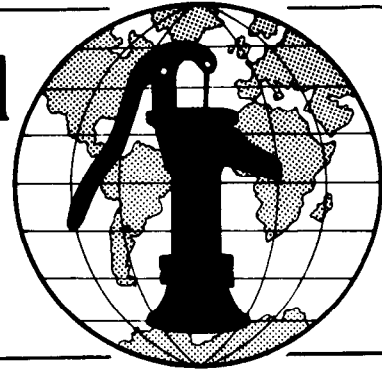


Water for the World



Constructing Septic Tanks Technical Note No. SAN. 2.C.3

A septic tank is a self-operating unit for sewage treatment. The tank receives raw sewage from a building, allows solids to settle out, and discharges effluent to an underground (subsurface) absorption system for final disposal. Figure 1 is a drawing of a septic tank. Constructing a septic tank involves digging a trench and hole at the proper location, laying sewer pipe, and either building a tank from concrete or masonry or installing a prefabricated one. This technical note describes each step in constructing a septic tank.

Read the entire technical note before beginning construction.

Useful Definitions

EFFLUENT - Settled sewage.

EXCRETA - Human body wastes.

FLOW LINE - The highest level to which liquid can rise in a septic tank, (usually 375mm below the top of the tank).

LIQUID DEPTH - The distance from the flow line to the bottom of the tank.

SEWAGE - All washwater, excreta, and water used to flush excreta that flows from a building, or buildings, through a sewer pipe, and into a septic tank, cesspool, or stabilization pond.

Materials Needed

The project designer must provide three essential documents before construction can begin:

1. A location map similar to Figure 2.

The map shows where the septic tank is to be located and the actual distances from the tank to water supplies, dwellings, property lines, trees, roads, and any other prominent features.

2. A plan view of the septic tank similar to Figure 3. The diagram shows the top, side, and end views of the tank with their dimensions. The septic tank should be built according to the specifications shown in the diagram.

3. A materials list similar to Table 1 describing all labor, materials, and tools necessary to construct the tank. (NOTE: Figures 1, 2, and 3 and Table 1 are samples only and cannot be used to build the septic tank. The documents you need will be provided by the project designer.)

After the project designer has given you these documents and after you have read this technical note carefully, begin assembling the necessary workers, materials, and tools.

Caution!

1. When excavating deeper than 1.5m, shore up the sides of the hole with logs, boards, bamboo, or other local material. Dig the hole so the sides slope slightly outward: 1 unit out for every 10 units deep. These precautions will help prevent cave-ins, which can be fatal to workers.

2. The top of the septic tank must be strong enough to support its own weight as well as the weight of the dirt that may cover it.

