Water for the World

Designing Aqua Privies
Technical Note No. SAN. 1.D.4

An aqua privy is an underground watertight vault filled with water that receives excreta and washwater from a drop-pipe, allows solids to settle to the bottom and discharges effluent to a soakage pit. Designing an aqua privy involves selecting a location, calculating the size of the vault and the soakage pit, and determining the labor, materials, and tools needed for construction. The products of the design process are: (1) a location map, (2) design drawings of the aqua privy, and (3) a detailed materials list. These products should be given to the construction foreman before construction begins.

This technical note describes how to design an aqua privy and arrive at these three end-products. Read the entire technical note before beginning the design process.

Useful Definitions

CONTAMINATE - To make unclean by introducing an infectious (disease-causing) impurity such as bacteria from excreta.

EFFLUENT - Settled sewage.

EXCRETA - Human body wastes.

FLOW LINE - The highest level to which liquid can rise in an aqua privy.

GROUNDWATER LEVEL - The level to which subsurface water rises during any given time of year.

WASHWATER - Water that has been used for bathing or washing clothes, dishes, or kitchen utensils.

Materials Needed

Measuring tape - To obtain accurate field information for a location map.

Ruler - To draw a location map.

General Design Information

The soakage pit or soakage trench connected to an aqua privy is identical to that described in "Designing Sumps, Soakage Pits and Trenches," SAN.1.D.7. For design information, and material on size, materials, and labor, refer to that technical note.

The walls and floor of an aqua privy vault must be waterproof. They are made from reinforced concrete or brick and mortar, and are 100mm thick. A sitting or squatting slab covers the vault. It is made from reinforced concrete and is 75mm thick. The drop-pipe is made from galvanized metal. It extends from the hole in the slab down into the liquid in the vault to a depth of 100mm. The overflow pipe extends from the back wall of the vault to the soakage pit or trench. It is 100mm in diameter and made from non-corrosive plastic or vitrified clay. The pipe is equipped with an elbow fitting or "T" fitting inside the vault. The bottom of the overflow pipe, and thus the flow line, is 300mm below the bottom of the slab as shown in Figure 2. The vent pipe extends upward from the rear wall of the vault just below the slab. It is 25mm in diameter and made from galvanized metal or similar material.

The minimum capacity of the vault should be 1.0m^3. Capacity is deter-

mined by multiplying the inside length times the inside width times the liquid depth (distance from the flow line to the floor of the vault).

Location

An aqua privy vault should be at least:

15m from the nearest water supply,
3m from the nearest dwelling,
3m from any property line.

A soakage pit or soakage trench should be downhill and at least:

30m from the nearest water supply,
6m from the nearest dwelling,
3m from any property line,
3m from trees or bushes.

The minimum distance between the vault and soakage pit is 3m. There is no maximum distance, but for practical reasons the vault and soakage pit are usually no more than 30m apart.

When sites for the aqua privy vault and soakage pit have been selected, the soakage pit site must be tested for soil suitability and groundwater levels to prevent contamination of water supplies. For details see "Designing Sumps, Soakage Pits, and Trenches," SAN.1.D.7.

When the soil has been found to be suitable, draw a location map similar to Figure 1 showing the aqua privy and soakage pit or trench in relation to all sources of drinking water, dwellings, property lines, and trees. Give the map to the construction foreman before construction begins.

Determining Size

To determine the size of the soakage pit or trench, see "Designing Sumps, Soakage Pits, and Trenches," SAN.1.D.7.

To figure the size of the aqua privy vault, first determine the number of persons who will regularly use the privy, then consult Table 1.

