SANPLAT

An alternative low-cost pit latrine system
for rural and peri-urban areas

TECHNICAL GUIDE

by

F SOLSONA
Development Services and Technology Programme
Division of Water Technology
CSIR

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1. INTRODUCTION

The provision of adequate latrines to all households and their safe and hygienic use will make a major impact on the health of a nation, particularly with respect to child mortality, and debilitating illnesses amongst school children and adults. The joint approach of focusing on the development of adequate clean water supplies, household sanitation, and the provision of hygiene education is recognised as being instrumental in significantly reducing the spread of certain diseases within communities.

People living in the poverty belts around the big cities, and rural inhabitants of many developing countries generally lack adequate sanitation services. This has resulted in infant mortality rates in these communities being well above the national averages.

A problem faced by health authorities is that, whilst communities will always recognise the importance of an improved water supply, sanitation seldom receives the same priority. Hence individual motivation to do something to improve household sanitation is often low.

Considering only the South African situation, it is estimated that one in every two people lack access to adequate sanitation (Palmer Development Group, 1992). An important word here is the word "adequate", since, although more than 50% of the people do have latrines, the state and acceptability of many of these toilets do not meet the criteria for adequacy. This is largely due to unhygienic structures where flies have ready access in and out of the pit, odour problems, and poorly constructed pedestals or squat holes which children and old people in particular are afraid to use.

With the declaration of the "International Water Supply and Sanitation Decade" of the 1980s, and the emphasis on "Health for All" during the 1990s, the improvement of sanitation has been receiving increased attention, particularly in developing countries. This need has been emphasized further with the rapid growth of many cities in third world countries, in which it has not been possible to provide any sanitation services in many cases. The high density of people within an urban area can lead to the rapid spread of diseases where sanitation and health services are inadequate.

In recent decades, a number of improved sanitation technologies have been developed and applied. Some of these which have been widely used are aqua privies, bucket latrines, composting toilets, "Feuillees" or ditch latrines, Blair or ventilated improved pit latrines (VIP) and several others. The VIP latrine has been viewed in Africa as the most appropriate and acceptable technology to meet the vast needs of the continent.

The VIP latrine has been found to be an affordable technology particularly suited to the dry, water scarce conditions of Africa. Its use has been promoted in many government programmes in Southern Africa, supported by international development organisations.

Nevertheless, the widespread use of VIPs has highlighted a few less desirable aspects related to their design and use in practice. The following have been some of the main perceived short-comings of the standard VIP latrine:

- The theoretical flow of air that should draw odours out of the pit through the vent pipe has not always been found to work as expected. In many cases users have complained of smells coming into the latrine enclosure from the pit through the pedestals or squat holes. This negative direction of air flow happens when the prevailing wind is from a certain direction.

- In dense settlements with a large number of VIP latrines, the odours coming from the pits through the vent pipes causes a general mal-odour in the community. This is especially the case in the early mornings and in the evenings when the air is still and temperature inversion prevents the odours escaping into the upper layers of the atmosphere.

- The vent pipes themselves do clog with spider webs and debris, and require regular cleaning. This task is, however, seldom carried out by the home-owners as it is not readily apparent when the vent pipe becomes clogged. The screen gauze on the top of the vent pipes to prevent flies from escaping is also seldom checked for tears, and then repaired if necessary. This results in a breakdown of control of the odours and/or flies from the pit.

- The necessity of making a well constructed superstructure to provide a dark environment within the latrines to discourage flies is not usually acceptable to the users. This also puts up the cost and results in the system being unaffordable to a large percentage of people. Users would normally like to have a well lighted interior of the latrine so that they can easily see debris and perhaps snakes on the floor, and to encourage children not to be afraid of the latrine. Where lower cost local building materials can be used for the superstructure, e.g. reeds, "wattle and daub", thatch, the latrine may often be affordable to a larger percentage of the residents. Furthermore, a light-weight structure which can be moved when the pit is full may be more suitable, especially in the remote areas.

- Typical slabs designed for pit latrines are not only relatively expensive but also very heavy. Generally slabs must be cast directly on the pit, or else alongside the pit and then moved over the pit when cured. It is difficult to maintain a high level of quality control in such circumstances, particularly if there is not water readily available for curing. Reinforcing steel for the slab may also not be available locally, and may then be a significant cost item for the latrine. Lastly, these heavy floor slabs cannot easily be moved for re-use when the latrine is fill and a new pit is dug.

However, it must be strongly acknowledged that the VIP has resulted in a significant improvement in the sanitation situation of many African villages, and even some peri-urban areas. The VIP is a vastly better toilet than the unimproved pit latrine, particularly regarding hygiene and user acceptability. Because of the promotion the VIP has vastly enjoyed in many countries including South Africa, it has come to be considered the least expensive sanitation option in terms of both capital costs and operation and maintenance costs (Palmer Development Group, 1992).

A study supported by the Water Research Commission of South Africa has estimated that the cost of VIP latrines ranges in South Africa between R 2 200 and R 3 300 (Palmer Development Group, 1992). Some private contractors however, who construct a large number of latrines such as implemented through governmental programmes, have been able to reduce those costs to approximately R 1 000. Similarly, the cost of VIPs in sanitation programmes in some rural areas are also approximately R 1 000 when small local building contractors are mobilised.

So the VIP is not always the perfect sanitation option nor a truly affordable one by households in the lower economic bracket.

Recent trends in what is called the appropriate technology philosophy, has shown the way to look for still more innovative soiutions and to reduce costs even beyond that which have been achieved in the past, with the only caution that the reduced costs should not impose a health risk. Or as the South African White Paper on Land Reform (1991) states: "...the accent must be on minimum standards and the systematic upgrading thereof."

2. THE SANPLAT CONCEPT

Background

The SanPlat concept is not new, but originated from earlier latrine designs where the pit was basically sealed except when in use. However, the concept had been poorly implemented and most "unimproved" pit latrines were not sealed and allowed flies free access in and out of the pit, as well as causing mal-odours.

The SanPlat programme originated in 1979 in Mozambique through a programme developed by the Mozambique National Directorate of Housing, later the National Institute of Physical Planning (Brandberg, 1991). With the support of the SIDA, Mr Björn Brandberg, an architect and building engineer from Sweden was contracted to design a latrine version more suitable to Mozambique than the standard VIP.

Mr Brandberg's idea was so successful that today throughout Mozambique and beyond, SanPlat programmes have been initiated for rural and peri-urban communities. Programmes have been developed in Angola, Bangladesh, Malawi, Kenya, Tanzania and Uganda. More than 100 000 units have been built and more than half a million people enjoy the benefits of their use (Brandberg, 1993 personal communication).

The primary concept of the SanPlat latrine is very simple. The excreta has to be completely isolated from any "vector" or germ carrier, such as people's feet or hands, flies, dogs, cats, cattle, insects and rodents.

Important features

The system comprises of a normal pit, with a slab and a superstructure, as in any other pit latrine. However, the main variation is in the slab itself. The platform or SanPlat, a term that stands for SANitary PLATform, does not allow "ventilation" of the pit, but rather the opposite - that of "complete isolation" of the pit.

The first important feature of the SanPlat is that the pit is kept sealed, which is incidentally contrary to what the VIP requires. The VIP is based on the principle that air is encouraged to flow into the superstructure, through the pedestal or squat hole, into the pit, and out through the vent pipe. This results in the flow of air helping to draw odours from the pit up through the vent pipe and into the atmosphere while keeping the interior of the latrine odour free.

The SanPlat does not function on this principle, but rather the flow of air into and out of the pit is prevented, with the only opening into the pit interior being the pedestal or squat hole. This hole is always kept tightly closed when not in use. Most odours then remain within the pit and are absorbed by the pit walls.

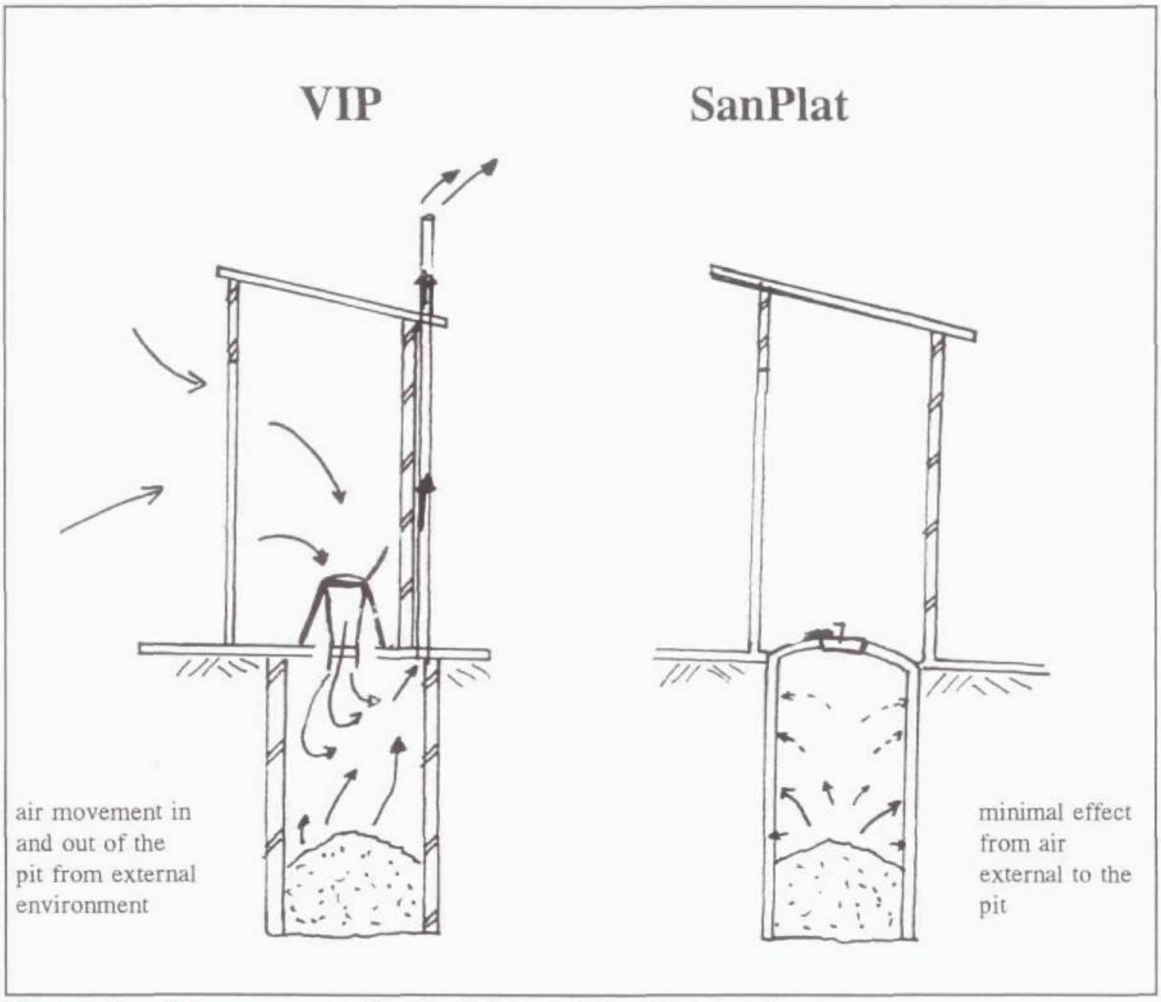


Figure 1: Air movement in the VIP and SanPlat latrines

Contrary to what may be expected, the odours do not escape from the pit during the very short period of time in which the latrine is used when the lid is raised or taken off. The interior of the latrine remains odour free, and no odours are drawn into the atmosphere above the latrine. This is an important consideration in densely settled areas, e.g. peri-urban environments, where a high density of vented pit latrines may give rise to a general mal-odour pervading the whole settlement.