3. The septic tank top must be watertight. The tank will not operate properly if surface water or ground-water enters.

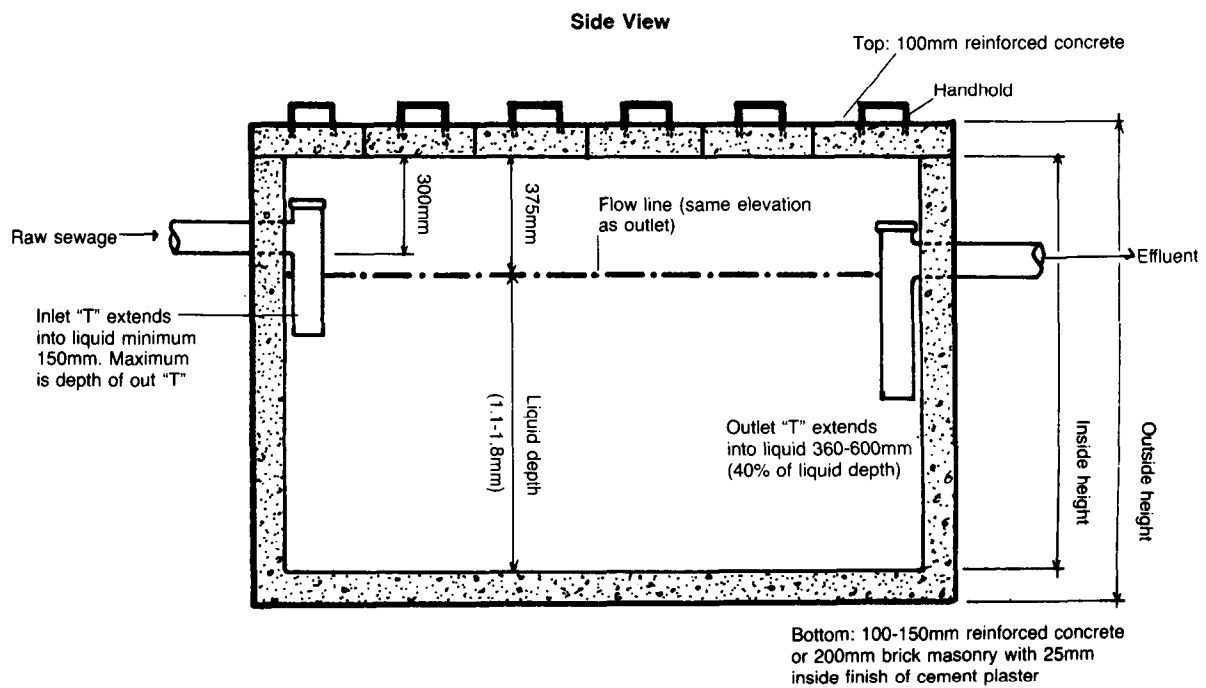
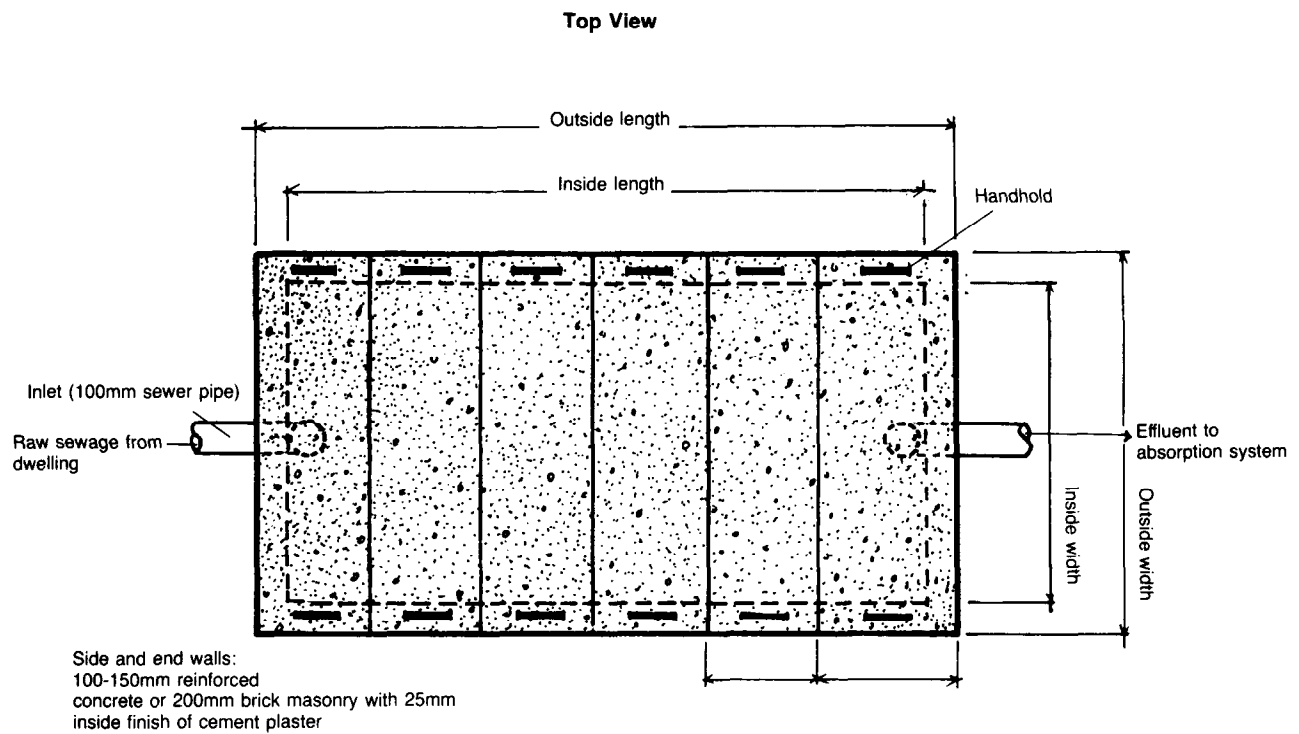