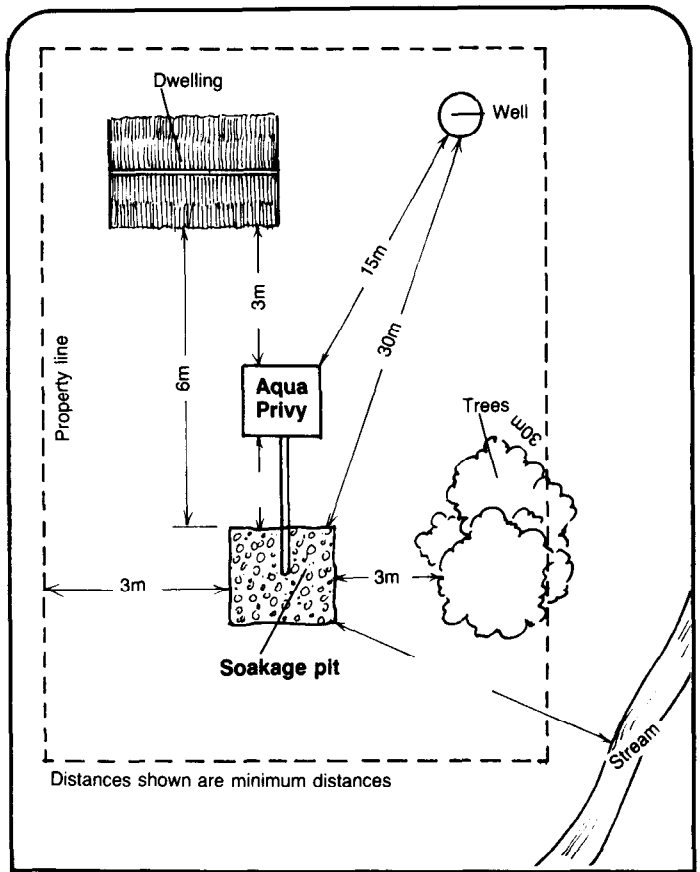

Figure 1. Location Map

Table 1. Recommended Measurements for an Aqua Privy Vault

Number of Persons	Capacity	Liquid Depth*	Inside Length	Inside Width	Inside Height**
8 or fewer	1.0m^3	1.0m	1.0m	1.0m	1.3m
9	1.1m^3	1.1m	1.0m	1.0m	1.4m
10	1.2m^3	1.1m	1.1m	1.0m	1.4m
11	1.3m^3	1.1m	1.1m	1.1m	1.4m
12	1.4m^3	1.2m	1.1m	1.1m	1.5m
13	1.6m^3	1.2m	1.2m	1.1m	1.5m
14	1.7m^3	1.2m	1.2m	1.2m	1.5m
15 or more	Build two or more aqua privies				

*Liquid depth is the distance from the flow line to the floor of the vault.

**Inside height equals the liquid depth plus 300mm.

For example, if nine persons will use the aqua privy, then: capacity = 1.1m^3; liquid depth = 1.1m; inside length = 1.0m; inside width = 1.0m; inside height = 1.4m. See Worksheet A, Lines 1-5.

Worksheet A. Calculations for an Aqua Privy

1. Number of persons using aqua privy = 9
2. Liquid depth (from Table 1) = 1.1m
3. Inside length (from Table 1) = 1.0m
4. Inside width (from Table 1) = 1.0m
5. Inside height (from Table 1) = 1.4m
6. Outside length = Line 3 + 200mm = 1.0 m + 0.2m = 1.2 m
7. Outside width = Line 4 + 200mm = 1.0 m + 0.2m = 1.2 m
8. Outside height = Line 5 + 175mm = 1.4 m + 0.175m = 1.575m

Quantities

9. Volume of slab = Line 6 x Line 7 x 0.075m = 1.2 m x 1.2 m x 0.075m = 0.1 m^3
10. Volume of walls = (2 x Line 6 x Line 5 x 0.1m) + (2 x Line 7 x Line 5 x 0.1m) = (2 x 1.2 m x 1.4 m x 0.1m) + (2 x 1.2 m x 1.4 m x 0.1m) = 0.34 m^3 + 0.34 m^3 = 0.7 m^3
11. Volume of floor = Line 6 x Line 7 x 0.1m = 0.1 m^3

When the liquid depth and the inside measurements have been determined, calculate the outside dimensions. The outside length equals the inside length plus two end walls. The outside width equals the inside width plus two side walls. The outside height equals the inside height plus the floor and the slab. Table 2 shows the thicknesses to use in calculating outside dimensions.

Table 2. Thickness of Walls, Floor, and Slab

Feature	Thickness
Wall	100mm
Floor	100mm
Slab	75mm

In the example, the outside dimensions would be as follows:

Outside length = 1.0m + 100mm + 100mm = 1.2m
Outside width = 1.0m + 100mm + 100mm = 1.2m
Outside height = 1.4m + 100mm + 75mm = 1.575m

See Worksheet A, Lines 6-8.

When all dimensions have been calculated, prepare design drawings of the aqua privy vault similar to Figure 2, and the soakage pit similar to Figure 3, showing all measurements. Give these drawings to the construction foreman before construction begins.

Determining Materials, Tools, and Labor

The walls of an aqua privy are made from reinforced concrete or brick and mortar. The floor and the slab are made from reinforced concrete.