The second important feature of the SanPlat is the slab itself. In general the VIP slab is of heavy construction and is difficult to move, especially once it is in place. Slab thicknesses of 100 mm and more are used in order to provide the platform with enough structural strength.

The SanPlat slab is designed as a lightweight, circular dome-shaped structure, with a thickness of only 40 mm. If constructed under well controlled conditions, the SanPlat slab does not require any reinforcement. Because of its light weight, it can be manufactured at a central casting yard and rolled or transported on a cart to each site. By this means quality of construction and the curing process can be better controlled. However, should quality control still be of concern, some minor reinforcement (chicken mesh fencing wire) should be added to the slab during construction.

The dome-shaped slab results in a lower cost slab than a conventional flat slab, but does mean that the pedestal or squat hole has to be located in the centre of the dome slab and hence the centre of the floor. Furthermore, no wall should be constructed directly on the slab unless additional structural strength is provided in the slab.

Because the slab and superstructure can be made of lightweight materials, it is possible to consider building the superstructure such that it and the slab can be moved when the pit is full. This makes the construction of a new latrine when the pit is full a relatively simple process.

The third important feature of the SanPlat is the simplicity of the superstructure. In the case of the SanPlat latrine, the superstructure only plays a role as a protection against the weather and to provide privacy. Hence the superstructure does not need to be specially constructed to ensure the proper working of the latrine, e.g. providing a dark environment inside the latrine. On the contrary, a more open structure, where plenty of natural light may enter, is encouraged.

Because of the lack of special requirements of this superstructure, it is possible either to build very simple structures through programmes with the intent of ensuring wide coverage, or to simply allow the beneficiary to build this protection according to his or her own choice. This results in a much wider choice in styles and costs, and can then be more closely pitched at the level of general affordability within a community.

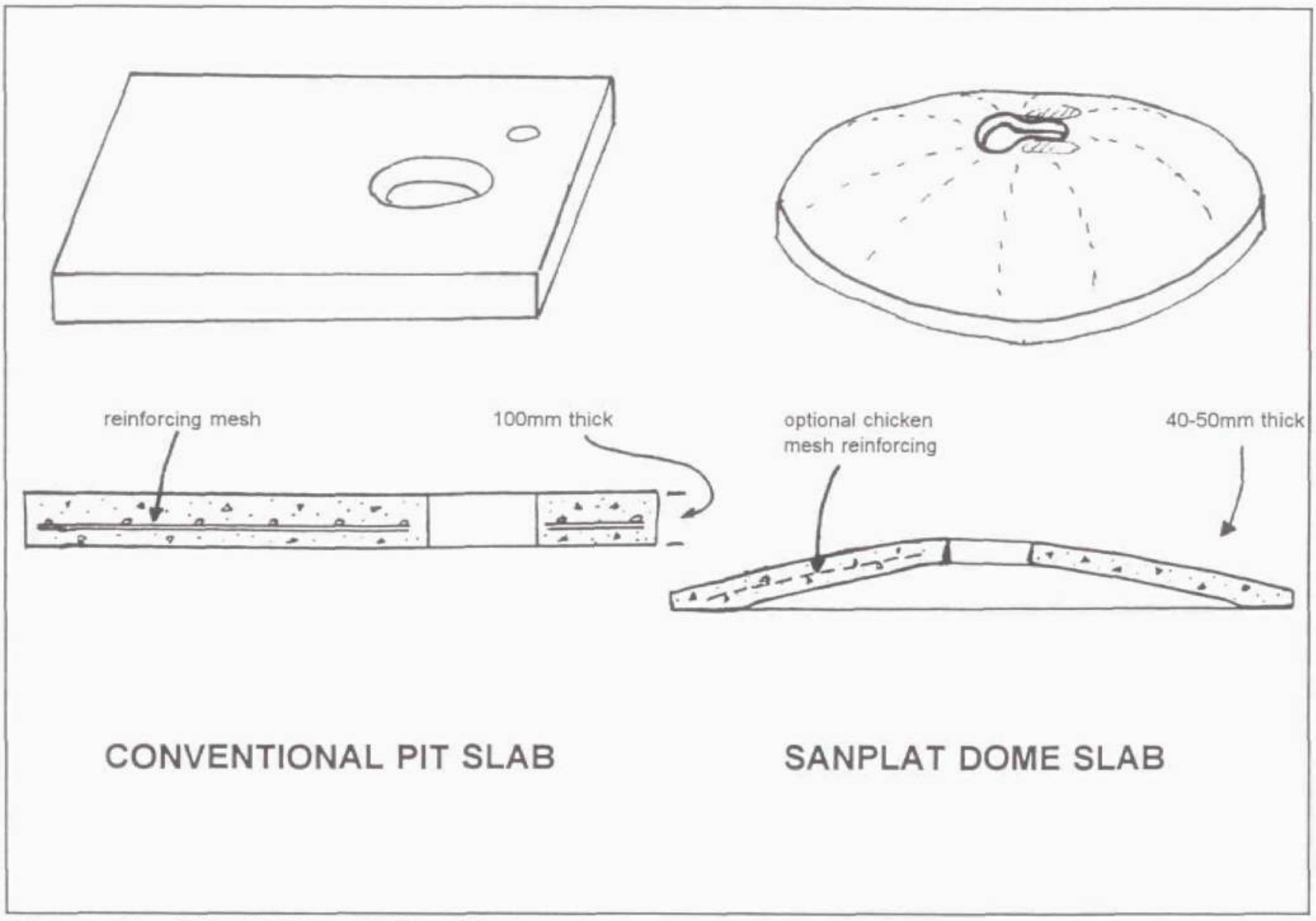


Figure 2: The VIP and SanPlat slabs

If a latrine programme is initiated in which the beneficiary would dig his own pit and provide his own superstructure, then the cost of a single latrine to the programme can be reduced to a very low level. The subsidy to ensure that latrines function adequately would be required only for:

- lining the pit if required (or constructing a pit collar),
- the slab,
- a pedestal or squat hole cover, and
- labour for lining the pit and installing the slab and pedestal.

Slabs can be manufactured by a locally trained builder.

When SanPlat latrines are provided through programmes where superstructures are also provided, the total cost for one SanPlat latrine in 1992 South African rands is in the region of R500 to R1000.

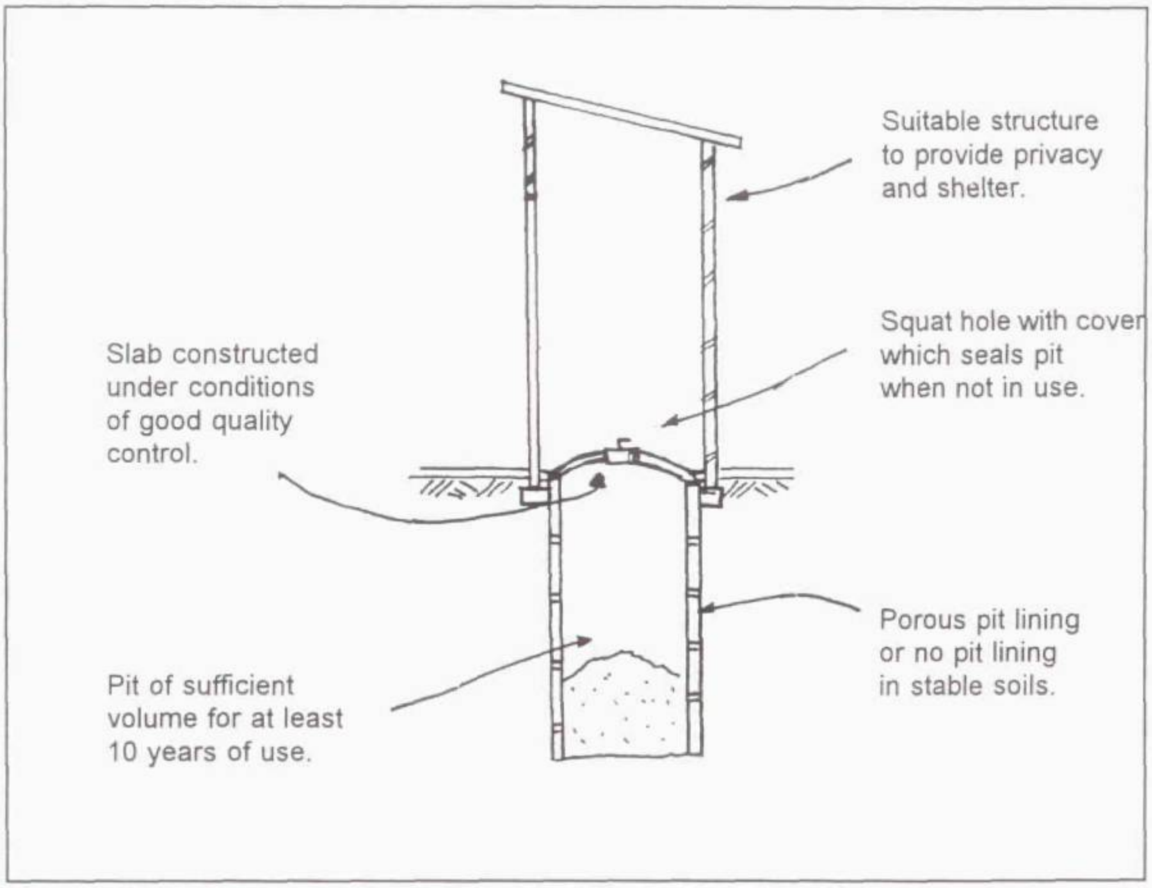


Figure 3: Important features of a SanPlat to ensure proper functioning

Finally, another important feature of this technology is that the use of locally based manpower to produce the slabs and construct the latrines can be encouraged.

