Sanitary Sewage Disposal

for

Rural and Suburban Areas

Oregon State Sanitary Authority
and
Oregon State Board of Health

PORTLAND

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FOREWORD

This pamphlet has been prepared for the purpose of presenting briefly the requirements of the State Board of Health and the State Sanitary Authority pertaining to sewage disposal for rural and suburban areas where community sewerage systems are not available. It is hoped that it will be of value to anyone designing or constructing individual sewage disposal facilities in such areas. The requirements which are presented herein are based on accepted sanitary engineering practices with due consideration being given to local conditions and experiences.

It is not within the scope of this pamphlet to present designs and detailed discussions covering every type of condition and circumstance. In areas where special difficulties are encountered the advice of the local city or county sanitarian should be solicited. Additional advice and information will be given in specific instances by the Division of Sanitary Engineering, provided a complete description of local conditions accompanies the request. Inquiries may be addressed to the Division of Sanitary Engineering, State Board of Health, Portland, Oregon.

SANITARY SEWAGE DISPOSAL FOR RURAL AND SUBURBAN AREAS

INTRODUCTION

In order to protect public health and to prevent nuisance conditions, safe and sanitary sewage disposal facilities should be provided at every home, camp, school, public institution or other establishment in rural and suburban areas, as well as in urban communities, even though public sewerage systems are not accessible. Many diseases such as typhoid fever, dysentery and various types of diarrhea, are transmitted from one person to another through the fecal contamination of food and water, due largely to the improper disposal of human wastes. Proper sewage disposal, therefore, gives protection against the spread of diseases which originate in the intestinal tract of man.

Safe and sanitary sewage disposal requires that human and household wastes be disposed of so that:

1. Drinking water supplies will not be contaminated.
2. Surface water which is or might be used for shellfish propagation, irrigation purposes, bathing, boating or for other recreational uses or as a supply of natural ice, will not be polluted or contaminated.
3. Such wastes will not be exposed or accessible to flies, rodents and other insects and vermin which are possible carriers of disease germs.
4. Nuisance conditions such as unpleasant odors or unsightly appearances will not be created.

To insure compliance with the above conditions and by virtue of the authority granted in Sections 99-103, 99-903, 99-1606, and 116-1122 of the Oregon Compiled Laws Annotated, the requirements for sanitary sewage disposal as set forth in this pamphlet have been adopted by the State Board of Health and the State Sanitary Authority.

Part I

GENERAL REQUIREMENTS FOR THE SANITARY DISPOSAL OF SEWAGE

A. REGULATIONS GOVERNING SEWAGE AND WASTE DISPOSAL

1. **Sanitary Sewage Disposal Facilities Required.** All human excreta, sewage and other household wastes shall be disposed of in properly designed, constructed and maintained community sewerage systems, individual septic tank systems, cesspools, privies, or by other means approved by the State Board of Health.
   (a) No human excreta, kitchen wastes, laundry water, sink water, or toilet wastes shall be allowed to discharge or flow upon the surface of the ground or into any ditch, gutter, street, roadway or public place, nor shall such wastes discharge onto any private property so as to create a nuisance condition or health hazard.

2. **Pollution of Water Prohibited.** No sewage, household wastes, or industrial or trade wastes shall be discharged into or disposed of in such a manner that access will be gained to any public waters of the State of Oregon unless such waste materials are first treated in a manner approved by the State Sanitary Authority, a division of the State Board of Health.
   (a) No abandoned or deep well shall be used for the disposal of sewage or as a receptacle for household wastes. No privy vault, cesspool, or septic tank disposal system, unless it be water-tight, shall be located in any water-bearing stratum which is, or may be, used as a source of domestic water supply, or shall be so otherwise located that pollution from the same can enter any domestic water supply.

3. **Submission of Plans and Specifications Required.** Plans and specifications covering the construction of new systems of sewers or sewage or waste disposal, or of modified or extended existing systems from which effluent is to be discharged into any surface or ground water or which is to be used by any number of persons exceeding ten families or fifty persons, shall be submitted to and be approved by the State Sanitary Authority before construction thereof may begin. The plans and specifications shall be submitted a sufficient length of time in advance of construc-

tion in order that the Authority may direct any changes deemed necessary. Preliminary plans and reports may be submitted in advance of final plans. Approval may be subject to modifications by the Authority upon due notice. Construction shall be according to the approved plans only.

4. **Disposal of Privy, Cesspool, and Septic Tank Contents.** No part of the contents of any privy, cesspool, or septic tank shall be discharged upon the surface of the ground unless subjected to additional treatment in a manner approved by the health officer. Final disposal shall be by incineration, burial, or other means approved by the health officer. No person shall engage in the transportation and disposal of the contents of privies, cesspools, or septic tanks without first obtaining a written permit from the health officer in the county in which the privies, cesspools, or septic tanks are located and from the health officer in the county in which final disposal of the material will take place. The permit shall designate where and in what manner the disposition of the material shall be carried out. The contents of privies, cesspools, and septic tanks shall be transported in a manner that will not create a nuisance or a public health hazard.

Part II

REQUIREMENTS FOR INDIVIDUAL WATER-CARRIED SEWERAGE SYSTEMS

A. INTRODUCTION

The water-carried sewage disposal system is in reality the system of piping and appurtenances through which all sewage and household wastes are conveyed by the flow of water from their point of origin to the point of final disposal. It begins at the plumbing fixtures which first receive the wastes and includes the building drain, the house or influent sewer, and the final disposal or treatment facilities.

Wherever a pressure water system is available, the water-carried method of sewage disposal is preferred to other methods, not only because it is more convenient but also, when it is properly designed, located and constructed, because it is more sanitary. The private or individual water-carried system has certain disadvantages, however, which must not be overlooked. These disadvantages are discussed thoroughly in this pamphlet.

In the individual sewage disposal system, final disposal is generally accomplished by percolation into the soil rather than by discharge of a treated effluent into surface waters as is the common practice with most municipal sewerage systems. The comparatively large volume of liquid wastes resulting from the water that is required to carry the solids away complicates the problem of trying to dispose of the sewage into the soil or natural earth formations.

For satisfactory results with this method of disposal, therefore, it is essential (1) that the amount of sewage produced daily be kept as small as possible, (2) that the solids be removed as efficiently as possible from the liquid by means of a sedimentation unit, such as a septic tank, (3) that the subsoil formation be fairly porous, (4) that a sufficiently large area of ground be available for the disposal field, and (5) that the ground water table be at all times lower than any portion of the seepage unit.

Another very important factor regarding this method of disposal is the possibility of ground water contamination. For this reason special precautions must be observed in the location of both the water supply and the sewerage system.

The problem of providing sanitary sewage disposal by water-carried methods has become especially acute in certain densely populated residential districts adjacent to but outside of the corporate limits of municipalities. In recent years numerous finance

companies, real estate agencies and promoters have subdivided into residential districts large tracts of land located in rural and suburban areas where public sewers are not available. In the majority of cases little or no consideration has been given to the problem of sewage disposal. It apparently was thought that the individual water-carried systems customary in rural areas would serve the purpose. As a result, hundreds of private sewage disposal systems have been built in the state of Oregon which do not function properly because they were either poorly designed, improperly located or carelessly constructed. In many of the areas which have been developed in this manner, the type of subsoil and other unsatisfactory local conditions that are encountered make subsurface disposal methods not only impracticable but impossible. The only satisfactory method of disposal for such areas is the installation of a public sewerage system with approved type treatment facilities and discharge of the effluent into a surface waterway. The organization of a sanitary district for the purpose of constructing a public sewerage system is provided for by state laws. It is not within the scope of this pamphlet, however, to discuss the organization of sanitary districts or the design of public sewerage systems.

The individual sewage disposal system generally consists of a septic tank with provisions made to discharge the effluent into a subsurface disposal field, an artificial sand filter or into a seepage pit. Cesspools are also used as a means of individual sewage disposal. In determining the type of system best suited for any particular installation consideration must be given to the possible locations, the topography or slope of the ground, the porosity of the soil, the amount of space available, the distance to the nearest water supply and the elevation of the ground water table.

The design, construction and operation of individual water-carried sewage disposal systems shall therefore, comply with the following requirements.

B. GENERAL REQUIREMENTS

1. **Design Capacity.** All sewers and sewage treatment facilities must have adequate capacity to properly dispose of the maximum daily sewage flow. In cases in which actual flow measurements are not available, the quantity of sewage to be treated or disposed of shall be estimated according to Table I. It shall be based on the maximum population anticipated. The population of private dwellings, motor courts and tourist cottages shall be estimated at two persons per sleeping room and of trailer camps at two and one-half persons per trailer space.

