Alto Beni (D.A.B.), Bolivia

Sector: DRINKING WATER SUPPLY and SANITATION

Working Paper No. 5

TECHNICAL ASPECTS

ANNEX

by: Karl Wehrle, SKAT, St. Gallen

for: COTESU (DEH/SDC), La Paz, Bolivia

St. Gallen, May/June 1985

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Content of Annexes

List of References

[1] Manual for Rural Watersupply, SKAT bookshop No. 3403 (Manual Technico de Aprovisionamiento Rural de Agua, traducción by SEMTA, La Paz, Bolivia)

[2] Environmental Health Engineering in the Tropics: An Introductory Text by S. Cairncross and R. Feachem (John Wiley & Sons Ltd.) SKAT bookshop No. 3648

[3] "Waterlines" Periodical on appropriate technologies for water supply and sanitation (Intermediate Technology Publications Ltd., 9 King Street, London WC2E 8HW, UK)

[4] "Helping Health Workers Learn" (A book of methods, aids, and ideas for instructors at the village level) SKAT bookshop No. 8043

[5] Guidelines for planning COMMUNITY PARTICIPATION in water supply and sanitation projects by A. Whyte, WHO, CH-1211 Geneva 27, Switzerland 1983, SKAT bookshop No. 3422

[6] CEPIS, Casilla 4337, Lima 100, Perú (CEPIS de divulgación técnica: johas)

[7] Guide-lines for Checklist for the feasibility study of drinking water supply - and sanitation projects in Alto Beni Area, Bolivia (SKAT R. No. 15/84)

[8] Practical hints for limited and simplified field testing of Water in tropical rural areas (SKAT Publication)

[9] Hand dug wells and their construction by Watt + Wood (provides practical step by step guidance) SKAT bookshop No. 3201

[10] Shallow Wells, DHV (practical report encl. illustrations and drawings) SKAT bookshop No. 3202

[11] Intakes from Small Streams for Drinking Water Supply- and Irrigation-Schemes, SKAT Publication

[12] IRCWD News No. 20, Horizontal-flow Roughing Filtration: An Appropriate Pretreatment for Slow Sand Filters (IRCWD Ueberlandstrasse 133, CH-8600 Dübendorf/Switzerland)

[13] Solar Disinfection of drinking water and oral rehydration solutions: Guidelines for Household Application in Tropical Countries, Unicef Reg. Office P.O. Box 811721-Amman, SKAT Bookshop No. 2356

[14] Traditional Water Purification in Tropical Developing Countries by S.A.A. Zahn, GTZ, Postfach 5180, D-6236 Eschborn 1, Germany

[15] Kirchner: Polimeras naturales y su applicadion como ayudantes de floculacion. Serie Documentos Tecnicos 2, Centro Panamericano de Ingenieria Sanitaria y Ciences del Ambiente, Lima

[16] Water Purification using small Artesian Filters by J.F. Mazariegos, Analysis and Testroy Division Central American Research Institute for Industry ICAITI, P.O. Box 1552, Guatemala

[17] A manual on the hydraulic ram for pumping water by S. Watt, SKAT bookshop No. 3311

[18] Rain and Stormwater Harvesting in Rural Areas by United Nations Environment Programme, SKAT bookshop No. 3101

[19] La construction de citernes a G.R.E.T. publication, SKAT 3419

[20] Ferrocement Water tanks by S.B. Watt, SKAT 3400

[21] From Ferro to Bamboo (case study and technical manual), SKAT

[22] Manual for Water Systems and Pipe work by SATA, Nepal, SKAT 3404

[23] Guidelines for Drinking-Water Quality by WHO, SKAT 3205

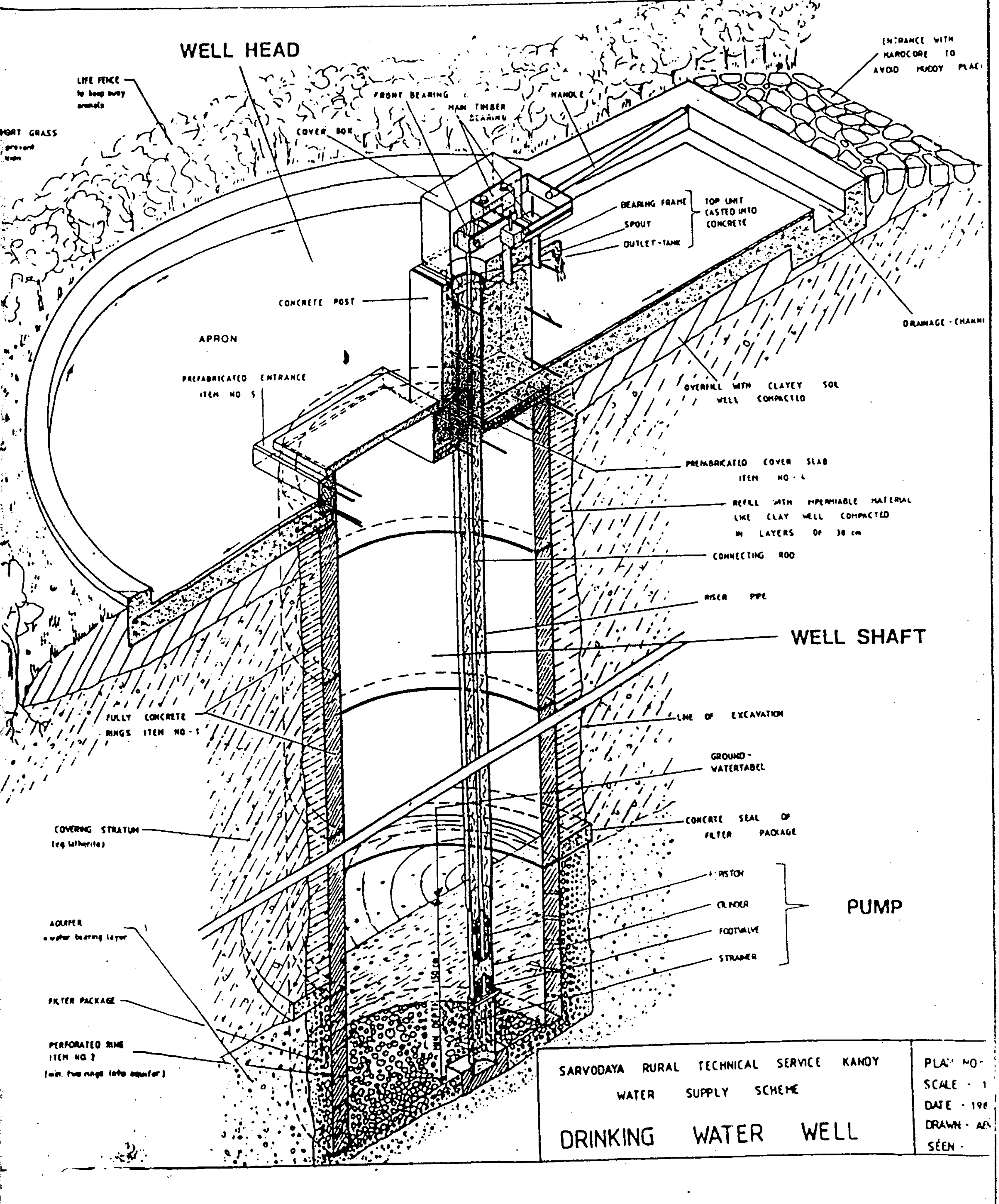
[24] Rural Watersupply - Operation and Maintenance - Eight Questions to Ask by WHO, CH-1211 Geneva 27, 1983 (15 p)

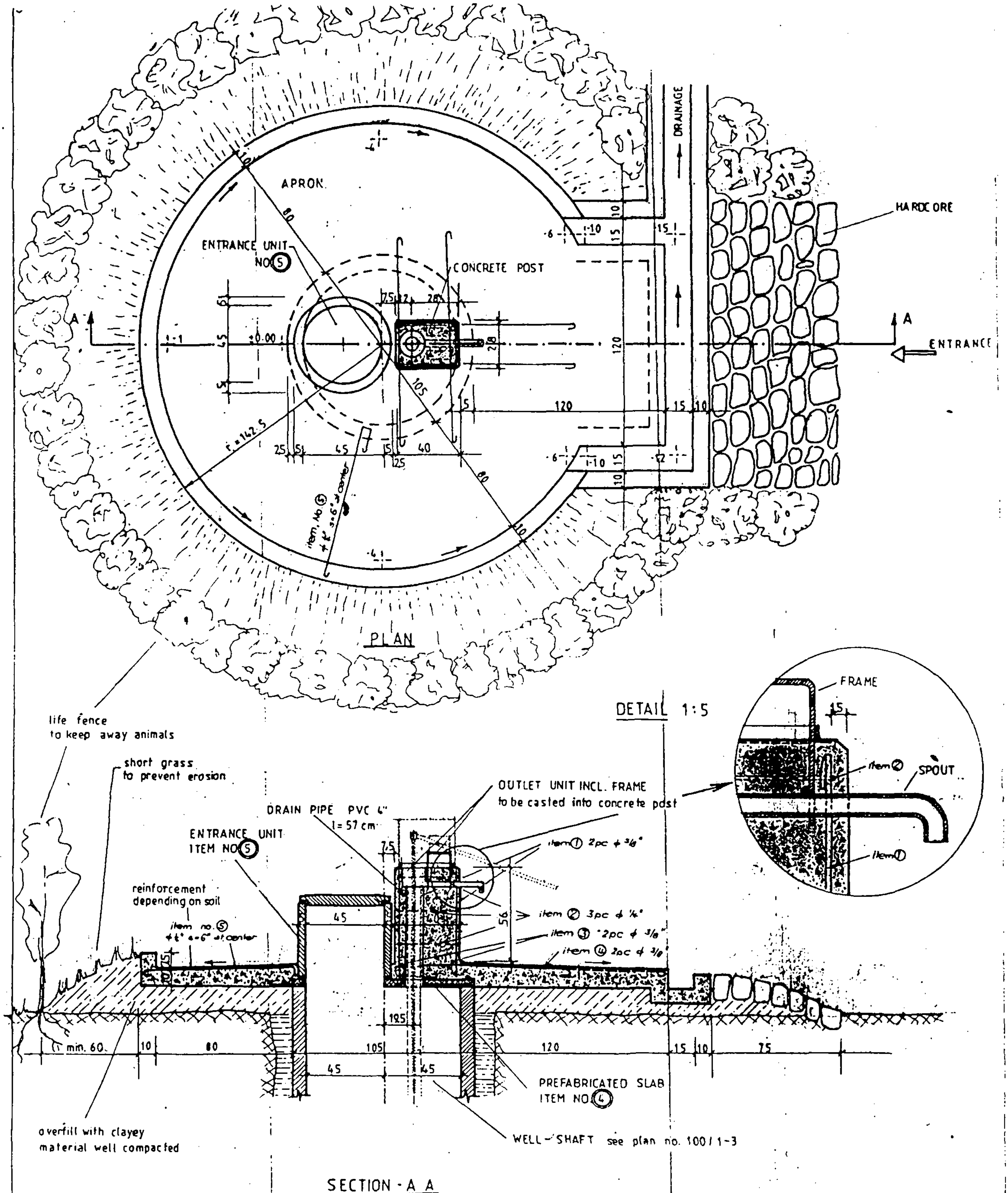
[25] Hannan-Anderson, Carolyn. Development of water supplies in Singida Region, Tanzania, Part Two: the realities for village women. Research Report No. 63, Institute of Resource Assessment, University of Dar-es-Salaam, Tanzania, 1984 (copies available from SKAT)

[26] World Bank Technical Papers and TAG Technical Notes
The following papers are in particular recommended:
No. 1 Methods f. Gathering Socio-cultural data
No. 3 VIP-Double Pit Latrine: A Construction Manual
No. 6 VIP Latrine: Vent Pip
No. 8 VIP Latrine: Field Manual
No. 9 Handbook for District Sanitation Coordinators
No. 10 Manual on Pour-Flush Latrines
No. 13 Designe of VIP Latrines
copies available from: The World Bank, 1818 H Street, NW, Washington DC 20433, USA

Annex II

Well Construction: An Example


WELL HEAD
LIFE FENCE to keep away animals
SHORT GRASS
COVER BOX
FRONT BEARING
MAIN TIMBER BEARING
HANDLE
ENTRANCE WITH HARDCORE TO AVOID MUDDY PLACE
BEARING FRAME
SPOUT
OUTLET-TANK
TOP UNIT CASTED INTO CONCRETE
CONCRETE POST
APRON
DRAINAGE-CHANNEL
PREFABRICATED ENTRANCE ITEM NO 5
OVERFILL WITH CLAYEY SOIL WELL COMPACTED
PREFABRICATED COVER SLAB ITEM NO-4
REFILL WITH IMPERMIABLE MATERIAL LIKE CLAY WELL COMPACTED IN LAYERS OF 30 cm
CONNECTING ROD
RISER PIPE
WELL SHAFT
FULLY CONCRETE RINGS ITEM NO-1
LINE OF EXCAVATION
GROUND-WATERTABEL
COVERING STRATUM (eg latherite)
CONCRETE SEAL OF FILTER PACKAGE
PISTON
CYLINDER
FOOTVALVE
STRAINER
PUMP
AQUIFER
FILTER PACKAGE
PERFORATED RING ITEM NO 2
150 cm
SARVODAYA RURAL TECHNICAL SERVICE KANDY
WATER SUPPLY SCHEME
DRINKING WATER WELL
PLAN NO-
SCALE - 1
DATE - 19
DRAWN -
SEEN -



LIST OF MATERIAL see list no. 100/5a
PREFABRICATED SLAB NO 4 see plan no. 100/8
ENTRANCE UNIT NO 5 see plan no. 100/9

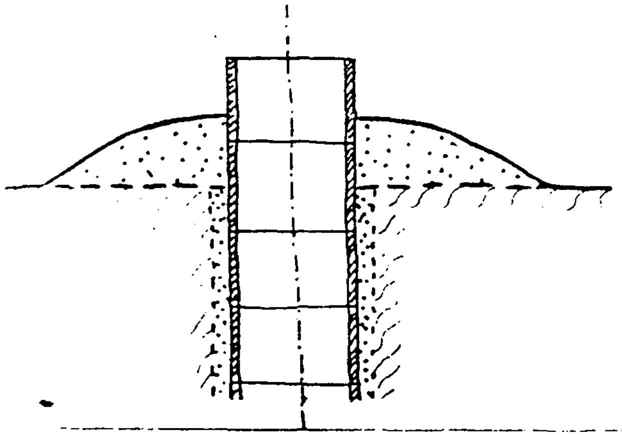
SARVODAYA RURAL TECHNICAL SERVICE KANDY

WATER SUPPLY SCHEME

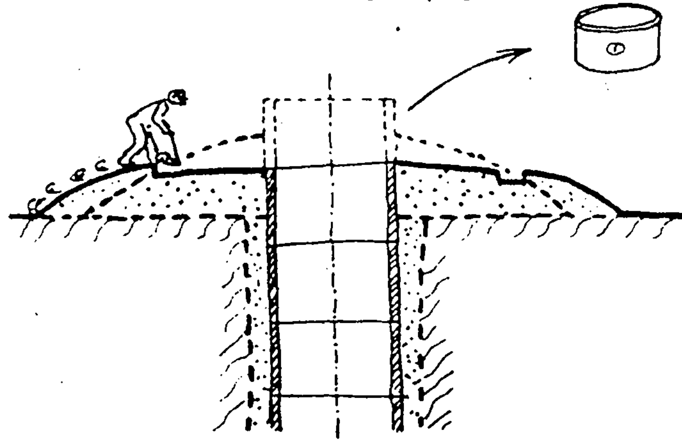
WELL HEAD

PLAN NO. 100/5
SCALE - 1 : 20
DATE - 1981.10.1
DRAWN - ABEYSING
SEEN - K. Wehrle

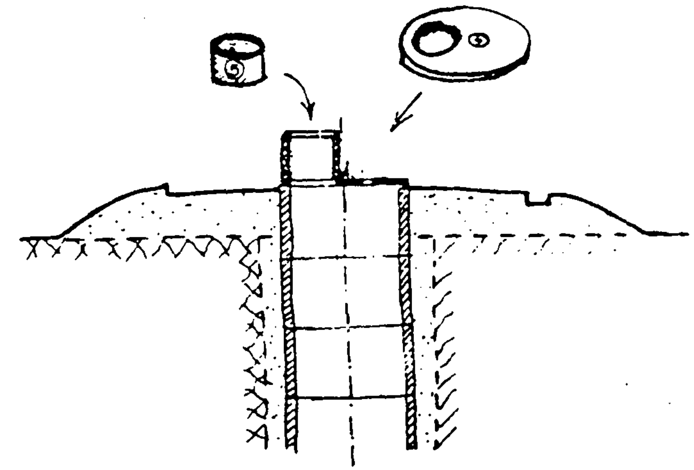
1 START CONSTRUCTION AFTER SETTLEMEN OF BACKFILL OF WELL - SHAFT



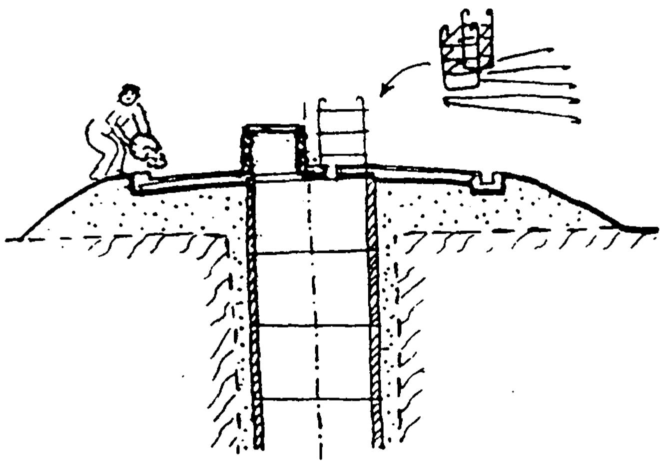
2 DIG FOUNDATION OF APRON TO CORRECT LEVEL AND REMOVE SURPLUS RING



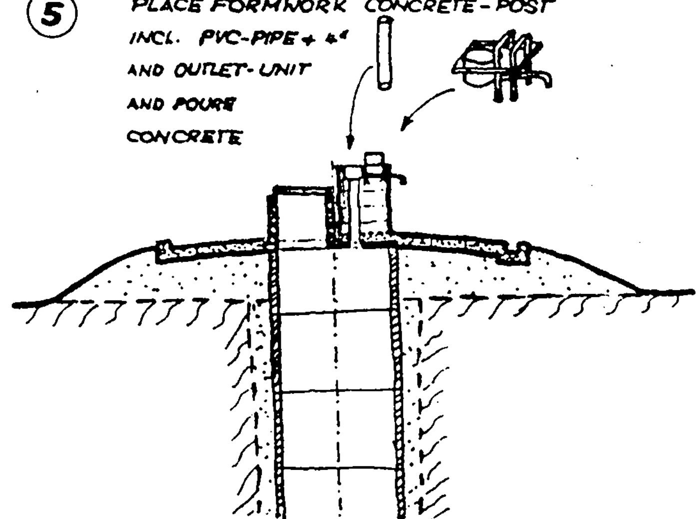
3 PLACE PREFABRICATED ITEMS NO ④ AND ⑤ IN MORTARBED



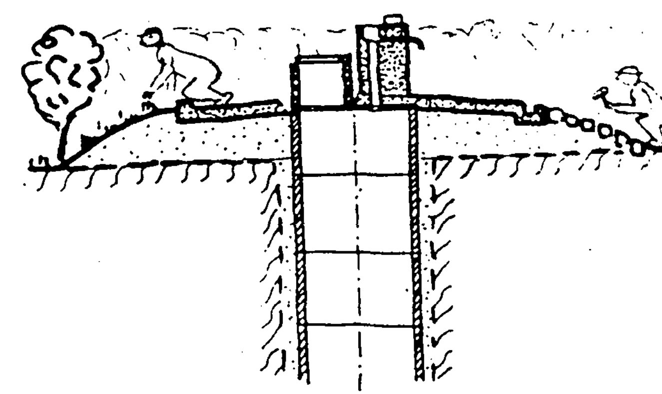
4 PLACE REINFORCEMENT AND CONCRET APRON



5 PLACE FORMWORK CONCRETE - POST INCL. PVC-PIPE + 4" AND OUTLET - UNIT AND POURE CONCRETE



6 COMPLETE SURROUNDING WORK INCL HARDCORE AT ENTRANCE, PLANTING OF GRASS AND LIFE FENCE ALL AROUND PROVIDE DRAINAGE 5 METERS OFF WELL-HEAD



FOR DETAILS COMPAIRE CONSTRUCTION - PLANS :

WELL - HEAD	PLAN	NO. 100/5
LIST OF MATERIAL	"	NO. 100/5a
ITEM NO. 4	"	NO. 100/8
ITEM NO. 5	"	NO. 100/9
OUTLET - UNIT	PUMP	NO. SRTS 81

