321.4 85TW

[redacted]

[redacted]

321.4-2513

LIBRARY IRC
PO Box 93190, 2509 AD THE HAGUE
Tel.: +31 70 30 689 80
Fax: +31 70 35 899 64
BARCODE: 2513
LO:
321.4 85TW

Library
IRC International Water
and Sanitation Centre
Tel.: +31 70 30 689 80
Fax: +31 70 35 899 64

TWIN LEACHING PIT TOILETS - DESIGN & CONSTRUCTION MANUAL

prepared for: UNDP Low Cost Sanitation Investment Project
project INS/81/002

prepared by : Frans Heynes

illustrator : Samyono Samsidin

publisher:

PUSLITBANG PEMUKIMAN
Jalan Tamansari 84
Bandung - Indonesia

Bandung 1985

Text and drawings guide you step-by-step through the design and construction of a Twin Leaching Pit toilet suited to local physical conditions, locally available building materials, skills and financial resources.

The manual covers a range of physical conditions and shows various alternatives. You may use it as a catalogue and photocopy relevant parts to compile a more specific manual.

Section 1 reviews briefly the principles and design variables of the TLP toilet to provide an overall picture.

Section 2 leads to a design and location of the toilet room and leaching pits, matching with the number of users, local physical conditions, and personal preferences.

Section 3 gives an overview of common building materials and construction methods. The quantities of materials for the proposed design can be determined by simple calculations. An economic choice can be made by adding local unit prices.

Section 4 explains the construction process: on-site production of pit covers, digging and lining of the leaching pits, laying the pipes from the pits to the toilet room and the construction of the toilet room.

A rotating disk, to hang in the toilet, shows the main operation and maintenance procedures of the TLP toilet. The dates of emptying and switching can be recorded on the card.

ACKNOWLEDGEMENT

This manual is based on existing literature and practical experience from the construction of demonstration TLP toilets in Cipedes, Bandung. A full list of references is given overleaf and their contribution is gratefully acknowledged.

The following individuals have made significant contributions.

Albert Kartahardja, previously Director of Environmental Sanitation in the Directorate General Cipta Karya. His direct involvement in Government sanitation policy and continued interest in the search for affordable sanitation solutions helped create the climate in which the production of this manual was possible.

Gerd-Jan de Kruijff, Low Cost Sanitation Adviser to the Government of Indonesia and firm advocate of on-site sanitation. He has converted technical information into operational standards, and his valuable advice on all the technical content improved the manual as a practical field aid.

Paul Heynes, educator, helped compile the manual with particular reference to repackaging of ideas into a digestible form and the use of plain, direct language. With no previous technical knowledge of sanitation, his advice improved the manual as a self-help field aid.

Tom Carter helped with the English language and highlighted the inseparability of semantics and syntax.

Samyono Samsidin, the illustrator, whose acute observation and fine, uncluttered graphic style bring the text to life and give it an unmistakable Indonesian face. Special thanks are due to him.

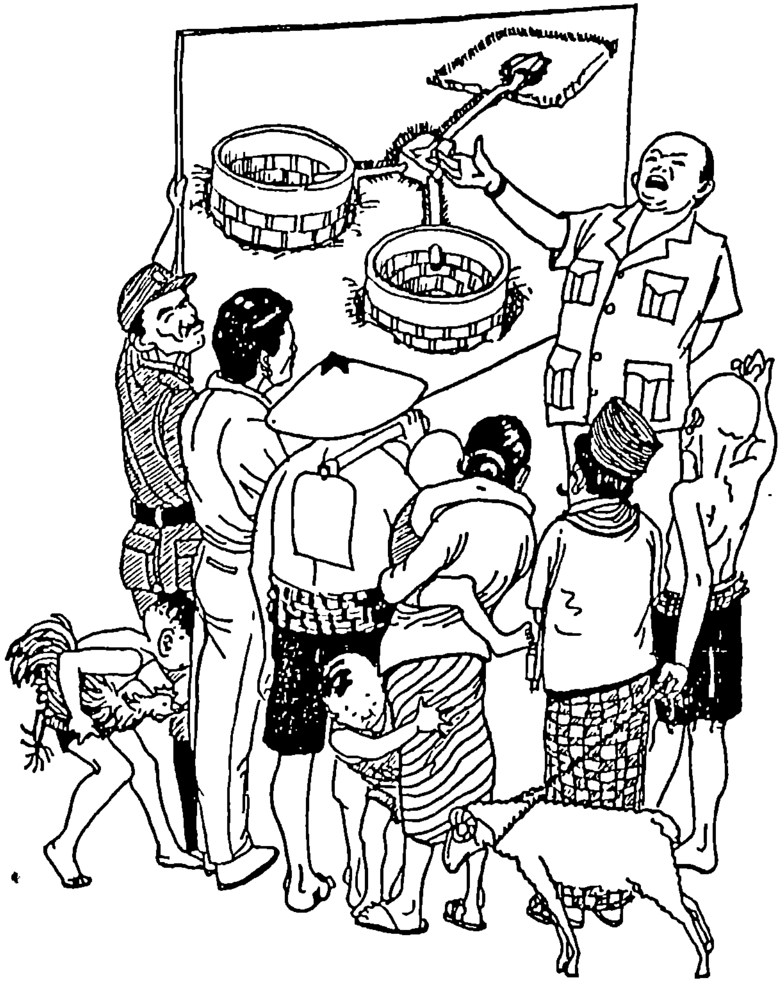
Le Clere, Maria, and Sherer, Keith; **A Workshop Design for Latrine Construction, a Training Guide** Wash technical report no 25; prepared for: Office of Health, Bureau for Science and Technology Agency for International Development OTD no. 122; June 1984.

Nostrand, van John; Wilson, James G. **The Ventilated Improved Double Pit Latrine: A Construction Manual for Botswana** TAG Technical Note Number 3, UNDP Interregional Project INT/81/047, April 1983.

Roy, A.K., et al. **Manual on the Design, Construction and Maintenance of Low-Cost Pour-Flush Waterseal Latrines in India** TAG Technical Note Number 10, UNDP Interregional Project INT/81/047, 1984.

Rybczynski, Witold, **Double-Vault Composting Toilets: A State-of-the Art Review** Environmental Sanitation Review no. 6, ENSIC Bangkok, Thailand, December 1981

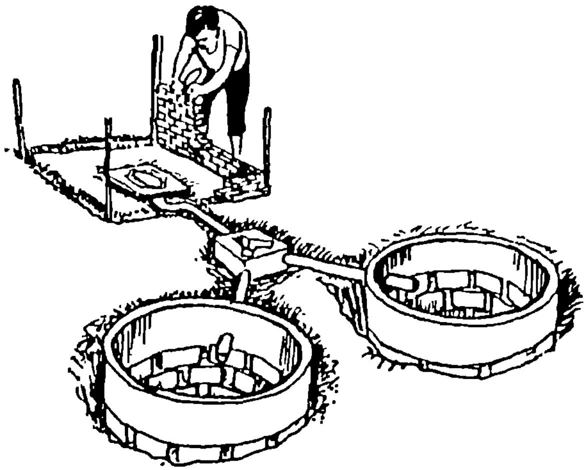
U.S. Environmental Protection Agency (EPA) **Design Manual Onsite Wastewater Treatment and Disposal Systems** (EPA 625/1-80-012) Office of Water Programme Operations, Office of R & D Municipal Environmental Research Laboratory, October 1980.

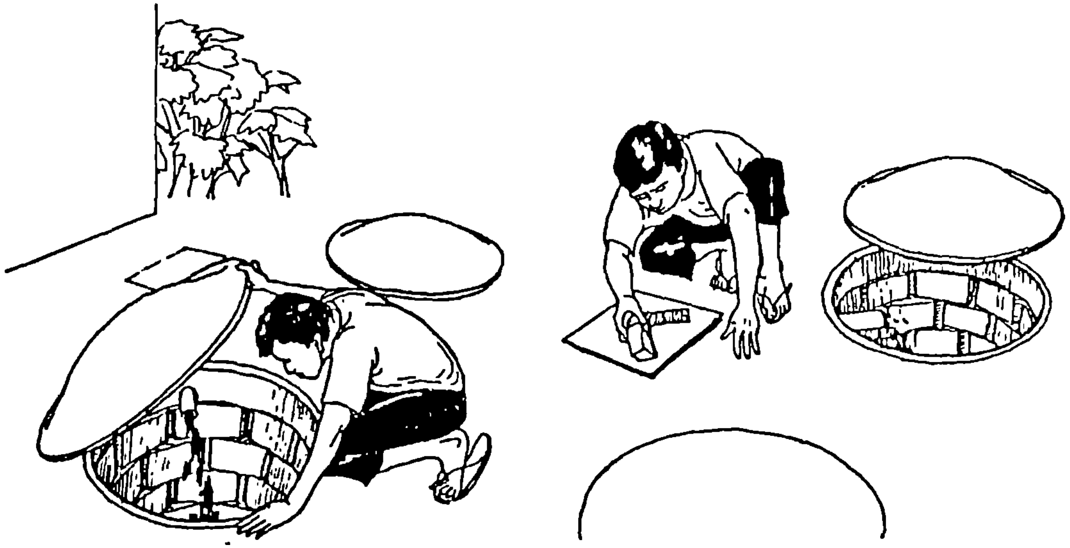


OVERVIEW

You may think that 100 pages is a lot to read to tell you how to dig 2 pits in the ground. There is more to the Twin Leaching Pit (TLP) Toilet than that. The first 8 pages explain exactly what is involved and offer you the opportunity to become familiar with the design principles and variables.

The wide variety of design variables allows you to tailor the basic design to fit local physical conditions, the skills at your disposal and the building materials you can afford.





PRINCIPLES OF THE TWIN LEACHING PIT TOILET

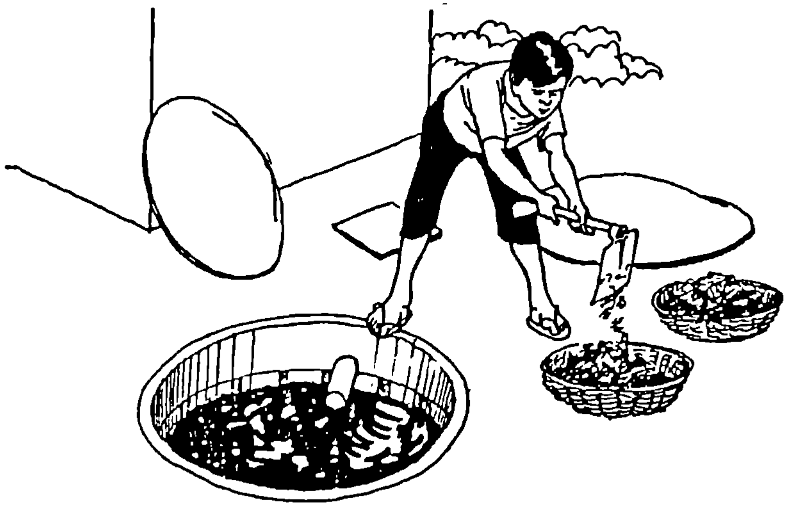
The main parts of the TWIN LEACHING PIT (TLP) TOILET are: a pour-flush toilet pan, a waterseal trap, a switch box, and two leaching pits.

The excreta are flushed manually from the toilet pan with only 1-2 liters of water. That amounts to about 6-10 liters per person daily. **A pour-flush toilet pan requires only a little water.**

From the pan the excreta pass through the waterseal trap. The ideal depth of the waterseal is about 2 cm. It prevents odours escaping from the pit via the toilet pan and prevents insects from entering or leaving the pit via the pan. **The waterseal makes a TLP-toilet hygienic: no insects, no odours.**

The **switch box** directs the flow into one of the two leaching pits. The inlet to the other pit is sealed, e.g. with a brick embedded in a weak mortar. The two leaching pits should never be in use at the same time.

In the pit, the solid excreta are digested biologically. Soluble compounds of the digested excreta dissolve in the flushing water and urine, and leach into the soil via holes in the pit lining. The soil assimilates the harmful compounds. Gases diffuse into the soil without fouling the outside air; therefore a ventpipe is not needed. Solids accumulate in the pit at a rate of about 25 liters - less than two buckets - per person per year.



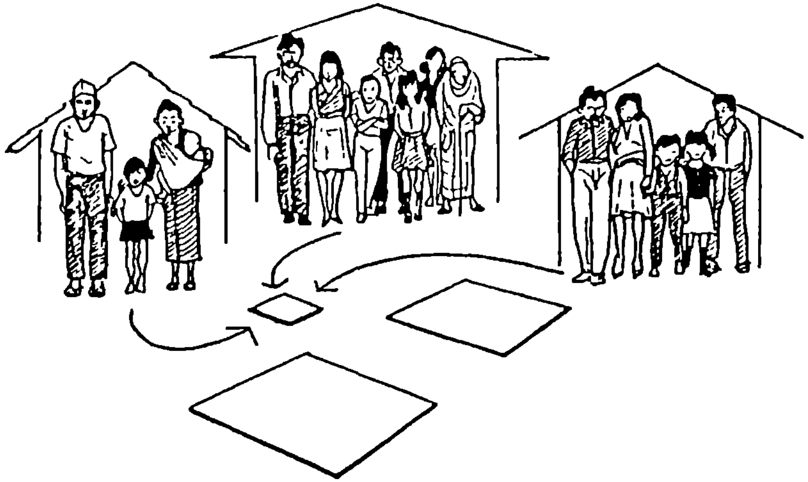
When the first pit is full, the switch box is opened to divert the flow into the second pit. This is done by removing the seal on the second pit and simultaneously sealing the first pit. The switch is made before the pit is so full that wastes backs up the inlet pipe.

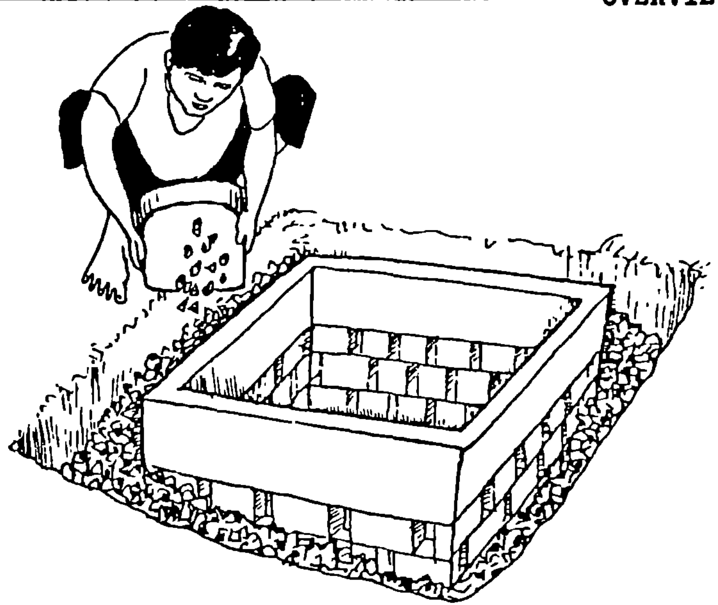
While the second pit is in use, the process of biological digestion in the sealed pit continues, killing disease-causing organisms. After two years, the minimum retention time, the contents have turned into compost. Compost is odourless and safe to handle. So the first pit sealed for a minimum period of two years, can be emptied without any health hazard.

When the second pit is full, the switch box is opened to redirect the flow into the first pit again, and to seal the second pit. In a further two years the second pit will yield compost.

Alternate use of the two pits provides permanent toilet facilities and a regular supply of compost.

Compost can be used as a fertilizer to improve the soil of gardens and fields. A TLP-toilet generates a small but welcome economic benefit.





DESIGN VARIABLES

Leaching pits need leaching surface to discharge the waste water. The leaching surface area of the pit is determined by the daily amount of waste water and the leaching capacity of the soil.

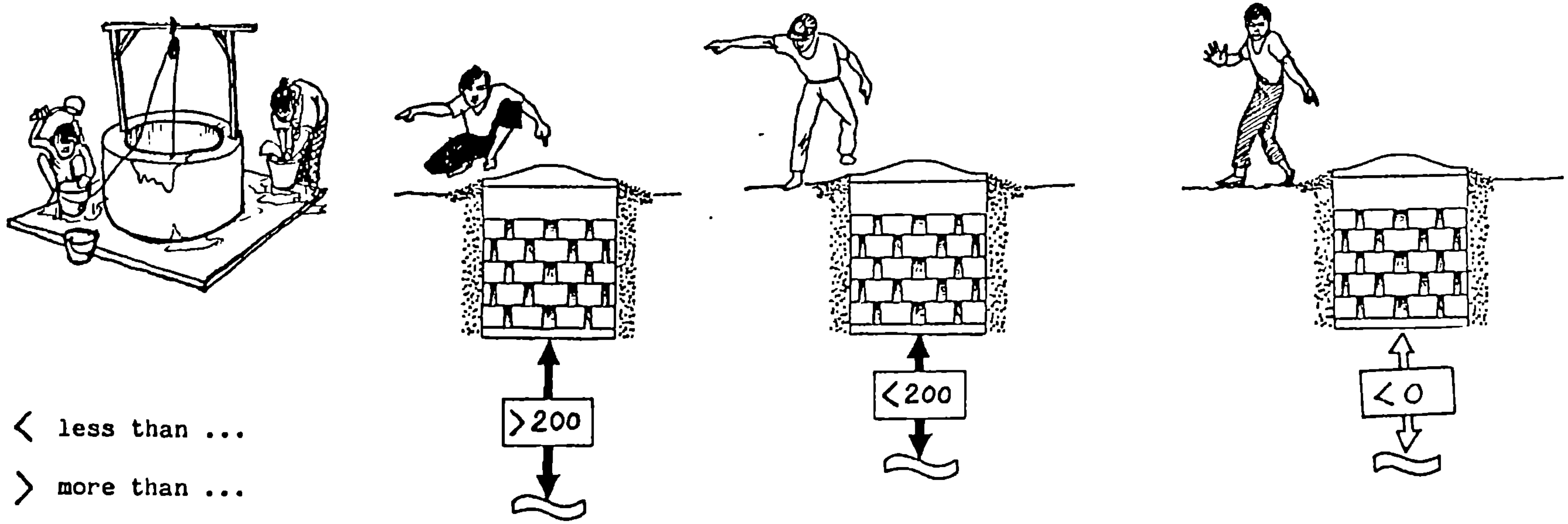
The amount of waste water depends on the flushing system and the number of users. More users require greater leaching surface area. It is possible to connect more than one toilet to one TLP-system. It is the total number of users connected to a pair of pits that counts.

All waste water must be absorbed by the soil surrounding the pit. Poorly leaching soils, such as clay, require greater leaching surface area.

The **leaching capacity of the soil** can be improved by a gravel backfill around the pit lining. The gravel facilitates the dispersal of liquids through soil. Extra leaching capacity can be provided by trenches around the pit lining.

A sand-loam backfill improves the filtering capacity of sand soils. It slows down the passage of liquids and gives more time for disease-causing organisms to die. This is necessary in areas where drinking water is obtained from shallow wells and the pit bottom reaches the groundwater level.

Even under unfavourable soil conditions, the TLP toilet performs well after carefully adjusting the soil surrounding the pit lining.



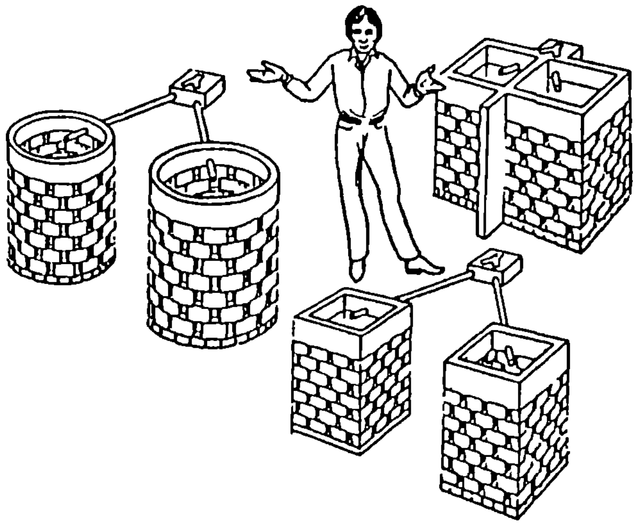
In areas where drinking water is obtained from shallow wells, groundwater pollution via leaching pits must be prevented. **The minimum permissible distance between a leaching pit and the nearest shallow well** depends on the soil type and the depth of the zone between the pit bottom and the groundwater level in the wet season.

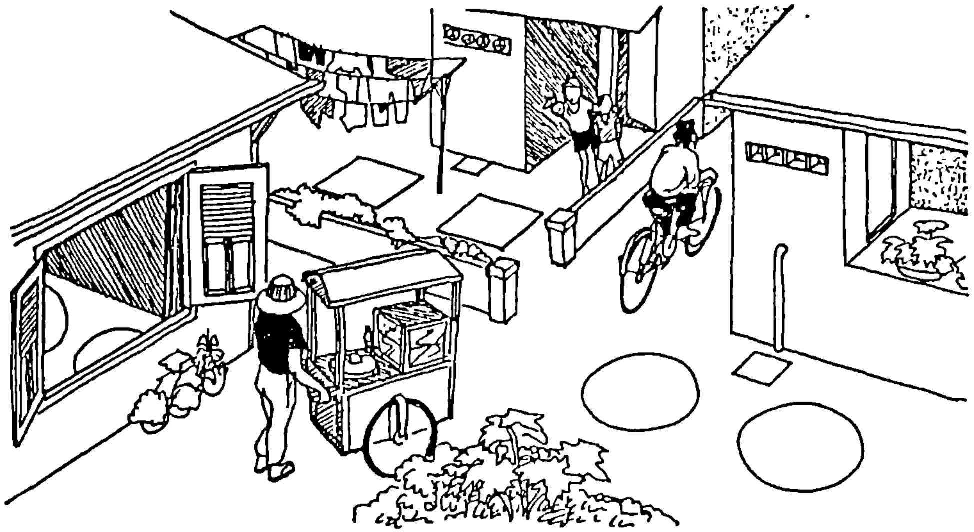
The zone depth should ideally be at least 200 cm. Pits can be made shallow or even raised above ground level to ensure a zone depth of 200 cm. A zone depth less than 200 cm is acceptable, but the nearest shallow well should be further away.

Leaching pits which reach the groundwater level still function but require a greater leaching surface area. They also increase pollution of groundwater. If drinking water is obtained from shallow wells, consider either a different sanitation system, e.g. a septic tank connected to a roadside drain (not a soakaway), or a different water supply system.

It is always good practice to boil drinking water, but if leaching pits reach the groundwater it is essential to boil drinking water.

The TLP-toilet does not pollute drinking water obtained from shallow wells after carefully adjusting the pit depth and keeping a safe distance between the leaching pits and shallow wells.



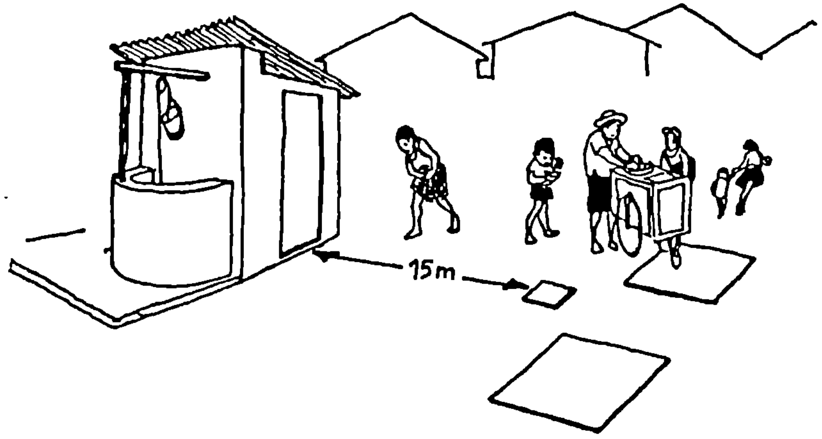


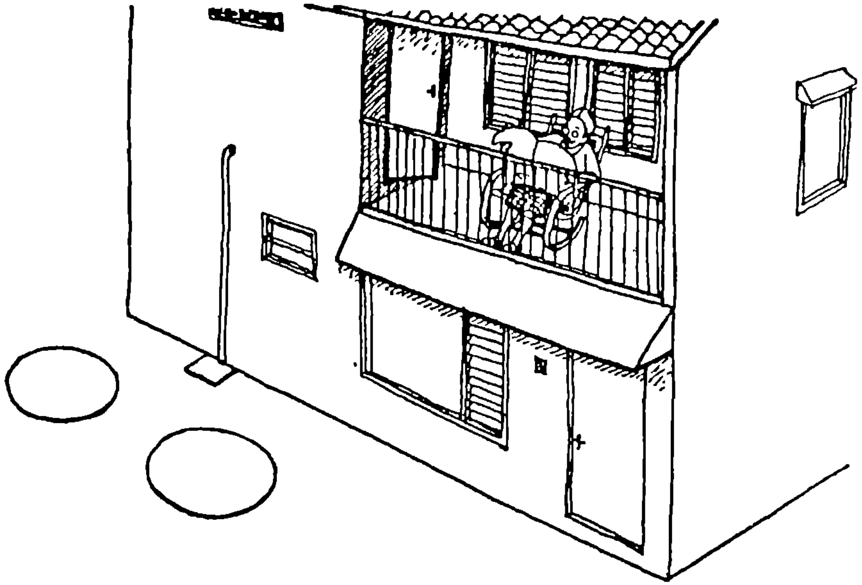
The best **TLP configuration** consists of two separate pits with a minimum distance between the pits equal to the pit depth. The soil between the pits prevents the contents of the sealed pit from becoming contaminated by fresh disease-causing organisms from the pit in use.

The **pit shape** can be square, rectangular, or circular. If space does not allow the minimum distance between the pits, a single pit divided into two compartments by a watertight wall can be built; a so-called combined pit.

The best **pit location** is within the plot. Because leaching pits are completely sealed off and cannot foul the outside air, even an indoors location is possible. If there is no space available within the plot, pits can be located under a public footpath or alleyway.

Whatever the location, easy access to the pits and switch box is essential for emptying the pits and diverting the flow. The space over the pits can still be used as long as the cover can easily be cleared. A large pit cover can be divided into removable and fixed sections. The space over the fixed section can be used permanently.

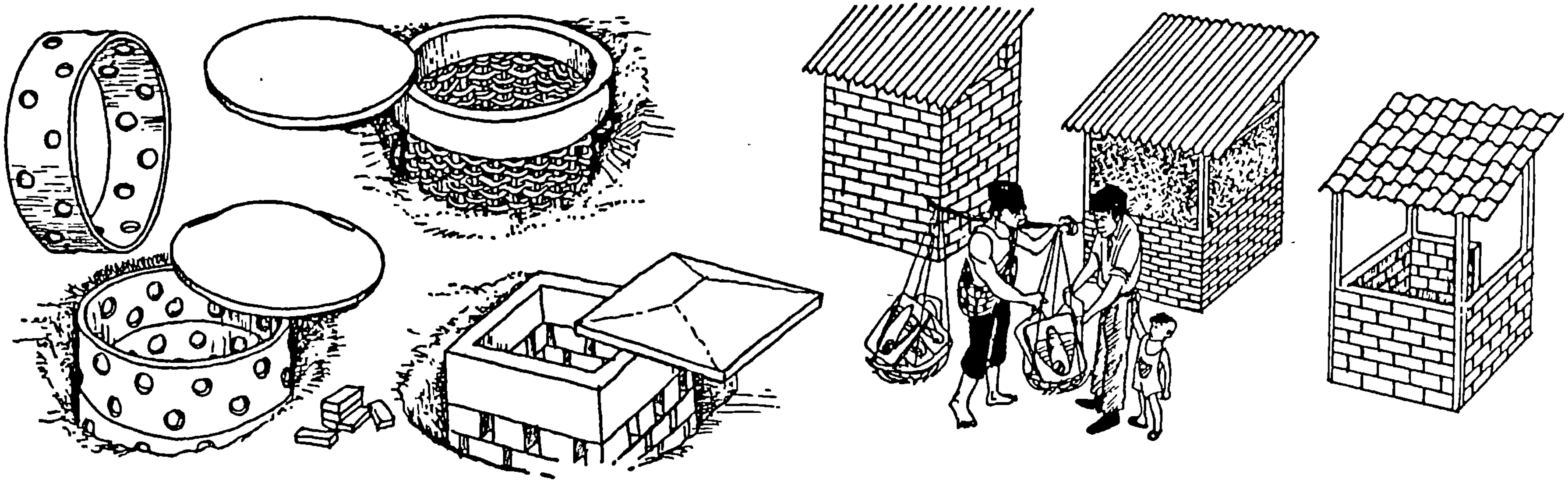




A short **pit-to-toilet connection** requires less pipe length and reduces the risk of blockage. The distance between toilet and pits should not exceed 15 meters. This offers a broad choice of pit-toilet arrangements. The toilet can be next to a well, as long as the leaching pits are at a safe distance. If space is limited, the toilet room can be built directly on top of the pits.

The **toilet room location** can be indoors, even on an upper floor. The waterseal trap prevents odours from the pit entering the house. Important considerations are easy access, particularly for children, and availability of water for anal cleansing, flushing of the toilet pan and washing hands.

The TLP-toilet is suitable for densely built-up areas. The toilet room location and the location and shape of the pits are adjustable to the space and conditions available.



The **pit walls** are lined to prevent collapse of the pit and damage when the pit is being emptied. Openings in the lining below a solid top ring permit leaching of liquids into the soil. Stabilized lime-cement blocks (batako) and burned clay bricks are commonly used as lining material. Alternative materials are: bamboo matting and prefabricated rings of concrete or burned clay.

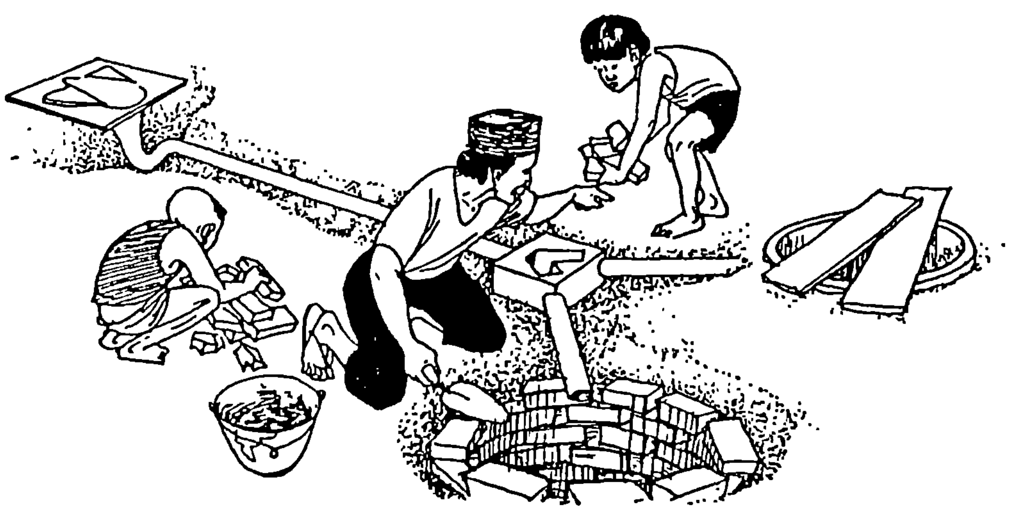
Pit covers can be made of wood, metal or concrete. Small concrete pit covers (or sections) for off-set pits within the plot boundary, do not require reinforcement if built in a dome shape.

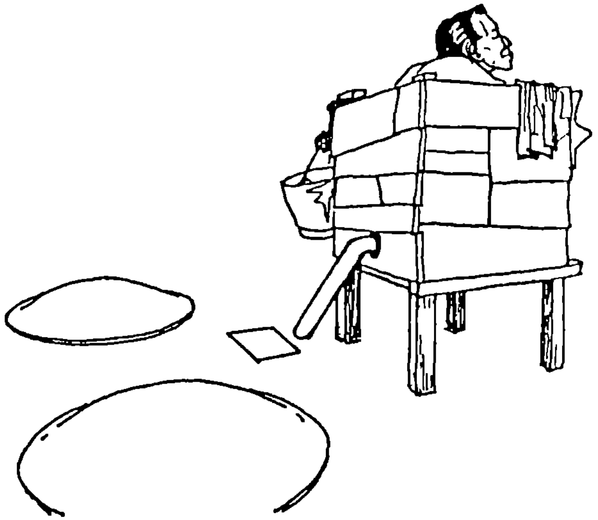
Pipes should have a smooth inner surface, and can be made of any anti-corrosive material, such as PVC or burned clay. If not available, pipes can be replaced by a covered brick drain.

The toilet pan and trap can be made of ceramic, concrete or fibre glass. The pan should allow flushing and cleaning with as little water as possible. The most important aspect of the trap is the waterseal and its resistance to prodding in the event of blockage.

The toilet room can be built from locally available building materials. The main concern is to prevent rain and stormwater from entering the toilet pan; this may flood the pits. In addition, it should be easy to keep the toilet floor clean.

The criteria for selecting the building materials are the price and available skills. Local building materials generally prove to be the best value.





The TLP-toilet is much cheaper to build and maintain than a toilet connected to a conventional sewerage system or a septic tank.

The **materials cost** of various TLP-toilet designs can be calculated using the bills of quantities in section 3: Materials.

Small households, each with a private toilet, may **share a twin-pit** to make better use of the pit capacity and reduce building costs.

The construction of a TLP-toilet does not require special construction skills. All construction can be done by **self-help** to reduce the cost.

Construction costs can also be reduced by **upgrading existing toilet facilities.** An existing toilet room can be connected to a pair of pits, or a single leaching pit can be extended with a second pit.

