on many Nebraska farms for the last twenty to twenty-five years and has proved practical and sanitary.

Septic Tank

A satisfactory septic tank should be a durable watertight reservoir into which waste water and sewage from the house is emptied. Bacteria present in the septic tank decomposes sewage into three substances: A mineral deposit referred to as sludge which settles to the bottom of the tank; a liquid known as "effluent" containing the dissolved sewage; and a sewer gas. These bacteria thrive in the absence of air and sunlight, and live under the scum and greases which collect on the surface of the liquid in the septic tank. It is important that the scum on the septic tank is not disturbed and that the liquid is kept at a constant level. Sanitary tees used for an inlet and outlet permit sewage to enter the tank without disturbing the scum, and allow the sewer gas to escape through the sewer line and stack. Soap, drain solvents and other mild cleaning or disinfecting solutions used for normal household purposes cause no trouble in the tank. Constant use in large quantities may reduce the bacterial action and cause rapid accumulation of sludge and clogging of the tile lines.



CONCRETE SEPTIC TANK

Since the decomposition process in the septic tank requires 48 to 72 hours, it is essential that a septic tank have sufficient capacity to retain sewage for this period. When tanks of too small capacity are used, frequent cleanings are required, and there is always a possibility of undecomposed sewage being carried into the drain tile, causing trouble in the absorption system. A satisfactory septic tank for the average farm family should have a capacity of 500 gallons or more.

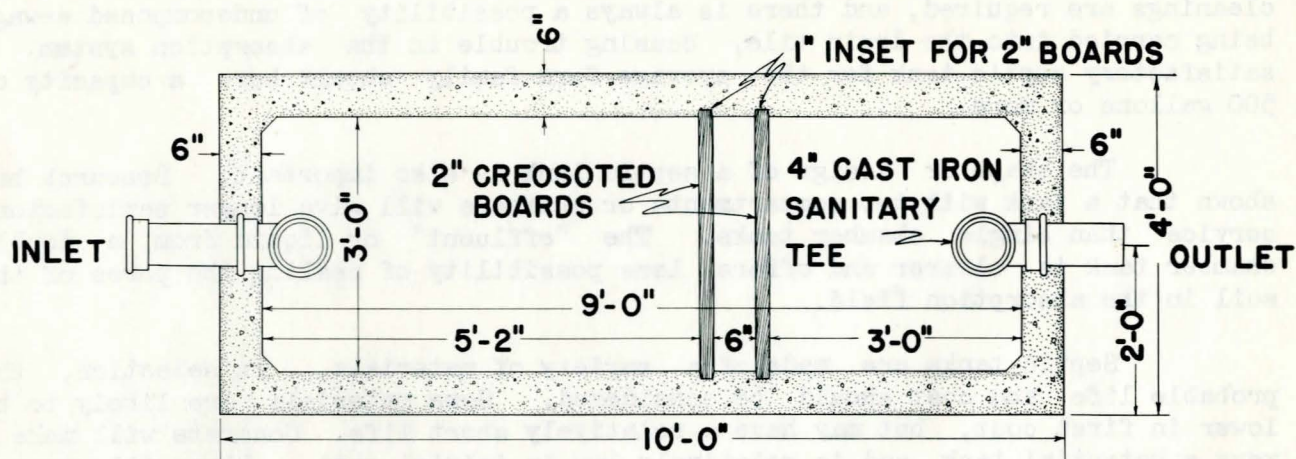
The shape or design of a septic tank is also important. Research has shown that a tank with two compartments or chambers will give longer satisfactory service than single chamber tanks. The "effluent" or liquid from a double chamber tank is clearer and offers less possibility of sealing the pores of the soil in the absorption field.

Septic tanks are made of a variety of materials. In selection, the probable life and cost should be considered. Some materials are likely to be lower in first cost, but may have a relatively short life. Concrete will make a very substantial tank and is relatively low in initial cost. Plans illustrated on the following page show a concrete septic tank, nine feet long, three feet wide and five feet deep. This tank can be built at the desired location with portable forms which will be discussed later.

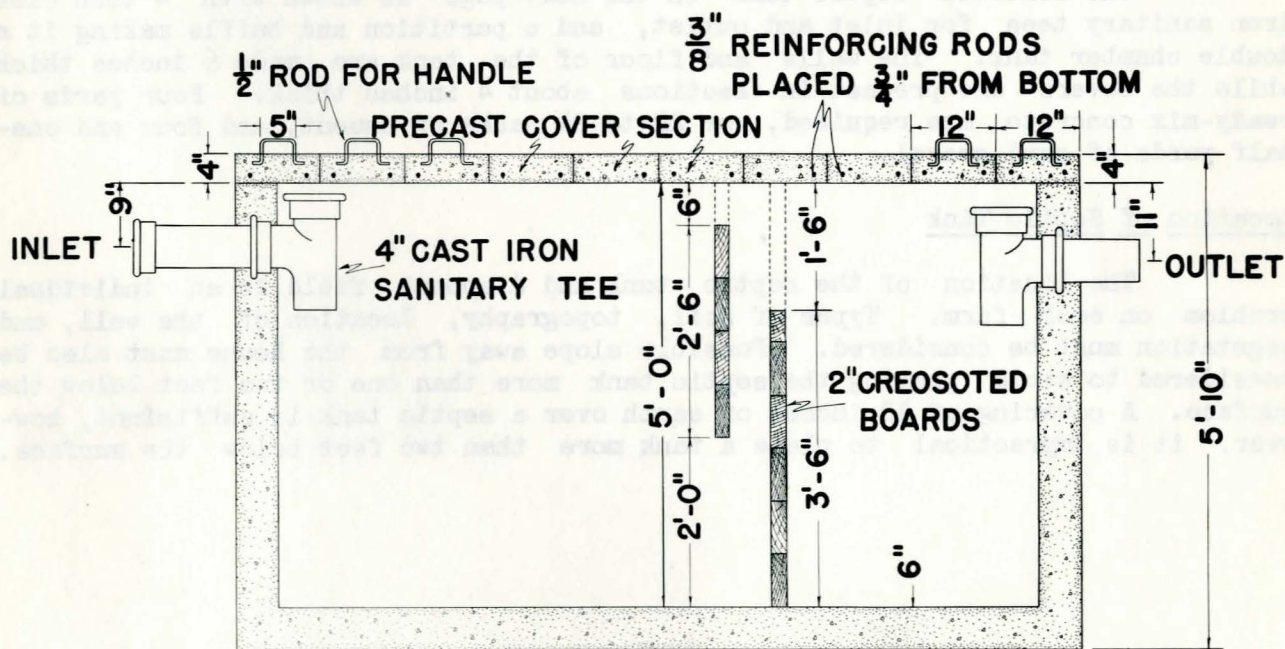
The concrete septic tank on the next page is shown with 4 inch cast iron sanitary tees for inlet and outlet, and a partition and baffle making it a double chamber tank. The walls and floor of the tank are made 6 inches thick while the covers are precast in sections about 4 inches thick. Four yards of ready-mix concrete are required, or 22 to 24 sacks of cement, and four and one-half yards of sand-gravel.

Location of Septic Tank

The location of the septic tank and disposal field is an individual problem on each farm. Types of soil, topography, location of the well, and vegetation must be considered. Possible slope away from the house must also be considered to avoid placing the septic tank more than one or two feet below the surface. A covering of 12 inches of earth over a septic tank is sufficient, however, it is impractical to place a tank more than two feet below the surface.