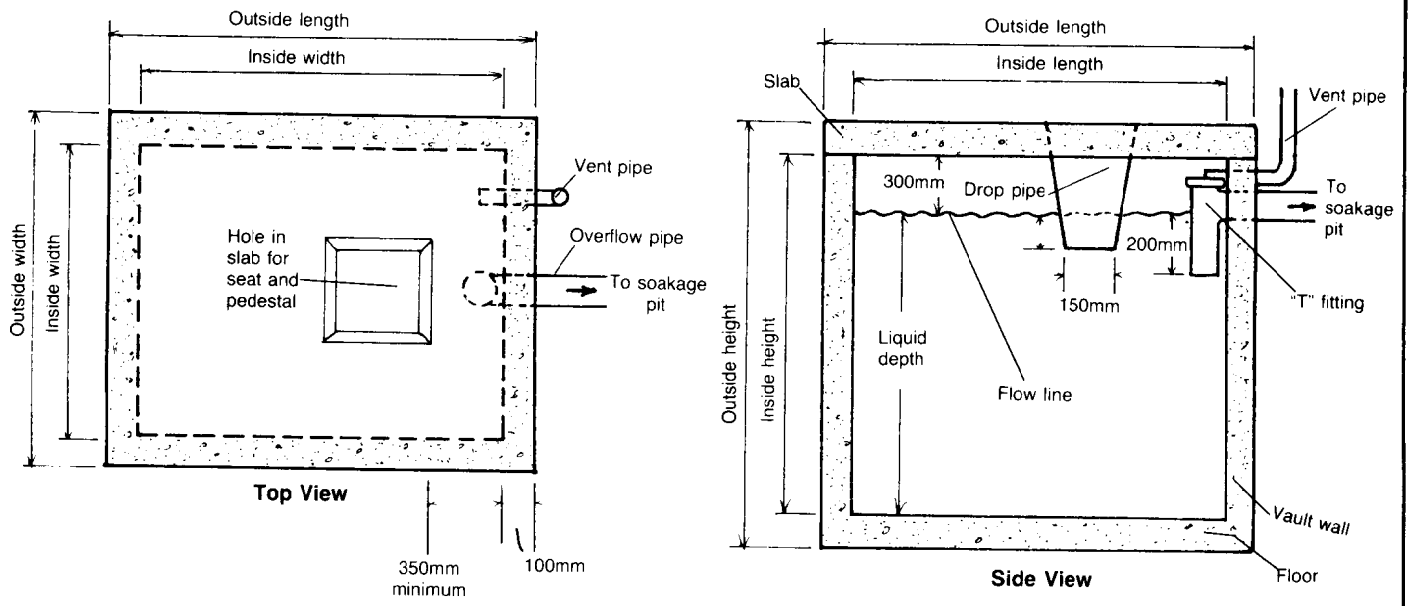

Figure 2. Aqua Privy

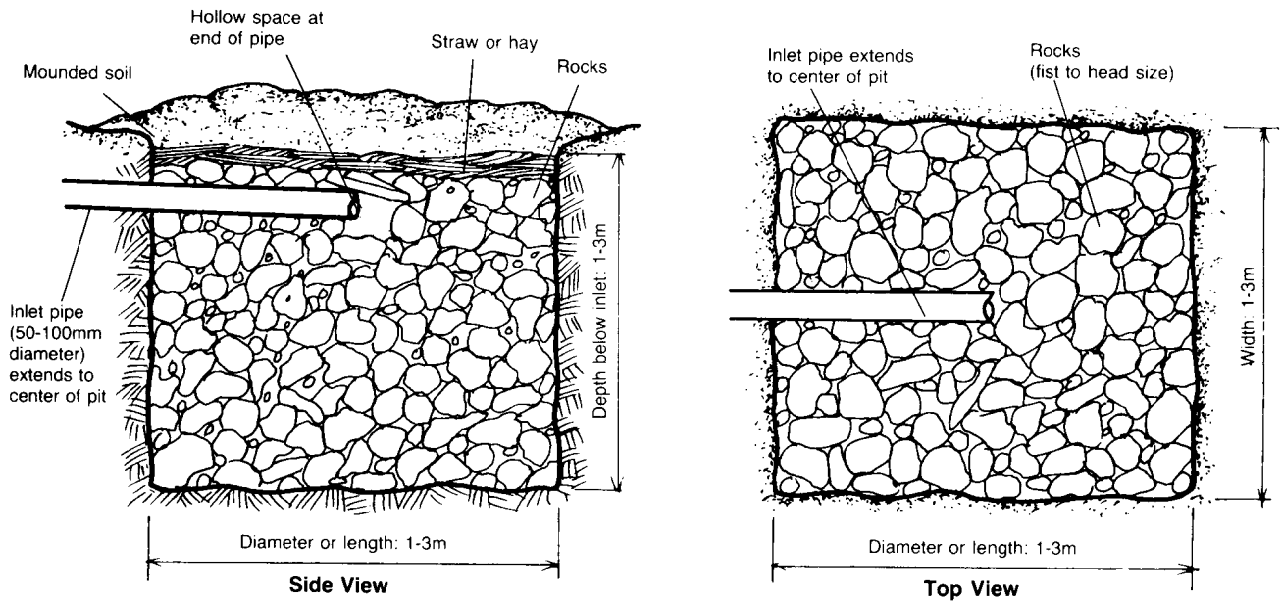

Figure 3. Soakage Pit

Concrete walls, floor, and slab require cement, sand, gravel, and water; containers and tools for mixing and smoothing concrete; reinforcing material; wood, hammer, saw, and nails for building forms; and at least one worker with some experience in concrete. See "Designing Septic Tanks," SAN.2.D.3, for complete details and specifications on concrete ingredients and reinforcing materials.

Brick and mortar walls require bricks or concrete blocks; cement, sand, and water for mortar and cement plaster; containers and tools for mixing and spreading mortar; and at least one worker with some experience with masonry. See "Designing Septic Tanks," SAN.2.D.3, for complete details.

For more information on slab design, see "Designing Slabs for Privies," SAN.1.D.1.

Quantities. The quantities of materials needed for the vault can be estimated by adding the volumes of the slab, walls, and floor.

Table 3. Sample Materials List for Aqua Privy

Item	Description	Quantity	Estimated Cost
Labor	Foreman	1	____
	Worker (skilled with concrete)	1	____
	Worker (unskilled)	1	____
Supplies	Wood (for forms)	____	____
	Nails (for forms)	____	____
	Cement (Portland)	____	____
	Sand (clean, sized fine to 6mm)	____	____
	Gravel (clean, sized 6-25mm)	____	____
	Water (clear)	____	____
	Reinforcing material	____	____
	Overflow pipe (vitrified clay, 100mm diameter)	____	____
	Elbow fitting (vitrified clay, 100mm diameter)	____	____
	Vent pipe (galvanized metal, 25mm diameter)	____	____
	Drop-pipe (galvanized metal, 400mm long)	____	____