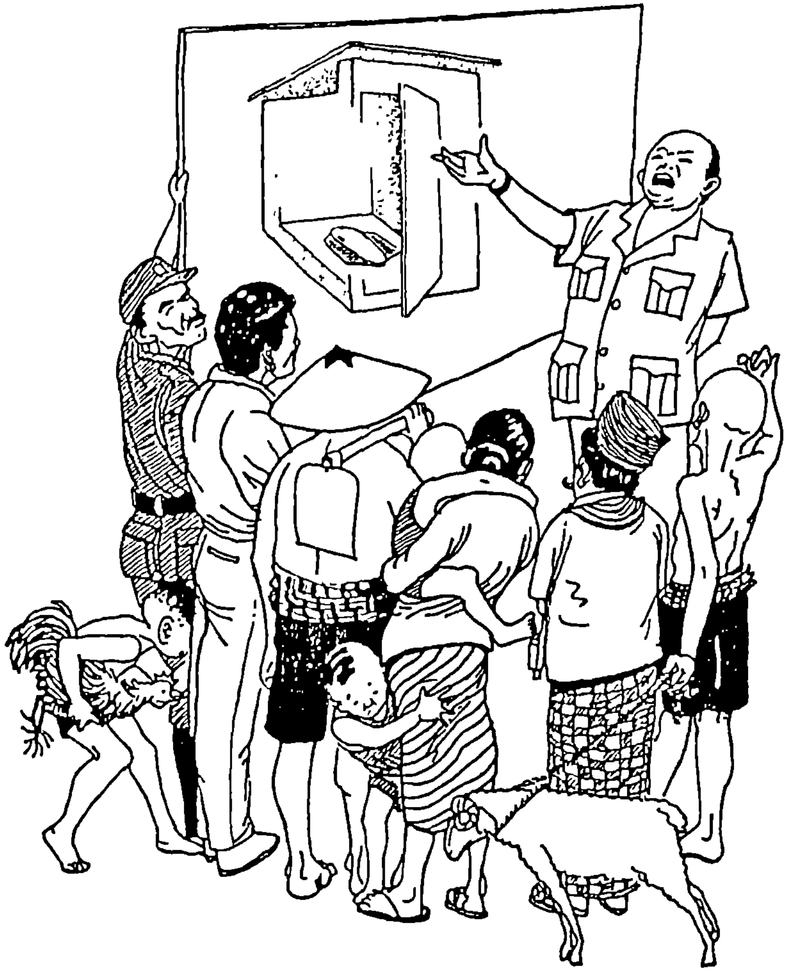
Construction of the second pit can be postponed until the first pit is about half full. In this way part of the construction cost is deferred to a later date.

The TLP-toilet is an economic toilet. Upgrading of existing toilet facilities, self-help, and sharing the twin pit make it even more affordable.

TOILET ROOM

step 1: CHOOSING THE INTERNAL TOILET ROOM LAYOUT

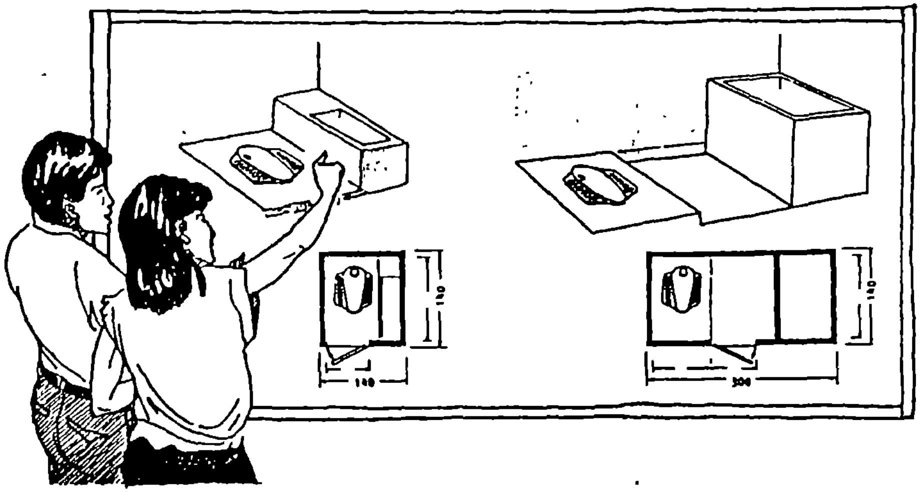
step 2: PLANNING THE TOILET ROOM LOCATION



THE TOILET ROOM

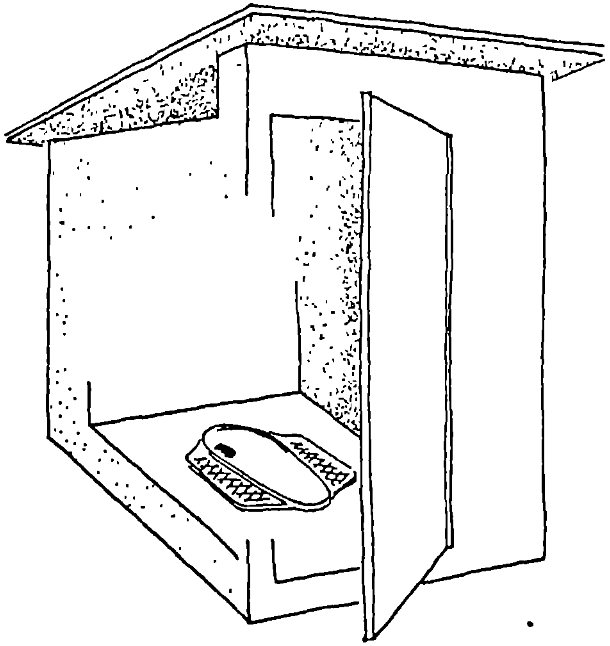
We begin by considering the toilet room, the only part that will be seen every visit. Make sure the toilet room is convenient for all household members, particularly the children.

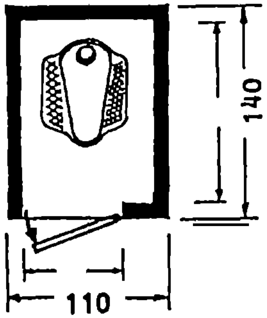
If you already have a toilet room, follow the steps to verify whether it meets the standards of a good toilet room.



step 1: CHOOSING THE INTERNAL TOILET ROOM LAYOUT

There is a limited number of practical toilet room layouts. Choose one of the following basic layouts and use it to determine the toilet room location. This is discussed in the next step.

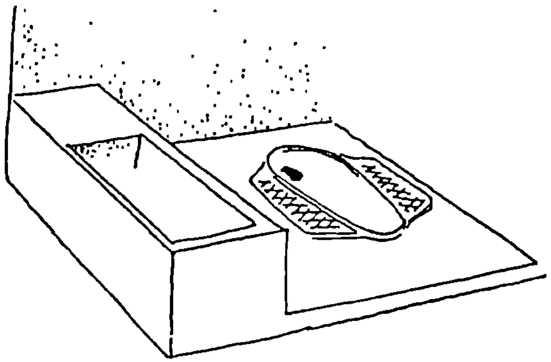


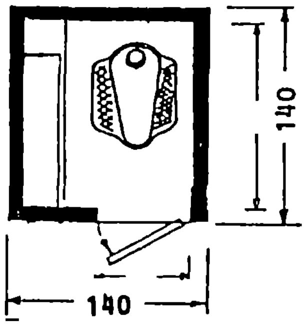


LAYOUT A

floor area: 1.1 m2
foundation: 4.7 m
wall area : 8.2 m2
roof area : 2.8 m2

The smallest toilet room layout.

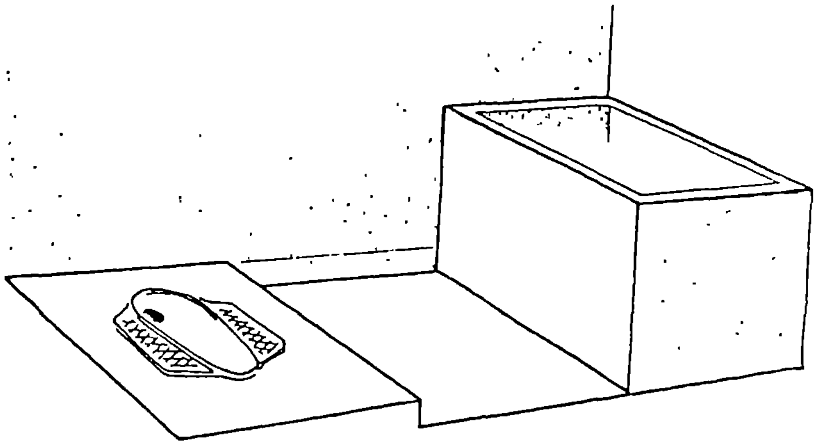


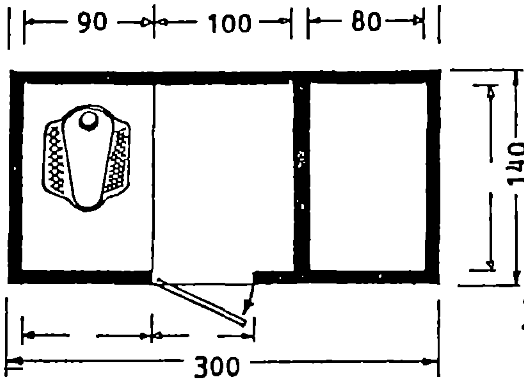


LAYOUT B

floor area: 1.5 m2
foundation: 5.3 m
wall area : 9.5 m2
roof area : 3.4 m2

Toilet room layout with water container for anal cleansing and flushing.

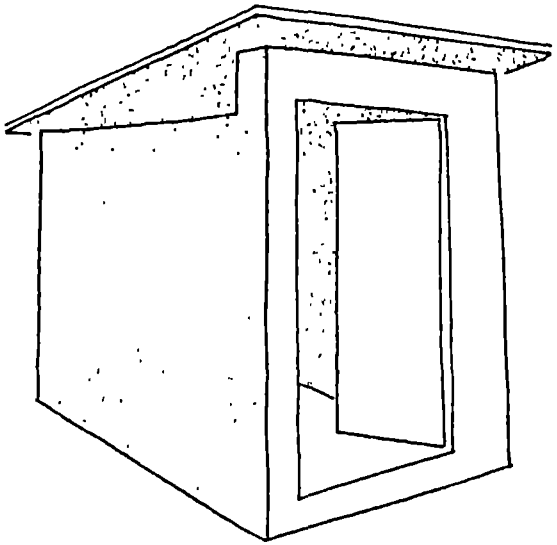


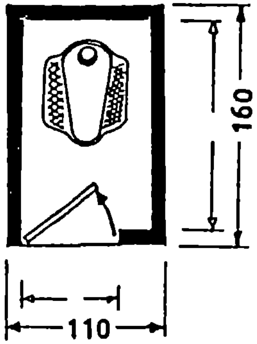


LAYOUT C

floor area: 3.4 m2
foundation: 8.5 m
wall area : 16.2 m2
roof area : 5.3 m2

Toilet room combined with bathroom. (bak mandi)

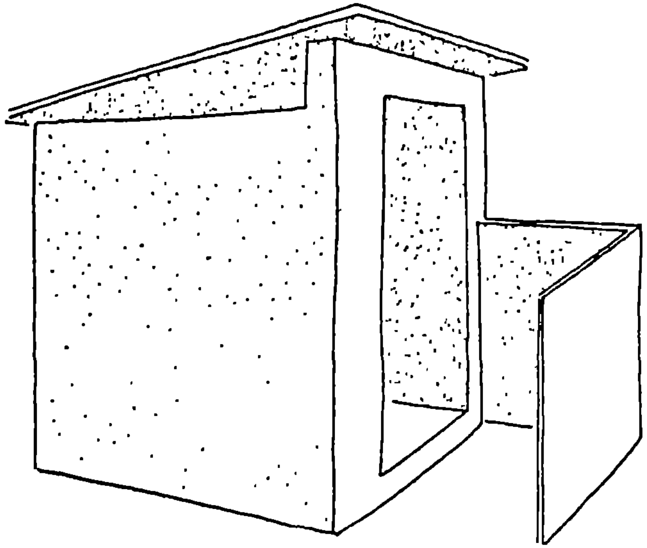


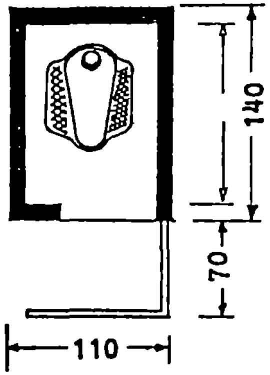


LAYOUT D

floor area: 1.3 m2
foundation: 5.1 m
wall area : 9.0 m2
roof area : 3.1 m2

Toilet room with an inwards opening door. This requires more space compared to Layout A.

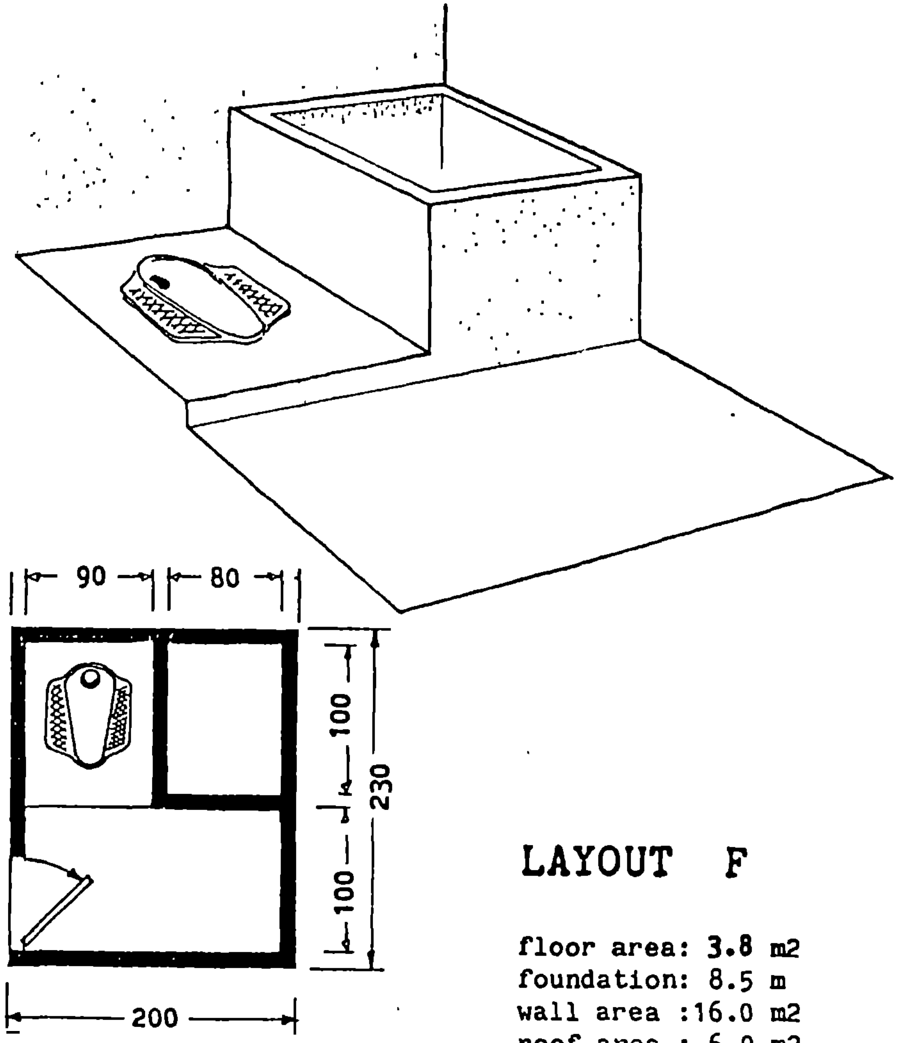




LAYOUT E

floor area: 1.1 m2
foundation: 4.7 m
wall area : 8.2 m2
roof area : 2.8 m2

A screen or curtain instead of a door is also possible to provide privacy. Compare with Layout A.

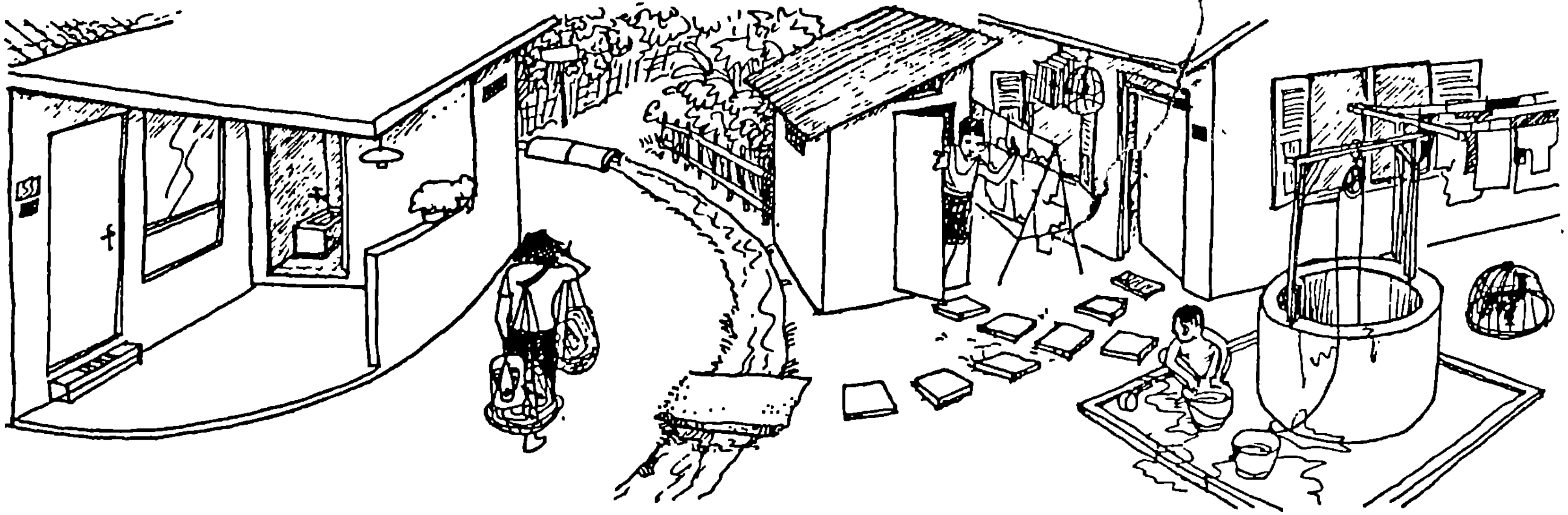


LAYOUT F

floor area: 3.8 m2
foundation: 8.5 m
wall area :16.0 m2
roof area : 6.9 m2

Toilet room combined with bathroom. (bak mandi) This layout offers more options for an entrance than layout C.

You may have to modify the basic layout to meet personal preferences and the location criteria described in the next step. Indicate modifications in the basic layout. With any change you make, always take into account that the dimensions given are minimum dimensions.



step 2: PLANNING THE TOILET ROOM LOCATION

The toilet room can be located **indoors**, e.g. at the end of a corridor, in the corner of a room, or even on an upper floor. Do not be afraid of bad smells and insects coming from the pits. These are stopped by the waterseal trap. Alternatively, you can locate the toilet room of course **outdoors**.

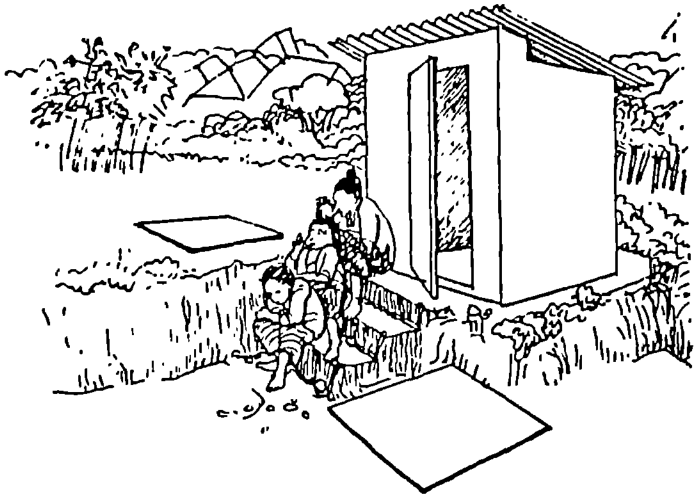
In choosing the location ensure that:

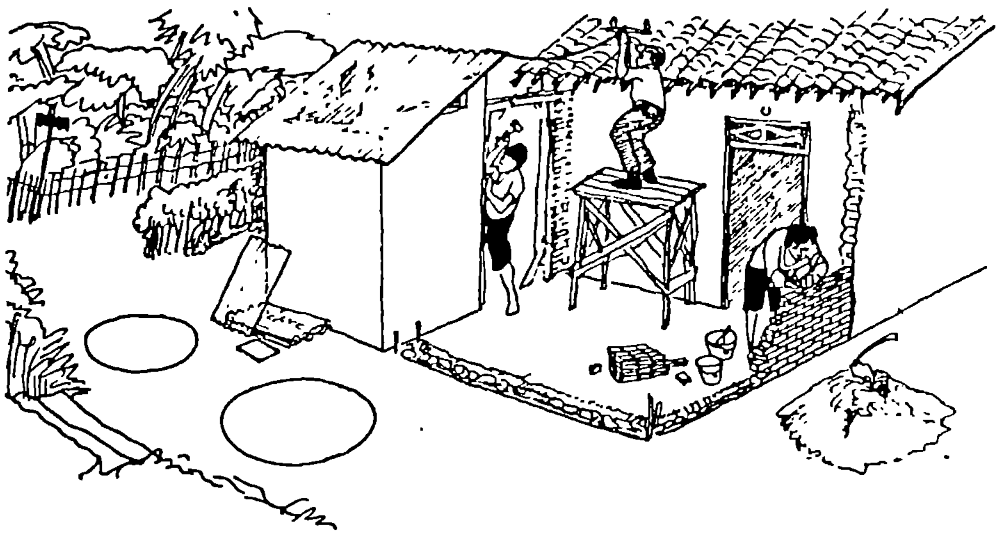
1. There is **water available** for anal cleansing, flushing, and washing hands after every toilet visit. You can locate the toilet room near a well, as long as the pits are at a safe distance. (see step 9, page 43)

2. All household members have **easy access** to the toilet room, also in the dark or when it rains. Particularly children and the elderly should have convenient access.

3. **Storm and rainwater** cannot enter the toilet room; water entering the toilet pan may flood the pit. To prevent this you can raise the floor, or orient the entrance facing downhill. An outdoors toilet room should have a sloping roof with an overhang of 20 cm on all sides to drain rainwater away from the entrance.

4. If the toilet room is combined with a bathroom, washing waste water drains away from the toilet pan and pits as it may flood the pit.





5. The toilet room is located on the same level or higher than surrounding land. This makes it easier to locate the pits, since these cannot be higher than the toilet floor.

6. The toilet room is private. Orient the entrance so that it is not directly visible to passers-by and neighbouring plots.

7. The toilet room is adequately ventilated. At least one of the four walls should be an external wall to allow ventilation openings.

8. Daylight enters the toilet room. Daylight can enter through ventilation openings, or you could use transparent roofing sheets.

9. The toilet room does not block future dwelling extensions or alterations.

Having chosen a toilet room layout and its location, check that all these criteria are met.

In the next steps we are going to consider the other end of the system: the leaching pits.

TOILET ROOM

step 1: CHOOSING THE INTERNAL TOILET ROOM LAYOUT

step 2: PLANNING THE TOILET ROOM LOCATION

LEACHING PITS

step 3: CHECKLIST

step 4: DETERMINING THE PIT DEPTH

step 5: ESTIMATING THE LEACHING SURFACE AREA

step 6: BACKFILL + TRENCHES

step 7: CHOOSING THE PIT SHAPE + DIMENSIONS

step 8: TECHNICAL DRAWING OF THE PIT DESIGN

step 9: PLANNING THE PIT LOCATION

step 10: FINAL DESIGN

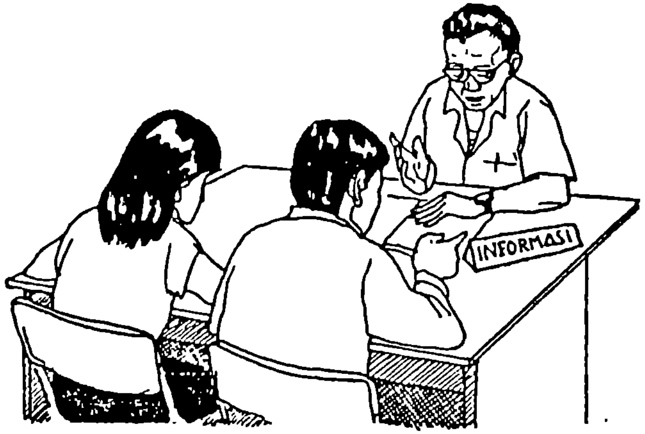
THE LEACHING PITS

Leaching pits make use of the leaching and filtering capacity of the surrounding soil. This capacity varies with soil type. To ensure good performance from the leaching pits you need to **know the soil type.**

Leaching pits might pollute the drinking water obtained from shallow wells. You therefore need to **know the groundwater level in the wet season** to determine the pit depth. The groundwater level is the level of water you can see in a shallow well.

The soil type, groundwater level and pit depth also determine the minimum acceptable distance between the leaching pits and a shallow well.

You may know the soil type of your plot. The person who fetches water from the well may remember the water level during the wet season. Check this information with your neighbours. Consult also well drillers. They will have more accurate information. Other sources of information could be: the Puskesmas (local health centre) with a SAMIJAGA programme, and the local building information centre. The checklist on the next page will help you to ask the relevant questions and to note down the answers.



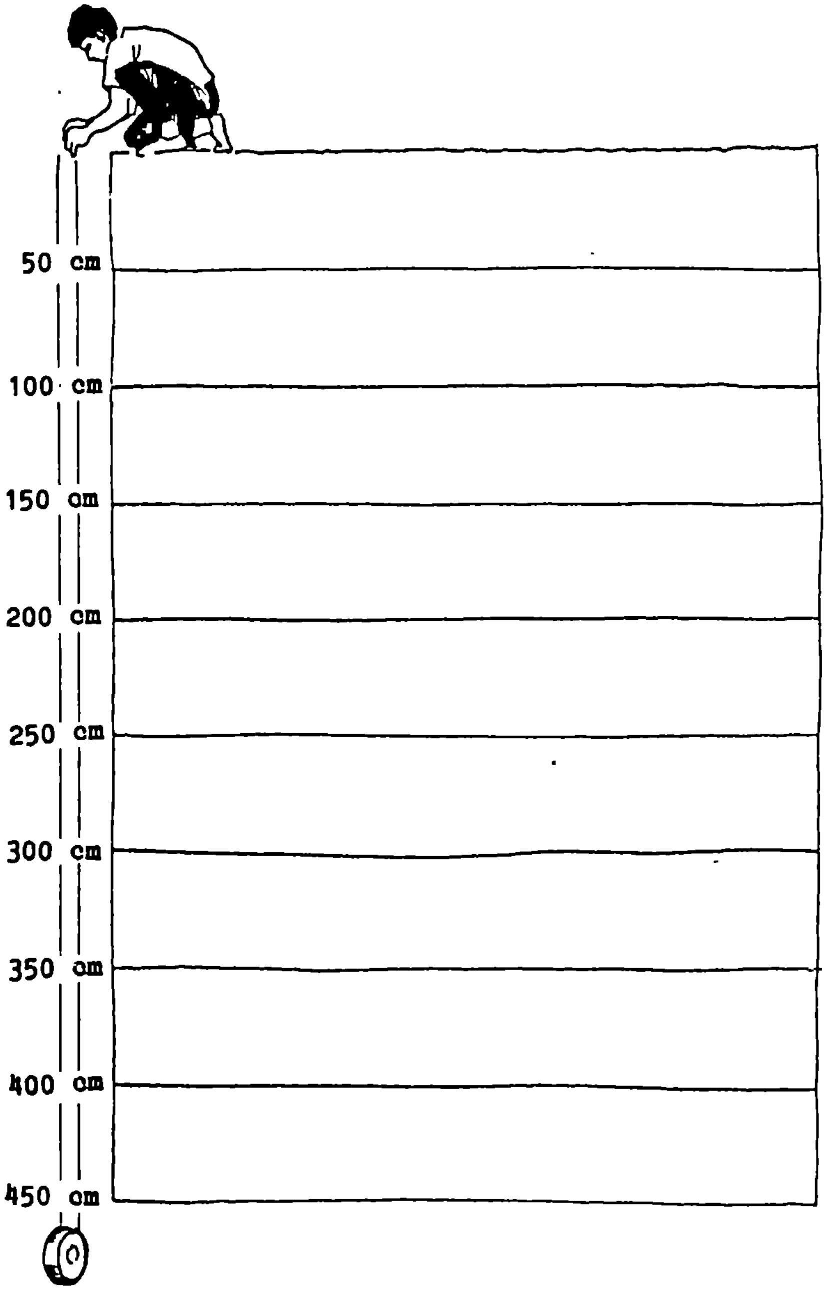
step 3: CHECKLIST

Question 1: Which types of soil can be expected on my plot and at what level?

Indicate the soil type at different levels, up to about 250 cm, on the chart.

Soil types are divided into three categories:
- clay, including clay loam
(soil with particles smaller than 0.002 mm)
- loam, including silt loam
(soil with particles between 0.002 and 0.05 mm)
- sand, including sandy loam
(soil with particles between 0.05 and 2 mm)

If no information is available from the sources mentioned in the introduction to this section, do soil test 2. (see step 10, page 52)



Question 2: What is the groundwater level in my neighbourhood in the wet season?

Indicate the groundwater level on the chart; be accurate, particularly where the groundwater is less than 300 cm below ground level.

Question 3: What kind of drinking water supply systems are in use in my neighbourhood?

- mains supply
- wells (deeper than 15 meters)
- wells (shallower than 15 meters)

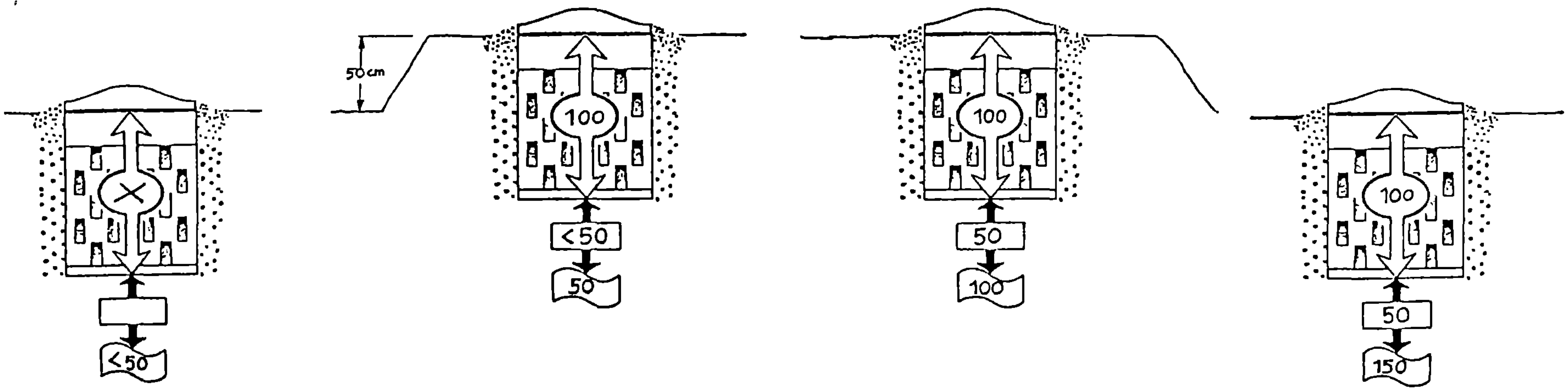
Question 4: Have leaching pits been built in the area? Where and when?

Question 5: Are failures being reported? What kind of failures, and how could these be avoided?

Question 6: What procedures should be followed if the leaching pits must be located under a public footpath or alleyway?

While looking for a pit location you may come to the conclusion that there is no space available within your plot boundary.

Question 7: Names and addresses of local suppliers of building materials and components.



step 4: DETERMINING THE PIT DEPTH

In areas where drinking water is obtained from shallow wells, it is important to use a pit depth that allows a maximum zone depth between the pit bottom and groundwater level in the wet season.

Even if you think you remember the groundwater level in the wet season, confirm this with the sources of information mentioned in the introduction to this section. Local well-drillers are a useful source.

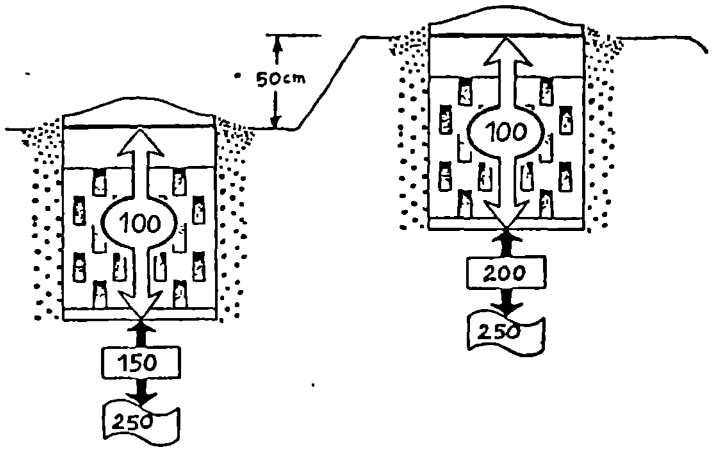
Fill in the wet season groundwater level: ..... cm below ground level.

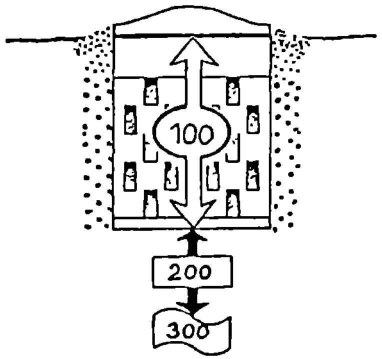
Determine the pit depth according to the groundwater level categories opposite. The minimum pit depth is 100 cm.

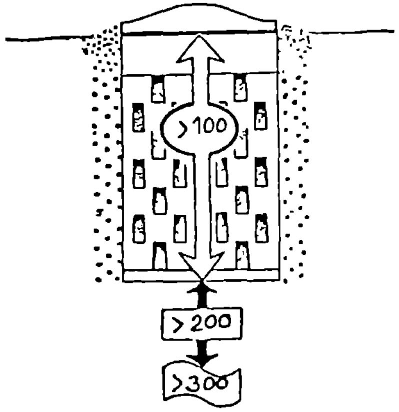
- **less than 50 cm below ground level:**
The pit will reach the groundwater and pollute it, even using the minimum pit depth of 100 cm and raising the pit 50 cm. If shallow wells are used in the area, consider either a different sanitation system or a different water supply system.