User preferences

Due to certain user preferences in South Africa, a pedestal which can be sealed has been added to the basic SanPlat design. The key-shaped squat hole has been replaced with a round hole. A plastic pedestal which has a lid which can be clipped closed thereby sealing the pit has been designed to fit this hole.

3. THE SANPLAT LATRINE SYSTEM

The components of the SanPlat latrine system are similar to any pit latrine system and consist of:

1) a pit;
2) a slab - in this case the SanPlat platform;
3) a squat hole cover (or a pedestal which can seal); and
4) a superstructure.

Figure 20 shows a brick or block masonary SanPlat latrine design in which a pedestal which can seal is incorporated.

3.1 The Pit

The pit is a very important component of a latrine and has important implications on:

a) the life of the latrine;
b) the structural strength/stability of the latrine
c) the location of the latrine; and
d) the cost of the latrine.

The shape of the SanPlat pit is circular for two reasons:

a) the SanPlat slab which covers the pit is circular; and
b) circular pits are more resistant to collapsing than rectangular pits due to the natural arching effect of the soil.

<u>Pit size and volume</u>

The diameter of the pit should be approximately 1.2 m, but no more than 1.3 m.

The volume of the pit is related to the design life and on the number of users of the latrine. The pit volume for a particular use can be determined according to a simple calculation as set out below.

The calculation to estimate the required pit volume is:

$$V_e = C.P.N \ m^3$$

where V_e = effective volume of the pit
P = number of people using the pit
N = pit design life in years
C = rate of solids accumulation (m^3/person/year)

The value of C ranges from 20 to 60 ℓ/person/year (Franceys et al, 1991) and depends on the diet. The ongoing addition of small quantities of water to the pit promotes decomposition of the pit contents and lowers the value of C. The addition of household rubbish (which is not recommended) increases the value of C. Conservatively, the value of C recommended for both rural and peri-urban areas is 50 ℓ/person/year.

The value of P, the number of people using the pit, may vary considerably at different times of the week or year. However the average household occupancy over the year should be estimated where the latrine is for the exclusive use of the household. A figure of 7.5 persons per household is considered appropriate.

The design life of the pit N is the estimated number of years it will take before the pit is full and must be either emptied or covered over and a new pit dug. A design life of 10 years is recommended.

This yields an effective pit volume:

$$V_e = 0.05 \times 7.5 \times 10 = 3.75 \ m^3.$$

Hence for a pit diameter of 1.2 m, the effective depth of the pit should be 3.3 m. The recommended freeboard between the top of the pit and the level of contents is 0.5 m. Thus, the required depth of the pit is 3.8 m.

Problems encountered with pit excavations

Adverse geological conditions may be encountered when excavating pits. The more common problems are:

a) rocky subsoil conditions which result in difficult excavations by hand tools;
b) cohesionless collapsing soils which make the pit unstable; and
c) the presence of a high water table or water logged conditions which could result in collapse of a hole even in good soil, as well as the pollution of the underground water table.

Notes:
- If the underground water table is used as a water source, special precautions against possible contamination must be made.
- Water in the pit does not reduce the rate of decomposition of the contents, but rather enhances it.

These conditions can be accommodated in the case of the SanPlat latrine system by:

a) raising the level of the top of the pit by building up a mound above ground level (figure 4a), or digging a long, rectangular pit with the same volume and using additional slab sections (figure 4b);
b) shoring the walls during construction and installing permanent pit liners such as blocks, bricks or concrete rings (figure 4c); and
c) completely sealing the pit by constructing a watertight lining or installing a prefabricated lining, but including a liquid drain system near the surface of the pit (figure 4d). Note also that a sealed pit should be filled with water under conditions of a high water table to prevent the lining from floating out of the ground.

These measures do result in an increase in the costs of the latrine. Hence in the case of stable soils conditions a pit lining is not necessary and only a pit collar is required to support the slab. If there is any doubt, however, it would be preferable as a general rule to line the pit.

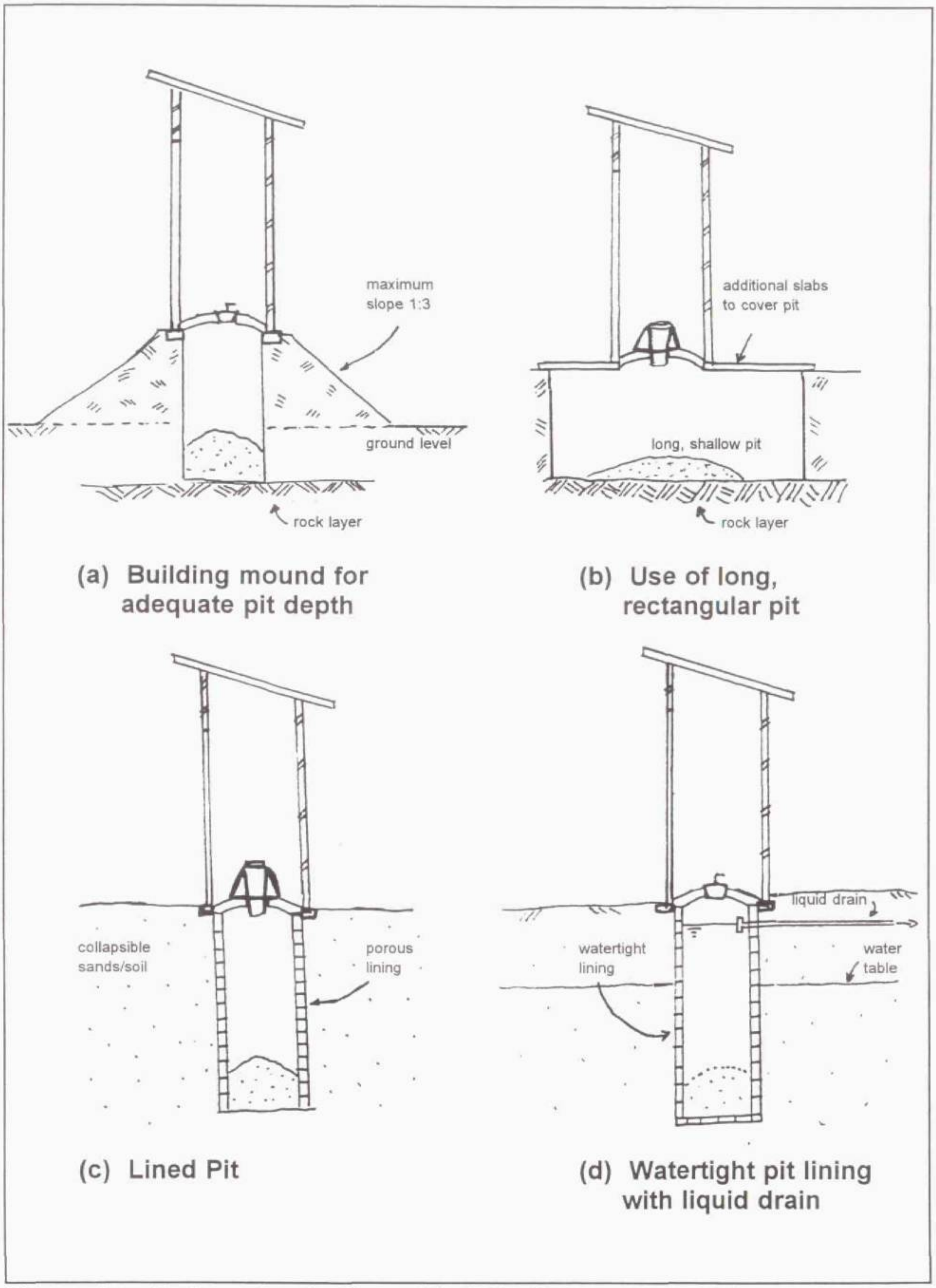


Figure 4: Options for dealing with difficult ground conditions

Ground water pollution

The extent of the pollution of ground water from a pit latrine depends on the soil material and ground water flow conditions. In fine grained loam soils and pits surrounded by a mature organic mat, the distance that contaminated water from the pit will travel may be as little as 3 m even after a number of years. In the case of a new pit in very porous soils and a high water table, pollution may travel as much as 25 m downstream of the pit. (Franceys et al, 1991). Generally, pollution extends from the pit in the direction of groundwater flow, with only very limited vertical and horizontal dispersion. Exceptions occur in fissured rock conditions where pollution may extend for several hundred metres, often in an unpredictable direction. The location of the pit with respect to ground water sources is illustrated in figure 5. Where problem conditions do occur, it may be feasible to construct an artificial barrier of fine clayey soil 1 m thick around the pit lining to control pollution (Franceys et al, 1991), or to seal the pit as described above.

3.2 The SanPlat Slab

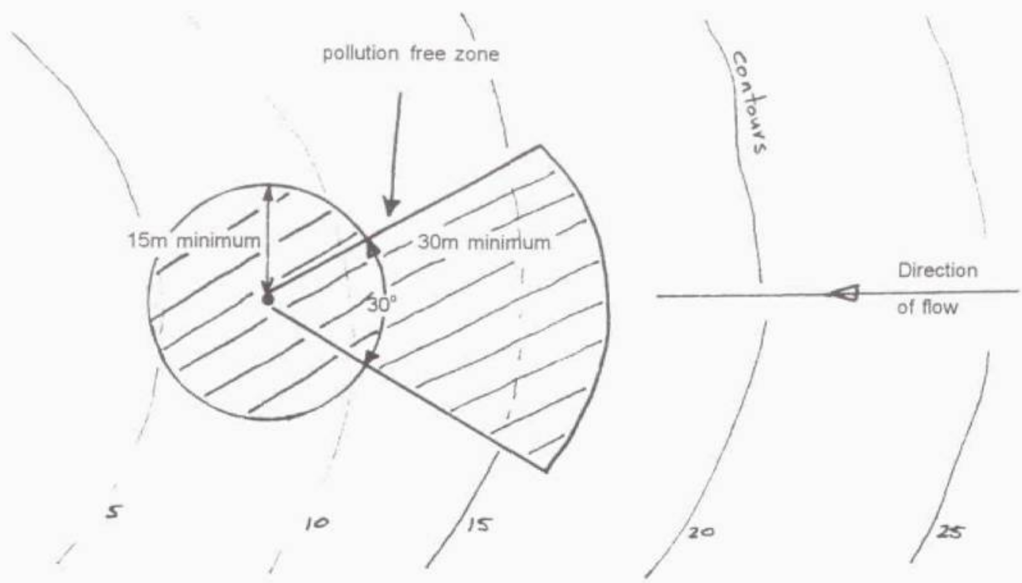
The slab has already been described in section 2. The SanPlat slab is a dome shaped slab, that may or may not contain reinforcement, having either a key shaped squat hole or a circular hole into which the pedestal fits. It derives its structural strength from its domed arch shape which remains in compression and hence does not require tensile reinforcement. However, chicken mesh may be used to reinforce the slab as a safety precaution.