Figure 1. Septic Tank

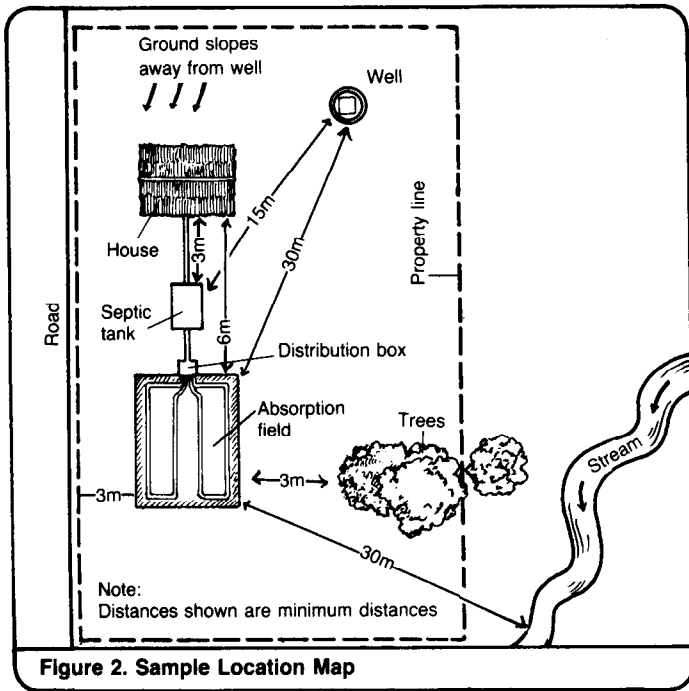


Figure 2. Sample Location Map

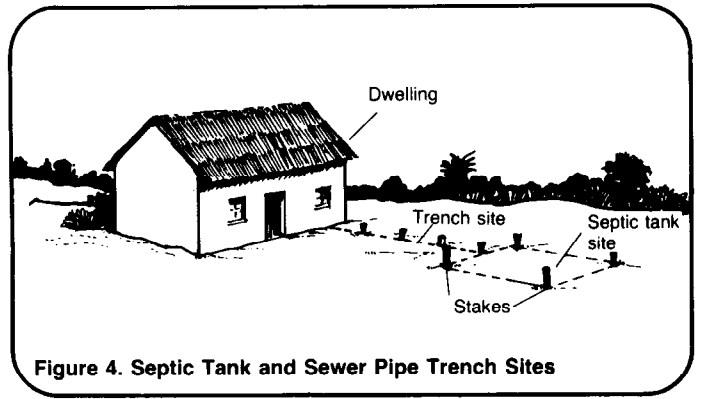


Figure 4. Septic Tank and Sewer Pipe Trench Sites

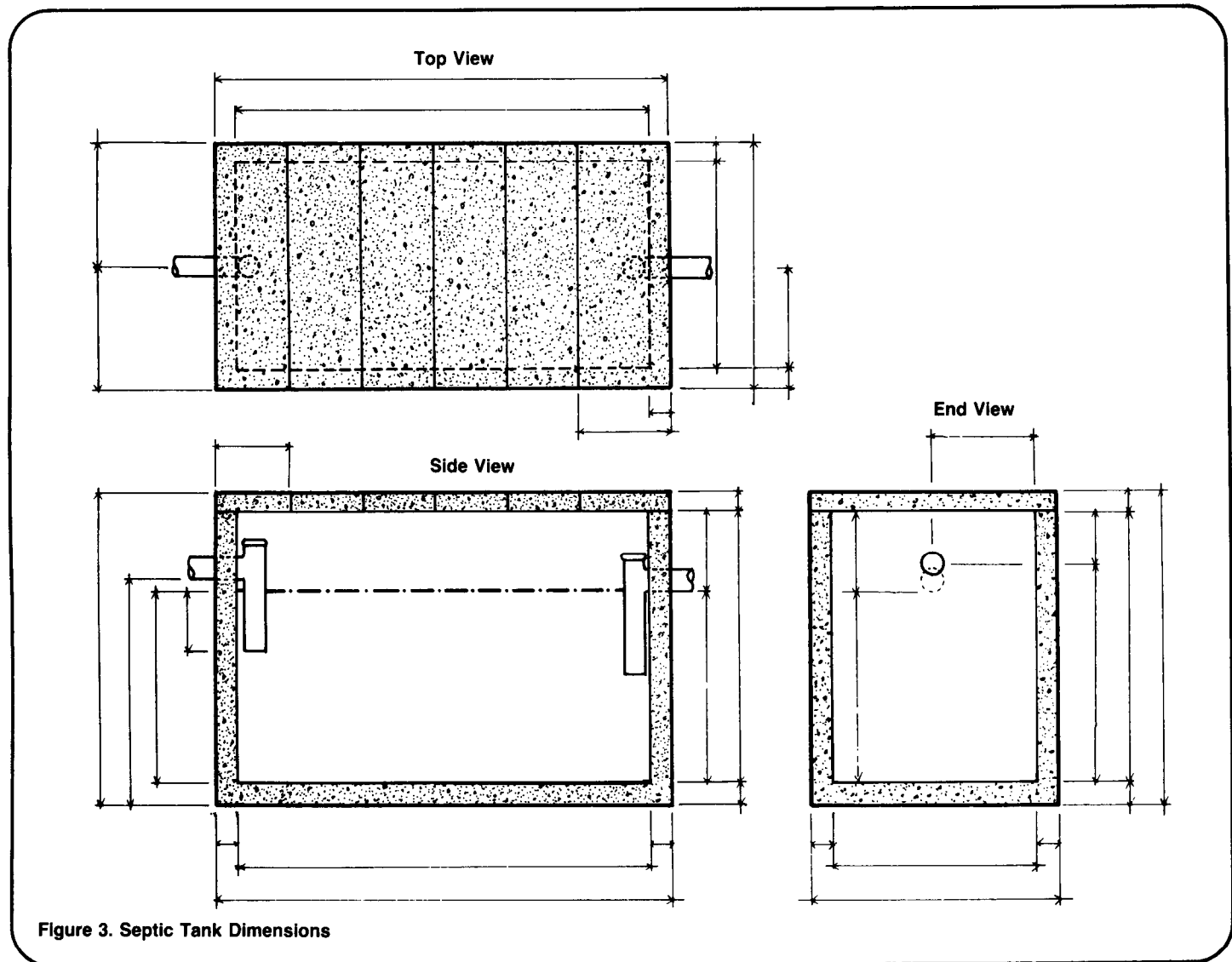


Figure 3. Septic Tank Dimensions

Table 1. Sample Materials List

| Item | Description | Quantity |
|----------|---|---|
| Labor | Foreman Laborers (NOTE: Either the foreman or one of the laborers must have some experience with concrete work.) | 1 2 (at least) |
| Supplies | Portland cement Sand: clean, fine to 6mm Gravel: clean, 6-38mm Water (enough to make a fairly stiff mixture; quantity is a rough estimate) Wire mesh (reinforcing material) Sewer pipe 100mm diameter vitrified clay "T" sewer pipe fittings (for inlet and outlet) Gravel for bedding material Wooden boards (for building forms) Timber, bamboo, or wood (for shoring up sides of hole) Tar or equivalent (for waterproofing top of tank) Nails (for building forms) Handholds (horseshoes or other bent pieces of metal) Tar, mortar, or oakum (for sealing pipe joints) Other | 0.5m ³ 0.9m ³ 1.4m ³ 300 liters 21m ² _____ m: enough to reach from dwelling to septic tank and from tank to field, plus several sections to be used as extensions to "T" fittings 2 _____ m: enough to spread under tank to a depth of 75mm _____ _____ _____ _____ 10 (2 for each section of top) _____ _____ |
| Tools | Measuring tape Shovels Bucket Container for mixing concrete (or hand mixer) Hoe Trowel Saw Hammer Plumb line (rock and string) Carpenter's level or equivalent (extremely useful, though not essential) Carpenter's square or equivalent (extremely useful, though not essential) Other | 1 2 (at least one per worker) 1 1 1 1 1 1 1 1 1 1 1 _____ |

DO NOT USE THE QUANTITIES IN THIS SAMPLE; PROJECT DESIGNER WILL PROVIDE CORRECT QUANTITIES

Construction Steps

Some construction steps will take only a few hours, while others may require several days. The amount of time needed for each step depends on local conditions, availability of materials, skill of workers, and so on.

Table 2 shows a sample work plan for building a septic tank including time estimates for each step. Draw up a similar work plan with rough time estimates. This will give you an idea of when during the construction process specific workers, materials, and tools will be needed.

Table 2. Sample Work Plan for Constructing a Septic Tank

| Time Estimate | Day | Task | Personnel | Tools/Materials |