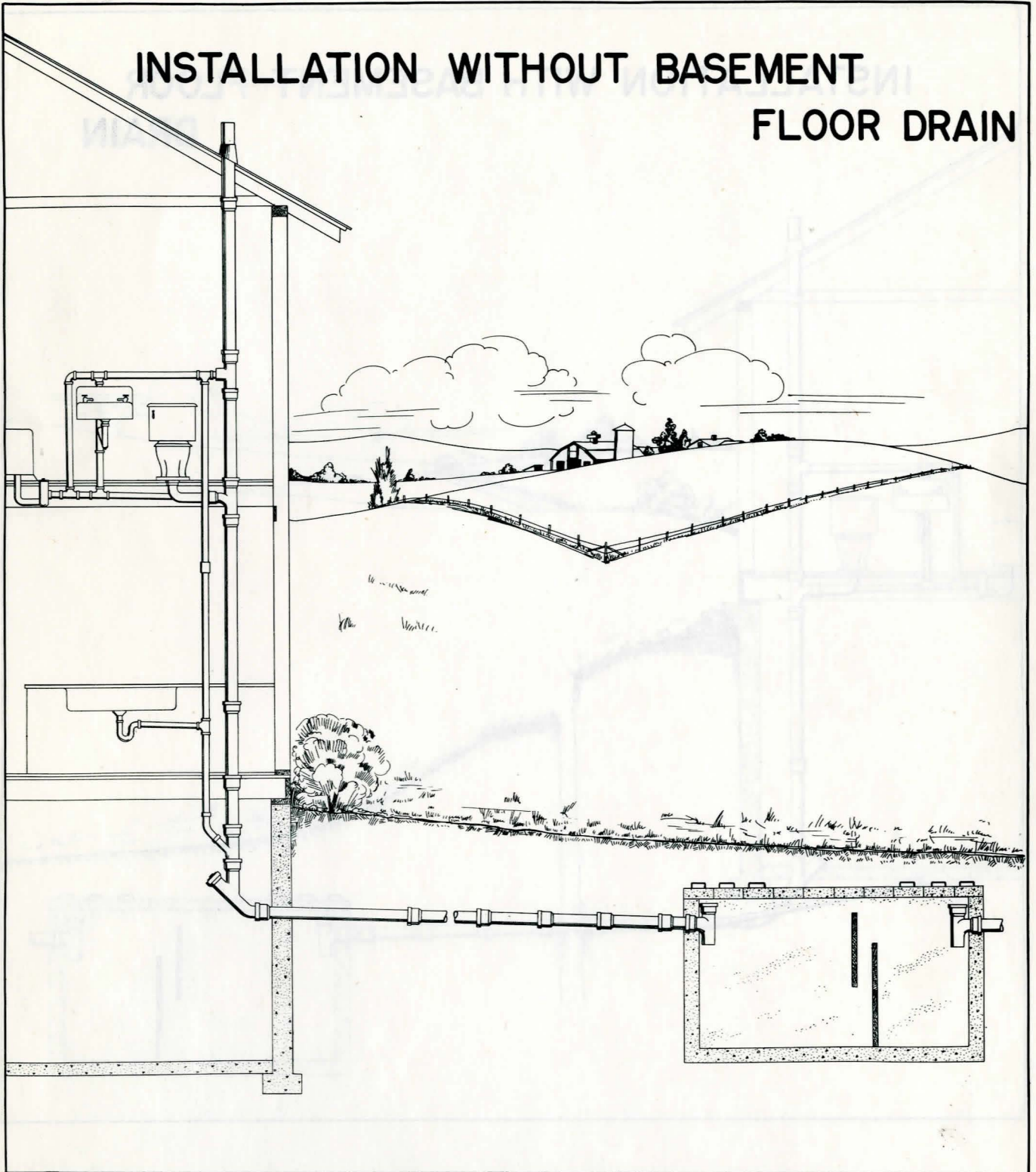
PLAN VIEW OF SEPTIC TANK



SECTION VIEW OF SEPTIC TANK

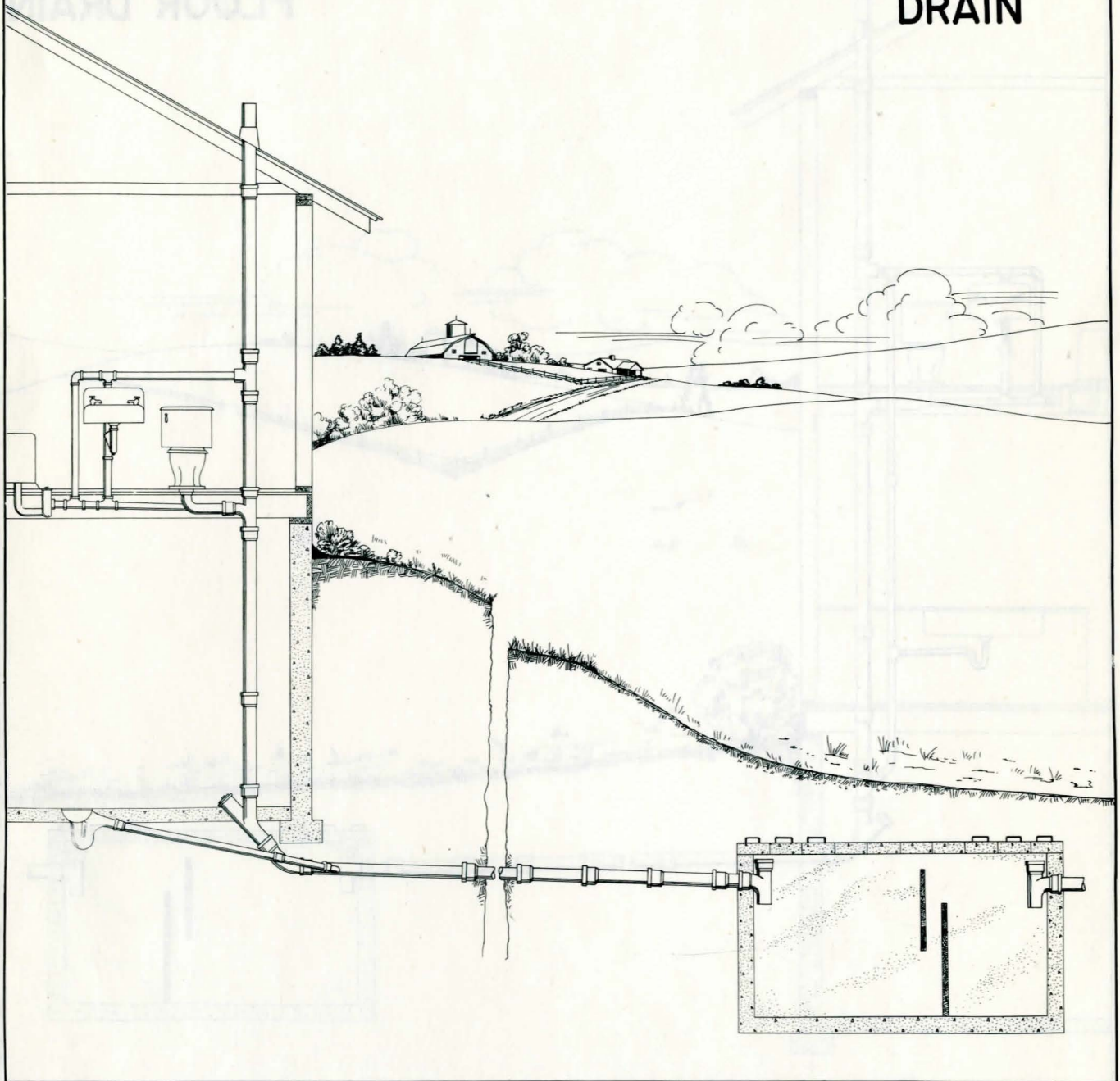
SEPTIC TANK

INSTALLATION WITHOUT BASEMENT FLOOR DRAIN



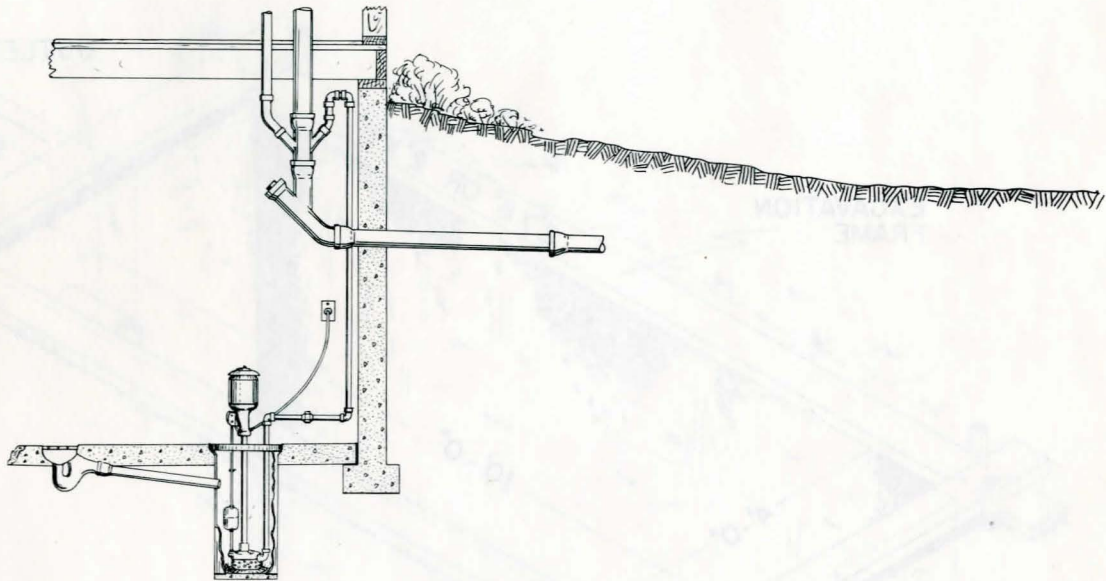
The illustration above shows an installation where it is impractical to provide a basement drain. This type of arrangement is satisfactory if a house has no basement or if a basement drain is not required.

INSTALLATION WITH BASEMENT FLOOR DRAIN



When adequate slopes of 2 to 3 feet per 100 feet are found, basement drains can be provided with a minimum of labor and expense. The plan shows an installation with a basement draining directly into the septic tank. Basement drains are very convenient in the farm home, if laundry is done in the basement or if provisions are made for showers.

When conditions of slope do not permit draining from the basement into the septic tank, provisions for using a sump pump or siphon can be made. The plan shown below shows a sump pump installed in a small sump or reservoir, located in the basement near a foundation wall and