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UNIFORM PLUMBING CODE ILLUSTRATED TRAINING MANUAL

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INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
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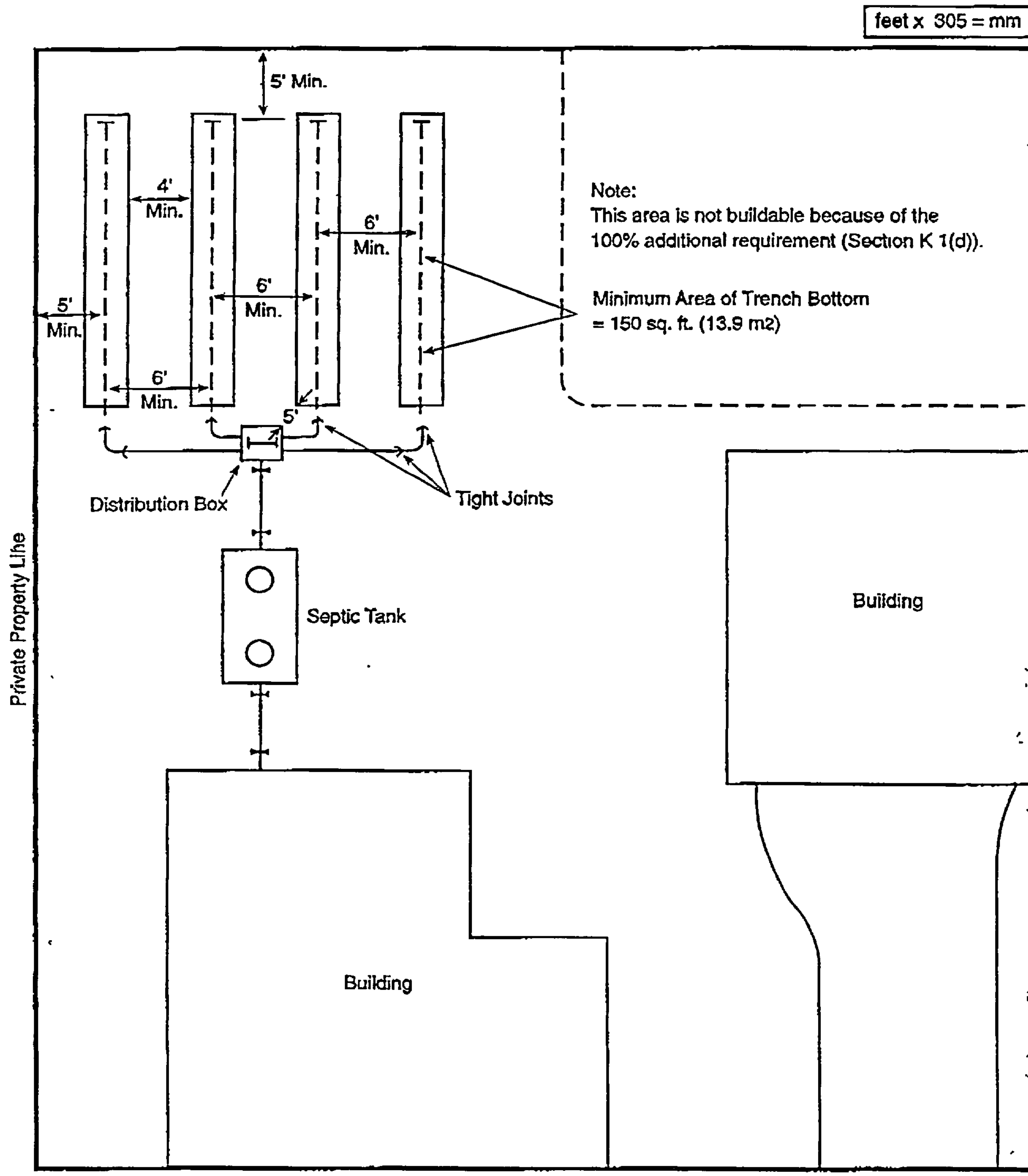


Figure K-1
Septic Tank System with Leach Lines for a Disposal Field

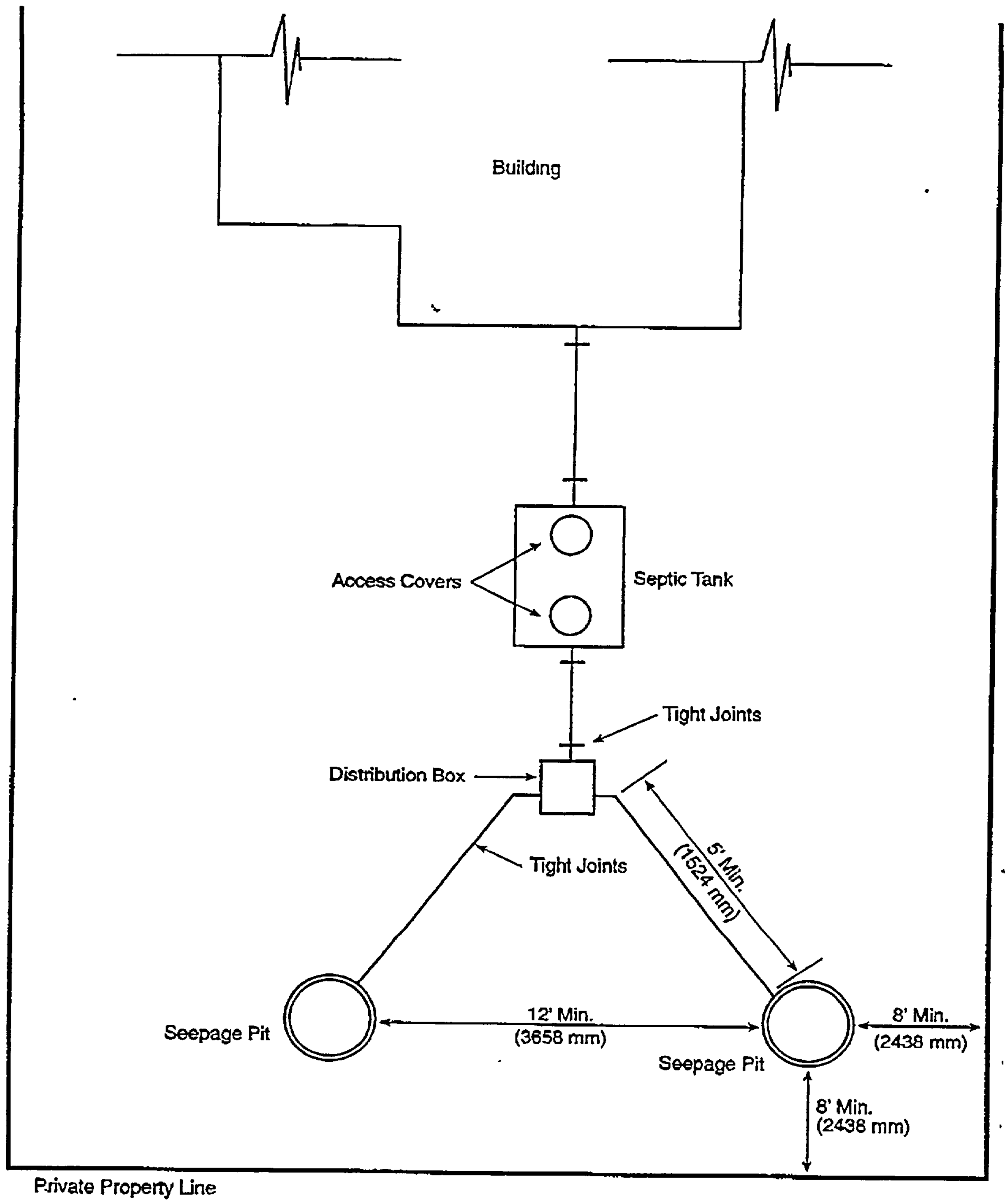


Figure K-2
Septic Tank System with Seepage Pits

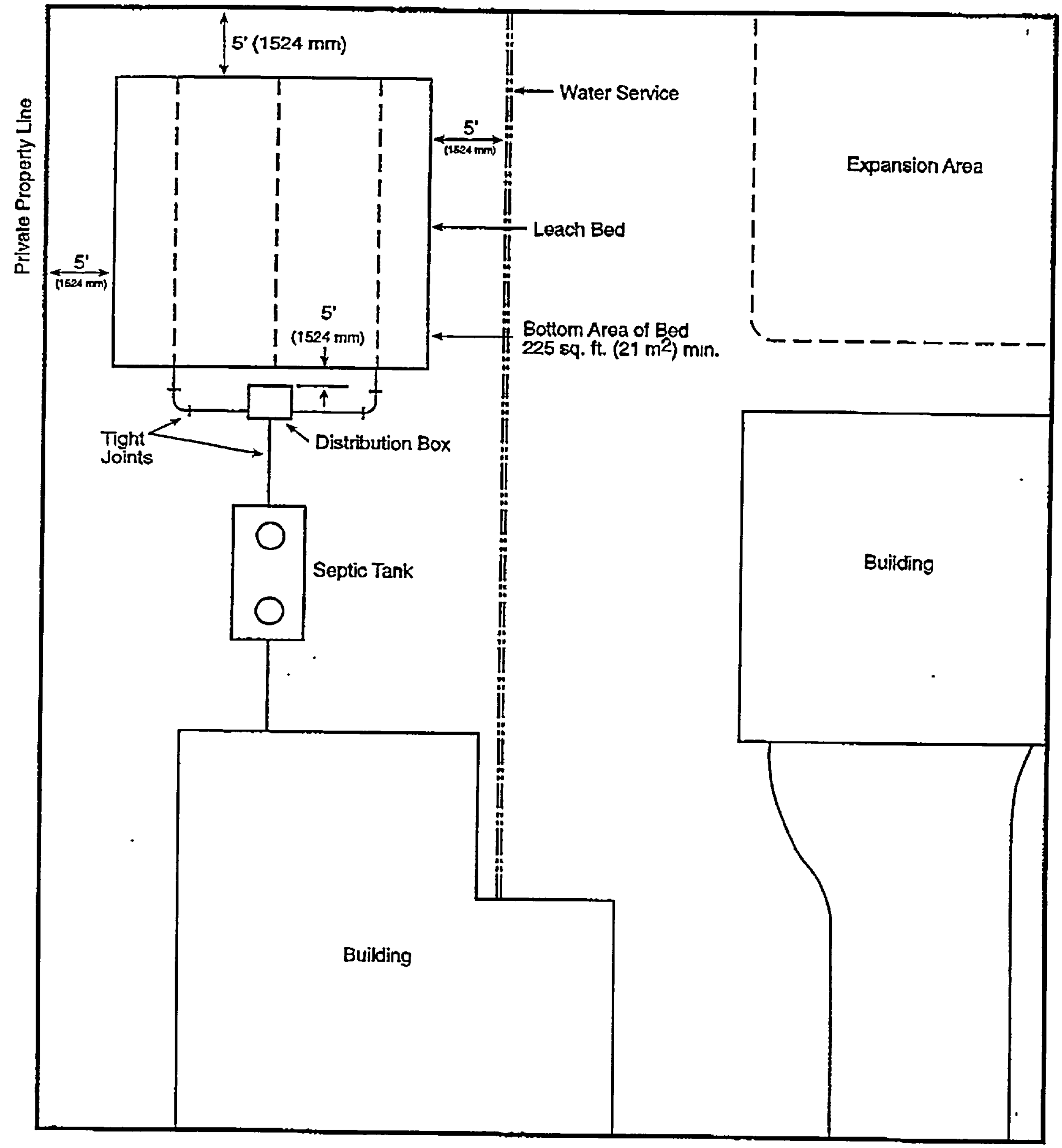


Figure K-3
Septic Tank System with a Leach Bed for a Disposal Field

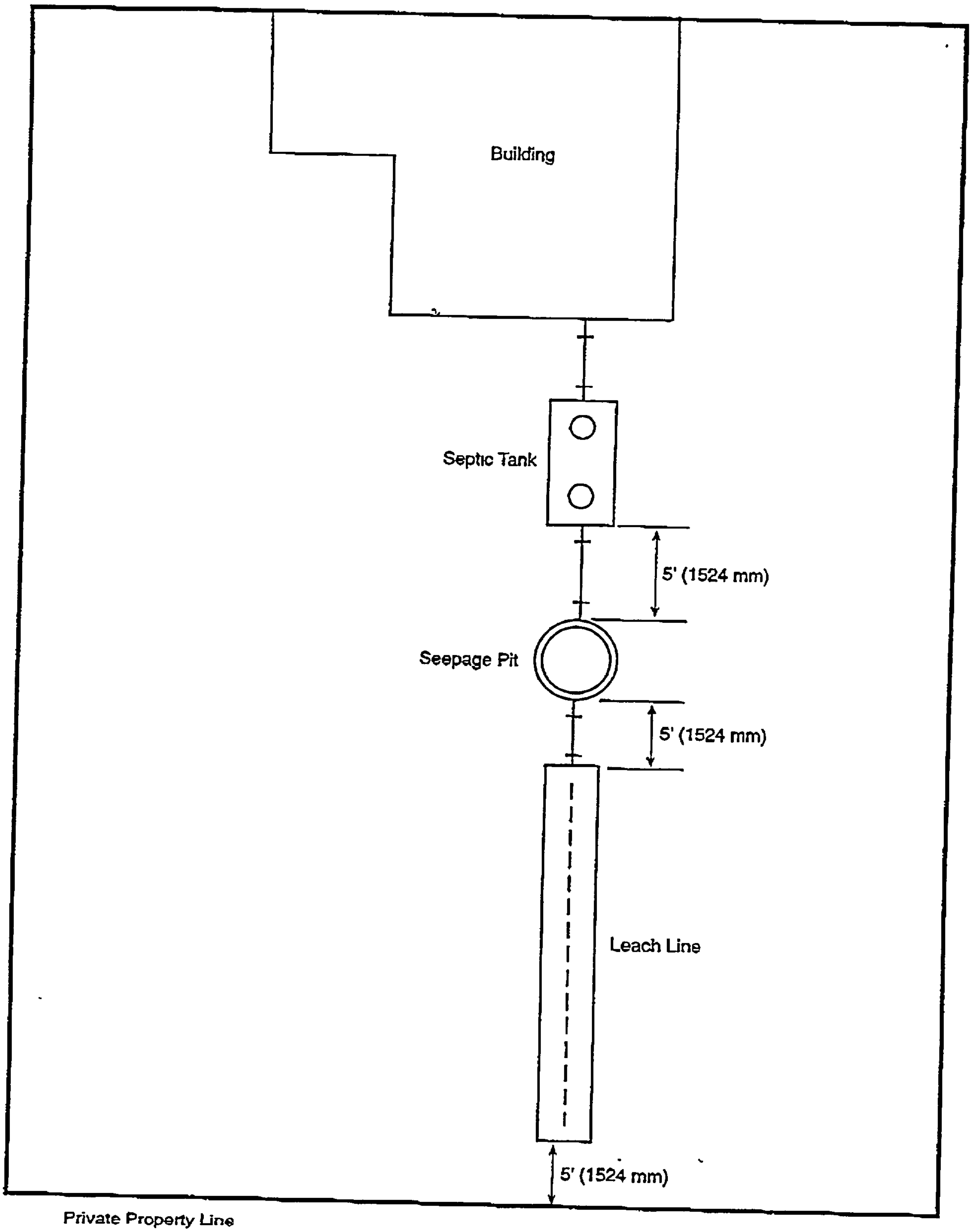


Figure K-4
Septic Tank System with a Combination Seepage Pit and Leach Line

LOT AREA

All private sewage disposal systems must be designed and laid out so that additional lot area is reserved for additional leach lines or seepage pits equivalent to at least 100% of the original system. The secondary part of the system will eventually fail or be unable to handle all the sewage. The space reserved must be suitable for the purpose and not built upon or subdivided until the property is connected to a public sewer system.