Table I

DAILY SEWAGE FLOWS

Type of Establishment	*Gallons per Person per Day*
Dwellings	50
Day Schools	15
Trailer Camps	20
Modern Motor Courts and Tourist Cottages	40
Industrial and Commercial buildings	25
Hospitals and other institutions	100

C. PLUMBING SYSTEM

The plumbing system of a building includes the water supply distribution pipes, the fixtures and fixture traps, the soil, waste and vent pipes, the building drain, the storm-water drainage, and all necessary appurtenances and connections.

Good plumbing is essential for the satisfactory operation of any water-carried sewage disposal system because if the fixtures and piping are not properly installed, the sewage will not be collected and carried away from the building in a safe and sanitary manner.

All interior plumbing installations must conform with the minimum requirements of the State Plumbing Code and the rules and regulations of the State Board of Heatlh.

There shall be no physical connection between a public or private potable water supply and any public or private non-potable water supply, sewer, sewage disposal works or appurtenance thereto, which would render possible passage of any non-potable or polluted water or any sewage into the potable water supply.

Storm water drainage pipes such as roof and surface drains must not be connected to the individual sewage disposal system. A separate disposal system must be provided for them.

D. HOUSE SEWER

The house sewer is the watertight pipe line which carries the liquid wastes from the interior plumbing system to either the public sewer system or to the septic tank or cesspool of the individual water-carried sewage system.

1. **Location.** No sewer shall be within ten feet of any well, spring, or other source of domestic water supply. All sewers, drains, or parts thereof, which are located between ten and fifty feet from a well, spring or other source of domestic water supply, shall be constructed of cast iron soil pipe or cast iron water pipe, and shall have watertight lead joints.

Sewers and water lines shall not be laid in the same trench. Parallel water and sewer lines shall be located at least ten feet apart horizontally. Wherever it is necessary for house sewer and water lines to cross each other, the crossing shall be at an angle of approximately 90° and the sewer shall either be located at least 3 feet below the water line or shall be constructed of cast iron soil or water pipe with watertight lead joints for a distance of ten (10) feet on both sides of the water line.

2. **Material.** Only bell and spigot cast iron, vitrified clay, or concrete sewer pipe, cement asbestos pipe, bituminized-fiber pipe, or pipe of other material approved by the State Plumbing Inspector shall be used. Extra-heavy cast iron pipe shall be used for sewers located in roads or driveways with less than three feet of cover.

DETAIL OF CLEANOUT

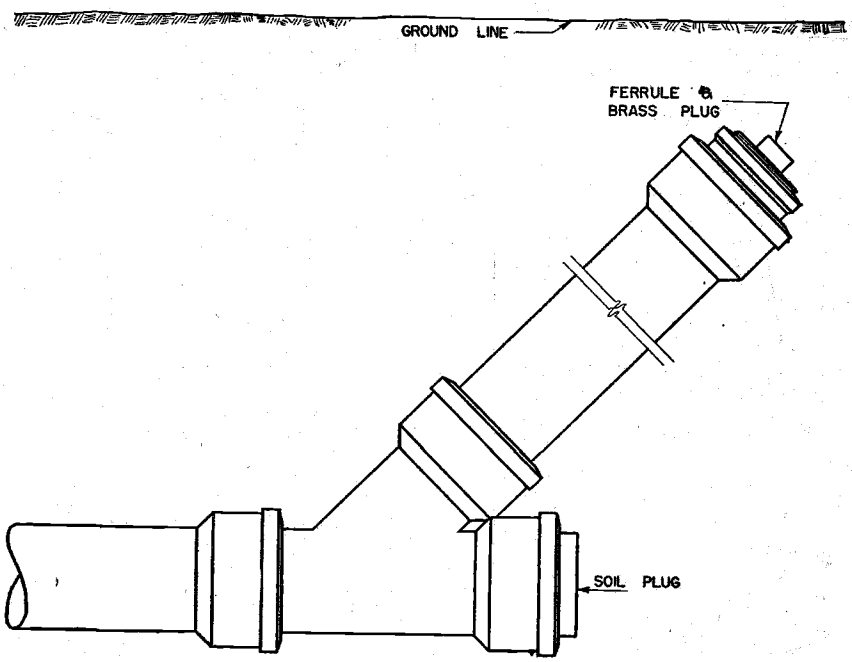


FIGURE. I

TYPICAL MANHOLE CONSTRUCTION

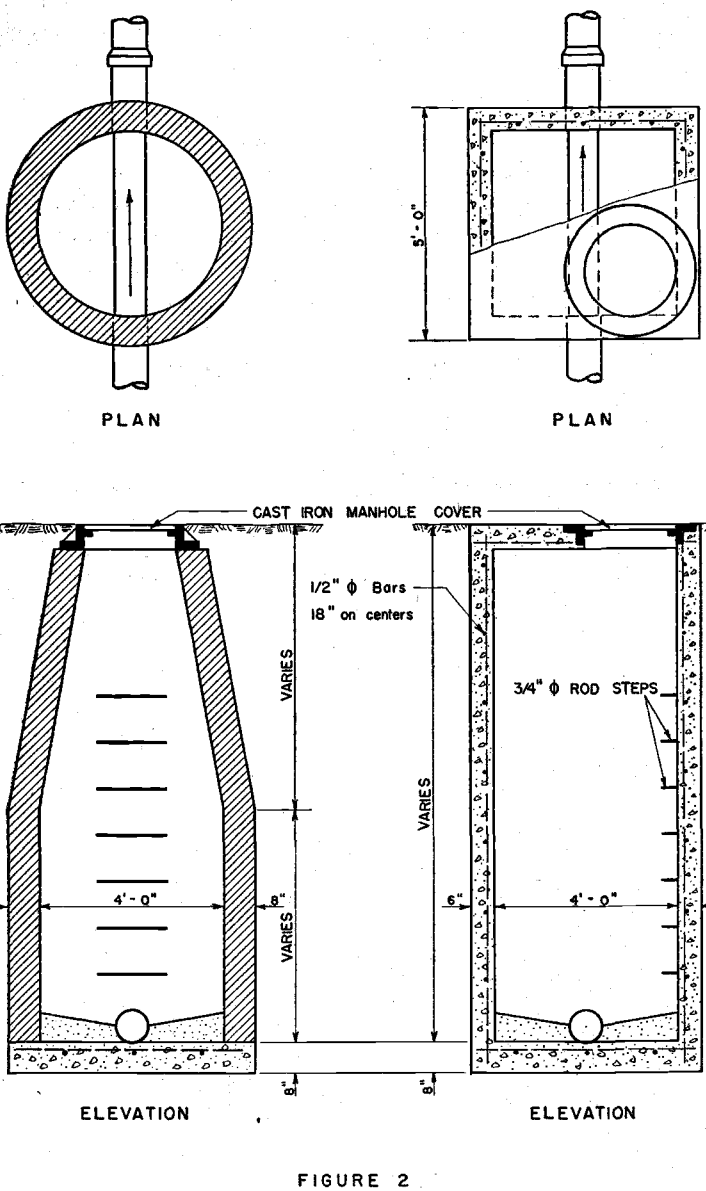


FIGURE 2

3. **Sewer Joints.** All sewer joints shall be as watertight as possible and shall be protected against the entrance of tree roots wherever necessary. Jute, oakum or other approved packing shall be used with either lead, cement mortar or approved bituminous joint material in all bell and spigot pipe joints.

4. **Minimum Diameter.** No pipe less than four inches in diameter shall be used.

5. **Sewer Grade.** All sewers shall be laid to an even grade and true alignment. The minimum grades for house sewers shall be ¼ inch per foot for 4-inch pipe, ⅛ inch per foot for 6-inch pipe, 0.4 foot per 100 feet for 8-inch pipe, and 0.28 foot per 100 feet for 10-inch pipe.

6. **Cleanouts.** Cleanouts shall be installed at every change in alignment in excess of 45° and at every change in grade in excess of 22½°. (See Figure 1.) A cleanout near the septic tank or cesspool is desirable for maintenance of the inlet structure. For sewers deeper than four feet approved type manholes should be used in place of cleanouts.

   For fairly large sewer systems, such as for public institutions, manholes shall be installed at all points of change in slope, direction, elevation and size of pipe; at each intersection or junction; at the upper end of all laterals which are more than 100 feet long, and at intervals of 500 feet or less. The minimum diameter of the manhole opening shall be 20 inches and the minimum inside diameter at the bottom shall be four feet. (See Figure 2.)

E. GREASE TRAP

A grease trap is a device in which the grease contained in sewage and household wastes is collected and from which the grease is periodically skimmed from the liquid surface for final disposal. **For the average sewage disposal system serving a private residence, a grease trap is considered unnecessary.** Experience has demonstrated that where grease traps are installed they are not cleaned out regularly and, therefore, are of little or no value. Furthermore, the majority of them are improperly designed.