|---------------|---------|---|---|---|
| 4 hours | 1 | Excavate trench | 2 laborers and foreman (foreman present during all phases of construction) | 2 shovels |
| 3 hours | 1 | Lay sewer pipe | 2 laborers | Sewer pipe, mortar |
| 2 days | 2 - 3 | Excavate hole and shore up sides | 2 laborers | Shovels, wood, hammer, nails |
| 6 hours | 4 | Build forms, mix and pour concrete for floor | Laborer and concrete worker | Wood, cement, sand, gravel, water, mixing container, trowel, reinforcing material |
| 6 hours | 5 | Build forms, mix and pour concrete for top | Laborer and concrete worker | Wood, cement, sand, gravel, water, mixing container, trowel, reinforcing material |
| 7 days | 5 - 11 | Allow concrete to set | | |
| 9 hours | 12 | Build forms, mix and pour concrete for walls | Laborer and concrete worker | Wood, cement, sand, gravel, water, mixing container, trowel, reinforcing material; plus two "T" fittings, |
| 7 days | 12 - 18 | Allow concrete to set | | |
| 6 hours | 19 | Extend sewer to inlet and outlet | 2 laborers | Shovels, sewer pipe, mortar |
| 3 hours | 20 | Place fill dirt around tank | 2 laborers | Shovels |
| 1 hour | 20 | Set top in place and waterproof | 2 laborers | Tar or equivalent |
| 1 hour | 20 | Cover with dirt (if necessary) and place marker | 2 laborers | Shovels, marker |

The following are general construction steps for building a septic tank.

1. Assemble all materials, tools, workers, and drawings needed to begin construction. Study all diagrams carefully.

2. Locate the site of the tank using the location map and measuring tape, and mark it on the ground with wooden stakes or pointed sticks as shown in Figure 4. Do the same for the trench line for the sewer pipe from the building to be served to the tank site. Double check the location map to make certain the staked-out locations are correct before beginning construction.

3. Excavate the trench from the building to the septic tank site with a downward slope of from 1 in 50 to 1 in 100. This means the trench drops 1 unit in elevation for every 50 to 100 units of length. Figure 5 shows the slope of the pipe trenches. The trench should slope evenly and be straight as possible. Avoid bends. The trench need not be more than 300mm wide and 300mm deep in ground sloping down to the tank site. In level or uneven ground, the trench may have to be deeper to attain the proper downward slope (1 in 50 to 100).

