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SEPTIC TANKS

for RURAL *and* SUBURBAN AREAS

By
JOHN M. HEPLER
GEORGE AMUNDSON
CLARE A. GUNN
WALTER SHELDON

MICHIGAN DEPARTMENT OF HEALTH
LANSING
and MICHIGAN STATE COLLEGE :: EXTENSION SERVICE
EAST LANSING

FOREWORD

This bulletin, describing sanitary sewage disposal systems for rural and suburban areas, has been prepared jointly by the Michigan Department of Health and Michigan State College.

Development of rural electrification and the rapid increase in the installation of water pressure systems and toilet facilities in farm and suburban homes—together with a similar rapid increase in the installation of modern plumbing in resort cottages, cabins, and other tourist accommodations—emphasize the assistance which can be offered through this joint bulletin and the combining of all the available resources for septic tank construction.

The system, the plans, and instructions for its installation, are the results of many years of experience in assisting house owners and builders in providing an efficient and safe method of sewage disposal. County agricultural agents and county health department engineers have supervised the installation and have inspected thousands of these systems. Their comments and suggestions for improving the systems have been carefully considered by the authors.

County agricultural agents and county health department sanitarians will gladly furnish additional information to anyone requiring assistance in installing this method of sewage disposal.

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Septic Tanks for Rural and Suburban Areas

By JOHN M. HEPLER,[1] GEORGE AMUNDSON,[2] CLARE A. GUNN,[3] and WALTER SHELDON[4]

THE SEPTIC TANK SYSTEM OF DISPOSAL

This bulletin describes the construction and operation of sewage disposal systems by the septic tank method. This is the only method of waste disposal that can be recommended for the disposal of wastes created by the use of a pressure water system, when a municipal or public sewer system is not available. All liquid wastes created in the dwelling either in the kitchen, bathroom, or laundry can be disposed of in this system. **Water from roofs, surface drainage, and footing drains should not pass into any part of the system.**

The sewage disposal system described in this bulletin consists of a septic tank and a disposal field with necessary connecting features.

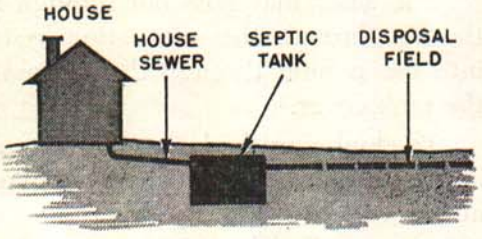

Fig. 1. Diagram of a septic tank sewage disposal system.

The principles upon which the septic tank operates are simple. Some of the solid material carried in suspension in sewage is slightly heavier and some is lighter than water. If the sewage is allowed to remain quiet in a tank the heavier particles settle to the bottom and the lighter ones float on the surface of the liquid.

The material which settles is called *"sludge"* and that which floats

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[1]Director, Bureau of Engineering, Michigan Department of Health.

[2]Extension Agricultural Engineer, Agricultural Engineering Department, Michigan State College.

[3]Research Assistant and Extension Specialist, Agricultural Engineering Department, Michigan State College.

[4]Assistant Professor, Agricultural Engineering Department, Michigan State College.

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"scum". The accumulations in the bottom soon begin to rot. The same action takes place in the scum to some extent but not so rapidly as in the sludge at the bottom. The decomposition process which changes part of the solids into liquids and gases is produced by the bacteria which are present in all sewage. **It is not necessary to add yeast or any other material to start the rotting action in a septic tank.**

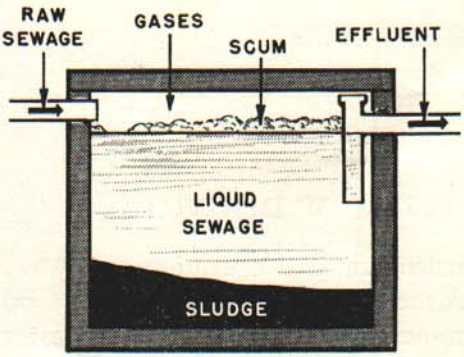


Fig. 2. Section through typical septic tank.

The gaseous products of decomposition form very small bubbles within the body of the sludge, and in time these bubbles increase the volume of the sludge enough to make it lighter than water; thus portions are detached and rise to the surface where the gases tend to escape. If all the minute bubbles should escape, the sludge would again settle, but free escape is interfered with by the material already floating and only part of the sludge returns to the bottom. The rest remains to increase the scum thickness.

The gases may pass out through the inlet sewer and escape into the air through the ventilating system of the house plumbing or into the ground through the disposal field or through the joints in the tank cover.

The tank must be large enough to provide for the storage of sludge and scum and of such a shape as to allow the sewage which flows in at one end to pass very slowly and quietly to the other end where it is drawn off. The liquid waste which flows from the tank is called *effluent*. A certain amount of organic matter will not settle out. A properly designed tank should remove nearly all of the settleable material, but the tank effluent is by no means pure, since very little of the organic matter or filth in solution is removed by settling. Septic tank effluent, therefore, should not be discharged into any open ditch, stream, lake, storm-water drain or upon the surface of the ground. The liquid waste from the tank will putrify and cause an odor nuisance if allowed to accumulate on the ground surface and it may contain disease-producing germs. For those reasons, the effluent should be allowed to seep into the soil through some type of disposal

field. Vegetables such as carrots, onions and radishes that are eaten raw should not be grown in the immediate vicinity of the disposal field.

The usual manner of providing a disposal field is to install lines of drain tile in specially prepared seepage trenches. The tile are laid with open joints so that a portion of the tank effluent seeps out at each joint. The tile are surrounded with gravel to insure a larger seepage area and the trenches are filled with earth so that they are neither conspicuous nor objectionable when located in lawns or other graded areas.

The effluent is acted upon by soil bacteria, is absorbed by grass and tree roots and in other ways disposed of in a manner which leaves no nuisance or health hazard.

Modifications of this method of disposal may be necessary in certain cases. A seepage bed, filter trenches, a sand filter bed or a seepage pit may have to be used but in no case should such change be made without consultation with the authorities mentioned below.

Previously, this bulletin recommended the use of a siphon installed between the septic tank and the disposal field. The purpose of the siphon was to distribute the tank effluent at specific intervals throughout the length of the tile system. By discharging the effluent periodically, allowing time for aeration and seepage, bacterial activity in the soil is maintained. The manufacture of siphons ceased during the war and many septic tank installations have now been made without this portion of the system. Where soil conditions were favorable and proper attention was given to the installation of the disposal field, the absence of the siphon has made no apparent difference in the successful disposal of the liquid wastes. Michigan State College and the Michigan Department of Health believe that, except in the most favorable soil conditions, the use of a siphon is desirable. When the small siphon suitable for home installations can be obtained, its use will again be recommended where soil conditions indicate this safeguard to satisfactory operation.

Advice in the planning, design and construction of a disposal system may be obtained from your county agricultural agent, your city, county, or district health department or by writing to the Michigan Department of Health at Lansing, or the Agricultural Engineering Department, Michigan State College, East Lansing.

Permission should be obtained from the County Road Commissioner before a connection is made to a roadside ditch or covered road drain.

A written permit must be secured from the County Drain Commissioner before making any connection to the County drain (Act 316, P. A. 1923).

It is contrary to state law to discharge into any of the lakes, rivers, streams, or other waters of Michigan, any waste or pollution of any kind that will tend to destroy fish life or be injurious to public health (Act 245, P. A. 1929).

Since the great majority of septic tanks are installed at homes, and since tanks for larger installations frequently require special considerations, this bulletin has been prepared in two parts:

Part 1 describes a disposal system designed to provide the proper size of tank and tile disposal field for the one-family home. This system will provide a satisfactory means of disposing of the wastes from the kitchen, laundry and bathroom of the home occupied by one family, whether it be the farm home, suburban home or resort cottage. It also provides the best possible method of safeguarding the water supply against contamination from such wastes.

Part 2 relates to larger septic tanks required to handle the wastes from multiple-family dwellings, schools, resorts, trailer coach parks, hotels and factories. Although the principles are the same, increases in size introduce certain difficulties which require additional attention to design and operation. Systems to dispose of the wastes from the places mentioned above should not be built before consulting the Michigan Department of Health or the county or district health department where the installation is to be made.

PART 1

DISPOSAL SYSTEM FOR ONE-FAMILY HOME

LOCATION

In planning a sewage disposal system, the first thought is "Where shall it be located?" The most practical location for the tank may be close to the wall of the house, but in no case should the foundation wall be used as one wall of the tank. The piping will usually be simplified by having the tank on the same side of the house as the bathroom (Fig. 3).