Grease traps are recommended only on waste lines from large kitchens such as those in camps, hotels, or restaurants where large amounts of grease are likely to be contained in the waste. In certain cases where kitchen wastes are disposed of by soil absorption in systems separate from those for the domestic sewage, grease

SUGGESTED CONSTRUCTION OF GREASE TRAPS

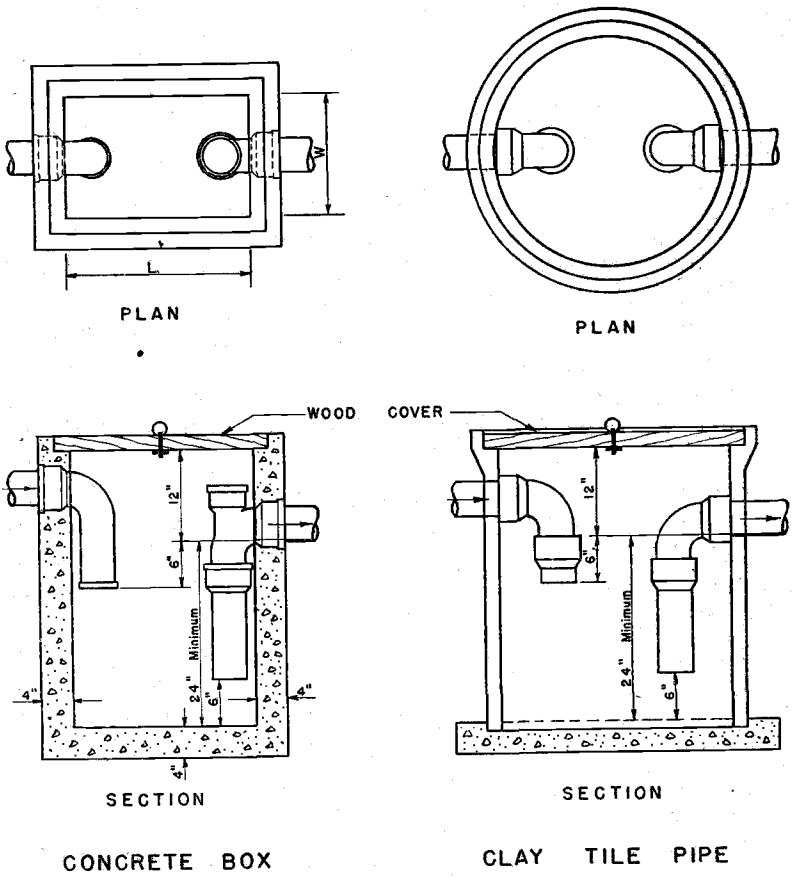


FIGURE 3

traps are used instead of septic tanks or cesspools. This practice is not recommended, however. Suggested designs for grease traps are shown in Figure 3.

Wherever grease traps are used the following recommendations should be complied with:

1. The trap should be located as near as possible to the point of grease production and in a place convenient for cleaning.
2. The trap should have adequate capacity to entrap and retain the grease. The capacity should be based upon the rate of

flow and the amount of grease produced daily. For a single family dwelling the capacity should be at least thirty gallons.

3. The trap should be constructed of impervious material such as metal, vitrified clay or concrete.
4. The trap should have sufficient depth to permit the outlet to be trapped and to assure retention of the grease. It should also be designed to permit easy access and cleaning.
5. Patented grease traps should not be installed unless their design meets the approval of the State Plumbing Inspector.
6. The trap should be cleaned at regular and frequent intervals. It should be inspected at least once every thirty days and more often if necessary.

F. SEPTIC TANK

The septic tank is merely a watertight chamber in which the settleable and floating solids are removed by sedimentation from the sewage which flows through it. It provides sufficient space for the retention of these solids, most of which settle to the bottom of the tank in the form of sludge and undergo gradual decomposition by bacterial action. The lighter solids float on top of the liquid surface as a scum. The bacteria contained in the sewage slowly convert the organic matter of the sludge into more stable compounds in the form of liquids, gases and inert material. The freed liquids flow out of the tank with the sewage effluent, the gases escape into the area above the liquid surface and the inert material remains in the bottom of the tank. The gradual accumulation of inert material makes it necessary to clean out the tank at intervals varying from one to several years depending upon the quantity and quality of sewage treated.

There are a great number of mistaken ideas about the operation of septic tanks. Contrary to popular belief:

1. **The septic tank does not make the sewage fit to drink.** Under normal operation 40 to 50 per cent of the solids will still remain in the septic tank effluent. The effluent is neither pure nor stable and its bacterial content may be equal to or greater than that of the tank influent. Furthermore, there is no assurance that all disease-producing bacteria are destroyed by the septic tank.
2. **There is no need to add yeast or any patented preparation in order to start or promote bacterial action in the tank.** The bacteria normally present in domestic sewage are the ones which decompose the sludge and sewage solids.

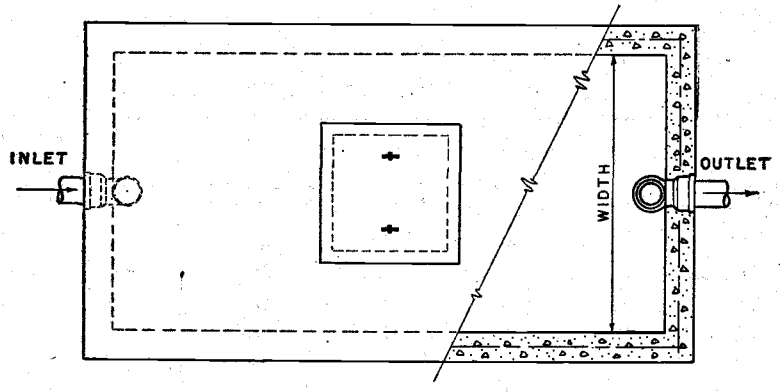
3. **The bacterial action in the tank does not destroy all of the solids.** The accumulation of inert material makes it necessary to clean out the septic tank periodically. On an average the capacity of a septic tank serving an individual dwelling will be reduced about 20 gallons per person per year by the accumulation of sludge.
4. **The discharge of normal quantities of laundry and kitchen wastes into the septic tank does not harm the bacterial action.** The grease contained in kitchen wastes and the bleaching solution contained in laundry water will not destroy the bacteria responsible for sludge decomposition. **It is recommended, therefore, that kitchen and laundry wastes be discharged into the same septic tank that receives the domestic sewage.** Under no circumstances should such wastes be discharged directly into a disposal field without first passing through a settling tank.

The septic tank should be so designed that the horizontal flow throughout the length of the tank will be uniform and well distributed, the sewage and sludge will both be retained for the proper length of time, and the tank can be operated and maintained with a minimum of expense and effort.

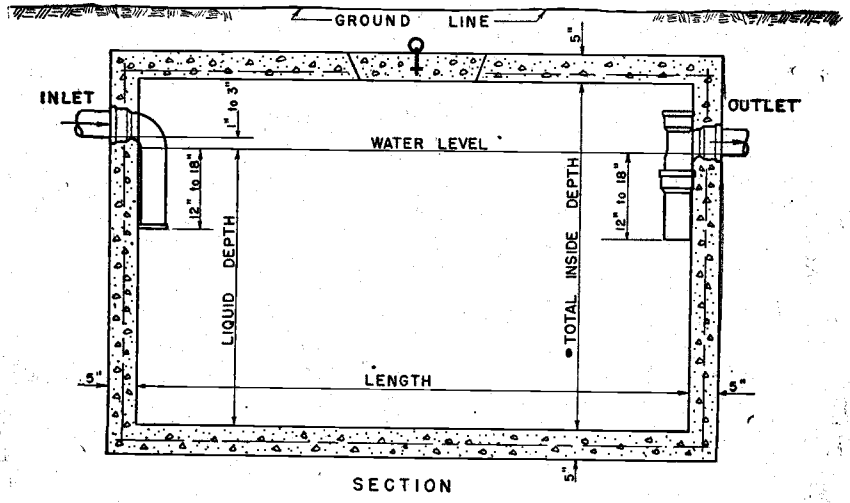
Experience seems to indicate little need for multiple compartments. Such construction adds to the cost and often reduces the efficiency of the tank by decreasing the sludge storage capacity in the inlet compartment and increasing the velocity of flow through the tank which interferes with sedimentation. If a partition is desired for structural purposes, it must be located not less than two-thirds the distance from the inlet end of the tank. Each septic tank installation shall comply with the following requirements. (See Figures 4 and 5 for approved designs of septic tanks.)