- **50 - 100 cm below ground level:**
Use the minimum pit depth of 100 cm and raise the pit 50 cm. The zone depth will be less than 50 cm. Double check the information on the groundwater level since it could be critical.

- **100 - 150 cm below ground level:**
Use the minimum pit depth of 100 cm. Raise the pit to give a zone depth of 50 cm.







- **150 - 250 cm below ground level:**
Use the minimum pit depth of 100 cm. The zone depth will be 50 - 150 cm.

- **250 - 300 cm below ground level:**
Use the minimum pit depth of 100 cm. The zone depth will be 150 - 200 cm.

- **more than 300 cm below ground level:**
Choose a pit depth that gives a zone depth of at least 200 cm. The maximum pit depth is usually not more than 250 cm.

Fill in the proposed pit depth: ..... cm.

The ideal zone depth is at least 200 cm. A shallower zone is acceptable but requires a greater distance between the pit and nearest shallow well. (see step 9, p 43)

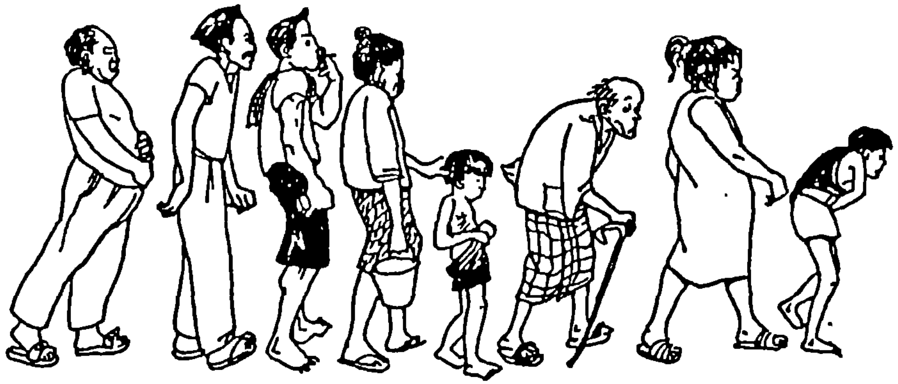
You can consider to increase the zone depth by raising the pit. A raised pit must be surrounded with an earth wall 150 cm around the pit lining which requires more space. In addition, you may have to raise the toilet floor as well.

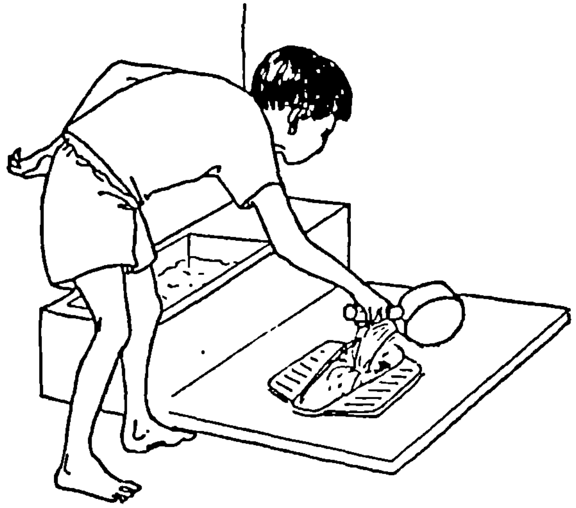
Tick the zone depth between the pit bottom and wet season groundwater level.

☐ more than 200 cm

☐ 0 - 200 cm

☐ pit bottom reaches groundwater





step 5: ESTIMATING THE LEACHING SURFACE AREA

To estimate the minimum leaching surface area required for each pit, you need to know:

1. Number of users

Count the number of regular users; consider also family expansion. If several toilets are connected to one twin-pit system, count the number of users of all toilets to be connected.

Fill in the total number of users: ....

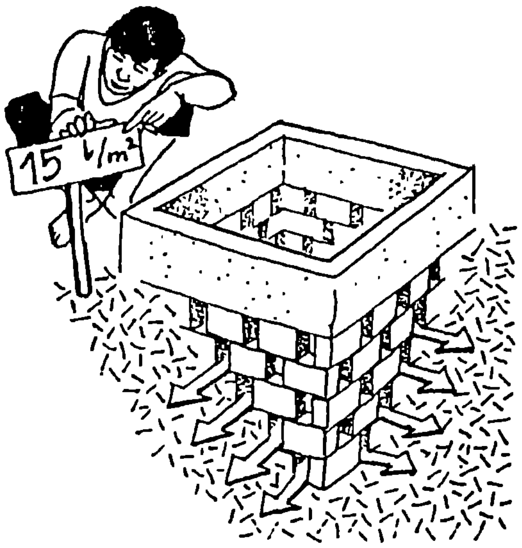
2. Quantity of waste water

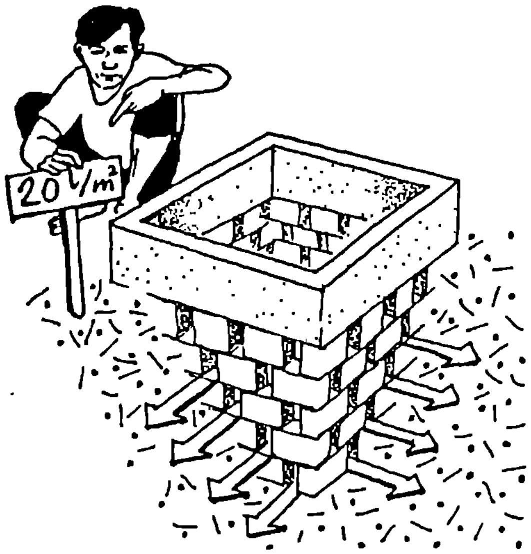
With a pour-flush toilet pan, one user produces 6 - 10 litres of waste water daily. To be on the safe side, take:

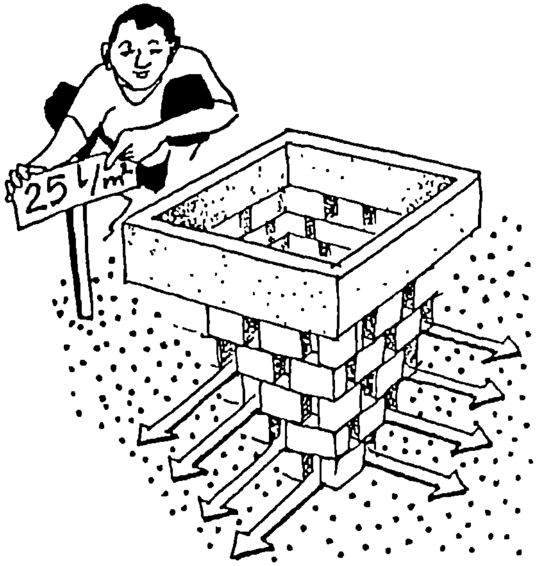
10 liters

If you already have a toilet with a pour-flush pan, replace it if its surface is rough. A smooth pan requires less flushing water and is easier to keep clean. (see 'Materials' page 68)

With a cistern-flush, the daily waste water flow will be about 35 liters per user. Although possible, this will require a greater leaching surface area and so a bigger, more expensive pit.







3. Soil type

All waste water must be absorbed by the soil. The leaching capacity per day is:

- clay soils: 15 liters per m2
- loam soils: 20 liters per m2
- sand soils: 25 liters per m2

If in doubt about the soil type, be on the safe side and choose clay.

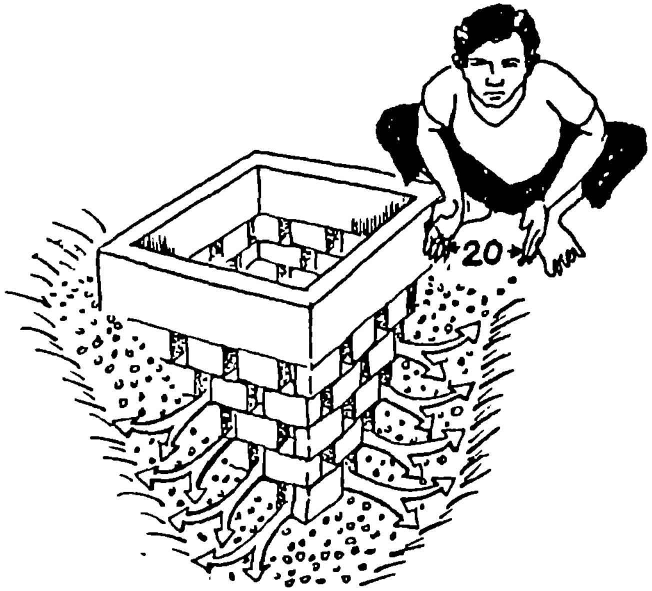
Reduce the leaching capacity by 5 liters per m2 if the pit reaches the groundwater level, because saturized soils leach less; see step 4.

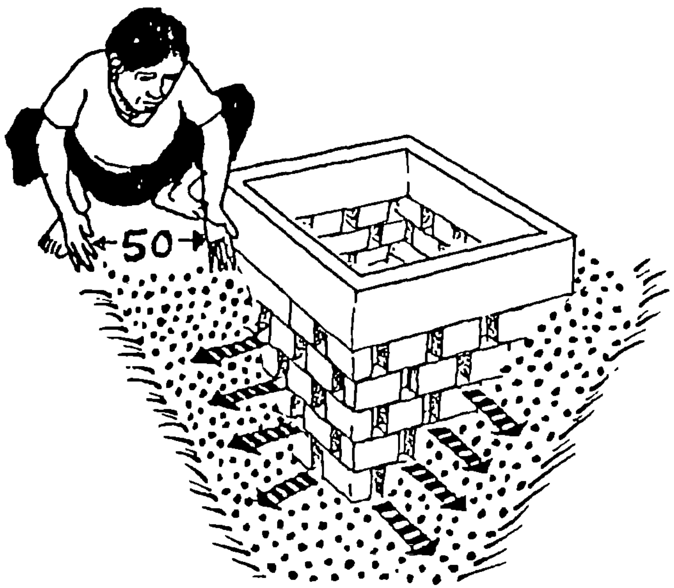
Fill in the expected leaching capacity of the soil on your plot:

.... liters/m2.

The minimum leaching surface area for each pit is:

(no. of users) .... x 10 liters
——————————————— = ... m2
(leaching capacity) liters/m2





step 6: BACKFILL + TRENCHES

Backfill is packing around the pit lining used to improve either the leaching capacity or the filtering action of soil.

Pits in sandy soils reaching the groundwater level and within 20 meters of a shallow well must have **loam-sand mix** backfill to improve the filtering action. Backfill slows down the passage of liquids and gives more time for the disease-causing organisms to die.

In all other conditions, **gravel backfill** is used to improve the leaching capacity by facilitating the dispersal of liquids through soil. Backfill also retards clogging of clay soils. Because the leaching capacity is increased, the pit lining can be reduced, resulting in lower costs.

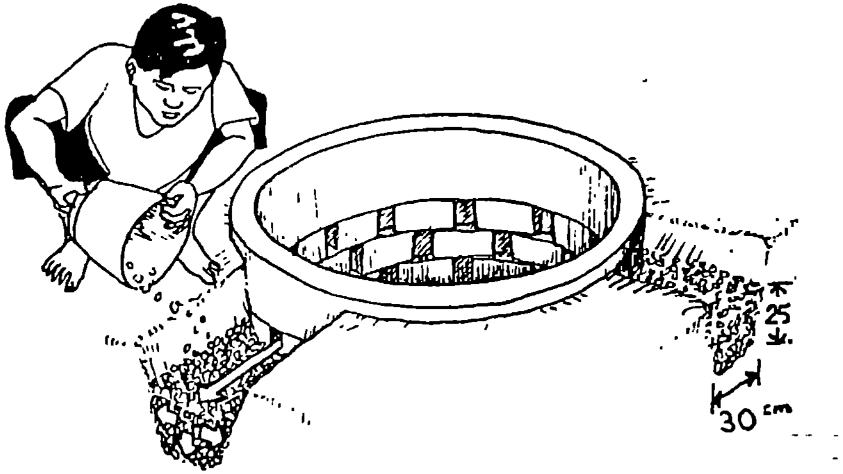
Tick the backfill to be used.

☐ leaching backfill: 20 cm gravel

☐ filtering backfill: 50 cm loam-sand mix

With the information collected you are now able to determine the dimensions of the leaching pits. This is described in step 7.

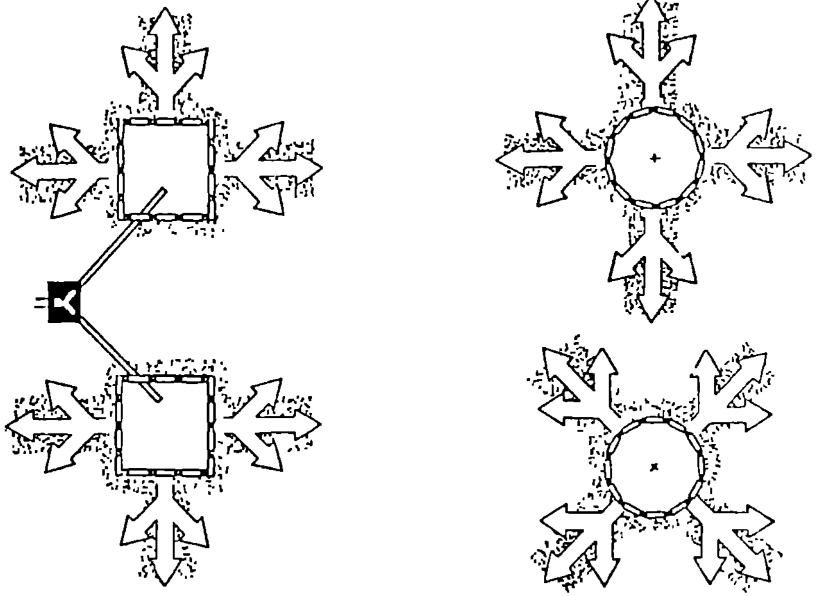
The instructions on trenches need only be followed if the pit does not provide sufficient leaching surface area. This will be clear after step 7.



A trench is a level shallow excavation, backfilled with gravel to supplement the pit leaching surface area.

The trench leaching surface area must equal the required leaching surface area (see step 5) less the leaching surface area provided by the pit (as determined in step 7).

A trench 30 cm wide and with a depth of 25 cm below the lower edge of the top ring has a leaching surface area of 0.8m2 per meter length.

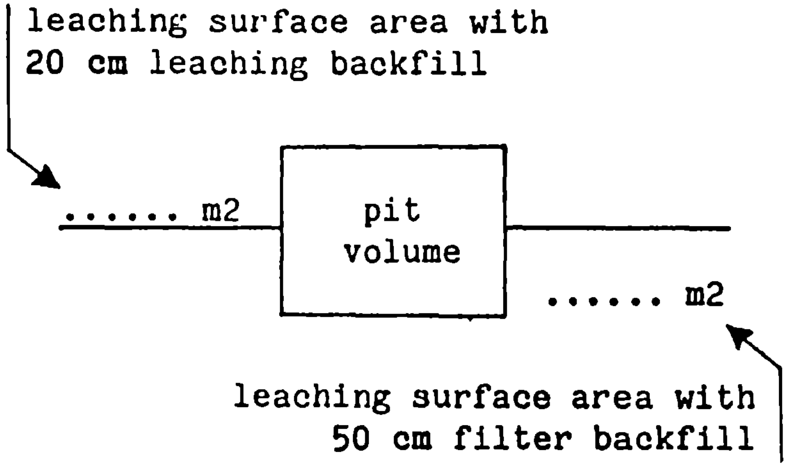


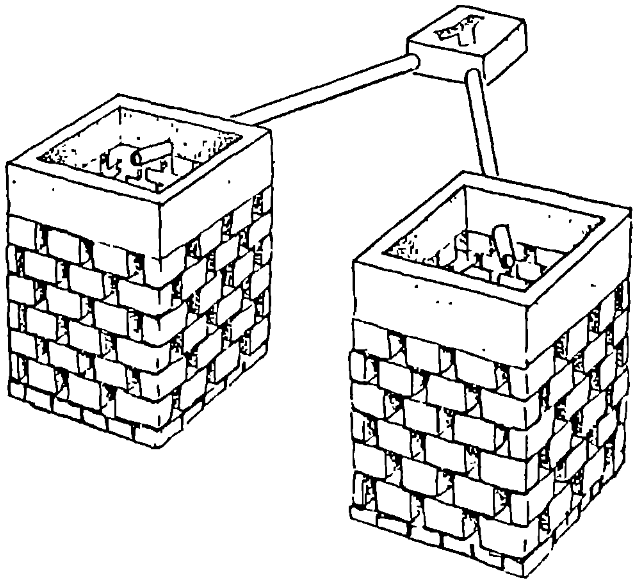
The total length of trench required is equal to: the trench leaching surface area divided by 0.8 m2

Fill in the length of trench required:

...... meters.

Up to four trenches can be arranged around the pit lining. A number of shorter trenches are prefered to one long trench because they disperse the leaching load. The final layout of the trenches will be determined when the location for the pit has been chosen.





step 7: CHOOSING THE PIT SHAPE + DIMENSIONS

This step uses three tables, one for each pit model. The tables consist of diagrams like the one above. Each diagram shows:

- pit volume
- pit leaching surface area with:
  - 20 cm backfill (upper left)
  - 50 cm backfill (lower right)

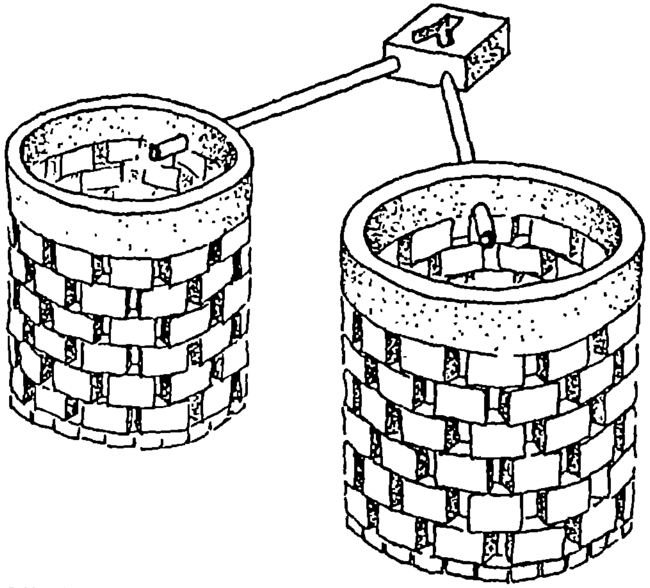
On the diagram above, fill in the minimum required leaching surface area (see step 5). Either on the

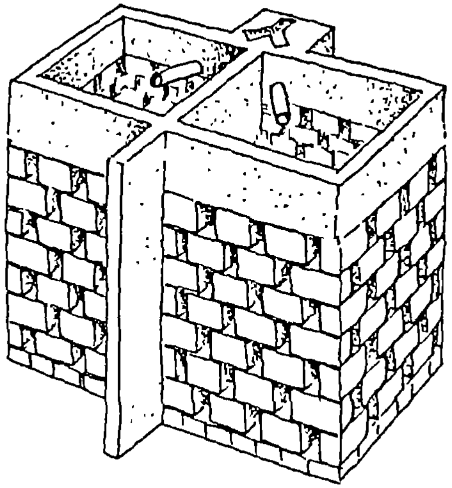
- left for 20 cm leaching backfill, or on the
- right for 50 cm filter backfill. (see step 6)

Study the three models and then make your choice.

Square and rectangular pits need less space than circular pits to meet the required leaching surface area.

Page 30-31 tells how you determine the dimensions of square and rectangular pits.





Circular pits are stronger than square pits. This is more significant with larger pit cover dimensions. (say more than 130 cm) Pits under a public footpath require a stronger construction and a circular pit could be the most economic choice.

Pit linings of bamboo matting or prefabricated rings only permit circular shapes. Bamboo lining and burned clay rings do not permit a pit location under a public footpath.

If you intend to use prefabricated rings as lining, enquire about the diameters available; see also 'Materials' page 62.

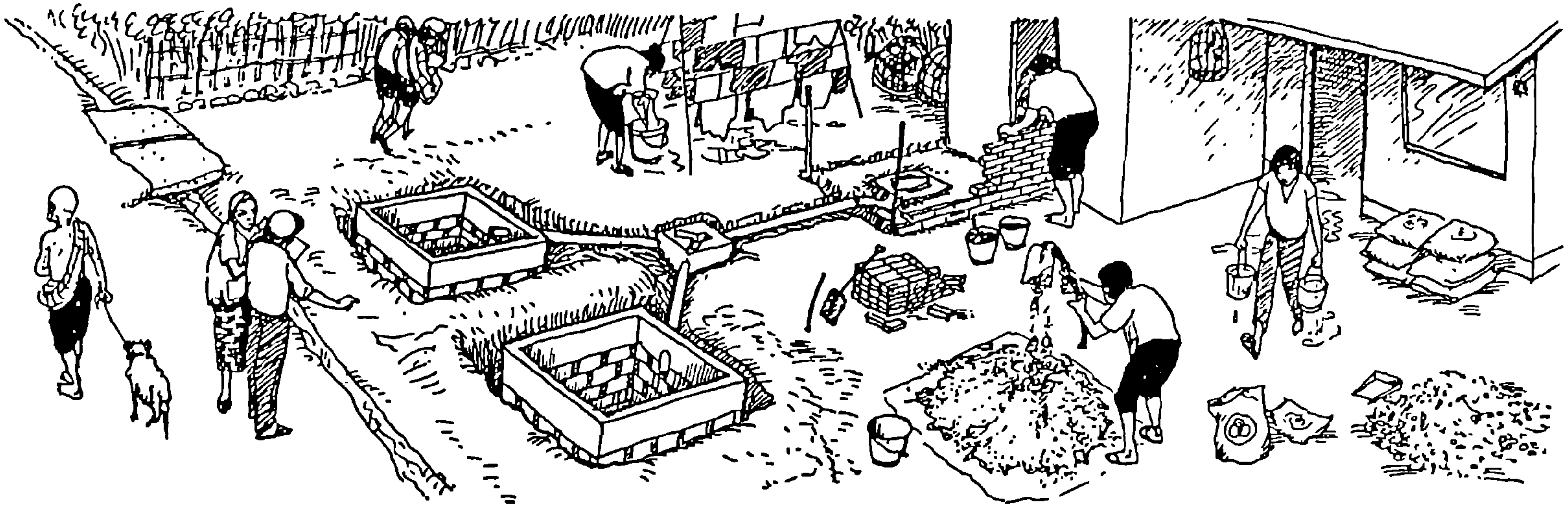
Page 32-33 tells how you determine the dimensions of circular pits.

A combined pit is a single pit divided into two compartments by a watertight wall. This wall is to prevent the contents of the sealed compartment from becoming contaminated by fresh disease-causing organisms from the pit in use.

A combined pit is not just two regular sized separate pits and built against each other. The required leaching surface area has to be reached with only three walls per pit. This results in a larger, more expensive pit cover. In addition, the dividing wall will increase the building costs.

Choose a combined pit only if the available space does not allow the minimum distance between the two pits. This will be clear at the end of step 9.

Page 34-35 tells how you determine the dimensions of a combined pit.



1. SQUARE AND RECTANGULAR SEPARATE PITS

- Underline in Table 1 the proposed pit depth (see step 4) and read the first diagram alongside the plotted depth.

- If the leaching surface area in the diagram is more than required: follow the diagrams upwards.

- If the leaching surface area in the diagram is less than required: follow the diagrams alongside the plotted depth. If the final diagram does not meet the required leaching surface area, go to step 6 and plan trenches.

- Mark the diagram with the required leaching surface area. If the required leaching surface area is between two figures, take the larger one; that means excess leaching surface area.

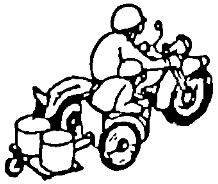
In how many years will the pit be full? Solids accumulate at a rate of 25 liters per person per year. So, the total quantity of solids per year is equal to the number of users times 25 liters.

Fill in the pit volume and the number of users, and calculate the retention time.

(volume:) .... liters

= .... years

(users:) .... x 25 liters



... go to step 8 page 36

TABLE 1

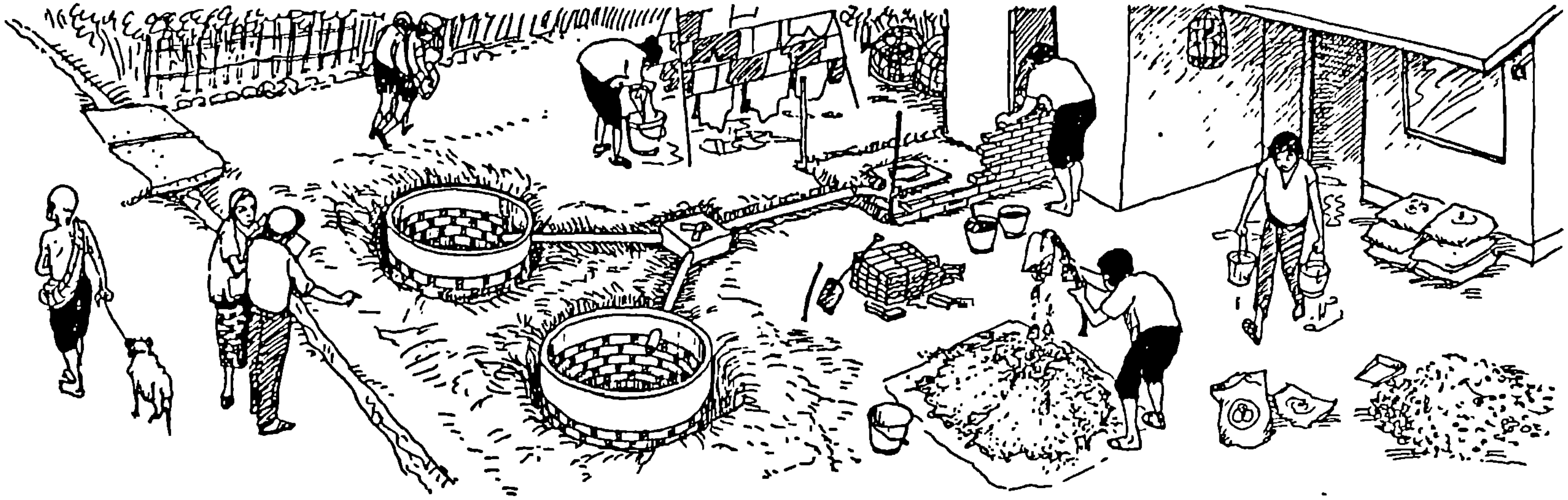
External length x width (cm)	100 x 100	100 x 120 110 x 110	100 x 140 120 x 120	110 x 150 120 x 140 130 x 130	120 x 160 140 x 140
Pit cover surface area	1.0 m2	1.2 m2	1.5 m2	1.7 m2	2.0 m2
Top ring surface area	1.2 m2	1.3 m2	1.5 m2	1.6 m2	1.7 m2
Pit depth					
100 cm	3.9 $\boxed{450}$ 2.8	4.2 $\boxed{570}$ 3.1	4.5 $\boxed{700}$ 3.4	4.8 $\boxed{850}$ 3.6	5.0 $\boxed{1010}$ 3.9
125 cm	5.3 $\boxed{600}$ 3.8	5.7 $\boxed{770}$ 4.2	6.1 $\boxed{950}$ 4.6	6.5 $\boxed{1150}$ 4.9	6.8 $\boxed{1370}$ 5.3
150 cm	6.7 $\boxed{770}$ 4.8	7.2 $\boxed{970}$ 5.3	7.7 $\boxed{1200}$ 5.8	8.2 $\boxed{1450}$ 6.2	8.6 $\boxed{1730}$ 6.7
175 cm	8.1 $\boxed{930}$ 5.8	8.7 $\boxed{1170}$ 6.4	9.3 $\boxed{1450}$ 7.0	9.9 $\boxed{1750}$ 7.5	10.4 $\boxed{2090}$ 8.1
200 cm	9.5 $\boxed{1090}$ 6.8	10.2 $\boxed{1380}$ 7.5	10.9 $\boxed{1700}$ 8.2	11.6 $\boxed{2050}$ 8.8	12.2 $\boxed{2450}$ 9.5
225 cm	10.9 $\boxed{1250}$ 7.8	11.7 $\boxed{1580}$ 8.6	12.5 $\boxed{1950}$ 9.4	13.3 $\boxed{2360}$ 10.1	14.0 $\boxed{2810}$ 10.9
250 cm	12.3 $\boxed{1410}$ 8.8	13.2 $\boxed{1780}$ 9.7	14.1 $\boxed{2200}$ 10.6	15.0 $\boxed{2660}$ 11.4	15.8 $\boxed{3170}$ 12.3

volume (liters): inner dimensions (lining 10 cm thick) and effective depth: depth - 30 cm.
leaching surface area: external dimensions and effective depth.
top ring: 30 cm high.

KEY

leaching surface area (m2) '20 cm' $\boxed{\text{volume}}$ '50 cm'

TABLE 1



2. CIRCULAR SEPARATE PITS

- Underline in Table 2 the proposed pit depth (see step 4) and read the first diagram alongside the plotted depth.

- If the leaching surface area in the diagram is **more than required: follow the diagrams upwards.**

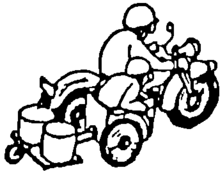
- If the leaching surface area in the diagram is **less than required: follow the diagrams alongside** the plotted depth. If the final diagram does not meet the required leaching surface area, go to step 6 and plan trenches.

- Mark the diagram with the required leaching surface area. If the required leaching surface area is between two figures, take the larger one; that means excess leaching surface area.

In how many years will the pit be full? Solids accumulate at a rate of 25 liters per person per year. So, the total quantity of solids per year is equal to the number of users times 25 liters.

Fill in the pit volume and the number of users, and calculate the retention time.

(volume:) .... liters
____________________ = ... years
(users:) .... x 25 liters



... go to step 8 page 38

TABLE 2

External diameter	100 cm	110 cm	120 cm	130 cm	140 cm
Pit cover surface area	0.8 m2	1.0 m2	1.2 m2	1.4 m2	1.6 m2
Top ring surface area	0.95 m2	1.05 m2	1.15 m2	1.25 m2	1.35 m2
Pit depth					
100 cm	3.1 350 2.2	3.3 440 2.4	3.5 550 2.6	3.7 660 2.9	4.0 790 3.1
125 cm	4.2 470 3.0	4.5 600 3.3	4.8 745 3.6	5.1 900 3.9	5.4 1070 4.2
150 cm	5.3 600 3.8	5.7 760 4.1	6.0 940 4.5	6.4 1140 4.9	6.8 1350 5.3
175 cm	6.4 720 4.6	6.8 920 5.0	7.3 1140 5.5	7.7 1370 5.9	8.2 1630 6.4
200 cm	7.5 850 5.3	8.0 1080 5.9	8.5 1330 6.4	9.1 1610 6.9	9.6 1920 7.5
225 cm	8.6 980 6.1	9.2 1240 6.7	9.8 1530 7.3	10.4 1850 8.0	11.0 2200 8.6
250 cm	9.8 1100 6.9	10.4 1400 7.6	11.1 1720 8.3	11.7 2090 9.0	12.4 2480 9.8

volume (liters): inner dimensions (lining 10 cm thick) and effective depth: depth - 30 cm.
leaching surface area: external dimensions and effective depth.
top ring: 30 cm high.

KEY

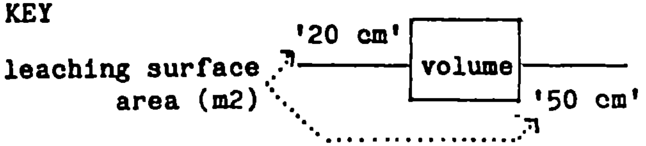
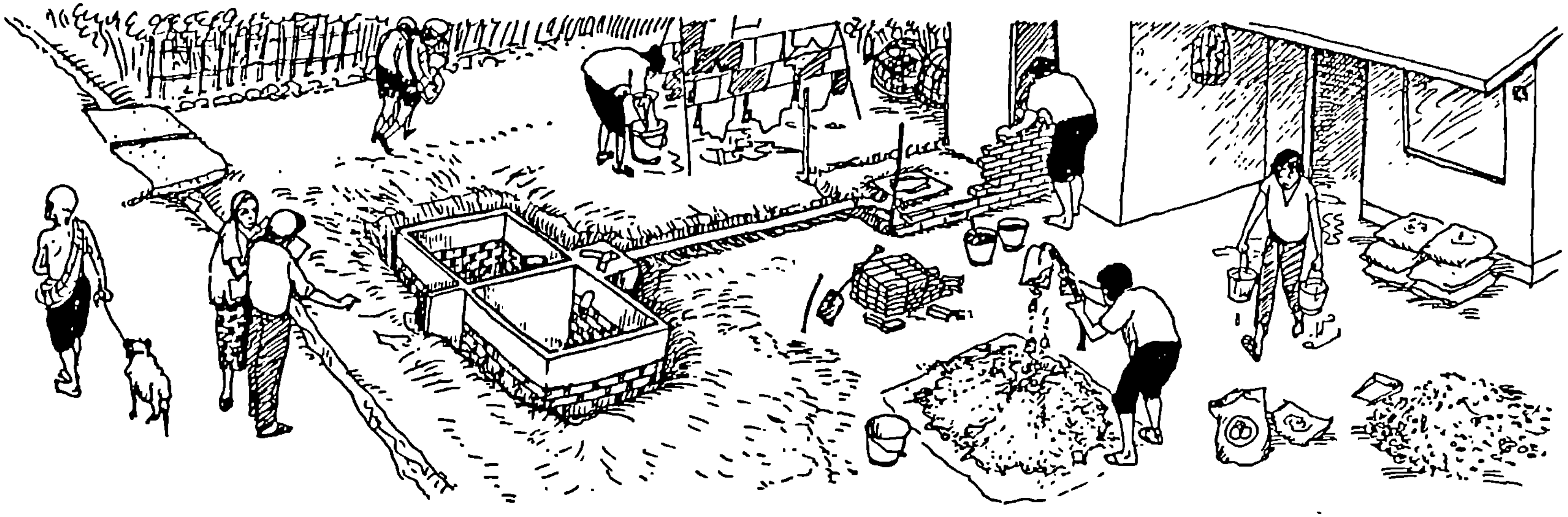


TABLE 2



3. COMBINED PITS

- Underline in Table 3 the proposed pit depth (see step 4) and read the first diagram alongside the plotted depth.