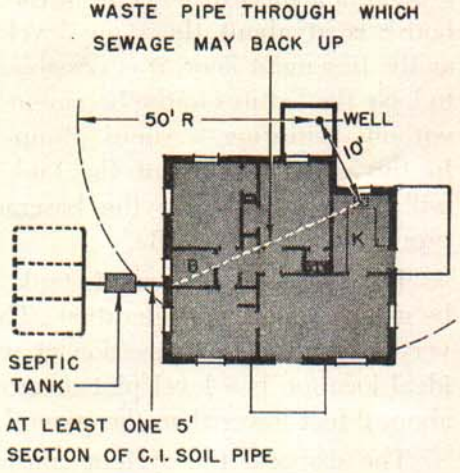


Fig. 3. Diagram showing minimum distances between water supply and sewage disposal systems.

The tank should not, however, be placed near the well. Health authorities agree generally that no septic tank or disposal field should be within 50 feet of any well, or suction pipe from the well to the pump, and no pipe carrying sewage, or no pipe through which sewage may back up, should be within 10 feet of any well. Any pipe carrying sewage that is within 50 feet, but more than 10 feet, of any well or suction pipe should be cast iron soil pipe with caulked lead joints. Where the well is intended for public use, for example at resorts, the Department of Health requires 75 feet between the well and any septic tank, disposal field, or other source of sewage pollution. This requirement of distance from the well may make it necessary to place the tank on the opposite side of the house from the well, or at some distance from the house.

The tank should not be placed under a porch, in the basement, or where it will not be readily accessible for cleaning. It may be placed in a driveway if the cover is sufficiently reinforced.

Where the land surface is flat, it is often necessary to take particular care in choosing a location for the tank and disposal tiles.

Where practical, the top of the tank should be about one foot below the surface of the ground. On level ground, the top of the tank may be even with the surface or slightly above and mounded over with earth. On level ground, it is not possible to have fixtures in the basement of the house unless the wastes from them are lifted by a pump to the elevation of the septic tank (Fig. 4A).

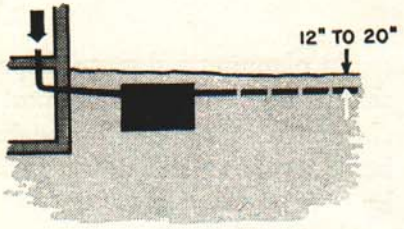


Fig. 4A. A sump pump would be needed to pump sewage from basement fixtures into septic tank when ground does not slope away from house.

Where the land is sufficiently rolling so that the surface of the ground at a short distance from the house is at about the same level as the basement floor, it is possible to have the fixtures in the basement without requiring a sump pump. In this case, the top of the tank will be located below the basement floor level but also near the ground surface (Fig. 4B).

In planning for the septic tank, the location of the tile field should be given primary consideration. The depth of the excavation depends very largely on the elevation at which the tile field is placed. The ideal location is a level plot of ground of a sandy or gravelly nature about 2 feet lower than the ground surface at the tank.

The disposal tile system consists of four-inch drain tile laid in trenches two feet or more apart, and not more than 2 feet below the surface. There must not be more than 12 to 20 inches of earth covering the tiles in order that grass roots and other minute plants and soil organisms may be used to the utmost in taking up the organic material in the sewage for plant food. Very little "rotting" takes place at a depth of more than 2 feet. The disposal tile should be laid with a slight slope, preferably not more than 1 inch of fall per 50 feet. The reason for laying the tile lines virtually level is to insure a more uniform distribution of the sewage. If the tile line has considerable fall, the sewage will collect at the lower end, creating a

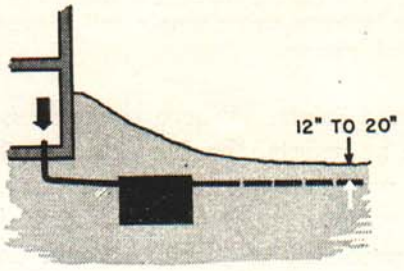


Fig. 4B. A slope away from house is necessary when sewage is taken from basement level.

saturated area which destroys the bacterial action in the soil and prevents the final rotting of the sewage.

For the tank described in this part of the bulletin, 150 feet of 4-inch tile will be required in favorable soil (sandy or gravelly in nature) and more in unfavorable soil. Certain soils and rock formations will absorb little or no water and in such cases, the system described in this bulletin cannot be recommended.

If there is a question relative to the ability of the soil to absorb the effluent, a measure of the absorptive ability of the soil can be obtained by making a simple percolation test. Dig a hole about one foot square and 18 inches deep (depth of the disposal tile). Fill with water to thoroughly moisten the soil and allow the water to seep away. While the bottom of the hole is still moist, fill to a depth of 6 inches and observe the time required for the water level to fall one inch. If the surface of the water does not lower more than one inch in half an hour, the ground is not porous enough for a disposal field. Under such conditions, a dosing tank and a filter bed or filter trench may be used if an approved outlet is available. The number of feet of tile required for varying soil conditions as found by making the percolation test is shown in the table below.

Time in minutes for water to fall one inch	*Number of feet of 4-inch drain tile in disposal field*
0 to 5	150
6 to 8	200
9 to 11	225
12 to 15	250
16 to 20	275
21 to 30	325

When more than 325 feet of tile are required, some other method of disposal involving the discharge of the filtered effluent to a surface source of disposal is usually necessary. In making such disposal of the effluent, the requirements for discharge into roadside ditches or drains, county drains, lakes, streams or other waters mentioned on page 7 should be observed.

Fig. 5A shows the pattern for a tile field in a rectangular area of level land. The pattern of the tile system may be as shown in Fig. 5B if there is a long narrow strip of level land. If the land is irregular, the individual tile lines should be laid along the contour lines (Fig. 5C) so that each line will have a fall of no more than 1 inch in 50 feet of tile. No single tile line should be more than 100 feet in length.

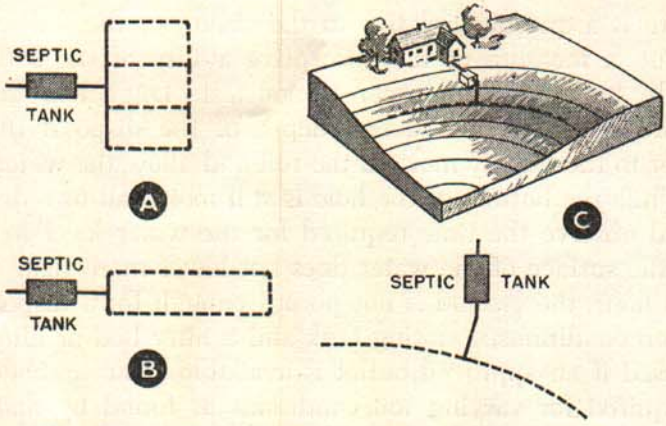


Fig. 5. (A) Diagram of the field in square area of level land. (B) Tile field in narrow rectangular area of level land. (C) The field in irregular land area.

BUILDING THE TANK

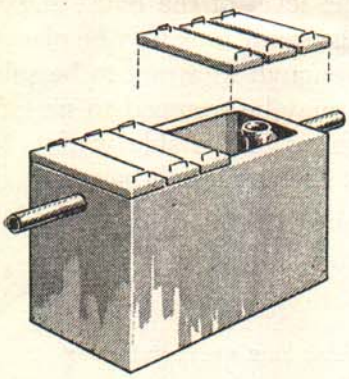
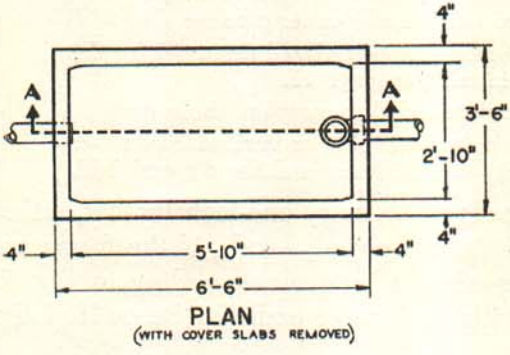
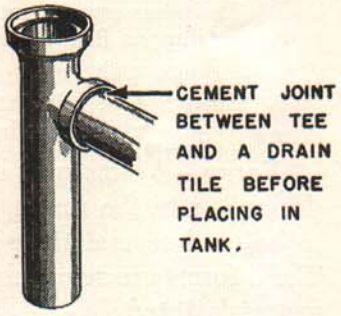
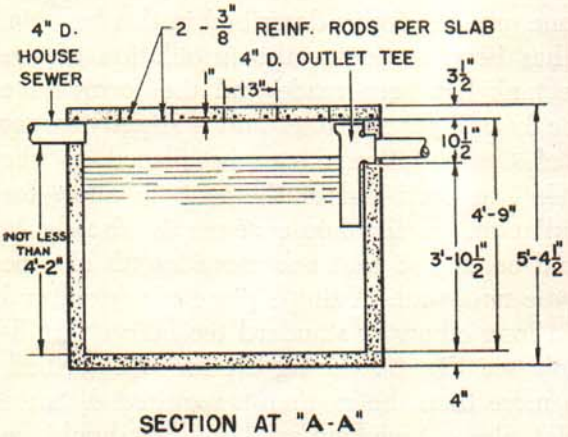
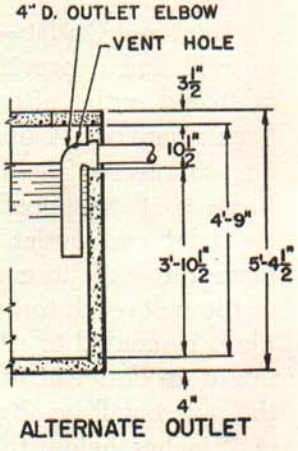


Fig. 6. Details of construction of septic tank.