When there is insufficient lot area or improper soil conditions for adequate sewage disposal for the building or land use proposed, and the Administrative Authority so determines, no building permit and no private sewage disposal system will be permitted.

Where available land area or soil conditions are critical, no building permit will be issued until engineering data and test reports satisfactory to the Administrative Authority have been submitted and approved.

Where space conditions are critical, the Administrative Authority may require that the system be installed at the beginning of the construction project to assure that all requirements for expansion, building and property line clearances have been maintained. All topography or sub-soil conditions do not always appear accurately on plans or reports.

AEROBIC SYSTEMS

When aerobic systems are approved for installation, they must produce sewage effluent at least equivalent to septic tanks, whether their aeration systems are operating or not. This requirement may be modified when the local Administrative Authority can be assured that there will be adequate full-time maintenance of the system.

SEPTIC TANK CONSTRUCTION

Septic tanks must be watertight and constructed of materials not subject to excessive corrosion or decay, such as concrete, coated metal, concrete block plastered smooth inside, fiberglass or other suitable materials. Wooden septic tanks are not acceptable. (See Table 14-1 for approved materials.)

Plans for all septic tanks must be submitted to the local Administrative Authority for approval. Such plans must show all dimensions, reinforcing, structural calculations, and other pertinent data as may be required.

Each tank must be structurally designed to withstand all anticipated earth or other loads. The UPC requires that tank covers be capable of supporting an earth load of not less than 300 pounds per square foot (2068.5 kPa) when the maximum coverage does not exceed 3 feet. (914.4 mm) Steel septic tanks should not be less than 12 US GA. [0.1084 inches] (0.275 mm). Plans for septic tanks should be prepared under the supervision of a professional engineer.

Prefabricated septic tanks with unusual configurations should be checked for accurate gallonage by metering water into a sample tank. Septic tanks may be of any configuration – rectangular, cylindrical, vertical or horizontal, round or any combination – so long as construction and configuration complies with parameters established in the UPC. The design must produce a clarified effluent consistent with accepted standards and still provide adequate space for sludge and scum accumulations.

COMPARTMENTS

Septic tanks must have a minimum of two compartments. Available research data indicates that two compartment tanks of the proper proportions provide better suspended solids removal than tanks with one compartment or tanks with more than two compartments. This is especially valuable for the protection of disposal fields or beds.

The inlet compartment of any septic tank must not be less than 2/3 of the total capacity of the tank, nor less than 500 gallons (1892.7 L) liquid capacity and shall be at least 3 feet (914 mm) in width and 5 feet (1524 mm) in length. Liquid depth must be not less than 2 feet 6 inches (762 mm), nor more than 6 feet (1829 mm).

The second compartment must have a minimum capacity of 250 gallons (646.4 L) and a maximum capacity of 1/3 of the total capacity of the tank. In tanks having over 1500 gallons (5678 L) capacity, the second compartment may not be less than 5 feet (1524 mm) in length.

See Figure K-5.

Prefabricated concrete septic tanks over 1500 gallons (5678 L) are usually installed in battery sections. These are standard dimensioned tanks with ends removed so that tanks shells may be fastened together end-to-end making the required capacity. The completed tank still should be of two compartments. For example, two 1200 gallon (4542 L) tanks may be fastened together to make a 2400 gallon (9085 L) tank. It is important that the compartment location meets the requirements of the preceding paragraphs. The use of two 1200 gallon (4542 L) septic tanks installed parallel to each other with the building sewer into a diversion box should not be used. There is no assurance that raw sewage will be equally divided into the two tanks.

See Figure K-6.

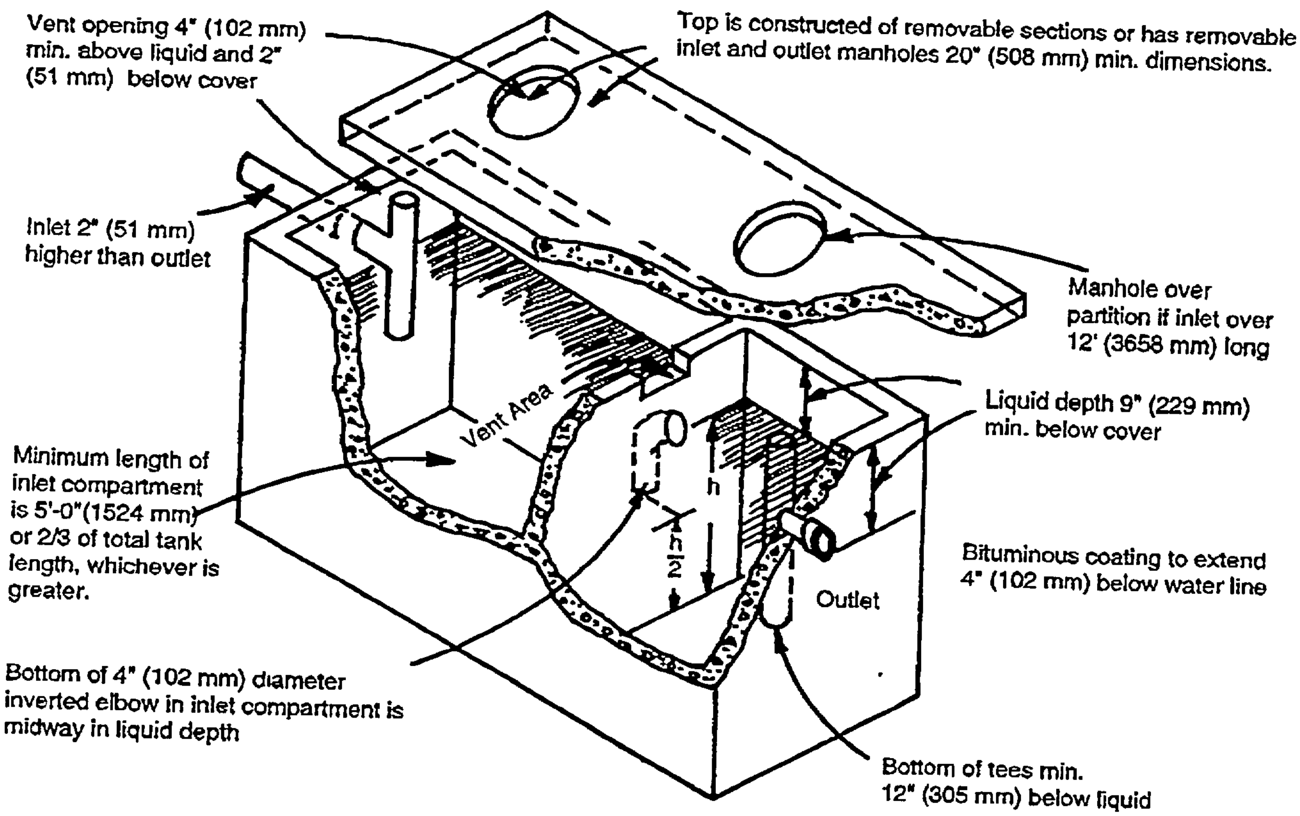


Figure K-5
Septic Tank Details

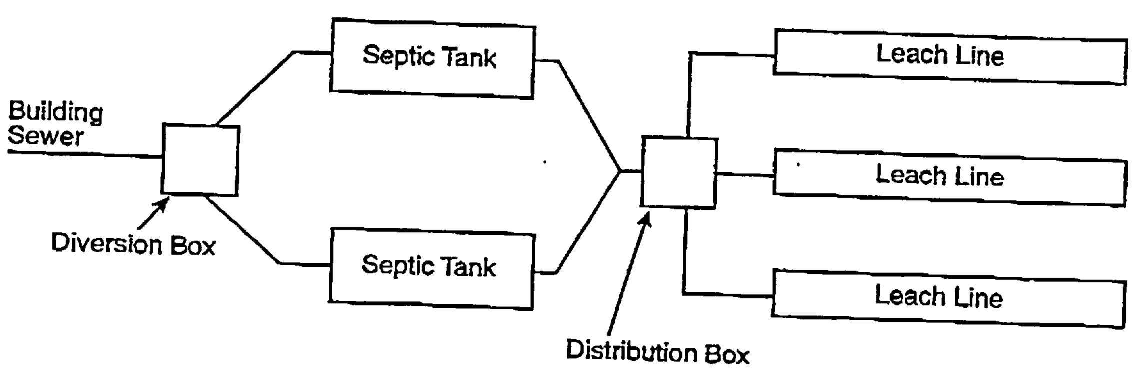


Figure K-6
Parallel Septic Tank Installation Should Not Be Used

Adequate access must be provided to each compartment of the tank for inspection and cleaning. Each tank should be provided with at least two (2) manholes 20 inches (508 mm) in minimum dimension or by an equivalent removable cover slab. One access manhole must be located over the inlet, and one located over the outlet. Manholes must be located so there is direct access to the inlet and outlet fittings or baffles for cleaning. Whenever a first compartment exceeds 12 feet (3657 mm) in length, an additional manhole must be provided over the tank compartment wall. The extra manhole on a large tank aids in the cleaning of the tank and allows the inspector to check the compartment fitting and back vent.

Septic tanks installed under concrete or blacktop paving must have the required manholes accessible by extending them to grade. Covers must be a type suitable for roadways and have a seal to keep odors from escaping.

TANK FITTINGS

The invert of the inlet fitting must be 2 inches (51 mm) above the invert of the outlet which will be the flow line. This is to allow for a momentary rise in liquid level during the discharge of the building sewer into the tank. This freefall drop prevents sewage from standing in the building sewer at the tank connection.

A vented inlet tee or baffle must be provided to divert the incoming sewage downward into the tank. To do otherwise would disturb the floating mat. The size of the vertical leg of the tee must be not less than the size of the building sewer or 4 feet (1219 mm) minimum. The sewage must enter into the tank at a point 12 inches (305 mm) below the liquid level. The outlet fitting is to be of the same configuration, except the invert is 2 inches (51 mm) lower than the inlet. Both fittings must have a free vent area equal to the required cross-sectional area of the building sewer connected to the tank. This is to provide free ventilation above the liquid surface from the secondary system through the septic tank, building sewer and building vent stack to the outer air.

The partition or baffle dividing the tank into compartments must be of durable material and must extend from the bottom to at least 4 inches (102 mm) above the liquid level. An inverted fitting (1/4 bend) equivalent in size to the tank inlet, but in no case less than 4 inches (102 mm), must be installed in the primary side of the partition with the bottom or inlet centered at the midpoint of the liquid level.

See Figure K-5.

Additional information on the manufacture of prefabricated concrete tanks and reinforced glass fiber tanks can be found in IAPMO Product Standard PS 1-93

Because chemically aggressive gases are generated in a septic tank, concrete must be protected by coating the wall to a point 4 inches (102 mm) below the liquid level and by covering all the internal area above that point. IAPMO Product Standard PS 1-93 contains the specification for the coating material.

Steel tanks must be coated both externally and internally to protect against corrosion by an approved bituminous coating.

CAPACITY OF SEPTIC TANKS

Capacity is one of the most important considerations in septic tank design. Studies have proved that liberal tank capacity is not only important from a functional standpoint, but is also good economy. The UPC requires the liquid capacity of all septic tanks to conform to Tables K-2 and K-3, as determined by the number of bedrooms or apartments in dwelling occupancies and the estimated waste/sewage design flow rate or the number of plumbing fixture units, as determined from Table 7-3, whichever is greater in other building occupancies. Mistakes have been made by using Table 6-4 (water pipe fixture units) rather than using Table 7-3. All examples in sizing will be the minimum standards required by the UPC.

Working with minimum standards of design for some time, a person begins to believe the minimum is best or adequate. This is not always the case. The examples used for septic tank sizing will also be used for sizing other parts of the system later in this chapter.

EXAMPLES:

1. What is the size of a septic tank for a four-bedroom single family dwelling?

   Refer to Table K-2 to determine that a 1200 gallon (4542.5 L) tank is required. Occasionally where space on a lot is critical, a builder will try to disguise a bedroom on the building plans by calling the room a den, office, sewing room, etc., in an attempt to reduce the system size, particularly the secondary system. It is best to resolve this kind of problem before plans are approved or the system has been installed.

2. What is the size of a septic tank for a twelve-unit apartment house with six one-bedroom units and six two-bedroom units?

   Refer to Table K-2 which shows that 10 units requires a 3500 gallon (13249 L) tank. By the footnote, the extra 2 units will add 250 gallons

Number of Fixtures		Fixture Unit Values (from UPC Table 7-3)			Totals
11	Water Closets	x	6	=	66
4	Urinals	x	2	=	8
6	Lavatories	x	1	=	6
3	Drinking Fountains	x	1	=	3
1	Service Sink	x	3	=	3
2	Floor Sinks	x	1	=	2
					88 Fixture Units

(946.4 L) each. The capacities shown are for one-bedroom units. Therefore, we must add 6 times 150 gallons (567.8 L) for the extra bedrooms.

Septic tank size would be:

3500 + (2 x 250) + (6 x 150) = 4900 gallons.

(13249 L + (2 x 946.4 L) + (6 x 567.8 L) = 18548.6 L)

Refer to Tables K-4 and K-5 which show that this size system can only be installed where the soil is classified as type 3 (sandy loam or sandy clay) or better. The maximum size septic tank permitted in type 3 soil is 5000 gallons (18927 L). If soils are less porous than type 3, plumbing in the building would have to be divided so that two smaller systems are installed at different locations on the property.

3. What is the size of a septic tank for a movie theater with 700 seats?

First, determine the total fixture unit loading on the building sewer from Table 7-3 and the estimated sewage waste per 24 hours from Table K-3. Assume the number and type of plumbing fixtures in the above table:

Note that six fixture units also are used for private use toilets when sizing septic tanks. See the footnote at the end of UPC Table 7-3.

88 Fixture units require a 3250 gallon (12302 L) septic tank. From Table K-3, a theater has a flow rate of 5 gallons (18.93 L) per seat per day.

700 seats x 5 = 3500 gallons sewage/day.

700 x 18.93 = 13251 Liters

Recommended design criteria for a septic tank system with over 1500 gallons (5678 L) per day is:

Flow x 0.75 + 1125 = septic tank size.

(13248.9 L x 0.75) + 4258.6 L = 14192.3 L

(3500 x 0.75) + 1125 = 3750 gallons.

Because the second design method produces the largest tank, this size would be the minimum required. Also, keep in mind the limitation on the maximum size tank from Table K-5.