The dimensions of the slab are:

diameter	1.5 m
minimum thickness	40 mm
squat/pedestal hole diameter	300 mm

The mortar or concrete required for the slab must be of a high standard. The recommended concrete mixes are:

1:2:2	cement:sand:stone	or
1:4	cement:sand	



• ground water source (spring, well, borehole)

pollution free zone - to be kept free of pit toilets, kraals, rubbish dumps, dwellings and graves

NOTE

In fissured rock, no potential sources of pollution should be located within 200m upstream of the water source, or geological advice should be sought.

Figure 5: Location of latrine relative to boreholes, wells or springs

The slab will weigh approximately 200 kg and hence can be manoeuvred over a pit by hand. The slab can therefore be constructed off the pit, even at a centrally located site within the settlement where more efficient production is possible, and good control can be maintained on production parameters.

The concrete slab is formed in the shape of a dome by mounding up earth to the required profile of the underside of the slab. Successive slabs can be cast on top of each other, using the top surface of the previous slab as the form or mould for the next slab. A special kit is used to produce the slabs and parts are illustrated below.

The SanPlat slab kit consists of:

a) Ring

The ring consists of a strip of flat iron which is 2 mm thick by 100 mm wide. The total length of the strip should be 5 m, with the ends bent back to form lugs to join the ends using a U-shaped connector. When the flat strip is bent in the form of a circle, the diameter should be 1.5 m, or a circumference of 4.71 m.

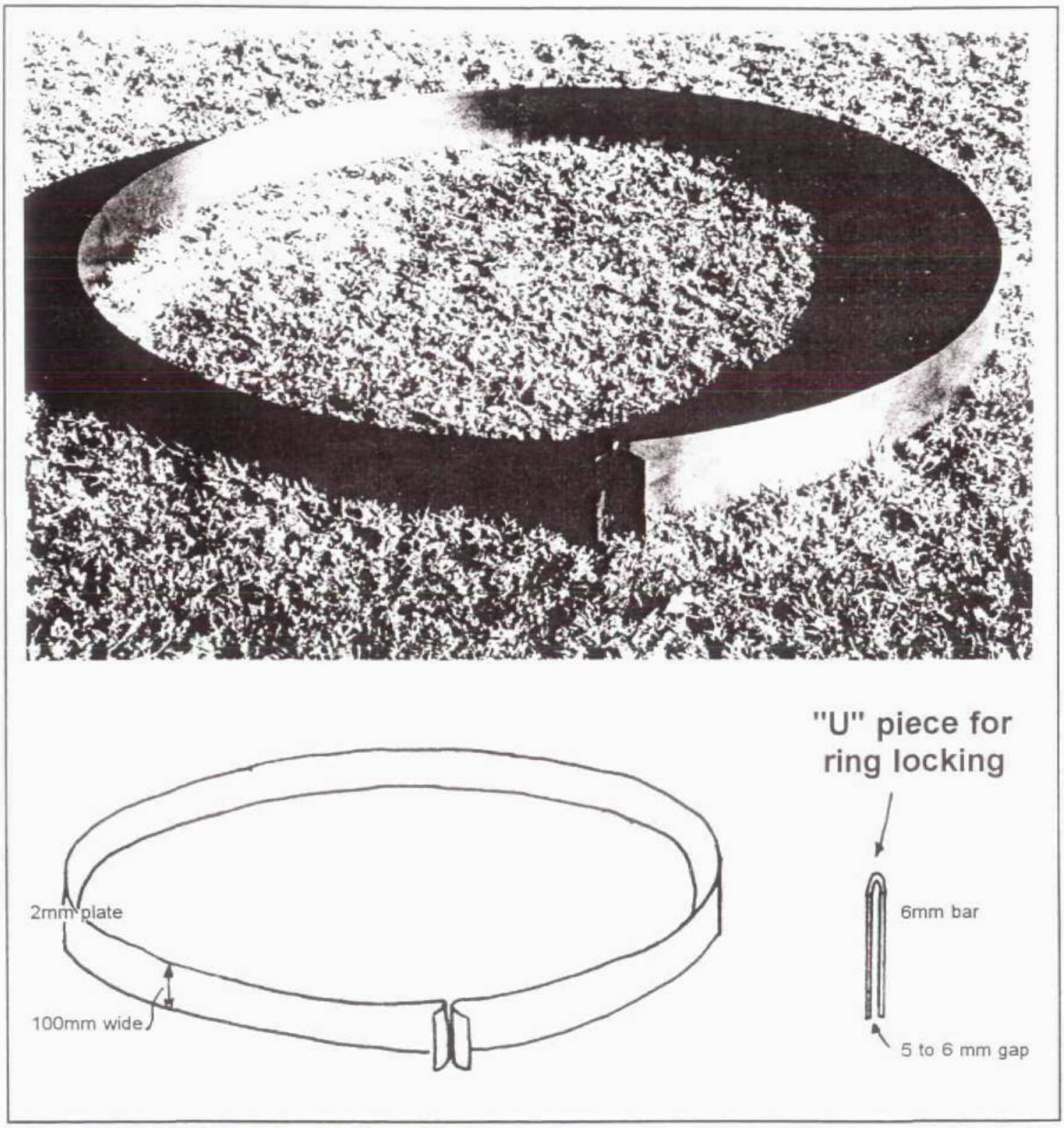


Figure 6: Ring mould for SanPlat slab

b) The squat hole and foot rest moulds

A key-hole shaped hole must be cast into the slab, and a key-hole cover manufactured. A special hole mould is used for this purpose, details of which are given in figure 8. In addition two foot-rests must be provided as part of the slab. This is accomplished by the use of a further mould - the footrest mould (figure 8). When the slab is cast, the footrest mould is placed over the hole mould and the concrete under the foot prints are roughened to provide a good key where the footrests are to be added later. Adding the footrests later enables the slabs to be cast one on top of the other on consecutive days. When ready (usually when the slab can be lifted) the footrest mould is now used to cast two raised foot platforms. When the latrine is in use, the placing of the feet on the footrest platforms will ensure accurate use of the latrine by all users.

c) Ruler

The ruler is a 25mm wooden profile corresponding to the shape of the slab dome. The ruler has a 4mm hole in the centre which fits over the centre pin on the hole mould and enables the ruler to swivel. Loose sand placed inside the ring is moulded into the shape of a dome by swivelling the ruler around the pin. The ruler shapes the sand within the ring to the required shape, and when casting the slab is used to ensures that the concrete is cast to the correct thickness.