SARVODAYA RURAL TECHNICAL SERVICE	PLAN NO.
WELL - HEAD	SCALE :
SEQUENCES OF CONSTRUCTION	DATE : 20
	K. Wehrle

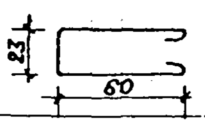
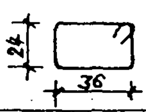
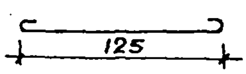
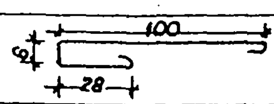
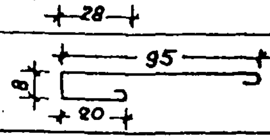
Sequences of construction

- levelling of foundation apron after backfill of well-shaft and overfill have well settled (min. 3 month)
- placing of prefabricated coverslab item no. 4
- placing of prefabricated entrance unit item no. 5 into mortar bed
- placing of reinforcement
- placing of outside formwork apron and drainage
- concreting of apron and drainage (make sure correct gradiants)
- placing of formwork pillar, drain-pipe PVC 4" plus outlet unit
- concreting of pump post
- surrounding work incl. planting of fence and short grass

List of material

cement	7 bags	steelrods ϕ ¼"	36 m (16 pounds)
sand	0.6 m^3	steelrods ϕ ⅜"	9 m (9 pounds)
metal	0.9 m^3	drainpipe PVC ϕ 4"	length 57 cm
rubbel	0.5 m^3	outlet-unit for SRTS-pump	

List of reinforcement

item	shape (cm)	no	ϕ	cutting-length m	tot. length m
1		2	3/8"	1.60	3.20
2		3	¼"	1.30	3.90
3		2	3/8"	1.40	2.80
4		2	3/8"	1.50	3.00
5		22	¼"	1.35	30.00

Sarvodaya - RTS WELL-PROGRAM

WELLHEAD

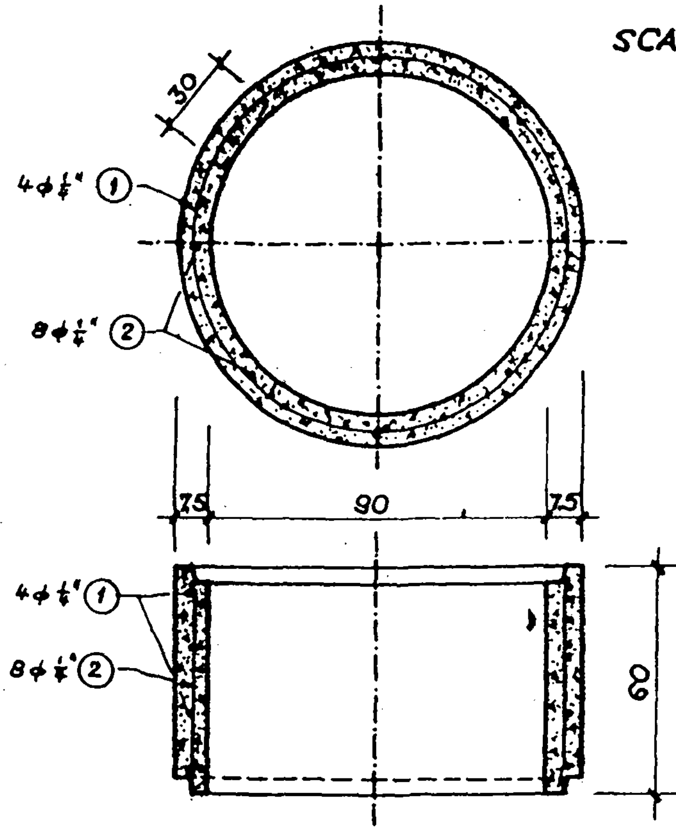
PLAN No. 100/5a

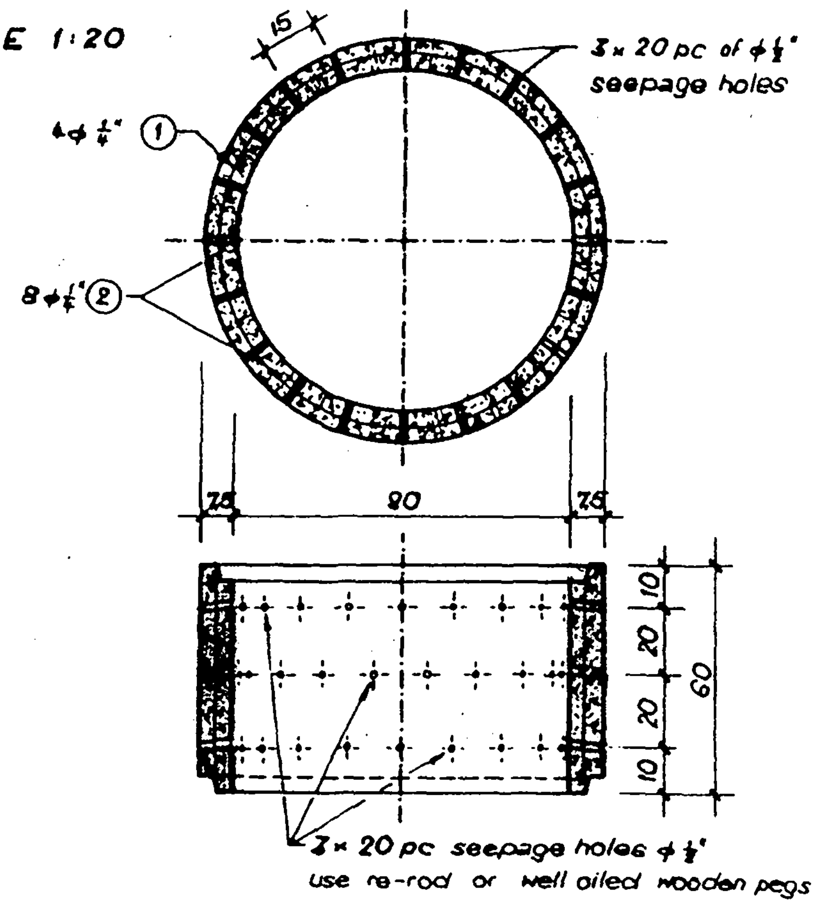
10 - 11 - 81

ITEM NO. (1)
FULLY CONCRETE RING

ITEM NO. (2)
PERFORATED RING

SCALE 1:20





WEIGHT : 350 KG

MIXTURE : 1 : 2 : 4

LIST OF MATERIAL	1 RING	10 RINGS
cement	⅘ bag = 4 pans	8 bags
sand	2 cu.f. = 6 pans	20 cu.f.
metal ¾"	4 cu.f. = 14 pans	40 cu.f.
reinforcement ϕ¼"	18.8 m	188 m

LIST OF REINFORCEMENT				
	nu.	ϕ	si. length	tot. length
1	4	¼"	360 cm	14.40 m
2	8	¼"	55 cm	4.40 m
total		¼"		18.80 m

POINTS OF IMPORTANCE:

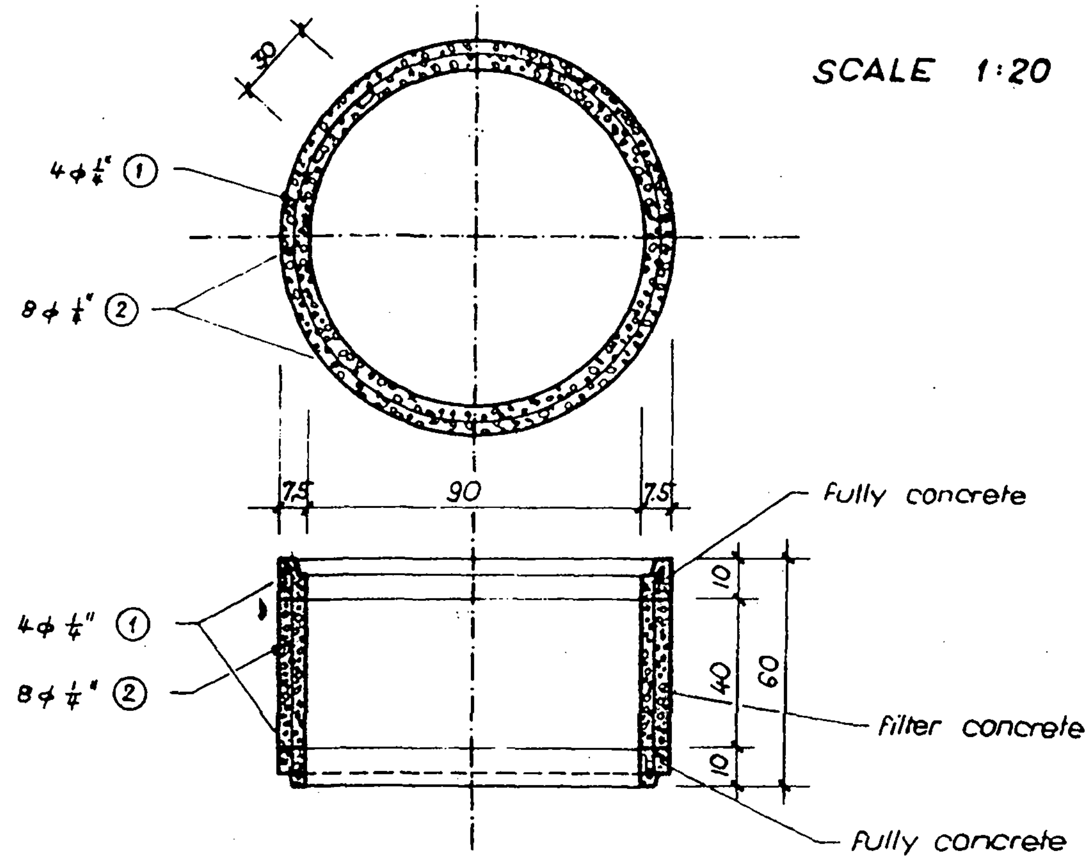
- cast rings in a shadow place
- mixe concrete on a mixing platform use only clean sand and less water
- place moulds on even and clean surface (preferable concrete floor)
- oil those faces of the mould which will come into contact with concrete (vegetabel-oil!)
- center inside mould with rebat-rings or wooden spacers (→ equal wall-thickness)
- poure concrete some 10 cm (4") deep at a time and compact by tamping with re-rod and pounding the moulds with a wooden piece
- wash the outside of the moulds and bolts immediately after concreting
- mark date of casting on top of ring
- remove moulds only 24 hours after casting but leave the rings in place for 3 days
- protect rings from exposure by covering with wet grass, leaves or bags
- cure them 3 times a day for at least one week
- transport the rings not before one week of setting, transport always in upright position
- put special attention to the offloading (e.g. use strong timber to roll them from trailor)

Sarvodaya-RTS	DRINKING WATER WELL	DRAW No. 100/6 26 - 2 - 1981

ITEM NO. 3

FILTER RING

SCALE 1:20



WEIGHT: 350 KG

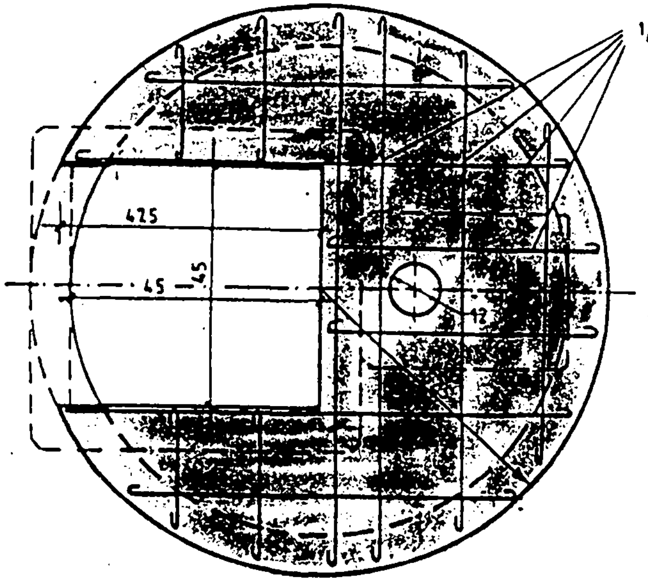
MIXTURE:
- fully concrete 1 : 2 : 4 (cement : sand : metal 3/4")
- filter concrete 1 : 4 (cement : metal 1/4" - 3/4")

LIST OF MATERIAL	1 RING	10 RINGS
cement	4/5 bag = 4 pans	8 bags
sand	3/4 cu.f. = 2 1/2 pans	7 cu.f.
metal 3/4"	1 1/2 cu.f. = 5 pans	14 cu.f.
metal 1/4" - 3/4"	4 cu.f. = 14 pans	40 cu.f.
reinforcement	20.80 m	208 m

LIST OF REINFORCEMENT				
	nu.	ϕ	si. length	tot. length
1	4	1/4"	360 cm	14.40 m
2	8	1/4"	80 cm	6.40 m
total		1/4"		20.80 m

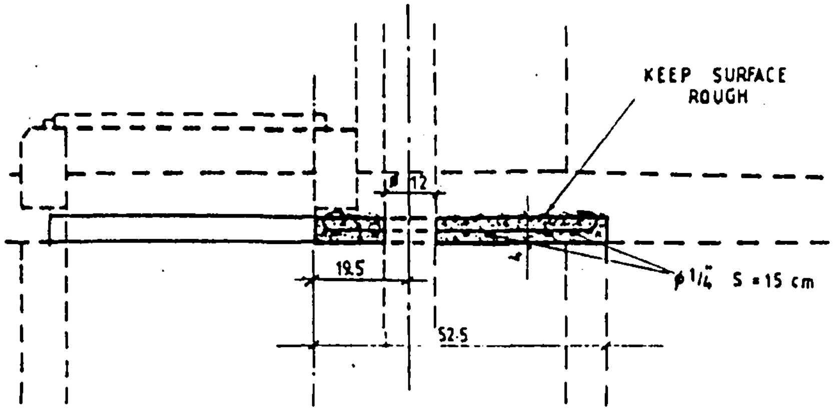
POINTS OF IMPORTANCE:

- compaire drawing No. 1
- filter metal has to be sieved (1/4" to 3/4") prefarably metal from riverbed
- If it contains organic or clay particles, wash them out
- When casting filter ring:
  - at first poure fully concrete (1:2:4) 10 cm (4") deep and compact
  - second poure filter concrete (1:4) 40 cm deep but only 10 cm (4") at a time and compact before pouring the next layer
  - at last poure fully concrete (1:2:4) 10 cm (4") deep and compact



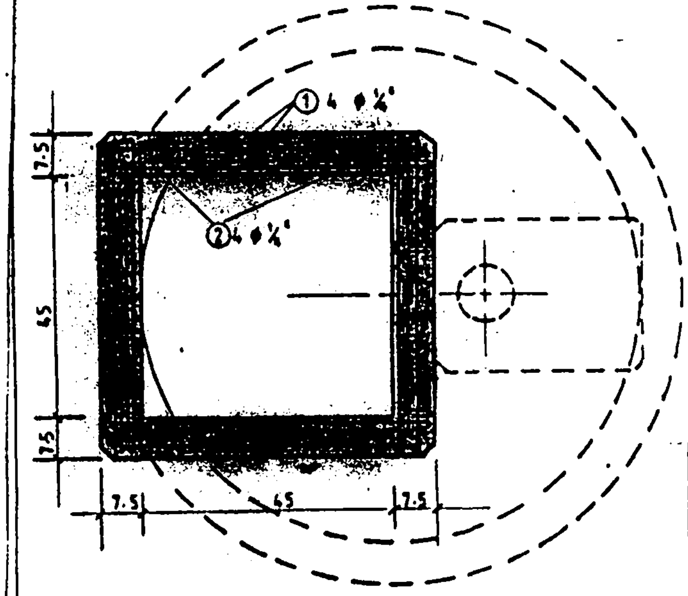
PLAN

LIST OF MATERIAL		
cement	1/4	bag
sand	4 pans	(15 lit.)
metal	6 pans	(22 lit.)
rods	ϕ 1/4"	18 m (8 pounds)



SECTION

SARVODAYA RURAL TECHNICAL SERVICE KANDY	PLAN NO - 100/8
WELL PROGRAME - WELL HEAD	SCALE - 1 : 10
PREFABRICATED - SLAB	DATE - 1981.10.12
ITEM NO - 4	DRAWN - ABEYSINGHE
	SEEN - K. Wehrle

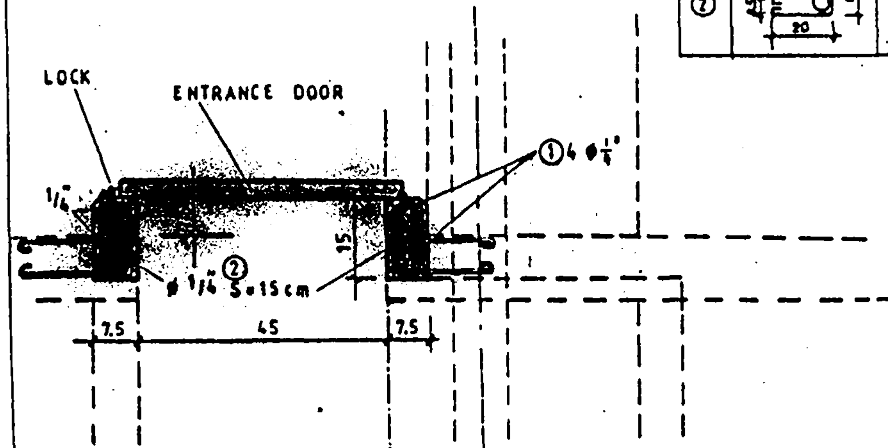


PLAN

LIST OF MATERIAL		
cement	1/4	bag
sand	2 1/2	pans (10 lit.)
metal	4	pans (15 lit.)
rods ϕ 1/4"	27 m	(12 pounds)

LIST OF REINFORCEMENT ϕ 1/4"

item	shape (cm)	no.	length m	tot.len m
①	58	16	0.70	11.2
②	4.5, 20	16	0.95	15.2



SECTION

SARVODAYA RURAL TECHNICAL SERVICE KANDY	PLAN NO - 100.
WELL PROGRAME - WELL HEAD	SCALE - 1 : 10
PREFABRICATED ENTRANCE	DATE - 1981.10.
ITEM NO - 5	DRAWN - ABEYSI
	SEEN - K. Wehr

Sarvodaya Rural Technical Service

List of Material
for Drinking Water Well Construction

<u>Concrete Ring</u> (items No. 1,2 or 3)

cement	4/5 bag	(8 bags for 10 rings)
sand	2 cu. feet	
metal ¾"	4 cu. feet	
reinforcement	ø ¼"	18,8 m = 9 pounds

<u>Prefabricated Slab</u> (item No.4)

cement	1/5 bag	(1 bag for 5 slabs)
sand	½ cu. feet	(15 lit. or 4 pans)
metal ¾"	¾ cu. feet	(22 lit. or 6 pans)
reinforcement	ø ¼",	18 m = 9 pounds

<u>Prefabricated Entrance</u> (item No. 5)

cement	1/6 bag	(1 bag for 6 entrances)
sand	2/5 cu. feet	(10 lit. or 2½ pans)
metal ¾"	½ cu. feet	(15 lit. or 4 pans)
reinforcement	ø ¼"	27 m = 13 pounds

<u>Well - Head</u>

cement	6 bags	
sand	22 cu. feet	(0.6 m3 or tractor load)
metal ¼"	33 cu. feet	(o.9 m3 or tractor load)
rubbel	18 cu. feet	(0.5 m3 or tractor load)
reinforcement	ø ¼"	36 m = 18 pounds
reinforcement	ø 3/8"	9 m = 10 pounds
drain pipe PVC	ø 4"	length 57 cm (2feet)

9/2/82 K.W.

SRTS Drinking water Well program

DISINFECTION OF WELL BEFORE USE

Preventing contaminated wastes from entering the well water is a more effective strategy in the long term for rural areas than disinfecting the water before it is used. (Such preventive measures are: location of well sites, e.g. off latherines etc., sealing of well head and shaft to prevent any surface water etc. from entering, safe extraction = handpump).

Disinfection is however essential after the well has been constructed. Open, handdug wells are particularly a risk for contamination during construction by well diggers. Disinfection should not only consist of disinfecting the well water but also the well-shaft and pump. Below a simple and easy way of disinfection of the completed well incl. handpump is described.

- Disinfection of well shaft:
  Prepare a solution by dissolving ca. 100 gram (¼pound) of tropical bleaching powder (25-35 %) in one bucket (10 lt.=2 gal.) of water and scrub the entire well shft and the inside of well head with this solution.

- Disinfection of well water, filter rings and package:

  The amount needed to disinfecte the well water is 100 gr. of bleaching powder per 1 m3 of water (1 pound per 1000 gal.). The powder is dissolved in water like above and then pured into the well. The water in the well must be well agitated to ensure good mixing. (e.g. circulate the water with engine pump).
  The strongly chlorinated water is left in the well after disinfecting the handpump for at least 12 hours. During this time the water should not be used, so it will be adviseable to immobilize the pump.