Prefabricated concrete battery sectioned tanks usually do not come in an exact size needed. It is necessary to pick a combination which will produce a size equal to requirements of the next available size above. In this case it may be necessary to install a tank as large as 4000 gallons (15141.6 L), or job construct a tank from approved engineered plans.

The designer of septic tank systems for commercial and industrial projects sometimes has difficulty establishing the actual flow rate before a building is constructed.

The first paragraph in Table K-3 clearly notes that it is not possible to set absolute values for waste/sewage flow ratio for all situations. The designer should evaluate each situation, and if figures in this table need modification, they should be made with the concurrence of the local Administrative Authority. The designer must also consider business expansion, peak loading and overloading where applicable.

In one case of a premature system failure, it was discovered that a restaurant was being used by a cross-country bus company as a rest stop. This was in addition to normal patronage from a freeway nearby. The system just was not designed or installed to accommodate this overloading.

Any plumbing fixtures roughed-in, but not installed, should be considered in the septic tank design.

SOIL ABSORPTION SYSTEMS

Generally there are two common soil absorption systems: disposal fields which are made up by either leaching line, leaching beds or leaching chambers, and seepage pits. These are the only systems that the UPC has specific requirements for in Appendix K.

See Figures K-1, K-2, K-3 and K-4.

The selection of the type of absorption system will depend to some extent on the geographical location of the site under consideration and on local regulations.

The UPC requires that the system be designed to utilize the most porous or absorptive portions of the soil formations. Some authorities disagree with this statement, in part because in very porous soils sewage may travel long distances without further treatment by the soil, which can contaminate the underground water.

The UPC requires that when the ground water level extends to within 12 feet (3658 mm) or less of the ground surface, or where the upper soil is porous and the underlying stratum is rock or impervious soil, a leaching line or bed must be used.

Conversely, when the upper soils are impervious due to hard clays, caliche, or similar soils, seepage pits have been found to be more effective.

No excavation for leach lines or bed shall extend to within 5 feet (1524 mm) of the water table, nor to a depth where sewage may contaminate the underground water stratum that is used for domestic purposes. The 5 foot (1524 mm) separation may need to be increased in porous soils.

Exception: In areas where the records or data indicates that the ground waters are grossly degraded, the 5 foot (1524 mm) may be reduced by the local Administrative Authority.

The same rules apply in the use of seepage pits, except the separation is increased to 10 feet (3048 mm) between the bottom of the pit and the underground water stratum that is useable for domestic purposes. The greater separation is required because of the hydraulic pressure developed by the vertical columns of effluent in a seepage pit. Ground water level should be that known to be the highest height recorded, rather than the level taken from a percolation test made at the time of system installation.

Table K-1 provides data to be used in locating a sewage disposal system. The horizontal distance may be increased by the local Administrative Authority, particularly for water supply wells, streams, ground water and pressure public water mains.

The slope of land upon which an absorption system is to be constructed is critical. The note after Table K-1 requires that the minimum horizontal distance between any part of the leaching system and ground surface be 15 feet (4572 mm). This is most critical when installing an absorption system next to road cuts or embankments. Most hillside areas are not uniform, and in many cases there is bedrock or reduced permeability close to the surface of the ground. Past experiences have shown that there is a good possibility that failure will occur by surfacing of effluents at the road cut or embankment.

Slopes greater than 30% should be discouraged for use as absorption areas. Underlying strata may not be suitable for seepage pits, and depth of leach lines must be increased to provide the 15 feet (4572 mm) horizontal separation between the leaching trench and grade.

CONSTRUCTION OF DISPOSAL FIELDS – LEACH LINES OR BEDS

(a) Currently the most common piping in use for distribution is plastic: high density polyethylene, ABS, or PVC. The UPC requires that there be sufficient openings for distribution of the effluent into the trench area. Manufactured pipe for this purpose has two rows of 1/2 inch (13 mm) or 5/8 inch (16 mm) holes 120 degrees (2.09 rad) apart and spaced approximately 5 inches (127 mm) on center. The pipe is installed with holes downward centered over the rock filter material. Pipe joints must be coupled together and fittings be used for changes in direction.

See Figure K-7.

(b) Before placing filter material or drain lines in a prepared excavation, all smeared or compacted surfaces must be removed from trenches by raking to a depth of 1 inch (25.4 mm) and the loose material removed. This problem is most prevalent in moist clay type soils. Failure to do this reduces the permeability of the soil leading to earlier clogging.

Clean stone, gravel, slag or similar filter material varying in size from 3/4 inch (19 mm) to 2-1/2 inches (64 mm) is placed into the trench or bed to the depth and grade required by the design. The drain pipe is placed on the filter material and the drain line covered with a minimum of 2 inches (51 mm) of filter materials. Rock materials used must be round, as opposed to flat. Slag obtained from steel mills should be material known as blast furnace slag. Slag materials should be investigated, as they have been known to break down by the chemical action of the sewage. Properly graded and sized volcanic cinder rock is an acceptable material, although it has been known to fracture sharp corners during transport to the job site. This produces a rock dust which should be removed before being placed in the trench.

Filter material over the drain pipe is then covered with untreated building paper, straw or similar porous material to prevent closure of voids with earth backfill.

(c) A grade board staked in the trench to the depth of the filter material must be used when the distribution pipe is constructed with drain tile or flexible pipe material, which will not maintain alignment without continuous support. Systems using flexible pipe and grade board are seldom used due to the added cost of the grade boards.

(d) When seepage pits are used in combination with disposal fields, the filter material in the trenches must terminate at least 5 feet (1524 mm) from the pit excavation, and the line extending from such points to the seepage pit must be approved solid pipe with watertight joints.

(e) Where two or more drain lines are installed, an approved distribution box of sufficient size to receive lateral lines must be installed at the head of each disposal field. The inverts of all outlets must be level and the invert of the inlet shall be at least 1 inch (26 mm) above the outlets. Distribution boxes must be designed to insure equal flow and be installed on a level concrete slab in natural or compacted soil.

See Figure K-8.

Later in the design section of this chapter we will discuss ways to shorten lines to the point that a distribution box may be unnecessary.

(f) All laterals from a distribution box to the disposal field must be constructed with approved sewer pipe with watertight joints. Multiple disposal field lines, whenever practicable, shall be of uniform length. Table K-1 requires that a distribution box have a 5 foot (1524 mm) horizontal clearance from the disposal field.

> Exception: Listed or approved plastic leaching chambers may be used in lieu of pipe and filter material.

Leaching chamber installations shall follow the rules for disposal fields and, where applicable, shall conform to the manufacturer's installation instructions. (See (i) below.)

(g) The connection between a septic tank and a distribution box also must be laid with sewer pipe with watertight joints on natural ground or compacted fill.

(h) Section K-6(h) establishes the requirements and design criteria for dosing tanks. A dosing tank is required whenever the lineal length of pipe in a leaching system exceeds 500 feet (152 m). These are seldom necessary, except for the very largest specially designed private sewage disposal system because the size of a septic tank is limited by Table K-5. Most installations can be kept to the 500 foot (152 m) maximum length.

The purpose of a dosing tank is to charge the leach line with effluent to 60 to 75 percent of the interior pipe capacity, then to allow the system to rest. This provides equal distribution throughout the system, and the rest period is beneficial in extending the life of the system. This is accomplished with an automatic siphon or by a pump. On systems where line lengths exceed 1000 linear feet (304.8 m), dual siphons or pumps are required to alternately dose each half of the system.

See Figure K-9.

One comment about alternating leach line systems is needed. A septic tank effluent diverter valve is available commercially. This is a manually operated device. Its purpose is to divert the effluent into half the leaching system for a period of up to a year and then divert to the other half for a year. This has a very beneficial effect in allowing the resting system to rejuvenate. Where layout permits, when an existing system fails due to clogging and a new system must be installed, a diverter valve can be placed in the line leaving the septic tank and diverting the sewage to the replaced system. After an extended rest period, the old system can again become effective. When installing a new dual system, each side of the system should be designed to 75% or greater of a single system. A major problem is remembering to change the valve at the predetermined time.

(i) Section K-6(i) includes a table (reproduced below) which establishes the basic construction limits to installing a disposal field.

(j) Disposal fields shall be constructed as follows:

Minimum spacing between trenches or leaching beds shall be 4 feet (1219 mm) plus 2 feet (610 mm) for each additional foot of depth in excess of 1 foot

	Minimum	Maximum
Number of drain lines per field	1	–
Length of each line	–	100 ft. (30.5 m)
Bottom width of trench	18 in. (457 mm)	36 in. (914 mm)
Spacing of lines, center to center	6 ft. (1.8 m)	–
Depth of earth cover of lines [preferred -18 in (457 mm)]	12 in. (305 mm)	–
Grade of lines	level	3 in/.100 ft. (25 mm/m)
Filter material under drain lines	12 in. (305 mm)	–
Filter material over drain lines	2 in. (51 mm)	–