NOTE: TEE AND ELBOW SHOWN ARE TO BE 4" DOUBLE STRENGTH SEWER PIPE TEE AND 4" DOUBLE STRENGTH SEWER PIPE FOUNDATION ELBOW RESPECTIVELY, AND MADE ACCORDING TO A. S. T. M. STANDARDS.

Excavation – Excavate a hole 6 feet 6 inches long by 3 feet 6 inches wide and 4 feet 6 inches below the level of the house sewer at the tank. Either the side or the end of the septic tank may be placed toward the house. If the ground is firm enough so as not to be subject to caving, the sides of the excavation may be trimmed to smooth vertical faces and used for the outside forms of the side walls. In sandy or other loose ground outside forms of lumber will be required.

Materials required to construct the tank are as follows:

*15 sacks of cement 2 yards of gravel 1½ yards of sand	or 2½ yards of ready-mix concrete

12 pieces ⅜-inch diameter by 3 feet 4 inches long steel reinforcing rods.

1 4-inch diameter glazed drain tile.

1 4-inch diameter standard vitrified clay sewer pipe tee.

The necessary amount of 4-inch diameter glazed drain tile for the disposal field as found in table on page 11.

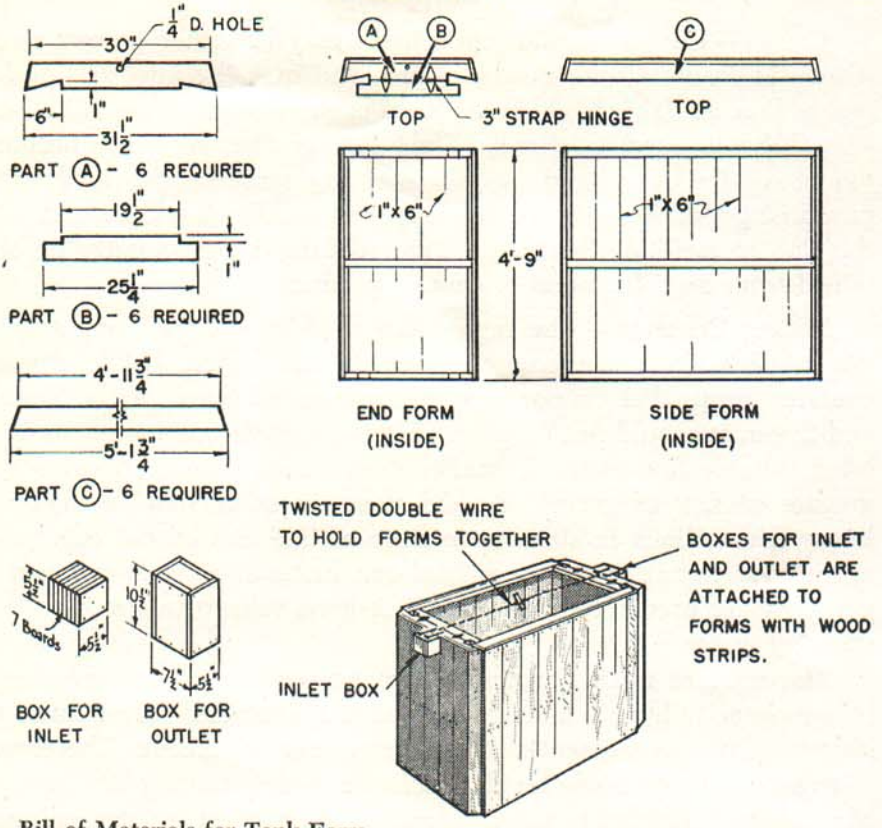
Fittings, such as tees or elbows needed to complete the system.

Enough 4-inch diameter cast iron soil pipe or vitrified clay sewer pipe to connect the tank with the house and the disposal field.

Forms – Forms may be made of ordinary one-inch lumber, either dressed or in the rough, or ¾-inch 5-ply plywood. If the forms are to be used several times, they should be made according to Fig. 7. These forms are removable without damage and may be built of the materials listed.

Inlet and Outlet – If one uses the forms described in this bulletin, he will find a provision has been made for the installation of the inlet and outlet after the tank has been made and the forms have been removed. A box (see Fig. 7) for the inlet and a slightly larger one to receive the bell of the outlet pipe can be placed on the forms so that a notch is left in each end of the tank to allow for the inlet and outlet installation. If the house sewer is already in place the excavation should be dug so that one more length of pipe or tile will reach through the tank wall. A single piece of agricultural tile is cemented to either a long elbow or standard tee before installing as an outlet in the tank (see Fig. 6). Using the forms described, the outlet will be slightly more than the minimum required distance of 2 inches below the inlet pipe. A cement-sand mortar should be used to grout in the inlet and outlet pipes.

*If outside forms are used, keeping the wall thickness an even 4 inches, the following will be required: 10 sacks of cement, 1 yard of sand, and 1 1/3 yards of gravel, or 2 yards of ready-mixed concrete.



Bill of Materials for Tank Form

8 pieces 2" x 4" x 8' long for Parts A, B, and C.

22 pieces 1" x 6" x 10' long for sides of forms.

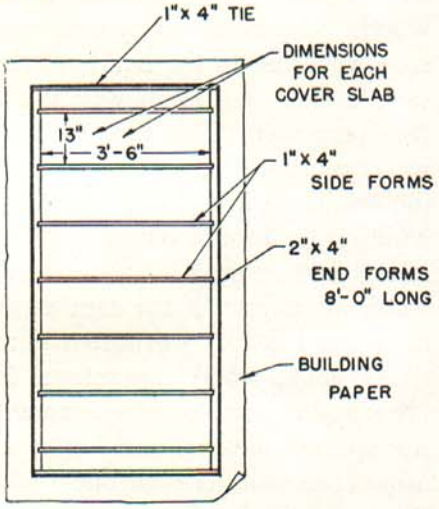
12 3-inch strap hinges.

3 pounds 8d box nails.

Bill of Materials for Cover Forms

2 pieces 2" x 4" x 8' long for end forms.

5 pieces 1" x 4" x 8' long for side forms.



PLAN
OF COVER FORMS
TO BE PLACED ON FLAT SURFACE.

Fig. 7. Details of portable inside forms and cover forms for septic tank.

Covers – Covers for the septic tanks may be either precast slabs or poured in place with manholes provided over the inlet and outlet pipes. Precast slabs should be 3 inches or more in thickness. Six slabs 13″ wide will cover this tank. Slabs greater than 18″ wide become too heavy for easy handling. Reinforcing must be provided with reinforcing rods (see Fig. 6). Some type of handle should be cast into the slab to facilitate handling. Precast slabs can frequently be obtained from manufacturers of cement products.

Mixing Concrete – The ingredients used in making concrete are cement, fine aggregate, coarse aggregate, and water. If the cement contains lumps that cannot be easily pulverized between the thumb and finger, it should not be used. Fine aggregate consists of sand or other suitable fine material smaller than ¼ inch in size. Coarse aggregate consists of gravel, crushed stone, or other suitable material larger than ¼ inch in size. A mixture of fine and coarse aggregate as found in nature is known as bank-run material or bank-run aggregate. Water used should be clean. A good rule to follow is to use drinking water.

The ratio of mixing water to the cement determines the durability, water tightness, and strength of the concrete. Most fine aggregate contains some water that is free to act on cement. Therefore, allowance must be made for this moisture in determining the amount of water to be added to the mixture. A simple test for determining whether the sand is very wet, wet, or damp, can be made by pressing some together in the hand. If the sand falls apart, it is damp; if the sand forms a ball, it is wet; if the sand sparkles and wets the hand, it is very wet. This test is also used in determining the amount of water present in bank-run material. Select a sample of the finer material and press it in the hand in the manner described above. Knowing whether the sand is damp, wet, or very wet will determine the amount of water to be used in the mixture. If the sand is damp, use ¾ as much water as cement; if the sand is wet, use ⅝ as much water as cement; if the sand is very wet, use ½ as much water as cement.

To make good concrete it is important to have the aggregate (fine and coarse) so proportioned that the finer particles will just fill the spaces between the larger ones. Good concrete can be made using bank-run material but it often requires the use of more cement. When fine and coarse aggregate are obtained separately, a workable mixture can be obtained by using 2¼ parts sand to 3 parts of gravel to one part cement.

Concrete may be mixed by hand on wooden platforms, but a small mixer should be used if one can be obtained. Machine mixing is easier and more thorough. If cement is being mixed in the mixer, put the measured amount of water in the mixer and then add a small amount of washed gravel or bank-run gravel. Adding this gravel to the water before cement is added will prevent cement paste from sticking to mixer drum. Then add the correct measured amount of cement. Add sand and gravel or bank-run gravel until a workable mixture is obtained. A workable mixture should be mushy but not soupy and should go into place readily. Usually one to two minutes are required for mixing after all materials have been added. After all particles have been coated with cement paste, dump out the concrete.