- Disinfection of handpump :

  Operate the handpump till the chlorine odour appears at the spout, then re-circulate the water back into the well for at least one hour.

- After 12 hours the handpump is brought into operation again, and the well water is pumped to waste until the odour of chlorine disappears. (Chlorine content below 0,7 - 1,0 mg/lt.)

Keep in mind that this one time disinfection will not keep the well water sterilised for more than a few days. So take all necessary measures to keep any contamination away from the well by sealing up the well head, keeping the surrounding clean, keeping the drainage channel clear, keeping the animals off the apron by a fence, preventing people from washing at the well site and instructing them to operate the handpump with care, attending promptly to any repairs required. (Compaire duty list for village caretaker).

Kandy 19.3.81 KW

Annex III

Standards of Well-Construction

Annex IV

Testing of Trinking Water Quality

"Simple method by attentative site observation" (without equipment)

4.1 Simple method by attentative site observation (without equipment)

This method requires a good deal of experience in assessing drinking water quality by the examinator. The criterias to be considered are as follows:

visual: color, turbidity (a clear glas-bottle may be of help) - good quality does neither present any colour, nor turbidity, nor growth of alguas etc. (Ref 1 p.106,111)

taste: no particular taste should be traceable, iron, chloride, brakish-water etc. can be detected (Ref 1 p.108,109)

odour: no odour should be traceable, any development of gas means that decation is somehow taking place (Ref 1 p.109)

surrounding: of the source: e.g. certain plants as well as specific insects and aquatic animals prefer clean and fresh water.

temperature of the water: reliable sources and groundwater show a stable temperature during a particular day and only slight differences over seasons. There temperature is normally slightly below the average air temperature.

iron: method: a) Pour fresh sample into cup or glass and observe over a period of time if a reddish yellow or brown deposit or precipitate develops. If so, iron is present.
b) Drip a few drops of sample onto white paper and allow them to dry. Check the edge of the watermark for brown stains. If found, iron is present.

manganes: method: a) Pour fresh sample into cup and observe over a period of time. If a black or grey deposit or precipitate forms, manganese may be present.
b) Drip a few drops of sample onto white paper and allow them to dry. Check the edge of the watermark for black stains. If found, manganese may be present.

variations of the flow of the source: Reliable sources arise from rainwater which has infiltered into the ground and seeps through the water-bearing stratum for a distance. This means, that increase of the yield by reliable sources would be delayed after heavy rains for days or at least some hours depending on the nature of soil and intake area. Occurance of turbidity after rain indicates short circuit and accordingly unreliability of the quality.

intake area: As more intact the ecology (vegetation) of the intake area still is as more reliale the source is. Settlements, farming activities etc. are high potential for pollution. (Intake areas can be improved by introduction of protection zones, which includes afforestation, soilconservation, but neither settlements nor intensive cultivation).

covering stratum: of sources and groundwater: Impervious layers protect the groundwater. Water-tightness depends on the nature of soil (preferable loamy soil, rock etc.) and depth of this layer.

Traditional relation to this source by the community This relation may indicate preferences or disregard. Reasons for any valuation should be carefully traced and analysed.

Health condition of the community who draws already water from the particular source. Such an evaluation can only be interpreted with limited meaning, because many other causes of disease transmission may exist (excreta disposal, hygien etc.)

Tasting by the examinator himself This type of test has also its limits since it depends also on the health condition e.g. resistance of the person.

)1 This list is quite incomplete. That's why any useful hints on practical experiences will be welcomed by the author.

Ref 1 = Field testing of water in developing countries by L.G. Hutton SKAT No. 3505

Annex V

"Designing Roof Catchments"
(of Water for the World)

Water for the World

Designing Roof Catchments

Technical Note No. RWS. 1.D.4

Roof catchments collect rainfall from a roof and channel it through a gutter into storage for use by individual households. The amount of water available for use depends on three factors: the amount of annual rainfall, the size of the catchment area and the capacity of the storage tank. This technical note discusses how to design a roof catchment to take advantage of the maximum amount of rainfall available.

Useful Definition

FOUL FLUSH - The first run-off from a roof after a rainfall.

The design process should result in the following two items which should be given to the person in charge of construction:

1. A list of all labor, materials and tools needed as shown in Table 1. This will help make sure that adequate quantities of materials are available so construction delays can be prevented.

2. A plan of the roof catchment system with all dimensions as shown in Figure 1.

Table 1. Sample Materials List

Item	Description	Quantity	Estimated Cost
Labor	Foreman	___	___
	Laborers	___	___
Supplies	Corrugated sheet metal, plastic or tiles (for roofing)	___	___
	Metal gutters, wood or bamboo (for gutters)	___	___
	Wire, rope or local fiber (to secure gutters to roof)	___	___
	Tar or caulk (to seal gutter connection to downpipe)	___	___
	Nails	___	___
	Wire screen	___	___
Tools	Hammer	___	___
	Machete (to split bamboo)	___	___
	Wire cutters	___	___
	Saw	___	___
	Chisel	___	___

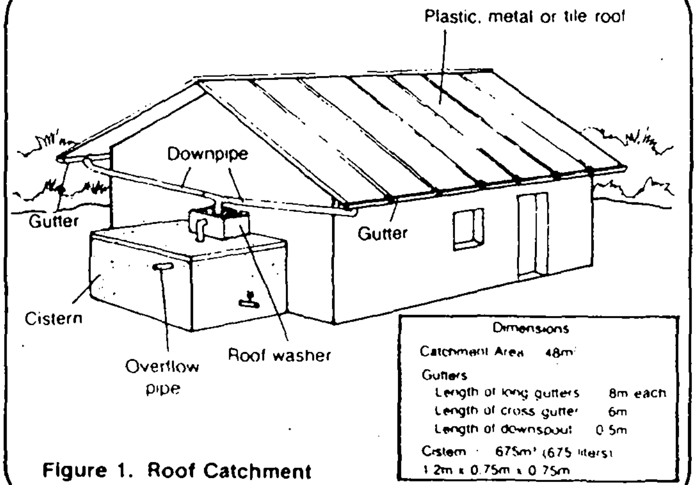


Figure 1. Roof Catchment

Annual Rainfall

Find the annual rainfall rates for the region. This information should be available from the national geographical institute, the Ministry of Agriculture, a meterological institute or university, or an airport. The amount of annual rainfall is measured in millimeters per year.

Catchment Areas

The roof of the house is the catchment area for the rainfall. To collect rainfall, the roof must be constructed of appropriate material, have sufficient surface area, and have adequate slope for water to run-off.

Corrugated galvanized steel or aluminum sheet metal, corrugated plastic or baked tile make the best catchment surfaces. Sheet metal is especially attractive because it is light-weight and requires little maintenance. Tiles also make excellent surfaces and are usually cheaper than sheet metal because they can be produced locally. The disadvantage of tile is the weight. A much stronger roof structure is needed to support tile. Tile roofs may even start to sag or leak after a time if structures are not strong enough.

To determine the amount of rainfall available for use as a water supply, it is necessary to know the area of the roof. Figure 2 shows how to determine the roof area available for water collection.

The effective roof area for collecting water is not the roof area itself but the ground area covered by the roof. In Figure 1, the effective water collecting area is $48m^2$ (8m x 6m = $48m^2$). The roof must slope as shown so that the water will flow into the gutter system installed to move the water to storage.

Using this information and the annual rainfall, it is easy to determine how much water will be available for use. Worksheet A shows how to make this calculation.

In the worksheet example, an average of 85 liters of water per day would be available to a family. For a family of six, each person would be able to use 14 liters per day. This is an average amount. During some months, more than 2560 liters will be available, while during the dry months, no rain may fall at all. A cistern will be needed to ensure adequate storage during the dry months.

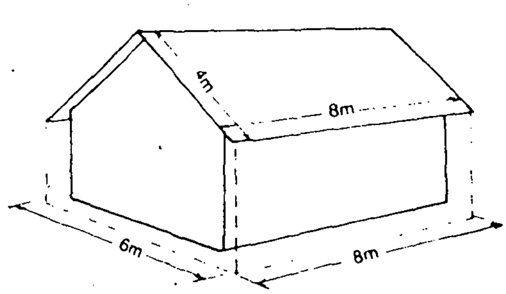


Figure 2. Roof Catchment Area

Worksheet A. Volume of Water Available from a Roof Catchment

Calculate the amount of water available from the catchment by following these steps and referring to Table 1. Figures used are the catchment size in Figure 2 and assumed rainfall of 800mm per year.

1. Multiply annual rainfall by the catchment area.

$\underline{48m^2}$ x $\underline{800mm}$ = $\underline{38400}$ liters/year.

2. Multiply this total by 80 percent. Not all water will be available because of losses due to evaporation and run-off that does not flow into the gutters. To be safe, figure a 20 percent loss for a rain catchment.

$\underline{38400}$ liters x .80 = $\underline{30720}$ liters/year.

3. Divide the total by 12 to get average monthly rainfall.

$\frac{30720 \text{ liters/year}}{12 \text{ months/year}} = \underline{2560}$ liters/month.

4. Divide again by 30 to determine liters per day.

$\frac{2560 \text{ liters/month}}{30 \text{ days/month}} = \underline{85}$ liters/day.

Gutters

Gutters must be installed on both sloping sides of the roof to collect all the run-off and channel it into the cistern. The gutters must be as long as the edge of the roof. Figure 1 shows a typical gutter design. There must also be a downpipe on a third side of the house so that water from both catchment surfaces is channeled to a single cistern. The design of gutters is quite simple and local materials can be used for them.

Metal gutters are the most durable and require the least maintenance, but are the most expensive. Gutters can be made of wood or bamboo. These materials are often available and inexpensive but will usually not last as long as metal because they will rot. Wood and bamboo gutters can be installed to overlap and can be tied together with wire, rope, or local fiber to avoid leakage. If wood is used, it should be hollowed out to form a channel. If bamboo is used, it must be split and the inside joint partitions removed. All gutters must have a small but uniform slope to prevent the formation of pools of water in the gutters. Still water can be a breeding place for mosquitoes.

A downpipe must be installed. The downpipe channels the water from the gutter into a cistern for storage. The joint where the downpipe and gutter connect must be sealed. If metal gutters are used, a connection can be sealed with a caulking compound. If bamboo is used, tar will prove the best material for sealing the connection.

During periods of no rain, dust, dead leaves, and bird droppings will accumulate on the roof. These materials are washed off with the first rain and will enter the cistern and contaminate the water if some basic steps are not taken.

To prevent leaves and other debris from entering the downpipe, a coarse mesh screen should be placed in the gutter over the downpipe. The mesh will catch the large debris but let the water through. The screen must be cleaned periodically to prevent clogging.

A downpipe that can be moved manually away from the cistern can be installed to divert the first flow of water from the roof. An example appears in Figure 3. When the pipe is moved away from the cistern, water simply runs to waste. For this method to be effective, someone must be at the house to move the pipe.

Several other techniques are available for diverting the first roof run-off from the storage tank. In Figure 4, water from the gutters runs through the downpipe and into a small box built on top of the cistern. The first run-off is caught by this box.

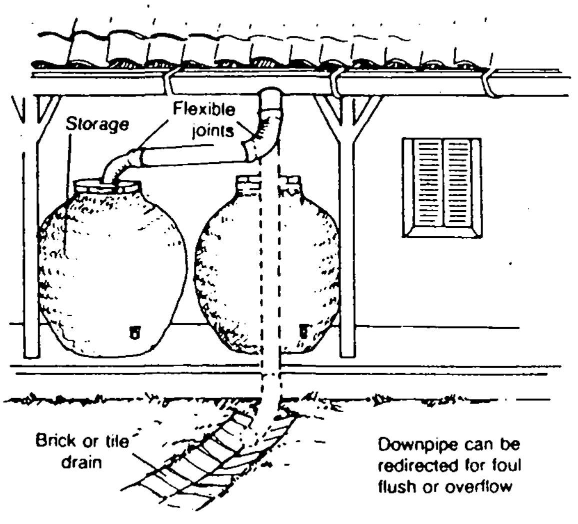


Figure 3. Flexible Downpipe

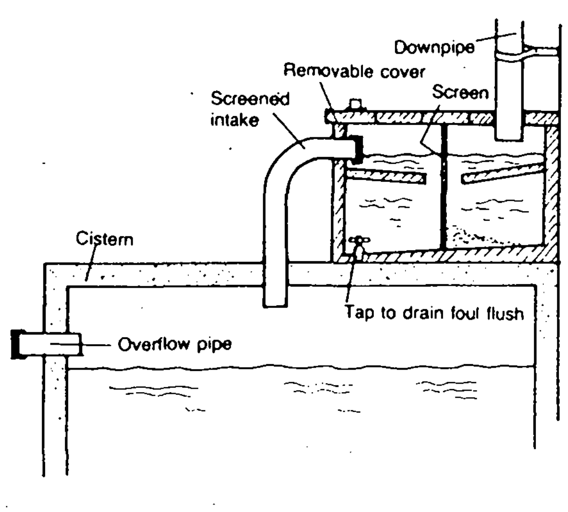


Figure 4. Foul Flush Box

When the box fills, water runs over the top of it into a channel that leads it to storage. A drain then empties the box of the dirty water. This small foul flush or first wash collection box can be made from concrete or from metal. It is most useful when permanent concrete cisterns are designed, because of the extra cost.

A small charcoal-sand filter box can also be installed as in Figure 5. As the rain water passes through the filter, sediment and debris are removed and clear water flows to storage. The advantage of this design and the box for the foul flush is that no one has to be present to divert the water flow from the roof.

Figure 6 offers another example of a useful and easily installed device for diversion of the foul flush. The downspout has two outlets. One runs to storage the other to waste. A lever on the outside is used to make water flow into one of the two channels. After the first wash flows to waste, the lever must be switched so that water runs into the cistern.

No matter which method is used to divert the first wash, the quality of water collected in the cistern must be checked. Water from roof catchments may need treatment before it can be consumed.

Cisterns

A cistern is an important part of a rainfall catchment system. There must be some type of cistern to collect and store rainwater. Several designs can be considered. The choice will depend on the amount of water needed, the amount of water available, rainfall distribution, cost, and availability of space. Basic design considerations and plans for household cisterns are shown in "Designing a Household Cistern," RWS.5.D.1, which should be used with this technical note to design an effective catchment system.

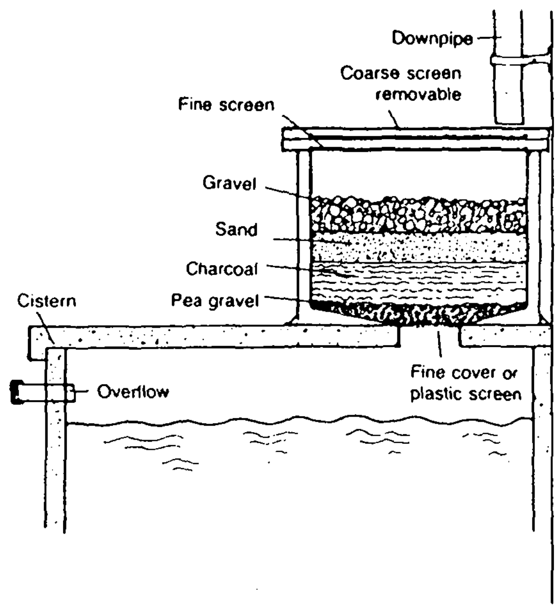


Figure 5. Filter System

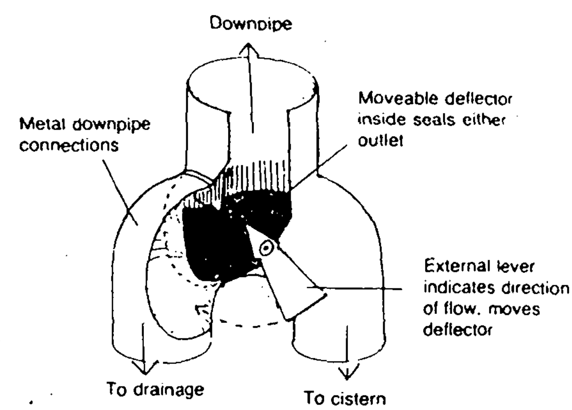


Figure 6. Roof Washer Device In Downpipe

Technical Notes are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.

Annex VI

"Constructing, Operating and Maintaining Roof Catchments"
(of Water for the World)

Water for the World

Constructing, Operating and Maintaining Roof Catchments

Technical Note No. RWS. 1.C.4

The construction of a roof catchment in an individual home is not difficult and generally no special skilled labor is required. With the necessary tools and materials, a catchment system can be installed by a family at a modest cost. This technical note outlines the steps for installing roof catchments. Read the entire technical note before beginning the construction of the system.

Useful Definitions

CAULKING COMPOUND - A filler that seals cracks and seams and makes them watertight.

CISTERN - A storage tank for water.

FOUL FLUSH - The first run-off from a roof after a rainfall.

Before construction begins, the project designer should give you two items:

1. A list of all labor, materials and tools needed for construction similar to the sample list in Table 1.

2. A plan of the roof catchment system with all measurements as shown in Figure 1.

Obtain all materials needed for construction so delays can be prevented.

Construction of the cistern should begin at the same time as construction of the catchment system. For information about constructing cisterns, see "Constructing a Household Cistern," RWS.5.C.1.

Table 1. Sample Materials List

Item	Description	Quantity	Estimated Cost
Labor	Foreman	____	____
	Laborers	____	____
Supplies	Corrugated sheet metal, plastic or tiles (for roofing)	____	____
	Metal gutters, wood or bamboo (for gutters)	____	____
	Wire, rope or local fiber (to secure gutters to roof)	____	____
	Tar or caulk (to seal gutter connection to downpipe)	____	____
	Nails	____	____
	Wire screen	____	____
Tools	Hammer	____	____
	Machete (to split bamboo)	____	____
	Wire cutters	____	____
	Saw	____	____
	Chisel	____	____

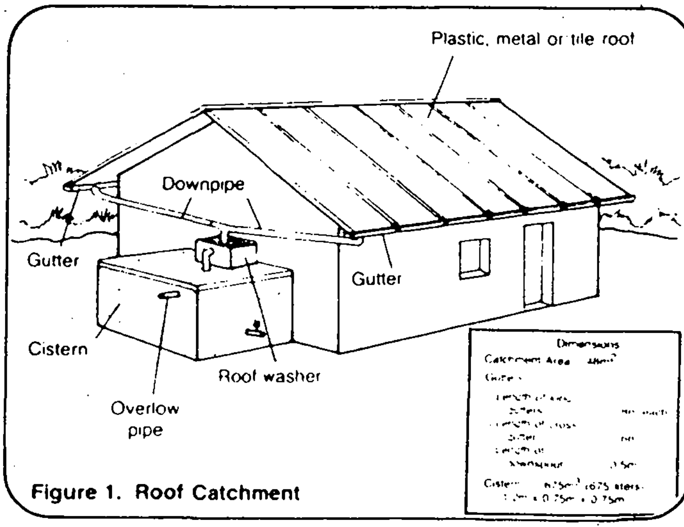


Figure 1. Roof Catchment

Installation

The installation process consists of three steps: construction of roof catchment structure, installation of gutters and connection of the downpipe to the cistern, and construction of a means to dispose of the foul flush.

Catchment Installation. For pre-existing houses, check the roof structure for strength. If the structure appears weak, it should be changed or reinforced. In new houses, or where an existing roof cannot be used, a completely new structure must be installed. The material used for roofing will determine the sizes and spacing of the rafters and cross-supports. Table 2 shows the dimensions of various types of roofing materials.

Table 2. Roofing Material Sizes

Materials	Width	Length
Galvanized steel roofing	0.6m	2.5-3.75m
Aluminum sheeting	0.9m or 1.2m	2.5-6.5m
Fiberglass sheeting	0.65m	2.5-3.75m
Tile	0.2m	0.4m

Place the roofing material on the structure starting from the bottom and working up. Tiles and sheets should overlap to prevent leaking. For tile roofs, cross-pieces should be placed close together so that all tiles have a firm base to rest on. For sheet metal or fiber glass roofs, use roofing nails to secure the sheets to the cross-pieces. If any leaking occurs through nail holes, seal them with a small amount of tar. See Figures 2 and 3 for examples of the installation of roofing materials.

Gutter Installation. Gutters must be installed to collect water from the roof surface. They can be made of metal, plastic, wood or bamboo.