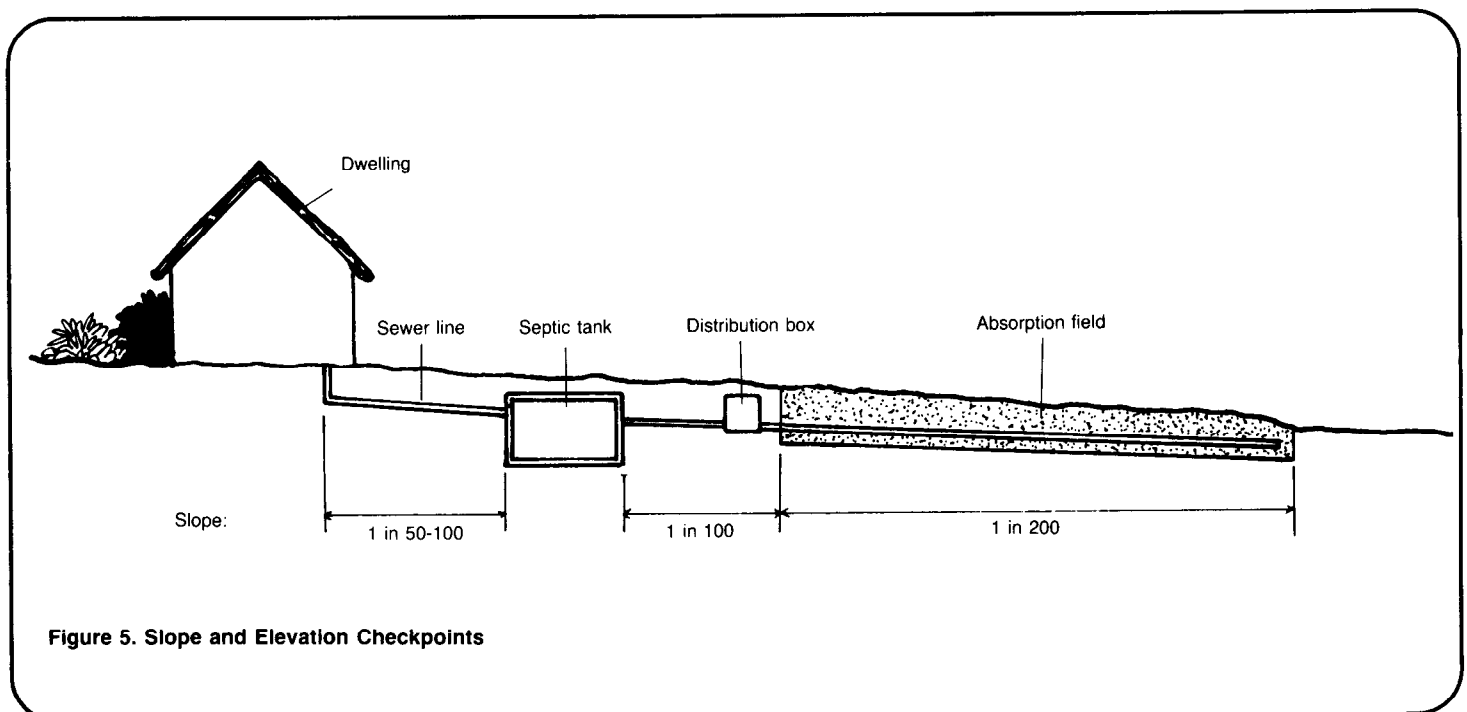
4. Lay sewer pipe in the trench. Pipe probably will be 100mm diameter

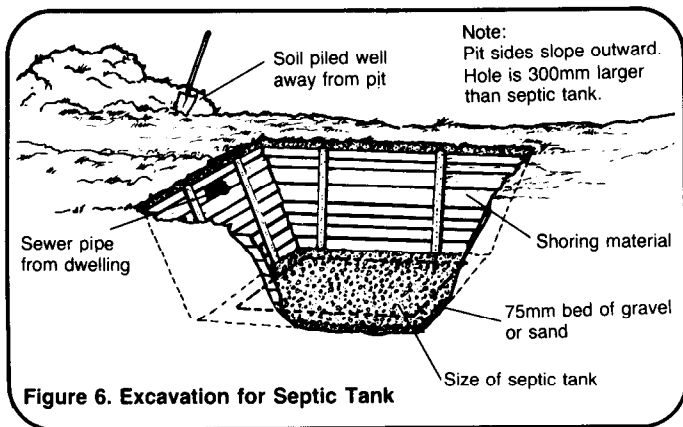
vitrified clay or other noncorrosive material. Seal all pipe joints with tar, mortar, oakum, or other local caulking materials. The pipe is laid at this stage to make certain that its slope is correct before continuing construction. Pour water in the pipe at the building to see if it flows through the entire pipe; if it does not, re-excavate the trench and re-lay the pipe until the slope is correct. Laying the pipe also shows the proper depth to excavate the hole for the tank. The depth is measured down from the end of the sewer pipe, not from the surface of the ground.

5. Dig the hole. Allow for outward slope of sides (at least 1 in 10) and working area around each side of at least 300mm. If the hole is to be more than 1.5m deep, begin shoring the sides as you excavate to prevent a cave-in. To determine how deep to dig the hole, measure down from the extended sewer pipe (this will be the inlet end of the septic tank as shown in Figures 1 and 6), then allow:

75mm
plus the liquid depth,
plus the floor thickness,
plus 75mm for the gravel bed.