1. **Location.** It shall be located at least 50 feet from any well, spring or other source of domestic water supply, 25 feet from any stream, river, or lake and 10 feet from any joint property line. The drainage from the site of the septic tank shall be away from all sources of water supply. Wherever possible it should be located at least 10 feet from any building. The elevation of the tank shall permit proper slope for the house sewer and shall allow locating the subsurface disposal field without excessive cover. The location shall permit easy access for inspection and cleaning. The tank should be covered with at least 8 to 12 inches of earth if landscaping is desired.
2. **Capacity.** Every septic tank shall have a liquid capacity of at least the average volume of sewage flowing into it during

DETAILS OF SEPTIC TANK CONSTRUCTION



PLAN



SECTION

FIGURE 4

See Table II for required Liquid Capacity and Table III for Recommended Dimensions.

a period of 24 hours, but in no case less than 500 gallons. In multicompartment tanks, the inlet compartment shall have a capacity of not less than two-thirds the total capacity nor less than 500 gallons. The minimum effective liquid capacities of septic tanks shall conform to those given in Table II.

Table II

MINIMUM CAPACITIES FOR SEPTIC TANKS

Maximum Number of Persons Served						Effective Liquid Capacity of Tank in Gallons
Private Dwellings	Day Schools	Trailer Camps	Motor Courts	Industrial Buildings	Hospitals, Etc.	
6	30	25	12	20	5	500
8	50	35	18	30	8	750
12	65	50	25	40	10	1000
14	80	60	30	50	12	1200
16	100	75	40	60	15	1500
24	140	100	50	80	20	2000
.....	170	130	65	100	25	2500
.....	200	150	75	120	30	3000
.....	230	170	85	140	35	3500
.....	270	200	100	160	40	4000
.....	300	230	115	180	45	4500
.....	350	250	125	200	50	5000

3. **Construction.** Septic tanks shall be constructed either (1) of reinforced concrete, (2) of not les sthan 10 gauge iron coated inside and out with asphalt or (3) of other sound and durable material approved by the State Board of Health.

   (a) The length of the tank shall be not less than two nor more than three times the width. Round tanks are not recommended but will be permitted for the 500 gallon size only. The round tank shall have a minimum inside diameter of five feet. No septic tank shall have a total inside depth of less than five feet or a liquid depth of less than four feet. There shall be an air space between the liquid level and the under side of the top of the tank of at least 12 inches. Ventilation of the tank air space shall be either through the vent pipes of the house plumbing system or through the disposal field. Recommended dimensions for septic tanks of various capacities are given in Table III.

   (b) The inlet and outlet pipes shall be located at opposite ends of the tank and shall be at least four inches in diameter.

SEPTIC TANK WITH PARTITION WALL

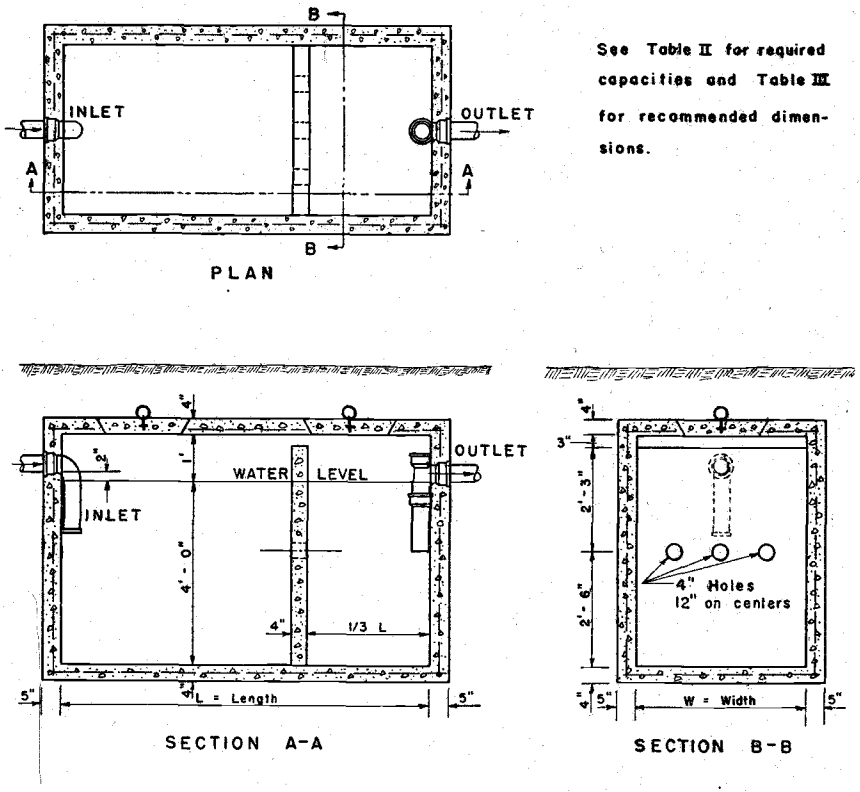


FIGURE 5

They shall be of cast iron, vitrified clay, or concrete bell spigot tee or quarter bend fittings. They shall extend 12 to 18 inches below the water surface. The inlet shall be at an elevation one to three inches higher than the outlet.

(c) Convenient access to the tank for inspection and sludge removal shall be provided by means of a manhole or removable cover. Where the top of the tank is more than three feet below the ground surface, a manhole shall be built up to within 12 inches of the ground surface.

In the building of a reinforced concrete septic tank care must be taken in the selection and mixing of the cement and aggregates in order to make sure that concrete will be water-

Table III

RECOMMENDED DIMENSIONS FOR SEPTIC TANKS

Effective Liquid Capacity of Tank in Gallons	*Recommended Inside Dimensions*			
	Width	*Length*	*Liquid Depth*	*Total Depth*
500	3′ 0″	6′ 0″	4′ 0″	5′ 0″
750	3′ 6″	7′ 6″	4′ 0″	5′ 0″
1000	4′ 0″	8′ 6″	4′ 0″	5′ 0″
1200	4′ 0″	9′ 0″	4′ 6″	5′ 6″
1500	4′ 6″	10′ 0″	4′ 6″	5′ 6″
2000	5′ 0″	11′ 0″	5′ 0″	6′ 3″
2500	5′ 6″	12′ 0″	5′ 0″	6′ 3″
3000	6′ 0″	13′ 6″	5′ 0″	6′ 3″
3500	6′ 0″	15′ 6″	5′ 0″	6′ 3″
4000	6′ 0″	18′ 0″	5′ 0″	6′ 3″
4500	6′ 9″	18′ 0″	5′ 0″	6′ 6″
5000	7′ 6″	18′ 0″	5′ 0″	6′ 6″

tight. The sand and gravel used for this purpose shall be clean and free of silt and clay. The water likewise shall be clean and free of excessive organic matter. For most construction of this type a 1-2-3 mix is satisfactory, that is, 1 part of cement, 2 parts of sand and 3 parts of gravel. The use of ungraded pit run gravel is not recommended. It is most important that the amount of water used be kept at a minimum. Use only enough water to make the mix workable. Do not use a soupy mix.

4. **Dosing Chamber with Automatic Siphon.** Dosing chambers with automatic siphons are not generally recommended in septic tank installations serving individual dwellings. Periodical dosing of the disposal field is desirable in most instances but the additional cost of automatic siphons is not considered justifiable in the small dwelling installations. Siphons should be provided on large septic tank installations (1000 gallons and more), but only when sand filter trenches or open sand filter beds are used for the disposal of the tank effluent. Siphons shall not be installed in any system where their use would require the tile lines in the disposal field to be more than 36 inches deep. Whenever a siphon is installed, the liquid capacity of the dosing chamber should be sufficient to fill all field lines from one-half to three-fourths full at each discharge, but the discharges should not occure more frequently than a 2- to 3-hour interval.

G. SUBSURFACE DISPOSAL FIELD

A subsurface disposal field is an open-jointed system of pipes or drains through which the septic tank effluent or overflow is distributed beneath the surface of the ground for percolation into the soil. The disposal field is the part of the septic tank system which is most likely to cause trouble and, therefore, it is essential that it be properly designed and carefully installed. The distribution tile must be kept near the surface of the ground and in the top soil if possible. Under no circumstances should it be more than 36 inches deep. In level areas it may be necessary to install automatic sump pumps to lift the laundry water and floor drainage from the basement level into the septic tank in order to keep the disposal field at a satisfactory elevation. To eliminate the need for installing basement sump pumps, however, it is recommended that if at all possible laundry trays be located in a utility room on the ground floor instead of in the basement. Sump pumps require careful maintenance and so their use should be avoided wherever posisble. It should be pointed out again that ground water drainage such as that from beneath the basement floor must not be discharged into the sewage disposal system. If necessary, such drainage can be discharged directly into the road ditch or street gutter.