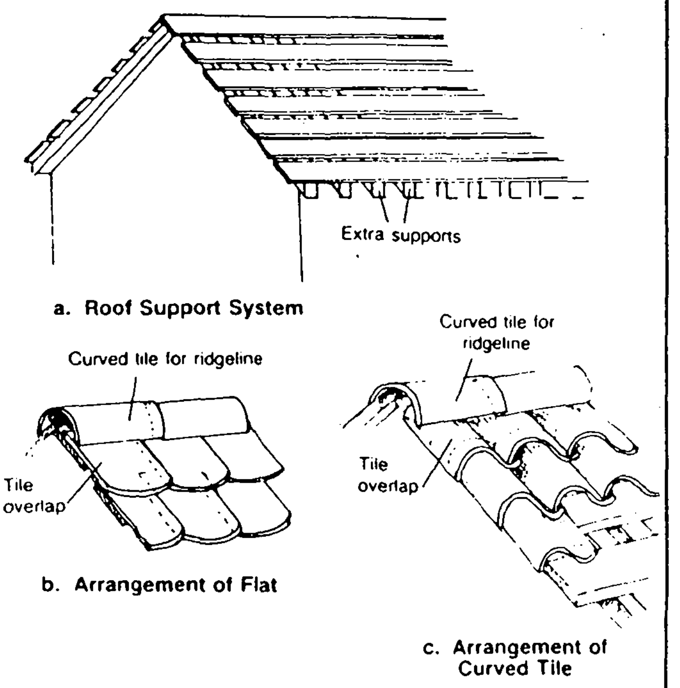


Figure 2. Tile Roofing for Catchment

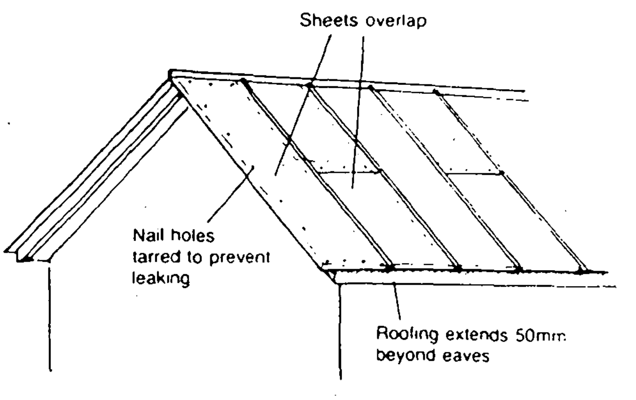


Figure 3. Metal Sheeting for Roof Catchment

Metal or plastic gutters must be bought, while wood or bamboo gutters can be made locally. If wood is used, it must be nailed into a trough and sealed with tar or a deep channel must be cut into the piece of wood to be used as a gutter. This channel must be deep enough to hold the collected water nd prevent it from spilling out onto he ground. Bamboo gutters are made by plitting long lengths of bamboo down he middle and removing the inside oint partitions. The cut halves form ery good collecting troughs, as shown n Figure 4. Follow these steps as you nstall the gutters.

1. Tie pieces of wire to the roof tructure to support the gutters. The ires should be located 50cm apart to provide adequate support. Extra support should be given to wooden gutters because of their weight. Wrap the wire around the gutters to hold them in place.

2. Join the gutter sections together. Use specially made joints for metal and plastic gutters. There are several techniques for joining bamboo gutters. One simple method is to place a piece of rubber at the joint to hold the two pieces together. The rubber fits underneath the gutters and is secured to them with wire. Tar or caulking can then be used to seal the connection and make it watertight. Figure 5 illustrates this technique. Be sure that the two pieces of bamboo fit together closely before sealing the joint.

3. Begin installing the gutters on the side of the house opposite the cistern and install the downpipe on the third side. The gutter should slope enough so that all water flows from the roof to the downpipe. The required slope is 0.8-0.10m per meter of gutter. Another method of installation is to place the cistern on a side of the house where the roof peaks. Place gutters on both sides of the house sloping toward the cistern. Water runs from both gutters into a single downpipe. Gutter slope is very important since without enough slope, water will stand in the gutters. If the time between rains is more than eight to ten days, mosquitoes will breed in the standing water.

4. Install a downpipe from the gutter to the cistern. Connect the downpipe directly to the gutter. The downpipe can either be placed at the end of the gutter or a hole can be made in the gutter where the downpipe is connected. Seal the joint where the downpipe meets the gutter with tar or caulking compound.

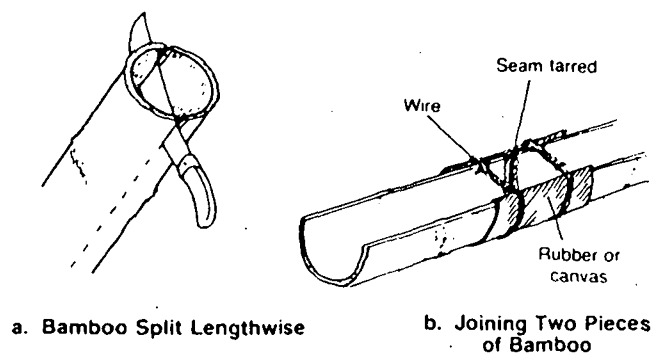


Figure 4. Making Gutters from Bamboo

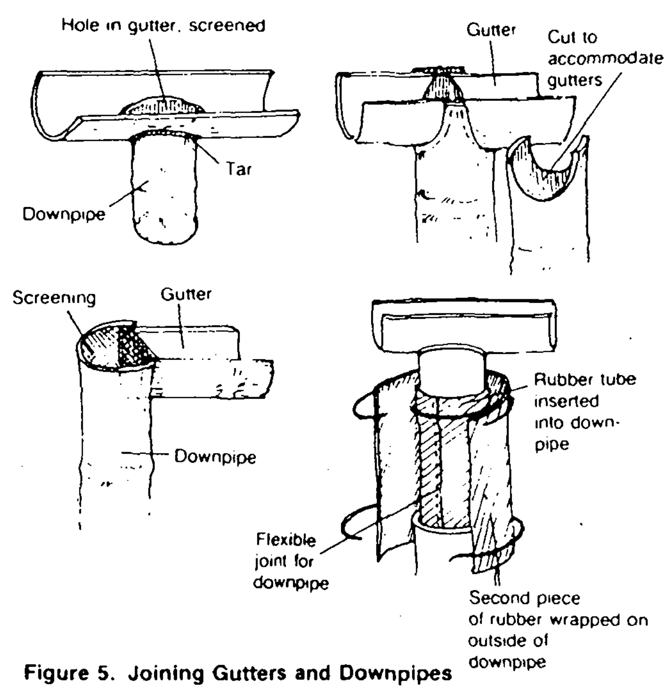


Figure 5. Joining Gutters and Downpipes

5. Place a small mesh wire screen over the opening of the downpipe so that leaves or other debris which could contaminate the water do not enter the cistern. The mesh should be large enough so that leaves and debris are caught but water continues to flow through.

Foul Flush Disposal. There are two ways to remove the foul flush or first wash from a roof. They are simple diversion and construction of a foul flush system.

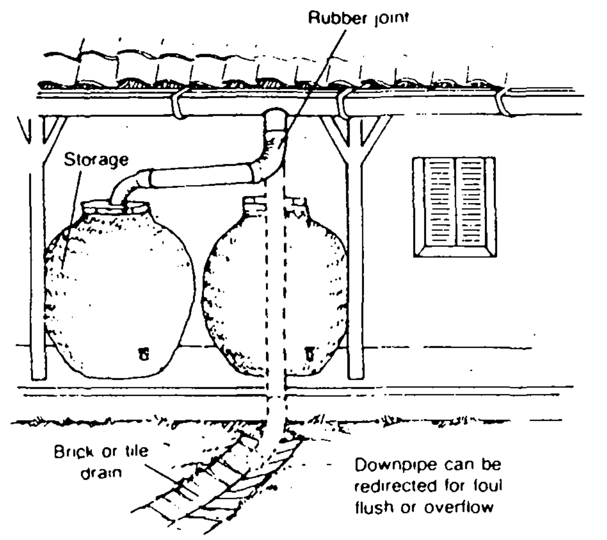


Figure 6. Flexible Joint in Downpipe

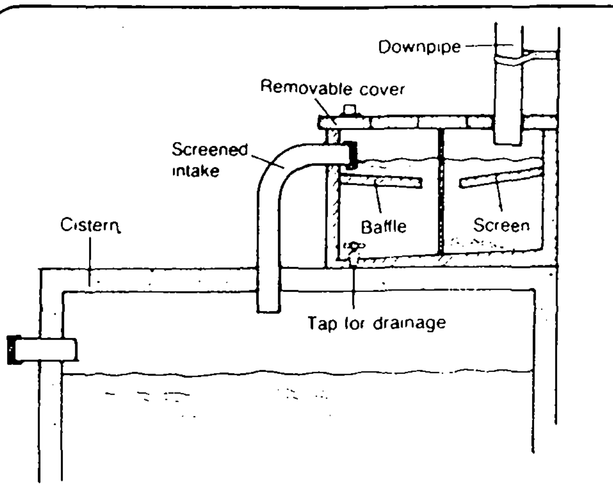


Figure 7. Collection Box for Foul Flush

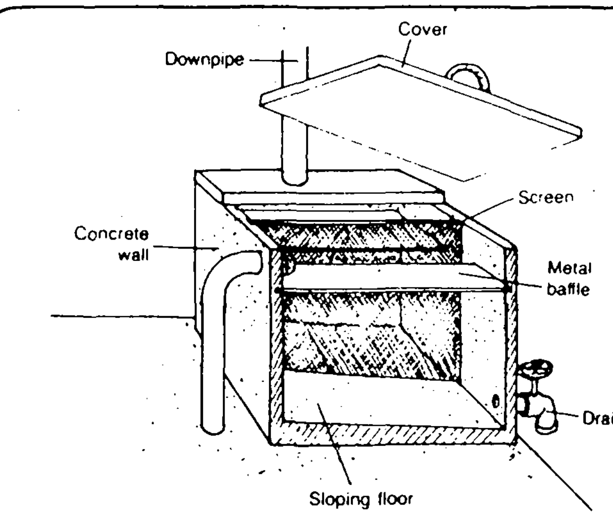


Figure 8. Detail of Collection Box for Foul Flush

For simple diversion, install a rope to the end of the downpipe. When the rain begins, the downpipe can be moved away from the cistern to let the dirty water flow to the ground. This method is useful when large jars are used for water storage. Someone must remember to move the spout at each rainfall. See Figure 6.

If the cistern and downpipe are connected, a small collection box can be built to collect the first run-off. See Figures 7 and 8 for details. The box can be as small as 250mm x 250mm x 250mm and should be made from impermeable material. Clean containers such as 20-liter cans can be used for receiving the first run-off from the roof. A filter system is made using a large can or filter box. Place a filter between the downpipe and the cistern. Line the filter bottom with pea gravel up to about 30mm, then place an equally thick layer of charcoal and on top of that a layer of sand 0.2-0.5mm in diameter. The sand layer should be between 30-50mm thick. On top of the sand place another layer of gravel as shown in Figure 9. Connect the downpipe to the box and connect an outlet pipe to the box and the cistern as shown. Place a screen at the very top of the box so that no large debris can enter. A tap or plug should be installed to empty out the dirty water after each rainfall. When the box fills, the cleaner water flows to the cistern.

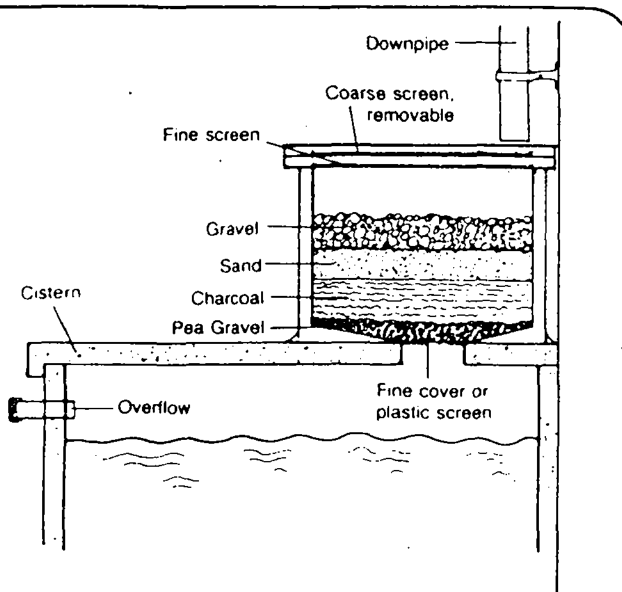


Figure 9. Filter System

Maintenance

Adequate maintenance of the catchment assures that the maximum amount of rainwater is collected and that the water is of good quality. Keep the catchment well maintained by doing the following:

1. Keep the roof in good condition. Repair any holes in the roofing material and change any broken tiles to prevent leaking. Seal any nail holes that are leaking.

2. Clean the roof between rains. Much debris and fecal matter from birds can be removed by sweeping off the roof often enough to keep it looking clean.

3. Keep the gutters in good condition. Be sure they are firmly tied to the roof and that they are well joined to prevent spilling. Repair ai holes. If bamboo or wood is used for gutters, check them once a year for rotting. If there is any sign of rot, replace them.

4. Remove leaves and other debris from the gutters to avoid clogging. Check the screen on the downpipe to be sure it is not clogged. If a gutter clogs, water may spill over its sides and be wasted. Watch for leaks and overflow during a rain. See Figure 10.

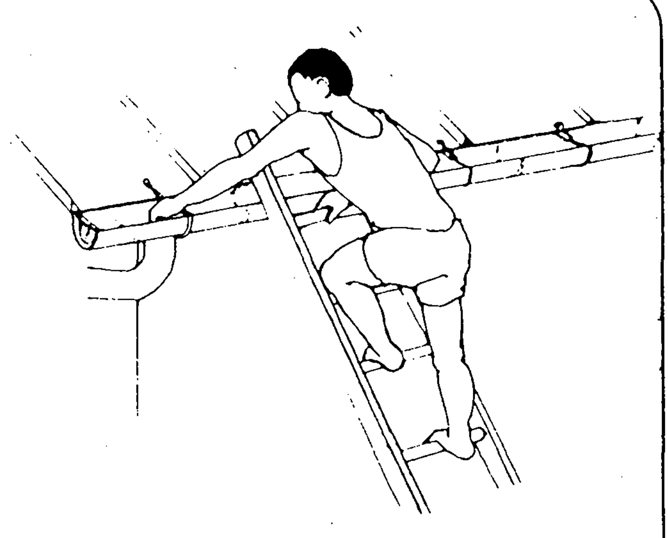


Figure 10. Cleaning Gutter and Screen

5. If a collection box for foul flush is used, clean it out after each heavy rain to remove any sediment or scum.

6. If a filter is used, clean the filter every several months. Wash and change the sand in the filter at least every six months.

Notes

Notes

Notes

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1982

Annex VII

A field report from Nepal about Ferro- and Bamboo-Cement Watertanks

Annex 7

AN EXTRACT OF:

Community Water Supply and Sanitation Programme
Pokhara
Swiss Association for Technical Assistance
SATA

FINAL REPORT

COVERING FIVE YEARS OF WORK 1980 - 1985 in the

COMMUNITY WATER SUPPLY AND SANITATION PROGRAMME

WESTERN DEVELOPMENT REGION POKHARA

NEPAL

HEINI MUELLER
POKHARA
MARCH 1985

CHAPTER 4 Ferrocement

In 1979 the first ferrocement water tank has been constructed in the Western development region. In the following years, slowly and very carefully, this new type of tank construction was tried out.Carefully, because nobody was willing to take the risk of a leaking tank.

At this time nobody had any real experience and it had to be tried with the manual nearby. Initially the technicians and the villagers were very sceptical towards the new type of water tank. The WSST were used to build the solid and long lasting type of masonry water storage tank of which the designs had been worked out in Cameroon.

For many reasons, this impressive looking solid water tank is in reality not so strong and carries a great risk of leaking very soon.An other important factor is , that a 38m3 masonry storage water tank is consuming a huge amount of material in stones, sand and cement.

In order to cover the tank, an arch is constructed.To build this arch a special frame has to be transported to the village and after its use transported back or to the next drinking water project. This transport for the archframe as well as for the cement, was paid from HMG.This transport was on the one hand a fairly expensive affair for HMG and on the other also a management headache in the sense that the archframes often seemed to be there where they were not supposed to be.All the above mentioned reasons made it imperative to look for an other solution for tankconstruction.

The SATA engineers in Pokhara through their trials had gained the confidence that ferrocement woulld be a viable option.In addition the fact that a ferrocement reservoir as compared to a stone masonry built storage tank is a cheap as well as a solid construction method,that it requires less material on the part of both the government and the villagers,that it can be completed within three weeks and that it does not require a "imported" shuttering were reasons enough to push the changover to ferrocement water tank construction in the programme.

The first designs have been redesigned in 1983 and a new standardisation has been made.At the same time the first batch of technicians received a practical training in ferrocement construction in Sirsekot/Syangja.

In the construction season 1983-84 all new storage tank were constructed in ferrocement.A few old type, masonry storage water tanks were still under construction in that construction season. This construction season, 1984-85 storage tanks are being built exclusively in ferrocement.The quality is very good.And the WSST are convinced about the quality and possibilities of this constructionmethod.

Still the villagers have their doubts about the new technique.

? The only 5 cm thick wall is too thin, it will break when it is filled with water?

? The haircracks in the cement roof is proof for the villagers that this construction method is not as solid as the masonry type of water tank?

? Bad people can damage the water reservoir too easy?

? If the tank needs maintenance, the village maintenance worker does not know how to maintain or to repair it properly?

These doubts about the ferrocement water tank are understandable,because the average villager believes only in a proven and very strong (say thick) construction.

The doubts of the villagers are in themselves important but can be overcome through good communication and good constructionwork by our technician!For our overseers and engineers a few questions posed themselves when we started with ferrocement.

- What influence does underground or overground construction have on the life of the ferro cement tank ?

- What damages can occur when acidic earth is touching the cement wall, and how can this be avoided?

- What sand quality is necessary to build a good and long lasting water tank?

- What is the minimum reinforcement when taking into consideration the relatively poor quality of steel bars, plain wire and chicken wire?

- How to make the shuttering for the wall and the roof construction so that the material can be used for all sizes of ferrocement tanks?

- How to keep the water cool in the storage tank ?

These are only a few questions which we faced when we designed the standardisation for the new ferrocement tanks. Designs from other regions of Nepal gave us some good and useful suggestions for our revised standardisation designs.

On the other hand, while designing the new standardisation I also realised that there are some few, but nevertheless important disadvantages like:

- The reinforcement material is not yet manufactured in Nepal and therefore sometimes also not available in the local market.

- In the case of any damages, the village maintenance worker is dependent on the help of our office. We have to train these village maintenance workers also in this subject to make sure that the VMW can do maintenance by himself in future.

- The normal cement work, the Nepali skilled labourers are used to making is not good enough for a ferrocement tank. The WSST therefore has to bring skilled labour from Pokhara to the village.

- Although the WSST knows how to build a ferrocement tank he needs supervision. A few of the supervisors unfortunately still do not really know how to build a ferrocement tank. Especially the lack of hands-on experience on the part of the overseers is an impediment for good supervision.

- For ferrocement fresh cement should be used, or at least the best cement that is available.

- Exact work is essential for the ferrocement tank.

- The sand quality must be very good and for that the villagers have to collect the sand sometimes from very far away.

These are some of the disadvantages of the new ferrocement tank. Or rather not so much disadvantages but rather factors that influence not so critically other methods of construction.

But the advantages are far more, so that the introduction of the ferrocement tank is more then justified.

- The construction of the tank takes only three weeks which is very short compared with a masonry tank.

- It is a very cheap type of reservoir,because a lot less cement is necessary and therefore the porterage charge is also less.

- The contribution of the villagers is far less then for a masonry tank.

- Arch-frames are not any more necessary for the roof construction.

- The 32mm HDP pipe used for the shuttering of the tank can be used afterwards for the water distribution network of the project.

These are the advantages of the ferrocement tank. Certainly the cost(refer to table)and the transport of the material have been decisive in introducing the ferrocement tank construction in the Western development region.

COST OF VARIOUS TYPES OF TANKS

cost in Nc.	4.5 m3 bamboo	5 m3 ferro	10 m3 ferro	9 m3 stone	22 m3 stone	20 m3 ferro
CWSS-Progr.	4500	13500	19000	23000	40700	24800
Village	1200	1300	2100	5500	10500	3200
Total	5700	14800	21100	28500	51200	28000

From the table it can be seen that the construction cost of the ferrocement tank is considerably lower than the stone masonry type.For example the cost at the roadhead of the 10 m3 tank is 19% less than the 9 m3(compensated for volume/cost ratio),and the 20 m3 even 35% less than the 22 m3.The differences between the community contributions for the various tanks are even greater.

The cost of a bamboocement tank are estimated at Nc.5700 if all the cost have to be borne by the agency.In case the villagers are putting in their own labour and locally available materials the bamboo tank can already be made for roughly Nc.3000.

In fact, about 98% of our programme is located at hilly regions which means that more or less al the required project material has to be carried by people to the project side. Only 10% of our drinking water projects can be reached by road.The rest of the projects are as far away as 1 to 5 days walk.Hence ferrocement construction makes a big difference in transport cost for our programme.In addition it also means a reduction in *Dukha* for the villagers who have to collect less sand and stones from often far away.

In the last two construction seasons-1983/84;1984/85-a total of 35 ferrocement tanks have been constructed. An achievement much liked by Nepali villagers with their penchant for tanks.