	Materials for soakage pit:		
	rocks	____	____
	straw	____	____
Tools	Measuring tape	1	____
	Hammer	1	____
	Saw	1	____
	Shovels	2	____
	Trowel	1	____
	Container for mixing concrete	2	____
	Carpenter's level (optional)	1	____
	Carpenter's square (optional)	1	____
	Tar or equivalent (for sealing slab to vault)	____	____

Total Estimated Cost = ____

Volume of the slab = outside length times outside width times thickness.

Volume of the walls = (2 x outside length x inside height x thickness) + (2 x outside width x inside height x thickness).

Volume of floor = outside length x outside width x thickness.

In the previous examples, the volumes would be as follows:

Slab = 1.2m x 1.2m x 0.075m = $0.1m^3$

Walls = (2 x 1.2m x 1.4m x 0.1m) + (2 x 1.2m x 1.4m x 0.1m) = $0.34m^3$ + $0.34m^3$ = $0.7m^3$

Floor = 1.2m x 1.2m x 0.1m = $0.1m^3$

See Worksheet A, Lines 9-11.

Other quantities include an overflow pipe of non-corrosive material, 100mm in diameter, the length of which equals the distance from the aqua privy to the soakage pit; a "T" or elbow fitting for the overflow pipe; a vent pipe of galvanized metal, 25mm in diameter and 2.0-2.5m long; a drop-pipe of galvanized metal, about 400mm long, 150mm diameter at the lower end, and large enough at the upper end to enclose the hole in the slab.

When all materials, tools, and labor requirements have been determined, draw up a materials list similar to Table 3 and give it to the construction foreman before construction begins.

In summary, give the construction foreman a location map similar to Figure 1, design drawings similar to Figures 2 and 3, and a materials list similar to Table 3.