The use of transit mix or ready-mix concrete is recommended where such concrete is available.

Pouring Concrete – Arrangements should be made for a sufficient amount of help, materials, and equipment to be on hand when the job is begun so as to permit the placing of all the concrete in the walls and bottom in a continuous pour. The concrete should be placed in forms in about 6-inch layers as soon as possible after it is mixed; never more than 45 minutes after mixing. Probably the best method is to pour the sidewalls of the tank first, having the forms hung from planks on the ground surface; then pour the bottom and make level with the bottom of the forms. Attention must be given to spading along the forms when filling the sidewalls. The cover slabs should also be poured at this time.

Removing Forms – The tank forms should be left in place long enough for the concrete to set, usually 24 hours. In removing forms, care should be used to prevent cracking the concrete. The forms as described in this bulletin can be loosened by turning up the hinged bars until they are free and force the side and end forms inward and then lift them out. The newly placed concrete is cured by keeping it constantly moist for about a week. A garden hose is often used for this purpose.

Finishing the Tank – The interior of the tank should be washed with a mixture of cement and water which is mixed to a consistency of cream and spread on with a broom or whitewash brush. Two coats should be applied and kept moist while setting.

Before the tank is covered, it should be examined for cracks and possible leaks and be repaired.

House Sewer – All connections between the house and septic tank and from the septic tank to the distribution header or distribution box should be laid straight and to an even grade. Curves in the line tend to cause stoppages and make cleaning difficult or impossible. The minimum grade for a 4-inch sewer should be 6 inches fall for each 50 feet of sewer.

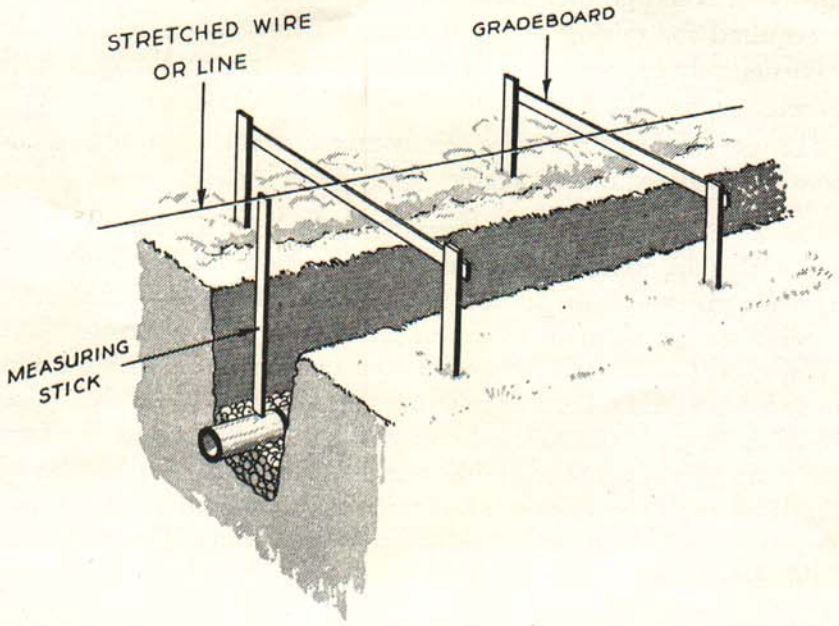


Fig. 8. Method of setting the grade for sewers or disposal tiles.

If it is necessary to lay the sewer less than 50 feet from a well, it should be laid with cast iron soil pipe with lead joints. In no case should the sewer be laid closer than 10 feet to a well or suction pipe.

When laying sewers or disposal tiles, the grades should be established on grade boards set across the trench so that a fine string or wire can be stretched from one grade board to another at a uniform distance above the grade line of the sewer. A measuring stick should be used when each tile is laid, to measure down from the string to the tile (Fig. 8).

Joints – If cement is used for making joints in the house sewer, the joints should first be caulked with oakum or jute, after which the joint must be completely filled all around with a mortar composed of two parts clean sand and one part of Portland cement. In using cement joints, care should be taken to wipe the inside of the pipe free from any protruding jute or mortar which would tend to obstruct the flow. If cement joints are made with great care by a skilled workman, fairly tight results may be expected if the pipe is laid in a dry trench, but this ideal is seldom realized in practice, and if much water is encountered, it is almost impossible to obtain impervious joints by this method. The objections to imperfect joints are: (1) pollution of the ground water, (2) furnishing an opportunity for tree roots to enter and clog the sewer, and (3) the entrance of large quantities of ground water.

Much more satisfactory results may be obtained by using an asphaltic or bituminous joint. Several jointing compounds are marketed and any pipe dealer should be in a position to supply them. Any melting required should be done on a stove, or some arrangement by which the heat may be controlled. The operation of pouring a joint is similar to the jointing of iron water mains with lead. The joints should first be caulked with dry oakum or jute tight enough and thick enough to prevent the jointing material from leaking into the pipe. A jointer of rubber hose, asbestos, or rope covered with wet clay should be placed around the body of the pipe close up against the bell of the next pipe, with a small opening left at the top for pouring. After the material has been poured and has cooled sufficiently, the jointer is removed. Several lengths of pipe may be joined on the surface and lowered together into the trench as soon as the joints are cooled. This plan not only insures permanent and substantial construction, but, best of all, eliminates the root nuisance.

The cost of poured joints will be only slightly above that of cement. Four-inch vitrified sewer pipe is the smallest practicable size which should be used for the house sewer.

More recently a jointing material which is applied to the tile by the manufacturer has come onto the market. By use of a solvent, the surface of the material becomes soft and adhesive. When two lengths of pipe are pressed together a water-tight joint results. Such "slip-seal" joints insure a much safer installation than when cement is used.

INSTALLING THE DISPOSAL SYSTEM

Tile Field Disposal – The satisfactory disposal of the effluent (liquid sewage) from the tank depends on a properly installed and ample sized disposal field. When trouble occurs and sewage shows on the surface of the ground, the cause can invariably be traced to a faulty disposal field. Since it is the purpose of the disposal field to provide as much absorption area as possible, the size of the trench, the amount of tile and the grade to which it is laid are all important.

The trench should be dug not less than 12 inches wide and 8 inches to 4 inches deeper than the tile are to be laid (Fig. 9). This extra depth should be filled with gravel from which the material smaller than ¼ inch in size has been screened out.

The tile should be laid on the gravel at a grade of approximately 1 inch fall per 50 feet of tile. See Fig. 8 for method of establishing grade.

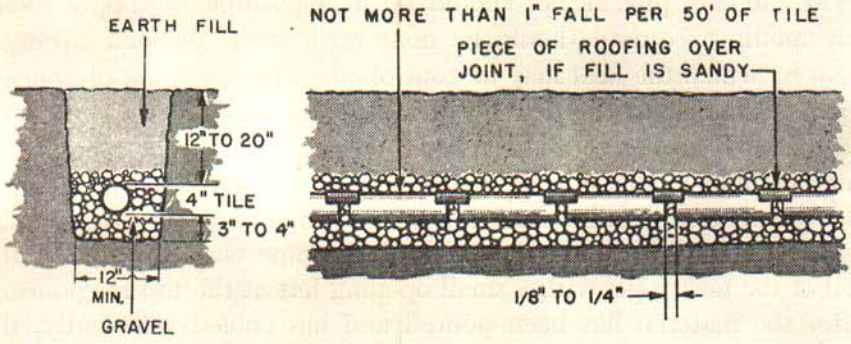


Fig. 9. Details of disposal trench.

Four-inch vitrified clay farm drain tile is generally recommended. The drain tile should be laid so that the ends will be about ⅛ inch and never more than ¼ inch apart. The gravel should be heaped above the top of the tile and the remainder of the trench filled with earth. In sandy soil, tarred paper or roofing cut in 7-inch squares may be placed over the top half of the joints to aid in keeping sand out of the tile. Perforated bituminous fiber or clay sub-drainage pipe or the more recently developed self-centering perforated pipe may be used in place of drain tile. If this type of pipe is used, it should be laid so the perforations occur only along the lower half of the pipe.

The amount of tile required has been indicated by the percolation test and table shown on page 11. The arrangement of tile in the disposal field is also shown on page 12, Fig. 5. Where the slope of the ground is quite marked it may be necessary to lay the tile at different levels (Fig. 10).