close to the sewer line. Waste water flows from the drain into the sump. When the water reaches a certain level, a float closes a switch and causes the pump to discharge the water into the sewer line. The motor automatically stops when the water in the sump reaches a low level.



INSTALLATION WITH SUMP PUMP

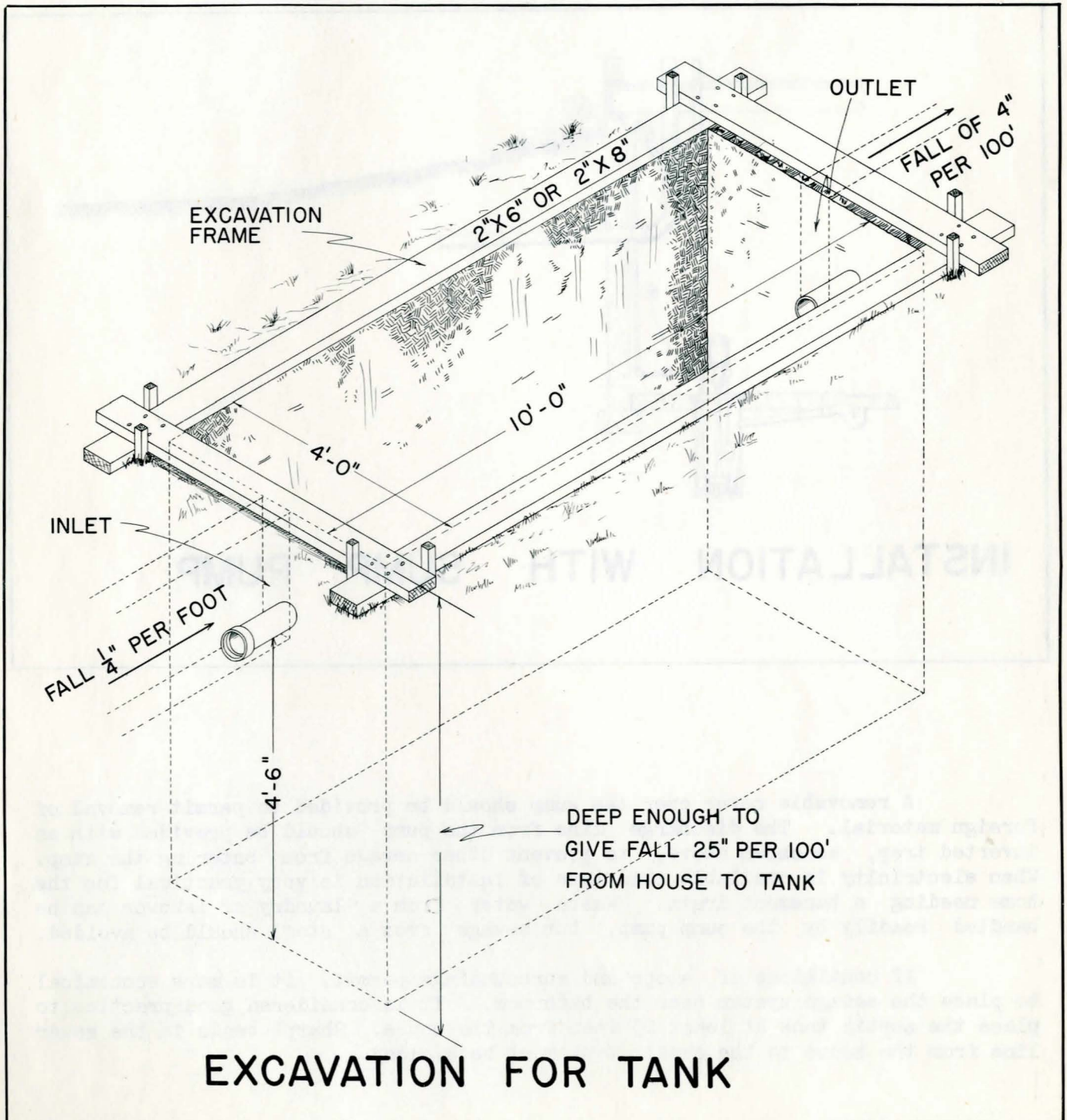
A removable cover over the sump should be provided to permit removal of foreign material. The discharge line from the pump should be provided with an inverted trap, as shown above, to prevent other sewage from entering the sump. When electricity is available this type of installation is very practical for the home needing a basement drain. Waste water from a laundry or shower can be handled readily by the sump pump, but sewage from a stool should be avoided.

If conditions of slope and surroundings permit, it is more economical to place the sewage system near the bathroom. It is considered good practice to place the septic tank at least 25 feet from the house. Sharp bends in the sewer line from the house to the septic tank must be avoided.