The bottom of the hole should be level.





6. Spread 75mm of sand, gravel, or crushed rock on the bottom of the excavation.

(NOTE: During construction continually check diagrams and field measurements to be certain the tank is built properly.)

For a Reinforced Concrete Tank:

1. Follow "General Construction Steps" 1 through 6.

2. Build wooden forms for the bottom of the tank. Build them in place at the bottom of the hole according to the dimensions (length, width, and thickness) on the plan view supplied by the project designer. Align forms with the sewer pipe. Check the distance down from the end of the sewer pipe to the top of the forms - this distance must be 75mm plus the liquid depth.

3. Position and secure reinforcing material within the forms. If L-shaped bars are to be used to help secure the walls to the bottom of the tank, they should be set in place at this point. The upper half of the bar should extend into the center thickness of the wall as shown in Figure 7.

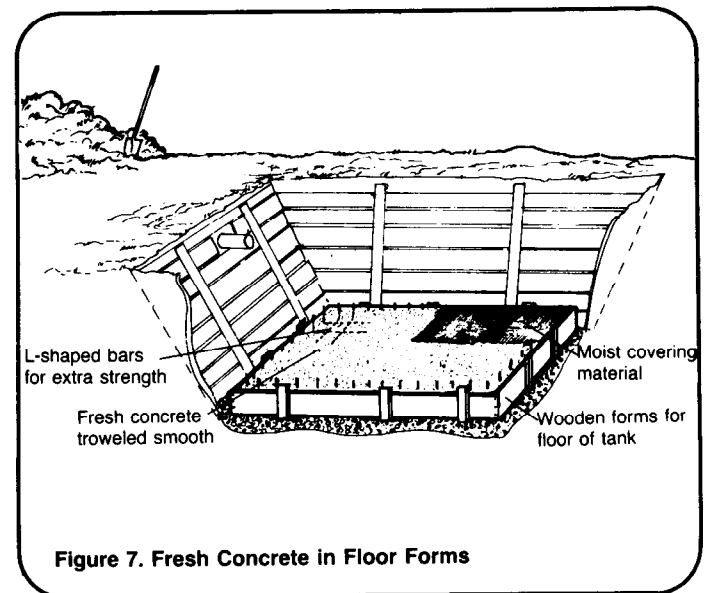
(NOTE: Double check all measurements before pouring concrete.)

4. Mix concrete with the proper proportions of cement, sand, gravel, and water. A common mix by volume is one part cement to two parts sand to three parts gravel and enough water to make a fairly stiff mix.

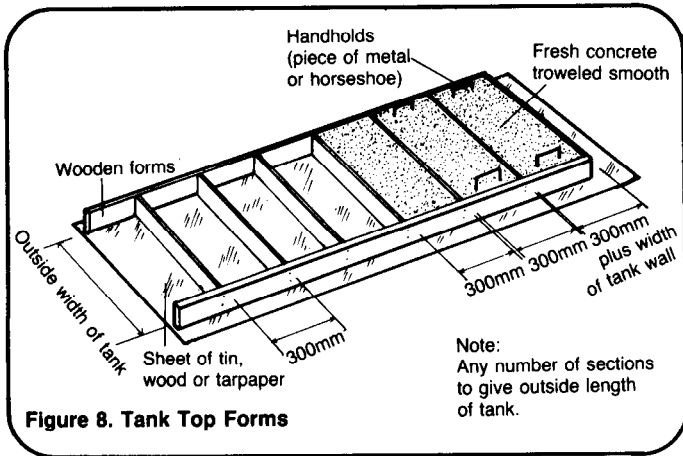
Cement: Use Portland cement. Remove any hard lumps of cement before mixing.
 Sand: Clean, fine to 6mm.
 Gravel: Clean, 6-38mm.
 Water: Clean and clear; drinking water, if possible.
 Mixing: Mix until sand and gravel are evenly coated with cement and water.

5. Pour concrete into forms. **IMPORTANT:** Concrete must completely fill the forms. Use a stout stick or steel rod to work concrete into the forms and between the reinforcing material. Leave no voids. Use a board or trowel to smooth concrete surface.

6. Cover freshly troweled concrete with straw, burlap bags, or other material to prevent concrete from drying out too rapidly and losing strength. Keep this cover material moist for seven days, then remove the cover material and the wooden forms. During this seven-day period, continue with steps 7 and 8.



7. Build forms for the septic tank top as shown in Figure 8. The top is made in sections, and each section except one is 300mm wide. The remaining section's width is 300mm plus the fraction of a foot necessary to account for the remainder of the total outside length of the tank.



EXAMPLE: Suppose the total outside length of the tank is 1.676m. The top would consist of 5 sections, whose widths would be:

$$300\text{mm} + 300\text{mm} + 300\text{mm} + 300\text{mm} + 476\text{mm} = 1.676\text{m}$$

Each section's length is equal to the outside width of the septic tank.