• If the leaching surface area in the diagram is more than required: follow the diagrams upwards.

• If the leaching surface area in the diagram is less than required: follow the diagrams alongside the plotted depth. If the final diagram does not meet the required leaching surface area, go to step 6 and plan trenches.

- Mark the diagram with the required leaching surface area. If the required leaching surface area is between two figures, take the larger one; that means excess leaching surface area.

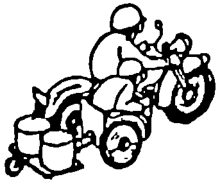
In how many years will the pit be full? Solids accumulate at a rate of 25 liters per person per year. So, the total quantity of solids per year is equal to the number of users times 25 liters.

Fill in the pit volume and the number of users, and calculate the retention time.

(volume:) .... liters

———————————— = ... years

(users:) .... x 25 liters



... go to step 8 page 40

TABLE 3

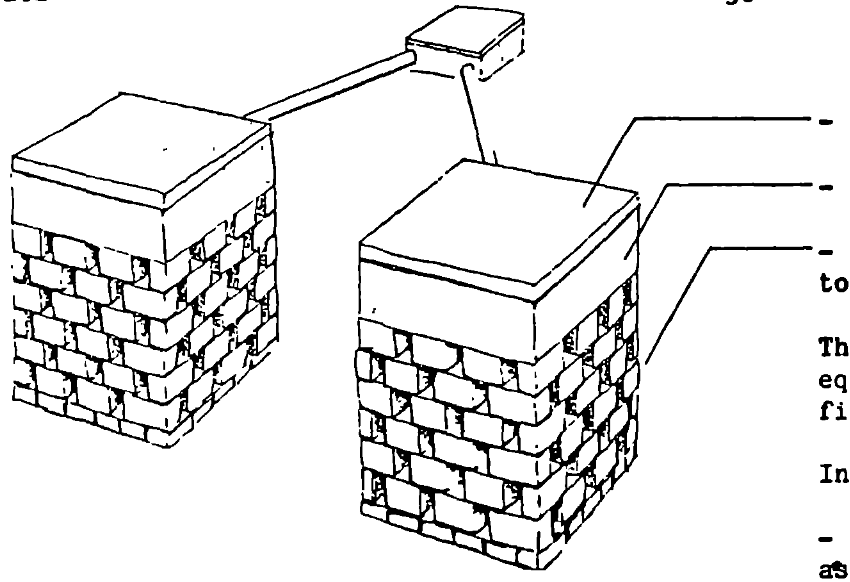
External length x width (2 pits)	100 x 190 cm	100 x 230 cm	100 x 270 cm	120 x 270 cm	140 x 270 cm
Pit cover surface area	0.95 m2	1.15 m2	1.35 m2	1.65 m2	1.90 m2
Top ring surface area	0.9 m2	1.0 m2	1.1 m2	1.2 m2	1.3 m2
Pit depth					
100 cm	2.5 450 2.0	2.8 560 2.3	3.1 670 2.5	3.2 840 2.7	3.4 1010 2.8
125 cm	3.4 600 2.7	3.8 760 3.0	4.2 920 3.4	4.4 1140 3.6	4.6 1370 3.8
150 cm	4.3 770 3.4	4.8 960 3.8	5.3 1150 4.3	5.5 1440 4.6	5.8 1730 4.8
175 cm	5.2 930 4.1	5.8 1160 4.6	6.4 1390 5.2	6.7 1740 5.5	7.0 2090 5.8
200 cm	6.1 1090 4.8	6.8 1360 5.4	7.5 1630 6.1	7.8 2040 6.5	8.2 2450 6.8
225 cm	7.0 1250 5.5	7.8 1560 6.2	8.6 1870 7.0	9.0 2340 7.4	9.4 2810 7.8
250 cm	7.9 1410 6.2	8.8 1760 7.0	9.7 2110 7.9	10.1 2640 8.4	10.6 3170 8.8

volume (liters): inner diameter (lining 10 cm thick) and effective depth: depth - 30 cm.
leaching surface area: external diameter and effective depth.
top ring: 30 cm high.

KEY

leaching surface area (m2) — '20 cm' — volume — '50 cm'

TABLE 3



step 8: TECHNICAL DRAWING OF THE PIT DESIGN

1. SQUARE AND RECTANGULAR SEPARATE PITS

On these pages you can note down the dimensions of your pit design. This information will be needed to find a pit location (step 9) and to calculate the quantity of materials. (section 3)

Ascertain from Table 1, step 7:

- Leaching surface area
with 20 cm leaching backfill: m2

- Leaching surface area
with 50 cm filter backfill: m2

Indicate the pit dimensions as listed opposite.

	1 pit	2 pits
- Pit cover surface area	..... m2 x 2 =	..... m2
- Top ring surface area	..... m2 x 2 =	..... m2
- Pit lining surface area to the top ring	..... m2 x 2 =	..... m2

The pit lining surface area to the top ring is equal to the leaching surface area with 50 cm filter backfill; lower right figure in diagram.

Indicate in the drawing opposite:

- external length and width of the pit
as decided in step 7, Table 1

- proposed pit depth
as decided in step 7, Table 1

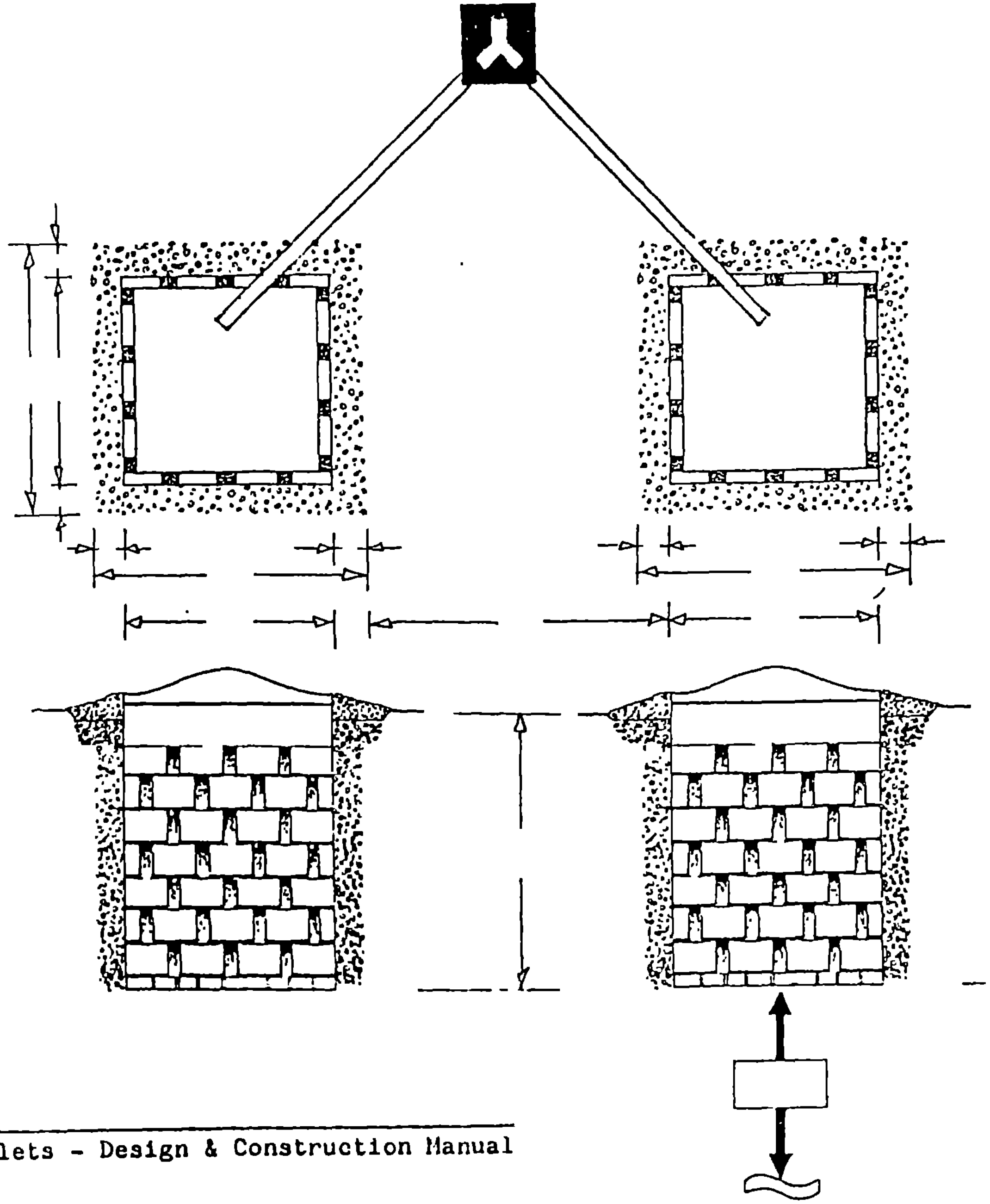
- distance between the pits
at least equal to the pit depth

- backfill
20 cm leaching backfill
50 cm filter backfill (as decided in step 6)

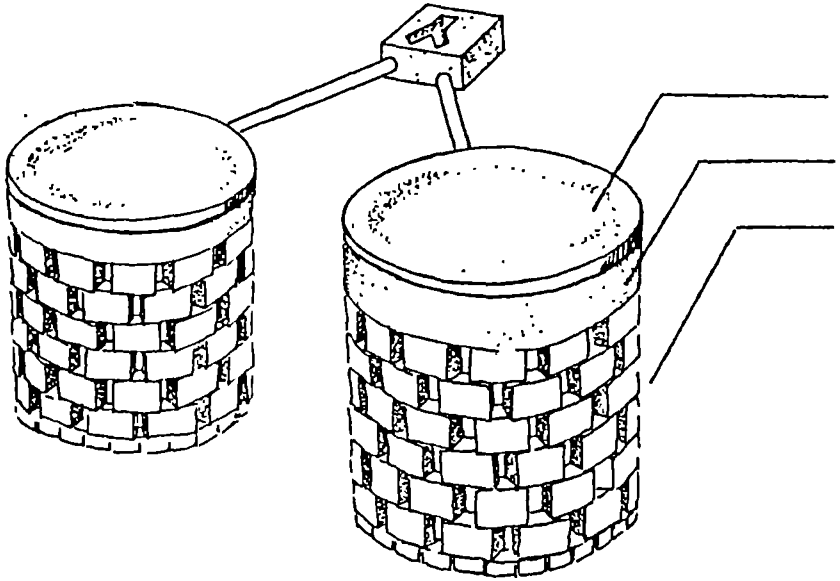
- zone depth
i.e. the high groundwater level minus pit depth; see steps 4 and 7, Table 1

- if the pits are raised: the ground level and the **perimeter of the earth wall** 150 cm around the pit; see step 4

- if trenches are planned: location and length of **trenches**; see step 6



DRAWING 1



2. CIRCULAR SEPARATE PITS

On these pages you can note down the dimensions of your pit design. This information will be needed to find a pit location (step 9) and to calculate the quantity of materials. (section 3)

Ascertain from Table 2, step 7:

- **Leaching surface area with 20 cm leaching backfill: m2**

- **Leaching surface area with 50 cm filter backfill: m2**

Indicate the pit dimensions as listed opposite.

1 pit 2 pits

- **Pit cover surface area** ..... m2 x 2 = ... m2
- **Top ring surface area** ..... m2 x 2 = ... m2
- **Pit lining surface area** to the top ring ..... m2 x 2 = ... m2

The pit lining surface area to the top ring is equal to the leaching surface area with a 50 cm filter backfill; lower right figure in diagram.

Indicate in the drawing opposite:

- **external length and width of the pit** as decided in step 7, Table 2

- **proposed pit depth** as decided in step 7, Table 2

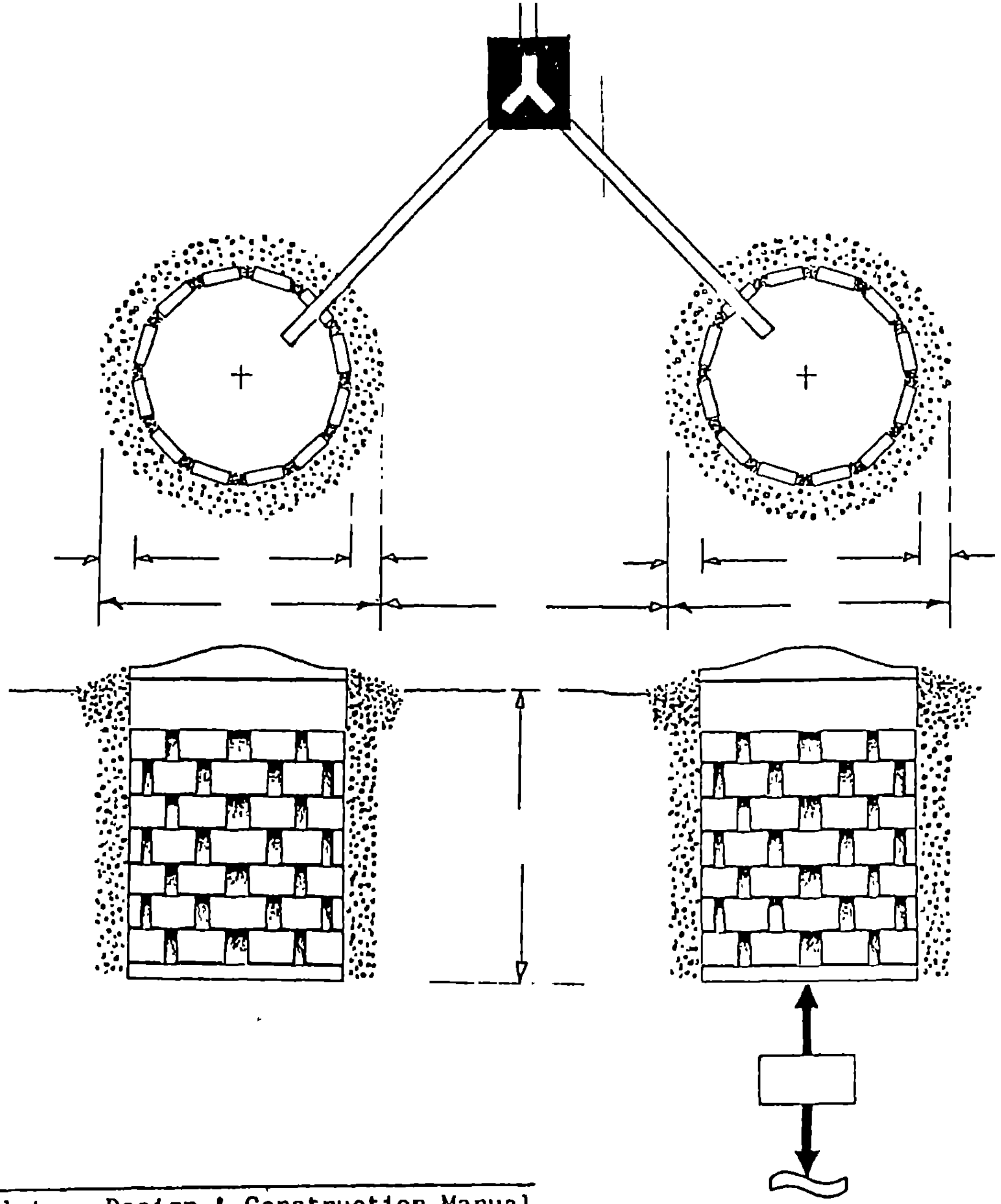
- **distance between the pits** at least equal to the pit depth

- **backfill** 20 cm leaching backfill 50 cm filter backfill (as decided in step 6)

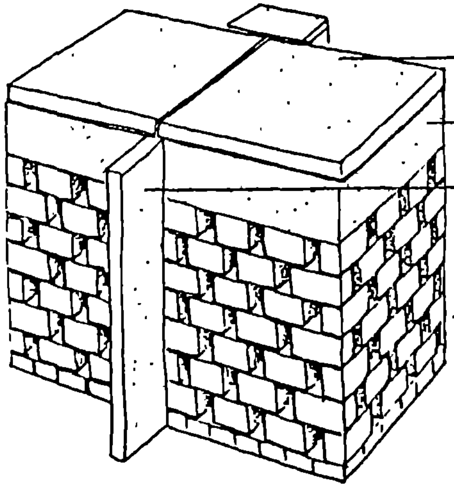
- **zone depth** i.e. the high groundwater level minus pit depth; see steps 4 and 7, Table 2

- if the pits are raised: the ground level and the **perimeter of the earth wall** 150 cm around the pit; see step 4

- if trenches are planned: location and length of **trenches**; see step 6



DRAWING 2



3. RECTANGULAR COMBINED PITS

On these pages you can note down the dimensions of your pit design. This information will be needed to find a pit location (step 9) and to calculate the quantity of materials. (section 3)

Ascertain from Table 3, step 7:

- Leaching surface area
with 20 cm leaching backfill: m2

- Leaching surface area
with 50 cm filter backfill: m2

Indicate the pit dimensions as listed opposite.

1 pit 2 pits

- Pit cover surface area ..... m2 x 2 = ... m2
- Top ring surface area ..... m2 x 2 = ... m2
- Dividing wall surface area:
pit width pit depth
(..... m + 0.60 m) ...... m = ... m2
- Perimeter wall surface area
..... m2 x 2 = ... m2

The perimeter wall surface area is equal to the leaching surface area with 50 cm filter backfill.

Indicate in the drawing opposite:

- external length and width of the pit
as decided in step 7, Table 3

- proposed pit depth as decided in step 7, Table 3

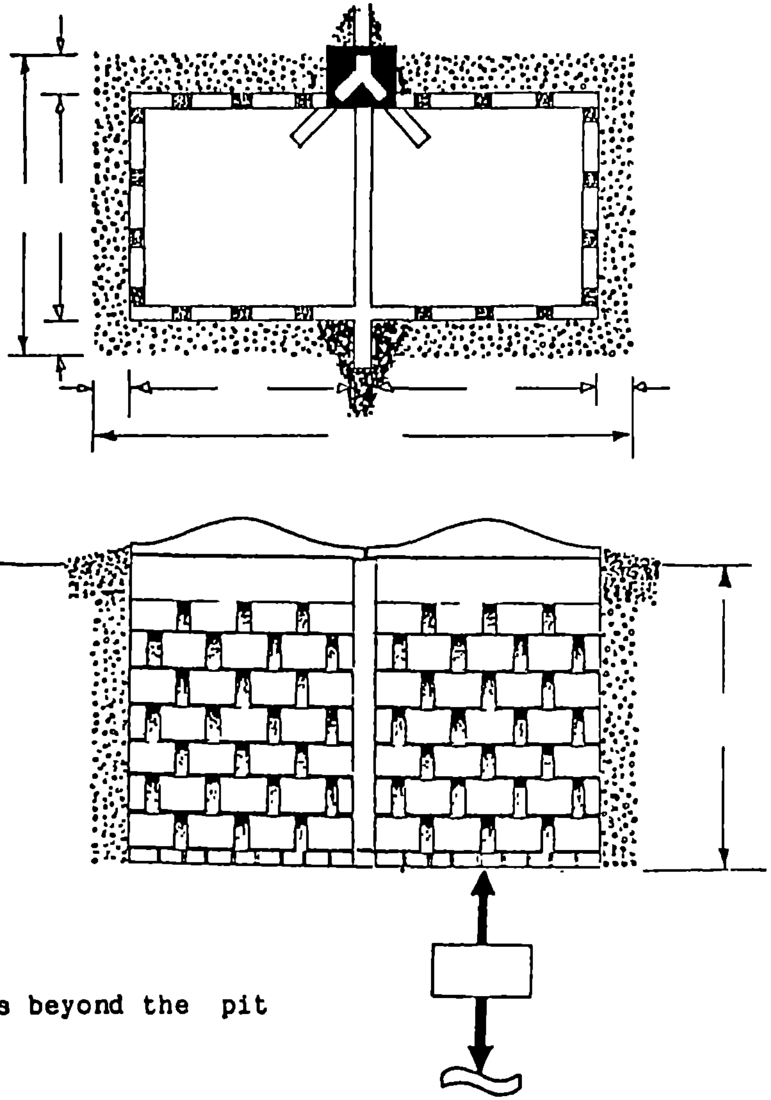
- distance between the pits
at least equal to the pit depth

- backfill
20 cm leaching backfill
50 cm filter backfill (as decided in step 6)

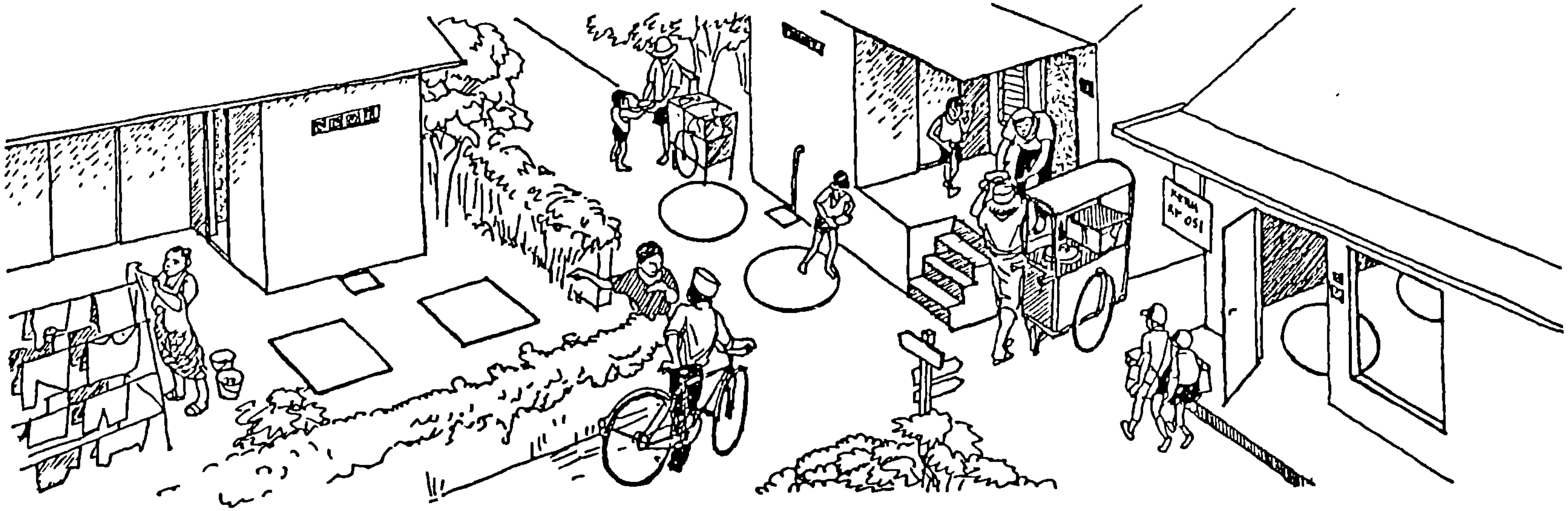
- zone depth i.e. the high groundwater level minus pit depth; see steps 4 and 7, Table 3

- if the pits are raised: the ground level and the perimeter of the earth wall 150 cm around the pit; see step 4

- if trenches are planned: location and length of trenches; see step 6



note: the dividing wall extends beyond the pit lining on both sides.



step 9: PLANNING THE PIT LOCATION

Always ensure easy access to the pits and switch box to allow emptying and switching the flow. The space above the pits can be used as long as you can easily clear the coverplate. A large pit cover can be divided into removable and fixed sections. The space above the fixed cover section can be used permanently.

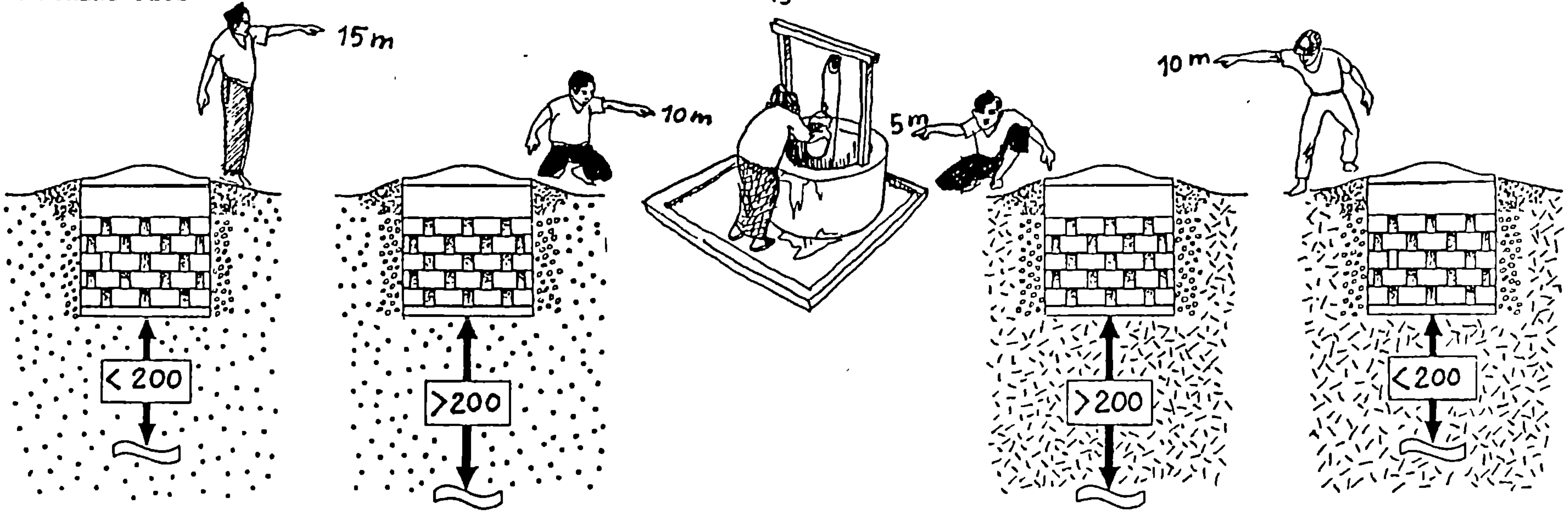
Locate the pits where they do not block future dwelling expansion or alterations.

The pits are best located within the plot boundary.

If it is not feasible to locate the pits within the plot boundary, consider one of the following second-best solutions.

You can locate the pits under a public footpath or alleyway. Extra attention must be paid to design and construction in order to prevent collapse of the pit. This may increase the cost. In addition, you probably need official authorization.

You can locate the pits indoors, under the floor of a room or verandah. If properly sealed, leaching pits are cut off from the outside air and will not give off odours in the house. When it is time to empty the pit, the contents are odourless.



Distance between leaching pits and shallow wells

The minimum distance between a pit and the nearest shallow well depends on the **soil type**, and the **zone depth** between the pit bottom and the wet season groundwater level.

Locate the leaching pits **downstream** from a shallow well.

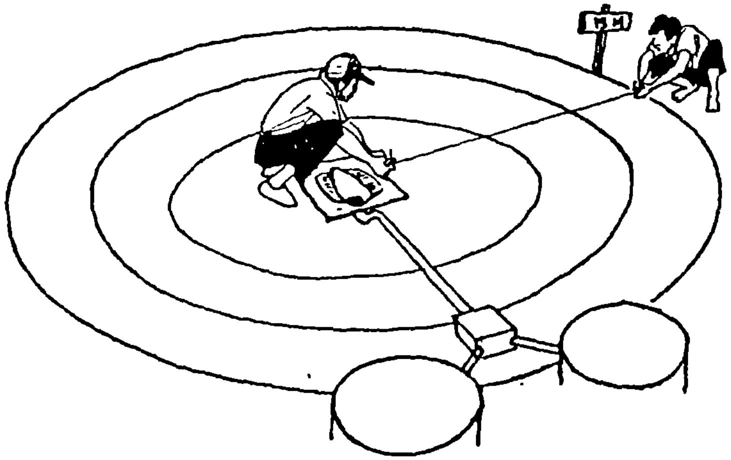
If the information on soil type and groundwater level is not reliable, be on the safe side and keep a minimum distance of 10 meters between a pit and the nearest well.

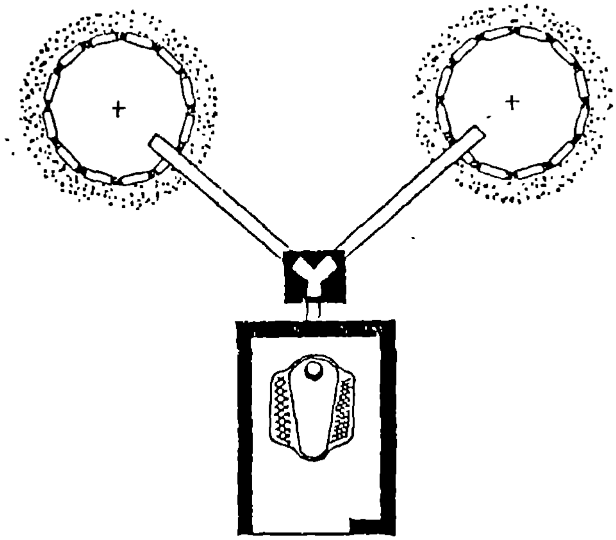
note: > more than ...
< less than ...

The table below shows the minimum distance between a pit and the **nearest** shallow well.

soil type	zone depth in the wet season is: less than 2 m	more than 2 m
sand	15 m	10 m
other soils	10 m	5 m

The distances given are **minimum** distances. It is always better to stay as far away from a well as possible.





Pit - toilet pan connection

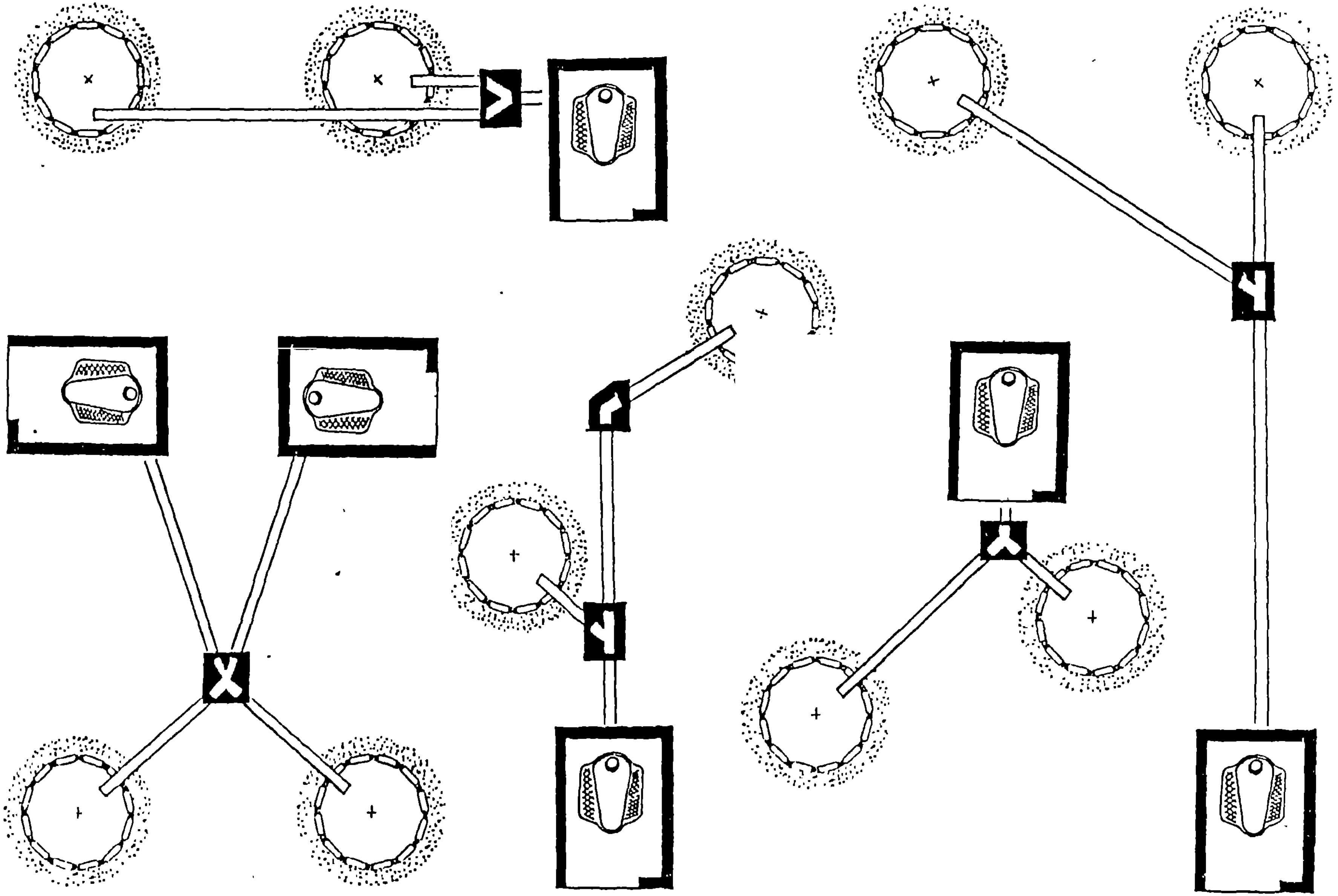
A pipe layout with as few joints and bends as possible allows easy flow of excreta from pan to pit. The pipe need a minimum slope of 1:50, i.e. 2 cm per meter.