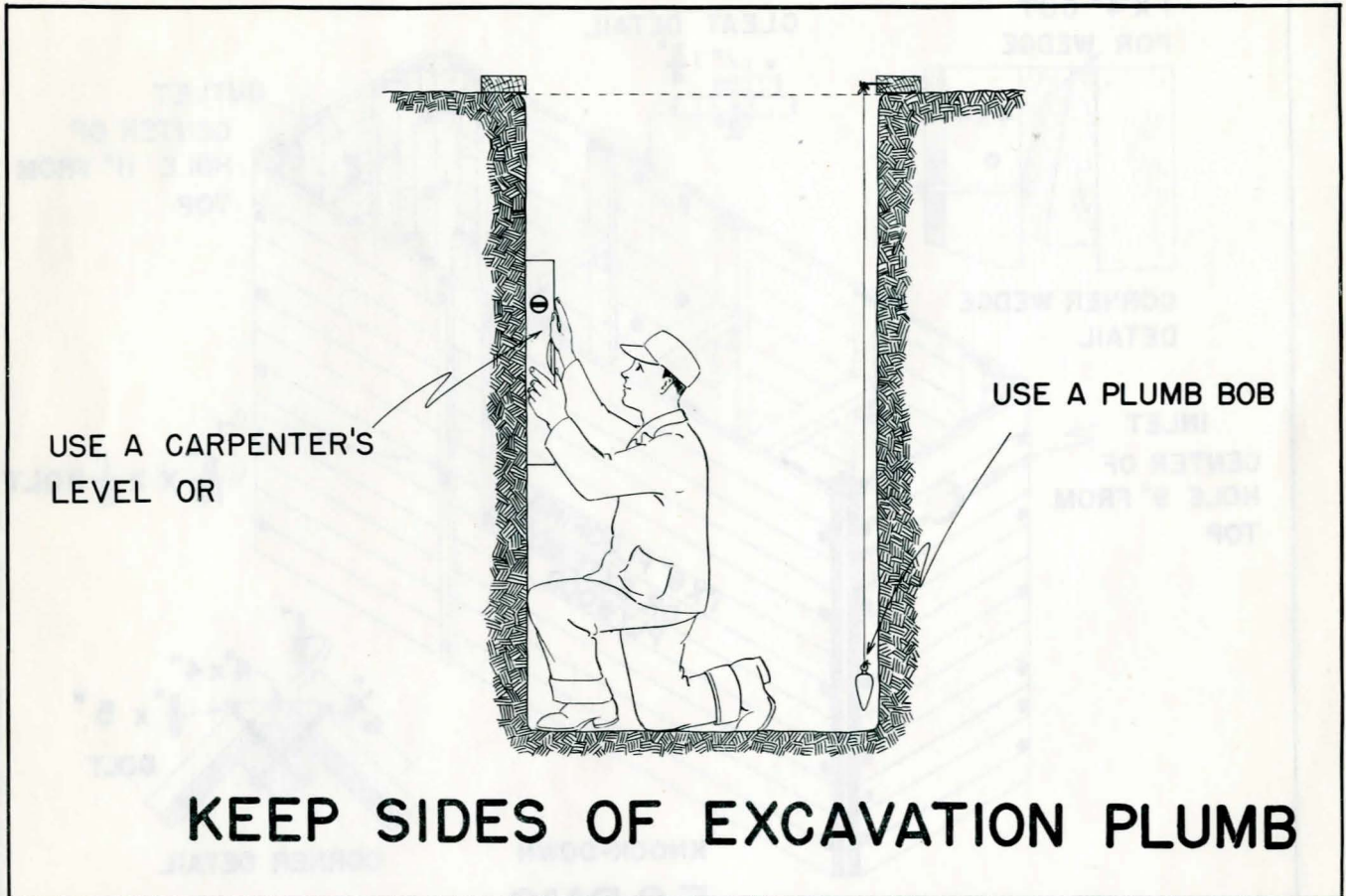
Excavation

After the location for the septic tank has been determined, a frame made of 2" x 6" or 2" x 8" material should be made as shown. This frame is staked in place to serve as a guide for the excavation. Note that the hole is dug 1 foot larger than the forms to provide space for six inch walls.

The tank should be planned with a sewer line grade of about $\frac{1}{4}$ inch per foot. The bottom of the excavation should be 4 feet 6 inches below the tile inlet to the tank as shown below.



It is important that the sidewalls of the excavation be plumb to avoid use of excessive quantities of concrete. The usual tendency is to make the bottom wider than the top. A plumb bob or carpenter's level, as shown in the illustration, will be of considerable help.



Septic Tank Forms

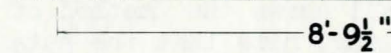
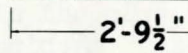
The construction of a concrete septic tank will be simplified, if a portable form can be rented. Some of the Nebraska County Extension Agents have these forms available for rental, or may have information on their availability.

The knock-down or portable forms are constructed as shown on the following page. The forms are designed to permit them being used for several installations. The form sides are made in one unit as shown, but the ends are made in three units to permit removal from around the sanitary tees. The end unit is cut through the center of the hole for inlet and outlet, and also about one foot from the bottom. Note that the center of the inlet hole is 9 inches from the top of the end, while the outlet hole is 11 inches.

The corner detail shows the method of securing the ends and sides to the 4" x 4"s. In assembling, note that the nuts on the 3/8" x 5" machine bolts are placed on the outside to permit removal of the corner 4" x 4"s. Corner wedges are placed as shown to relieve the bolts of side pressure, and to permit their being removed easily. After the form has been assembled, paint marks should be placed on the inside of the corners to aid in quick reassembly.



FORMS



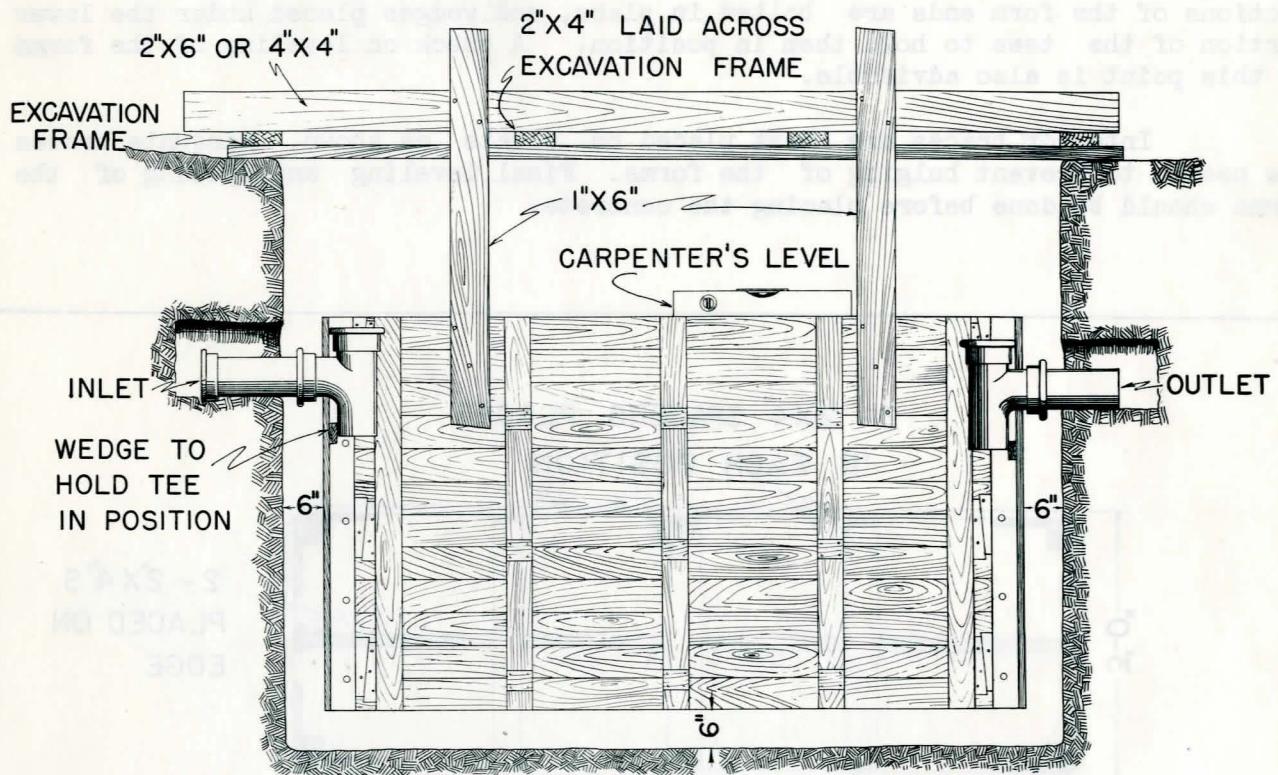
END & SIDE OF FORMS

The following materials are needed for constructing the forms:

- 24 -- 1" x 6" x 12'-0" Flooring
- 10 -- 1" x 4" x 10'-0"
- 2 -- 2" x 4" x 9'-0"
- 1 -- 2" x 4" x 10'-0"
- 3 -- 2" x 4" x 12'-0"
- 2 -- 4" x 4" x 10'-0"
- 44 -- Bolts, machine $\frac{3}{8}$ " x 5"
- 8 dozen -- Washers $\frac{3}{8}$ "
- 4 lbs. -- 5d Cement coated nails

Setting Forms

The septic tank forms should be assembled above ground except the corner wedges, the interior braces, and the upper ends of the end sections. Corner bolts should be drawn up snug, not tight.



FORMS SUPPORTED IN EXCAVATION

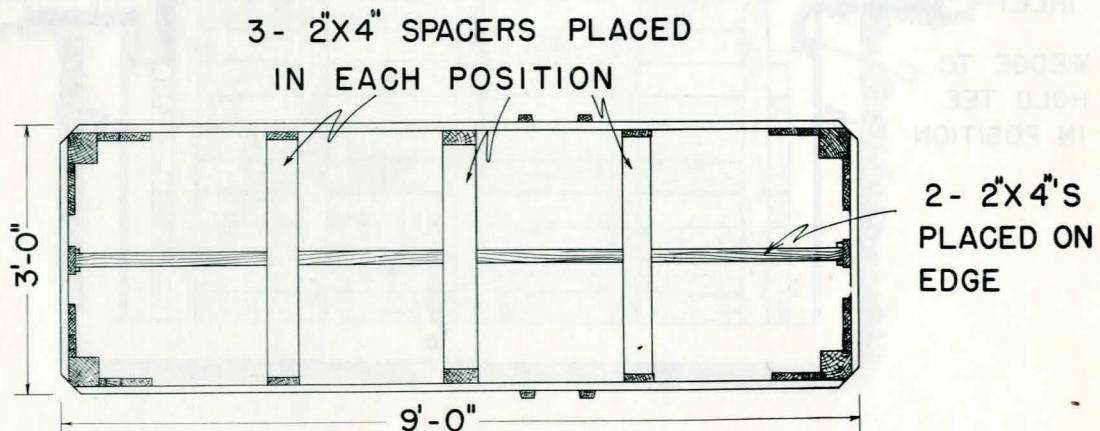
Short planks should be placed across the excavation to serve as a support for the forms. The forms are placed on these supports, and are given one or two coats of used crankcase or form oil to prevent the forms from absorbing moisture from the concrete, and also to aid in giving a smoother finish to the concrete.

Six men and three ropes are recommended for lowering the forms into the excavation. The forms should be placed on temporary supports in each corner about six inches above the floor, until hangers can be installed as shown. Check the forms at this point to see that they are approximately level. More accurate leveling should be done later.

Six wedges should be placed in each corner as shown. They should be driven snugly in place and held with a small nail.

The next step consists of placing the sanitary tees for inlet and outlet connections. A short length of 4 inch sewer pipe approximately two feet long is needed. The section used at the inlet should have a bell fitting, as shown, to permit connection to the sewer line from the house. The connection on the discharge requires no bell fitting. Small holes are dug at opposite ends of the forms in line with the part of the end section which fits around the sanitary tee. Careful fitting is necessary to secure proper connections. The upper sections of the form ends are bolted in place, and wedges placed under the lower portion of the tees to hold them in position. A check on leveling of the forms at this point is also advisable.

Interior braces are next placed on cleats as shown. Adequate braces are needed to prevent bulging of the forms. Final leveling and spacing of the forms should be done before placing the concrete.



TOP VIEW OF FORM SHOWING BRACES

Mixing and Placing Concrete

Since it is important 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 between the gravel. Sand-gravel should always be clean, that is, free from silt, clay and organic matter.

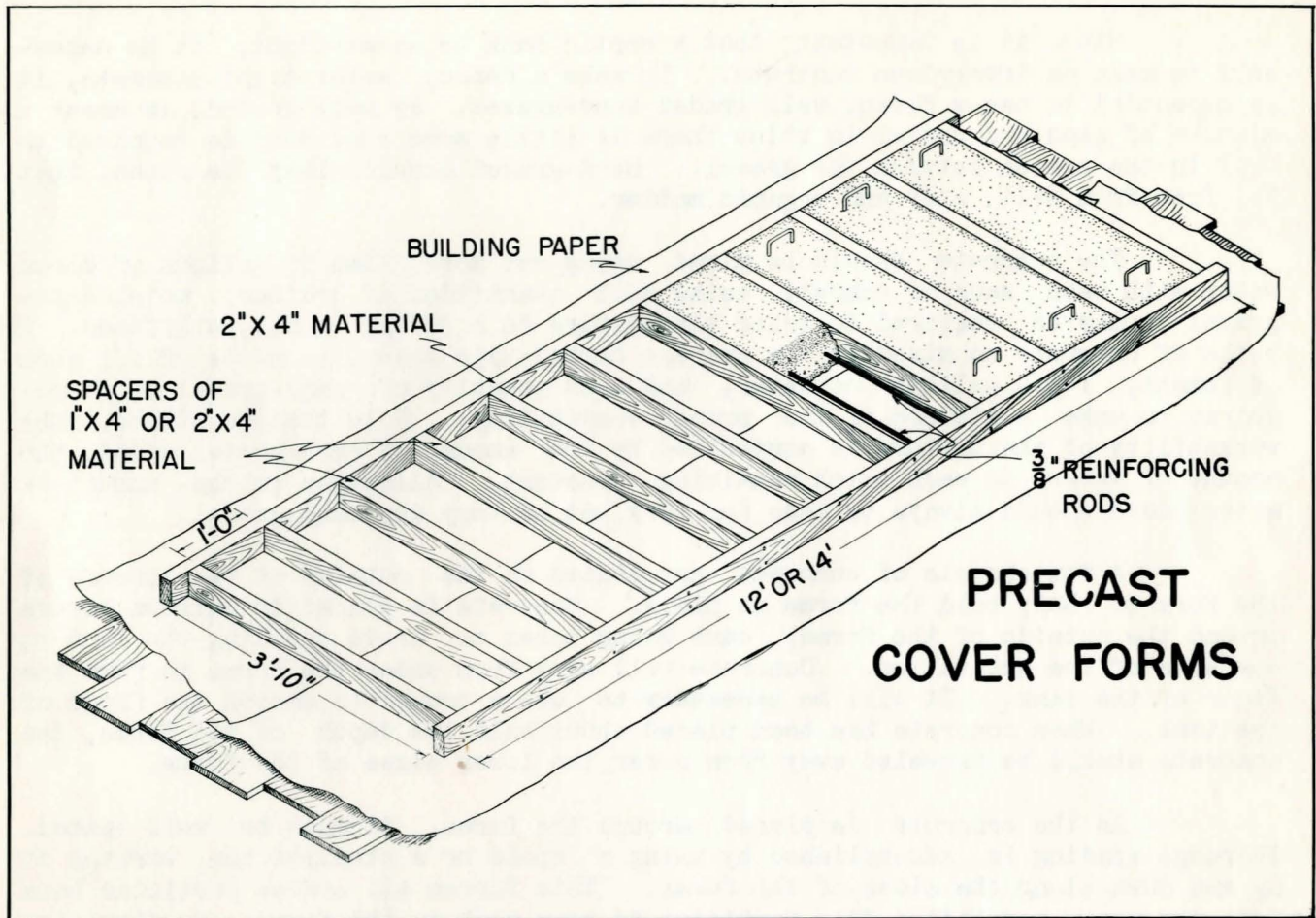
The concrete should be mixed using not more than $5\frac{1}{2}$ gallons of clean water with each sack of cement, using such quantities of ordinary moist sand-gravel as may be required to bring the mixture to a jelly, quaky, stiffness. A batch of concrete as mixed in the average barrel-type mixer, consists of $\frac{1}{3}$ sack of cement, $1\frac{3}{4}$ gallons of 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.