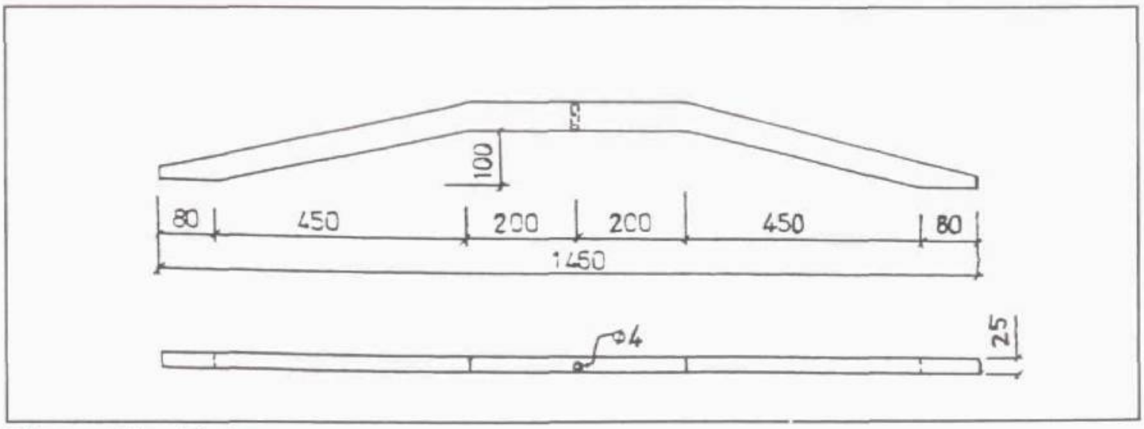


Figure 7: Ruler

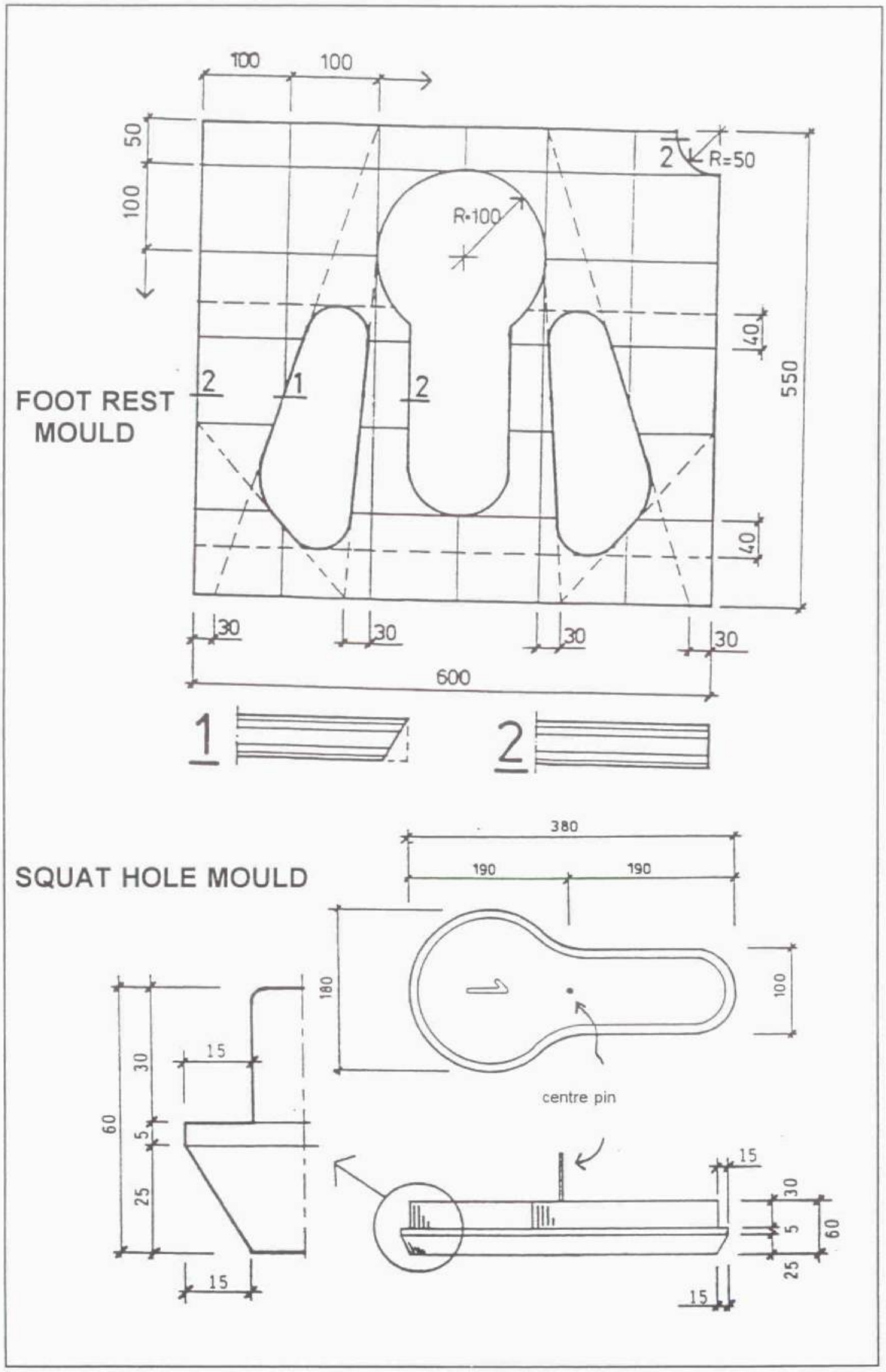


Figure 8: Moulds for squat hole

d) Centre pin

A threaded 3 mm steel pin approximately 200 mm long is attached to the hole-mould. The ruler swivels on the pin and is then used to position the ring and to shape the sand.

e) Squat hole cover mould

A tapered steel mould is used to make simple cement covers for the squat holes. The cover mould has the same profile as the squat hole mould. Alternatively, the hole in the slab is used as a mould for the squat hole cover. The tapered edge ensures that the cover fits snugly in the hole to seal it from flies and odours.

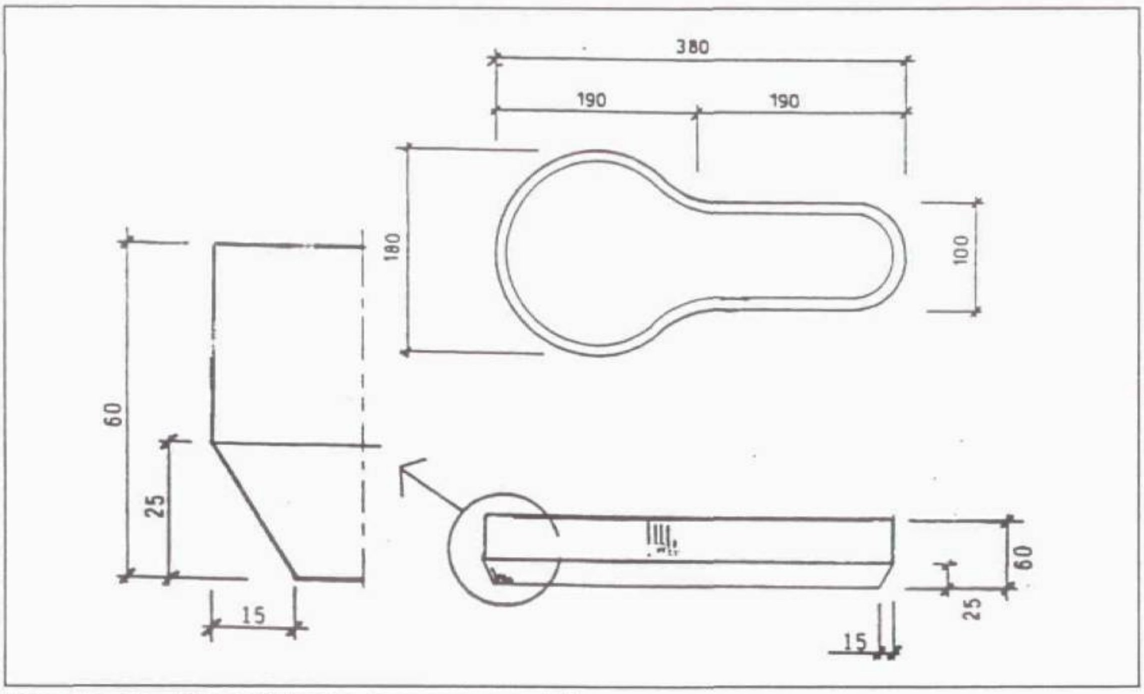


Figure 9: Squat hole cover mould

3.3 The Optional Toilet Pedestal

Many users prefer to use a pedestal than to squat. This does not mean that the SanPlat cannot be used in such situations, but it must be modified for the pedestal. In South Africa most communities select to use pedestals, and as a result a number of pedestals suitable for use on pit latrines are commercially available. One commercial pedestal has been designed specifically for use on SanPlat latrines in that the pedestal isolates the pit when the lid is closed.

A modification must be made to the slab to accommodate a pedestal. A round hole is cast into the slab instead of the key-hole, which then can accept a standard fabricated pedestal, or a block pedestal can be constructed around the hole. The commercially available SanPlat pedestal is made of plastic and consists of two components which are: 1) the seat support/funnel; and 2) the seat with a hinged clip on lid.

The seat support or funnel is cone-shaped with the smaller end fitting into the round hole in the SanPlat slab. The bigger end has a lip to support the seat. The pedestal seat dimensions, that is the height and size of the seat, are similar to those of a conventional pit latrine type toilet seat.

The pedestal lid clips closed when not in use to ensure isolation of the pit.

Alternative pedestals can be considered, for example commercially available plastic VIP pedestals or block constructed pedestals fitted with a plastic seat, but these should seal when the lid is closed. Most of these alternative seats do not seal when closed, and modifications to the seats would be required to ensure this. One way of sealing such seat lids is to attach a strip of rubber or dense foam rubber to the underside of the lid where it meets the seat.

Many pedestal seats are such that both the lid and the seat itself are hinged and can be lifted. In such cases both sections will need to be lined to ensure that they seal when closed.

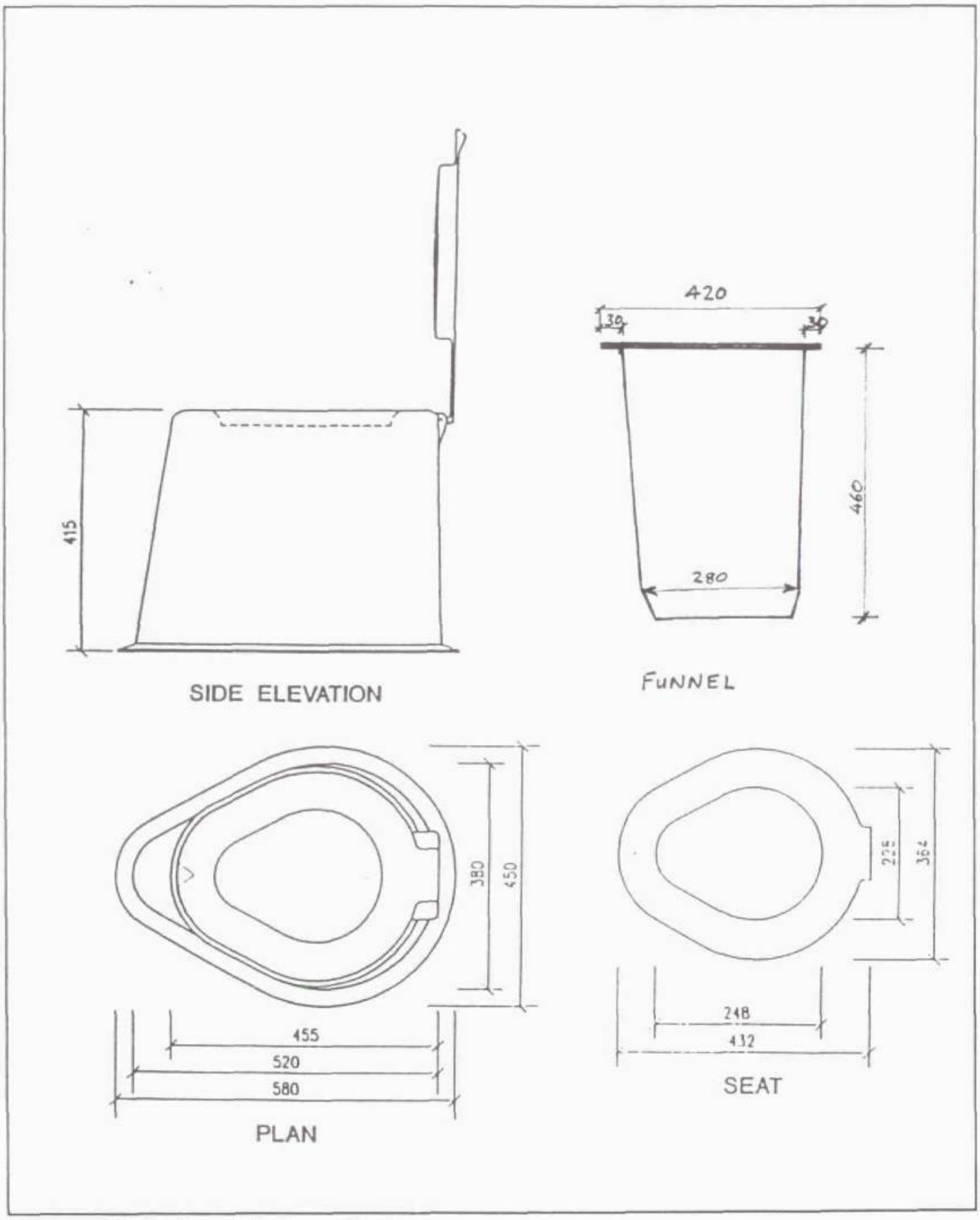


Figure 10: SanPlat pedestal

Hole-mould for pedestal option

When a pedestal is to be used, a round hole mould is used for the slab in place of the key-shaped mould used for the squat hole. A metallic tapered steel mould 40 mm high, with a nut welded at the centre of the cover, is used to create the pedestal hole in the slab during casting of the concrete. Besides the centre pin which screws into the mould for positioning the ruler, the mould also comes with a T piece threaded on the long end for removing the mould after casting the slab. The mould is placed in the centre of the ring as with the squat hole mould.