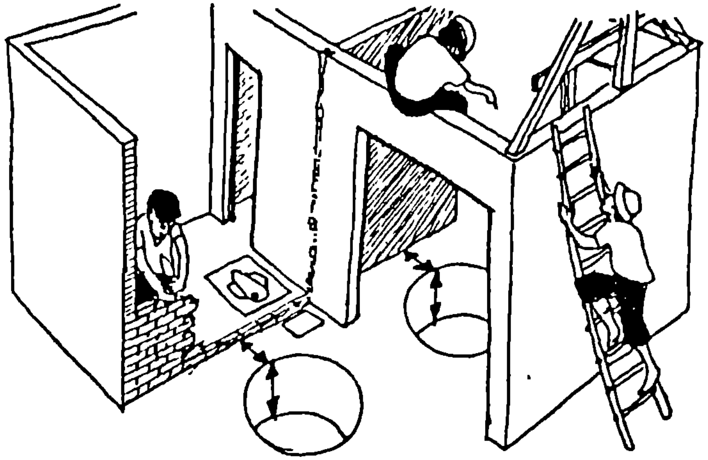
Place the pits as near as possible to the toilet room to save on pipes and reduce the risk of blockage. The greater the distance the more attention should be given to the material of the pipes and joints. The **maximum distance** allowed between toilet and pits is **15 meters.** If it is difficult to find a pit location within 15 meters, think of changing the toilet room location.

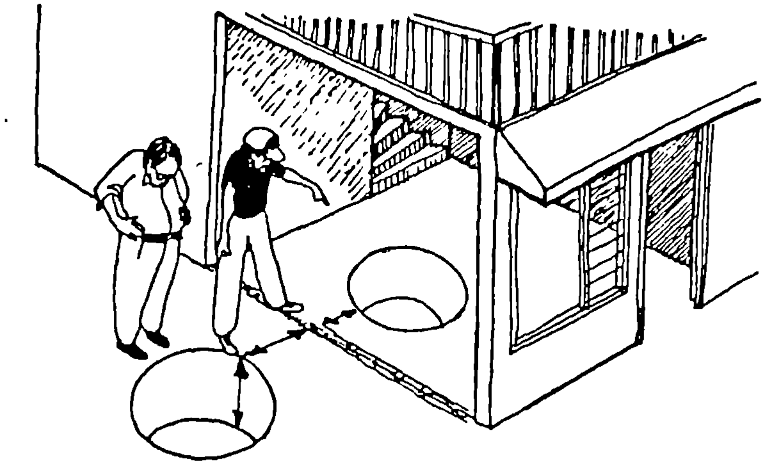
Try to avoid positioning the toilet **between** the two pits. It would place the switch box under the toilet floor and present construction problems.

Position the switch box so that you get straight line connections between toilet - switch box, and between switch box - pits. A switch box near the pits saves on pipes. However, avoid sharp bends in the switch box.

If bends in the pipe lay-out are unavoidable, make curves with a large radius. Avoid 90° elbows; better use two 45° elbows. If possible, locate bends at accessible spots where you can make a **rodding point** to clear a blockage.





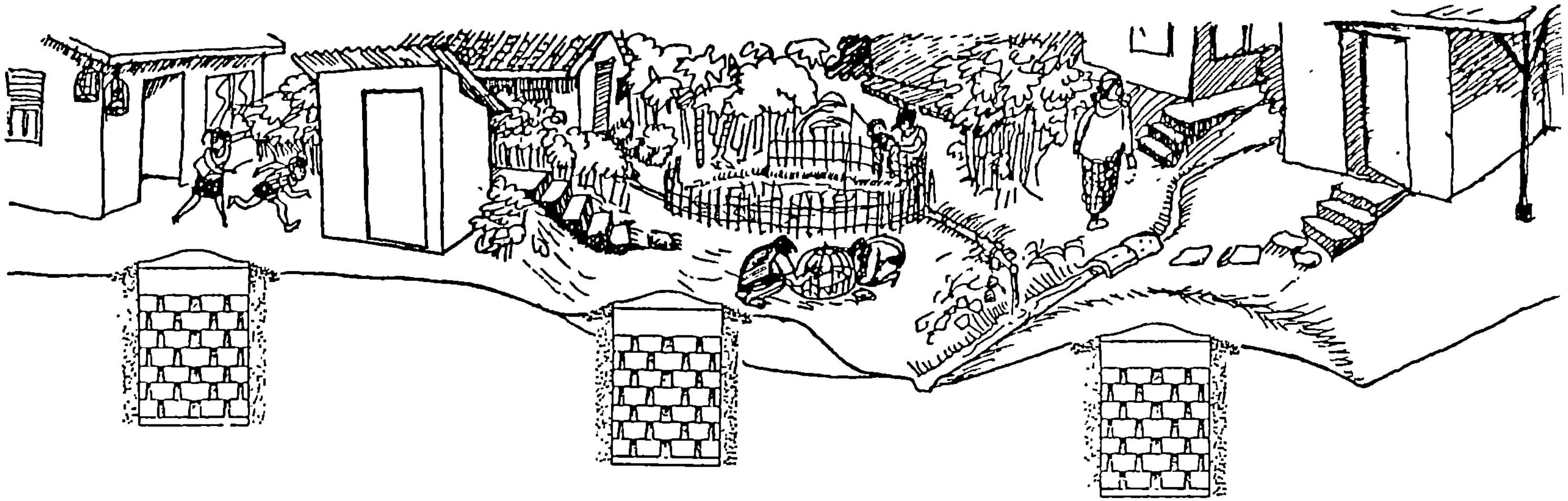


Distance between leaching pits and foundations

Leaching pits near a building are more liable to collapse and may undermine foundations. The **minimum permissible** distance between a pit and foundation is given in the table opposite.

Where leaching pits are at the minimum distance, the openings in the pit lining facing the foundation must be made smaller to reduce leaching.

	building height	
pit depth	one floor	two floors
100 cm	20 cm	30 cm
150 cm	30 cm	45 cm
200 cm	40 cm	60 cm
250 cm	70 cm	105 cm



Topography and vegetation

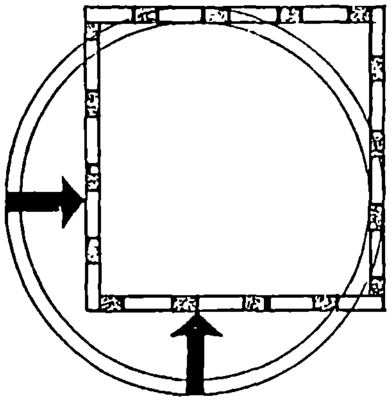
The pit location should be at the same level or lower than the level of the toilet floor so that the flushing water with excreta will flow down.

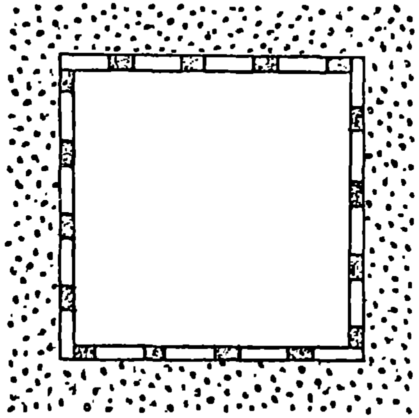
Do not locate leaching pits where you could expect root channels of former trees. These are runways for liquids from the leaching pit and extend the risk of groundwater pollution.

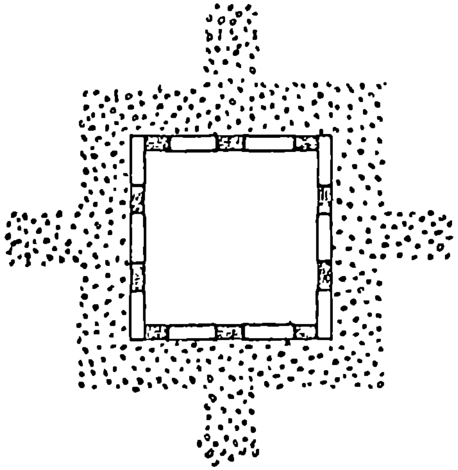
Preferably do not locate the pits in depressions where waste water and rain water is likely to collect around and over the pits. The pits may get flooded.

If a depression is the only suitable location, you must raise the pit and surround it with an earth wall 150 cm around the pit lining. This to prevent flooding of the pit. Raising the pit may mean you have to raise the toilet floor as well.

After you have found a location for the pits, continue with step 10: final design. If you cannot find a suitable location, turn over the page and read 'trouble shooting'.







TROUBLE SHOOTING

There are various options, or combinations of options to reduce the space needed.

- If you proposed a cistern flush system, change to a pour-flush toilet pan. A reduction in waste water flow results in a proportional reduction of required leaching surface. Go to step 5.

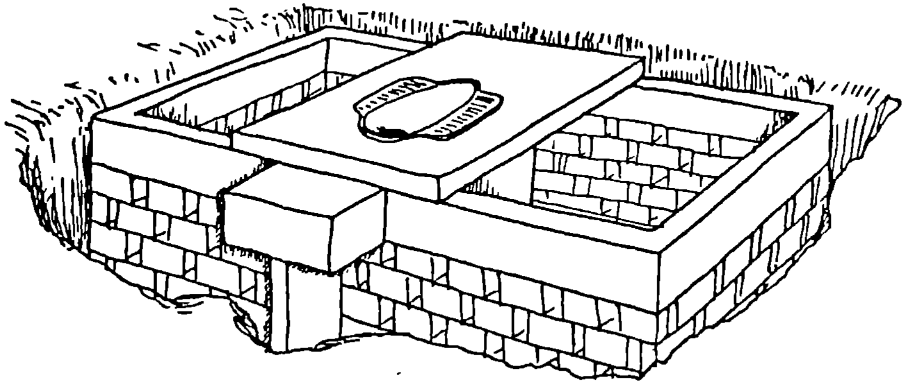
- If you proposed a circular pit shape, consider changing the shape to square or rectangular. This will reduce the pit dimensions by maximum 30 to 40 cm. Go to step 7.

The first illustration shows a circular and square pit with the same leaching surface area for a given pit depth.

- Reduce the volume of the pit and build trenches to comply with the required leaching surface area. Go to step 6, p 27.

The second and third illustration show pits with the same leaching surface area; the location of the trenches gives a wider choice to fit the space available.

- If you assumed a clay soil type, check by doing soil test 3 described in step 10 page 54. The soil may prove to have better leaching qualities than you expected so allowing to reduce the leaching surface area.

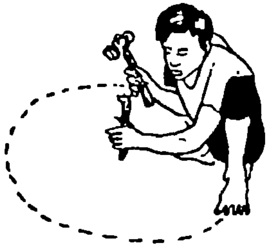


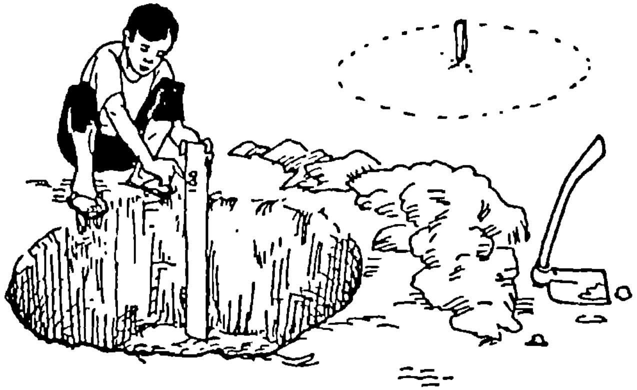
- If you cannot comply with the minimum distance between the two pits, consider:
- sharing the pits with a neighbour, with one pit in each plot;
- changing the pit configuration from separate to combined pits as described in step 7 page 29. With a combined pit the toilet room can be built on top of the pits with the switch box at the rear.

- Consider **second-best locations** for the leaching pits as described in this step. Build one or both pits in a depression, under a public footpath, or indoors. (page 42 + 47)

- If the pits have been designed to serve more than one household, you can build two or more independent TLP systems and reduce **the number of users per unit**.

- **Increase the depth of the pit.** Only use this option as a last resort if the pit bottom is less than 200 cm above the high groundwater level, and drinking water is obtained from shallow wells. There is a high risk of groundwater pollution. (see step 4, p 22) In addition, the distance between the two pits and the distance between a pit and nearest shallow well should be increased. (see step 8, p 37, 39 or 41 and step 9, p 43 + 46)





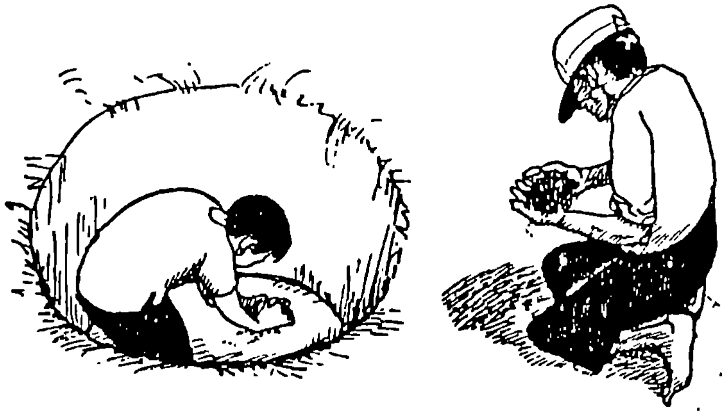
step 10: FINAL DESIGN

There are three soil tests to check whether the pit design is in accordance with the soil type and groundwater level at the pit location.

- soil colour test to indicate the high groundwater level.
- feel and appearance test to identify the soil type which will give a rough idea of the leaching capacity.
- percolation test to determine more accurately the leaching capacity of the soil.

You can then compare the test results with the information on which you based the leaching pit design and location.

Dig a small hole at the centre of the proposed pit location. Take soil samples at a depth of about one meter. If you expect different soil conditions in the two pits, take samples from each pit location.



SOIL TEST 1: soil colour

The colour and colour patterns in the soil indicate levels the groundwater can reach.

Pick up some soil and, without crushing it, observe the colour. It is important to have good sun light. If ped faces are dry, sprinkle some water over the sample.

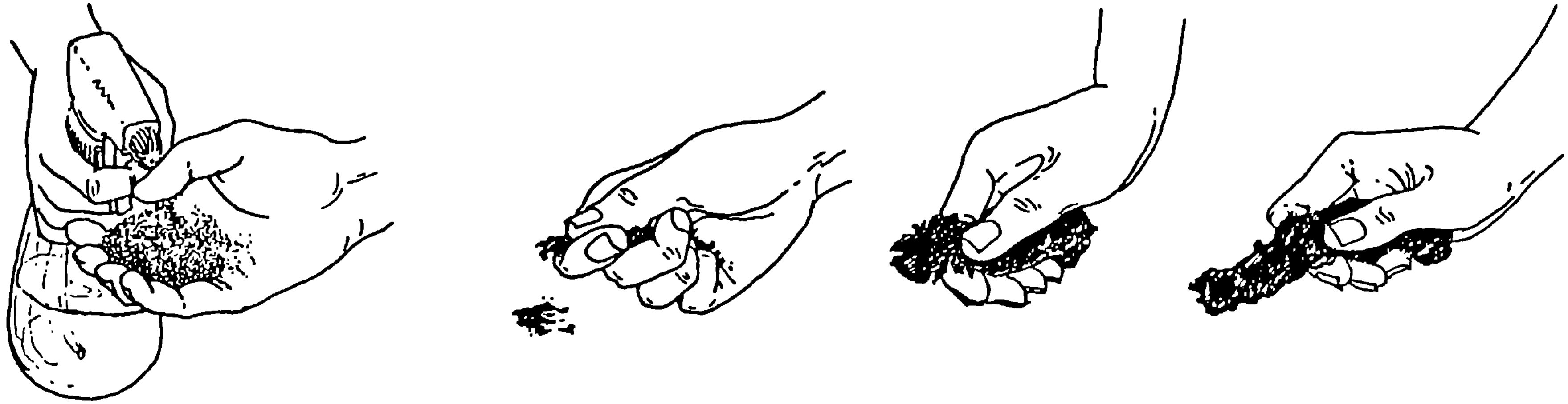
A uniform red, yellow or brown colour indicates soils are well aerated and rarely or never saturated with water.

A grey or blue colour indicates soils that are saturated for extended periods or all the time. A uniform grey or blue colour indicates the constant groundwater level.

Spots or streaks of different colours, called mottles, indicate seasonally saturated soils. This indicates the groundwater level during the wet season.

If you find spots or streaks or soils of a grey / blue colour, the leaching pit will reach the groundwater level. If that does not correspond with the assumed groundwater level, choose another pit location or see step 4 for the proper adjustments.

This soil colour test is simply a first indicator of the groundwater level. When you have excavated the pits to their full depth, a second soil colour test will give more definite information.



SOIL TEST 2: 'Feel and Appearance' test

Take another soil sample, about 2 cm in diameter, from the hole and do a 'feel and appearance' test.

Sprinkle the sample till the consistency is like putty. Too much moisture results in a sticky material, which is hard to work.

Try to form a cast:

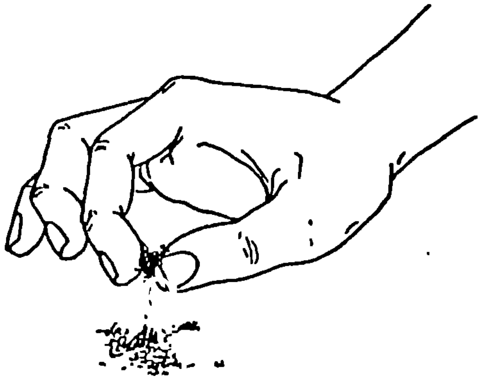
If you cannot form a cast or the cast crumbles when touched, it is sand.

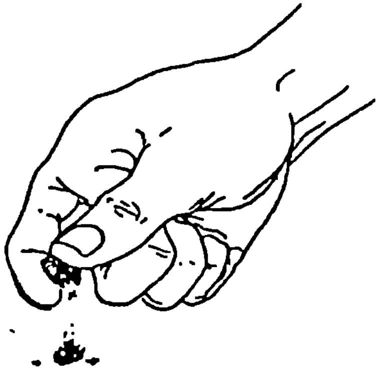
If the cast can be handled freely without breaking it could be either loam or clay. In this case:

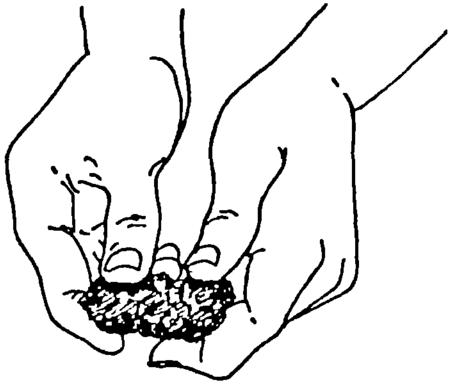
Press and squeeze the cast between thumb and forefinger and try to form a ribbon.

If you can hardly form a ribbon, it is loam.

If it forms a thin, flexible ribbon, which retains its plasticity when elongated, it is clay. Clay is sticky and puddles easily.







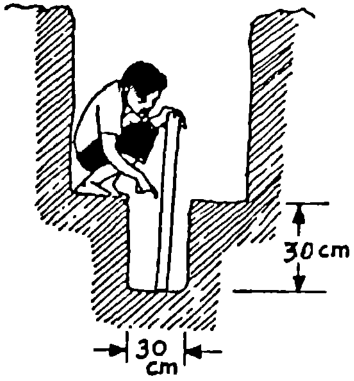
To double-check the results, take another sample of soil and, without moistening it, do a second feel and appearance test.

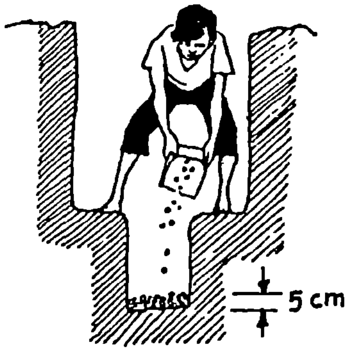
Sand has a large percentage of single grains which can easily be seen. It feels gritty. Squeezed it will not hold its shape.

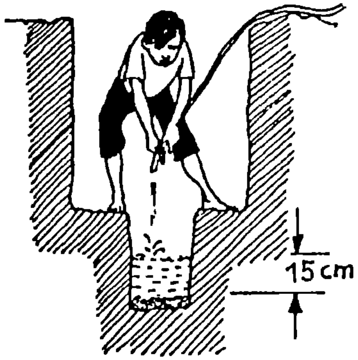
Loam has a fairly smooth or slightly gritty feel, and clods are crumbled easily. Squeezed it forms a cast.

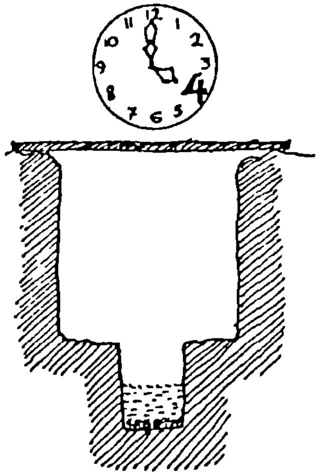
Clay is finely textured, clods are hard to very hard and strongly resist crushing by hand. When pulverized, it has a grit-like feeling due to the harshness of the very small aggregates which persist.

Compare the field test results with the soil type on which you based the pit design (see step 5) and go to page 57. If the soil type differs so much that you should redesign the pit, you must do soil test 3 first. Also when you doubt the results of the 'feel and appearance test, do soil test 3.









SOIL TEST 3: leaching capacity of the soil

A percolation test is the most commonly used indicator to measure the ability of soils to absorb water. A simple percolation test to perform in the field is the falling head test. The procedures are as follows:

1. Dig or bore at one meter deep a test hole 30 cm deep and with a diameter of 30 cm. If you expect different conditions in the two pits dig test holes at both locations.

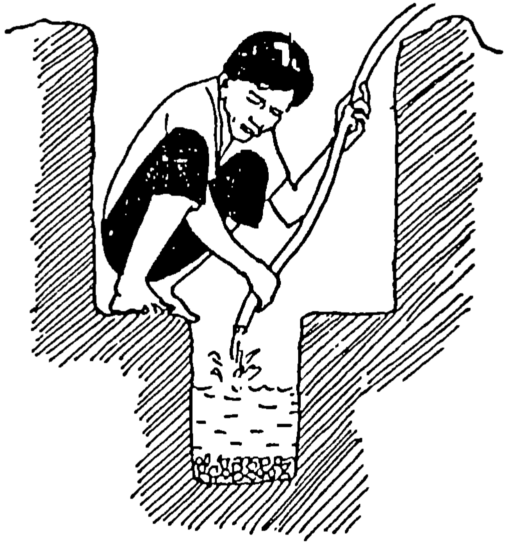
2. Scratch the sides and the bottom of the hole with a sharp stick to get a natural soil surface and remove any loose material.

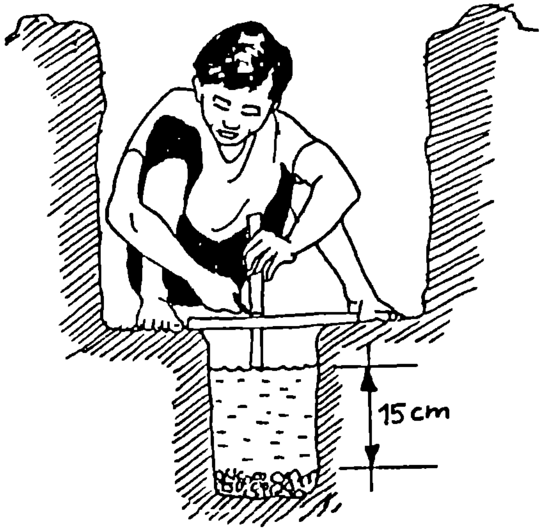
3. Place crushed gravel (Ø 10-20 mm) to a depth of about 5 cm in the hole to protect the bottom from scouring when the water is added.

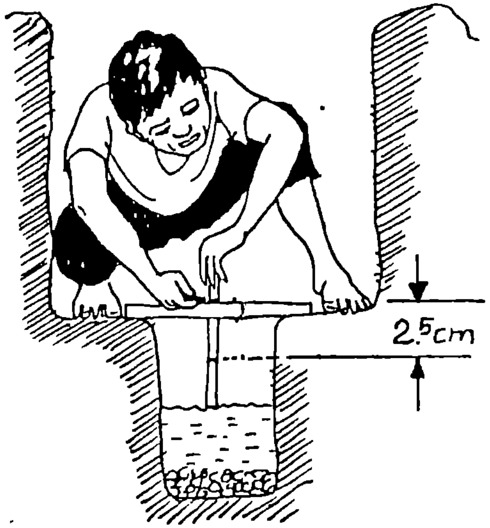
4. Fill the holes slowly with at least 15 cm of clean water above the gravel. Do this slowly to prevent the water washing away the sides of the hole. You may use a funnel with a hose attached.

5. Cover the hole and leave it for 4 hours so the soil becomes saturated. This is very important. Immediately after the 4 hours soakage period begin measuring the percolation.

If the water seeps away completely in less than ten minutes after filling the hole twice, you may begin the measurement immediately.







Measuring the percolation rate

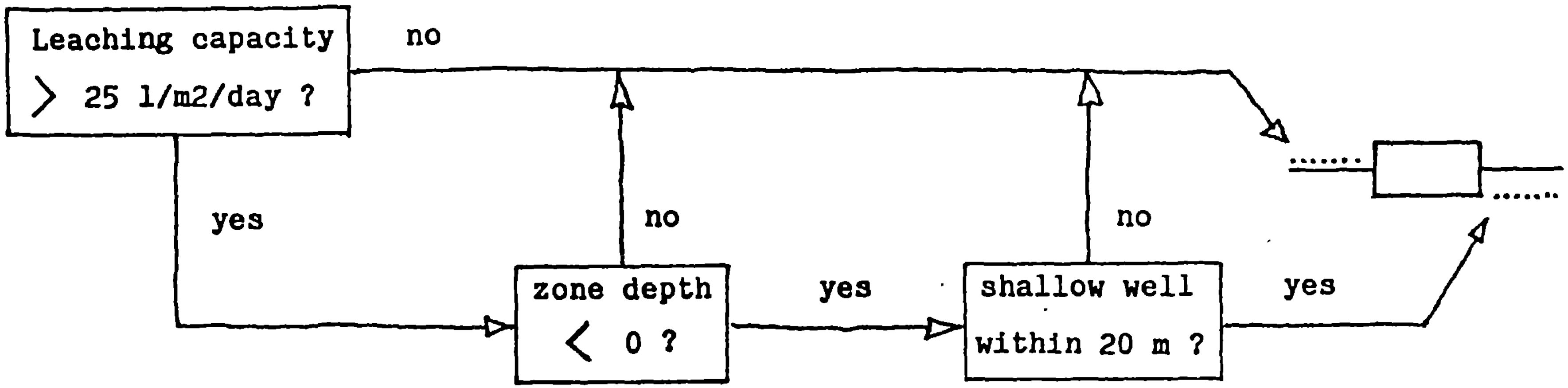
1. Fill the hole with water to a depth of 15 cm above the gravel.

2. Record the period of time it takes for the water level to drop 2.5 cm, beginning immediately after the hole has been filled.

3. As soon as the level has dropped 2.5 cm, repeat (1) and (2) until two successive measurements differ by less than 2 minutes. You must repeat the test at least 3 times even if the first two measurements differ by less than 2 minutes.

4. Take the last time period recorded and mark the leaching capacity of the soil on the table opposite.

time period minutes	leaching capacity per day
1	35 liters/m2
2	28 liters/m2
3	25 liters/m2
4	23 liters/m2
5	22 liters/m2
10	19 liters/m2
20	17 liters/m2
30	16 liters/m2
60	14 liters/m2
90	13 liters/m2



Pit dimensions

Assessing the soil test results

Compare the soil test results with the leaching capacity assumed in step 5. (p 24)

You must redesign the pit if:

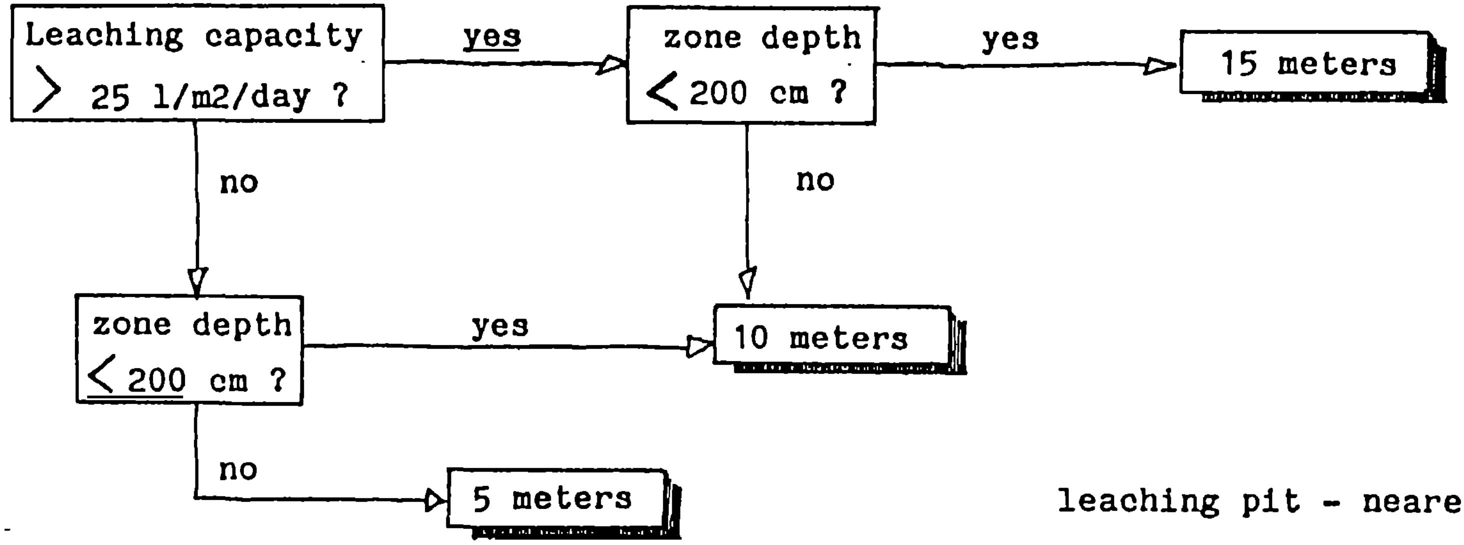
- the soil leaches less than assumed. You can consider trenches to provide extra leaching capacity (see step 6, p 26) or enlarge the pit lining surface area.
- the soil leaches more than 25 liters/m2/day, the pit bottom reaches the groundwater and there is a shallow well within 20 meters from the pit.

Follow the instructions on 'redesign of the pit'.

In all other cases where the soil leaches more than assumed, keep your original design. The pits have excess leaching capacity.

Alternatively, you may use the excess leaching capacity established by the field test, and buid a smaller pit if you have difficulty in finding a pit location or want to save money.

Also when you do not have to redesign the pit, follow the redesign procedure to check your pit design.



Distance

leaching pit - nearest shallow well

Redesign of the pit

- If the percolation test was carried out in the dry season and the pit bottom reaches the groundwater level (see step 4, p 23), reduce the leaching capacity established by the percolation test with 5 l/m2/day.

- Calculate the required leaching surface area (as explained in step 5, p 25) based on the leaching capacity established by the percolation test.

- Follow the algorithm 'Pit dimensions' (above left) and fill in the calculated leaching surface area in the diagram.

- Determine the new pit dimensions, see step 7 table 1, 2 or 3 (p 31, 33 or 35) and compare these with the original dimensions.

- If you have to redesign the pit, indicate the modifications in the technical drawing; step 8, p 37, 39 or 41.

You may have to change the distance between the leaching pit and nearest shallow well if you redesign the pit.

- Follow the algorithm 'Distance leaching pit - shallow well' and read the minimum permissible distance.

The design is now complete. In the next section we are going to choose building materials for the proposed TLP toilet design.

3. MATERIALS

LEACHING PITS	1. PIT COVERS
	2. PIT LININGS
	3. BACKFILL + TRENCHES
PIT - TOILET PAN	4. PIPES
	5. SWITCH BOX
	6. TOILET PAN + WATERSEAL TRAP
TOILET ROOM	7. FOUNDATION
	8. FLOOR
	9. WALLS
	10. ROOF

MATERIALS

The next job is to compile a shopping list of the building materials you will need to build your TLP-toilet.

This section reviews a wide selection of alternative materials. It is subdivided according to the various parts of the TLP-toilet to facilitate the most appropriate choice. You can determine the required quantities for each part by simple calculations.

Price is the main criterion in selecting the materials. No information is given here on prices. These differ from place to place and would in any case soon be out of date. After calculating the total quantities you can make a cost comparison by using local, up-to-date unit prices.

All estimates of quantities are based on 2 pits. A retention time of more than two years allows you to postpone the construction of the second pit till the first pit is about half full. The reduction in initial building costs can be calculated at the end of this section.

1. PIT COVERS

Pit covers can be made of wood, metal or concrete. This manual only deals with concrete pit covers, because these are more durable.

Covers for off-set pits within the plot boundary can be made of non-reinforced concrete. Non-reinforced covers have a dome shape to give internal strength. You save on reinforcement bars, but extra care is required during construction of non-reinforced covers. The cement-sand mix is more critical.

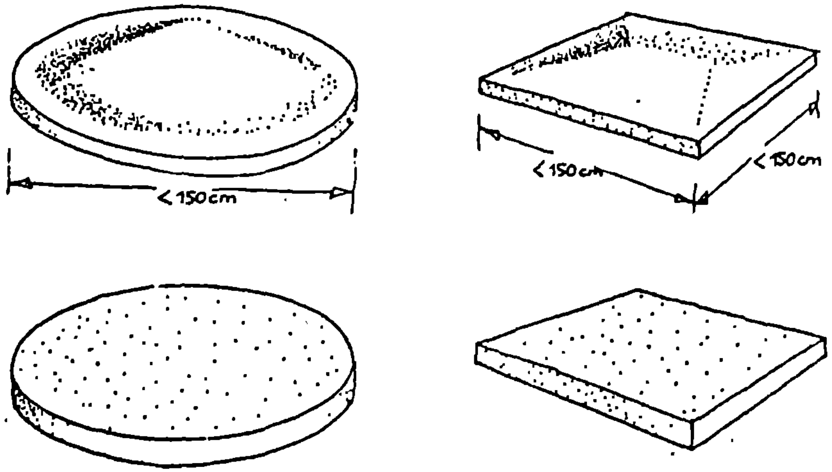
The diameter of a circular domed cover must not exceed 150 cm; the maximum size for a rectangular domed cover is 150 x 150 cm. You can divide larger pit covers into section so non-reinforced covers can be used. (see also page 78)

Reinforced covers are flat. These can be used for off-set pits within the plot boundary and for pits under the toilet.