Subsurface disposal fields shall not be used in heavy clay soil or in areas in which the groundwater table during any season of the year is within 24 inches of the natural ground surface. Disposal fields shall conform with the following requirements:

1. **Location.** They shall be located at least 100 feet from any well, spring or other source of domestic water supply, 25 feet from any stream, river or lake, and 10 feet from a building or property line. Wherever it is necessary for any tile line in a subsurface disposal field to be located within 10 feet of a water line, it shall be constructed with watertight joints. Typical layouts for disposal fields are shown in Figure 6.
2. **Distribution Box.** A distribution box of sufficient size to accommodate all field lateral lines shall be provided for each disposal field having more than one lateral or more than 100 feet of tile. Each field lateral line shall be connected separately to the distribution box. The invert of all outlets shall be level and approximately one inch lower than the inlet. (See Figure 7.)
3. **Minimum Seepage Area.** The amount of seepage area (total flat area of bottom of trenches) required for each disposal

field depends upon the porosity of the soil and shall be determined either by the use of Table IV, or by making a percolation test according to the following instructions:

TYPICAL FIELD LAYOUT FOR DISPOSAL FIELD

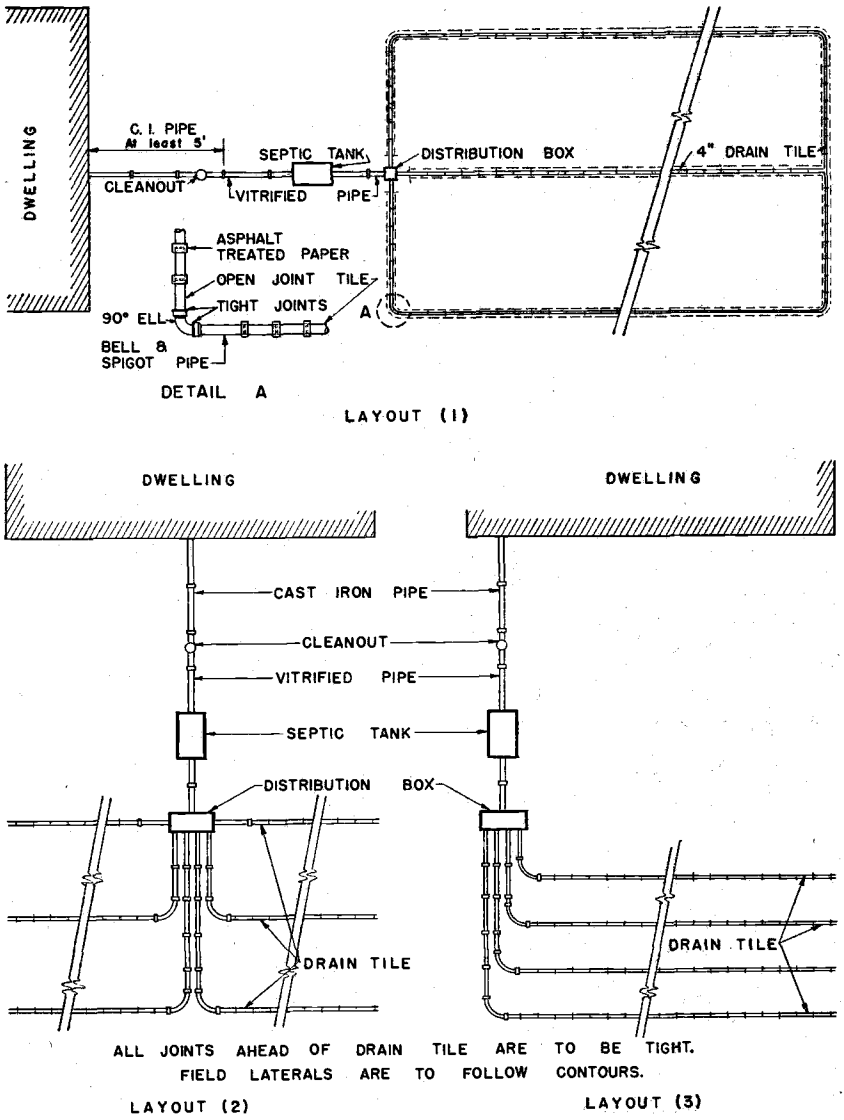


FIGURE 6

CONSTRUCTION OF DISTRIBUTION BOX

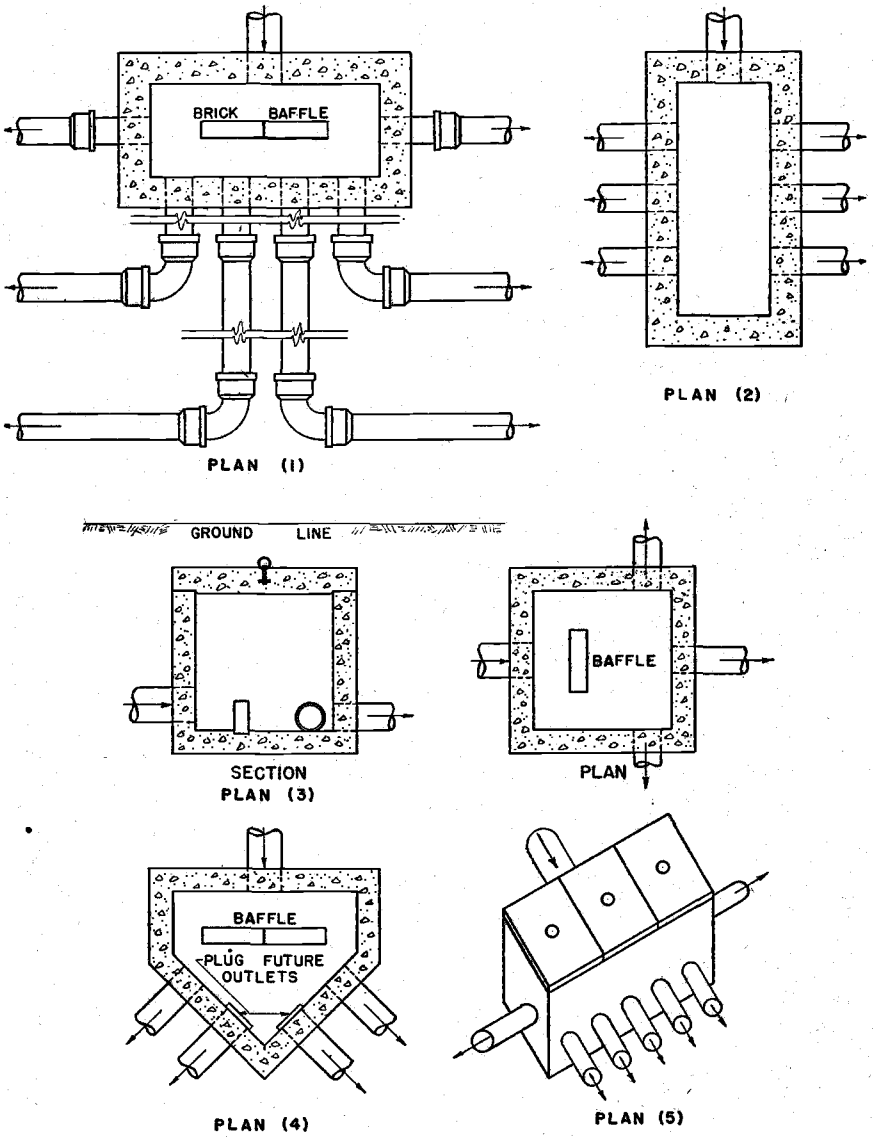


FIGURE 7

Table IV

MINIMUM SEEPAGE AREAS FOR DISPOSAL FIELDS

Character of Soil	*Effective Absorption Area (Area of Bottom of Disposal Trench) in Square Feet per 100 Gallons of Daily Sewage Flow*
Clean coarse sand or gravel	50*
Clean fine sand	80*
Light loam	100*
Clay with considerable sand or gravel	150*
Clay with small amount of sand or gravel	240
Heavy clay, hardpan, rock or other impervious formations	Unsuitable

*NOTE: A minimum of 150 square feet of effective absorption area (100 lineal feet of 18-inch trench) shall be provided for each individual dwelling unit.

Instructions for Making Percolation Test

a. Excavate hole one food square to the depth of the proposed disposal trench.
b. Thoroughly wet sides and bottom of hole, and while the bottom is still moist, fill the hole with 6 inches of water.
c. Record the time, in minutes, required for water to completely seep away. Divide the time by six to obtain average time for one inch of water to seep away.
d. Make at least two percolation tests at different locations for each disposal field.
e. Determine from Table V the seepage area (in square feet) required for the estimated average daily sewage flow.