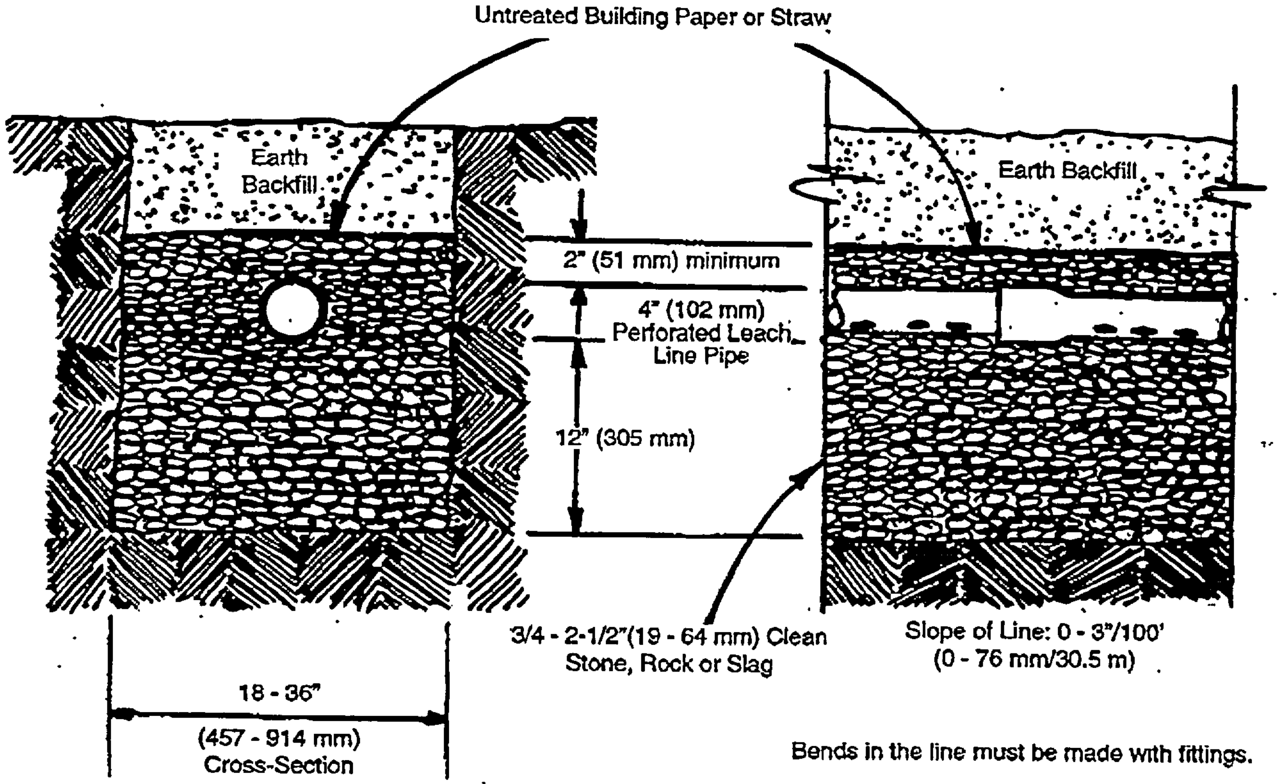


Figure K-7

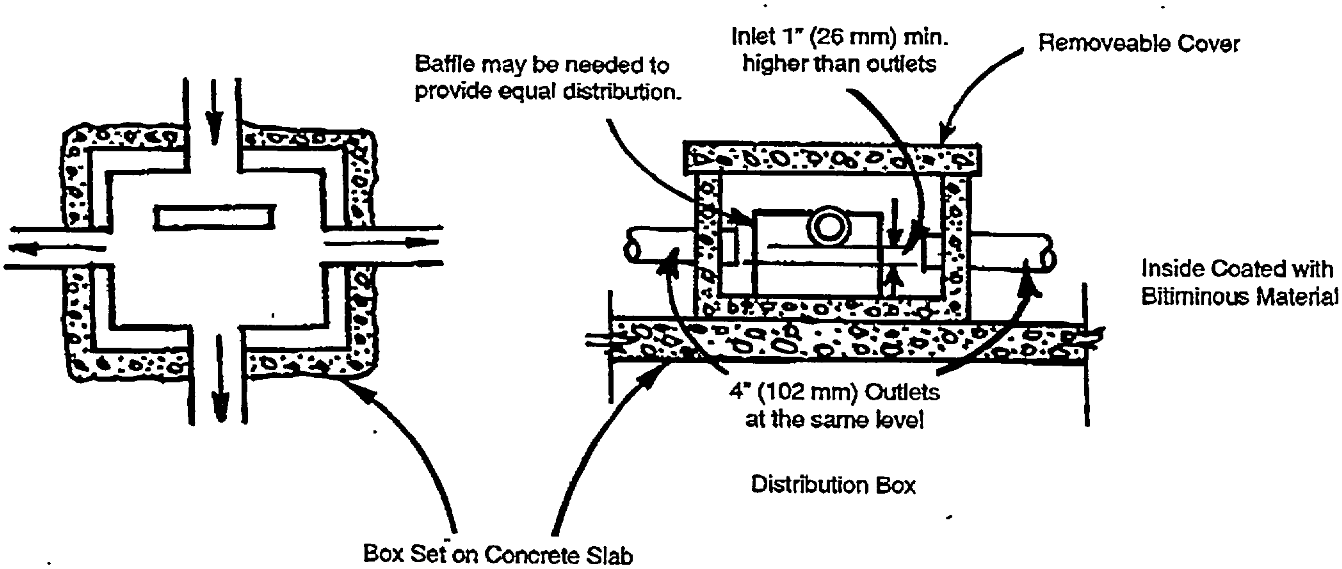


Figure K-8

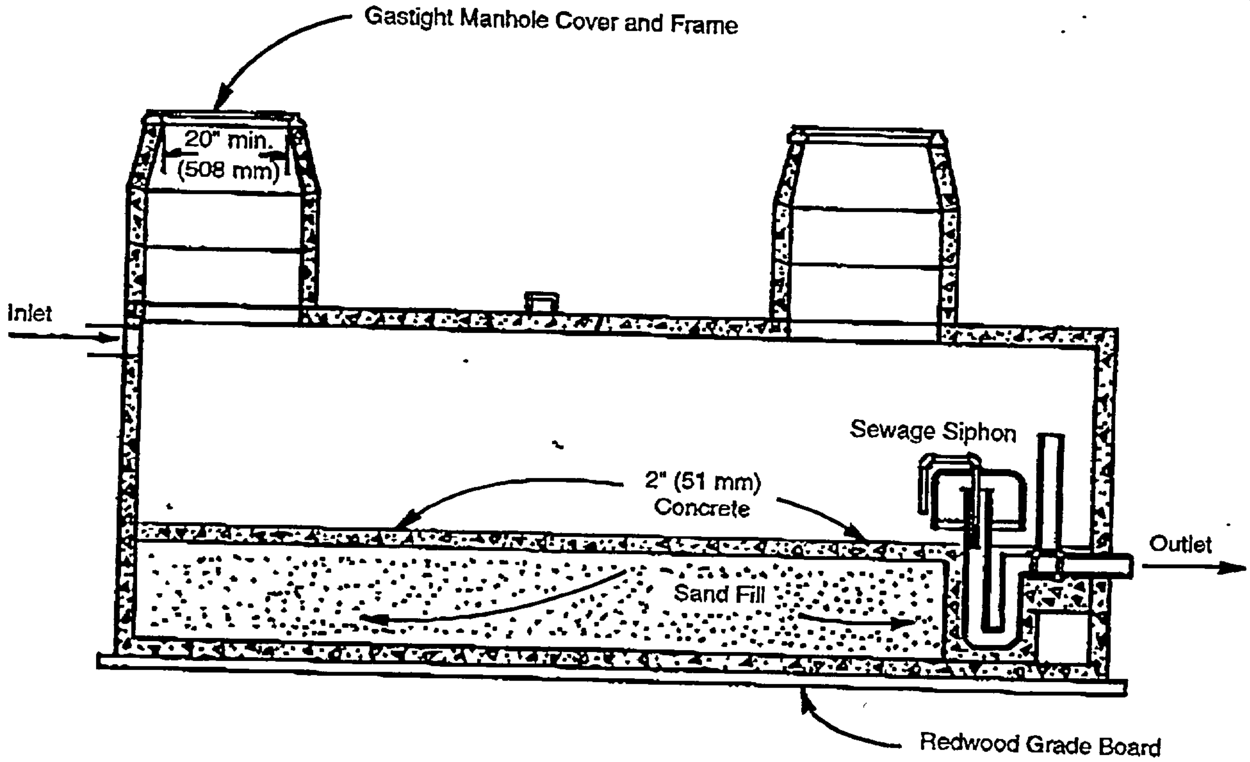


Figure K-9
Dosing Tank

(304.8 mm) below the bottom of the drain line. Distribution drain lines in leaching beds shall not be more than 6 feet (1829 mm) apart on centers and no part of the perimeter of the leaching bed shall be more than 3 feet (914 mm) from a distribution drain line.

The table above does not specify a minimum length for a leach line. Section K-3(1) requires that the minimum total length of lines must produce 150 square feet (13.935 m²) of trench bottom. That results in a trench 36 inches (914 mm) wide by 50 feet (15240 mm) in length or a trench 24 inches (610 mm) wide by 75 feet (22860 mm), or other variation totaling 150 square feet (13.935 m²).

The maximum width of a leach line trench is 36 inches (914 mm). For any trench over 36 inches (914 mm), requirements for a leach bed applies. The minimum spacing of leach lines center to center is 6 feet (1829 mm). Additionally, leach line trenches must be spaced a minimum of 4 feet (1219 mm) edge-to-edge. This spacing must be increased by 2 feet (610 mm) for each 1 foot (305 mm) of rock used in the trench beyond the 12 inches (305 mm) minimum. Trenches with 2 feet (610 mm) of rock below the leach line would require a spacing of 6 feet (1829 mm), another extra 1 foot (305 mm) or 3 feet (914 mm) of rock would increase the spacing to 8 feet (2438 mm).

If a leach bed is used, the 6 foot (1829 mm) line spacing applies regardless of the depth of rock. Leach bed lines must not be spaced greater than 3 feet (914 mm) from the perimeter of the bed.

The grade of leach lines must be laid as near level as possible, but not sloped more than 3 inches (76 mm) uniformly per 100 feet (30.5 m). This is to provide as much equal distribution as possible.

When the site of a leach field is sloping, lines must follow the site contours to maintain the required minimum slope. When there is insufficient land width to accommodate the system design absorption area on one contour, the lines must be stepped. It becomes necessary to install one or more lines at a lower level on the site. This is known as a Serial Distribution System. The UPC requires the line between each horizontal section be made watertight. It must be designed and fitted so each horizontal line will be utilized to its maximum capacity before the effluent passes to the next lower leach line. It is important that the connecting lines be installed on natural and unfilled ground. If the connection trench is overdug, effluent will follow the trench down around the pipe, never allowing the upper trenches to completely fill. Use a poured concrete dam to correct an overdug trench.

Failure to follow this procedure will allow the effluent to immediately drain down to the lowest trench and overload the trench. This will lead to eventual early failure without the upper lines being used to any great degree.

Disposal fields, trenches and leaching beds shall not be paved over or covered by concrete or any material that can reduce or inhibit any possible evaporation of sewer effluent.

See Figures K-10A and B.

DISPOSAL FIELD FAILURE

Before discussing the layout and computing areas for disposal fields, it is important to understand the major causes of failure. Failures may be identified by the submersion of the system, surfacing of effluent, which is evident by a run off from the site, or by a sluggish or slow flow in building drain. Most of these failures can be prevented or delayed.

Failures may be attributed to:

(a) Faulty construction methods, incorrect materials or improper physical condition of the site.

(b) Overloading caused by undersizing the system or the improper evaluation of the soil's permeability. Overloading can be caused by a leaking toilet or other defective valve. In public use facilities, self closing valves help to reduce the loading. Urinals should be equipped with flush valves to avoid the automatic cyclic flow from the flush tanks.

(c) High ground water level may cause system failures. The ground water level used in the design should be the highest ever recorded. Tests made during dry years or the dry time of the year may provide false data.

(d) The buildup of ground water under the system. This is caused by the system being situated just above bedrock or a hard pan layer of soil and by locating in soils with a low permeability that will not provide for sufficient lateral drainage away from the area.

(e) The loss of infiltration capacity by alteration of the rocks in the soils to clay by wetting and drying or by chemical action. A percolation test may show that soil has a good percolation rate due to cracks and fissures in the soil. Over a period of time sewage effluent breaks down the soil and plugs the cracks and fissures. In these cases soil needs further evaluation.

(f) Plugging of the filter material by lack of septic tank maintenance. A carryover of scum or sludge into a disposal field can soon effect the life of the system.

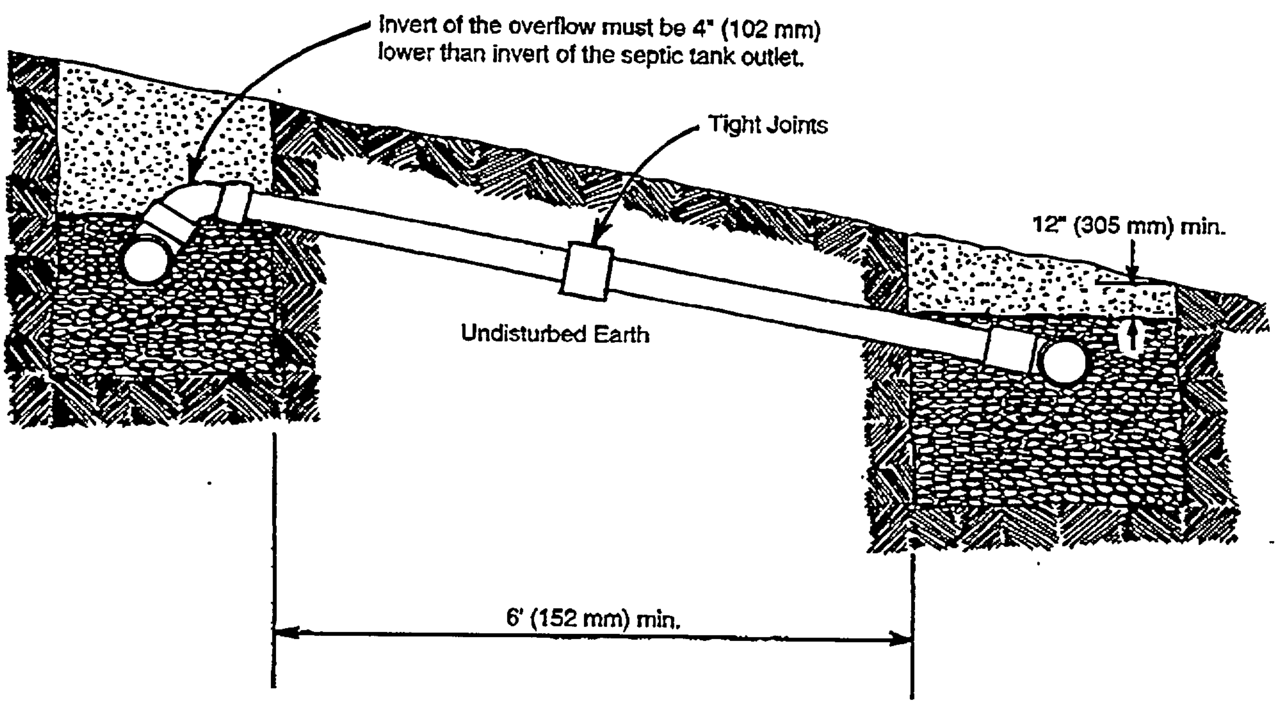


Figure K-10A
Serial Distribution

ABSORPTION AREA DESIGN OF DISPOSAL FIELDS

First site the system and determine the percolation rate by tests or by using Table K-4. These two steps must go together, as subsoils can change from one location to another on the same site. The slope of the site, proximity to stream, springs, road cuts, embankments, other disposal field systems and buildings must be taken into consideration. Table K-1 is useful in establishing the required horizontal distance.

Erosion from storm water and the ponding of storm water over the leach field area also must be considered. These conditions can usually be resolved by making adjustments in grading of the site.

The UPC does not recognize evapotranspiration in sizing a disposal field or bed because conditions are hard to control. Nevertheless, evapotranspiration should be given consideration in heavy or poor soils. In these soils it is important not to locate a disposal field under blacktop paving or driveways. Evapotranspiration can be improved in these soils by importing lighter soils to the site for covering the leach line trenches or bed and maintaining the line depth to the preferred depth of 18 inches (457.2 mm) below finished grade.

The total depth of a disposal field or bed also should be considered. As mentioned earlier in this chapter, septic tank effluent contains dissolved and suspended solids which are worked upon by soil bacteria. These are aerobic organisms which require the presence of available oxygen for life. The maximum limit for this function is approximately 5 feet (1524 mm) below ground surface. This function can be improved by covering the system with a light soil, especially at a heavy soil site.

Section K-4 states: "When a percolation test is required, no private disposal system shall be permitted to serve a building if that test shows the absorption capacity of the soil is less than 0.83 gallons per square foot (33.8 L/sq. meter) or more than 5.12 gallons per square foot (208 L/sq. meter) of leaching area per 24 hours. If the percolation test shows an absorption rate greater than 5.12 gallons per square foot (208 L/sq m) per 24 hours, a private disposal system may be permitted if the site does not overlie ground waters protected for drinking water supplies, a minimum thickness of 2 feet (610 mm) of the native soil below the entire proposed system is replaced by loamy sand, and the system design is based on percolation tests made in the loamy sand."

Some building and safety departments and

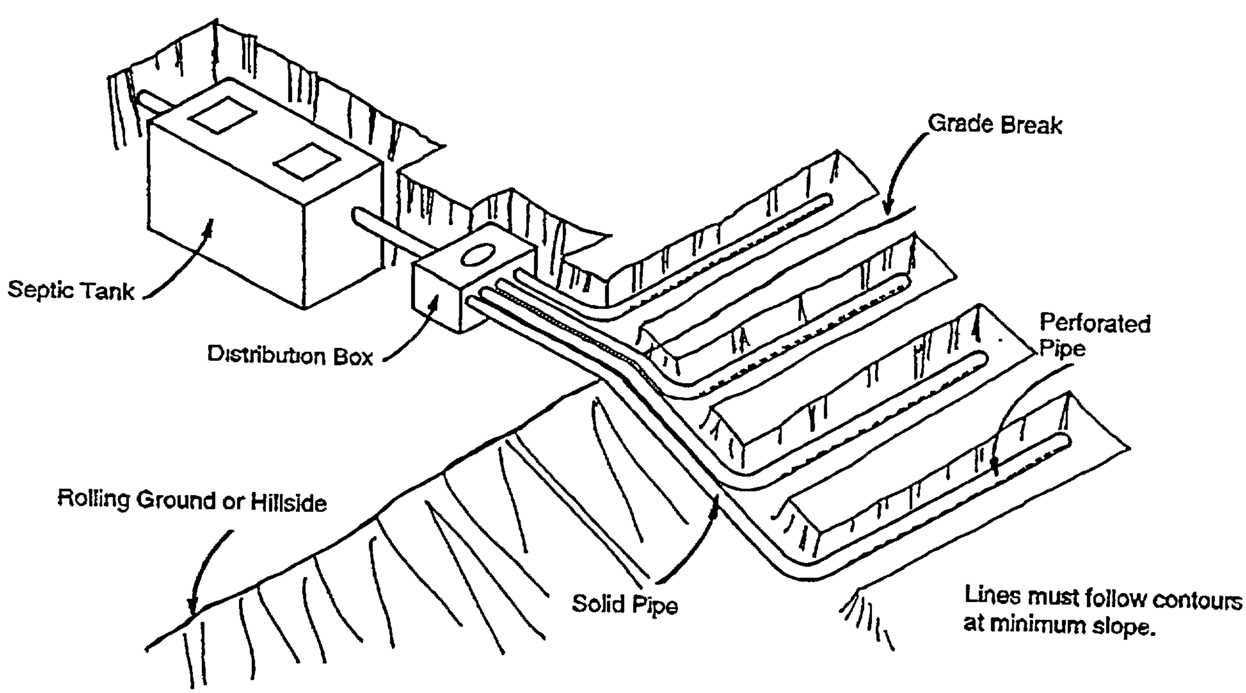


Figure K-10B
Alternative to Serial Distribution

health departments have established design rates for many areas within their jurisdiction. It may not be necessary to evaluate the soils, although an on-site inspection should be made to verify the physical conditions.

When it is necessary to evaluate soils using Table K-4, some excavation work must be done at the site to determine the soils at the leaching depth. The excavation should be made to a minimum of 5 feet (153 mm) below the bottom of a proposed leach line or bed trench to check for ground water and impervious strata. It may be necessary to choose a new location or change to a different type of absorption system when adverse conditions are found.

Table K-4 shows the design rate for five basic soil types. There are many other soil classifications which are not listed. The designer must evaluate the soil and classify to the nearest material according to texture and permeability of soils in Table K-4. With proper excavation work, a qualified person can usually make a good judgement as to which design criteria to use. He also should be able to identify soils which are questionable or where a system should not be installed. A soil percolation test is required when the soil is questionable, on large projects, or when required by the local Administrative Authority.