- Ascertain from Design step 8 (p 36, 38 or 40):

Pit cover area .... m2. (for 2 pits)

Increase the pit cover area by 0.4 m2 if you plan to use a bamboo pit lining; the diameter of the top ring is 20 cm larger than the pit diameter.



PIT COVERS: non-reinforced (dome shaped)

Remember, these covers can only be used for off-set pits within the plot boundary, and the dimensions of the pit cover (or sections) should not exceed 150 cm.

- **Fill in the pit cover area (m2)** —— (3 times)

A dome shape cover is 5 cm thick; concrete mix of cement-sand-gravel (1.5:2:3).

	thickness (m)	quantity/m3	PIT COVERS dome shape
..... x	0.05	x 0.375 (cement)	= ..... m3 cement
..... x	0.05	x 0.50 (sand)	= ..... m3 sand
..... x	0.05	x 0.75 (gravel)	= ..... m3 gravel

PIT COVERS: reinforced

- **Fill in the pit cover area (m2)** —— (3 times)

A reinforced cover is 10 cm thick; concrete mix of cement-sand-gravel (1:2:3).

	thickness (m)	quantity/m3	PIT COVERS reinforced
..... x	0.1	x 0.25 (cement)	= ..... m3 cement
..... x	0.1	x 0.50 (sand)	= ..... m3 sand
..... x	0.1	x 0.75 (gravel)	= ..... m3 gravel

Reinforcing bars (Ø 6 mm) ....

2. PIT LININGS

The pit walls are lined to their full depth to prevent collapse of the pit and damage when the pit is being emptied.

The upper part of the lining, about 30 - 40 cm, is a watertight solid ring, fully mortared and plastered. This top ring prevents surface water from entering the pit.

The **lining below the top ring** has open spaces to permit flushing water, urine and soluble compounds of digested excreta to pass through and leach into the surrounding soil.

A variety of materials can be used as lining. The choice should depend on availability of materials, skills, and prices.

Batako (lime-cement blocks) and **burned clay bricks** are the most common lining materials.

Bamboo matting can be used for circular pits if these are not located under a public footpath. It is very cheap but coating of the matting with bitumen is required to extend its durability.

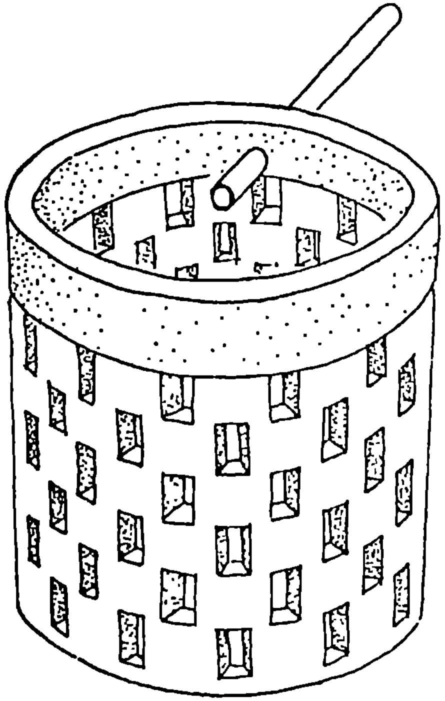
Punctured rings of pre-cast concrete or burned-clay are more expensive than the other alternatives mentioned. Consider this alternative only where high groundwater, also in the dry season, hampers digging and lining of the pit. In that case the pre-fabricated liners can be sunk as the pit is dug.

- Ascertain from Design step 8 (p 36, 38 or 40):

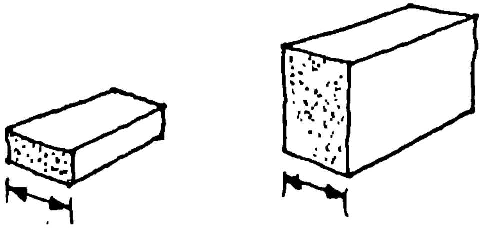
Top ring surface area .... m2. (for 2 pits)

Pit lining surface area to top ring .... m2.
(for 2 pits)

If you planned a combined pit, add the surface area of the dividing wall to the top ring surface area.



PIT LINING: top ring



Blocks can be laid on edge to save money.

The top ring is 10 cm thick and made of bricks or blocks. To calculate the number of bricks:

- Fill in the top ring surface area (m2)

note: for bamboo lined pits, increase the surface area by 0.4 m2, because the top ring diameter is 20 cm larger than the pit diameter.

- Fill in the brick length and height (m)

TOP RING

$$\frac{\ldots\ldots \text{ m2}}{(\ldots\ldots + 0.01\text{ m}) \times (\ldots\ldots + 0.01\text{ m})} = \ldots\ldots \text{ bricks}$$

length height

To calculate the quantity of cement and sand, you first calculate the quantity of mortar per brick:

length height width

(... m + ... m) x ... m x 0.01 m = ... m3 mortar

- Fill in the quantity of mortar per brick and the number of bricks

note: cement - sand mix to be used is 1 : 6; if lime will be used, double the quantity of cement.

TOP RING

mortar per brick		number of bricks		
...... m3	x	....	x 1/7 =	..... m3 cement
...... m3	x	....	x 6/7 =	..... m3 sand

Plastering the top ring

To calculate the quantity of cement and sand to plaster the inside and outside of the top ring:

- Fill in the top ring surface area (m2)

TOP RING

..... x 2 x 0.004 m3 = ... m3 cement

..... x 2 x 0.1 m3 = ... m3 sand

PIT LINING: below the top ring

Bricks and blocks

A brickwork pit lining is 10 cm thick. To calculate the number of bricks to be used:

- Fill in the pit lining surface to the top ring
- Fill in the brick length and height (m)

PIT LINING
to the top ring

.... m2
(.... + 0.1 m) x (.... + 0.01 m) = ... bricks
length height

To calculate the quantity of cement and sand, reduce the brick length by 0.1 m (openings!) and calculate the quantity of mortar per brick.

length height width

(... m + ... m) x ... m x 0.01 m = ... m3 mortar

- Fill in the quantity of mortar per brick and the number of bricks

note: cement - sand mix to be used is 1 : 6; if lime will be used, double the quantity of cement.

mortar per brick · number of bricks · PIT LINING to the top ring

.... x .... x 1/7 = ... m3 cement

.... x .... x 6/7 = ... m3 sand

PIT LINING: bamboo

To calculate the amount of bitumen required to preserve the bamboo matting:

- Fill in the pit lining surface area to the top ring (m2)

bitumen per m2 · PIT LINING to the top ring

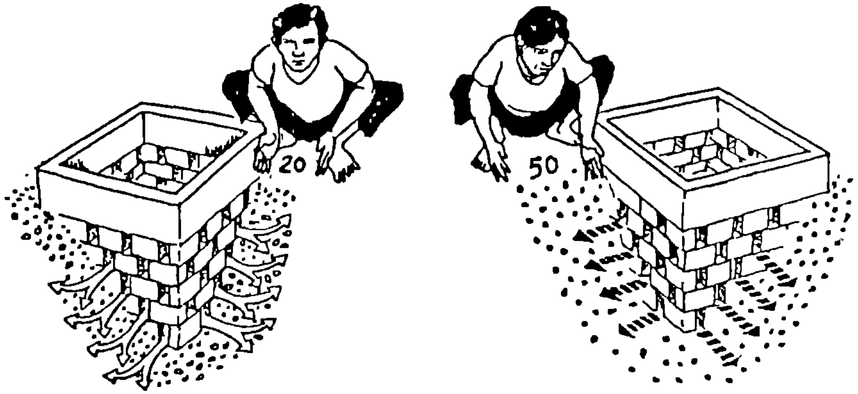
.... x .... kg = ... kg bitumen

3. BACKFILL + TRENCHES

As explained in Design step 6 (p 26) all pits are planned to have a backfill, either a 20 cm leaching backfill or a 50 cm filter backfill.

Suitable leaching backfill materials are gravel and coarse sand.

Suitable filter backfill material is sand-loam mix.



- Ascertain from Design step 8 (p 36, 38 or 40):

The leaching surface area with 20 cm backfill and fill in this figure ...

BACKFILL

... for a 20 cm backfill: ________ ..... m2 x 0.36 m = ... m3 gravel

... for a 50 cm backfill: ________ ..... m2 x 1.08 m = ... m3 sand-loam

If trenches are planned:

TRENCHES

- Fill in the total length of trenches (m) ________ ...... x 0.06 m3 = ... m3 gravel
(see Design step 6, p 27)

4. PIPES

The pipes can be made of any anti-corrosive material. A smooth inner surface is important. Most commonly used are PVC, burned-clay (glazed inside), and asbestos cement. The inner diameter of the pipes should be between 7.5 and 10 cm.

Buy maximum pipe lengths to reduce the number of joints. It is the joints which can cause blockages. Do not use short pipes (like burned-clay pipes) if a pipe run is more than 5 meters.

If pipes are not available, a covered drain can be built instead using concrete and bricks, but only if the pits are located within the boundaries of the plot. A switch box is not necessary with a covered drain.

- **Measure** the distance between:

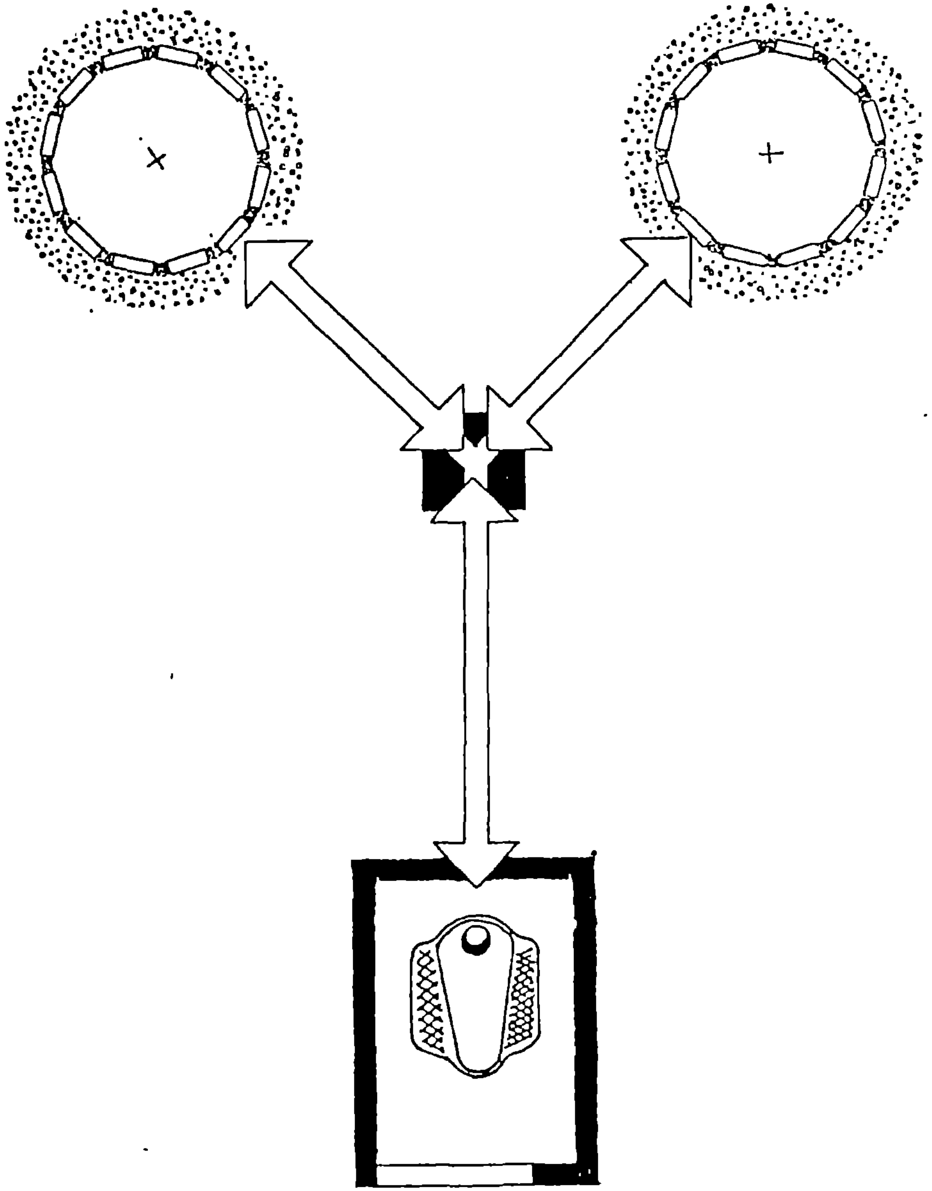
1. pit 1 and the switch box: .... m

2. pit 2 and the switch box: .... m

3. switch box and toilet : .... m

add an extra : 0.50 m

TOTAL LENGTH :...... m



5. SWITCH BOX

The switch box can be a solid piece of concrete. The quantities of materials are the same for all designs and are already included in the final calculation.

In stead of solid concrete, the box can be masoned with blocks or bricks.

You can use a brick, embedded in a weak mortar, to seal the pipe inlet. You can also use a length of inner tube, with one end fixed over the pipe coming from the toilet pan and the other end inserted into the pipe inlet leading to a leaching pit.

Rodding points require the same quantity of materials as a switch box.

6. TOILET PAN + WATERSEAL TRAP

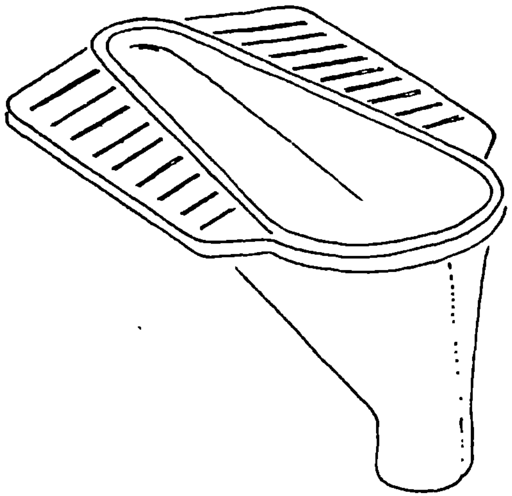
Toilet pans can be made of concrete, but it is difficult to achieve a smooth finish on these. In addition, they get rough and unattractive after some time due to the action of urid acid. Glazed ceramic and fiberglass pans retain a smooth surface, even after years of use, are easier to keep clean and need less water for flushing. Fiberglass pans are light and do not break easily during transport. They get their strength by being embedded in the concrete of the toilet floor.

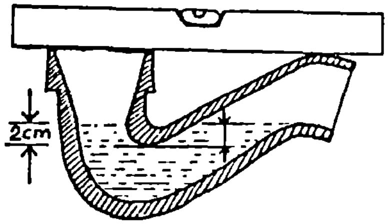
THE WATERSEAL TRAP can be made of concrete, but fiberglass, and ceramic traps have a smoother finish. The trap should be robust to withstand rodding in the event of blockage.

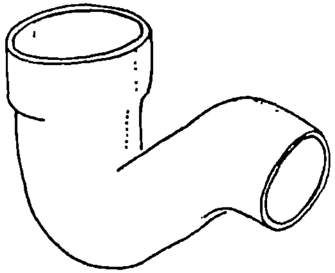
When you buy a trap, check the waterseal with a spirit level. The optimal depth of the waterseal is about 20 mm. Without a waterseal bad smells from the pit will enter the toilet room.

There are pans available which incorporate a trap. However, a separate trap can be fixed to the pan with the outlet pointing in any direction. This gives greater flexibility in locating the toilet and the pits.

The toilet pan introduced by the UNDP project INS/81/002 has a steeper slope than regular pans, does not foul easy and needs less water for flushing. Minimizing the amount of flushing water is particularly important if pits are located in poorly leaching soils, such as clay.







7. FOUNDATION

The toilet room foundation is normally 40 cm deep and can be made of rocks, blocks or bricks. To calculate the number of bricks to be used:

- Fill in the length of foundation (m)
- Fill in the brick length and height (m)

FOUNDATION

..... m x 0.4 m

(.... + 0.01 m) x (.... + 0.01 m) = ... bricks

length height

To calculate the quantity of cement and sand, you first calculate the quantity of mortar per brick:

length height width

(... m + ... m) x ... m x 0.01 m = ... m3 mortar

- Fill in the quantity of mortar per brick and the number of bricks

mortar per brick	number of bricks	FOUNDATION
..... m3 x	......	x 1/7 = ... m3 cement
..... m3 x	......	x 6/7 = ... m3 sand

note: cement - sand mix to be used is 1 : 6; if lime will be used, double the quantity of cement.

8. FLOOR

A toilet floor made of concrete is impervious, durable, and is easy to keep clean. A concrete floor is 10 cm thick.

- Calculate the floor area (inner length) x (inner width) and fill in this figure (m2)

quantity/m2	FLOOR
..... x 0.25	= ...... m3 cement
..... x 1.25	= ...... m3 sand
..... x 2.50	= ...... m3 gravel

9. WALLS

The walls can be built from a wide variety of materials. Possible materials are:
- batako blocks,
- burned clay bricks,
- sun dried bricks,
- wood or bamboo structure with wood boards or bamboo matting.

note: Use readily available materials which you can afford. Traditional materials for walls and roofs may require more regular maintenance but the cost of repairs will probably pose less of a financial burden than using more expensive materials.

Three walls should be 180-200 cm high, the fourth wall about 20 cm higher to create a sloping roof. To reduce the costs it is possible to divide the wall into two parts:
- a lower part about 1.50 m high using blocks to provide privacy;
- an upper part, using bamboo matting, or kept open; you can always fill in this part at a later date.

If you plan to use bricks or blocks, calculate the wall area to be built with bricks.

WALLS

- Fill in the wall area (m2) —— m2
- Fill in the brick length and height (m) —— (.... + 0.01 m) x (.... + 0.01 m) =..... bricks

length height

To calculate the quantity of cement and sand, you first calculate the quantity of mortar per brick:

length height width

(... m + ... m) x ... m x 0.01 m = ... m3 mortar

- Fill in the quantity of mortar per brick and the number of bricks

mortar per brick		number of bricks	WALLS
...... m3	x	.... x 1/7 =	..... m3 cement
...... m3	x	.... x 6/7 =	..... m3 sand

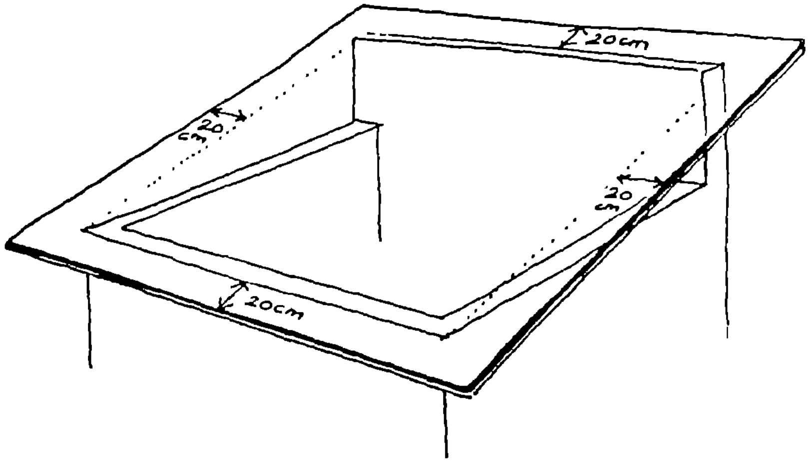
10. ROOF

The roof gives protection against rain and prevents rainwater entering the toilet pan.

A wide variety of materials are possible for the roof. Commonly-used materials are:
- corrugated iron sheets,
- asbestos cement sheets,
- bamboo strips with palm thatch,
- roofing tiles,
- transparent corrugated plastic sheets; these have the particular advantage of allowing daylight to enter.

Most roofing materials, such as roofing tiles, and sheets with small corrugation, require **purlins** for support.

The roof should have an **overhang of 20 cm** on all sides to prevent rain entering via the ventilation openings and entrance.



length width ROOF

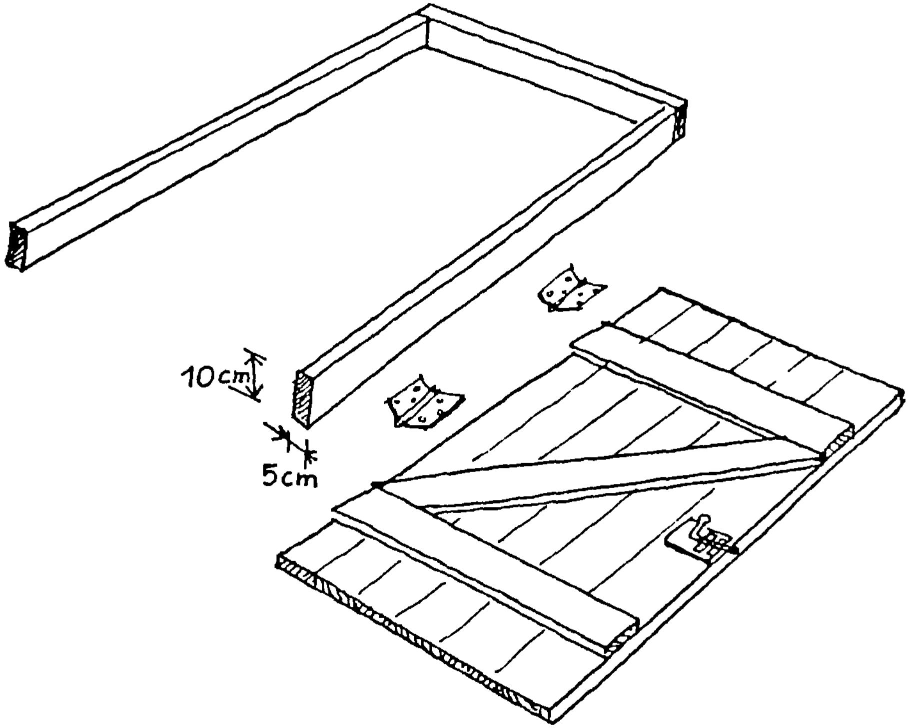
- **Fill in the length and width of the roof** —— (...... + 0.2) m x (...... + 0.2) m = ... m2

MISCELLANEOUS ITEMS

- Door; the door may have an air gap at the bottom to allow for ventilation.
- Door frame (5 x 10 cm)
- Hinges
- Latch

- Materials for a screen if no door is planned

- Materials for a water container for anal cleansing and bathing



The required quantities for each item can be filled in on the next page and added together.

leaching pits	number of bricks	cement	sand	gravel	sand-loam
pit covers		....	....	....	
pit lining	....	....	....	....	
top ring	....	....	....	....	
backfill/trenches					....
switch box		0.02	0.03	0.04	
rodding points	(.......)	(.......)	(.......)	(.......)	
	+	+	+	+	+
sub-structure TOTAL	...... no	...... m3	...... m3	...... m3	...... m3

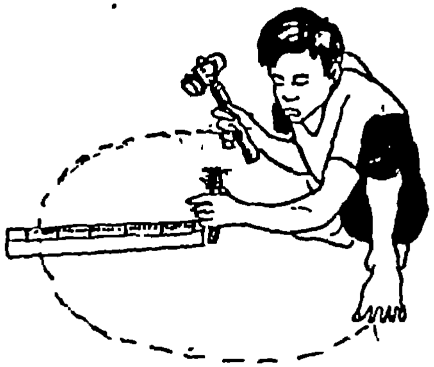
Toilet room	number of bricks	cement	sand	gravel
foundation	....	....	....	
floor		....	....	....
walls	....	....	....	
	+	+	+	+
super-structure TOTAL	...... no	...... m3	...... m3	...... m3

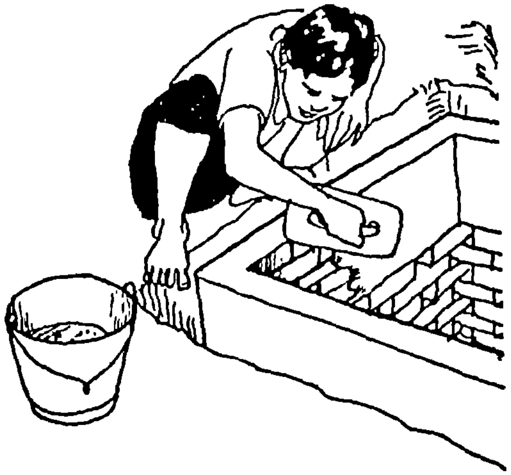
& add 10% for losses

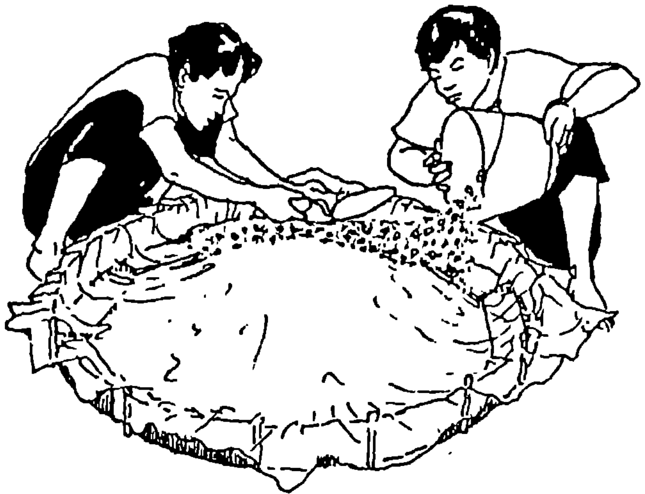
TOOLS

Before you begin the construction, ensure you possess or have access to the necessary tools. The kind of tools you need partly depends on the building materials chosen. In any case you need:

- tape measure
- wooden pegs
- hammer
- string
- spade
- spirit level
- trowel + float
- carry bags
- bucket







SUB-STRUCTURE

bricks no ..... @ Rp .... - Rp ....

cement bags* ... @ - .... - - ....

sand m3 ..... @ - .... - - ....

gravel m3 ..... @ - .... - - ....

reinforcing bars (Ø 6 mm) ...... - - ....

backfill m3 ...... @ - .... - - ....

** sub-total 2 pits Rp. ....

pipes m1 ..... @ - .... - - ....

waterseal trap .... - - ....

toilet pan .... - - ....

+

SUB-STRUCTURE TOTAL Rp. ....

SUPER-STRUCTURE

bricks no ..... @ Rp .... - Rp ....

cement bags* ... @ - .... - - ....

sand m3 ..... @ - .... - - ....

gravel m3 ..... @ - .... - - ....

walls m2 ..... @ - .... - - ....

m2 ..... @ - .... - - ....

.. .. @ - .... - - ....

door + door frame .... - - ....

roofing m2 ..... @ - .... - - ....

purlins m ..... @ - .... - - ....

+

SUPER-STRUCTURE TOTAL Rp. ....

* A bag of cement contains 40 kg.=0.03 m3

** If you plan to postpone the construction of the second pit, divide this figure by 2 to estimate the materials cost of 1 pit.

LEACHING PITS

step 1: CONSTRUCTING THE PIT COVERS

step 2: MARKING AND EXCAVATING THE PITS

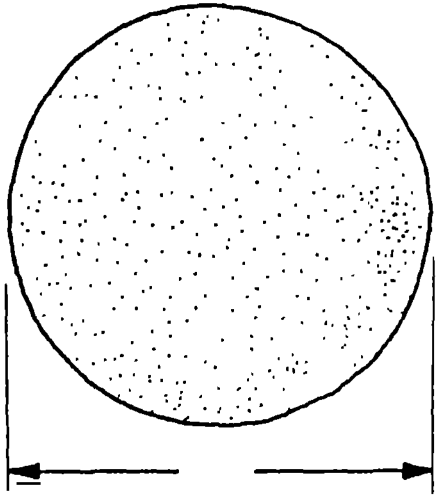
step 3: LINING THE PIT WALLS

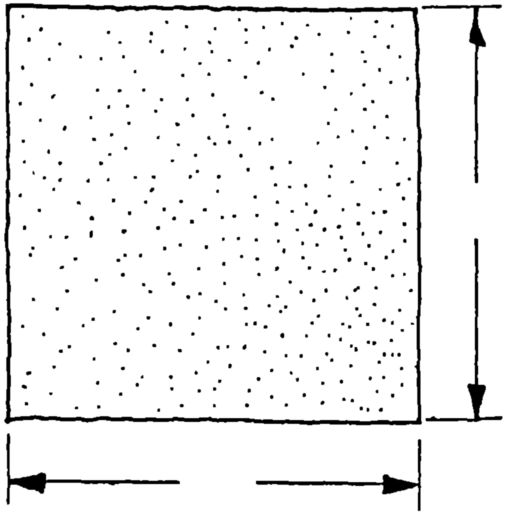
CONSTRUCTION OF THE LEACHING PITS

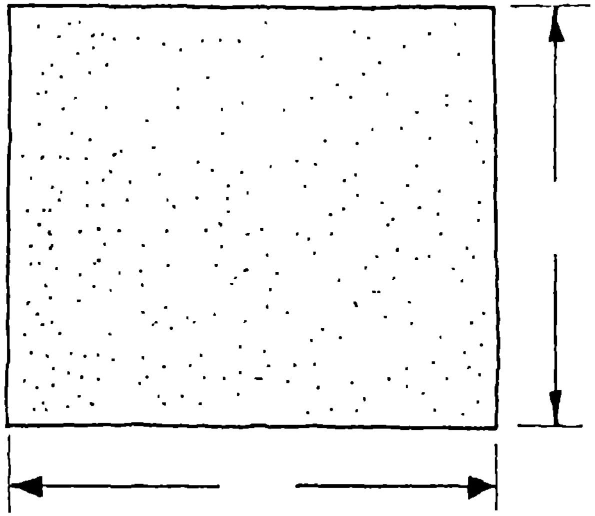
The leaching pits are the core of the TLP-toilet system. Although they will not be visible, follow carefully the instructions and your technical drawing (Design step 8) to ensure the pits will not need further attention.

The construction begins with making the concrete pit covers. The instructions on preparing concrete explain how you make a safe and durable pit cover. Most important is to use the least amount of water that still gives you a workable concrete mix.

While the covers are hardening, the pits are dug and lined.







step 1: CONSTRUCTING THE PIT COVERS

MAKING THE FORMWORK

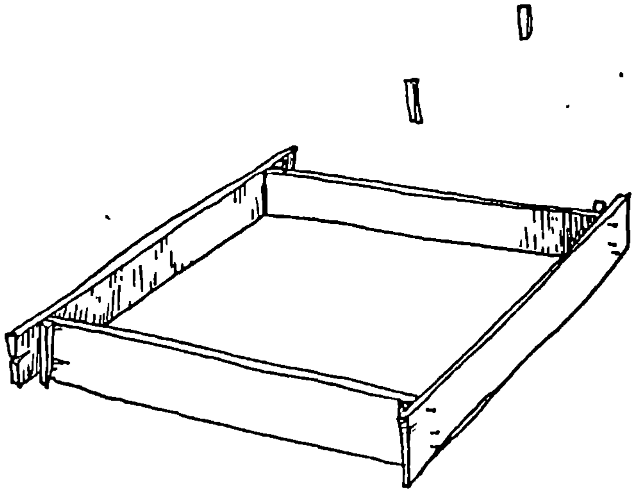
Fill in the dimensions of the pit cover (or sections) in the drawing above. (see Design step 8, page 37, 39 or 41)

If you plan to use non-reinforced dome shaped covers, divide the cover plate into sections if the diameter of a circular cover, or the length of a rectangular cover exceeds 150 cm.

You may divide a large pit cover to make it easier to lift it up. Concrete weighs 2400 kg/m3; e.g. a cover 0 120 cm and 10 cm thick weighs 270 kg!

1. Choose a shady, level place which will not interfere with other other construction activities.

The next page,
on the left: square/rectangular pit covers,
on the right: circular pit covers.



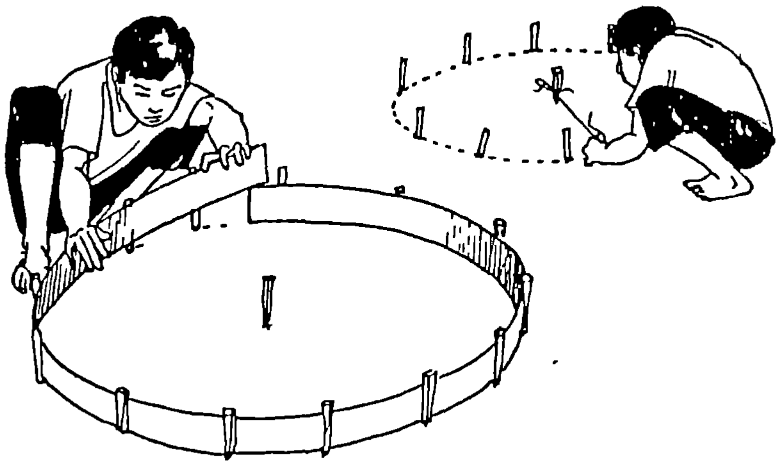
Rectangular pit covers:

2. Mark the corners with wooden pegs.

3. Use stiff, straight boards for the form, 5 cm high for a dome shaped cover, 10 cm high for a reinforced cover.

4. Place the boards outside the pegs and nail the boards together. Do not drive the nails all the way in to make it easier to remove the boards.

5. Remove the pegs and secure the formwork at the outside with enough pegs to prevent deformation. Set the pegs below the formwork to make screeing easier.