But not only water tanks can be built with this new technology,also ferrocement squatting slabs and water break pressure tanks are being constructed successfully in Nepal.Ferrocement allows a very flexible kind of work.In the long run I believe that the ferrocement construction will be an integrated part of developing work in Nepal, because it saves material and money for the government, as well as strenuous work for the villagers.

CHAPTER 5 BAMBOO REINFORCED WATER TANKS

This type of new technology was introduced in 1982. In order to find again a cheaper method to build , or even to repair ferrocement tank leaks, we started research work on bamboocement.

The first experiment was made with two ready-made baskets. We plastered the inner and outer side with mortar. The containers were filled with water to test its water tightness.They have been filled for the last two years and still are not leaking.One of them was partially destroyed,to see how the bamboo looks but no deterioration was found.

The second experiment took place during the village maintenance worker course in 1983 in Sirsekot, Syangja District. A 500lt. container was built and since two years no leaks have been seen. In Sirsekot we made the first experiences on how to construct a pukka bamboo cement tank.

The success encouraged us to conduct a special training with a few WSST. In 1984, during this training a total 5 bamboo reinforced water tanks were built. The capacity was ranking between 1000 lt and 4500 lt. Different type of bamboo were used for the reinforcement in order to find out the best and most appropriate bamboo type.The bamboo type is an important factor for the life-span of the tank.Together with the WSST I gained quite a lot of experience and I feel it is worthwhile to train all our WSST in this new type of work.

Many of our WSST are requested in the village were they are building a water project, to help the villagers to build private water tanks or even water tanks were the district has given the necessary material like pipe and cement.Mostly the villagers do not have the money to buy expensive steel-bars, chicken-wire and plain-wire to make a ferrocement tank. A bamboo reinforced tank is much cheaper for them , because bamboo is available everywhere.

It has come into praxis that were we have build a school latrine that instead of a expensive water drum, a bamboo water container is being built. These small containers are easy to build and very cheap.A farmer, living near by a school latrine were we also have built a bamboo cement container , adopted the new idea and has built his own bamboo reinforced water container of 200 lt.

If villagers start copying such technologies it shows me that we are on the right track.Still some tricks how to make a bamboo reinforced water tank or container must be known.

The main problems with bamboo reinforced containers are associated with the proper bonding between the mortar and the bamboo net.Also when building a bigger sized tank the joints of the bottom and roof with the wall requires attention. One should not be too much fixed using only local materials. It is better to put a few meter chickenwire in the joint between the bottom and the wall.Smaller size containers do not require this "to be on safe side" measure.

What effect does it have when one makes the bamboo reinforced tank underground?I do not know what will happen when the tank is in contact with mud, without protection. But I assume that it will affect the shrinkage of the bamboo.The bamboo is always wet and the damage could be that the bamboo will too soon decay.If the tank is built overground,this may not happen so soon.That the bamboo once will rot I think is unavoidable.Therefore the lifetime of a bamboo tank will be not more than say 8 to 10 years, which is quite acceptable relative to the cost of construction, which is about 3000.- NC or 180.- US$ for a 4500 lt. tank.

During the bamboo cement tank construction, we were trying to use the local knowledge on bamboo as much as possible.Local people told me, to cut the bamboo used for that kind of special activities only by full moon and at midnight.Local people know a lot about the best use of bamboo, and they are familiar with its weaving technique.It therefore should not be too difficult for them to learn to build bamboo reinforced water tanks for their own use.

Bamboo cement activities

- 1982 The first two bamboo cement containers were made on the compound of RD Pokhara.

- 1983 During the village maintenance worker course at Sirsekot the first bamboo cement tank was constructed,5001t.

  One of our WSST built a 25001t. tank during a training for new peace corps staff.

  For a school latrine at Phul-Bhari,Pokhara two water drums were constructed,2x3001t.

  For two private latrines at Pokhara two small containers were made of each 50 lt.

  One latrine superstructure,similar to the type built in Zimbabwe,was made at RD Pokhara.

- 1984 The first bamboo reinforced water tank training was conducted with 10 WSST.During this training ,the following tanks were constructed:

  One 4500 lt tank at Nadipur Pokhara.
  One 4500 lt tank at Arwa CWSS.
  One 4500 lt tank at Naya-Bazar primary school.
  One 1000 lt tank at Naya-Bazar primary school
  One 1000 lt tank at RD Pokhara.

  Not during the training was built:

  One 2000 lt tank at Arwa CWSS.

- 1985 One 2000 lt tank at Sunpandeli.

This list shows the bamboo cement construction activities during the last three years within the CWSS programme in Pokhara.To include all activities our WSST have done in their private time is not possible and I think also not necessary.It shows enough that this activity is likely to incrase in the next years.I feel that bamboo reinforced water tanks will turn out to be a quite attractive and possible alternative to solve water storage problems in the villages in the hilly regions of Nepal.

Annex VIII

Worksheet for Calculation of a Latrine Pit

Worksheet for Calculations for Privy Pit

Capacity of Pit

1. Number of users = 6
2. Designed life of pit in years = 8
3. Line 1 x Line 2 = 48
4. Is there a pour-flush bowl? [x] no [ ] yes
5. If "no", then Line 3 x 0.06 = 2.8
6. If "yes", then Line 3 x 0.04 = ___ m3
7. Do anal cleansing materials readily decompose? [x] yes [ ] no
8. If "yes", then capacity = Line 5 (or Line 6) = 2.8 m3
9. If "no", then capacity = 1.5 x (Line 5 or Line 6) = ___ m3.

Dimensions of Pit

10. Capacity (from Line 8 or Line 9) = 2.8 m3
11. Pit is for (check one): [ ] pit privy [x] ventilated pit privy

    [ ] offset pit privy

12. Theoretical depth

13	14	12
diameter choosen	volume per 1m depthe	theoretical depth = $\frac{\text{line 10}}{\text{column 14}}$
0,90 m	0,64 m3/ml	
1,00 m	0,78 m3/ml	
1,00 m	0,95 m3/ml	$\frac{2.8}{0,95} = 3.0$
1,20 m	1,13 m3/ml	
1,30 m	1,33 m3/ml	

15. Required total depth = column 12 + 0,50 m = 3,5 m

Comparision with prerequisites at the site (comp. chapt. 11.3)

16. bottom of pit at least 1,0m above groundwater tabel — yes [x] no [ ]

17. bottom of pit at least 1,0m above impervious layer — yes [x] no [ ]

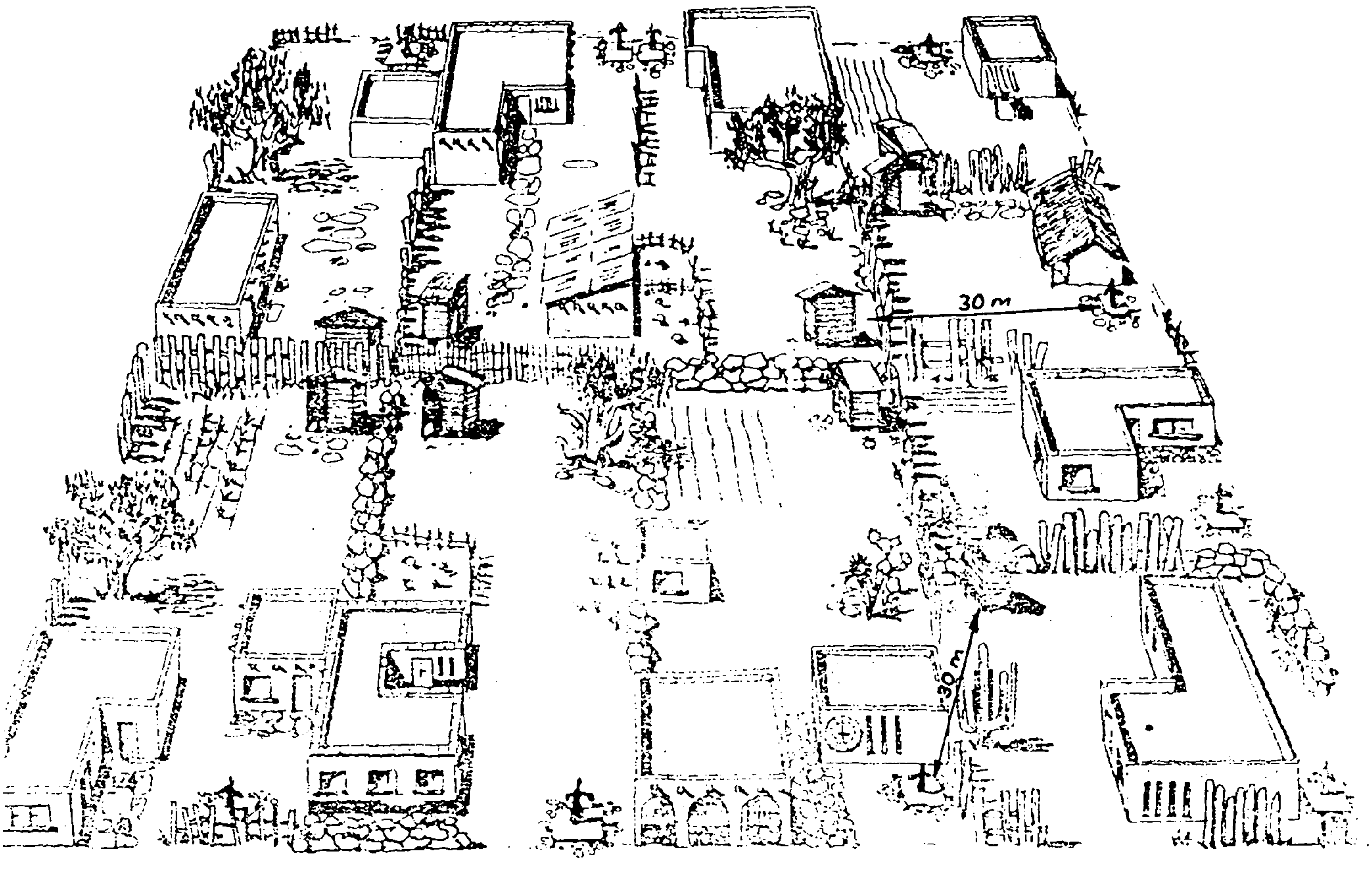
18. Required depth (column 13) is not more than 3,5 m — yes [x] no [ ]

19. Check wether line 16, 17 and 18 indicate all yes:

yes [x] : The pit can be constructed according to the choosen diameter (column 13) : 1,0 m and the calculated depth (column 15): 3,5 m

no [ ] : any of the choosen parameters need to be changed:
- increasement of diameter
- reduction of life span
- type of latrine (e.g. pour-flush instead of pit)

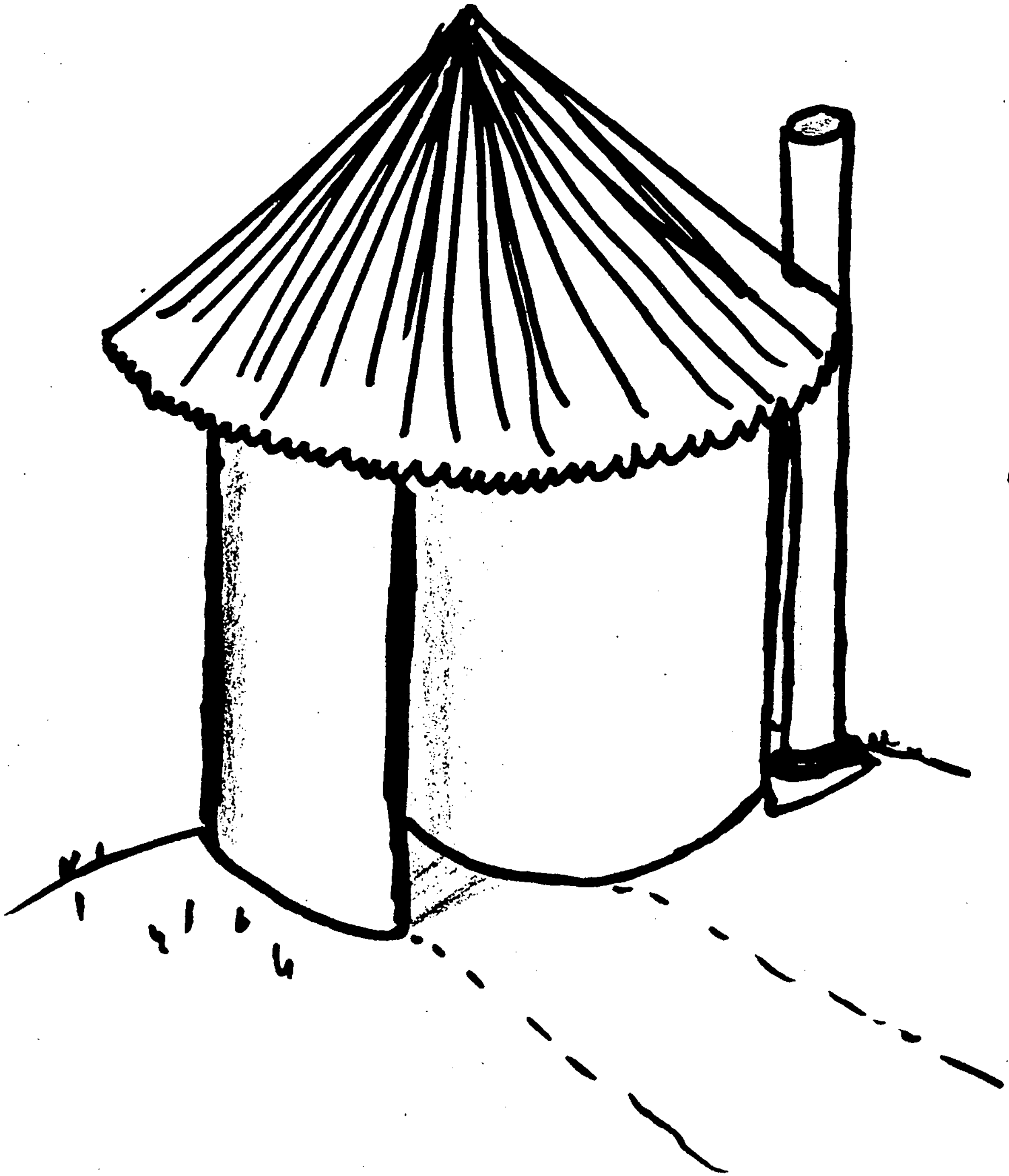
localización adecuada en una comunidad



Un ejemplo de manzana en una comunidad rural, en la que las letrinas se encuentran situadas a la distancia correcta de los pozos de agua y las viviendas, para evitar la contaminación del agua en [illegible]

Annex X

Draft of a Manual for Latrine-Construction and Use



A DRAFT OF A MANUAL for LATRINE-CONSTRUCTION AND USE

INTRODUCTION :

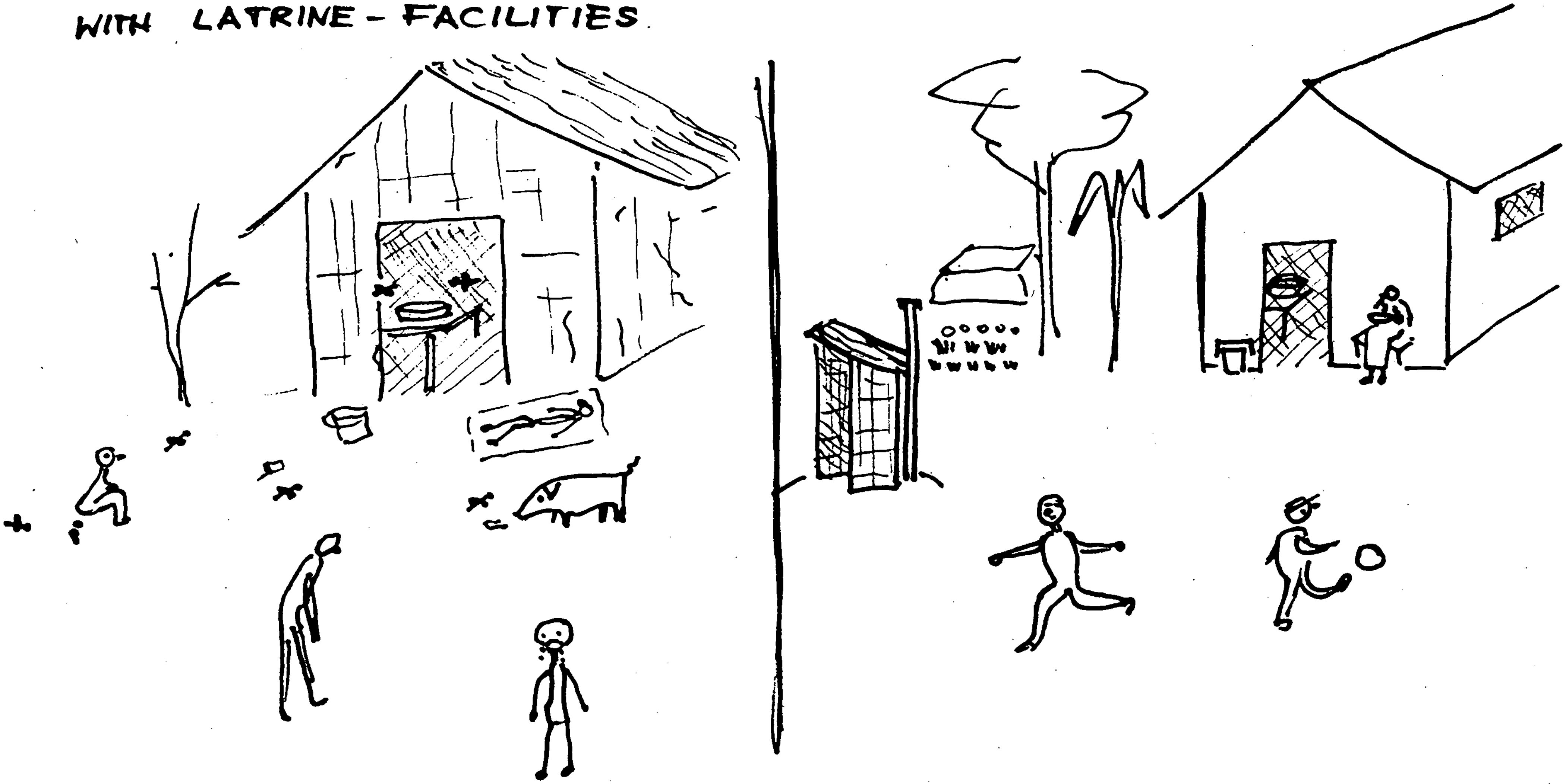
- THIS DRAFT IS INCOMPLETE
- AIM OF THIS DRAFT IS TO PROVIDE IDEAS FOR A MANUAL WHICH IS ADAPTED TO A PARTICULAR LOCAL CONTEXT
  - FIRST OF ALL THE MOST APPROPRIATE WAY OF COMMUNICATION HAS TO BE FOUND OUT (HOW DO VILLAGERS INTERPRET PICTURES ETC.)
  - DRAWINGS HAVE TO CONSIDER THE LOCAL CIRCUMSTANCES
  - THE STEPS SHOWING THE CONSTRUCTION HAVE TO FOLLOW THE LATRINE DESIGN FOUND APPROPRIATE FOR A PARTICULAR SITE
  - POSSIBILITIES OF HOW TO CONTACT LOCAL INSTITUTIONS MAY BE SHOWN AS WELL
- IT IS ESSENTIAL TO WORK OUT AT FIRST DRAFT CONSIDERING THE LOCAL CONTEXT AS MUCH AS POSSIBLE AND THAN TO WORK WITH THIS TEACHING TOOL IN VILLAGES. AFTER AN INTRODUCTION PHASE THE MANUAL SHOULD BE FINALISED CONSIDERING THE EXPERIENCES GAINED.

SOMETIMES IT IS INCONVENIENT
TO DEFECATE IN THE OPEN FIELD

SOMETIMES IT IS EMBARRASSING TO DEFECATE AT THE EDGE OF THE VILLAGE


IT STINKS IF YOU
DEFECATE AT THE SIDE
OF THE ROAD, OR CLOSE TO THE VILLAGE
WHAT WILL PEOPLE THINK IF
YOU DO SO?

DEPENDING ON THE PERCEPTIONS OF THE VILLAGERS, IT MIGHT BE ADVISEABLE TO REPLACE PAGE 42) BY ALTERNATIVES AS FOR INSTANCE BY SHOWING ON ONE SIDE A VILLAGE WITHOUT ANY FACILITIES FOR EXCRETA DISPOSAL AND ON THE OTHER SIDE HEALTHY VILLAGE WITH LATRINE-FACILITIES.