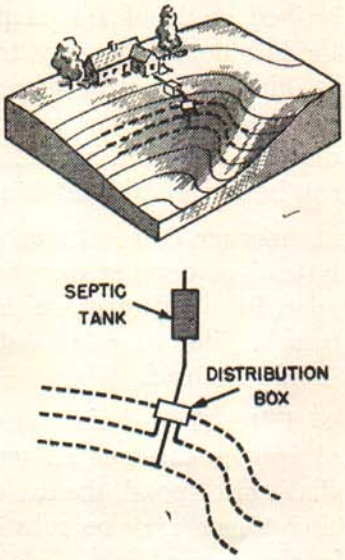
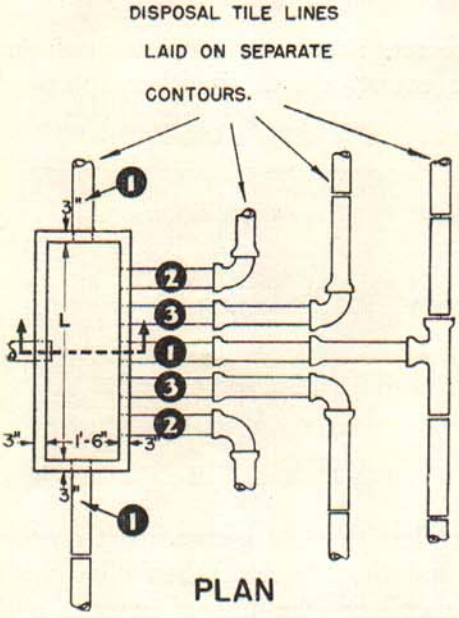


Fig. 10. Sewage disposal system in irregular land.



Outlets	*Inside Length "L"*
1	2'-0"
1 and 2	2'-6"
1, 2 and 3	4'-6"

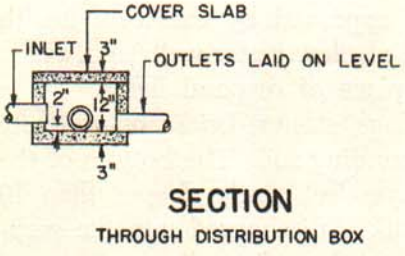


Fig. 11. Details of distribution box.

To accomplish this a distribution box (Fig. 11) should be used. All tiles leading to the various lines must be set at the same elevation.

For hillside installations, the first tile at the box should be laid level and the next few tile slope down to the desired level of that particular line. From that point the drain tile should be laid at the pre-

scribed grade of 1 inch per 50 feet, following the contour line on the hillside, if necessary, to maintain the 12 to 20 inch depth of cover.

Places where the ground water level is nearer than 3 feet to the surface at any time, especially in the spring, are not suitable for a disposal field and should be avoided unless the ground water level can be lowered by ditching or tile drainage.

Seepage Bed – A seepage bed may be made by excavating an area instead of digging trenches. The tile lines are laid 2 feet or more apart in a bed of gravel in the same manner as in the disposal field trench. The same amount of tile as shown in the table on page 11 should be used.

Filter Trenches – When it becomes necessary to use underdrains to convey the treated sewage to county drains or other approved places of disposal, the use of the filter trench may be substituted for the disposal field. This method of disposal is accomplished by widening and deepening of the trench in which the drain tile are laid, and placing a drain surrounded with gravel in the bottom of the trench (Fig. 12). On top of this is placed at least 18 inches of sand. The two or more tile lines receiving the effluent from the tank are laid not less than 24 inches apart on top of the sand in a bed of gravel, and the trench is then filled with earth to grade. The under-drain collects the filtered sewage and discharges it to the county drain or other approved outlet.

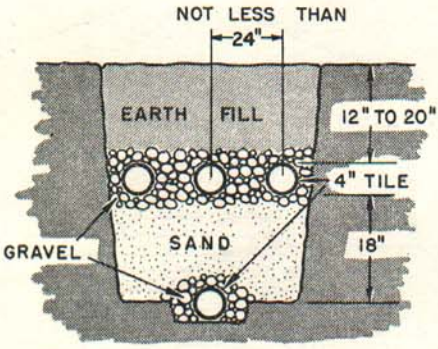


Fig. 12. Details of a filter trench.

Filter Beds are described in Part 2.

Seepage Pits (dry wells) may be approved by the local health authorities in areas where there are no shallow water wells and where soil conditions indicate their use in place of disposal fields. These pits are usually built with walls of logs, stones, bricks or concrete blocks providing openings to the surrounding soil. The bottom of the pit should extend to a porous soil layer but rarely deeper than 10 feet. The overflow from the septic tank is discharged into the seepage pit and allowed to seep out through the side wall openings and bottom into the surrounding soil.

The size of pit varies greatly and the depth is largely dependent upon the location of suitable soil strata. In general, a pit 5 or 6 feet in diameter and about 5 feet deep below the inlet should be sufficient to serve a family of 5 to 10 persons. The pits should have a substantial cover capable of supporting any reasonable load including earth if the pit is to be buried. This may be built of boards or logs but preferably should be made of concrete.

Cesspools – The cesspool is a covered hole or pit in the ground into which raw sewage is discharged. It is not recommended nor approved. The sewage enters the ground at such a depth that little assistance can be expected from natural agencies and harmful liquids soak into the ground saturating it with gross pollution. In many cases, it may be the means of contaminating the water supply for a large area around it.

"Leak-wells" are no more than cesspools constructed as a well instead of being a pit. They should never be used for sewage disposal because of the danger of contaminating a water supply.

SIPHONS

To add the siphon it is necessary to build a shallow tank with a water capacity of ¼ to ⅓ that of the septic tank. For the tank shown in Fig. 6, the dosing tank may be placed alongside the septic tank, in which case the inside dimensions would be 5 feet 10 inches long, 2 feet 6 inches wide and 23 inches deep (Fig. 13A). When the dosing tank is added as a continuation of the septic tank, its inside dimensions will be 5 feet long, 2 feet 10 inches wide and 23 inches deep (Fig. 13B). If the dosing tank is preferred as a separate tank placed several sewer tile lengths from the outlet end of the septic tank, it should be 3 feet 10 inches square (Fig. 13C). The septic tank effluent is held in this dosing tank until it is about 13 inches deep when the siphon operates and discharges the sewage to the disposal field. There are no moving parts in the siphon. Its action depends upon the compression of the air which collects under the bell.

Details for building the dosing tank, setting the siphon and its connections, and the completed installation are shown in Fig. 13. While setting the siphon, both open ends should be kept plugged to keep out the concrete and other foreign material. The same precau-

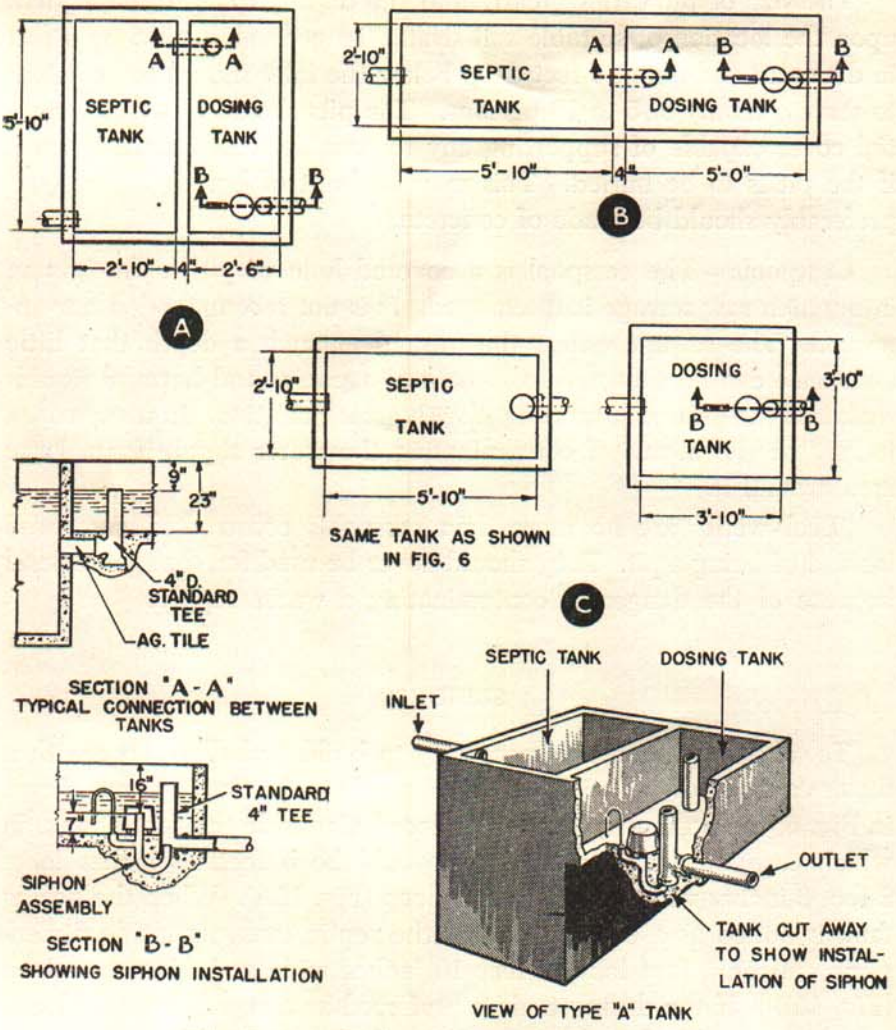


Fig. 13. Details of septic tank with dosing tank.

tions for removing the forms and finishing the dosing tank should be observed as are prescribed for the septic tank on page 17. After completing the construction, a pail of water must be poured into the siphon to start it.