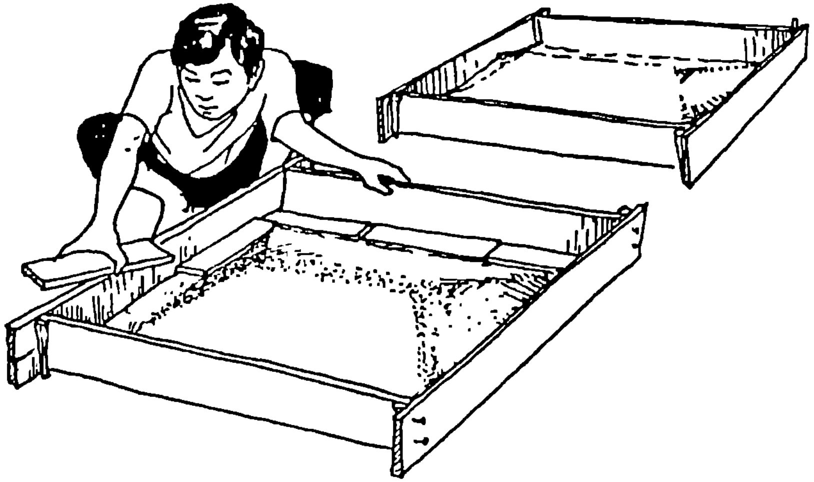
Circular pit covers:

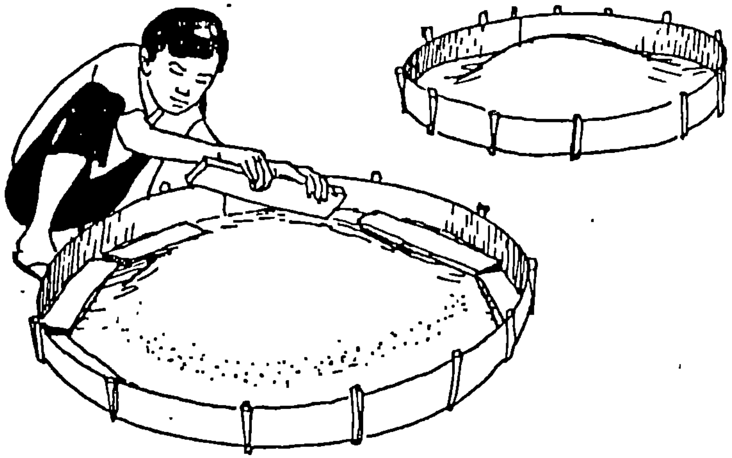
2. Mark the centre of the cover with a wooden peg and fix a cord half the length of the cover diameter to the central peg.

3. Trace the circle and mark the cover perimeter with pegs well secured into the ground. Use enough pegs so the perimeter is well defined.

4. Use flexible wooden strips (e.g. triplex) for the formwork, 5 cm high for a dome shaped cover, 10 cm high for a reinforced cover.

5. Place the strips at the inside of the pegs. Set the pegs below the form to make screeing easier.





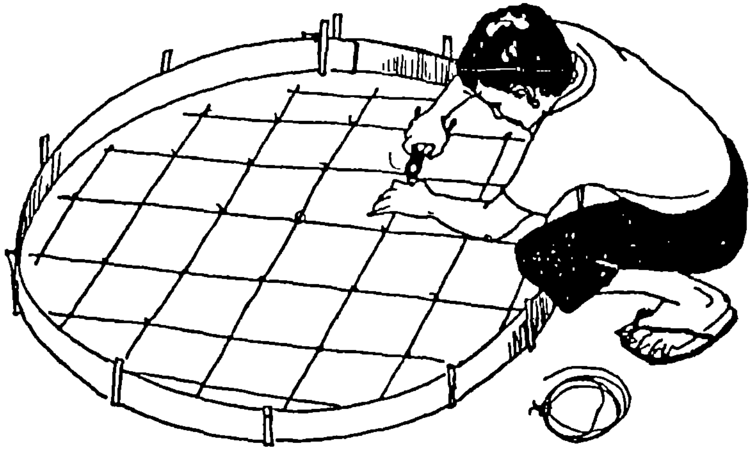
If you had chosen reinforced covers, continue with the next page 'preparing reinforcing bars'.

Making the dome

1. Form a dome with tamped earth sloping gently away to the edge of the formwork until level with the surrounding earth.

The dome should be 10 - 15 cm high at the centre; a square/rectangular dome has a ridge along the length.

2. Lay wooden strips along the formwork where the cover will be placed on the pit lining to ensure a smooth surface for sealing.



Preparing reinforcing bars (re-bars)

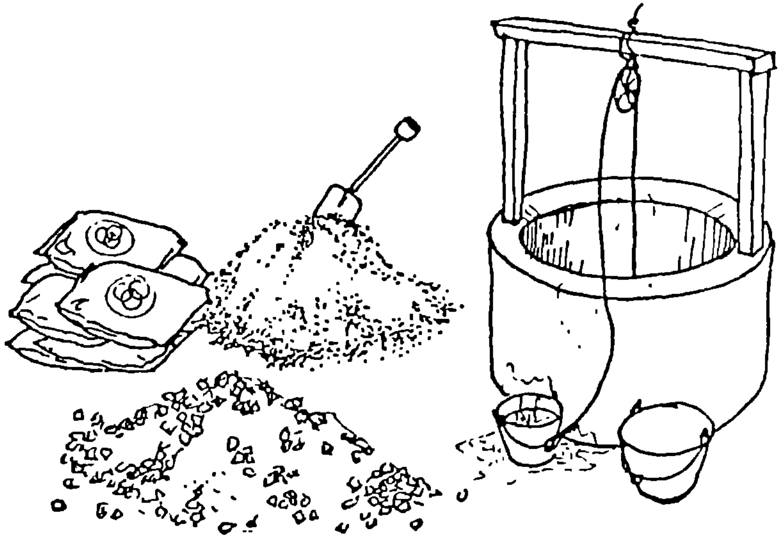
1. Brush the re-bars with a stiff wire brush so they are clean and free of loose scales and rust.

2. Assemble the re-bars inside the formwork to ensure a good fit.

3. Arrange the re-bars in a straight and square grid pattern of 15 cm; leave a gap of about 3 cm between the formwork and re-bars.

4. Tie all intersections with thin whire.

5. To increase the length of a re-bar, you can tie two re-bars onto another with an overlap of at least 15 cm.



PREPARING THE CONCRETE

Before you begin make sure that:

- the cement is a free-flowing powder. Do not use cement containing lumps that cannot be pulverized between thumb and finger. A few lumps can be removed.

- the sand and gravel are clean: free from loam, clay and vegetable matter. The size of gravel should not exceed 1/3 of the cover thickness.

- the water is clean: free from oil, alkali or acid. Water fit to drink is suitable to use.

The **water : cement ratio** controls the strength, durability and watertightness of the concrete. Keeping the volume of water to the minimum required will assure good quality concrete.

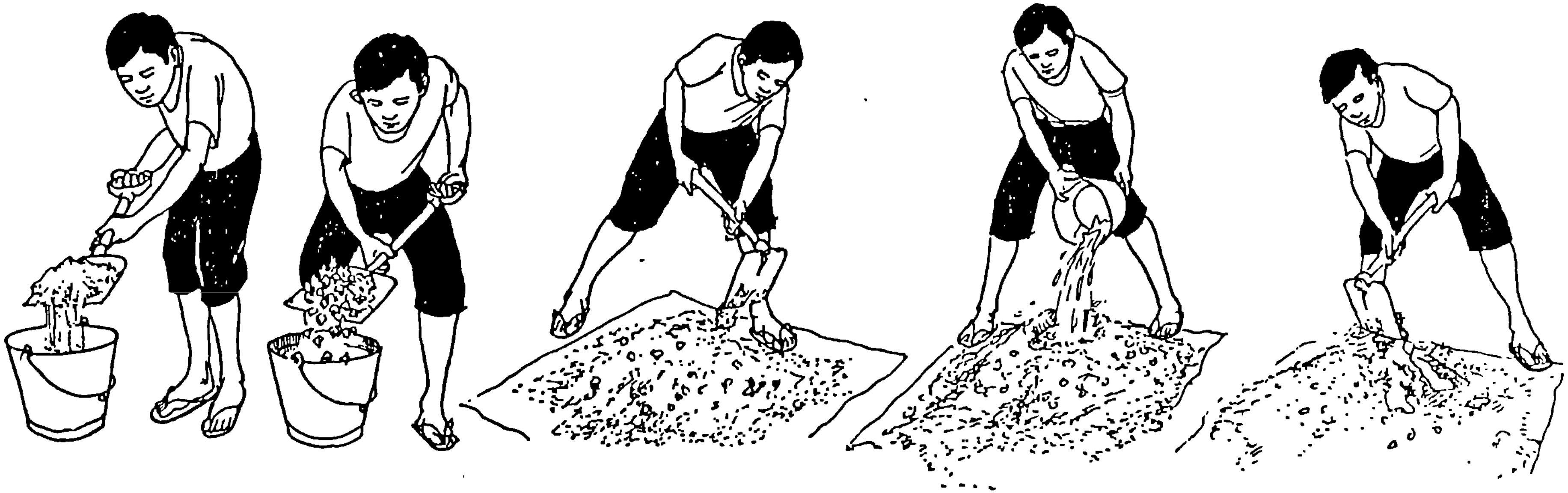
Most sand contains a surprising amount of water. To add the correct amount of water to the mix, do a simple test.

Press some sand together in your hand and open it again:

- if it falls apart and does not leave moisture on your hand, the sand is **damp:**
  - **use 3 buckets of water to 4 buckets of cement.**
- if it forms a ball holding its shape and leaves a little moisture on your hand, the sand is **wet:**
  - **use 2.5 buckets of water to 4 buckets of cement.**
- if it sparkles and wets your hand, the sand is **very wet:**
  - **use 2 buckets of water to 4 buckets of cement.**

Write down the **water : cement ratio** .. : 4.

note: the quantity of cement, sand and gravel can be ascertained from 'Materials', page 61.



MIXING THE CONCRETE

1. Prepare a mixing slab with a clean, watertight surface. You can use a plastic sheet, or a wooden board.

2. Measure the required amounts of cement, sand, gravel and water. Use the same bucket to get the right proportions.

3. Spread the measured amount of sand on the slab and spread the cement evenly over it.

4. Mix the two materials thoroughly with a shovel until they are a uniform colour.

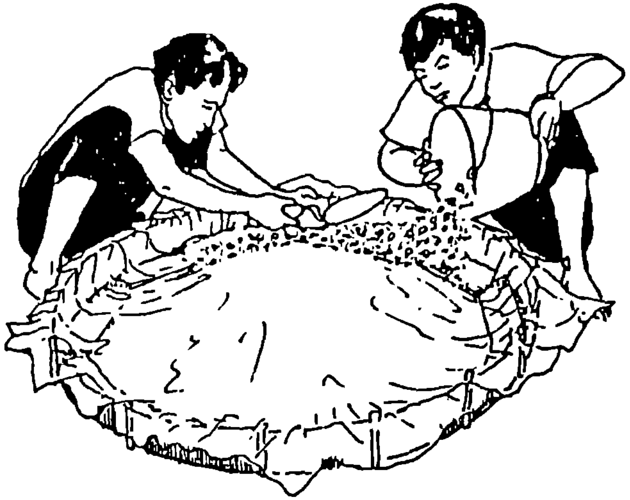
5. Spread this mix out evenly and spread the gravel on it. Mix thoroughly again.

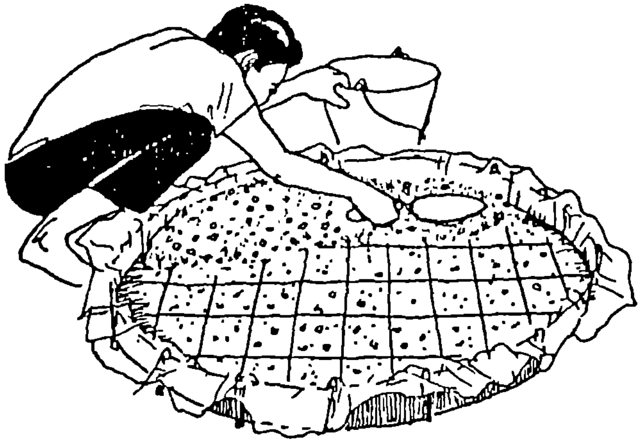
6. Form a hollow in the material and slowly add the measured quantity of water, mixing after each addition.

7. Continue mixing until cement paste completely covers every particle of the gravel.

8. The mix should be smooth and plastic. Neither so wet that it runs, nor so stiff that it crumbles. If the mix is too wet, add small amounts of sand and gravel in proper proportion (2:3).

9. Pour the wet concrete into the formwork immediately after mixing. Do not let it stand.





POURING THE CONCRETE INTO THE FORMWORK

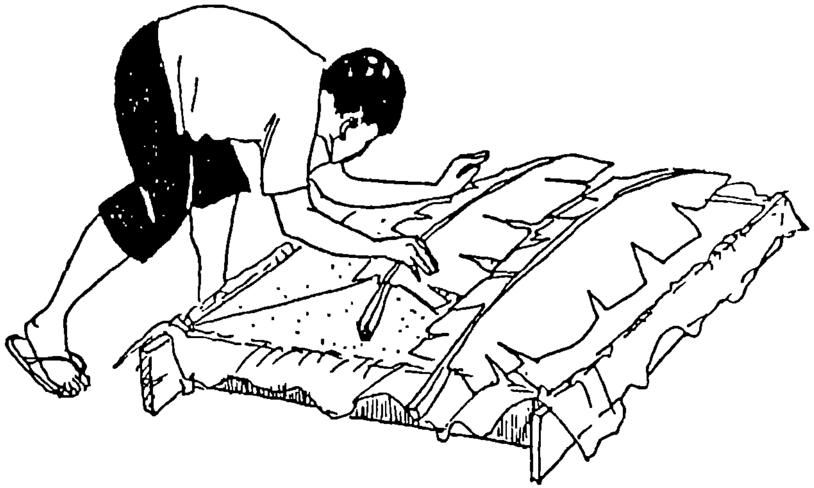
1. Lay sheets of plastic or paper (e.g cement bags) in the formwork and over the edges to ease the removal of the formwork after curing.

2. Pour the mix evenly around the formwork where it is to be used. Do not drop it from a heigth greater than one meter as it may spoil the mix.

3. Work the mix into place and make sure the concrete fills completely in against the form. Concrete that flows out on its own is too wet and therefore weak.

4. Compact the concrete with a thin bar so there will be no air holes, which would leave weak spots in the concrete.

If reinforcement is used: after a first layer of about 3 cm, position the reinforcement and continue with pouring the rest of the concrete.



5. Once the concrete begins to harden slightly, finish the surface with a wooden float to give a somewhat rough texture. This will prevent a smooth, slippery surface.

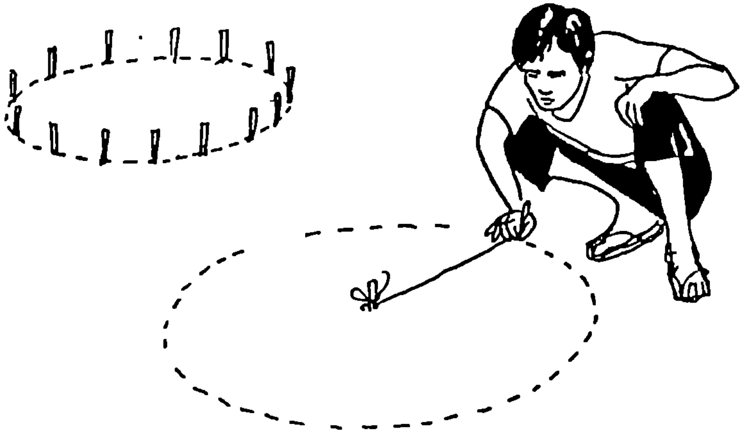
CURING OF THE CONCRETE

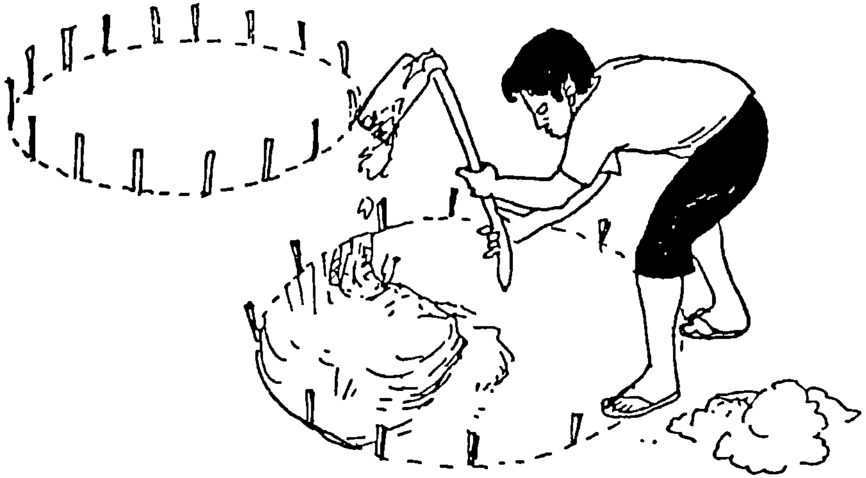
The curing period must be at least 7 days. Keep the concrete continuously damp and shaded during this period. Once the concrete dries it will stop hardening.

1. Cover the concrete with e.g. empty cement bags, burlap, plastic, palm or banana leaves, or sand.

2. Keep the covering wet so it will not absorb water from the concrete.

While the covers are hardening, the pits can be dug and lined.





step 2: MARKING AND EXCAVATING THE PITS

Marking

1. Determine the location of the pits, using a measuring tape. Peg out the dimensions, including the backfill.

2. Mark the inlet of the pipe leading to the switch box.

3. Clear the area of any vegetation that might hinder the excavation.

4. Run a string or chalk ground-line between the pegs.

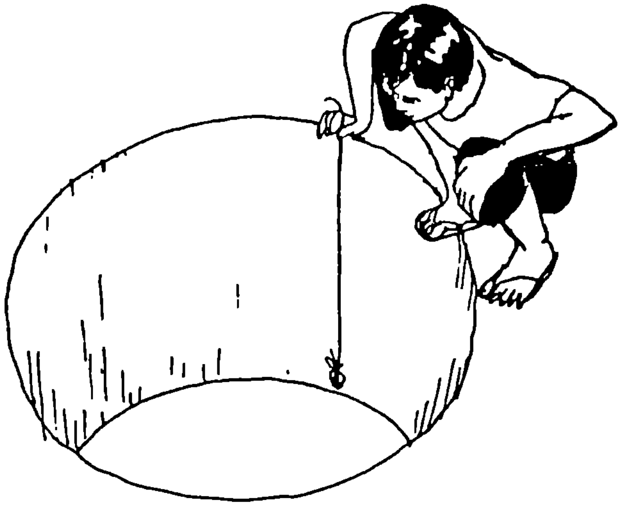
Excavating

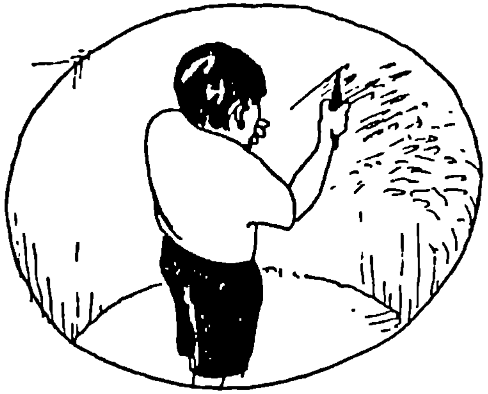
1. Before you begin digging, double check the dimension and the location of the pit: distance to the nearest well, foundations and toilet room.

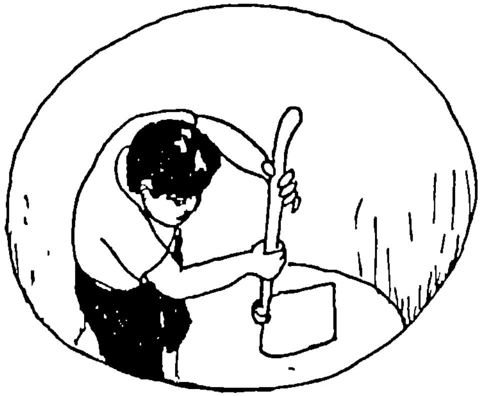
2. Excavate the pits as defined by the pegs.

3. Remove the earth well away from the pits. Also keep tools and other objects away from the edge of the pit.

4. Pits might cave in, especially while you are getting in or out of the pit. Something to step on (e.g. a box) will make it easier to get out of the pit without damaging the pit walls.







5. Look out for old root channels. They could endanger the well drinking water supply. Choose another location or ask advice from the local building information centre.

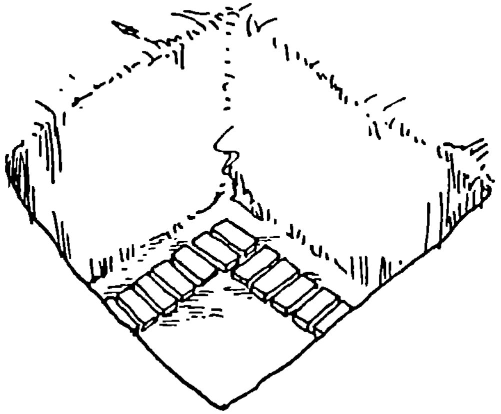
6. While digging, compare the soil type and colour with the soil and groundwater data on which you based the pit design.(see Design step 10, page 51) Make adjustments if necessary.

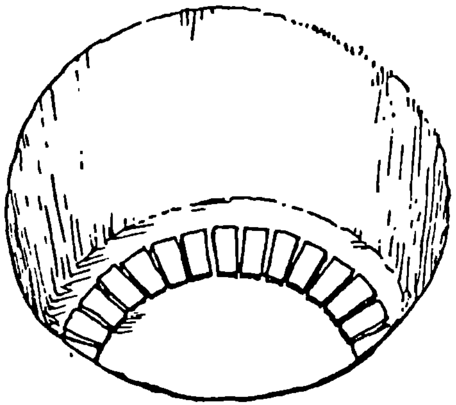
7. When the required depth has been reached, ensure the pit has the correct size and the walls are vertical, using a string and pebble.

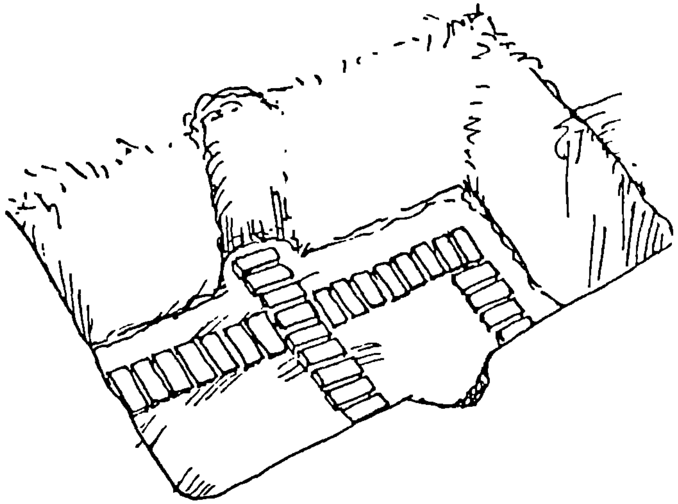
8. Scratch the sides of the excavated pit with a sharp stick to expose a natural soil surface. Clay soils in particular easily get a smeared or polished finish from the action of the shovel which reduces the leaching capacity of the soil.

9. Tamp the earth of the bottom of the pit and form a level foundation for the lining.

note: Cover the pit (e.g. with wooden boards and plastic) when you stop working to prevent accidents and to keep the pit dry.







step 3: LINING THE PIT WALLS

If you have chosen a bamboo pit lining, continue with page 91; bamboo lined pits do not need a foundation.

Foundation

1. Ensure a level, firm base for the foundation.

2. Peg out the lining on the bottom of the pit: 20 cm or 50 cm from the pit wall, depending on the backfill used.

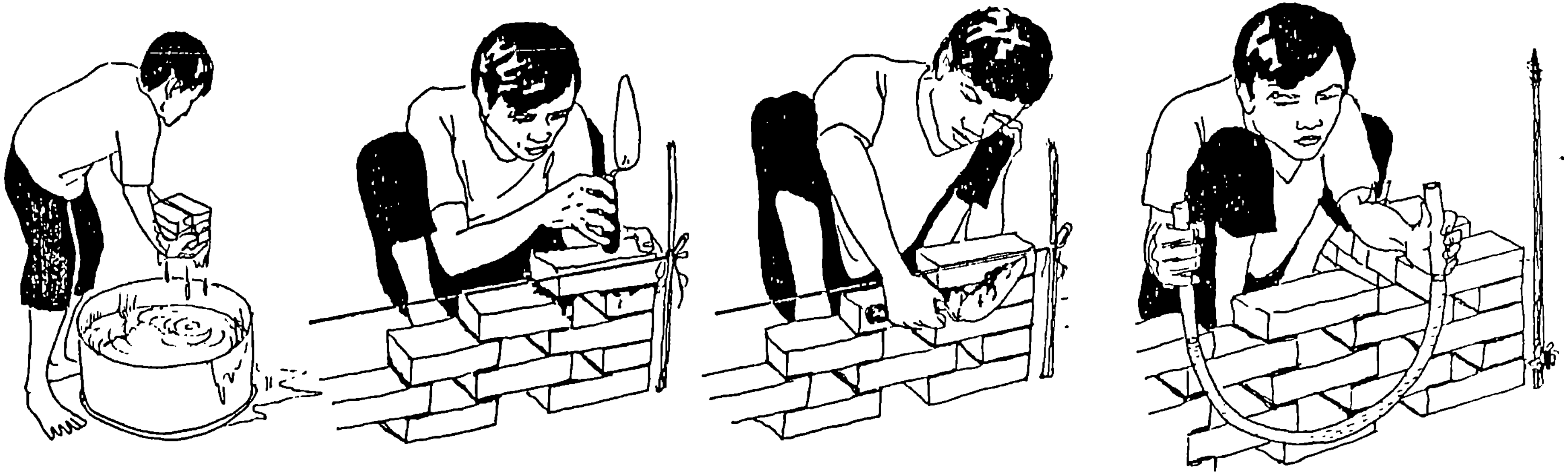
3. Lay the first course of bricks loosely without mortar, spaced with regular joints of one cm.

4. Prepare the mortar with a volume ratio of: cement-sand 1:6 or lime-sand 1:3.

5. Check that the bricks are level, using a spirit level.

6. Mortar the vertical joints and the foundation is ready.

note: You prepare mortar the same way as concrete, except you do not add gravel to the mix. Keep the volume of water to a minimium and use clean ingredients in the correct proportion. It might be good to read again the instructions on concrete.



Bricklaying is a precise craft.

1. Brush moss and dust from the bricks using a moist brush.

2. Dip porous bricks in water for about 2 minutes and immediately after this, use the brick.

3. For rectangular pits, begin laying bricks at the corners working up to a few (4 to 5) courses. Then you have extreme points between which you can stretch a line to give alignment and height for the in-between bricks.

4. Throw a mortar bed for one brick and spread it evenly out covering the surface of the brick(s).

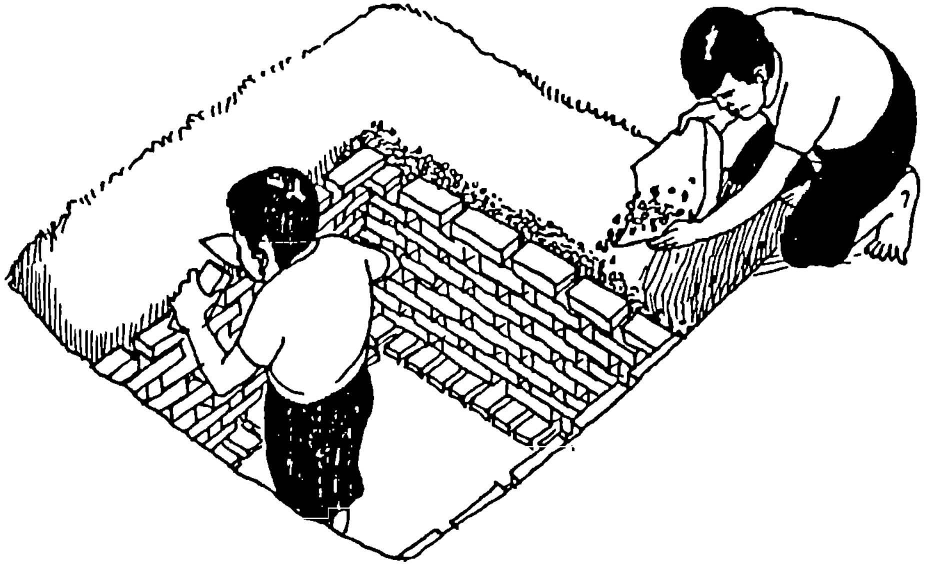
The overlap with the lower course should be at least 1/4 of the brick length. The joints should be about 1 cm thick.

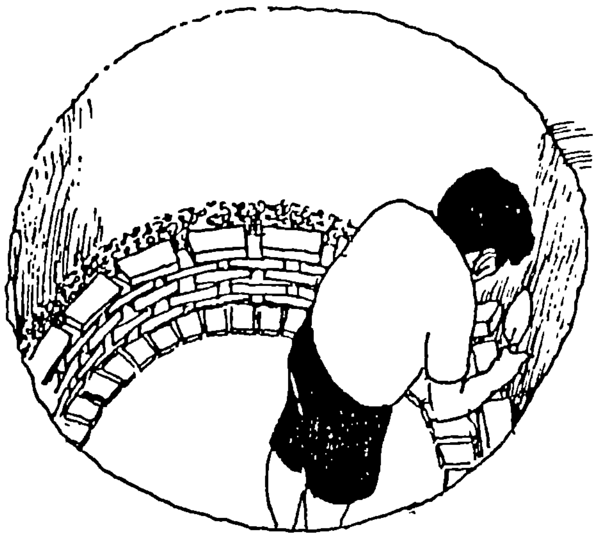
5. Position the brick with a slight pressure downwards and tap it once with the handle end of the trowel. Do not hit heavily to get the brick in line, you will weaken the bond.

6. Cut off excess mortar to a flush joint.

7. Do not disturb a brick after it is laid in final position. It will break the bond between the brick and the mortar.

8. Work carefully to ensure strong brickwork:
- keep joints uniform (about 1 cm)
- check regularly that the brickwork is plumb and level using a spirit level.





Lining to the top ring

1. Lay the next courses of bricks, each brick overlapping the joints of the lower course.

Blocks are laid on edge (to save on blocks) as long as the pit lining is about 10 cm thick.

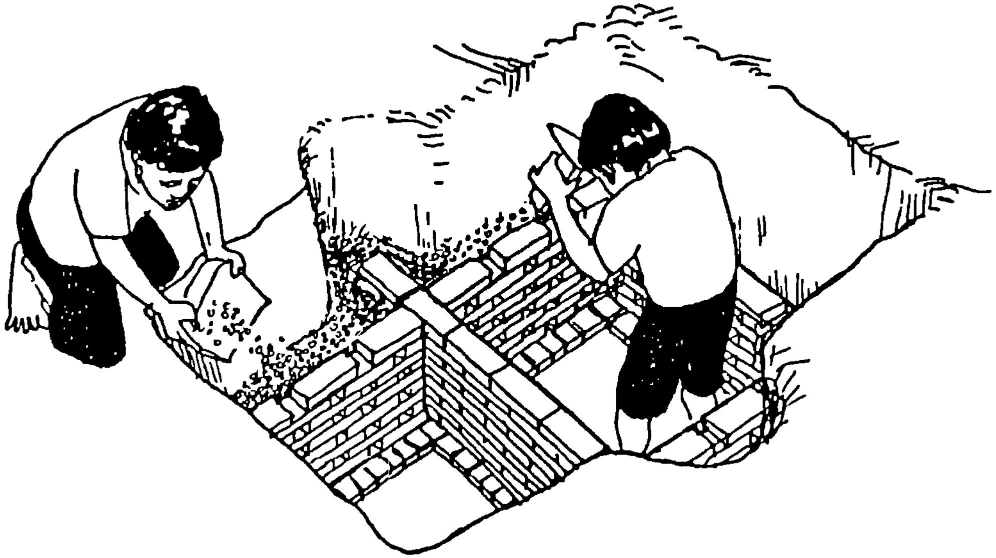
2. Leave all vertical joints open; the width of the openings is 5 - 10 cm. But the overlap of a brick with the lower course should be at least 1/4 of the brick length.

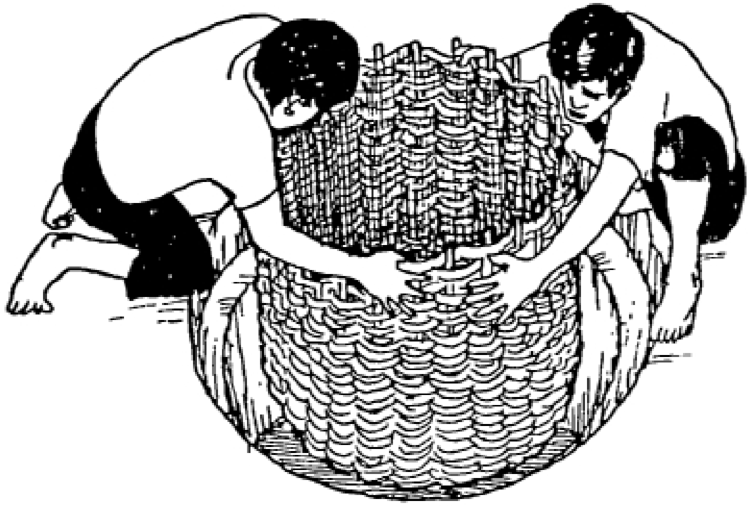
If the pit is near the foundation of a building, reduce the width of the openings nearest to the building to a maximum of 1 cm.

3. As the lining is built up, insert the backfill loosely compacted between the brickwork and the edge of the excavation.

4. Check regularly that the brickwork is plumb and level.

When you have reached the inlet level of the pipe, the top ring can be laid.