A few shovels of concrete are placed on the outside of the corners of the form to help hold the forms in place. Concrete is placed in uniform layers around the outside of the forms, care being taken to avoid crowding the form to one side of the excavation. Concrete will work from under the forms to form the floor of the tank. It will be necessary to use a trowel to smooth the floor of the tank. When concrete has been placed about half the depth of the forms, the concrete should be troweled away from under the lower edges of the forms.

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

Tank Covers

Forms for the tank covers are made as shown on the following page. The cover slabs are 4 inches thick, and should be one foot wide and three feet ten inches long. Forms should be oiled before concrete is placed. The concrete slabs must be reinforced by placing two $\frac{3}{8}$ inch steel rods, three feet ten inches long, in each slab. These rods should be placed about three-quarters of an inch above the bottom of the slab. Horseshoes or bent rods may be provided for handles.



Curing Concrete

The last step in making water-tight concrete is to cure it properly. After concrete has set for a few hours it should be covered with straw or earth and kept wet for several days. 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 at least seven days. 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.

Removal of Forms

Septic tank forms can safely be removed two days after the concrete has been placed. Proceed by removing the interior braces, corner wedges, and bolts from 4" x 4"s. Next, the corner 4" x 4" members can be removed, followed by the sides of the form. In removing the end section, the lower unit is removed first to permit the center unit to drop clear of the sanitary tee. If the concrete has been carefully spaded, the side walls of the tank should have a smooth finish free from air pockets or voids.

The forms for the cover slabs should not be removed for about five days. This permits the concrete to gain strength and reduces danger of breakage.

Partition and Baffle

The partition and baffle should be made from cypress or redwood. If this material cannot be obtained, creosoted lumber may be used. The grooves in the side walls provide a means for securing the baffle and partition. The boards should be cut approximately three feet two inches long.

Placing Tank Covers

The concrete covers should be placed on the tank after the partition and baffle have been secured, and the covers properly cured. After the covers are placed on the tank they should be covered with heavy building paper to prevent earth from falling through any cracks. The tank is covered with earth to a level of the present grade, or mounded to a depth of about one foot, if the tank is placed extremely close to the surface.

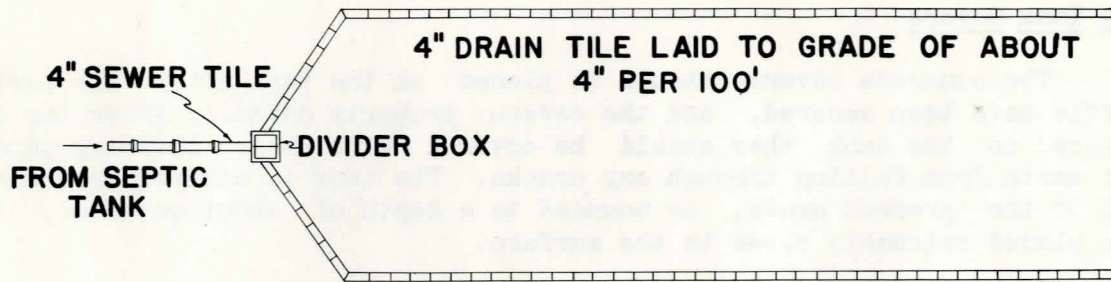
Disposal or Absorption Field

A septic tank installation is not complete without an adequate and carefully installed absorption field. Contrary to general opinion, the effluent from the septic tank is not pure, but contains many germs and bacteria, and should not be emptied into a cesspool, an open ditch, or allowed to come in contact with well water. A disposal field constructed of four inch drain tile will probably be less expensive to build than a cesspool. It will also eliminate any possibility of sewage following underlying gravel strata or water veins, and thus contaminating the family water supply.

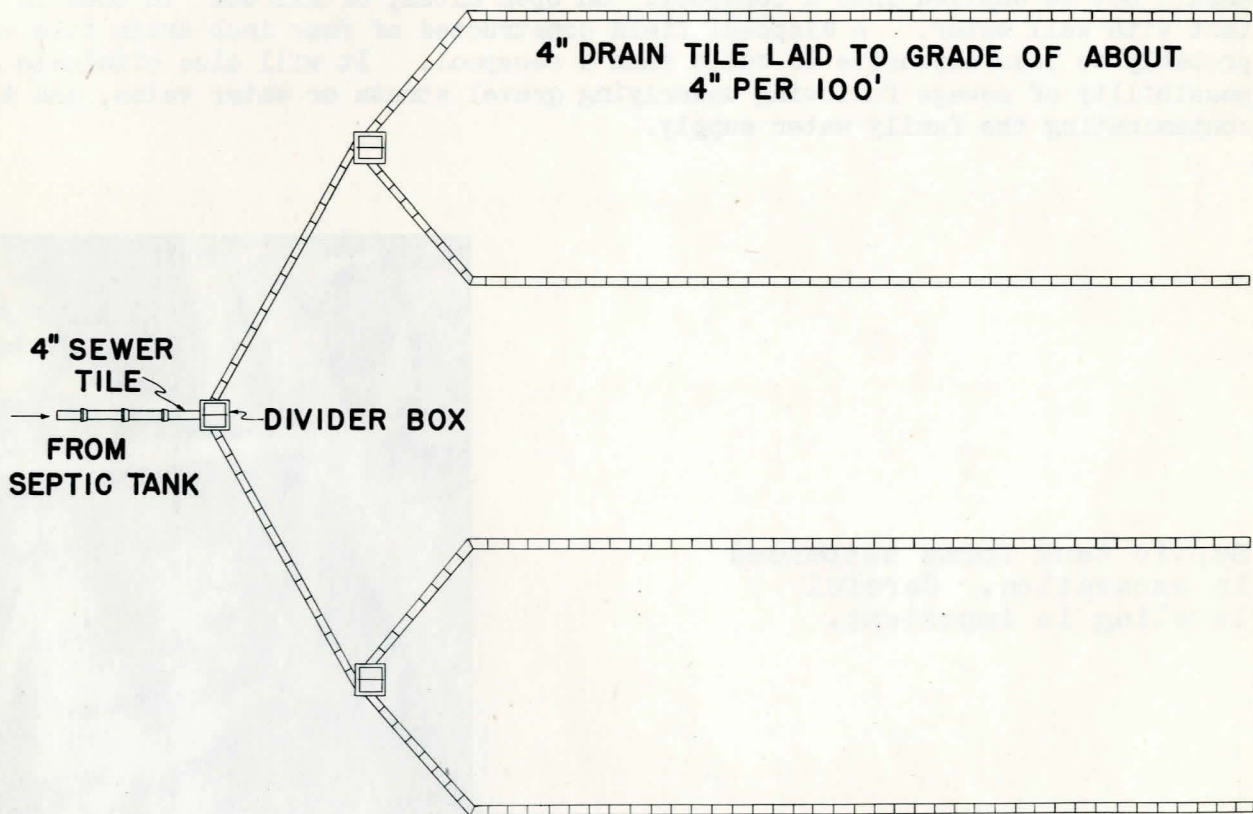
Septic tank forms suspended in excavation. Careful leveling is important.