NOTE: Judgment is required in determining how soil conditions at time of test vary from year-around average. Where soil appears exceptionally dry, the test should be repeated. In no case shall tests be made in filled or frozen ground. The condition of the ground during the season of winter rains must especially be taken into consideration.

Table V

SEEPAGE AREA REQUIREMENTS ACCORDING TO PERCOLATION TESTS

Time Required for Water to Fall One Inch (in Minutes) by Percolation Test	*Effective Absorption Area (Area of Bottom of Disposal Trench) in Square Feet per 100 Gallons of Daily Sewage Flow*
2 or less	50*
5	80*
10	100*
15	125*
30	175
60	250
Over 60	Unsuitable

*NOTE: A minimum of 150 square feet of effective absorption area (100 lineal feet of 18-inch trench) shall be provided for each individual family dwelling unit.

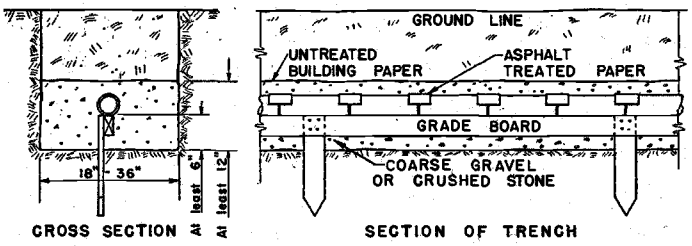
4. **Construction.** All disposal field trenches shall conform with the following standards. (See Figure 8.)
   a. Maximum length of any lateral tile line shall be 100 feet.
   b. Minimum width of bottom of trench shall be 18 inches.
   c. Maximum depth of seepage trench shall be 36 inches.
   d. Maximum grade of tile line shall be 6 inches per 100 feet.
   e. Size and minimum spacing of trenches shall conform to Table VI.

Table VI

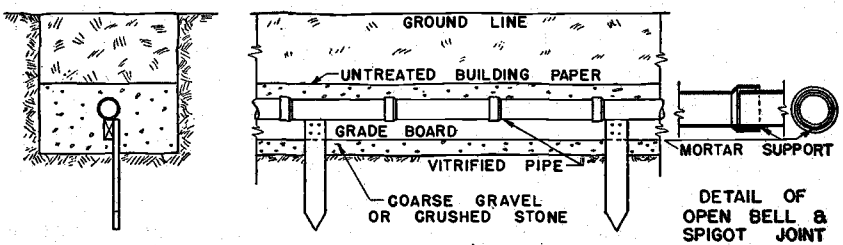
SIZE AND MINIMUM SPACING FOR DISPOSAL TRENCHES

Width of Trench at Bottom in Inches	*Depth of Trench in Inches*	*Effective Absorption Area in Square Feet per Lineal Foot*	*Minimum Spacing of Tile Lines in Feet*
18	18 to 30	1.5	6.0
24	18 to 30	2.0	6.0
30	18 to 36	2.5	7.5
36	24 to 36	3.0	9.0

DISPOSAL TRENCH CONSTRUCTION



UNGLAZED DRAIN TILE



BELL & SPIGOT VITRIFIED PIPE

FIGURE 8

f. Minimum depth of filter material beneath tile shall be 6 inches. Minimum total depth of filter material in trench shall be 12 inches.
g. The filter material shall be clean crushed stone, gravel, slag or cinders varying in size from ½ to 2½ inches. The filter material shall be covered with untreated building paper, or a 2-inch layer of straw or hay before the trench is backfilled with earth.
h. The field tile shall have a minimum diameter of 4 inches and shall be laid with ¼ inch open joints or be otherwise perforated to permit seepage into the filter material. Open joints shall be protected on top by strips of asphalt-treated building or tar paper. Vitrified clay or concrete drain tile or perforated bituminized fiber pipe may be used as field tile.
i. Grade boards shall be used underneath all short length drain tile. They are not necessary with bell and spigot pipe or with bituminized fiber pipe.
j. Brick or concrete drop boxes or ells with cemented joints shall be used where necessary to maintain proper grade and cover.

H. SEEPAGE PIT

A seepage pit is a covered pit with open-jointed lining through which settled sewage or laundry wastes may seep or leach into the surrounding porous soil. A seepage pit is sometimes used in conjunction with a cesspool and may also be used with septic tanks in areas where proper subsoil conditions are found.

1. **Location.** Seepage pits shall be used only in areas approved by the local health department. They shall not be used in limestone areas or in areas where shallow wells are used as a source of domestic water supply. They shall be located at least 150 feet from a well, spring, or other source of domestic water supply, 25 feet from any stream, river or lake, and 10 feet from a building or property line.
2. **Liquid Capacity.** The liquid capacity of a seepage pit shall be at least that of the septic tank or cesspool which precedes it. It shall have a minimum inside diameter of 4 feet, and it shall penetrate at least 5 feet of porous formation. If ground water is encountered, at least 2 feet of clean coarse sand shall be placed in the bottom of the pit above the water table. The effective absorption area required shall be determined in accordance with Table VII.

Table VII

REQUIREMENTS FOR SEEPAGE PIT DESIGN

Character of Soil	*Effective Absorption Area (Square Feet of Side Wall Area of Pit, Exclusive of Curbing) per 100 Gallons of Daily Sewage Flow*
Clean coarse sand or gravel	20
Clean fine sand	30
Light loam	50
Clay with considerable sand or gravel	80
Clay with small amount of sand or gravel	160
Heavy clay, hardpan, rock or other impervious formation	Unsuitable

3. **Construction.** The design of a seepage pit is illustrated in Figure 9. The seepage pit shall be lined with stone, brick, or concrete blocks laid up dry with 2- to 4-inch open vertical joints that are backed up with at least 3 inches of clean, coarse gravel to the elevation of the inlet. Above the inlet level the joints shall be sealed watertight with cement mortar. A reinforced concrete slab at least 4 inches thick shall be used as

SEEPAGE PIT CONSTRUCTION

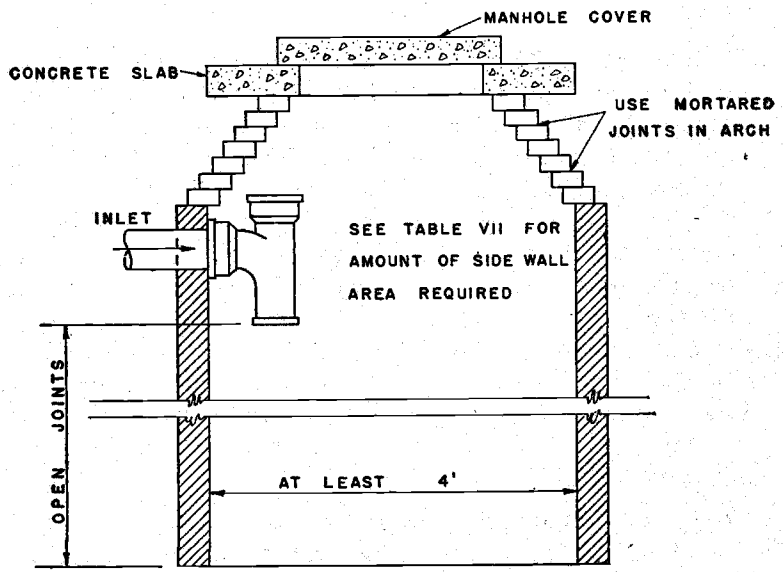


FIGURE 9

a top for the pit. The top shall have a manhole and shall be located from 1 to 2 feet below the finished ground surface. Tight jointed sewer pipe shall be used for making connections to the pit.

If conditions require that seepage pits be located near large trees, the pits may be constructed without lining. In such cases the entire pit should be filled with loose rock. This type of construction will provide means for the roots to enter the pit without causing any damage.

Where more than one seepage pit is used, a distribution box shall be provided to divide the flow evenly among them.

I. SAND FILTER TRENCH

A sand filter trench is a subsurface artificial sand filter with an underdrain system which collects and carries the filtered effluent by gravity into a suitable drainage way. It is used only in areas where impervious soil conditions make other methods of disposal impossible, where the topography is favorable, and where satisfactory receiving streams are available. Because of its inefficiency it can not be used for every type of location.

1. **Location.** No sand filter trench with effluent discharging into an open ditch or water course shall be constructed in any location without the written approval of the State Board of Health.

2. **Construction.** The sand filter trench shall be constructed by laying two lines of tile, one above the other, in a trench or series of trenches with at least 30 inches of artificial filtering medium between the two lines. The upper line is for the purpose of distributing the sewage over the top of the filter medium and the lower line is to collect the filtered liquid and convey it to the point of discharge. The filtering material shall be clean coarse sand all passing a ¼ inch mesh screen. The distributing and collection tile shall be laid in graded gravel of a size ranging from ¼ inch to 1 inch in size. The distribution tile shall be laid on an even grade of not more than 6 inches per 100 feet. Other construction details shall be similar to those given above for the subsurface disposal field. (See Figure 10.)