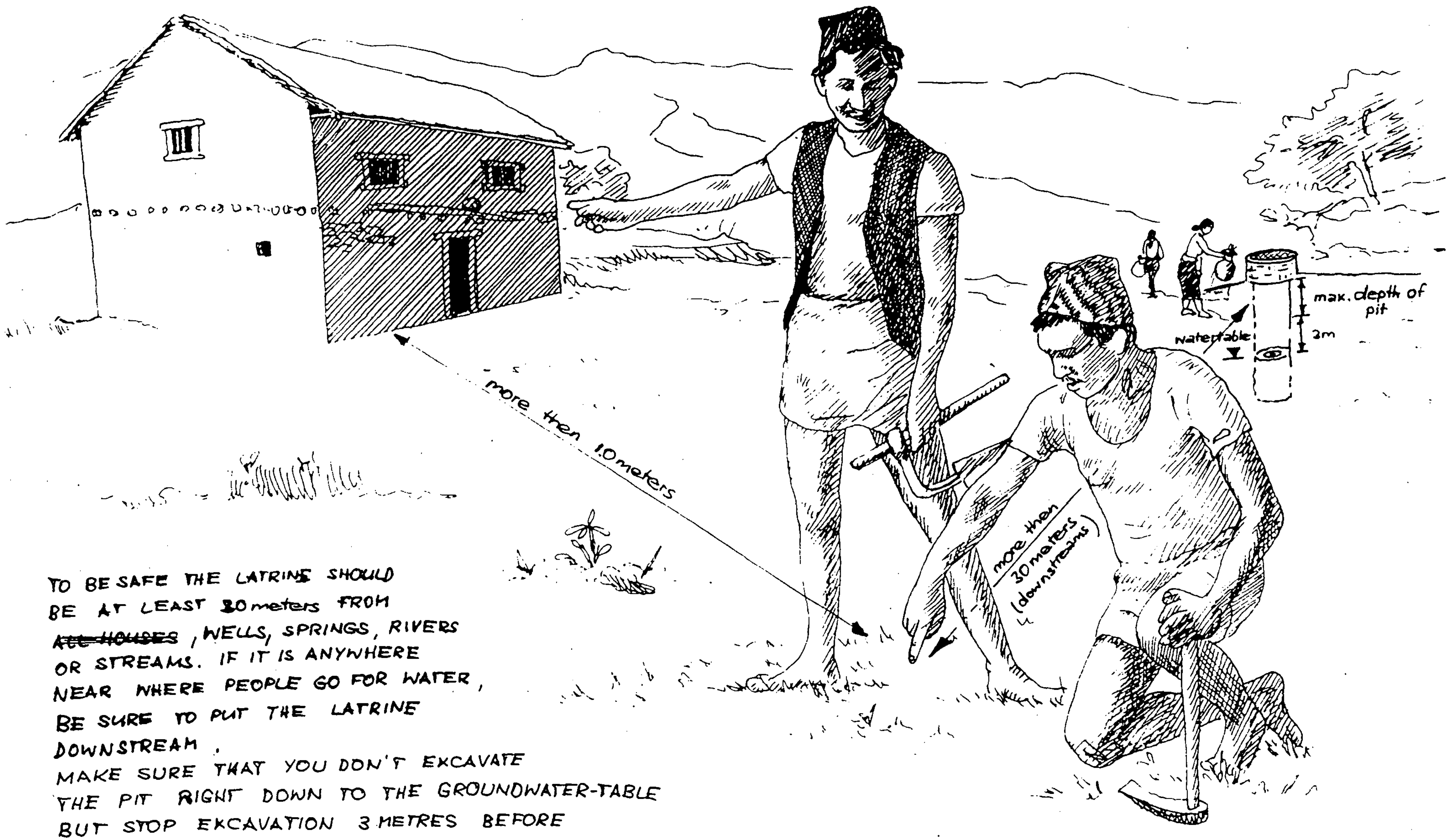
IF EXCRETA IS EXPOSED NEAR THE HOUSE FLIES MAY CARRY SMALL AMOUNTS OF EXCRETA ON THEIR FEET AND WILL THEREFORE CONTAMINATE YOUR FOOD WHEN THEY COME TO EAT ON IT. SOME DAYS LATER YOU MAY START SUFFERING FROM DIARRHOEA OR OTHER SERIOUS STOMACH PROBLEMS.....

..... IF THE EXCRETA ARE DEPOSITED IN A PIT LATRINE FLIES CAN NOT GET TO THEM SO EASELY ANY-MORE. THIS WILL HELP TO PROTECT YOURSELF, YOUR FAMILY AND THE VILLAGERS

IF AN INFESTED PERSON DEFECATES NEAR TO A WELL THE EXCRETA MIGHT BE WASHED INTO THE WELL BY RAIN OR SOMEBODY MIGHT STEP ON IT AND CARRY THE DISEASE TO THE WELL. → PERSONS DRINKING WATER FROM THAT WELL MIGHT GET SICK AS WELL.
BUT IF PEOPLE USE LATRINES FOR DEFECATION THIS WILL HELP TO KEEP THE WELL WATER FREE OF DISEASES AND TO IMPROVE THE HEALTH OF THE VILLAGERS.

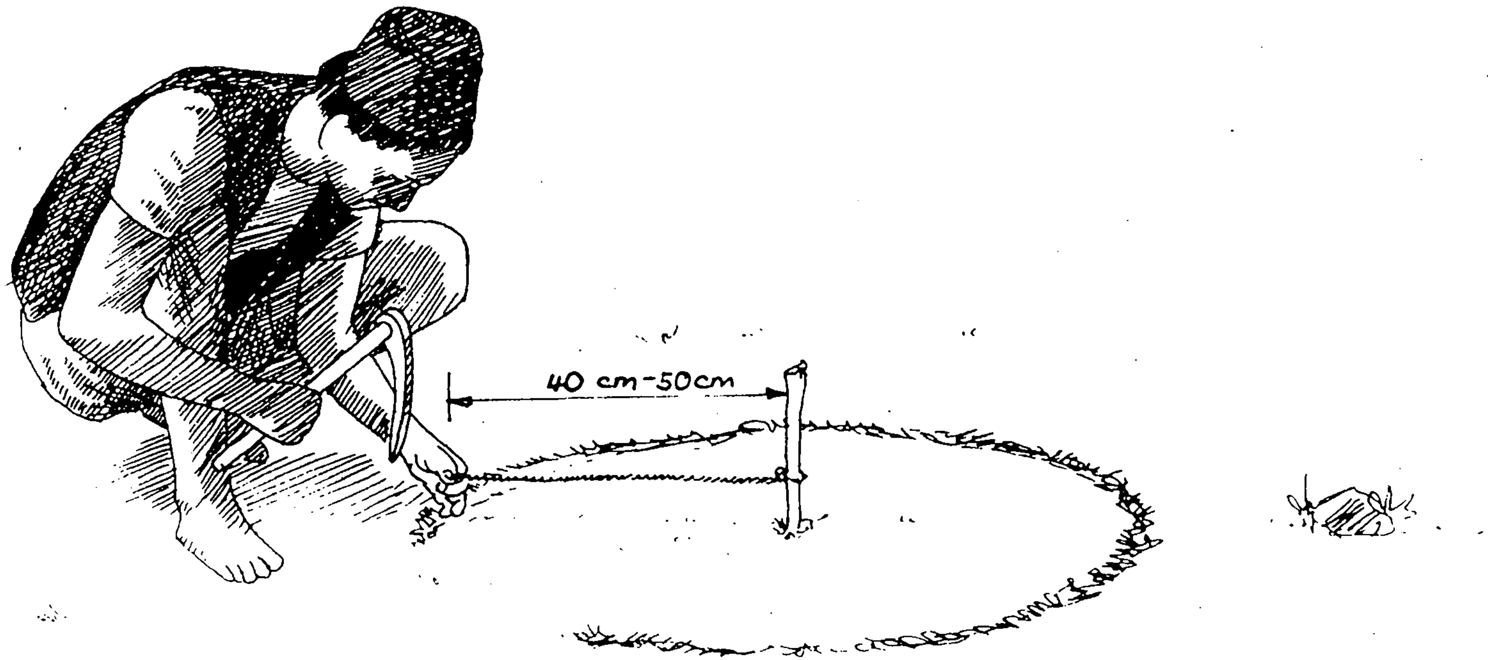
TRANSMISION OF DESEASES BY HAND

IMPORTANCE OF WASHING HANDS
WITH SOAP ETC.



TO BE SAFE THE LATRINE SHOULD BE AT LEAST 30 meters FROM ~~ALL HOUSES~~, WELLS, SPRINGS, RIVERS OR STREAMS. IF IT IS ANYWHERE NEAR WHERE PEOPLE GO FOR WATER, BE SURE TO PUT THE LATRINE DOWNSTREAM.

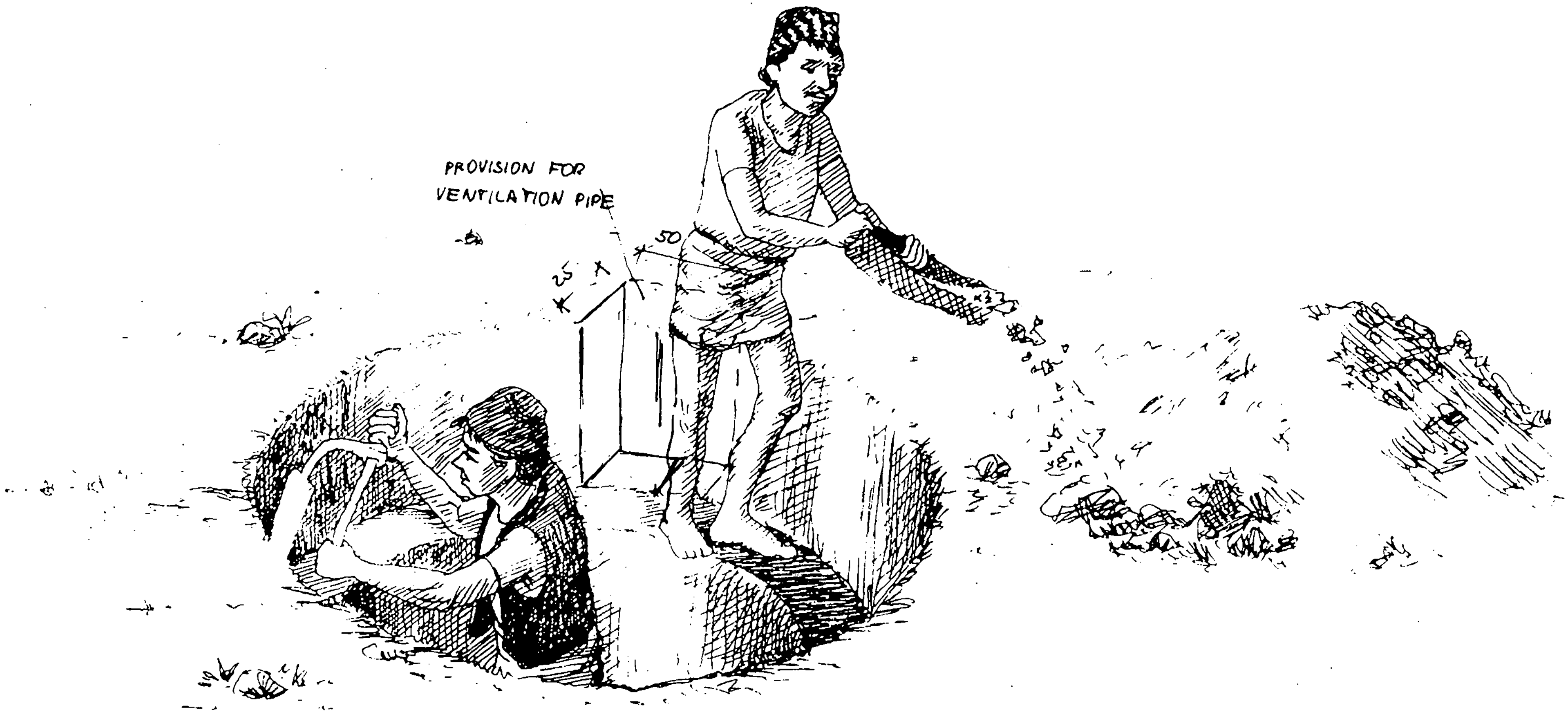
MAKE SURE THAT YOU DON'T EXCAVATE THE PIT RIGHT DOWN TO THE GROUNDWATER-TABLE BUT STOP EXCAVATION 3 METRES BEFORE REACHING THE GROUNDWATER



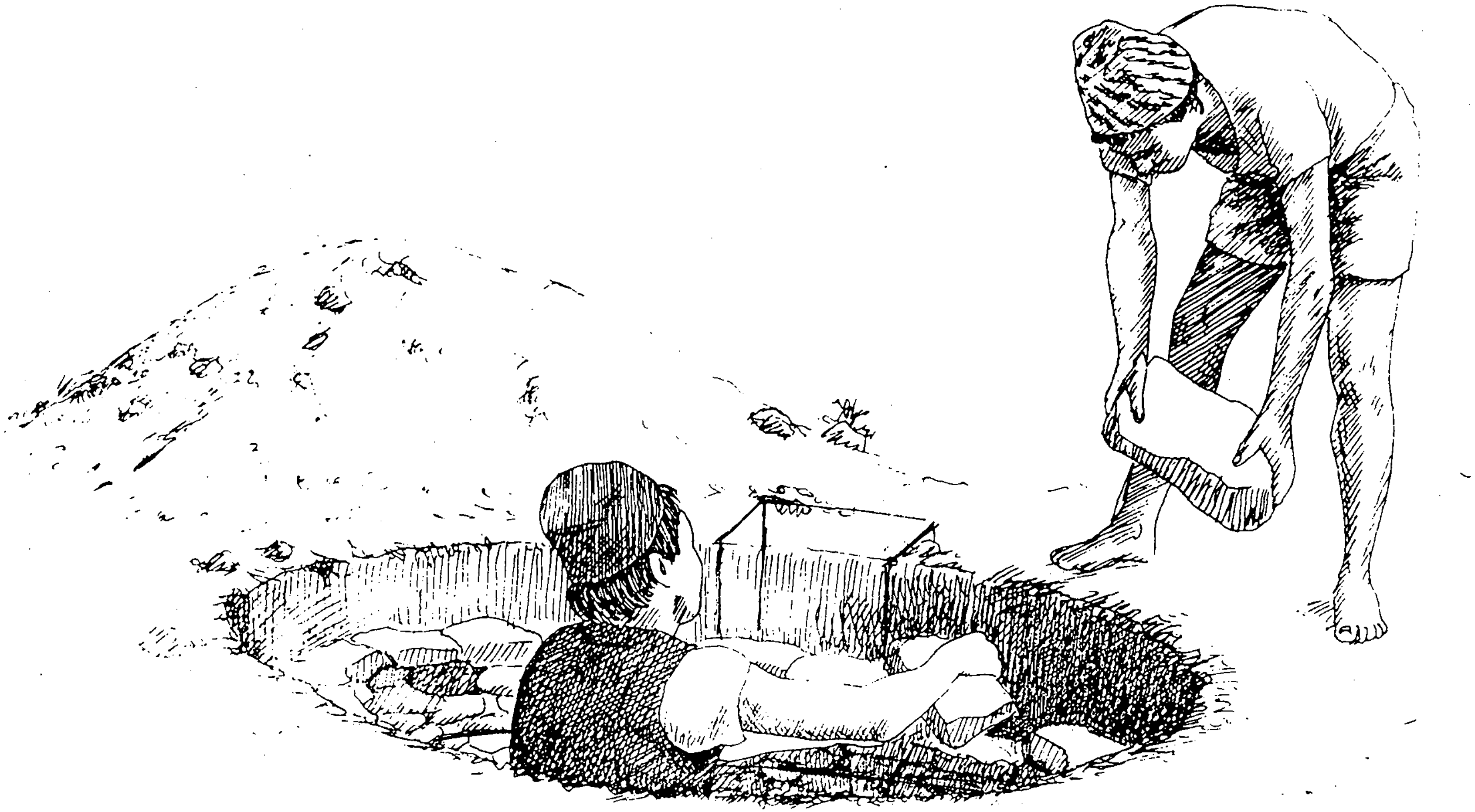
MARK THE GROUND SO AS TO DIG
A CIRCULAR PIT OF ABOUT 80-100 cm. in
DIAMETER

AS YOU DIG THE PIT,
PUT ALL THE EARTH ON ONE SIDE.
YOU WILL NEED IT LATER FOR THE
EARTHFILL ARROUND THE SUPERSTRUCTURE
AND EVENT. FOR MUD MASONRY

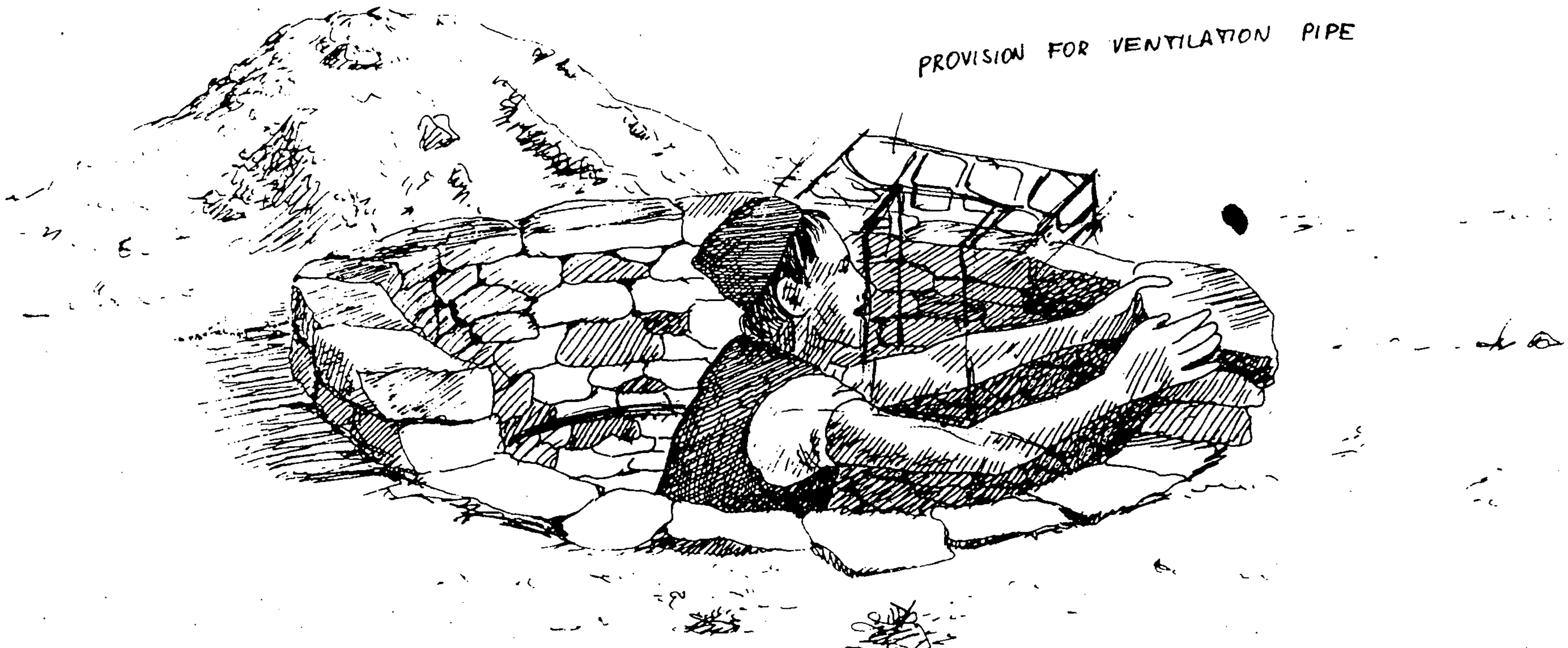
DIG THE PIT ACCORDING TO REQUIREMENTS 2-3 metres DEEP
(MAKE SURE THAT THE BOTTOM OF THE PIT REMAINS STILL AT
LEAST 3 metres ABOVE THE GROUNDWATERTABEL OR ANY ROCK FORMATION)



DIG THE UPPER 30 to 40 ~~contimetres~~ (1' to 1½')
ca. 25 cm ~~m~~ (10") wider to get a ~~good~~ firm
foundation for the masonry-ring. (or event.
concrete-ringbeam ca. 20×20cm which may be excavated
and casted ~~to~~ insitu before excavation of the pit.)



PUT A DRY-MASONRY-STONE WALL AROUND THE PART THAT HAS BEEN DUG WIDER. THIS WAY THE LOOSE TOP SOIL WILL NOT FALL INTO THE PIT, AND YOU GET A SOLID BASE FOR THE SQUATTING SLAB.

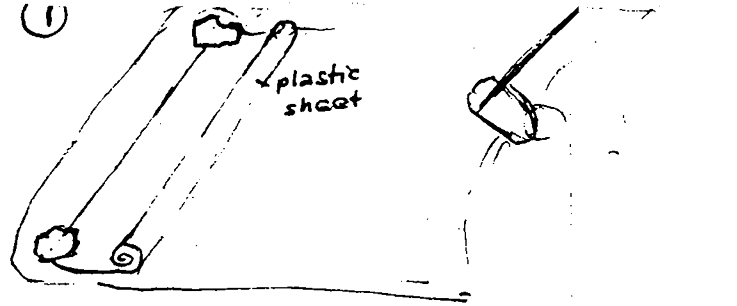


BUILD THE WALL ABOUT 20cm (8") HIGHER THEN THE GROUND ALLAROUND THE MOUTH OF THE PIT. THE LAST COURSE OF STONES MAY BE BUILT IN MORTAR MASONRY.