8. Mix and pour concrete into the forms as described in steps 4 and 5.

9. Set handholds into the concrete near both ends of each top section. Cover the wet concrete with straw, burlap bags, or other material as in step 6. The cover material and the forms must remain in place for seven days, then they should be removed.

10. Build wooden forms and position reinforcing material for the walls of the tank. Build these forms in place on the concrete floor of the tank. Brace the forms to prevent the risk of collapse when the concrete is poured as shown in Figure 9.

(NOTE: There are two ways of doing step 11. Decide which is most convenient before proceeding. Either (a) pour concrete into wall forms up to inlet and outlet elevations, allow to set, mortar the pipe sections in place in wall, and pour remainder of the concrete into wall forms; or (b) set one pipe section for the inlet and one for the outlet in place in the forms before pouring concrete (this may require some realignment of reinforcing material) then pour concrete for entire wall. In either case, it is most important that the inlet and outlet fittings are set at the correct elevations.)

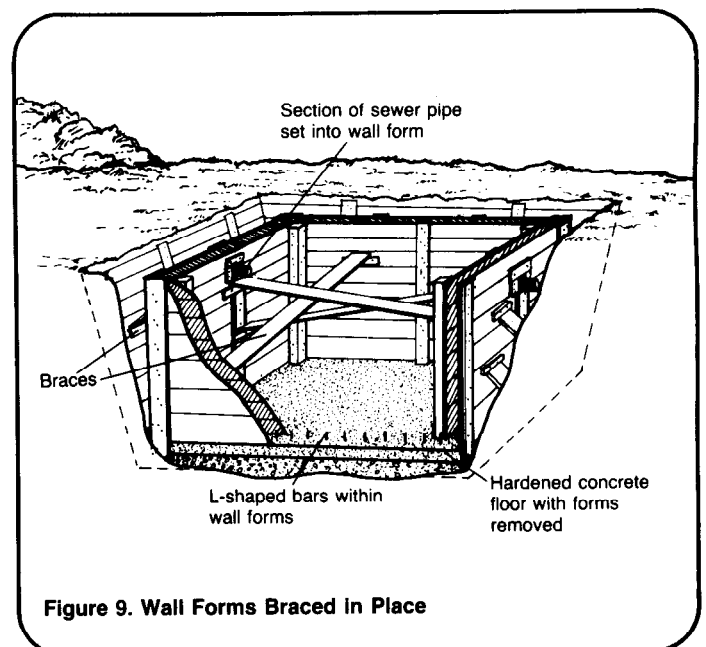
11. Mix and pour concrete into the wall forms as described in steps 4 and 5.

12. Trowel tops of walls smooth and cover with moist material as described in step 6. Leave cover material and forms in place for seven days, then remove.

13. Mortar the joints between walls and floor to ensure that the tank will be watertight. A common mortar mix is one part cement to three parts sand and enough water to make a workable mix. See step 4 for specific amounts of cement, sand, water, and mixing. Mortar inlet and outlet pipe "T" fittings in place and mortar extensions to the fittings. The fittings and extensions will have to be held in place, possibly by wooden braces, until the mortar sets.

14. Extend the sewer pipe to the inlet fitting and mortar in place.

15. Excavate at least 3m of trench from the outlet end of the septic tank toward the site of the subsurface absorption system (see "Constructing, Operating and Maintaining Subsurface Absorption Systems," SAN.2.C.1). The trench must slope downward away from the tank at a slope of about 1 in 100. Extend sewer pipe from the outlet of the septic tank into the trench. Mortar all pipe joints.



16. Add a little water to fill dirt and carefully shovel into the space between the septic tank and the earth walls of the hole as shown in Figure 10. The water will help prevent later settling. Tamp dirt well. Be careful not to disturb or damage the sewer pipe or the inlet and outlet fittings.

17. Make a final check of the septic tank. Be certain all joints are sealed with mortar. Remove any debris, wood scraps, tools, and so on.

18. Remove cover material and wooden forms from the top sections of the tank. Carefully place sections on top of tank. Thoroughly waterproof with tar or other waterproofing material between each section and between the sections and the top of the tank walls.

If the top of the tank is level with or higher than the surface of the ground:

19. Determine whether tank should be covered with dirt.

a. Do not cover the tank if there is concern that it will not be inspected at least once a year (see "Operating and Maintaining Septic Tanks," SAN.2.0.3) because of being covered with dirt and possibly forgotten.

b. Cover the tank if there is concern that it will be opened or damaged by unauthorized persons.