CARE AND MAINTENANCE

Thirty years' experience with the septic tank method of sewage disposal shows that very little attention is required when the tank is properly installed. Occasionally, however, the scum or sludge in the tank may become too thick and may have to be removed.

The tank should be examined every two or three years to determine if too much sludge or scum is accumulating. One foot of sludge in the bottom and a foot of scum on the surface, do not interfere with the operation of the tank. As a general rule, when the total depth of scum and sludge equal or exceed one-third of the water depth in the tank, it should be cleaned. It is not always necessary to completely empty and scrub down the tank when the scum and sludge are removed. However, it should be filled with water before again being placed in operation.

The tile should be kept as far away from trees as possible, especially maples, willows, elms, and trees with similar root systems.

Virtually no trouble has been reported from either the tank or the tile system freezing when they were constructed according to the directions given.

A question frequently asked is: Can soapy water from the sink, showers, bathtub or laundry be put into the septic tank, and are washing powders injurious? It has been found that a septic tank of proper size and design will handle all these wastes from the average home without injury or trouble.

The effect of the use of household chemicals on the action of a septic tank is also the subject of questions sometimes asked. It is probable that an unusual amount of waste of an acidic nature discharged into the tank would interfere with the natural decomposition by killing the bacteria which carry on the action but the amounts of such acids commonly used in domestic processes are too small to be the cause of trouble. The tank contents are normally alkaline enough to neutralize any acidity which would ordinarily be added. Substances used for cleaning waste pipes or disinfecting clothing or plumbing fixtures are not strong enough when diluted with the water in the tank to cause trouble and may be disposed of without hesitation. In similar manner, salt solution from reconditioning water softeners will not interfere with the action of the tank. The addition to the tank of more than a few gallons of milk wastes at any time should be avoided.

OTHER METHODS OF SEPTIC TANK CONSTRUCTION

Cement Block Tanks – Generally a cement block tank is not as desirable as one of poured concrete. Under certain local conditions such as lack of suitable materials, however, such a tank may sometimes have to be used. In such cases it is recommended that the tank be made 5½ blocks long by 3 blocks wide and 7 courses deep using 8″x8″x16″ blocks with the first course laid as shown in Fig. 14. This will require a total of 105 blocks. A slab 4 inches thick, 4 feet wide, and 7 feet 4 inches long should first be poured as a bottom for the tank, and after the initial set has taken place, the block walls can be laid. The joints should be well cemented and the entire interior should be given a plaster coat of 1 to 3 cement and sand mixture. Careful workmanship is essential in the construction of a block tank.

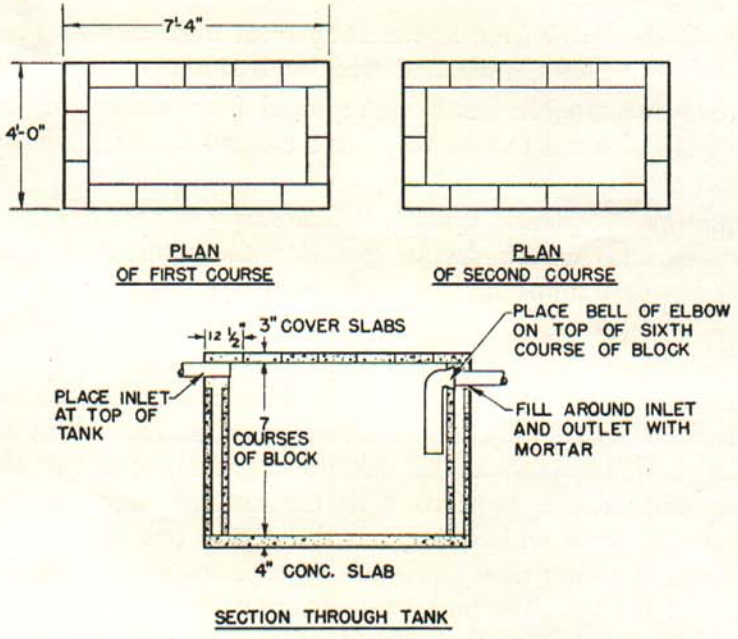


Fig. 14. Details of concrete block tank.

Inlet and outlet details are the same as for a poured tank and should be located in the 7th course as shown. Cover slabs as described on page 16 and shown in Fig. 6, or precast slabs should be used. Forms similar to those shown in Fig. 7 may be used.

Precast Tanks – Cement products manufacturers have been making precast septic tanks. Such tanks have the advantage of being

made under specially favorable conditions and are usually well reinforced. They are frequently made in several sizes but when using this type of tank, care should be taken to see that they possess the recommended fundamentals of design given below.

Metal tanks are not recommended due to the short life of the installation when buried in the ground. Nothing less than 10-gage iron, coated inside and outside with a hot asphalt dip can be expected to give even a reasonable length of service.

RECOMMENDED FUNDAMENTALS FOR A SEPTIC TANK FOR SINGLE FAMILY USE

For a disposal system to serve the one-family home, the following fundamentals have been indicated and should be observed:

Septic Tank . . . not less than 500 gallons (66.5 cubic feet) capacity below the outlet pipe.

not less than 4 feet water depth.
an inlet two or more inches above the outlet.
no elbow, tee or baffle at the inlet end.
effluent drawn off in the mid-third of the water depth.
at least 8 inches air space above the liquid.
length at least twice but not more than three times the width.

Dosing Tank . . . When a siphon is used, it should have no more than a 13-inch drawing depth and be installed in a tank having ¼ to ⅓ the capacity of the septic tank.

Disposal Field . . . not less than 150 feet of 4-inch tile, and more if percolation test indicates the need.

tile surrounded by gravel.
tile laid to grade of 1 inch per 50 feet.

Minimum sizes of tanks to meet these fundamental requirements might be:

Water Depth	*Inside Length*	*Inside Width*
4′ - 0″	5′ - 10″	2′ - 10″
4′ - 0″	6′ - 0″	2′ - 9″

Minimum sizes where local regulations may require greater water depth:

Water Depth	*Inside Length*	*Inside Width*
50″	5′ - 9″	2′ - 10″
50″	5′ - 10″	2′ - 9″
52″	5′ - 8″	2′ - 9″
54″	5′ - 6″	2′ - 9″

PART 2

LARGER INSTALLATIONS FOR SCHOOLS, HOTELS, APARTMENT HOUSES, CAMPS, AND TRAILER COACH PARKS

The standard tank, as described in Part 1, is designed to serve the home occupied by one family. When more than one family or more than 8 to 10 persons are to be accommodated, the capacity of the tank and the disposal system must be increased.

The following discussion deals with the design, construction and installation of septic tanks and disposal fields for the larger installations as may be required to serve schools, hotels, apartment houses, camps, and trailer coach parks.

THE SEPTIC TANK

The liquid capacity of the septic tank should approximate 24 hours' flow of the sewage expected under normal conditions, but in no case should it be less than 500 gallons. The tank depth below the water level should not be less than 4 feet and for larger installations, about 6 feet.

While the tank in this part may appear to be different from the one in the first part of this bulletin, it is essentially the same, except for size (see Figs. 6 and 15). The water depth varies with the liquid volume to create a satisfactory and economical shape. In the larger sizes, the length may be as much as 5 times the width.

In the plan described in Part 1, designed to be built with portable forms, the use of the siphon is largely dependent upon the nature of the soil, topography and the availability of siphons. In this part, the siphon is necessary and is recommended in a separate tank at the end of the septic tank.

For tanks less than 4 feet wide, the top should be of removable precast concrete slabs for ease in cleaning and for inspection. The dimensions and other details for the various sizes of tanks described in Part 2 are shown in the following table. For other than the sizes of tanks shown in the table and for other methods of construction, the Michigan Department of Health or your local health department should be consulted for advice on type and size of installations.

The action of the septic tank has been described in the fore part of this bulletin. The tanks described here are designed to serve the same function as the one for the single family. In designing the larger tanks, experience indicated that there are no logical reasons for partitions, baffle walls, and connecting pipes inside the tank. They only add to the cost and often detract from the efficiency of the tank by decreasing sludge capacity and setting up unnecessary currents which seriously interfere with efficiency of sedimentation.