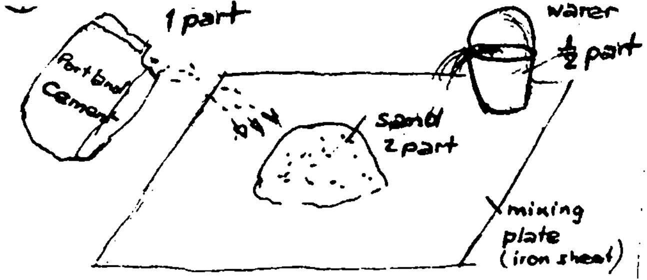
INFORMATIONS ABOUT WHAT TO DO IN CASE OF :

- LOOSE SOIL (e.g. lining of pit)
- High water-table
- Rocky ground
- etc.

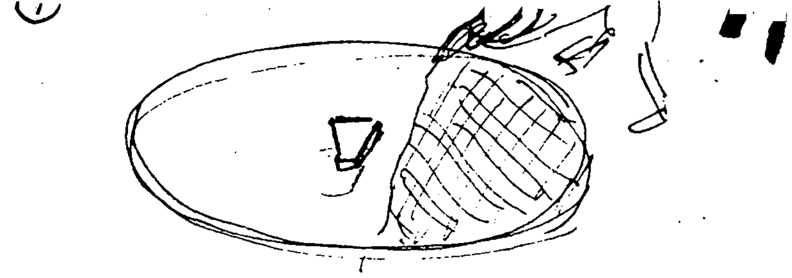
(1)



prepare a level groundsurface ca. 150 x 150 cm in a shady place

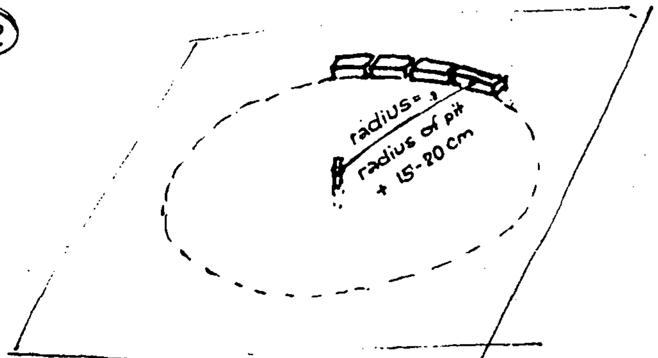


prepare cement mortar mixture of 1 : 2 : 0,4 (cement : sand : water)



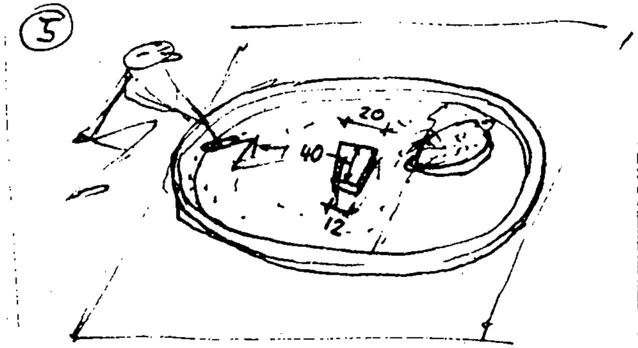
add aproximatively 15 mm of mortar and ramm it well into the wiremesh below

(2)



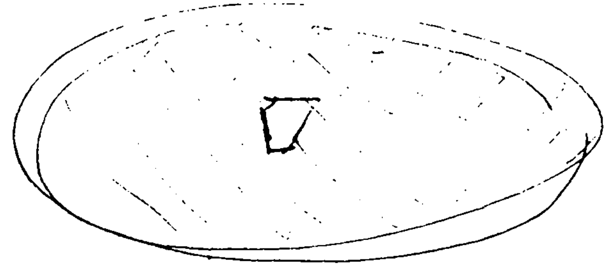
place formwork (bricks or timber) to give the desired size

(5)



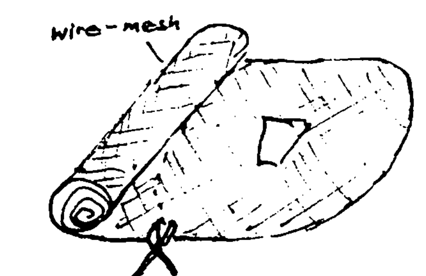
lay a first layer of mortar ca 4 mm thick

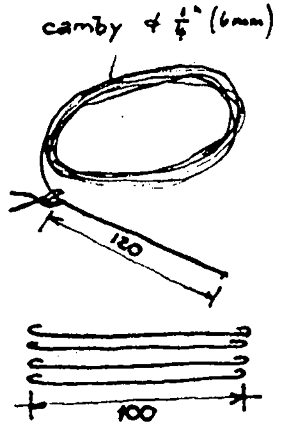
(8)



place the second wire mesh into the fresh mortar

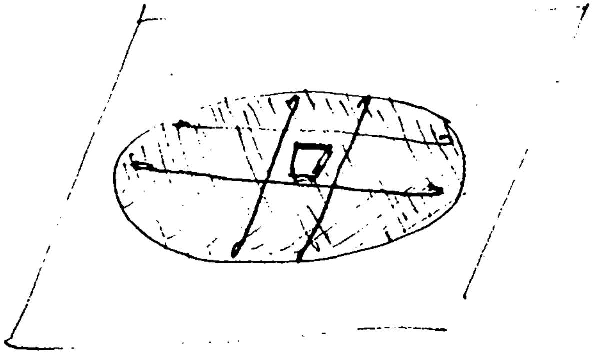
(3)





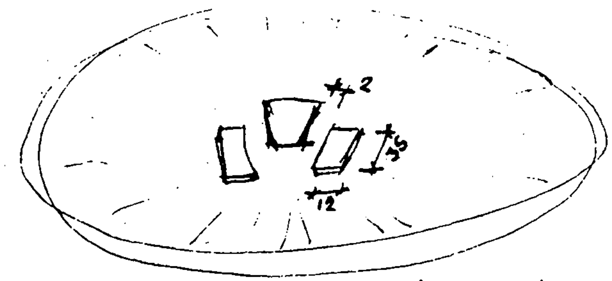
prepare 2 layers wire mesh and 4pc of ∅ 6mm steel-bars cut to required length

(6)



lay one net of wire mesh and the 6mm steelbars on top of the mortar when it is still fresh

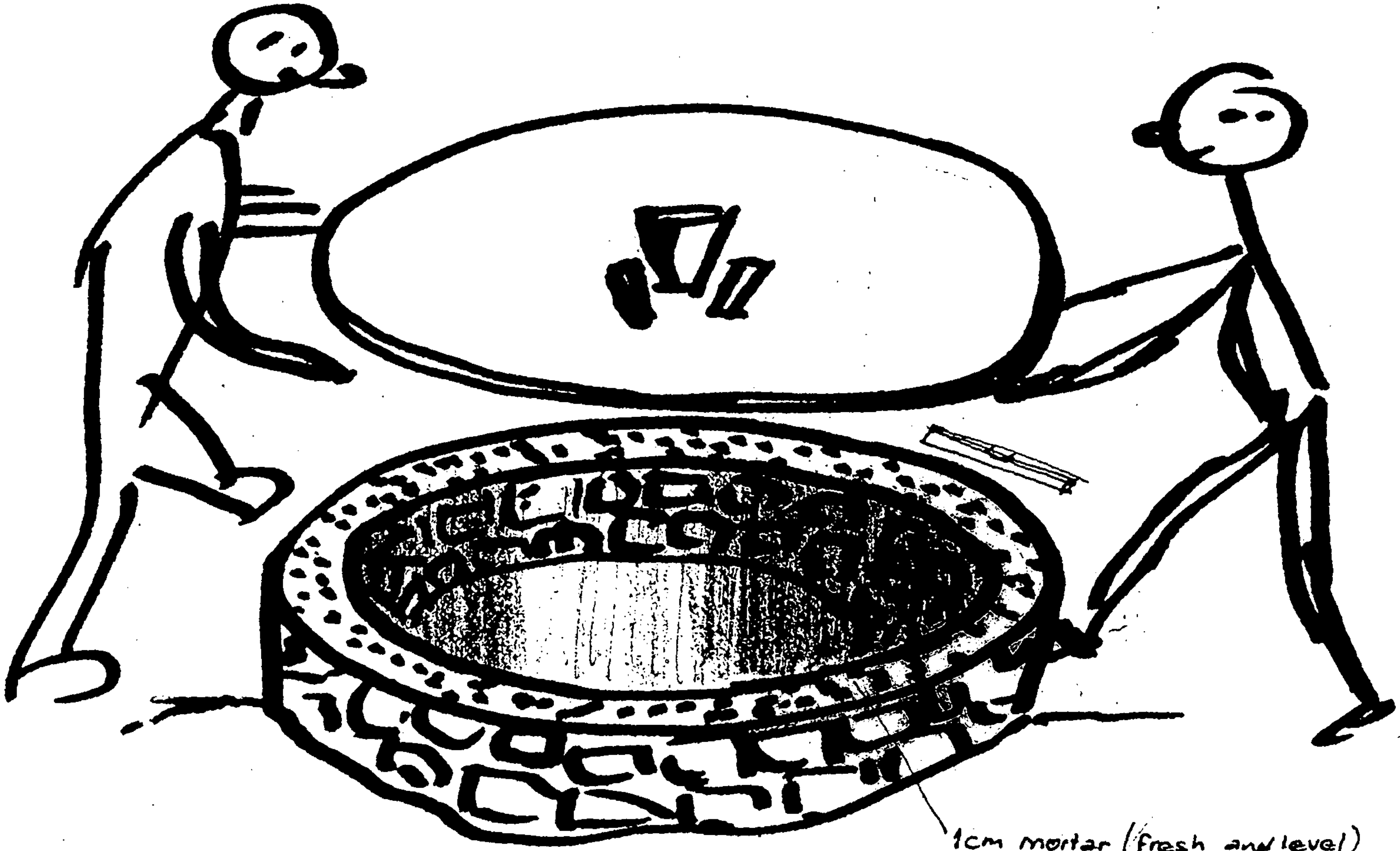
(9)



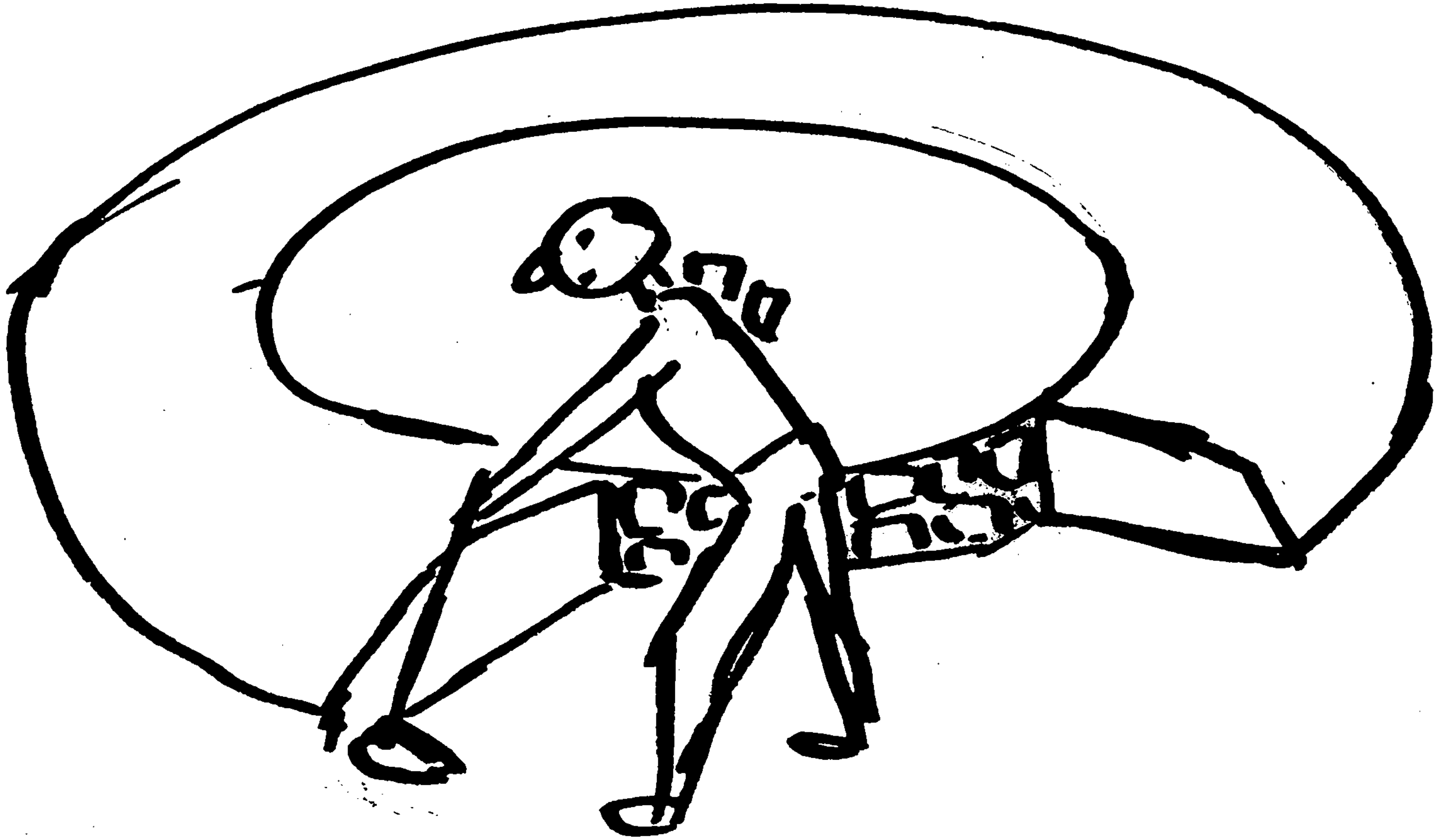
add the last layer of mortar to provide a slab-thickness of 3cm at the centre and 4-5cm at the edges (slope towards squatting hole) Make sure a smooth surface. (incl. footrests)

keep it covered and wet for the next 7days before you might lift it to the pit.

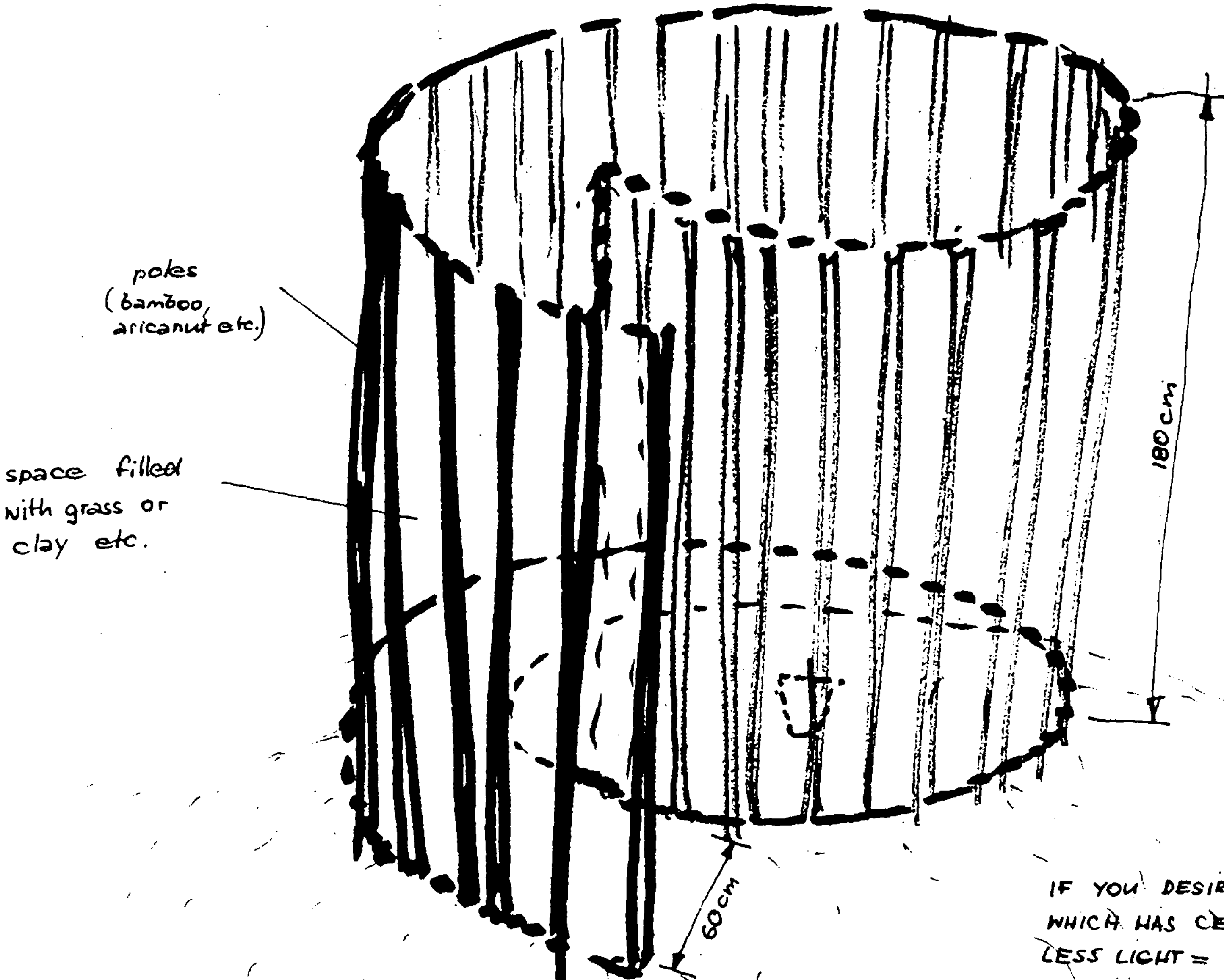
CONSTRUCTION OF FERROCEMENT SQUATTING SLAB



PUT ABOUT 1cm (½") of Mortar ON THE STONEMASONRY-RING, LEVEL ~~BEFOR~~ IT PROPERLY AND WHEN IT IS STILL WET PLACE THE PREFABRICATED FERROCEMENT SQUATTING SLAB ON IT. MAKE SURE THAT IT IS ALL AROUND WELL SUPPORTED!

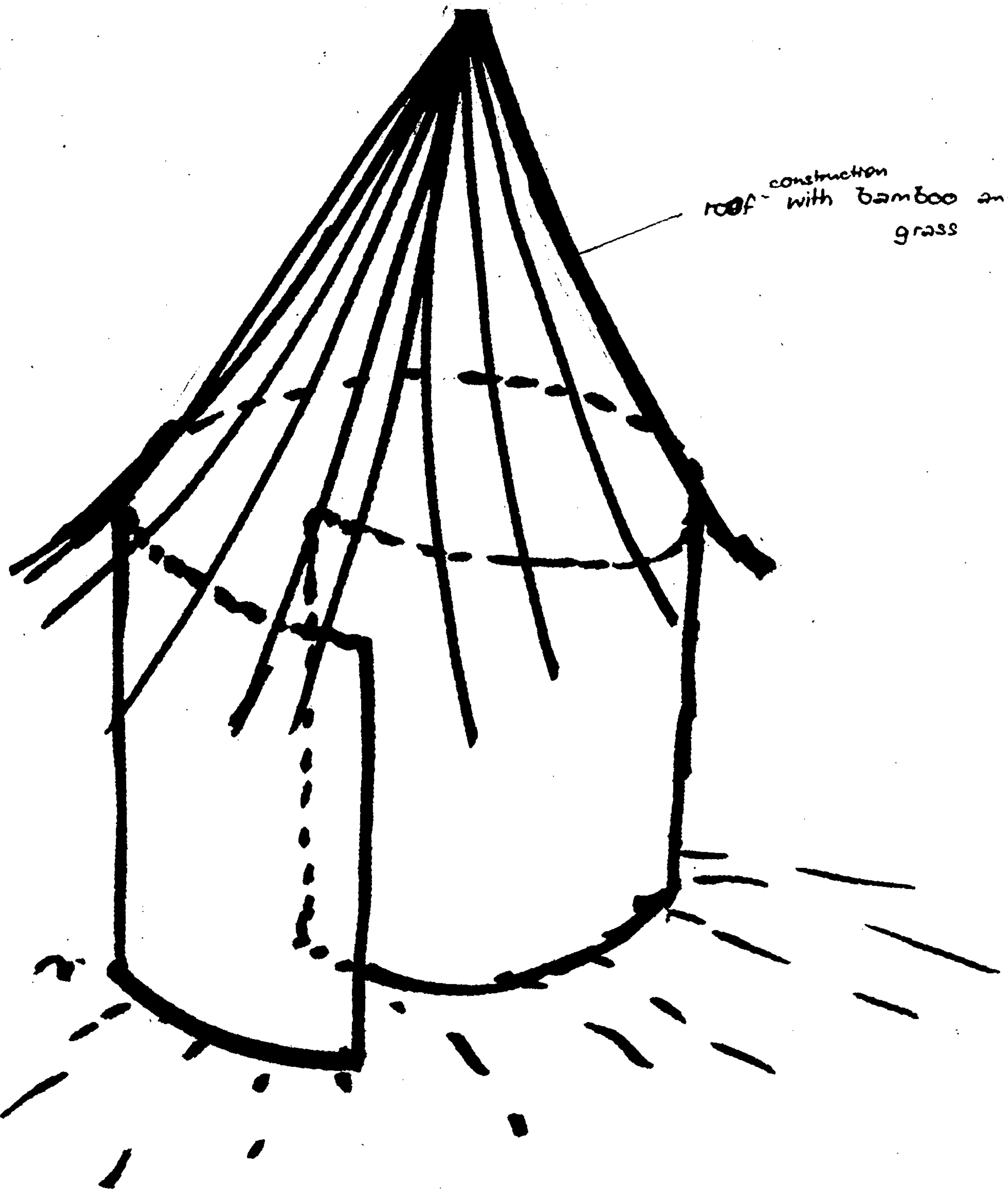


AFTER COVERING THE PIT
FILL EARTH ~~ARROUND~~ TO THE LEVEL
OF THE SLAP ALL AROUND.
COMPACT WELL.