Most local jurisdictions have adopted a standard testing procedure such as is found in the U.S. Public Health publication, "Manual of Septic Tank Practice." Some Administrative Authorities have developed their own testing procedures. Test reports should be submitted to the local jurisdiction for approval prior to doing design work. The conclusions in the report may be adjusted by the jurisdiction, based upon area failure rates or other data.

Section K-3 states that the minimum effective absorption area in disposal fields or beds in square feet (m^2) shall be predicated on the required septic tank capacity in gallons and/or estimated waste/sewage flow rate, whichever is greater. Additionally, it shall conform to Table K-4, as determined for the type of soil found in the excavation or design criteria by an approved percolation test and shall be as follows:

(1) When disposal fields are installed, a minimum of 150 square feet (13.94 m^2) of trench bottom shall be provided for each system exclusive of any hard pan, rock, clay or other impervious formations. Side wall area in excess of the required 12 inches (305 mm) and not to exceed 36 inches (914 mm) below the leach line may be added to the trench bottom area when computing absorption areas.

See Figure K-11.

COMMENT—When conditions permit, a narrow trench with 36 inches (914 mm) of filter material under the leach line has been found to be one of the best of designs.

(2) Where leaching beds are permitted in lieu of trenches, the area of each bed shall be at least 50% greater than the tabular requirements for trenches. The minimum bottom area for a leach bed would be 150 x 1.50 = 225 sq. ft. (13.9 m^2 x 1.50 = 20.85 m^2). Perimeter side wall area in excess of the required 12 inches (305 mm) and not to exceed 36 inches (914 mm) below the leach line may be added to the trench bottom area when computing absorption areas.

See Figure K-12.

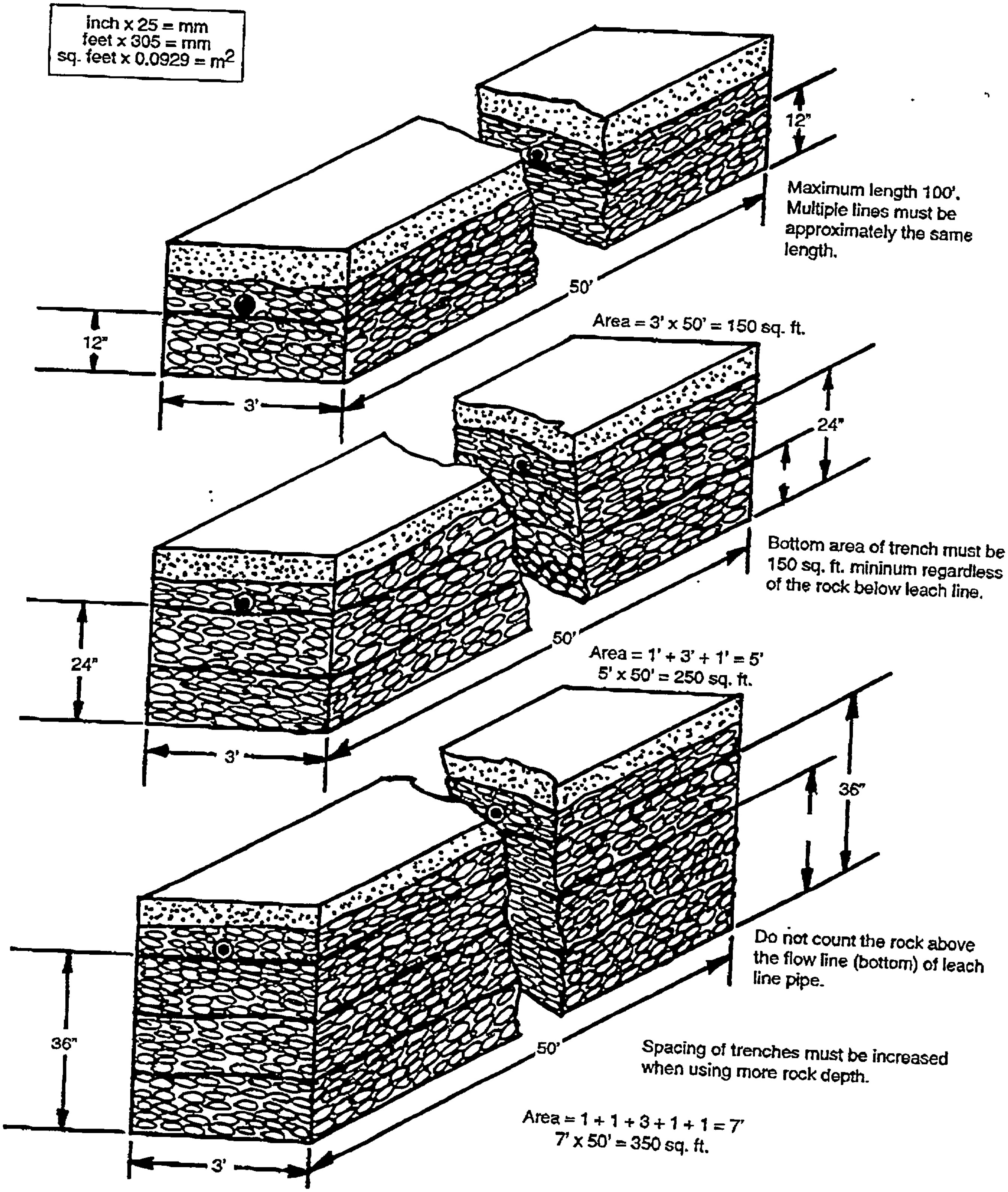
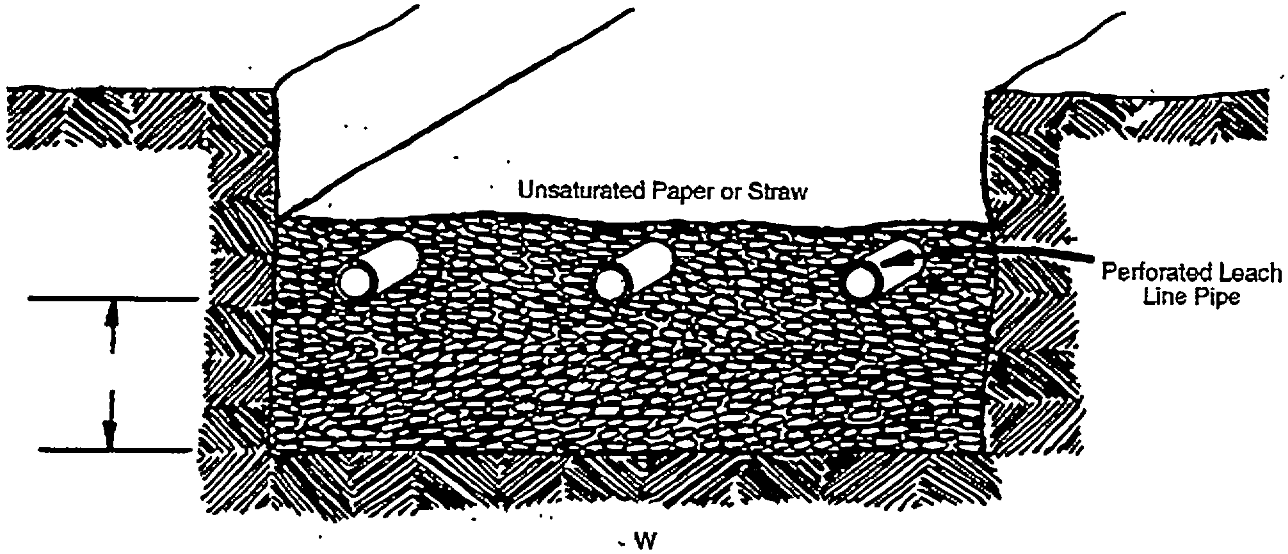
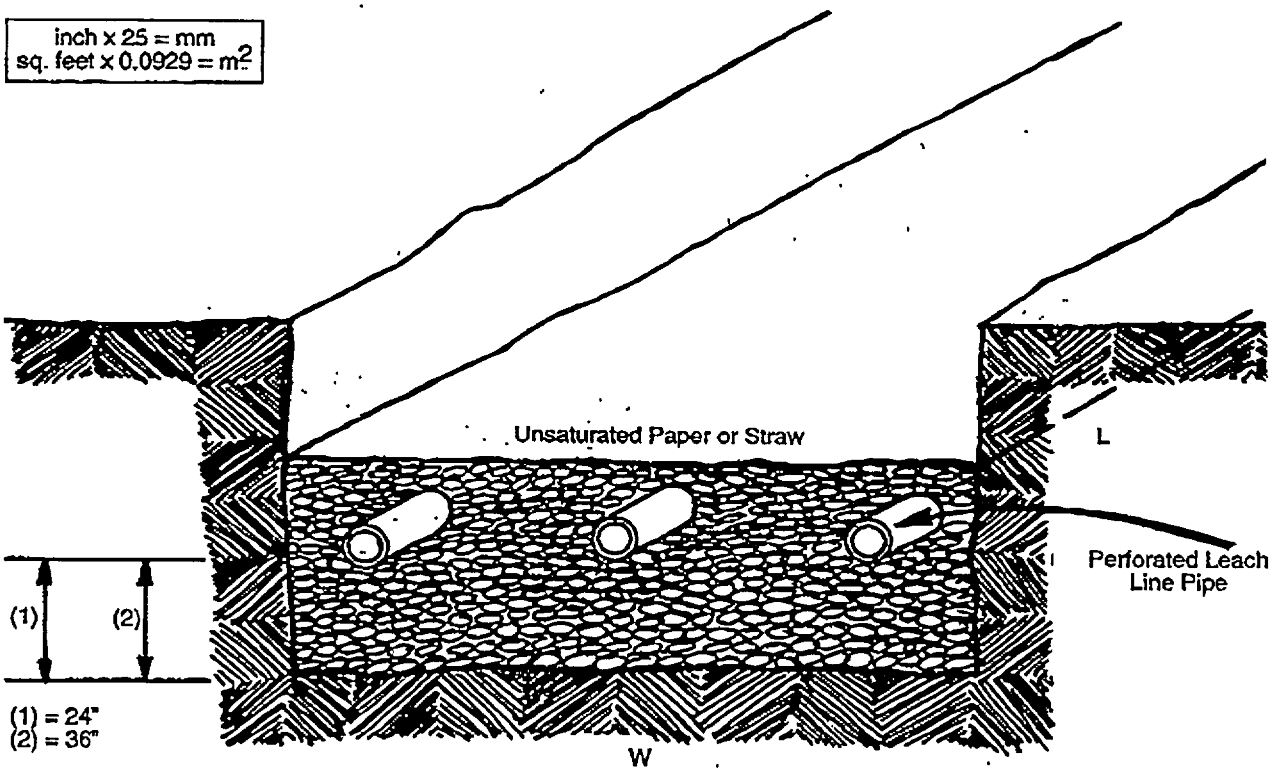


Figure K-11
Computing Leach Line Areas



Absorption area = L x W = sq. ft.

inch x 25 = mm
sq. feet x 0.0929 = m^2



(1) Absorption area = (L x W) + 1 x perimeter dimension = sq. ft.
(2) Absorption area = (L x W) + 2 x perimeter dimension = sq. ft.

Figure K-12
Computing Absorption Areas

COMPUTING ABSORPTION AREAS

EXAMPLES (See Figs. K-13 through K-16.)

(1) A four-bedroom dwelling requires a 1200 gallon (12006 L) septic tank. Assume the soil has been classified as type 3 per Table K-4 (sandy loam or sandy clay). The required disposal field would be 40 sq. ft. (3.72 m^2)per each 100 gallons (378.5 L) of the required septic tank.

SOLUTION:

40 x 12 = 480 sq. ft. (3.72 m^2 x 12 = 44.6 m^2) of absorption area for a field or 480 sq. ft. x 1.5 = 720 sq. ft. (44.6 m^2 x 1.5 = 66.9 m^2) for a leaching bed.

Assume the designer wishes to use a leach-line trench 2 feet (610 mm) wide with 12 inches (305 mm) of filter material below the leach line. With only 12 inches (305 mm), the absorption area would equal 2 sq. ft. (0.186 m^2) per running foot of trench or bottom area of the trench.

480 ÷ 2 = 240 lineal feet (44.6 m^2 ÷ 2 = 22.3 m^2) of leach line required. When the line is over 100 ft. (30480 mm), multiple lines are required, or 3 lines 80 feet (24384 mm) long must be connected to the septic tank by a distribution box.

See Figure K-13.

(2) Using problem (1) above, the designer wishes to use a different trench. Assume the trench to be 3 feet (914 mm) wide with 36 inches (914 mm) of filter material below the leach line pipe.

SOLUTION:

Absorption area would equal 7 sq. ft. per running foot (0.65 m^2 per 304.8 mm) of the trench.

See Figure K-11.

480 ÷ 7 = 68.5 lineal feet of leach line (44.6 m^2 ÷ 7 = 6.37 m^2). Also evaluate the trench bottom area to determine that it is at least 150 sq. ft. (13.9 m^2) 3 x 68.5 = 205 sq. ft. (3 x 6.37 m^2 = 19.1 m^2) which is greater than 150 sq. ft (13.9 m^2). This calculation is satisfactory.

See Figure K-14.

As you can see, the second design reduces the need for a distribution box and the necessary land needed to be reserved for expansion has been greatly reduced.

(3) Using problem (1) above, the designer wishes to install a leach bed with 12 inches (305 mm) of filter material covering the whole bed below the lines.

SOLUTION:

720 sq. ft. (66.89 m^2) of bottom area is required. Section K-6(i) requires that lines be spaced 6 feet (1829 mm) maximum and no more than 3 feet (914 mm) from the excavation perimeter.

A bed which is 18 feet (5486 mm) wide x 40 feet (12192 mm) long with three lines would meet these conditions. The bottom area also exceeds the minimum of 225 sq. ft. (20.9 m^2)

See Figure K-15.

If the designer wishes to use 24 inches (610 mm) of filter material below the lines in the bed, the extra square foot (0.093 m^2) of depth around the exterior perimeter may be added to the bottom area. This becomes a trial and error method to obtain the required precise amount. The 18 feet x 40 feet (5486 mm x 12192 mm) bed above with 24 inches (610 mm) would have an absorption area of:

(18 x 40) + 18 + 18 + 40 + 40 = 836 sq. ft.

(5.49 m x 12.18) + 1.67 + 1.67 + 3.72 + 3.72 = 77.65 m^2

(4) Compute the disposal field for the movie theater. The flow rate governing the design of the septic tank must be used in the design of the disposal field.

Flow rate = 700 seats x 5 gal. (18.93 L) per seat = 3500 gal. (13,249 L) per day discharge.

Assume the soil has been classified as type 2 (fine sand) from Table K-4. This table has a column which is headed "Maximum absorption capacity gallons/ sq. ft. (L/m2) of leaching area for a 24 hr. period".

Fine sand has an application rate of 4 gallons per square foot (162.9 L/m^2) per day.

3500 ÷ 4 = 875 sq. ft. (13249 ÷ 162.9 = 81.33 m^2) of absorption area in trenches.

Assume the designer wishes to use trenches 30 inches (762 mm) wide with 30 inches (762 mm) of filter material below the leach lines. Absorption area of the trench would be

2.5 ft + (1.5 x 2) = 2.5 + 3 = 5.5 sq. ft. per running foot of trench.