3. **Area of Filter Bed Required**. Each sand filter trench installation shall have an area sufficient to produce a filtration rate of not more than 2.0 gallons per square foot per day for the maximum estimated sewage flow.

SAND FILTER TRENCH CONSTRUCTION

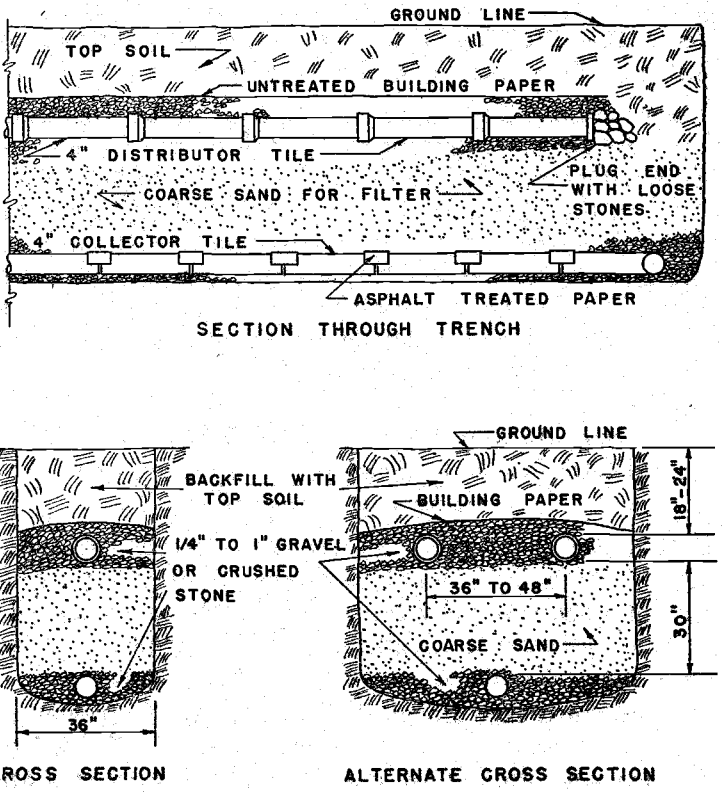


FIGURE 10

J. CESSPOOL

A cesspool is a covered pit with open-jointed lining into which raw sewage is discharged, the liquid portion of which is disposed of by seepage or leaching into the surrounding porous soil, the solids or sludge being retained in the pit to undergo bacterial decomposition. (See Figure 11.)

1. **Location.** Cesspools shall be used only in areas approved by the local health department. They shall not be used in limestone areas or in areas where shallow wells are used as a source of domestic water supply. Cesspools shall be located at least 150 feet from any well, spring, or other source of

domestic water supply, 15 feet from a seepage pit or other cesspool, 25 feet from any stream, river, or lake, and 10 feet from a building or property line.

2. **Liquid Capacity**. The minimum inside diameter shall be 4 feet and the minimum depth beneath the inlet shall be 15 feet. The effective absorption area shall penetrate at least 5 feet of clean coarse gravel or equally porous material.

3. **Construction**. The lining and top shall be constructed as required for a seepage pit except that, if desired, the top may be constructed of brick in the form of an arch and with the inlet at the crown of the arch. All joints in the brick arch shall be sealed tight with cement mortar. In areas where the porosity of the soil is questionable a seepage pit or pits having a total liquid capacity equal to or greater than that of the cesspool should be installed for disposal of the cesspool overflow.

K. OPERATION AND MAINTENANCE OF THE INDIVIDUAL WATER-CARRIED SEWAGE DISPOSAL SYSTEM

A well designed, properly located, and installed water-carried sewerage system using subsurface disposal will give years of safe and satisfactory service provided it is properly operated and maintained. The following recommendations if carefully carried out will help prolong the life of such a sewerage system:

1. Keep unnecessary flows of water out of the sewer system. Provide a separate drainage system for the disposal of roof, surface, and ground waters. Repair leaky faucets and any other leaks in the water system as soon as they are noticed. By so doing you will cut down on the water consumption and may also reduce your water bill, in addition to decreasing the load on the sewer system.

2. Do not use the sewer system for the disposal of every conceivable type of waste. Garbage should not be emptied into the sewer through the kitchen sink or toilet bowl. Fruit and vegetable skins, rinds, seeds and pits and similar solids decompose very slowly and, therefore, help fill up rapidly the septic tank or cesspool. Put garbage in the garbage pail and not in the sewer. Kitchen fats and grease float on the liquid surface in septic tanks or cesspools and decompose very slowly. If unnecessarily large amounts are allowed to reach the seepage pit or disposal field, they soon cause the soil to become

CESSPOOL - CONSTRUCTION -

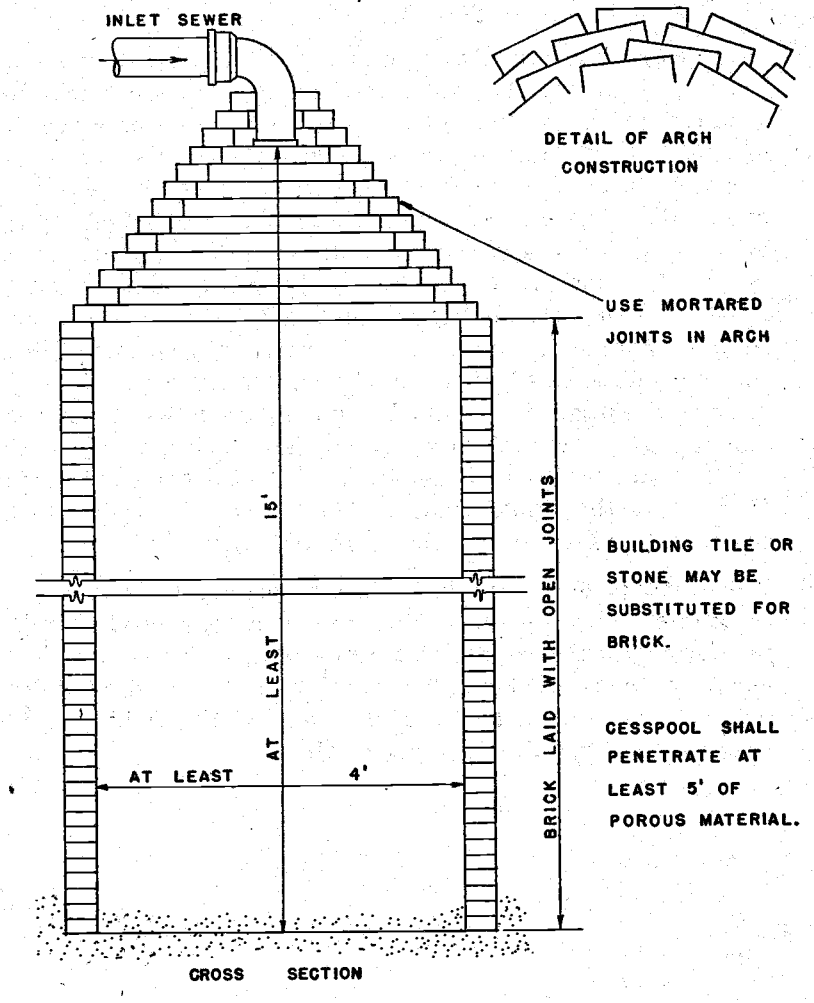


FIGURE 11

clogged and before long a new system is required. Therefore, dump all the fats and grease possible into the garbage pail instead of down the sewer.

Caution: Do not install a household garbage grinder in your home unless a regular community sewerage system is accessible. The amount of kitchen garbage produced daily in the average home would soon overload either a septic tank or cesspool sewage disposal system.

3. Inspect the septic tank at regular intervals, at least once each year, to determine the amount of sludge and scum that has accumulated in it. If the tank is allowed to become too full of sludge, it will fail to operate efficiently and the solids will overflow into the seepage system, causing the latter to eventually clog up. The tank should be cleaned out if the volume of sludge and scum equals one-third or more of the depth. The amount of scum and sludge can be determined by means of a long stick being pushed through the liquid contents to the bottom of the tank. From the pressure required to force the stick downward, it is possible to estimate the depth of scum and sludge. It should be remembered that by merely looking into the tank one cannot tell if it actually needs cleaning out for there is always a fairly thick layer of scum floating on the liquid surface. This makes it appear to be completely full of solids when perhaps it actually is not.