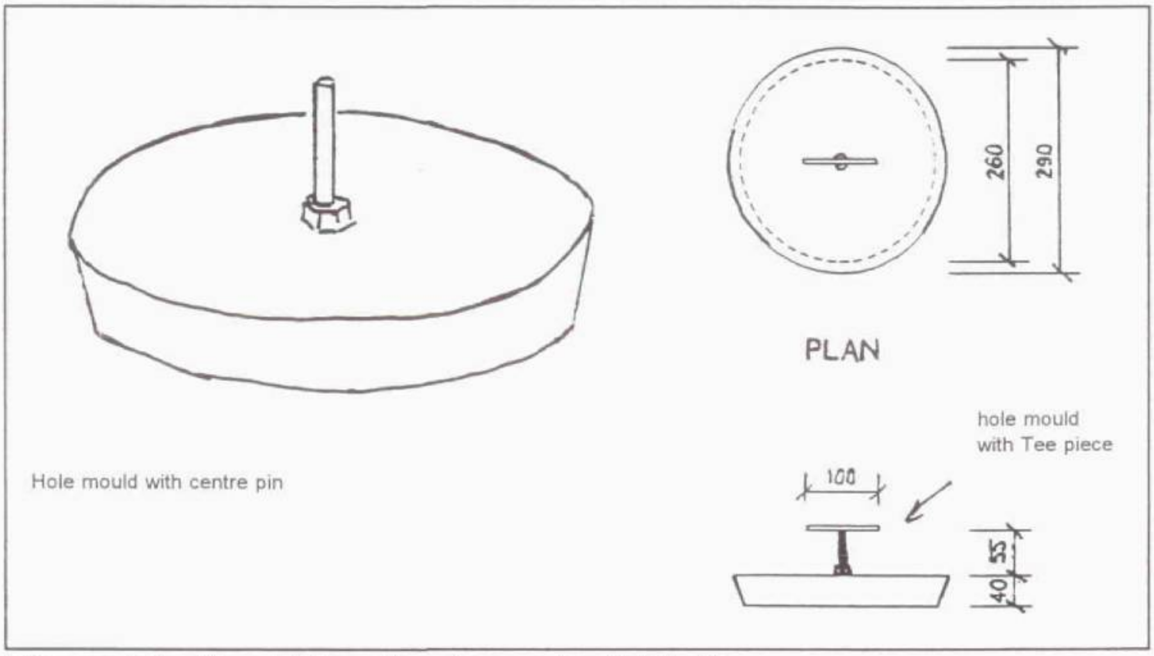


Figure 11: Mould for circular pedestal hole

3.4 The Superstructure

One of the important features of the SanPlat latrine system is that the superstructure does not play a vital role when considering the health or functional aspects. The superstructure is used only for protection from inclement weather and to provide privacy to the user. Thus, any suitable local materials may be used for the construction of the superstructure. The one proviso, however, is that if the wall is made of solid, heavy materials (brick, block, stone), it should not be constructed directly on the slab.

A shelter of concrete blocks with roof of corrugated-iron sheets

A spiral-shaped shelter built of mud and wattle

Mud and wattle walls and palm-thatch roof

. Timber walls and corrugated iron or asbestos-cement roof

Figure 12: Options for toilet superstructure

4. CONSTRUCTION OF A SANPLAT LATRINE

The construction of a cement block SanPlat latrine structure with a corrugated iron roof and a fully lined pit is described in this chapter. However, it should be remembered that alternative superstructure materials such as reeds, bamboo, mud blocks and ferrocement for the walls and thatching or a cement slab for the roof can also be used. Reeds and bamboo superstructures and thatched roofs will require more frequent repair but these materials may be readily available locally at a minimum cost. Where there are stable and suitable ground conditions, it may not be necessary to line the pit. A simple collar around the top of the pit on which to place the slab would only be required.

STEP 1: OBTAIN TOOLS AND MATERIALS

4.1 Tools and Materials

The tools required are basic construction tools and the kit for the SanPlat slab production. These tools are:

*	picks and shovels	(for digging the pit, mixing concrete, etc.);	
*	wooden and steel floats	)	
*	trowel	(	*for concrete*
*	a tape measure	)	*and masonry*
*	a spirit level	(	*work*
*	string	)	
*	a hammer	)	
*	a wheelbarrow		
*	several 10ℓ concrete buckets		
*	a ladder (for general construction procedures)		
*	the SanPlat slab kit		

The SanPlat slab kit can be made locally where there is a welding and a woodwork shop using the detailed drawings in this manual, or can be ordered from various suppliers in South Africa.

The building materials required are listed in Table 4.1 below. These materials can be purchased at most hardware shops or builders suppliers. Where possible, locally manufactured materials should be used as this promotes the local industry.

Table 4.1: Material for A Block Masonry SanPlat Latrine

ITEM	UNIT	QUANTITY	RATE R/unit	AMOUNT R
1. Bricks for lining pit (size 190x90x90)	No	500	0-30	150-00
[Alternately blocks (size 440x150x190)]		[125]	[1-80]	[225-00]
2. Cement	50 kg	6	20-00	120-00
3. Building sand	m^3	2	50-00	100-00
4. 19mm stone	m^3	0,1	60-00	6-00
5. 25mm chicken mesh	m^2	2.25	6-00	13-50
6. bricks for walls	No	400	30	120-00
[alternately blocks]		[100]	[1-80]	[180-00]
7. Roof timber (76x50mm)	m	4	5-00	20-00
8. Roof iron (0.7m)	m	2.5	10-00	25-00
9. Pedestal	set	1	100-00	100-00
10 Miscellaneous (nails, etc.)				20-00
Total (1994 prices)	with bricks			675-00
	with blocks			[810-00]

STEP 2: CHOOSE LATRINE SITE

4.2 Siting of latrine

The latrine should be sited following the recommendations illustrated in *Figure 13*. The latrine should be sited at least 15m from an individual household domestic borehole, and 30m from a community borehole, and if possible never upstream of a borehole. In addition for convenience, it should be sited near the house, preferably downwind of it, with the door facing the house. A slightly raised site relative to the surrounding ground would allow easy drainage of rainwater away from the pit. The site should not be close to any big trees whose roots might interfere with the excavation of the pit, and later grow into the pit blocking it and making pit emptying very difficult. The pit should also be sited such as to avoid rocky ground where digging is difficult.

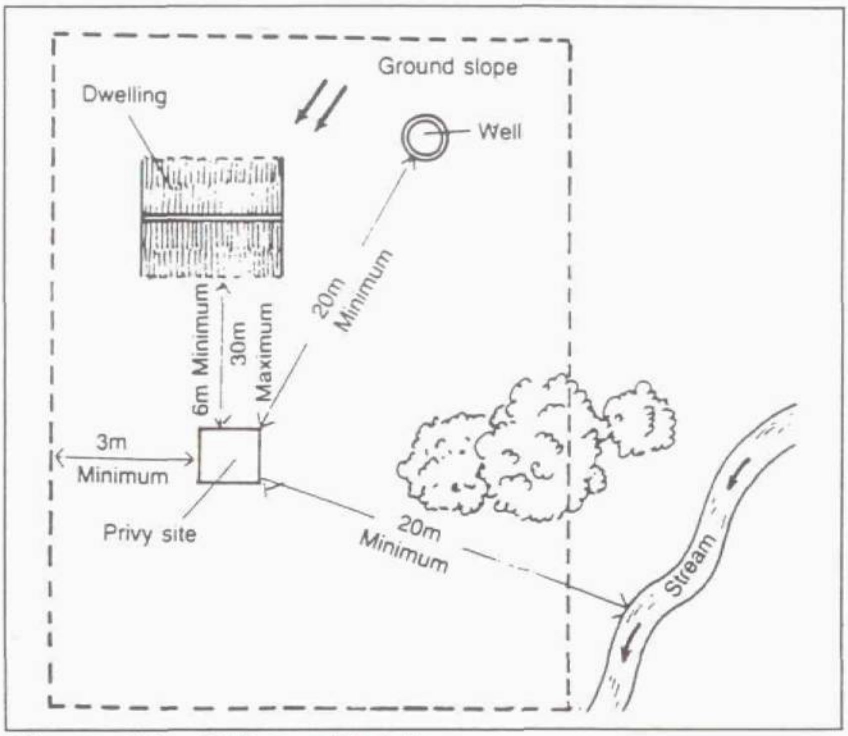


Figure 13: Siting of latrine

STEP 3: MARKING, DIGGING AND LINING THE PIT

4.3 The Pit

After siting the latrine an area of about 2,0 m by 2,0 m is cleared and a circle of 1,2 m diameter is marked on the ground. Now enlarge the circle to make allowance for the blocks or bricks to be used for lining the pit. For 150mm bricks, a circle with a total diameter of 1.5m should be marked out (*Figure 14*), or 1.7m for a concrete block lining. A circular pit is then dug to a depth of at least 3,5 m. It is very important though to ensure that the sides of the pit will not collapse while it is being dug, as the person in the hole could be trapped. Adequate shoring must be provided under conditions of collapsible soils. The sides of the pit should be straight and lined with bricks or blocks from the bottom to the top. The lining should have open joints to allow water to seep out and to allow odours to be absorbed into the surrounding soil. The mortar mixture for the lining is 1 part cement to 4 parts sand. The collar of the pit should be finished off as illustrated in *Figure 15* and should be above the surrounding ground level. If the ground is very firm and solid, and is unlikely to collapse even when wet, it may not be necessary to line the whole pit. In this case only a collar at the top of the hole is required.