[0.762 + (1.5 x 0.610) = 1,676 m^2/m]

875 ÷ 5.5 = 159.1 feet (81.34 ÷ 1.676 = 48.5 m) or 2 leach lines 30 inches wide (762 mm) x 79.5 feet (24,231.6 mm) long with 30 inches (762 mm) of filter material under the leach line. Both lines would be connected to the septic tank through a distribution box. See Figure K-16.

What is the required spacing between the trenches? The spacing must be increased beyond the 4 foot (1219 mm) minimum, because additional filter material was used beyond the 12 inch (305 mm) minimum.

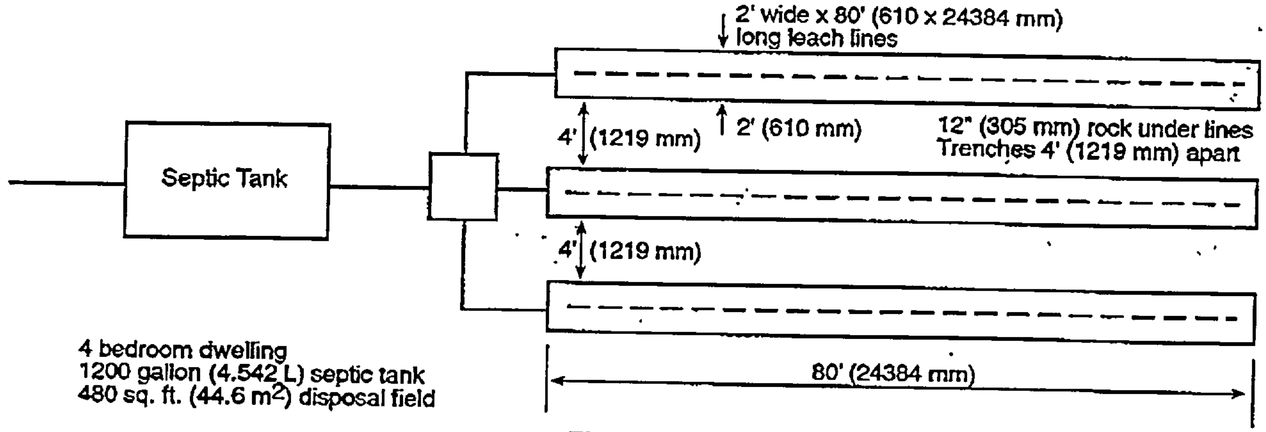


Figure K-13
Computing Absorption Areas – Example 1

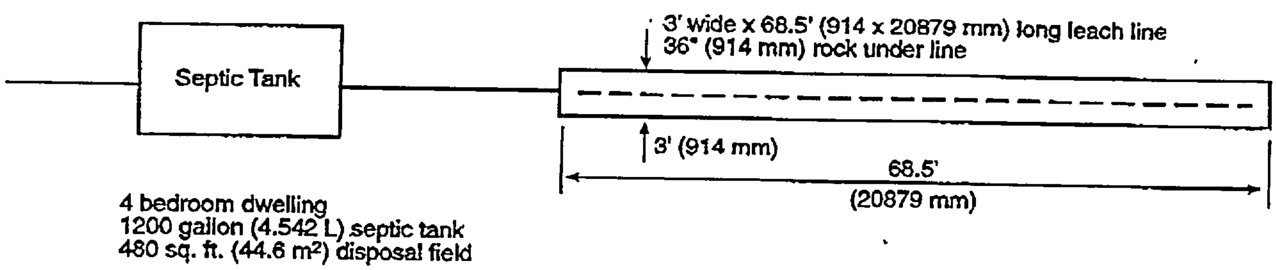


Figure K-14
Computing Absorption Areas – Example 2

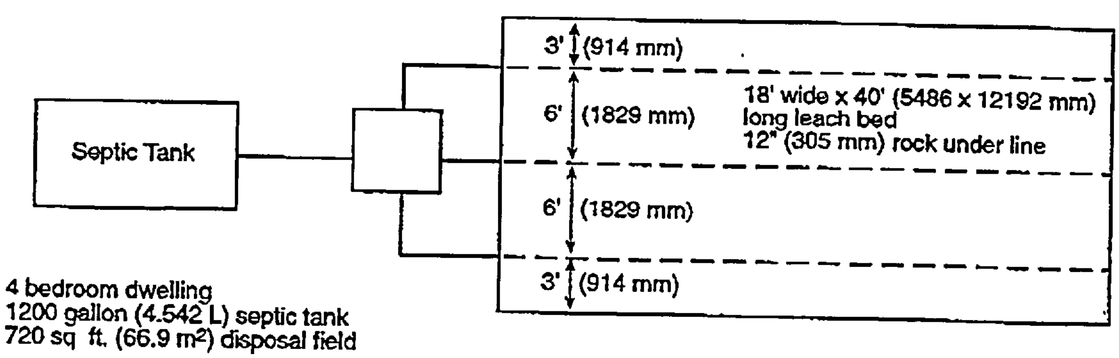


Figure K-15
Computing Absorption Areas – Example 3

Increase spacing 2 feet (610 mm) for additional 1 foot (304.8 mm) of filter material.

Spacing = 4 + (2 x 1.5) = 7 ft.

[1.219 + (0.610 x 1.5) = 2.134 m]

A problem encountered by the field inspector is determining the amount of filter material used when the inspection is requested. The trench is usually complete except for earth backfill when inspection is requested. One method will be discussed under "Inspection" later in this chapter.

CONSTRUCTION OF SEEPAGE PITS

Each seepage pit must be circular in shape and shall have an excavated diameter of not less than 4 feet (1219 mm). Each such pit must be lined with approved type whole new hard burnt clay brick, concrete brick or concrete circular type cesspool blocks. Approval must be obtained from the local Administrative Authority prior to construction for any pit having an excavated diameter greater than 6 feet (1829 mm). Larger diameters present a safety hazard due to the loading on the lid as well as the unmortared bricks lining the wall.

The lining in every seepage pit must be laid on a firm foundation. The lining materials are to be placed tight together and laid with joints staggered. Except in the case of approved type pre-cast concrete circular sections, no brick or block shall be greater in height than its width and must be laid flat to form at least a 4 inch (102 mm) wall. Brick or block greater than 12 inches (305 mm) in length must have chamfered matching ends and be scored to provide for seepage.

Excavation voids behind the brick, block, or concrete liner must have a minimum of 6 inches (152 mm) of clean 3/4 inch (19 mm) gravel or rock.

See Figure K-17A.

The gravel or rock behind the pit liner has three functions:

1. It provides secondary treatment of the effluent to help prolong soil clogging.

2. It fills the voids behind the liner, avoiding ground settlement that sometimes occurs. Voids are created during excavation work by caving or slough-off due to rocks, or loose strata.

3. It reduces silting of the pit. Soil with a considerable amount of fines or silt has a tendency to work into the pit through the pit wall by pumping action. As effluent rises and lowers due to changes in loading, some of the effluent, which has moved away from the pit laterally, will flow back into the pit as the level in the pit lowers, bringing with it fine silt from the surrounding soils. Over a period of time this can significantly change the pit depth, as well as create voids behind the liner. Rock behind the liner helps to prevent this problem.

The top of seepage pits may be constructed in three ways. Section K-7 states:

(1) Approved type hard burnt clay brick or solid concrete block or brick laid in cement mortar.

(2) Approved block or brick laid dry. In both methods (1) and (2) an approved cement mortar covering of at least 2 inches (51 mm) in thickness shall be applied, said covering to extend at least 6 inches (152 mm) beyond the sidewalls of the pit.

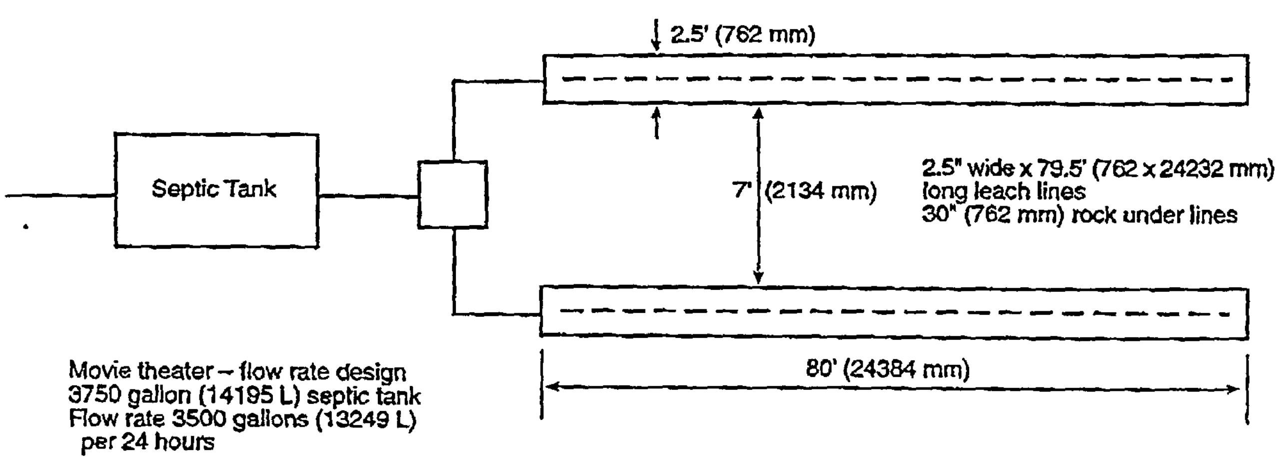


Figure K-16
Computing Absorption Areas – Example 4

(3) Approved type one or two piece reinforced concrete cover slab of 2500 psi (17237.5 kPa) minimum compression strength; not less than 5 inches (127 mm) thick and designed to support an earth load of not less than four hundred (400) pounds per square foot (1953 kg/m²). Each such cover shall be provided with a 9 inch (229 mm) minimum inspection hole with plug or cover. The cover slab must be coated on the underside with an approved bituminous or other nonpermeable protective compound.

The top of the arch or cover must be at least 18 inches (457 mm), but not more than 4 feet (1219 mm), below the surface of the ground.

An approved vented inlet fitting must be provided in every seepage pit so arranged as to prevent the inflow from damaging the sidewall.

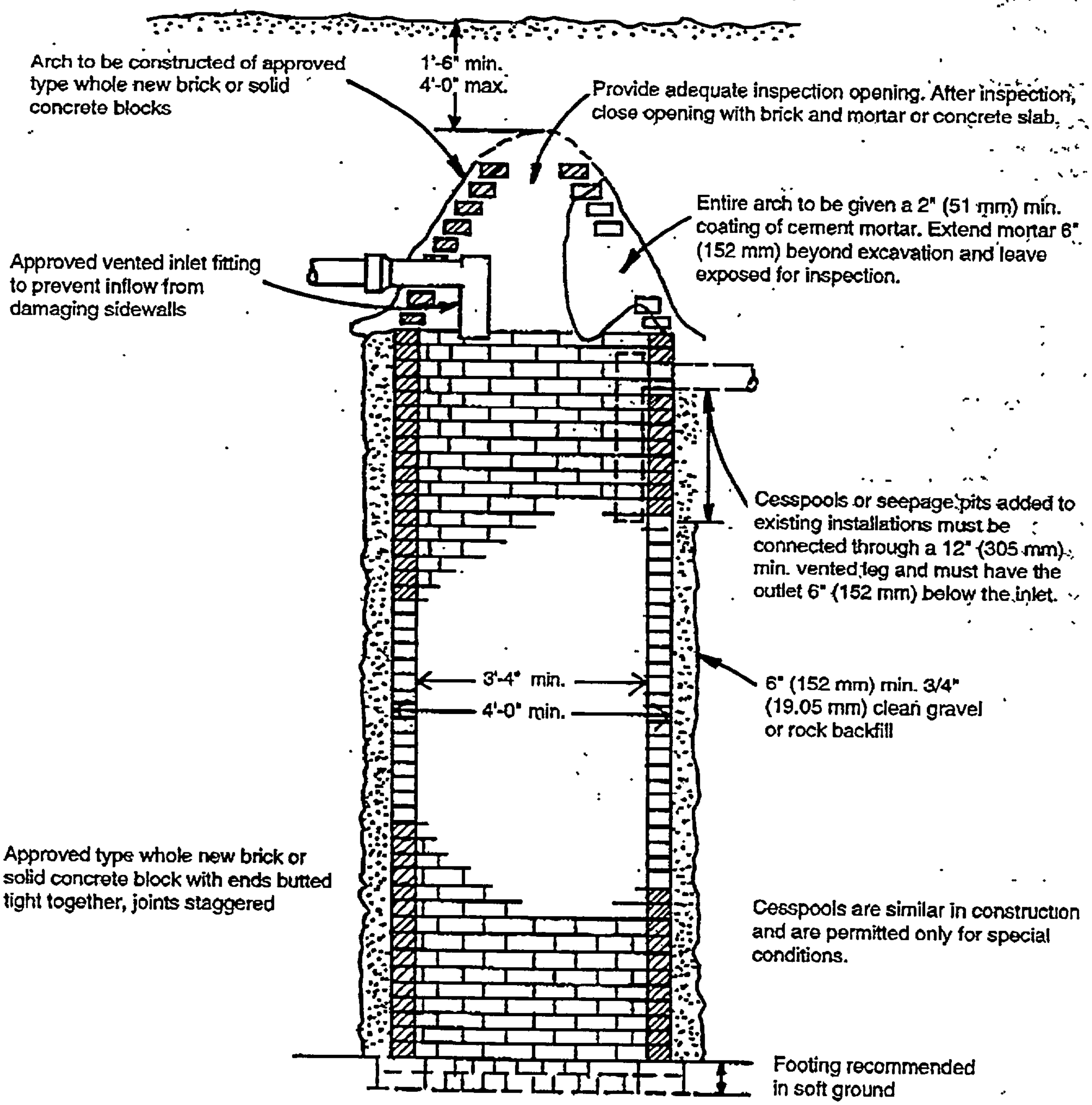


Figure K-17A
Seepage Pit

Exception: When using a flat top cover slab, the fitting may be a 1/4 bend fitting discharging through an opening in the top of the slab cover. On multiple seepage pit installations the outlet fitting must be an approved vented leg fitting extending at least 12 inches (305 mm) below the inlet fitting.

See Figure K-17B.

SEEPAGE PIT FAILURE

Failure is usually evident by a sluggish or stopped-up building drain or backup in the lower fixtures in the building. Another indication is the surfacing of effluent, especially if the pit is located on a considerable downhill slope from the building. Caving or subsidence at the pit may also indicate a failure.

The causes of failure are basically the same as for disposal fields:

(a) Faulty construction.

(b) Overloading caused by undersizing or improper evaluation of the soils permeability.

(c) High ground water.

(d) The loss of infiltration capacity by altering the rocks in the soil to clay by wetting and drying or by chemical action.

(e) Silting of the pit, as mentioned earlier.

(f) Lack of septic tank maintenance.

(g) Structural failure due to the erosion of concrete by the attack of gases generated by the sewage can occur in old seepage pits.