4. When stoppage occurs in a sewer system, it is generally advisable and more economical to call a registered plumber to investigate the source of trouble than to hire someone to clean out the septic tank. The trouble may be in the building drain, house sewer, septic tank inlet, or tile field and the tank may not require cleaning at all.

Part III

NON-WATER CARRIED SEWAGE DISPOSAL METHODS

A. INTRODUCTION

Every home and occupied building not provided with running water and sewers should have a sanitary privy. The earth pit privy is the most common type. It is generally a fairly satisfactory means of waste disposal and is economical to build. It is especially suitable in porous soil formations where the groundwater table is below the bottom of the pit. It consists of a pit or vault in the earth into which human excreta is discharged and from which liquids seep into the surrounding soil. The pit is covered by a small building. The open back, surface privy exposes to flies, rodents and other vermin, human wastes which may contain dangerous disease germs. It is difficult to construct a fly-tight privy and to maintain it so that no unpleasant odors will be created. There is also the possibility of the seepage from the pit contaminating nearby ground water supplies. Unless special precautions are taken, therefore, in the location, construction and maintenance, the privy is apt to constitute both a nuisance and a public health hazard.

In areas where it is necessary to prevent contamination of shallow ground waters either a watertight concrete vault privy, a pail-type privy, or a chemical toilet should be used. The pail-type privy is also suitable in areas where for other reasons it is not practicable to execavate a pit.

The concrete vault privy is essentially a pit privy in which the pit is lined with impervious material and in which provision is made for the removal of excreta. It has a building over it the same as the pit privy. Because the vault is water-tight, the liquids do not leach away into the soil. Consequently, it is necessary to remove the contents at regular intervals and dispose of them by burial under at least one foot of soil in an area where the ground water will not be polluted.

The pail privy is one that employs the use of a watertight container directly beneath the seat for receiving deposits of human excreta. The container is small and should be empied frequently, preferably daily. Final disposal of the contents is by burial or by discharging into a manhole of a water-carried sewerage system.

The chemical toilet is somewhat similar to the watertight vault privy except that the underground receptacle located directly beneath the seat for receiving the human excreta generally consists

of a metal drum or tank which holds the chemical solution. It has a stirring device for mixing the chemical solution with the sewage. The chemical solution consists of a strong caustic such as sodium hydroxide. Its main purpose is to emulsify the fecal matter and paper and to liquefy the contents. If the chemical solution is maintained strong enough, it will help keep down unpleasant odors. Final disposal of the tank contents is by burial under the ground surface. The contents should not be discharged into a sewerage system where treatment processes are involved. This type of toilet requires very careful maintenance and should not be installed if proper supervision cannot be given.

B. EARTH PIT PRIVY

The construction of earth pit privies shall comply with the following requirements. (See Figure 12.)

1. **Location.** They shall be located at least 50 feet from any well, spring or other source of domestic water supply, 25 feet from any stream, river or lake, and 10 feet from any property line. The drainage shall be away from and not toward the water supply. The pit shall not extend within two feet of the groundwater table.
2. **Construction.** The pit shall have a minimum capacity of 50 cubic feet, shall be at least 5 feet deep, and shall be lined with lumber to prevent caving. The pit shall be covered by a building of substantial construction located on either a concrete or a creosote-treated wood sill or foundation. An earth embankment shall be placed around the sill to make it as fly-tight and rodent-proof as possible from the outside. The floor and riser shall be built fly-tight of wood, metal or concrete. The seat opening shall be covered with a lid, hinged and so constructed that when closed it will exclude flies from the pit. Vents connected to the pit shall be covered with 16-mesh copper wire screen. The building shall have a tight-fitting door and a substantial roof.
3. **Maintenance**. The seat covers shall be kept closed during the fly season when the privy is not in use. The contents of a privy shall not be permitted to overflow onto the surface of the ground or be exposed to flies and rodents. When the pit becomes filled to within 18 inches of the ground surface, either the contents shall be removed and disposed of by burial or a new pit shall be excavated and the old one shall be backfilled with at least two feet of earth.

C. PRIVIES WITH WATERTIGHT RECEPTACLES

On the water-sheds of public water supplies, concrete vault privies, pail privies, or chemical toilets shall be used in the place of earth pit privies for the disposal of human excreta. The vaults and receptacles shall be constructed of reinforced concrete or metal and shall be watertight. They shall be maintained in a sanitary condition and the contents shall be disposed of by burial beneath at least one foot of earth in a location where the ground water will not be polluted.

EARTH PIT PRIVY CONSTRUCTION

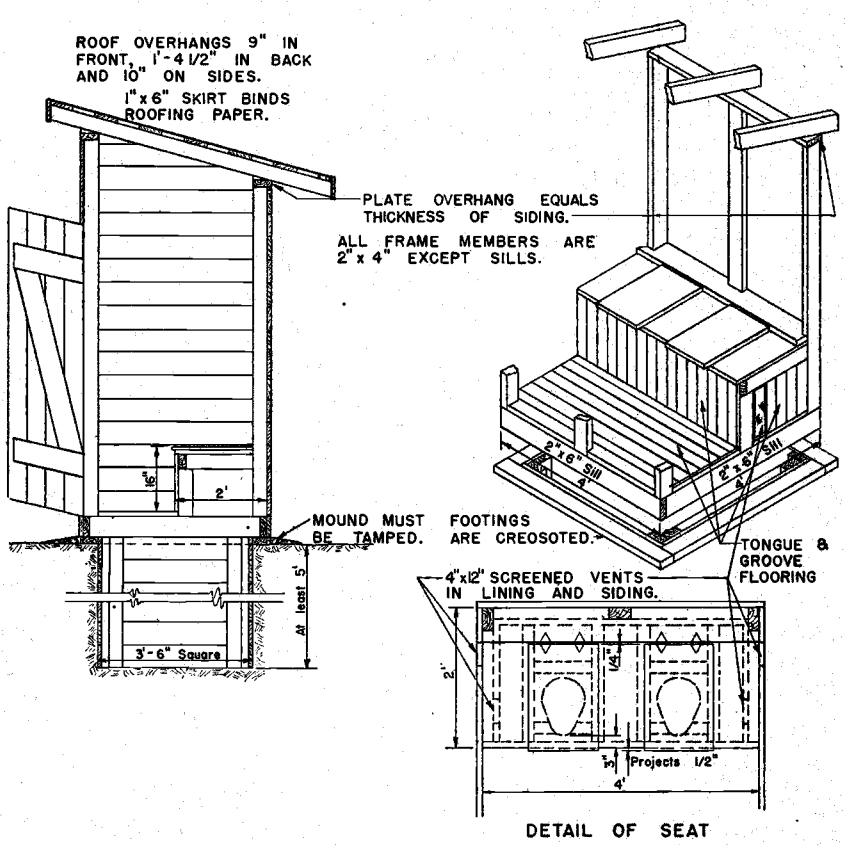


FIGURE 12

D. OPERATION AND MAINTENANCE OF NON-WATER CARRIED SEWAGE DISPOSAL SYSTEM

As previously mentioned, special attention must be given to the maintenance of privies if odor nuisances and health hazards are to be avoided. The most important item is to keep them as fly-tight as possible. It is possible that the common house fly plays an even greater role in the transmission of certain diseases than is realized at the present time. Therefore, always keep the seat lids closed when the privy is not in use. This practice will not only prevent flies from carrying filth and disease germs from the privy to our food and drink, but it will also help prevent the escape of unpleasant odors. To assist in making the pit fly-tight, make certain that the earth is banked up around the foundation of the privy building.

Keep the seat, floor and ground immediately surrounding the building clean. If the seat or floor becomes soiled, it should be scrubbed with warm water and soap.

Keep the door closed and latched when not in use.

When the privy pit becomes filled to within 18 inches of the ground surface, either clean it out or excavate a new pit.

The privy pit should be disinfected to prevent the breeding of flies and other insects and to control odors. This can best be done by spraying a mixture of crude oil and cresol over the contents of the pit once each week or more often if necessary. Kerosene can be used to thin the spray mixture for use in a spray gun.

The above recommendations also apply to the maintenance of a concrete vault privy. In the operation of the pail-type privy, it is essential that the receptacle be emptied at least daily. After the contents have been properly disposed of the receptacle should be thoroughly cleaned before being replaced.

In addition to the above precautions the following recommendations are submitted regarding the operation of chemical toilets:

1. Place 6 inches of water in the vault or tank when it is first placed in operation.
2. Add ¼ pound of lye or caustic for each cubic foot of tank capacity.
3. Add small quantities of lye or caustic from time to time to prevent odors.
4. Agitate the mixture of chemicals and sewage each time the toilet is used.
5. Clean out the tank when it becomes three-fourths full and dispose of the contents by burial beneath the ground as far from any source of water supply as possible.