SUGGESTED DISPOSAL FIELDS

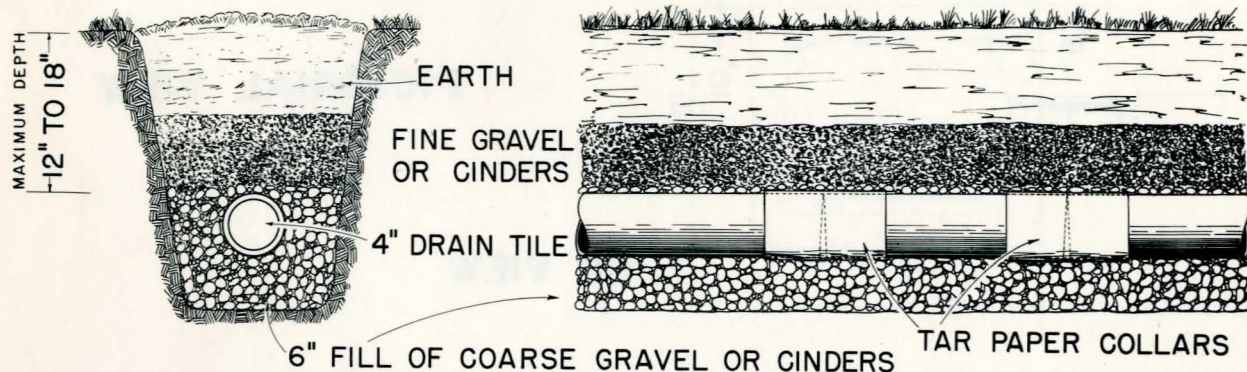


FOR LEVEL GROUND—LIGHT SOIL



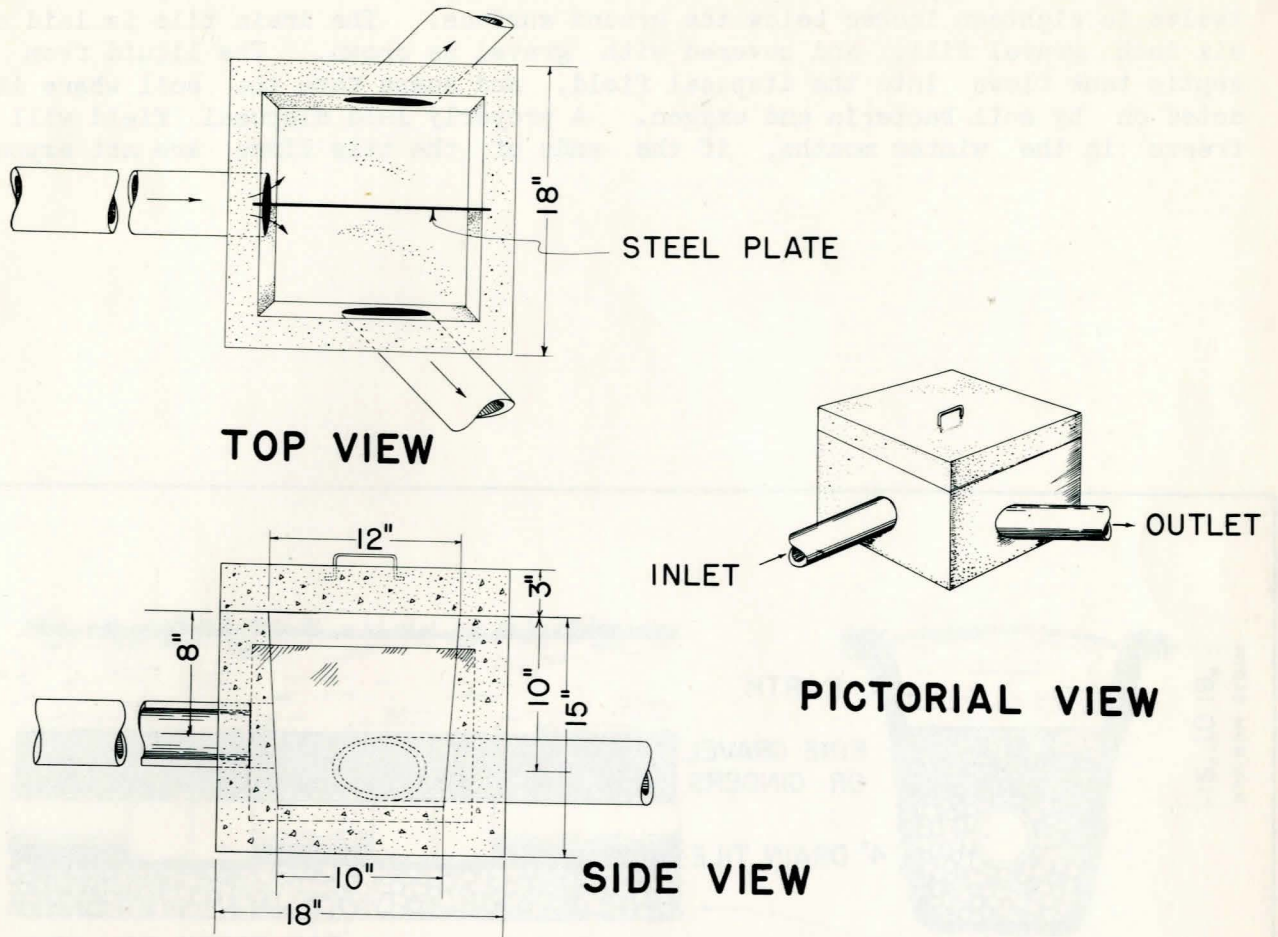
FOR LEVEL GROUND—HEAVY SOIL

The absorption field consists of two or more lines of drain tile laid twelve to eighteen inches below the ground surface. The drain tile is laid on a six inch gravel fill, and covered with gravel as shown. The liquid from the septic tank flows into the disposal field, and seeps into the soil where it is acted on by soil bacteria and oxygen. A properly laid disposal field will not freeze in the winter months, if the ends of the tile lines are not exposed.

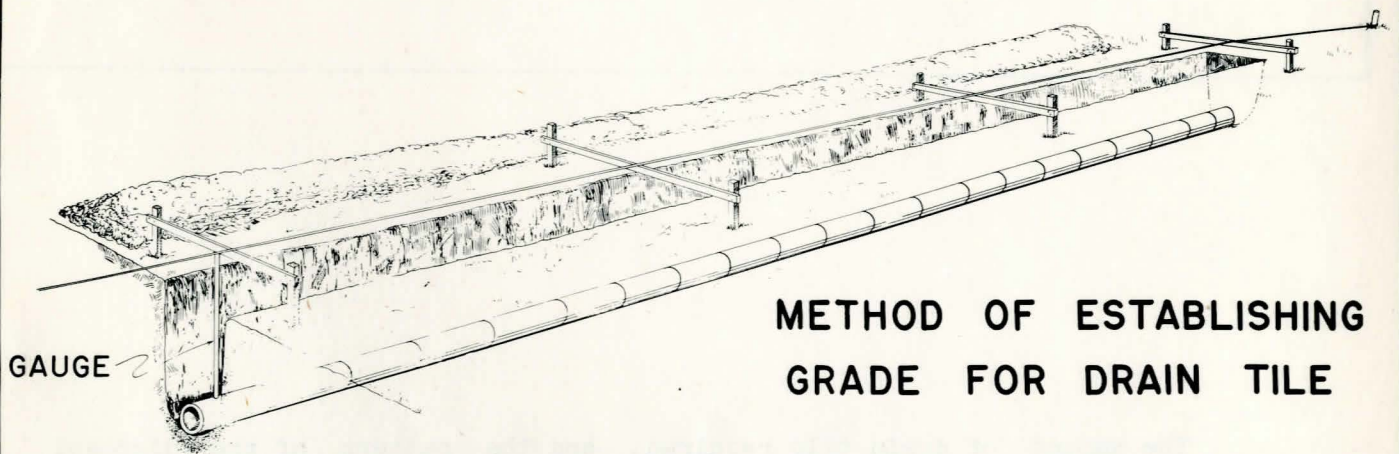


METHOD OF PLACING DRAIN TILE

The amount of drain tile required, and the pattern of the disposal field will depend upon the type and topography of the soil. Light, sandy soils may require only 150 to 200 feet of drain tile, while 350 to 450 feet may be needed in heavy clay soils. Drain tile lines longer than 100 feet are not recommended. Divider boxes should be used where lines branch.