For combined pits, follow the procedure as described for separate pits. In addition:

1. Key the bricks of the dividing wall into the perimeter wall.

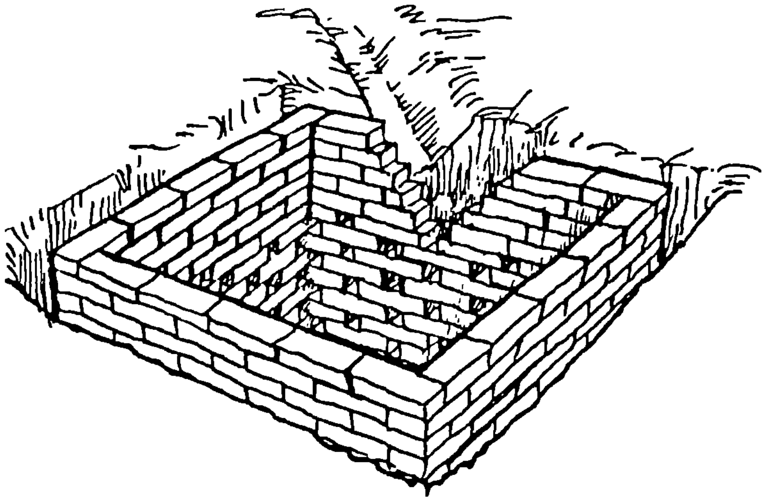
2. Mortar the vertical joints in the dividing wall; these joints are reduced to normal width.

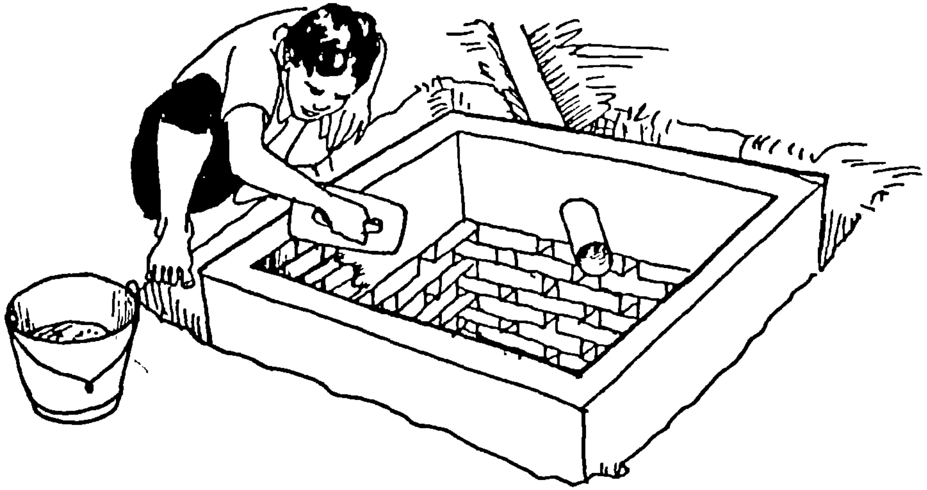
3. Insert compacted clay or a cement stabilized soil mix (1:10) at both ends of the dividing wall to separate the backfill of the two compartments.

Bamboo lined pit walls.

1. Coat both sides of the bamboo matting with bitumen.

2. Place the bamboo cilinder and insert the backfill loosely compacted between the bamboo matting and the edge of the excavation.





Top ring

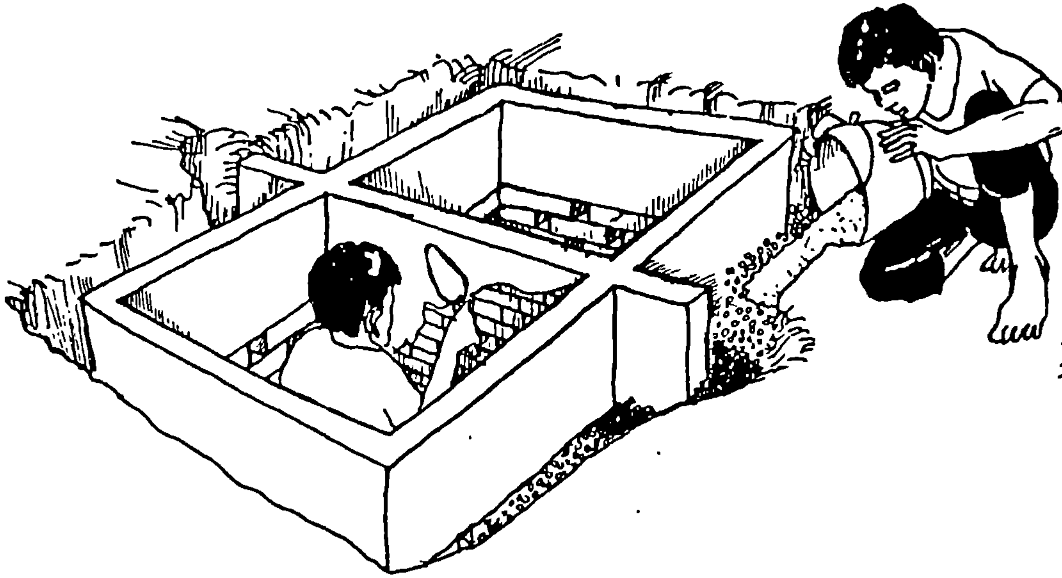
All pit linings, also bamboo lined pits, need a solid top ring of about 30 - 40 cm high. Again, use a cement-sand mix (1:6) or a lime-sand mix (1:3).

1. Reduce the vertical joints of the next courses to normal width and seal them throughout.

2. Leave space for the inlet pipe.

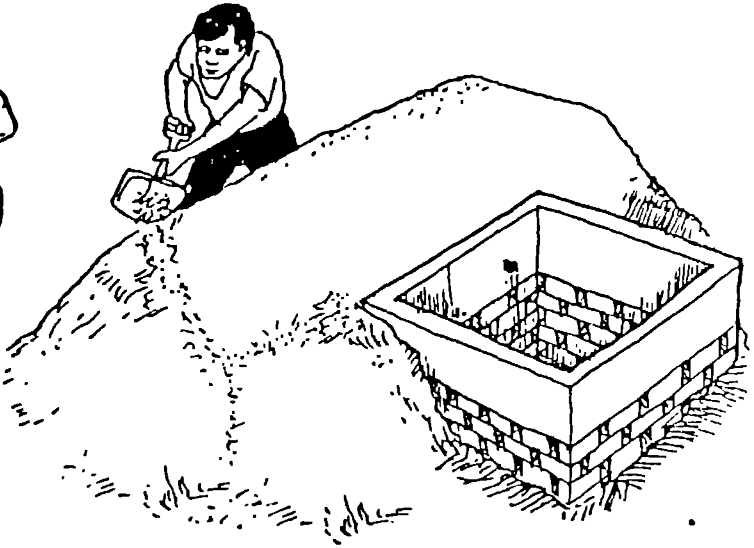
3. Plaster the top courses to make them watertight. Use a cement-sand mix (4:1).

4. Plaster the top of the ring to ensure a good fit with the pit cover.



In the case of combined pits, also plaster the dividing wall.

In the case of raised pits, enclose the pit lining with an earth wall 150 cm around.



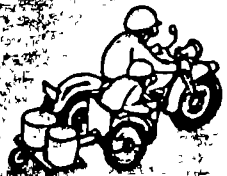
5. Insert backfill around the top ring. You can use compacted clay or a cement stabilized soil mix in the proportion of 1:10. This is to prevent rainwater entering the pit via the backfill.

LEACHING PITS

step 1: CONSTRUCTING THE PIT COVERS

step 2: MARKING AND EXCAVATING THE PITS

step 3: LINING THE PIT WALLS



PIT - TOILET PAN

step 4: EXCAVATING THE CONNECTIONS

step 5: CONSTRUCTING THE SWITCH BOX

step 6: CONSTRUCTING THE TOILET FOUNDATION

step 7: CONNNECTING THE PIPES AND TRAP

step 8: FINISHING THE PITS

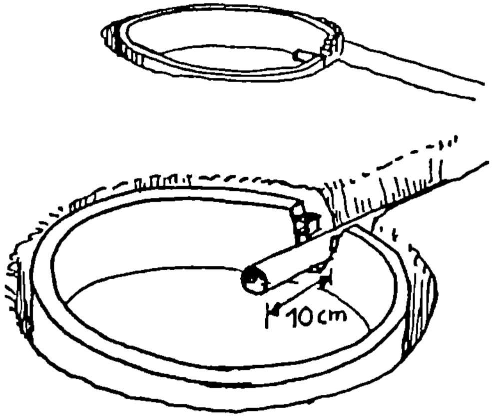
step 9: FINISHING THE SWITCH BOX

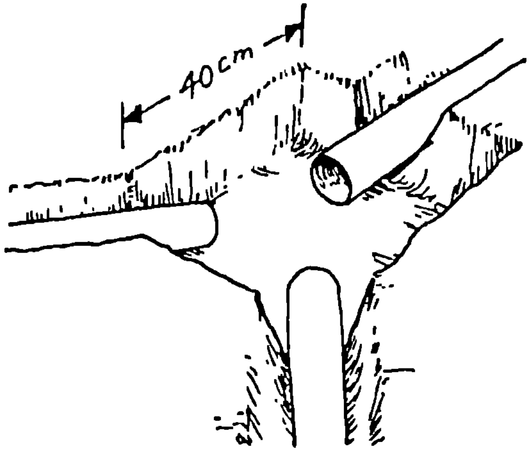
step 10: CONSTRUCTING THE TOILET FLOOR

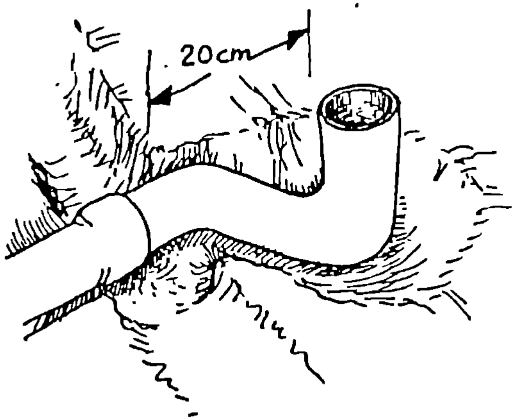
CONSTRUCTION OF PIT TO TOILET PAN CONNECTION

A carefully constructed connection between the toilet pan and the leaching pits will reduce the risk of blockage and saves you the trouble of subsequent clearing.

Cover the pits temporarily with wooden boards and plastic to prevent accidents and to keep the pits dry.







step 4: EXCAVATING THE CONNECTIONS

1. Peg the position of the switch box and toilet pan, using a measuring tape.

2. Excavate pipe trenches with a minimum slope of 1:50 (i.e. 2 cm per meter) going up from the pit inlets, via the switch box position, to the toilet pan location.

3. Dig a hole 40 x 40 x 40 cm where the switch box has been marked. Where the pipe trenches make sharp curves, dig holes for the construction of rodding points.

3. Remove sharp objects, such as stones, from the bedding of the trenches.

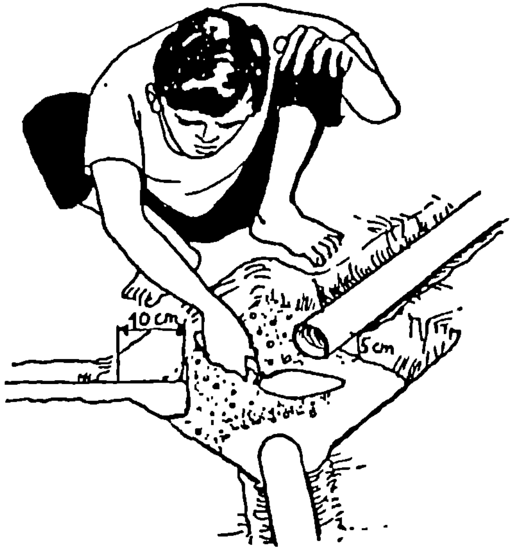
4. Lay the pipes and trap provisionally in the correct position:

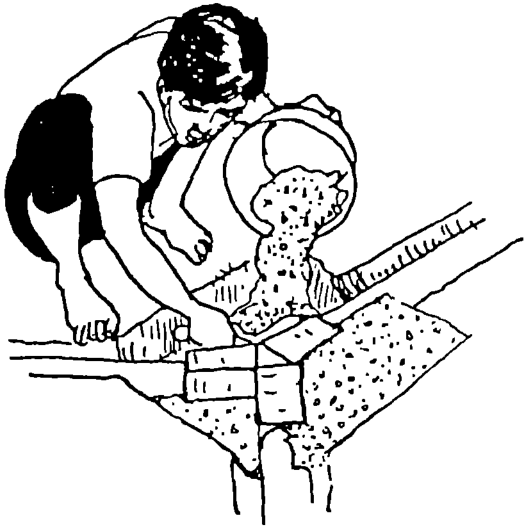
- with a slope of at least 1:50,

- the pipe inlet to the pit projecting at least 10 cm into the pit,

- the pipe inlets to the switch box projecting about 10 cm into the hole,

- the waterseal trap is at least 20 cm away from the inside of the toilet wall.





step 5: CONSTRUCTING THE SWITCH BOX

The switch box is a solid piece of concrete connecting the pipes with open trenches. The trenches are formed with three blocks inserted before pouring the concrete. The blocks are removed after curing.

The construction of **rodding points** is similar to the construction of the switch box.

1. Ensure that: the depth of the hole is at least 5 cm deeper than the bottom of the pipes; the pipes project about 10 cm inside the hole for the switch box; the distance between the pipes is enough to place the three blocks.

2. Pour a layer of concrete (1:2:4) in the hole until it is flush with the bottom of the pipes.

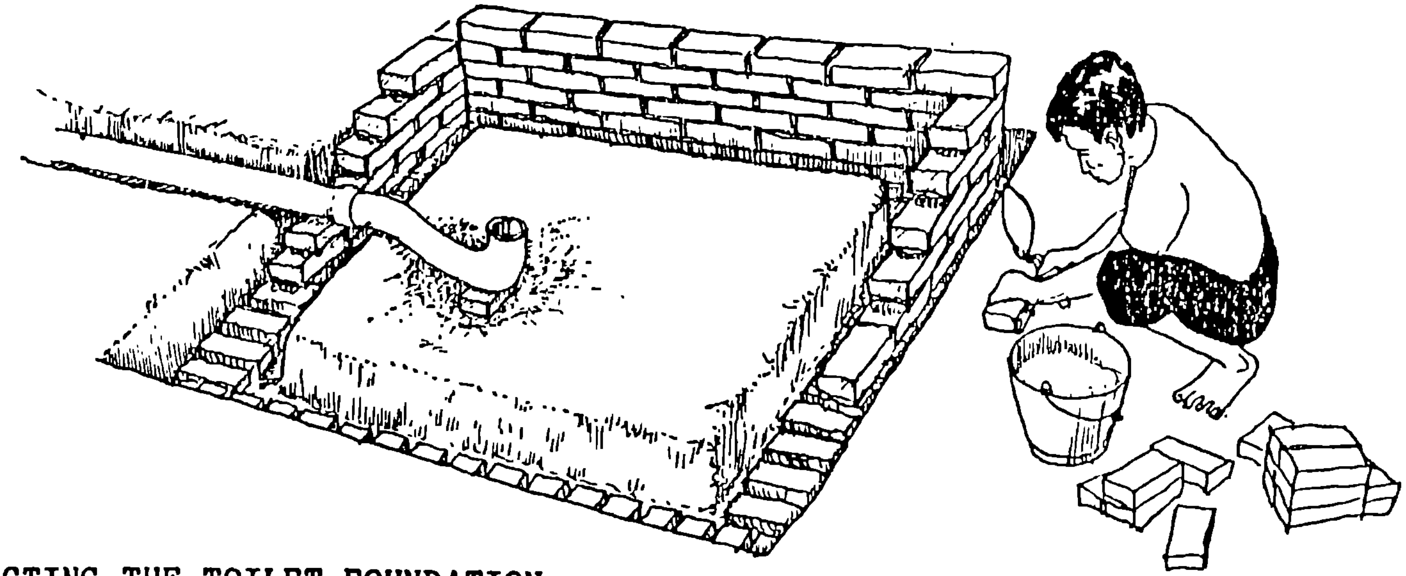
3. Take 3 blocks equal in size to the diameter of the pipe or slightly larger. Wrap the blocks in plastic or paper.

4. Position each block in the direction of a pipe, blocking the inlet so concrete cannot enter.

5. Fill up the hole with concrete until being level with the top of the blocks.

6. Prepare a formwork for the cover of the switch box, and fill it with concrete. You may also use a tile as cover.

While the switch box is curing, you can make the toilet foundation, mortar the pipes and place the pit covers.



step 6: CONSTRUCTING THE TOILET FOUNDATION

1. Peg out the toilet room foundation and excavate a trench about 40 cm wide and 40 cm below the proposed toilet floor level.

2. Tamp the earth of the bottom of the trench to a level and firm base for the foundation.

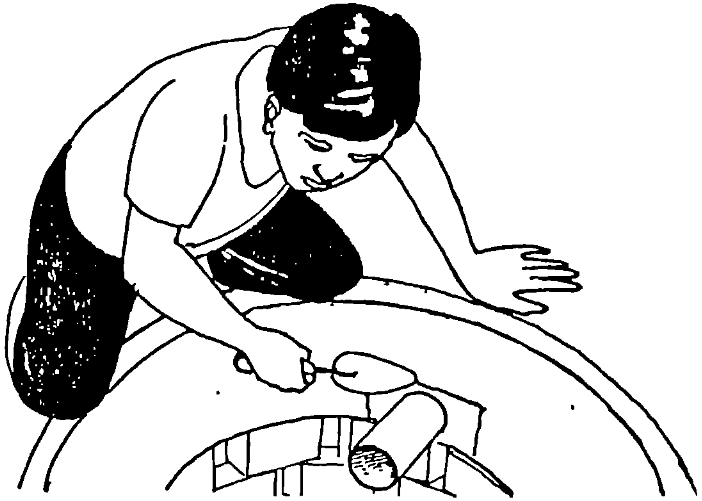
3. Lay loosely the first course of bricks, spaced with regular joints.

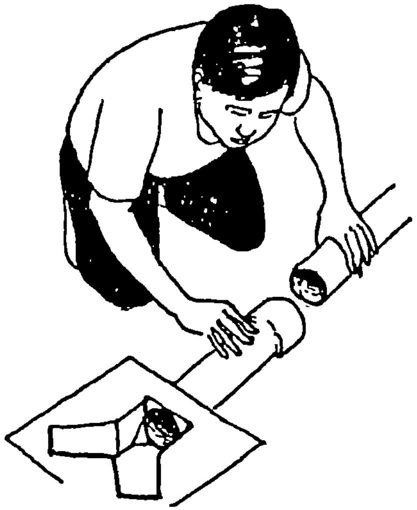
4. Ensure the bricks are level, using a spirit level.

5. Mortar the vertical joints with a cement-sand mix (1:6) or lime-sand mix (1:3).

6. Mortar the next courses overlapping the joints of the lower course; leave space for the pipe.

7. The final course of bricks must reach at least 15 cm above ground level.





step 7:. CONNNECTING THE PIPES AND TRAP

The pipes connecting the pits with the toilet can now be fixed. Use a cement-sand mix of 1:1.

1. Mortar the joints of the pipes beginning from the switch box.

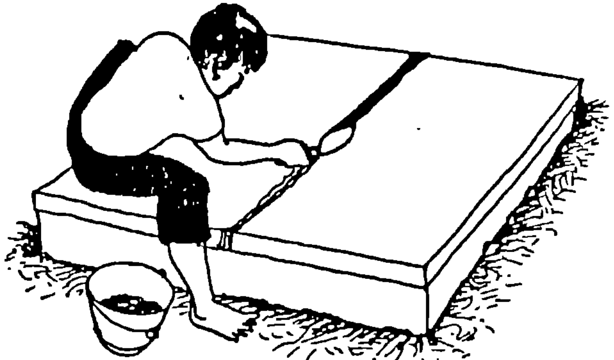
2. Mortar the pipe inlet to the pit and plaster it to make sure it is watertight and airtight.

3. Check the position of the waterseal trap:
- at least 20 cm away from the inside of the toilet wall,
- ensure a proper waterseal with a spirit level.

4. Having fixed the correct position of the trap:
- place a brick under the trap for support,
- mortar the trap to the pipe,
- embed the trap in sand or weak mortar.

5. To check all the joints: remove the blocks from the switch box, and throw a bucket of water through the trap. If there are leaks, seal the joints with extra mortar.

6. Backfill the pipe trenches, and tamp the earth firmly but gently to avoid harming the mortar seals. The backfill material should be free of stones.



step 8: FINISHING THE PITS

The formwork can be removed from the pit covers after a minimum of 7 days. A brickwork lining should have hardened for at least 3 days.

1. Remove the formwork and check the covers for cracks, exposed reinforcement, or damage to the edges.

2. Test the strength of each cover:

- place four blocks under the edge of the cover.
- check that all blocks touch the cover.
- stand on it with as many adults as possible.
- if the cover can bear this load, it is well made and can be placed.

Placing the pit covers

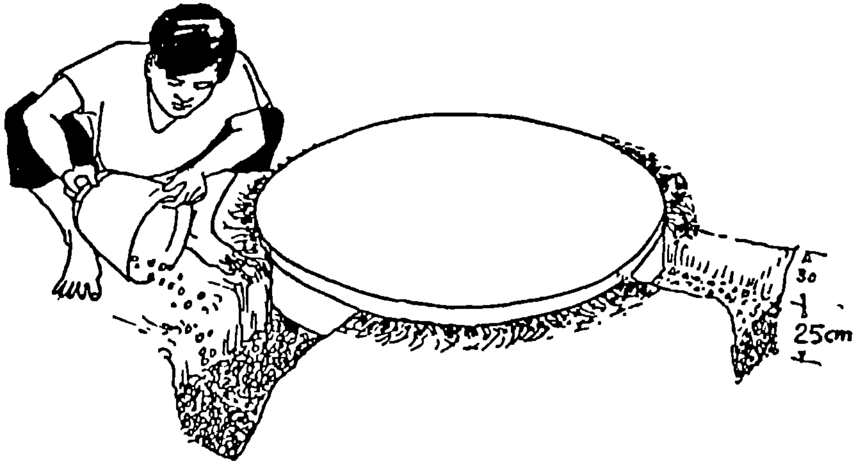
3. Remove any scrap material from the pit, such as surplus mortar.

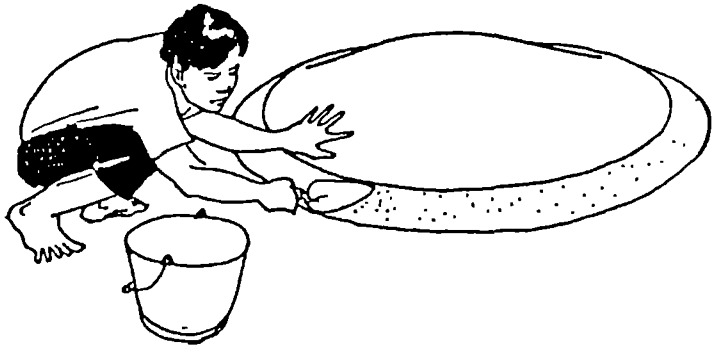
4. Brush the top ring clean of sand and dust.

5. Apply a thin layer of mortar, evenly spread out over the top ring; use a cement-sand mix (1:6) or lime-sand mix (1:3).

6. Place the cover over the pit without removing the mortar.

7. Seal the joint between pit cover and top ring and, if applicable, the joints between cover sections, to make it watertight and airtight.





If trenches are planned to provide extra leaching surface:

1. Dig trenches 25 cm wide and 25 cm below the lower edge of the top ring. The length of trenches can be ascertained from your technical drawing, Design step 8, page 37, 39 or 41.

2. Scratch the bottom and sides of the trench with a sharp stick to expose a natural soil surface.

3. Insert gravel loosely compacted up to the lower edge of the top ring.

4. Cover the gravel with building paper or plastic sheets (to prevent the topsoil moving into the gravel) and backfill the trenches with compacted clay or cement stabilized soil mix (1:10).

Finishing the top surface around the pit covers

Use a cement stabilized sand or soil mix (1:10) to finish the top surface around the pit cover. This layer is 10 cm thick and slopes away from the pit cover to prevent rain and stormwater from entering the pit.

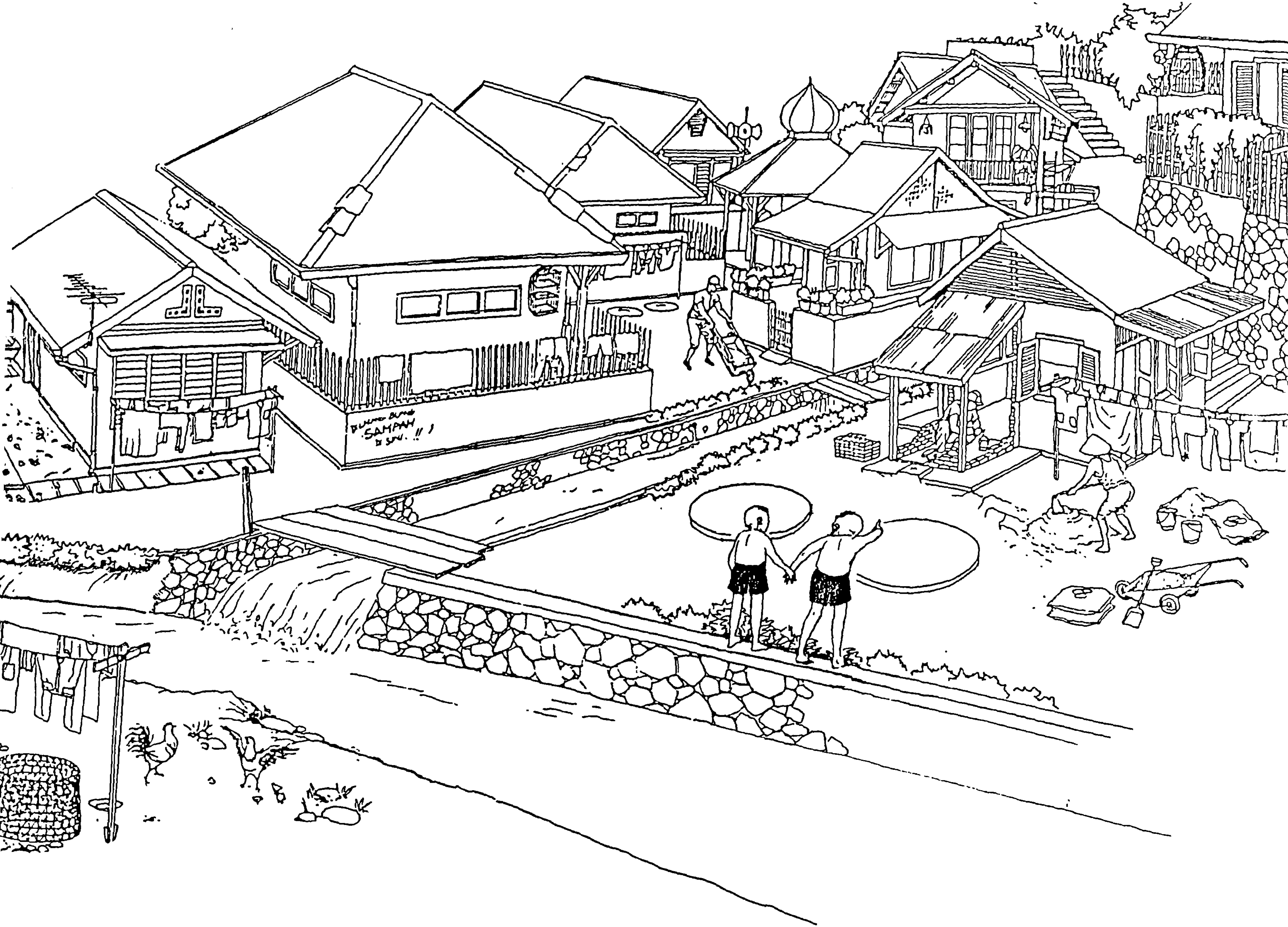
step 9: FINISHING THE SWITCH BOX

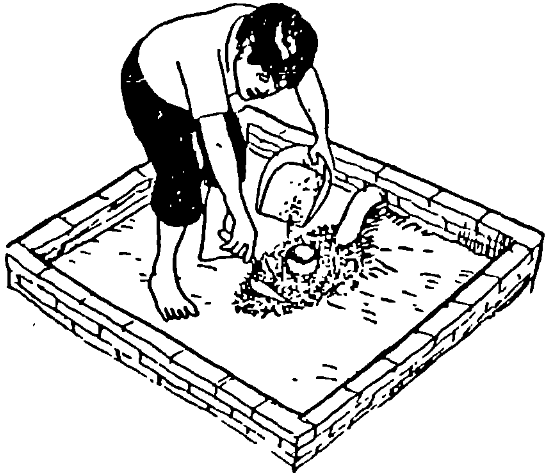
1. Plaster the inside of the box to get a smooth surface with a slight slope towards the pit.

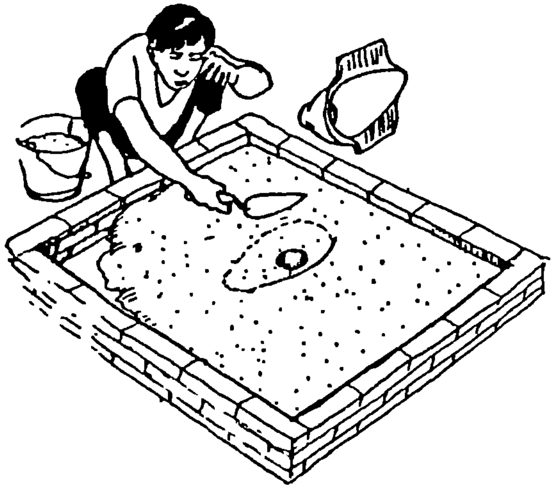
2. When the plaster is dry throw a bucket of water through the pan to check that a smooth flow occurs and no stagnant water remains in the switch box.

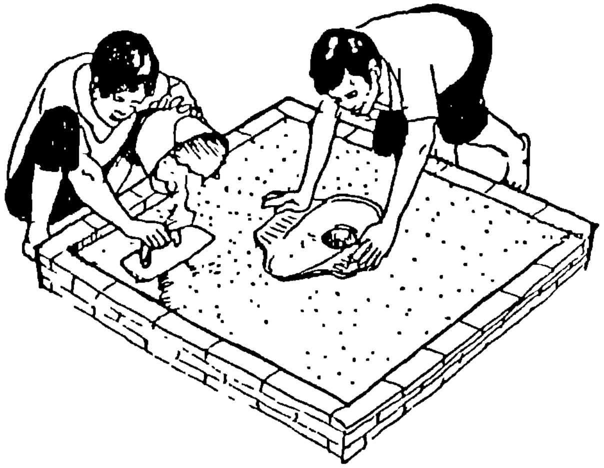
3. Seal one of the pipe inlets with a brick, embedded in a weak cement-sand mix (1:6) or lime-sand mix (1:3).

4. Mortar the cover over the switch box with a weak mortar placed all around the edge of the box. Make sure no mortar falls into the box, sealing off the pipe inlets by mistake.


Dilarang Buang
SAMPAH
Di sini. !!!







step 10: CONSTRUCTING THE TOILET FLOOR

1. Place the toilet pan provisionally into the trap. Make sure the pan fits freely into the trap and is level with the foundation.

2. Place a 10 cm backfill of sand or weak mortar under the toilet pan.

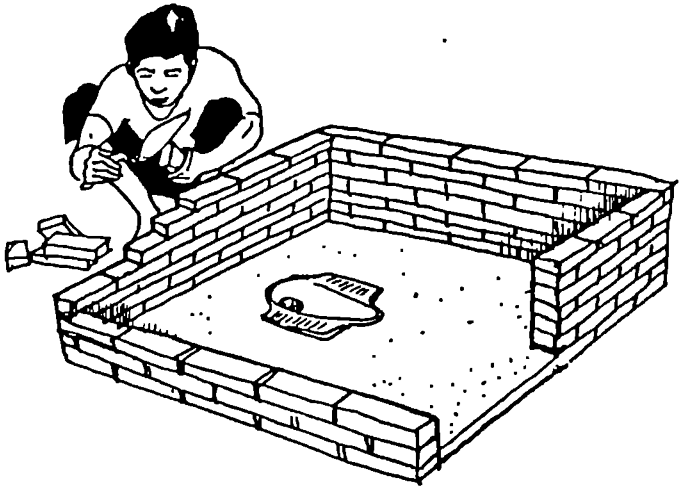
3. Pour a first layer of concrete (1:6:12) 7.5 cm thick, i.e. about 2 cm under the top of the foundation.

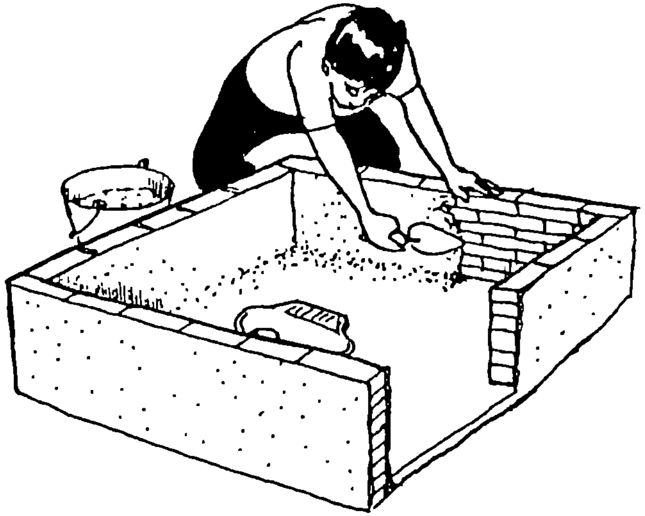
4. Pour a second layer of concrete (1:2:4) 2 cm thick and perfectly flush.

5. Apply a cement-sand mix (1:1) against the inner surface of the waterseal trap and press the toilet pan in position, firmly embedded in the backfill and the floor.

6. Check that the toilet pan is level and is flush with the floor. Finish the floor with a wooden float or brush to give the surface a slightly rough texture.

7. Leave the floor to dry out for 2 days, until all moisture has disappeared.





8. Lay a brick wall on the foundation to 40 cm above the toilet floor; leave a drainhole in the first course of the brickwork.

9. Prepare a cement-sand mix (4:1) and using a wooden or steel float, plaster:
- the exterior of the walls to protect against rain damage
- the toilet floor, with a slight slope towards the drainhole, and the interior walls to provide an easily cleaned interior.

White cement with coloured marble chips gives an attractive finish.

The toilet floor and lower walls are now ready. You can build the rest of the toilet room.