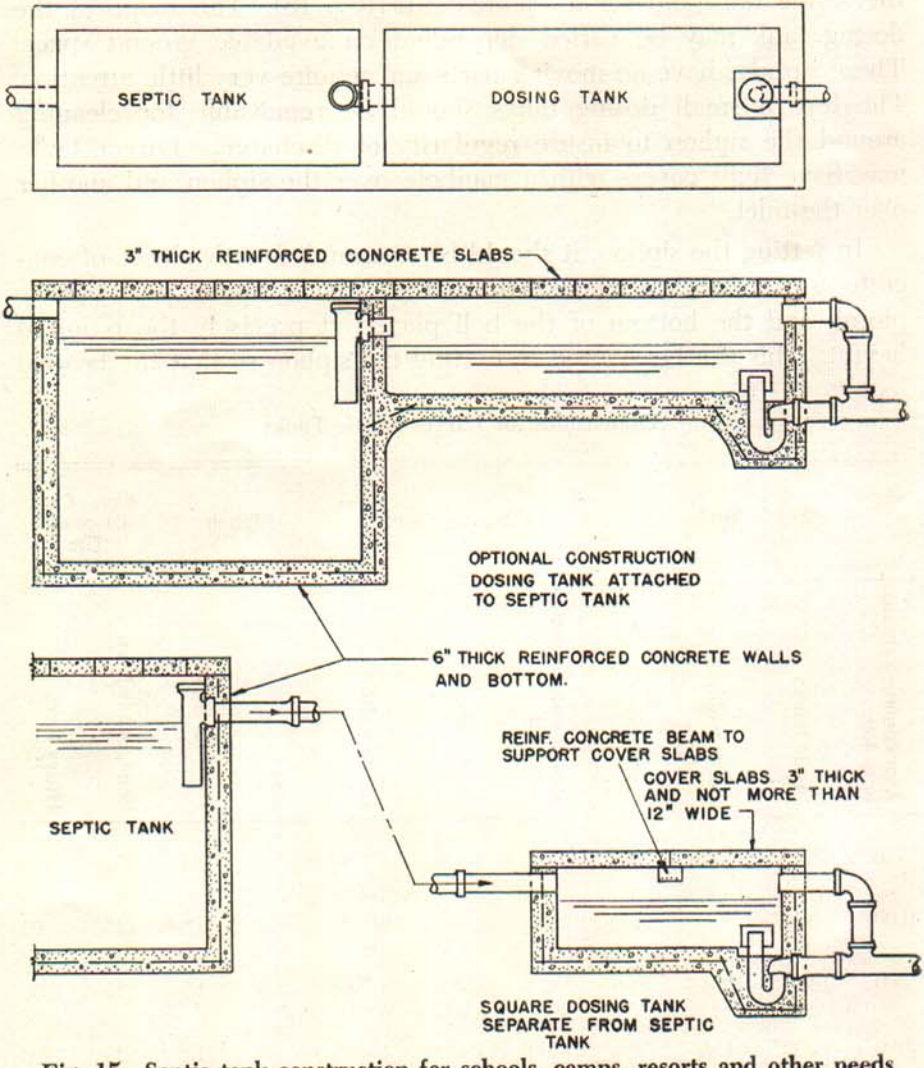


Fig. 15. Septic tank construction for schools, camps, resorts and other needs greater than residential.

THE DOSING TANK

For the larger tank, it is desirable that the effluent be distributed into the ground intermittently. The action of the siphon has been described on page 23. The size of the dosing tank should be such that it will discharge not more than three or four times during 24 hours under ordinary use. The size and drawing depth of siphon suitable for each size of disposal system is shown in the table. In each case, dimensions have been given for a dosing tank of the same width as the septic tank and for a square tank (Fig. 15). The shape of the dosing tank may be varied dependent on available ground space. These siphons have no moving parts and require very little attention. The top of small dosing tanks should be removable for cleaning around the siphon to insure regularity of discharge. Larger tanks may have tight covers with a manhole over the siphon and another over the inlet.

In setting the siphon, it should be surrounded with plenty of concrete and great care taken to have the vertical siphon pipe exactly plumb and the bottom of the bell placed at precisely the required height. This can be assured by setting the siphon so that the beaded

Dimensions for Larger Septic Tanks

Septic Tank				Dosing Tank			Siphon		Feet of 4″ Disposal Tile	
Approximate capacity in gallons	Inside length	Inside width	Water depth	Approximate capacity in gallons	Inside length	Inside width	Size	Drawing depth	Sand, sandy loam	Heavy loam
750 . .	6′-8″	3′-0″	5′-0″	200	8′- 4″ 5′- 0″	3′- 0″ 5′- 0″	3	13	350	450
1000 . .	9′-0″	3′-0″	5′-0″	250	10′- 4″ 5′- 6″	3′- 0″ 5′- 6″	3	13	425	600
1500 . .	10′-6″	3′-6″	5′-6″	375	13′- 3″ 6′-10″	3′- 6″ 6′-10″	3	13	625	800
2000 . .	12′-0″	4′-0″	5′-6″	500	15′- 6″ 7′-10″	4′- 0″ 7′-10″	3	13	825	1000

ring about the long leg of the siphon comes exactly at the floor level of the dosing tank. The bell of the siphon is a separate unit and is removable. Both ends of the siphon pipe should be kept securely plugged during construction to exclude dirt, concrete, or other foreign matter. When the work is completed, a pail of water must be poured into the vertical leg of the siphon.

In places where the ground is flat and when plumbing fixtures are in the basement, it may not be possible to build a septic tank and dosing tank high enough to keep the disposal tiles at the proper depth to take advantage of the oxidizing action of the soil. Fig. 16 shows a plan suggested to meet these conditions. In this type of installation, the pump lifts the septic tank effluent to an elevation higher than the tank outlet. The septic tank and disposal tiles are designed as usual and a pump takes the place of the siphon in the dosing tank. This tank should have the same liquid capacity whether emptied by siphon or a pump but when the pump is used, the shape of the dosing tank may be made nearly cubical for the sake of economy.

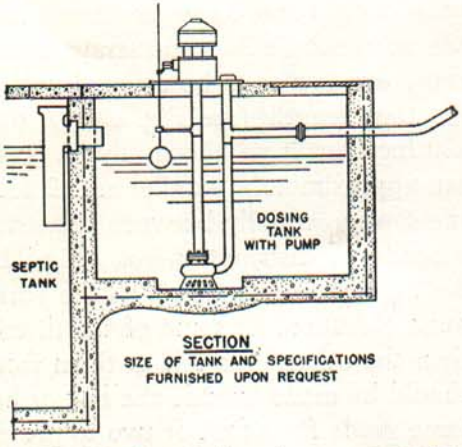


Fig. 16. Installation of sump pump in dosing tank to pump effluent to desired level.

COVERS

Septic tanks and dosing tanks are covered to prevent accidents, control odors, and avoid unsightly appearances and not to aid to any great extent in the successful operation of the tank. For small sizes, the covers of the septic tank and dosing tank may be made of precast concrete slabs, or cast iron plates in small units, so as to be easily removable for cleaning and inspection. Individual slabs should not weigh more than 200 pounds. It is not advisable to use planks for this purpose, because they are not durable under such conditions. In installations so large that slabs are not practical, the tops may be poured in place and access provided by means of manholes over the

inlet and the outlet pipes. If the structures are to be placed in a lawn, the tops may be covered with earth and the surface seeded or sodded and any exposed parts screened by shrubs if desired.

THE DISPOSAL FIELD

Seepage Trenches – The distribution of the septic tank overflow or effluent into the soil is generally best accomplished by means of lines of vitrified drain tile laid 12 inches to 20 inches underground, with open joints, so as to allow the liquid to pass out freely. These tile need not be laid in a straight line, but may follow the contour of the ground so as to be covered with about one foot of earth throughout their length (see Fig. 10). A single line of tile may be laid up to 100 feet, but it will generally be preferable to build shorter lines that are approximately parallel and 2 feet or more apart. To proportion the sewage equally between the several lines, it is advisable to build a header or distribution box (Fig. 11) to receive the sewage from the dosing tank and from which the various distribution lines start at the same elevation. If some of the distribution lines are on a lower level than the others, the fall to them from the distribution box or header should be made outside the box or header; all outlets should have the same grade for a foot or two to prevent some from taking more water than others.

All distribution lines should be laid on a gravel fill in a trench 12 inches or more in width. This fill should be 3 inches to 4 inches deep. Gravel should also be placed around and over the tile to a depth of at least 2 inches (Fig. 17). The gravel aids the distribution of the sewage into the ground. It should be screened to remove material passing through ¼-inch openings.

The length of tile needed for distributors for different sizes of tanks and for different kinds of soil is given in the table on page 30. The total volume of the tiles must be at least equal to the volume discharged from the dosing tank.

If there is a question relative to the ability of the soil to absorb the effluent, it can be determined by making the percolation test described in Part 1, page 11. If the drop of one inch in water level occurs in less than 15 minutes, use the amount of tile indicated in the table, page 30 under the heading "Sand, Sandy Loam". For 15 to 30 minutes, use amount of tile under heading "Heavy Loam". For greater lengths of time, a filter bed is recommended.