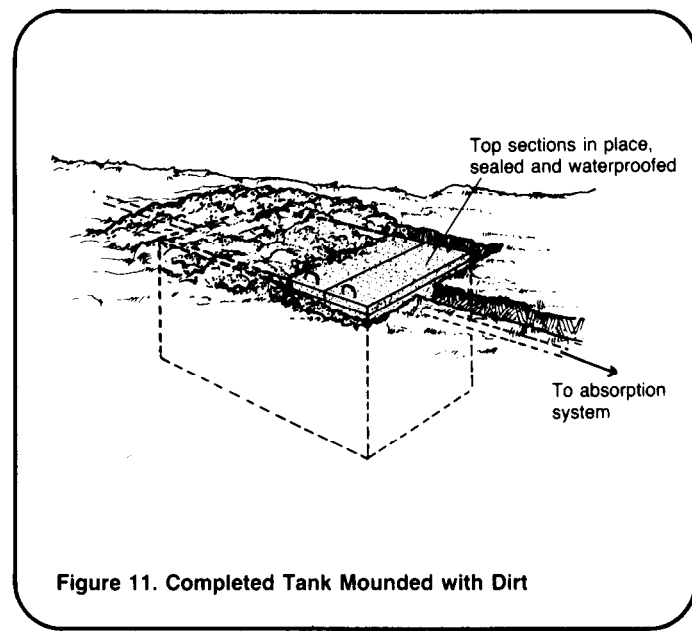


Figure 11. Completed Tank Mounded with Dirt

If the top of the tank is below the surface of the ground:

20. Cover the tank with a mound of dirt to prevent surface water from forming a pool on top of the tank as shown in Figure 11. Mark the tank site with sticks, stakes, piles of rocks, or other means to help find it at inspection time. The mound itself can be a means of identifying the tank site.

(NOTE: The septic tank is part of a system and is not ready to operate until it is connected by sewer pipe to a subsurface absorption system. See "Constructing, Operating and Maintaining Subsurface Absorption Systems," SAN.2.C.1.)

For a Laid-Up (Masonry) Tank:

1. Follow "General Construction Steps" 1 through 6.
2. Follow "Construction Steps for a Reinforced Concrete Tank" 1 through 9.
3. Remove cover material and wooden forms seven days after pouring concrete for the bottom of the tank. Using masonry stone, bricks, or concrete and cement mortar, begin to lay up the walls of the septic tank according to design specifications on the drawing provided by the project designer. Directions for mixing cement mortar are in step 4 of "Construction Steps for a Reinforced Concrete Tank."

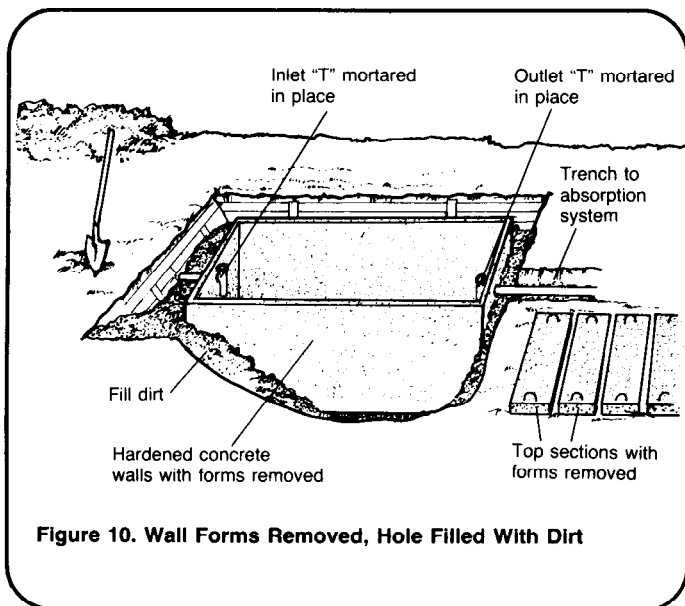


Figure 10. Wall Forms Removed, Hole Filled With Dirt

When the walls attain the proper height:

4. Install the "T" fittings on the inlet and outlet pipes. Be certain the elevations of these fittings are correct. Mortar the joints around the fittings and mortar extensions to the fittings. These may have to be braced with wood until the mortar sets.

5. Continue laying up the walls to the top. If hollow blocks are being used, fill in the hollow spaces in the top layer.

6. Plaster the inside walls of the septic tank with a 25mm layer of cement mortar. Apply the layer in two applications of 12mm each. Let the first set for several days before applying the second.

7. Follow "Construction Steps for a Reinforced Concrete Tank" 14 through 20 after the walls have set for seven days.

For a Prefabricated Tank:

1. Follow "General Construction Steps" 1 through 6. Be certain that the bed of gravel is level. If it is not, the tank will not be level and the inlet and outlet fittings will not be at the correct elevations.

2. Check to be certain that the inlet and outlet ends of the tank are pointing in the correct direction, then carefully lower the tank into the hole.

3. Mortar inlet and outlet fittings in place and mortar extensions to fittings, if necessary, depending on the design of the prefabricated tank.

4. Partially fill the tank partly full with water. This prevents the tank from floating out of the hole before it is in operation, particularly in areas of high groundwater levels.

5. Follow "Construction Steps for a Reinforced Concrete Tank" 14 through 16.

6. Use tar or other waterproofing material to seal edges of manhole cover(s).

7. Follow "Construction Steps for a Reinforced Concrete Tank" 19 through 20.

(NOTE: The septic tank is part of a system and is not ready to operate until it is connected by sewer pipe to a subsurface absorption system.)