Reasonably new systems can fail sometimes, due to a breakage of the building sewer connection to the septic tank, or from the septic tank. This is due to settlement of the septic tank or seepage pit. Replacement seepage pits have been dug only to find that the trouble is not with the existing seepage pit, but with building sewer piping.

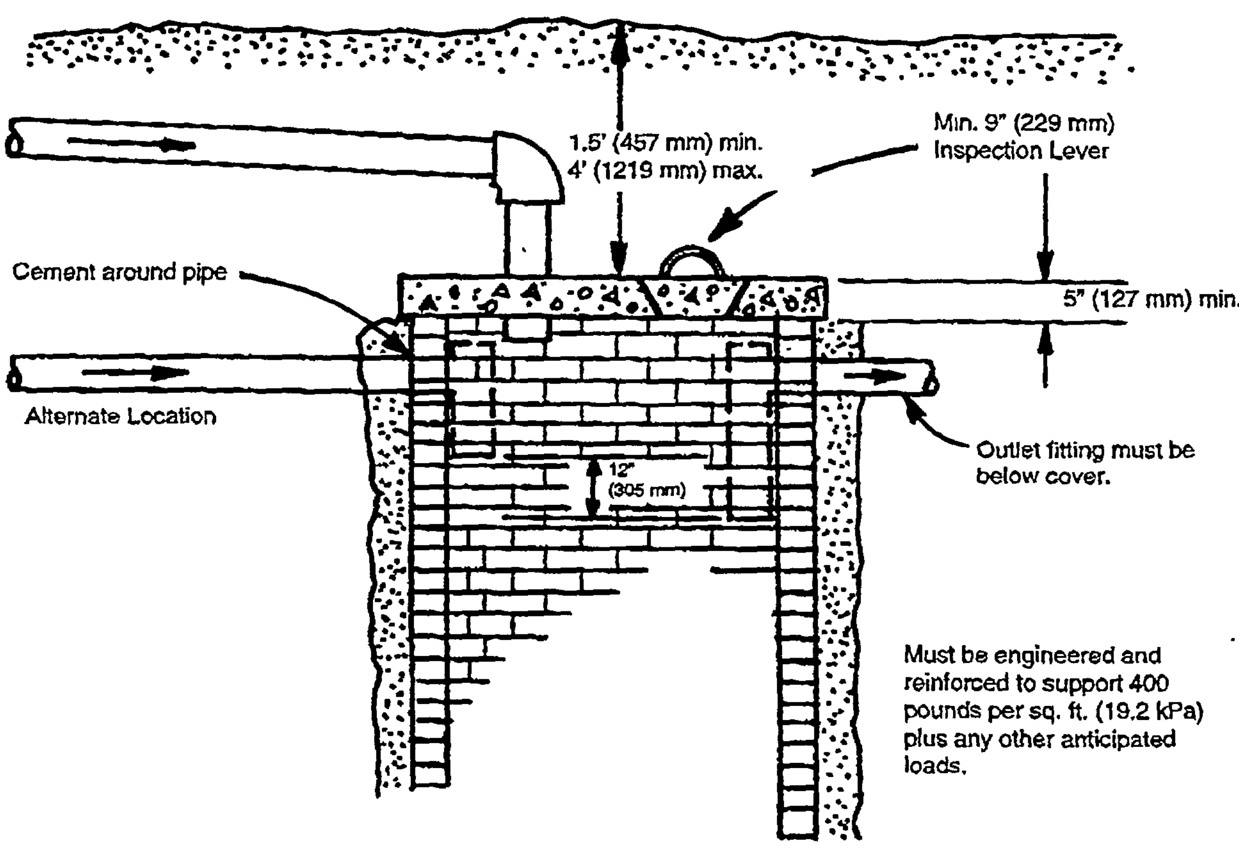


Figure K-17B
Flat Top Concrete Seepage Pit or Cesspool Cover

ABSORPTION AREA DESIGN FOR SEEPAGE PITS

Most of the requirements for seepage pit design are the same as those for disposal fields and beds. In choosing a site for a seepage pit system, Table K-1 requires greater horizontal distances in nearly all cases. The slope to the site is not as critical, although it is a factor when moving drilling or excavating equipment onto a site. In mountainous areas, many building departments or health departments restrict the secondary part of the disposal system to disposal fields.

The absorption area is based upon side wall area in square feet (m^2). The side wall area is predicated on the required septic tank capacity in gallons (L) and/or estimated waste/sewage flow rate, whichever is greater.

This is to be exclusive of any hardpan, rock, clay or other impervious formations. In addition, each seepage site shall have a minimum side wall depth of 10 feet (3048 mm) below inlet, not including the arch.

First establish the design or application rate. This can be done in three ways:

1. Check with the local Administrative Authority to determine if criteria has been established at the site location. If so, this may be in the form of minimum or maximum depths below ground surface, the side wall area per 100 gallons (378.54 L) of septic tank capacity or gallons per square foot (L/m^2) of side wall per 24 hours.

2. A soil boring to depth estimated to be the depth of the pit based upon preliminary evaluation. Any test boring must be taken to a depth of at least 10 feet (3048 mm) below the estimated depth to verify that no ground water exists. A boring log or record should be prepared to be used in classifying or matching the soils to those in Table K-4.

   See Figure K-18.

   Because soils change with depth, there may be several stratas which have different permeabilities.

3. Soil Percolation Test. The local Administrative Authority will designate the test procedure to be used.

EXAMPLES (see Figs. K-19 through K-21)

1. A four-bedroom dwelling requires a 1200 gallon (4542.48 L) septic tank. Assume the soil has been classified as type 3 (sandy loam or sandy clay) 40 sq. ft./100 gallons (0.010 m^2/L) of septic tank.

SOLUTION:

40 x 12 = 480 sq. ft. side wall area.

(0.010 x 4.542 = 45.42 m^2)

Assume a 5 foot (1524 mm) excavated diameter seepage pit is to be used. The full excavated diameter is used, not the diameter of the brick liner. The circumference of a 5 foot (1524 mm) hole is 15.71 ft. (4788.4 mm)

480 ÷ 15.71 = 30.55 ft. effective depth below the inlet. (45.42 ÷ 4.788 m = 9.486 m)

See Figure K-19.

2. An apartment house requires a 4900 gallon (18548 L) septic tank. Assume the soil has been classified as type 2 (fine sand) 25 sq. ft./100 gallons (0.006136 m^2/L) of septic tank.

SOLUTION:

25 X 49 = 1225 sq. ft. (0.006136 x 18549 = 113.8 m^2) side wall area.

Assume that 6 foot (1829 mm) diameter seepage pits will be used. The circumference of a 6 foot (1829 mm) diameter hole is 18.85 feet (5746 mm).

1225 ÷ 18.85 = 64.99 ft. effective depth below the inlet (373.38 ÷ 5.745 = 64.99 m).

Because the depth is excessive it is advisable to use two pits each 32.5 ft. (9906 mm) below inlet. These may be connected to the septic tank through a distribution box or be connected in series.

See Figure K-20.

3. In the movie theater problem earlier in this chapter, you were required to use flow rate for the septic tank design so that method must be used in sizing the seepage pit. The flow rate was 3500 gallons/day (13247 L/day).

Assume the soil has been classified as type 3 (sandy loam or sandy clay) 2.5 gallons per square foot (101.9 L/m^2) per 24 hours.

3500 ÷ 2.5 = 1400 sq. ft. side wall area.

(13249 L ÷ 101.9 L/m^2 = 130 m^2)

Assume that 5 foot (1524 mm) diameter seepage pits will be used.

1400 ÷ 15.71 = 89.1 ft. (130.06 ÷ 4.788 m = 27.164 m) effective depth below inlet.

Because of excessive depth, use 3 pits, 5 foot (1524 mm) diameter and 30 ft. (9144 mm) below inlet.

See Figure K-21.

4. This example shows how to establish seepage pit size when multiple stratas are found in a test boring. The soils have been matched to the soils in Table K-4 as closely as possible and the depth of each layer shown.

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS More than 50% of coarse fraction is SMALLER than the No. 4	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Coarse		

No. 200 No. 40 No. 10 No 4 3/4 in. (19.1 mm) 3 in. (76 mm) 112 in. (2845 mm)

U.S. STANDARD SIEVE SIZE

Figure K-18
Unified Soil Classification System

Assume the septic tank is 1500 gallons (5678 L) and two 5 foot (1524 mm) seepage pits will be used.

Ground Surface

	5' (1.524 m)	Estimated flow line into pit
1	10' (3.048 m)	90 sq. ft./100 gal. (0.022 m²/L) clay with a considerable amount of sand and gravel
2	20' (6.096 m)	40 sq. ft./100 gal. (0.010 m²/L) sandy clay
3	4' (1.219 m)	25 sq. ft./100 gal. (0.006 m²/L) fine sand
4	16' (4.877 m)	40 sq. ft./100 gal. (0.010 m²/L) sandy loam

end of boring

SOLUTION:

1. Use the best soil classification 25 sq. ft./100 gal. (0.006 m²/L).
2. 15 x 25 = 375 sq. ft. required sidewall area (5678 x 0.006136 = 34.839 m²) if all soil classifications is 25 sq. ft./100 gals (0.006 m²/L)
3. Compute the sidewall area for each strata.
   (a) 10' x 15.71 = 157 sq. ft. (3.048 x 4.788 = 14.593 m²)
   (b) 20' x 15.71 = 314 sq. ft. (6.096 x 4.788 = 29.188 m²)
   (c) 4' x 15.71 = 63 sq. ft. (1.219 x 4.788 = 5.838 m²)
   (d) Depth needed.
4. Compute the equivalent of soil to 25 sq. ft./100 gals (0.006136 m²/L)
   (a) 25/90 x 157 = 43.61 sq. ft.
   (0.006/0.022 x 14.593 = 4.0 m²)
   (b) 25/40 x 314 = 196.25 sq. ft.
   (0.006/0.010 x 29.188 = 18.21 m²)
   (c) 25/25 x 63 = 63 sq. ft.
   (0.006/0.006 x 5.8 m² = 5.8 m²)
   Area needed: 375 - 302.86 = 72.14 sq. ft.
   (34.8 - 28.0 = 6.8 m²)
   (d) 25/40 x A = 72.14 (0.006/0.010 x A = 6.8 m²)
   25A = 72.14 x 40 (0.006 A = 6.8 x 0.010)
   A = 115.42 sq. ft. (A = 10.7 m²)

115.42 ÷ 15.71 = 7.35' needed in bottom strata.
(10.723 ÷ 4.788 = 2.240 m)
Overall depth below inlet.
10' + 20' + 4' + 7.35' = 41.35'
(3.048 + 6.096 + 1.219 + 2.240 = 12.603 m)

USE OF CESSPOOLS

The use of a cesspool must be approved by the local Administrative Authority. This should only be considered as a temporary expedient pending the construction of a public sewer system, as an overflow facility when installed in conjunction with an existing cesspool or as a means for limited, minor or temporary use.

Cesspools are to be constructed to the same standards as seepage pits except vertical side walls, not including the arch, need not exceed 20 feet (6096 mm) below the inlet or need not exceed 10 feet (3048 mm), if 4 feet (1219 mm) of gravel or other equally pervious material is found in this depth. Examples of minor use are for condensate waste disposal and swimming pool filter backwash disposal.

ABANDONED SEWERS AND SEWAGE DISPOSAL FACILITIES

Every abandoned sewer or part thereof must be capped in an approved manner. The cap shall be done within 5 feet (1524 mm) of the property line. Inspection is required before covering the cap.

Any cesspool, septic tank and seepage pit which has been abandoned or discontinued from use must have the sewage removed and, be completely filled with earth, sand or concrete. The UPC requires this to be completed within 30 days of the abandonment. Inspection is required. Filling shall not extend above the outlet fitting or vertical portions of the sidewall until inspection has been made. After inspection has been made back filling may be completed to finished grade.

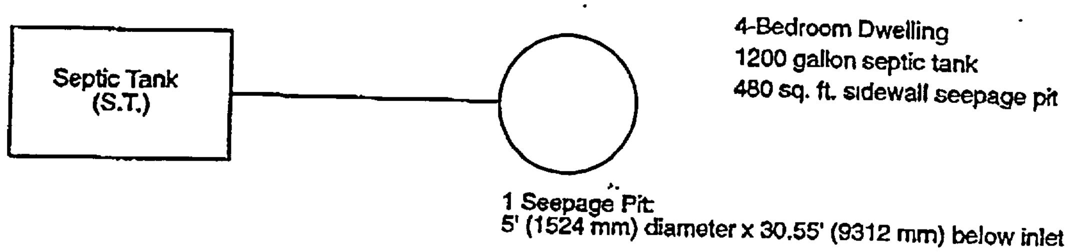


Figure K-19
Computing Absorption Area for Seepage Pits – Example 1

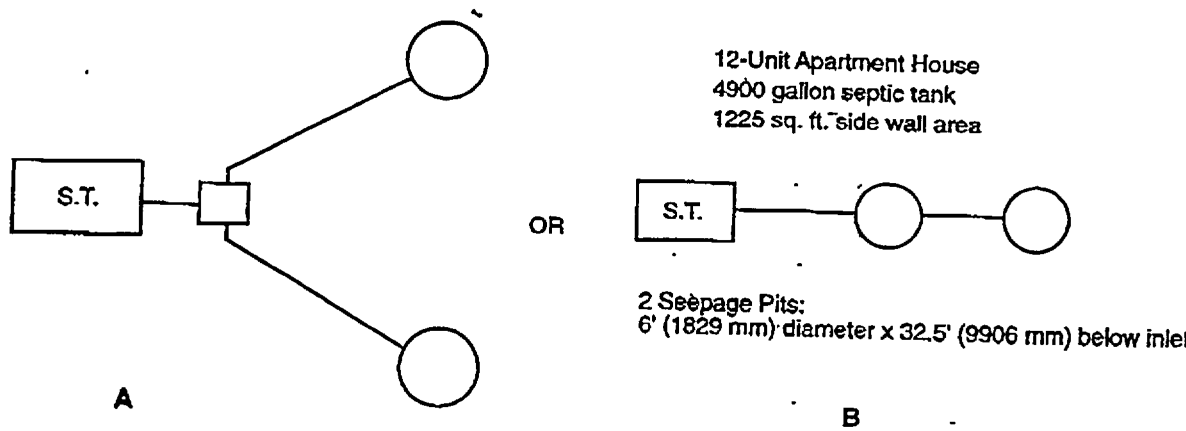


Figure K-20
Computing Absorption Area for Seepage Pits – Example 2

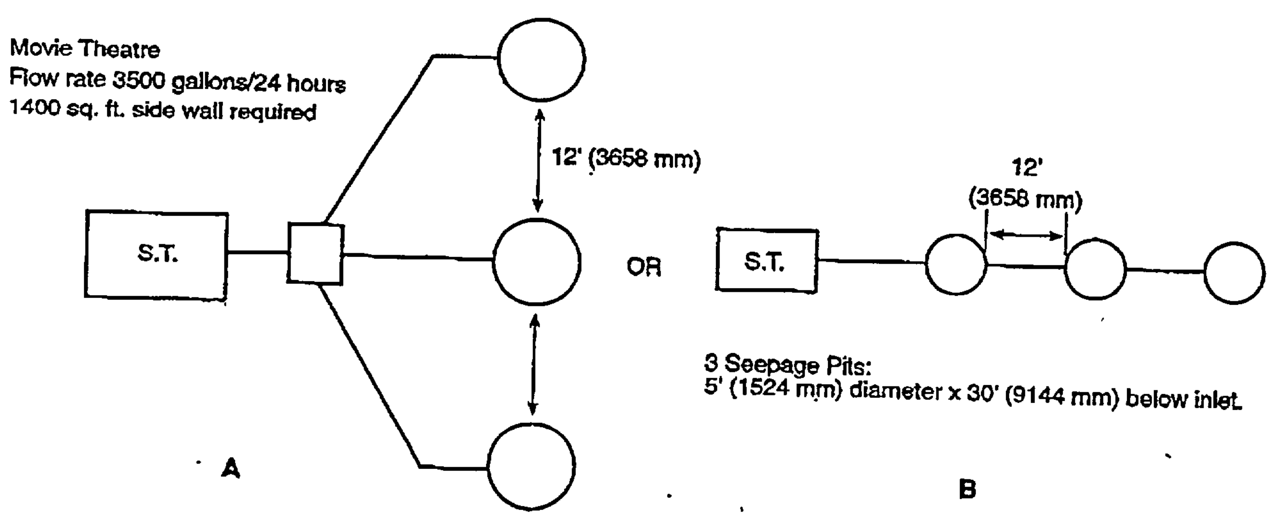


Figure K-21
Computing Absorption Area for Seepage Pits – Example 3

INSPECTION AND TESTING

If the design of the system was predicated on a percolation test or soil boring, the system must use the same location. In addition to routine inspection items, such as approved pipe and components, size, grade of sewer piping, and location on the site according to approved plans and horizontal clearances to Table K-1, the following checklist of items should be considered:

1. Septic Tank

(a) Tank has not been reversed.