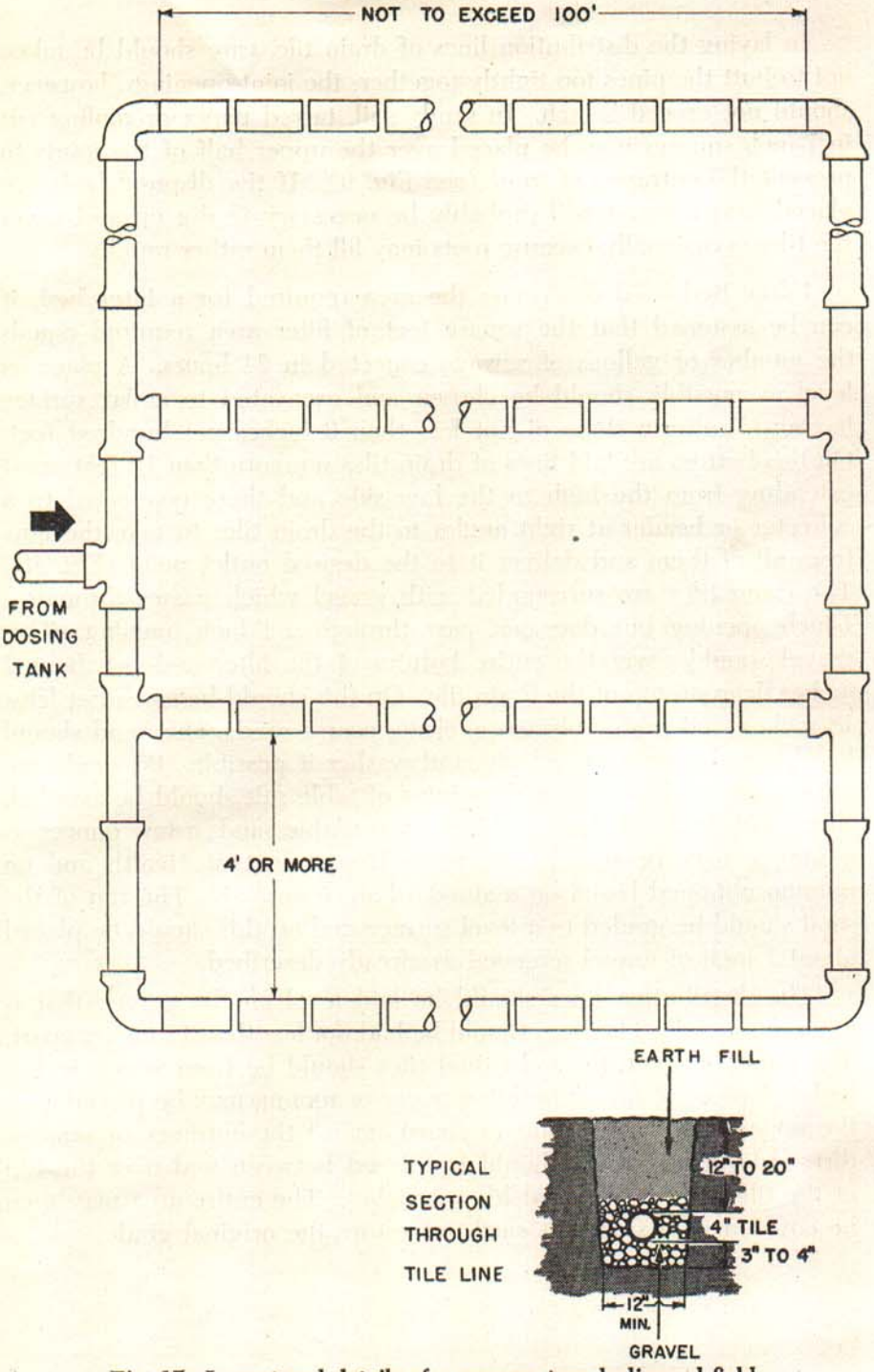


Fig. 17. Layout and details of a seepage trench disposal field.

In laying the distribution lines of drain tile, care should be taken not to butt the pipes too tightly together; the joint openings, however, should not exceed ¼ inch. In sandy soil, tarred paper or roofing cut in 7-inch squares may be placed over the upper half of the joints to prevent the entrance of sand (see Fig. 9). If the disposal beds are placed near trees, it will probably be necessary to dig up and clean the tiles occasionally because roots may fill them rather rapidly.

Filter Bed – To determine the area required for a filter bed, it can be assumed that the square feet of filter area required equals the number of gallons of sewage expected in 24 hours. A place as level as possible should be chosen and excavated to a flat surface having a uniform slope of not less than 6 inches per hundred feet. On this bottom are laid lines of drain tiles no more than 10 feet apart extending from the high to the low side and there connected to a collector or header at right angles to the drain tiles to take the flow from all of them and deliver it to the desired outlet point (Fig. 18). The drain tiles are surrounded with gravel which passes through a 1-inch opening but does not pass through a ¼-inch opening. This gravel should cover the entire bottom of the filter and be about 2 inches deep on top of the drain tile. On this should be spread at least 18 inches, and preferably more, clean, coarse sand. This sand should be obtained from a gravel pit sand washer if possible. Pit sand containing material finer than the grains of table salt should be avoided. In case of doubt of the suitability of available sand, a few ounces as a sample may be sent to the State Department of Health and an opinion obtained based on a standard sieve analysis. The top of the sand should be graded to a level surface and on this should be placed about 1 inch of gravel screened as already described.

The distribution lines should be laid level on the gravel, that is without any fall. The lines should be laid not less than 12 inches apart. The joints between the individual tiles should be from ⅛ to ¼ inches wide. A piece of tarred building paper or roofing may be placed over the upper half of each joint to guard against the entrance of sand or dirt. Additional gravel should be placed between and over the top of the tiles to a depth of at least 2 inches. The entire area may then be covered with sufficient earth to restore the original grade.

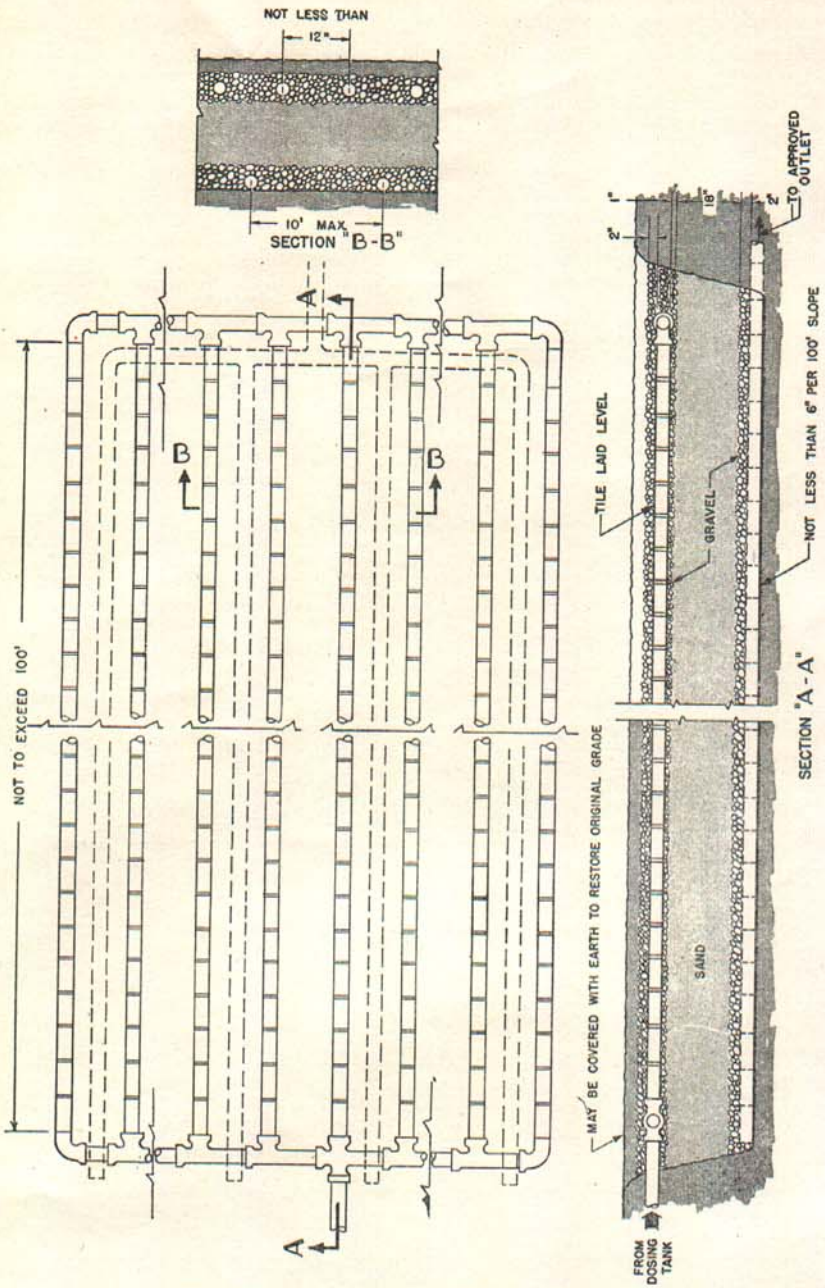


Fig. 18. Layout and details of a filter bed.

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