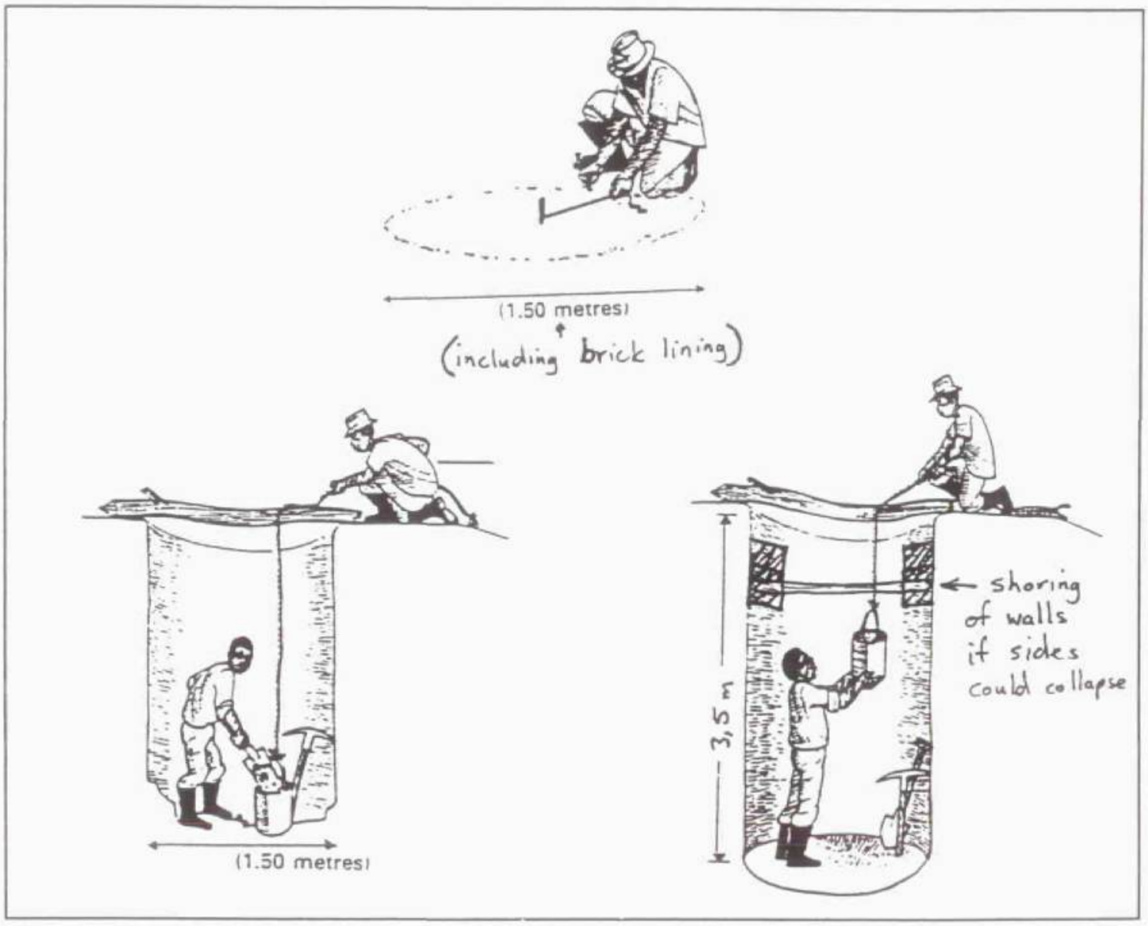


Figure 14: Marking and excavation of the pit.

Figure 15: Finishing the pit collar

STEP 4: CASTING OF THE SLAB

A decision must be made whether to construct the slab on-site, or whether to establish a central slab construction site where all the slabs for the project are constructed. The advantage of the latter method is that stricter quality control can be maintained of slab casting and curing procedures, and advantage can be taken of the opportunity to cast the slabs stacked one on top of the other, in which the lower slab is used as a mould for the next slab in each case. Up to seven slabs can be cast in a single stack. Because each successive slab effectively covers the one below it, the lower slabs are covered and do not dry out, improving the curing of these slabs.

4.4 The SanPlat Slab

The step-by-step procedure set out below should be followed when casting the slabs:

<u>Setting up</u>

- Choose a level piece of ground at least 4,0 m in diameter.
- Set up the ring as shown in *Figure 16*.

<u>Making the slab mould</u>

- Place 3-4 wheelbarrows of sand inside the ring, and shape the sand into a mound with the high point in the middle of the ring.
- Place the hole mould with the pin screwed into it on top of the sand heap at the centre of the ring.
- Place the ruler on the hole mould pin, and adjust the position of the hole mould such that the ruler does not extend past the ring at any point.
- Shape the sand to a dome by rotating the ruler as shown in *Figure 16*, removing excess sand or adding sand as necessary.
- Use the end of the ruler to create a 40 mm space for the mortar from the sand level to the top of the ring mould as shown in *Figure 17*.
- Wet and compact the sand well.
- Check the shape of the sand mould with the ruler after compacting.
- Remove the ring mould and fill the hole it may have left in the sand.

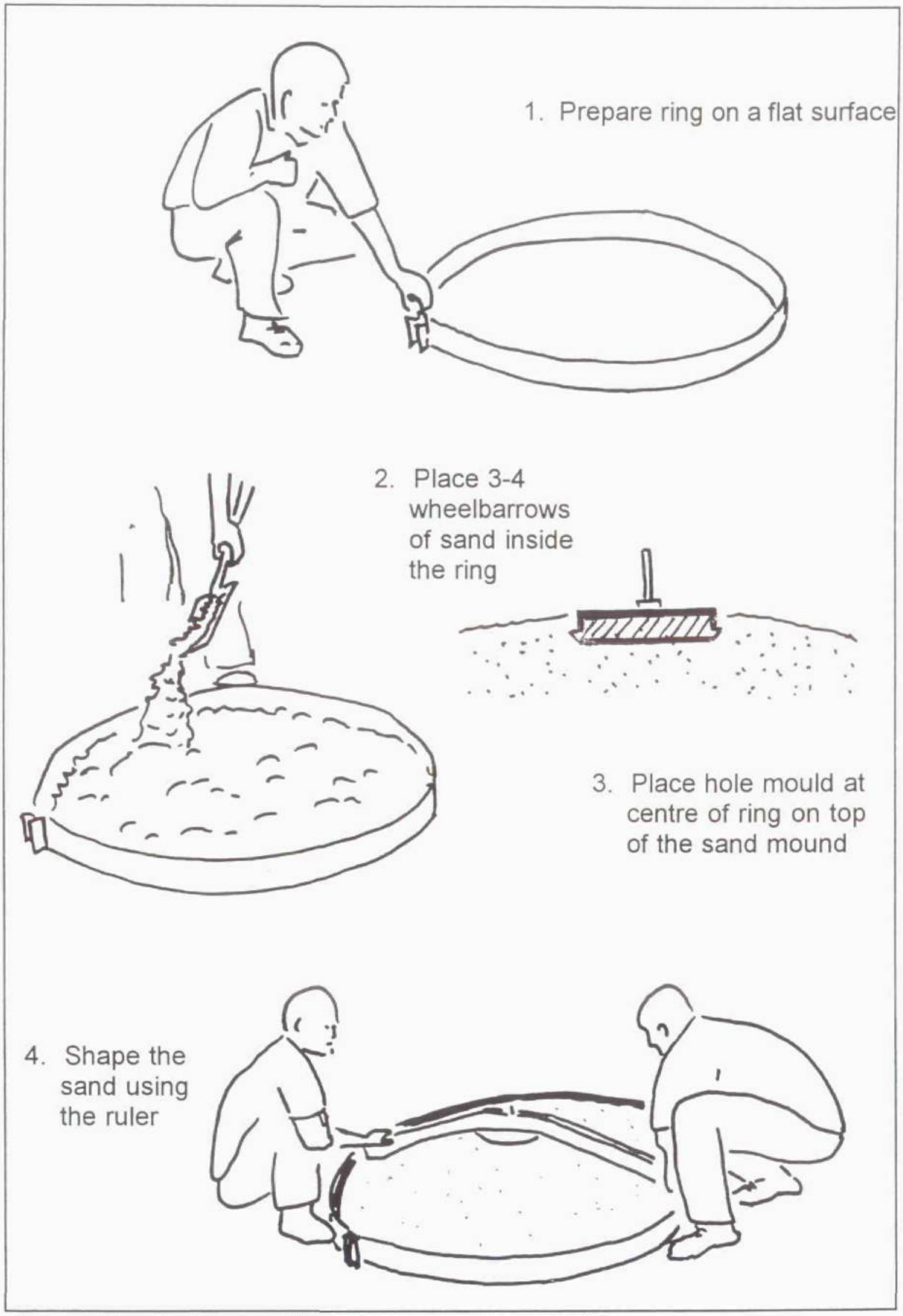


Figure 16: Setting up the ring and slab mould

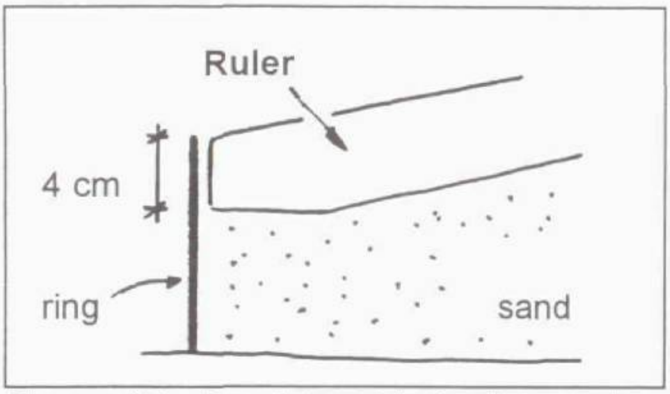


Figure 17: Sand mould at edge of ring

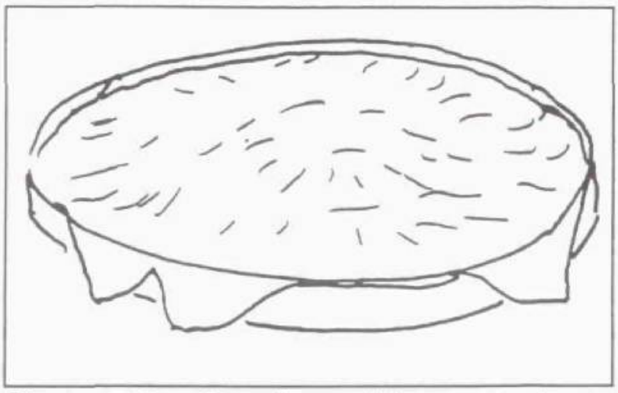


Figure 18: Sand mould covered - ready for concrete

- Prepare the mould to receive the concrete by wetting it and covering with plastic sheets or newspaper, see *Figure 18*.
- Cut the chicken mesh to a diameter of 1,45 m and cut out the shape of the hole mould at the centre of the mesh. Check that the mesh fits evenly on the dome mould formed in the ring with no gaps larger than 5 cm from any edge.