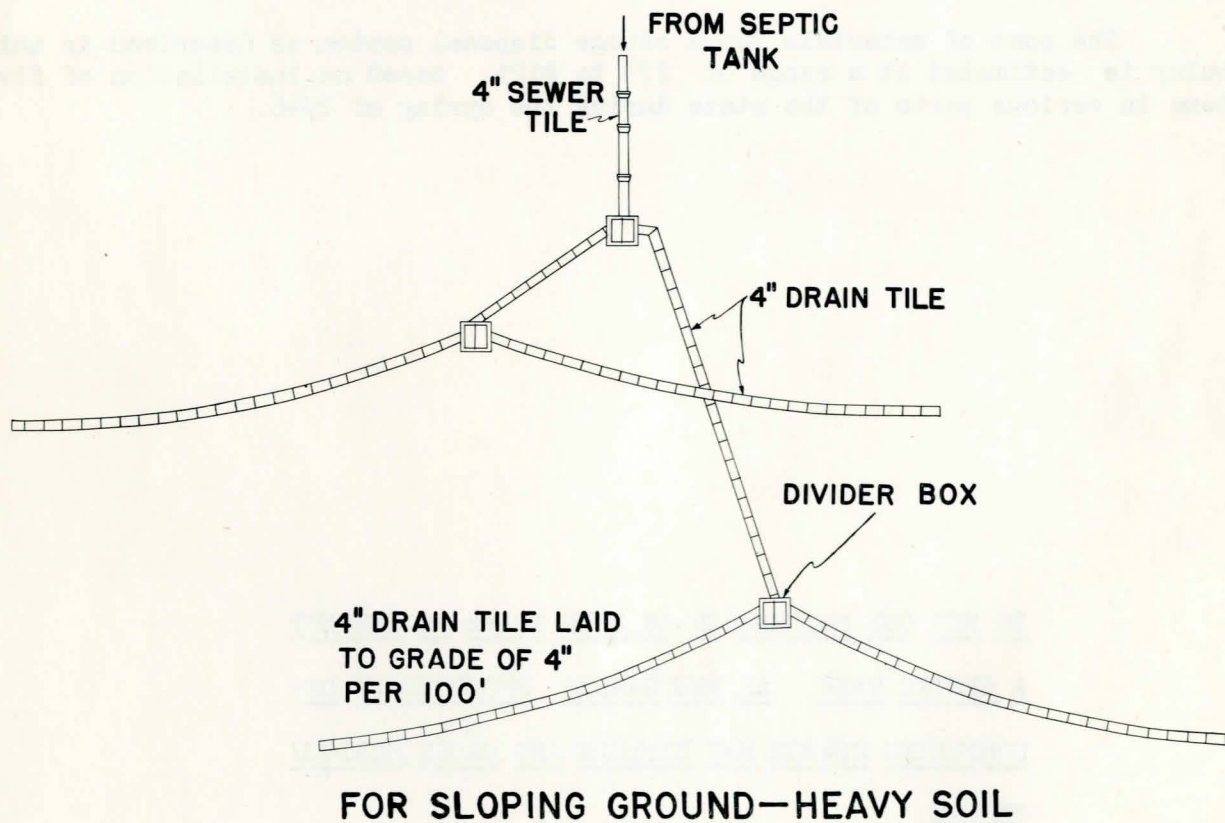
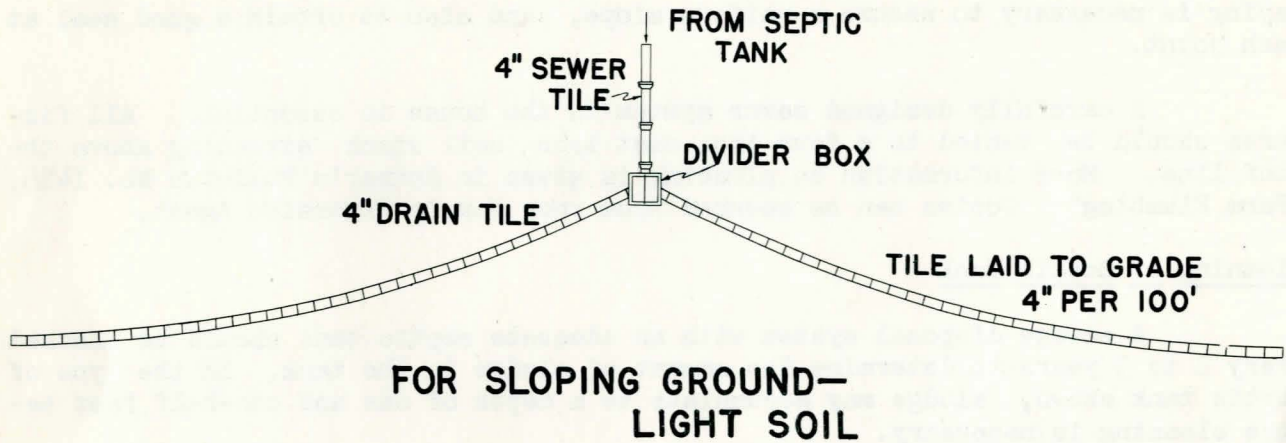
CONCRETE DIVIDER BOX



METHOD OF ESTABLISHING GRADE FOR DRAIN TILE

The illustrations of disposal fields show the various patterns suggested for varying conditions of slope and soil. Location of the absorption system near trees and shrubs should be avoided, as roots will close the tile lines. Alfalfa roots are also a source of trouble.

SUGGESTED DISPOSAL FIELDS



Sewer Lines

The sewer line from the house to the septic tank should be laid to a grade of about $\frac{1}{4}$ inch per foot. The sewer line inside of the house and extending at least five feet beyond the house, should be cast iron soil pipe. Beyond this point, vitrified clay sewer tile or other suitable material can be used. Care in laying is necessary to secure a uniform slope, and also to obtain a good seal at each joint.

A carefully designed sewer system in the house is essential. All fixtures should be vented to a four inch cast iron soil stack extending above the roof line. More information on plumbing is given in Farmer's Bulletin No. 1426, "Farm Plumbing". Copies can be secured from your County Extension Agent.

Cleaning of Septic Tank

A sewage disposal system with an adequate septic tank should be checked every 2 to 3 years to determine the amount of sludge in the tank. In the type of septic tank shown, sludge may accumulate to a depth of one and one-half feet before cleaning is necessary.

Cost of Installation

The cost of materials for a sewage disposal system as described in this circular is estimated at a range of \$75 to \$125, based on installation of five systems in various parts of the state during the spring of 1946.

DO NOT USE MATCHES OR AN OPEN FLAME TO INSPECT
A SEPTIC TANK, AS THE GASSES PRODUCED BY DE-
COMPOSING SEWAGE MAY EXPLODE AND CAUSE SERIOUS
INJURY.