(b) Tank is level.

(c) Inlet invert is 2 inches (51 mm) above the invert of the outlet.

(d) Fittings are properly vented and legs extend minimum 12 inches (305 mm) below the liquid level.

(e) Compartment fitting is in place.

(f) Tank coating is in accordance with the tank material used.

(g) Tank is approved for location and depth cover. Tanks located in traffic areas need to be designed for this loading.

(h) Job site constructed tanks have form and reinforcing steel inspection.

(i) External coating on steel septic tanks has been preserved.

(j) Tanks made of fiberglass have been installed in accordance with manufacturer's instructions.

(k) Provisions for bringing manholes to grade where tank is to be under blacktop paving.

(l) Where required, the manhole has been provided over the compartment.

(m) Battery tanks have support under bottom of tanks to prevent differential settlement. Redwood timbers are sometimes used.

2. Disposal Field or Bed

(a) Filter material is clean and correct size.

(b) Lines should be checked for consistent grade. (0" to 3"/100")

(c) Fittings used for making bends rather than mitering of pipe.

(d) The correct material used for covering filter material.

(e) A check to verify trench was properly prepared. This is difficult with filter material in place. If smeared soils appear above the filter material, there is a good chance that there are smeared soils below filter material.

(f) Verification of the correct amount of filter material above pipe and below pipe. This can easily be done with a pointed tee-handled probe made of 5/8 inch (16 mm) diameter steels rods. The probe should be approximately 4 feet (1219 mm) with this tee-handle welded to one end. As the probe makes contact with the bottom soil, it can be felt so depth can be determined.

(g) Spacing of trenches or leach lines is correct.

(h) Leach line pipe is minimum 4 inch (1219 mm) diameter.

(i) Multiple lines are of approximately equal length.

(j) In a serial distribution system, the upper trench will be saturated before effluent passes to the next lower trench. The connecting down line is installed on natural, unfilled soil.

3. Distribution Box

(a) Set level on concrete slab.

(b) Inside coated with a bituminous coating.

(c) Invert of inlet is 1 inch (25 mm) above outlets which are the same level.

(d) Baffled, where necessary, to provide equal flow to all outlet piping.

(e) Located a minimum of 5 feet (1524 mm) from disposal fields, beds or seepage pits.

4. Seepage Pits – Cesspools

(a) Flat top covers have bituminous coating on bottom side.

(b) Cover is designed for the loading conditions to be encountered.

(c) Domed arch covers have been covered with a minimum of 2 inches (51 mm) of concrete mortar extending 6 inches (152 mm) beyond the pit wall.

(d) Brick or block have been laid end-to-end with staggered joints tightly together. Brick or block are whole, not broken or in pieces. (A mirror aimed toward the sun makes an excellent light for checking inside of seepage pits or cesspools.)

(e) Vented fitting used in pit if sewage enters or discharges through the sidewall.

(f) Fittings entering or discharging through the side wall are cemented in place.

(g) Gravel or rock backfill is clean and the correct size. Rock sized for leach lines or bed should not be used. There is no way to check depth of rock backfill without continuous inspection. This must be self certification by the installing contractor. When appropriate a weight masters ticket can be checked to verify the amount of material weight delivered to the job site.

SYSTEM TESTING

(a) Septic tanks and other components must be filled with water to flow line prior to requesting inspection. All seams or joints must be left exposed (except the bottom) and the tank and other components must be watertight.

(b) A flow test must be performed through the system to the point of effluent disposal. The test should begin at the point where the building sewer connects to the building drain, using the cleanout, if provided, or a fixture inside the building. All lines and components must be watertight. Capacities, required air space, and fittings must be in accordance with provisions of the UPC.

The filling of the septic tank with water serves four functions:

(1) Provides a check on all seams and walls for leaks.

(2) Provides a weight load in the tank, so that if any settlement is to take place, it occurs before covering. This helps to reduce line breakage.

(3) Provides a positive way to check the level of tank and the proper elevation of inlet and outlet fittings.

(4) Helps prevent floating of the tank in the event rainwater or other source of water gets into the tank excavation.

MAINTENANCE OF SEPTIC TANKS

There are no exact rules for cleaning (pumping) a septic tank system. Hardly any two systems will be loaded or used in the same manner. It is recommended that a new system be checked every two years until a schedule of necessary cleaning can be established. Large systems should be checked on a yearly basis.

The tank should be pumped when the scum level is down within 3 inches (76 mm) of the partition fitting opening, or the sludge level gets to within approximately 8 inches (203 mm) of the partition fitting opening. This second dimension may be reduced for shallow liquid designed tanks.

When pumping of the tanks is necessary, all compartments should be pumped, leaving a small amount of residual sludge in the tank for seeding purposes.

The function of a septic tank is not improved by adding enzymes or other chemicals. In some cases they may do damage to the system. Keep faucets and plumbing in good repair. Septic tank systems for dwelling occupancies, when designed to the UPC, are suitable for garbage disposals. For other occupancies, the use of a garbage disposal must be considered in the design.

UPC TABLE K-1
Location of Sewage Disposal System

Minimum Horizontal Distance In Clear Required From:	Building Sewer	Septic Tank	Disposal Field	Seepage Pit or Cesspool
Buildings or structures[1]	2 feet (610 mm)	5 feet (1524 mm)	8 feet (2438 mm)	8 feet (2438 mm)
Property line adjoining private property	Clear[2]	5 feet (1524 mm)	5 feet (1524 mm)	8 feet (2438 mm)
Water supply wells	50 feet[3] (15240 mm)	50 feet (15240 mm)	100 feet (30480 mm)	150 feet (45720 mm)
Streams	50 feet (15240 mm)	50 feet (15240 mm)	50 feet[7] (15240 mm)[7]	100 feet[7] (30.5 m)[7]
Trees	–	10 feet (3048 mm)	–	10 feet (3048 mm)
Seepage pits or cesspools	–	5 feet (1524 mm)	5 feet (1524 mm)	12 feet (3658 mm)
Disposal field	–	5 feet (1524 mm)	4 feet[4] (1219.2 mm)	5 feet (1524 mm)
On site domestic water service line	1 foot[5] (304.8 mm)	5 feet (1524 mm)	5 feet (1524 mm)	5 feet (1524 mm)
Distribution box	–	–	5 feet (1524 mm)	5 feet (1524 mm)
Pressure public water main	10 feet[6] (3048 mm)	10 feet (3048 mm)	10 feet (3048 mm)	10 feet (3048 mm)

Notes:

When disposal fields and/or seepage pits are installed in sloping ground, the minimum horizontal distance between any part of the leaching system and ground surface shall be fifteen (15) feet (4572 mm).

1. Including porches and steps, whether covered or uncovered, breezeways, roofed porte-cocheres, roofed patios, carports, covered walks, covered driveways and similar structures or appurtenances.
2. See also Section 313.3 of the Uniform Plumbing Code.
3. All drainage piping shall clear domestic water supply wells by at least fifty (50) feet (15240 mm). This distance may be reduced to not less than twenty-five (25) feet (7620 mm) when the drainage piping is constructed of materials approved for use within a building.
4. Plus two (2) feet (610 mm) for each additional foot (304.8 mm) of depth in excess of one (1) foot (304.8 mm) below the bottom of the drain line. (See also Section K 6.)
5. See Section 720.0 of the Uniform Plumbing Code.
6. For parallel construction – For crossings, approval by the Health Department shall be required.
7. These minimum clear horizontal distances shall also apply between disposal field, seepage pits, and the ocean mean higher high tide line.

UPC TABLE K-2
Capacity of Septic Tanks*

Single family dwellings – Number of bedrooms	Multiple dwelling units apartments – one bedroom each	Other Uses: Maximum Fixture Units Served per Table 7-3	Minimum Septic Tank gallons	(liters)
1 or 2		15	750	(2838.0)
3		20	1000	(3785.0)
4	2 units	25	1200	(4542.0)
5 or 6	3	33	1500	(5677.5)
	4	45	2000	(7570.0)
	5	55	2250	(8516.3)
	6	60	2500	(9462.5)
	7	70	2750	(10,408.8)
	8	80	3000	(11,355.0)
	9	90	3250	(12,301.3)
	10	100	3500	(13,247.5)

Extra bedroom, 150 gallons (567.8 liters) each.
Extra dwelling units over 10, 250 gallons (946.3 liters) each.
Extra fixture units over 100, 25 gallons (94.6 liters) per fixture units.

*Note: Septic tank sizes in this table include sludge storage capacity and the connection of domestic food waste disposal units without further volume increase.

UPC TABLE K-3
Estimated Waste/Sewage Flow Rates

Because of the many variables encountered, it is not possible to set absolute values for waste/sewage flow rates for all situations. The designer should evaluate each situation and, if figures in this table need modification, they should be made with the concurrence of the Administrative Authority.

Type of Occupancy	Unit Gallons (liters) Per Day
1. Airports	
	15 (56.8) per employee
2. Auto washers	5 (18.9) per passenger
3. Bowling alleys (snack bar only)	Check with equipment manufacturer
4. Camps:	75 (283.9) per lane
Campground with central	
comfort station	
with flush toilets, no showers	35 (132.5) per person
Day camps (no meals served)	25 (94.6) per person
Summer and seasonal	15 (56.8) per person
5. Churches (Sanctuary)	50 (189.3) per person
with kitchen waste	5 (18.9) per seat
6. Dance halls	7 (26.5) per seat
7. Factories	5 (18.9) per person
No showers	
With showers	25 (94.6) per employee
Cafeteria, add	35 (132.5) per employee
8. Hospitals	5 (18.9) per employee
Kitchen waste only	250 (946.3) per bed
Laundry waste only	25 (94.6) per bed
9. Hotels (no kitchen waste)	40 (151.4) per bed
10. Institutions (Resident)	60 (227.1) per bed (2 person)
Nursing home	75 (283.9) per person
Rest home	125 (473.1) per person
11. Laundries, self-service	125 (473.1) per person
(minimum 10 hours per day)	
Commercial	50 (189.3) per wash cycle
12. Motel	Per manufacturer's specifications
with kitchen	50 (189.3) per bed space
13. Offices 20 (75.7) per employee	60 (227.1) per bed space
14. Parks, mobile homes	
picnic parks (toilets only)	250 (946.3) per space
recreational vehicles –	20 (75.7) per parking space
without water hook-up	
with water and sewer hook-up	75 (283.9) per space
15. Restaurants – cafeterias	100 (378.5) per space
toilet	20 (75.7) per employee
kitchen waste	7 (26.5) per customer
add for garbage disposal	6 (22.7) per meal
add for cocktail lounge	1 (3.8) per meal
kitchen waste –	2 (7.6) per customer
disposable service	
16. Schools – Staff and office	2 (7.6) per meal
Elementary students	20 (75.7) per person
Intermediate and high	15 (56.8) per person
with gym and showers, add	20 (75.7) per student
with cafeteria, add	5 (18.9) per student
Boarding, total waste	3 (11.4) per student
17. Service station, toilets	100 (378.5) per person
	1000 (3785) for first bay
18. Stores	500 (1892.5) for each additional bay
public restrooms, add	20 (75.7) per employee
19. Swimming pools, public	1 per 10 sq. ft. (4.07 L/ m^2) of floor space
20. Theaters, auditoriums	10 (37.9) per person
drive-in	5 (18.9) per seat
	10 (37.9) per space

(a) **Recommended design criteria** – Sewage disposal systems sized using the estimated waste/sewage flow rates should be calculated as follows:

(1) Waste/sewage flow, up to 1500 gal/day (5677.5 L/day)
Flow x 1.5 = septic tank size (L/day x 1.5 = L)

(2) Waste/sewage flow, over 1500 gal/day (5677.5 L/day)
Flow x 0.75 + 1125 = septic tank size (L/day x 0.75 + 4.259 = L)

(3) Secondary system shall be sized for total flow per 24 hours.

(b) Also see Section K 2 of this appendix.

UPC TABLE K-4

Design Criteria of Five Typical Soils

Type of Soil	Required sq. ft. of leaching area/ 100 gals.	(m^2/L)	Maximum absorption capacity gals./sq. ft. of leaching area for a 24 hr. period	(L/m^2)
Coarse sand or gravel	20	(0.005)	5.0	(203.7)
Fine sand	25	(0.006)	4.0	(162.9)
Sandy loam or sandy clay	40	(0.010)	2.5	(101.9)
Clay with considerable sand or gravel	90	(0.022)	1.1	(44.8)
Clay with small amount of sand or gravel	120	(0.030)	0.8	(33.8)

UPC TABLE K-5

Required sq. ft. of Leaching Area Septic Tank Capacity		Maximum Septic Tank Size Allowable		
100 gals.	(m^2/L)	(gallons)	(liters)	(m^3)
20-25	(0.005–0.006)	7500	(28,387.5)	(28.388)
40	(0.010)	5000	(18,925.0)	(18.925)
90	(0.022)	3500	(13,247.5)	(13.248)
120	(0.030)	3000	(11,355.0)	(11.355)

NUCLEAR REGULATORY COMMISSION

Docket No. ______ Official Exh. No. 163

In the matter of PFS

Staff ______ IDENTIFIED ✓

Applicant ______ RECEIVED ______

Intervenor ✓ REJECTED ______

Other ______ WITHDRAWN ______

DATE 4/24/02 Witness ______

Clerk ______