IF YOU DESIRE TO BUILD A CIRCULAR HUT WHICH HAS CERTAIN ADVANTAGES (NO DOOR REQUIRED, LESS LIGHT = LESS ~~LIGHT~~ FLIES) THEN YOU RAM BAMBOO OR ARICANUT (POLES ~~ETC~~ ETC.) ACCORDING TO ABOVE DESIGNE INTO THE GROUND. THE WALLS CAN BE FINISHED EITHER WITH CLAY WORK OR GRASS, OR MATTING.

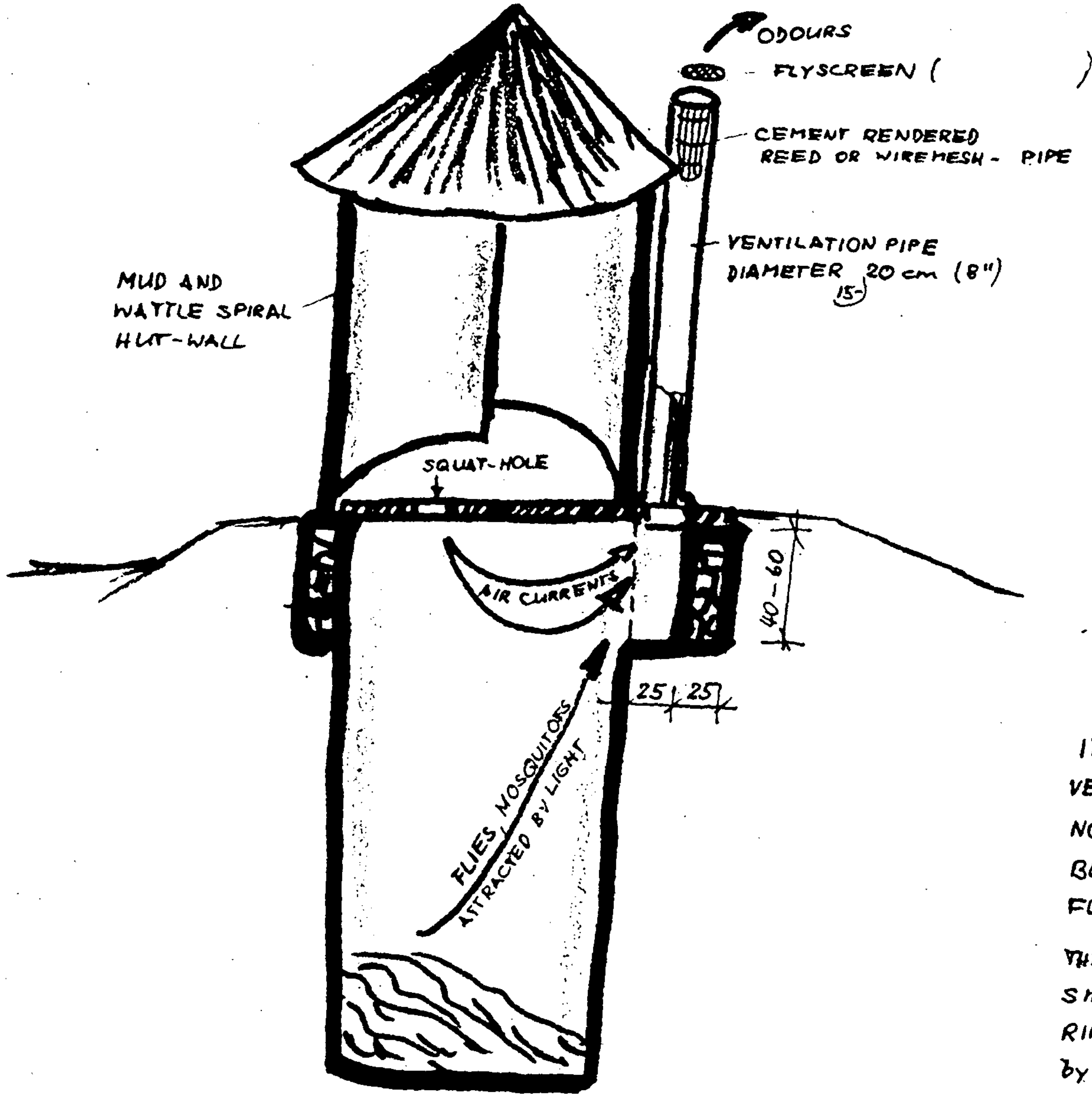
(THE ENTRANCE SHOULD SHOW AWAY FROM EAST OR WEST IN ORDER TO AVOID BRIGHT SUNLIGHT IN THE LATRINE DURING MORNING AND EVENING HOURS



THE ROOF MAY BE SIMPLY THACHED

(A SMALL SPACE MAY BE LEFT OPEN BETWEEN THE WALL AND THE ROOF.) THE INTERIOR OF THE LATRINE SHOULD HOWEVER BE QUITE DARK IN ORDER TO MAKE THE LATRINE UNATTRACTIVE FOR FLIES

BUT ALSO A RECTANGULAR HUT MAY BE BUILT IF DESIRED. MAKE WALLS ON THREE SIDES WITH REEDS, STRAW, GRASS OR CLAY-WORK. PUT A DOOR ON ONE SIDE.



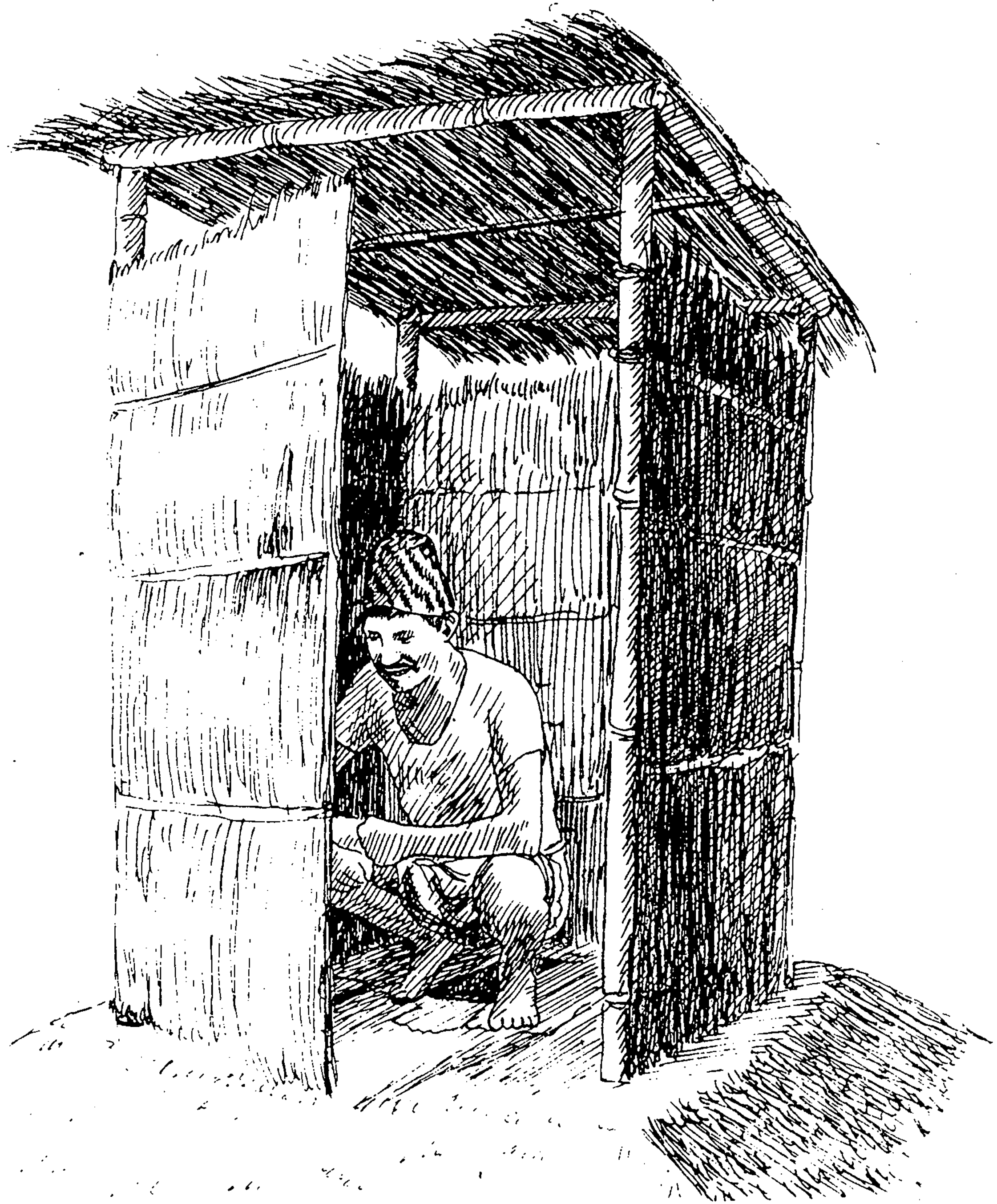
IT IS VERY ADVISEABLE TO ADD A SCREENED VENTILATION PIPE TO THE PIT LATRINE. NOT ONLY TO GET RID OF BAD ODOUR BUT TO REDUCE THE NUMBER OF MOSQUITOES AND FLIES LEAVING THE PIT

THE PROPOSED CONSTRUCTION IS QUITE SIMPLE: JUST ADD TO THE UPPER ~~AN~~ RING AN OTHER EXTENSION OF 25 cm by 50 cm AT THE OPPOSITE SIDE OF THE ENTRANCE.* BUILD THE STONE WALL ACCORDINGLY. ADD A COVER SLAB of 50 cm by 50 cm with a hole for the ventilation-pipe. A FIX THE VENTILATION PIPE ONTO THIS SLAB

*(IF POSSIBLE AT THE SUNNY SIDE)

INCASE OF A CONVENTIAL PIT LATRINE (BUT NEVER FOR V.I.P. LATRINE, WHERE AIRCIRCULATION IS ESSENTIAL)

MAKE A WOODEN LID WHICH TIGHTLY COVERS THE SQUATTING HOLE NICELY. THIS WAY IT WONT SMELL AND FLIES WON'T COME TO COLLECT DISEASES TO YOUR FOOD.



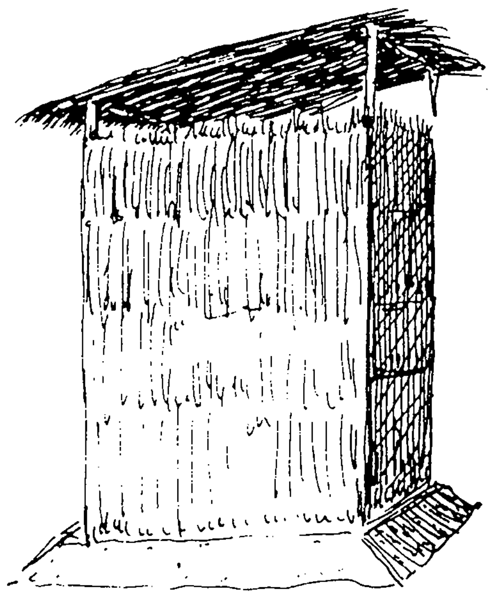
NOW THE PIT LATRINE IS READY
CLOSE THE DOOR AND RELIEVE
YOURSELF WITHOUT ANY WORRIES.
KEEP THE DOOR ALSO SHUT
AFTER USE (TO KEEP FLIES
AWAY)

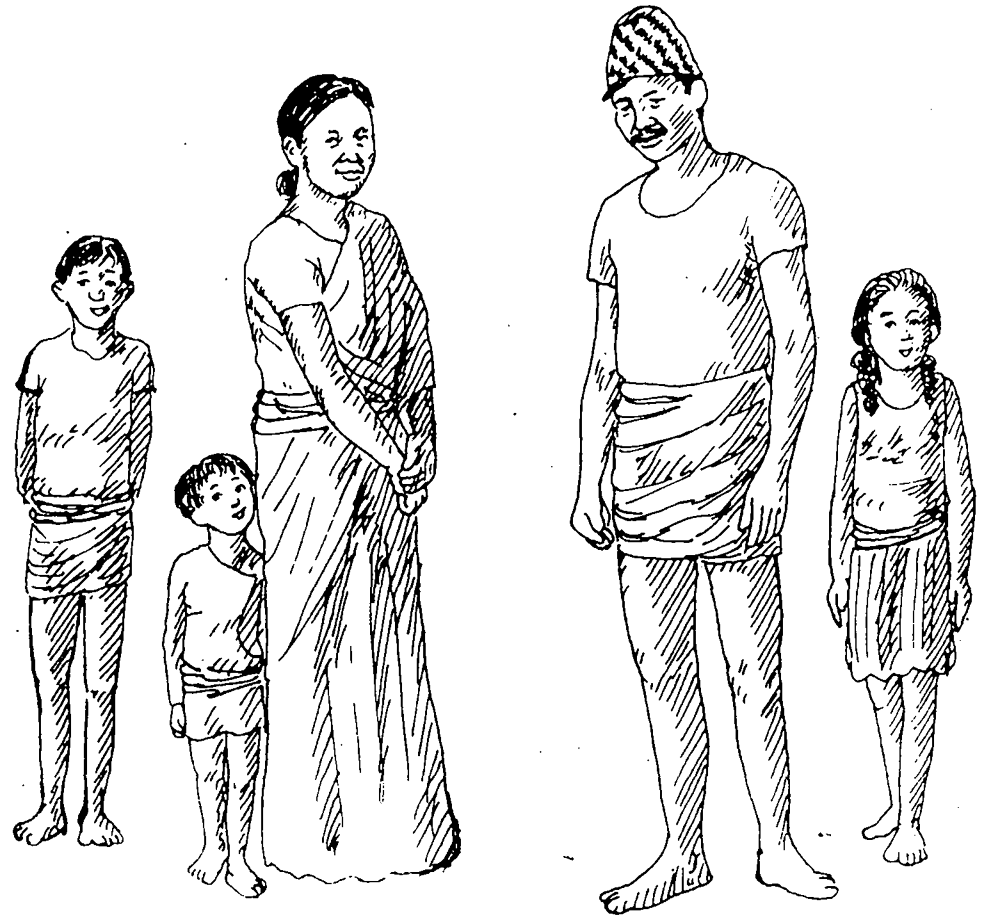
IMMEDIATLY AFTER DEFECATING, WASH YOUR HANDS WELL WITH SOAP OR ASHES AND PLENTY OF WATER

EVERYBODY IN YOUR FAMILY
SHOULD USE THE LATRINE THEREFORE
TEACH YOUR CHILDREN TO USE
THE PIT LATRINE.
PARENTS SHOULD TAKE CARE ~~FOR~~
OF THE CHILDREN SO THAT NO ONE
FALLS INTO THE PIT OR MAKES
THE ~~LATRP~~ LATRINE DIRTY.

ALWAYS KEEP
THE PIT LATRINE CLEAN.

IF YOU PUT ASHES, EARTH OR DRY LEAVES INTO THE PIT FROM TIME TO TIME IT WON'T SMELL.





NOW, SINCE EVERYBODY IN YOUR FAMILY IS USING THE LATRINE THE AREA AROUND YOUR HOME WILL NOT BE CONTAMINATED WITH EXCRETA ANYMORE... THEREFORE YOUR FAMILY (THE CHILDREN IN PARTICULAR) WILL NOT FALL SICK AS FREQUENTLY AS BEFORE, HEALTH WILL IMPROVE

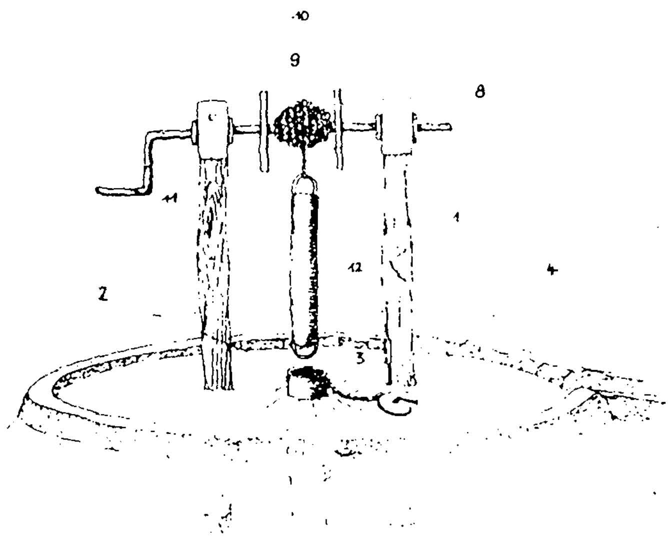
YOU WON'T HAVE TO MAKE A NEW PIT LATRINE FOR THE NEXT FIVE YEARS IF YOU OPERATE AND MAITAINE THE LATRINE CORRECTLY

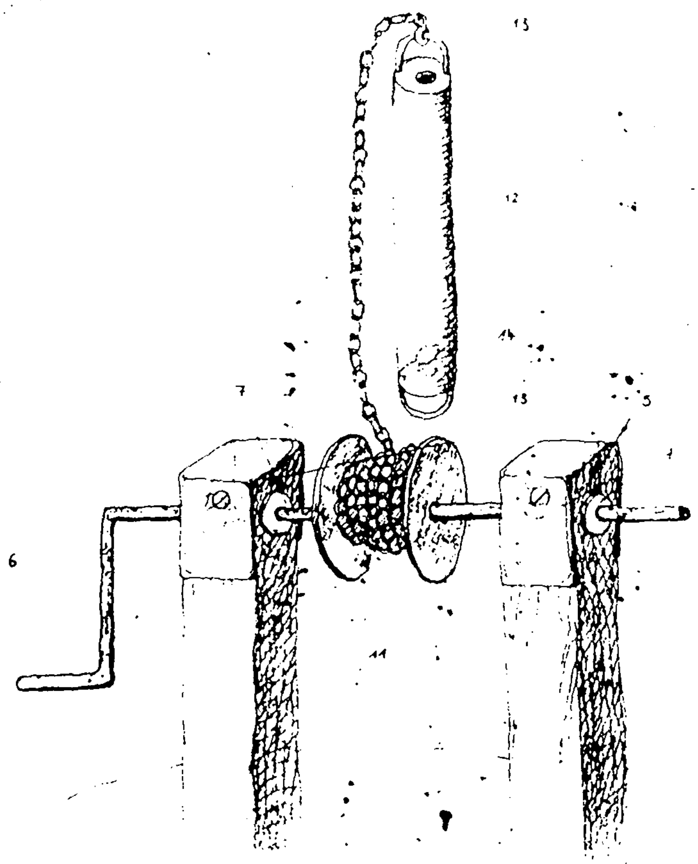
What to do when the pit is full

- moving the pit to a new site
  (who selects a new site ?)
- how to handle excreta
  (e.g. emptying only after 12 months)

dirt adhering to the bott[illegible] to guarantee rapid bucket [illegible] valve[11] is fitted to the bottom. [illegible] simply a rubber flap fitted above a hole bored in the base. It's as simple as that.

If you should decide to build your own version of the bucket pump, please send us a brief report on your experiences together with a photo or two. Your experiences are very important to us at GATE, even when they are negative. You will find our address on page 2 of this issue. And another thing. Please remember not every technique can be used in every individual case! This can help to avoid disappointments. ■





The bucket pump. 1 post. 2 casing. 3+8 chain. 4 lid. 5 slot. 6 hand-crank. 7 washer. 9 disk. 10 sheet metal. 11 [illegible] 12 bucket. 13 steel.

Drawings: Andreas Reckener