Mixing the mortar

- Mix the mortar as follows

Concrete mix	1:2:2	cement:sand:stone or
	1:4	cement:sand

Table 4.2 Materials for Making One SanPlat Slab

MATERIAL	QUANTITIES
1:2:2 Mix Cement Sand Stone (maximum size 10 mm)	 37 kg or 3/4 bag or 25 litres 1 Concrete Wheelbarrow 65 litres 1 Concrete Wheelbarrow 65 litres
1:4 Mix Cement Sand	 37 kg or 3/4 bag or 25 litres 2 Concrete Wheelbarrows or 65 litres

- Place the stone on the mixing area first followed by the cement and then the sand.
- Mix thoroughly.
- Add water to achieve a workable consistency. Note that too much water should not be added as this will make the final slab weaker. The total amount of water should not exceed 50 ℓ.

Making the slab

- Place the hole mould on top of the dome and centre it.
- Place a thin layer of mortar on top of the newspaper/plastic sheeting, not more than half the thickness of the slab.
- Place the chicken mesh on top of the mortar.
- Place the remaining mortar over the chicken mesh to obtain a total slab thickness of 40mm using the top of the ring mould and the hole mould as a guide *Figure 19*.

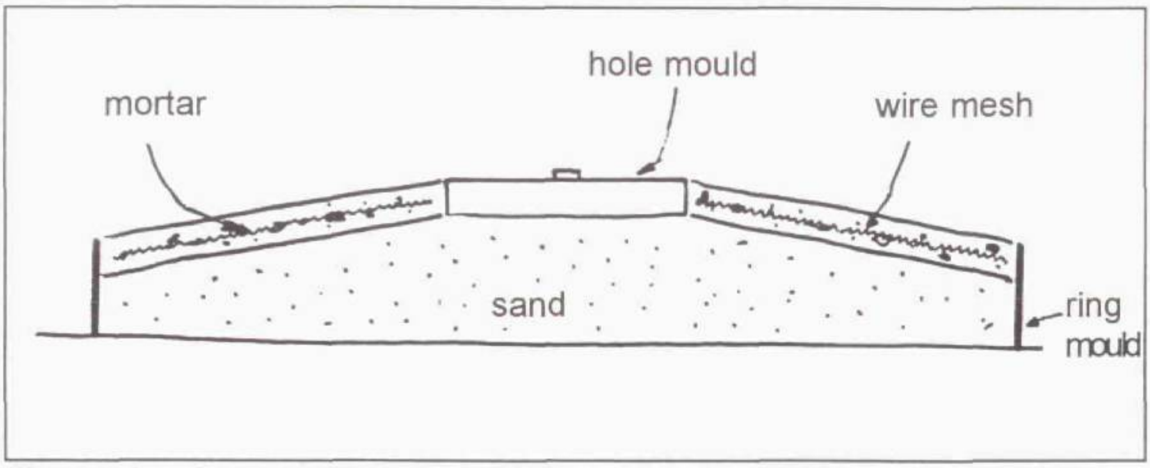


Figure 19: Completed slab

- Use a wooden float to float the mortar, checking the shape of the slab and that it is of uniform thickness with the ruler.
- Place the foot-rest mould over the key-hole mould, and scrape grooves into the slab where the foot-rests are to be cast later. This provides a key for the cement to attach to when the foot-rests are cast.
- Remove the hole mould after the concrete has set for a few hours.

Curing the slab

- After the concrete has set place old sacks or cement packets or a layer of sand over the slab.
- Wet these thoroughly and keep wet for at least two weeks (wetting at least twice daily).
- If plastic sheeting is available cover the whole slab and ensure the sheet is well secured. This will reduce the frequency at which additional water needs to be put on the slab to keep it wet.
- If the next slab is to be cast on top of the slab just cast, the next slab also helps to prevent this slab from drying out and hence helps curing.

Making a cover for the squat hole

- Prepare the cover mould by oiling it so that it can be easily released. Alternatively, if the hole in the slab is to be used as the mould, line the hole with plastic or paper.
- Bend a 650mm length of 5 to 6 mm wire into a U shape, with one leg being 300mm long which is cast into the cover (*figure 20*).
- Position the wire long ways in the mould, and fill with a concrete mix similar to that used for the slab.
- Allow to cure for at least 2 days before carefully removing from the mould and continuing the curing process by placing the cover into a container of water. Allow to cure for 2 weeks.

Figure 20: Squat hole cover

Making a Second Slab on top of the first Slab

- If the slab is to be used as a mould for the next slab, one day should be allowed after the first slab has been made, before the next slab is cast.
- Raise the ring mould by 40 mm *Figure 21*.
- Fill in the hole with sand.
- Place plastic sheeting or newspaper on the first slab and use this

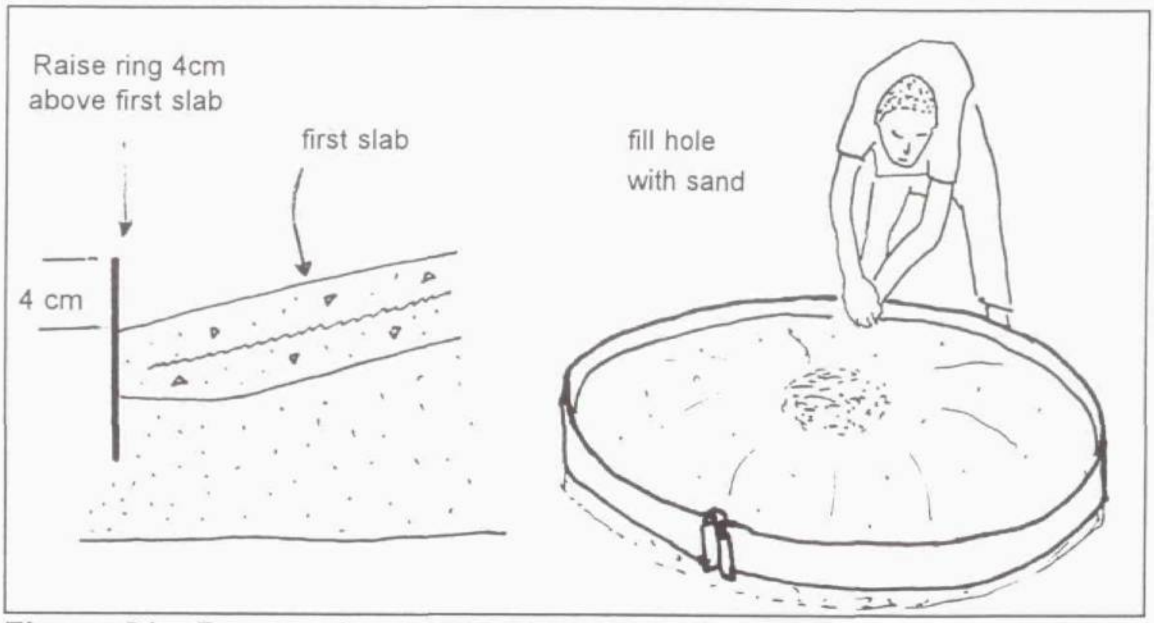


Figure 21: Preparation for casting second slab

- Repeat the procedure for making the slab and curing as above.
- Up to seven slabs can be made on top of each other in a single stack.
- At least two weeks should be allowed from when the top slab is cast before the slabs are moved.

Casting foot-rests

- To cast the foot-rests (only for slabs with squatting key-hole), the slabs must be removed from the stack and placed out individually.
- Place the foot-rest mould on the slab to line up with the hole. The grooved cement sections should be within the foot print holes.
- Mix a small amount of cement (1:4) and fill the foot-rest holes. Slightly roughen the foot-rests to ensure a non-slip surface.
- Remove the foot-rest mould after 2 - 3 hours.

Transporting and testing the slab

- The slab should be transported by either lifting it along the outer edge, or rolling it.
- The strength of the slab can be tested after curing (two weeks minimum) as follows:
  - place the slab on level ground;
  - let six adults stand together on the slab;
  - it will not crack or break if the instructions have been followed correctly.

Placing the slab on the pit collar

- Transport the slab to the pit.
- Place a 10 mm mortar layer of 1 part cement to 4 parts sand on the collar.
- Place the slab gently on the collar.
- Check that the mortar seals the joint between the slab and the collar properly to prevent entry of flies, mosquitoes and rodents into the pit.
- Place the hole cover on the slab hole.

STEP 5: COMPLETION OF THE LATRINE

4.5 The Superstructure

The superstructure is built according to standard building principles. The foundation for the superstructure is excavated on the outside of the pit slab and should be made using a concrete mix the same as that used for the slab. The superstructure is then built to the plan given in the appendix or any suitable alternative. If a door is desired then the outer wall acting as a screen can be omitted. The cement mortar used is 1 part cement to 4 parts building sand. The gap between the SanPlat slab and the superstructure walls is filled with a concrete screed to bring it flush with the collar height. To facilitate drainage of the toilet when washing, the floor should slope towards the door. The internal walls of the toilet can be plastered and painted to make the toilet more hygienic and easier to wash down.

The roof rafters are preferably attached to the wall by bolts cast into the wall or tied with hoop iron to the wall. The purlins are nailed to the rafters and in windy areas they should also be strapped or wired to the rafters. The iron sheets are nailed to the purlins.

A variety superstructures that can be used are shown in figure 12 (page 23).

Where a pedestal is used, the seat support funnel is placed in the slab hole and the seat on top of the funnel. A mortar collar is then applied around the lip on the seat to hold the seat in position.

5. OPERATION AND MAINTENANCE

5.1 Operation and toilet hygiene

The principal of operation of the SanPlat latrine is isolation of the pit from the external environment. If a pedestal is used, the toilet pedestal lid should therefore always be well clipped into the seat. If a squat hole is used, the hole cover must be covered when not in use, and the cover must always be in a good condition so the hole is properly closed when the cover is placed on it. This will ensure that there is minimal ventilation of the pit, so that odours are contained in the pit and flies and mosquitoes do not have access to the pit.

The area around the squat hole including the foot rests should be cleaned on a daily basis. Where a pedestal is used, the pedestal funnel should be maintained clean by washing with a brush and water. The brush should be disinfected after use. However, no disinfectants should be poured into the toilet itself as this will affect the biological breakdown of the pit contents. The seat should be regularly cleaned with soap and water. The toilet floor and walls should be kept clean by regular sweeping and washing.

5.2 Maintenance

Toilets constructed out of more permanent materials such as blocks , bricks and ferrocement will require very little maintenance over their lifetime if they are well constructed. Those constructed out of less permanent materials such as bamboo, reeds and thatching will require periodic repairs or replacement of the sections that have aged or been damaged.

If the lid is accidentally damaged then it should be repaired if possible otherwise it should be replaced. It is important that it can always be clipped onto the seat.
The ground surrounding the toilet structure should be maintained clean and tidy.

APPENDIX A

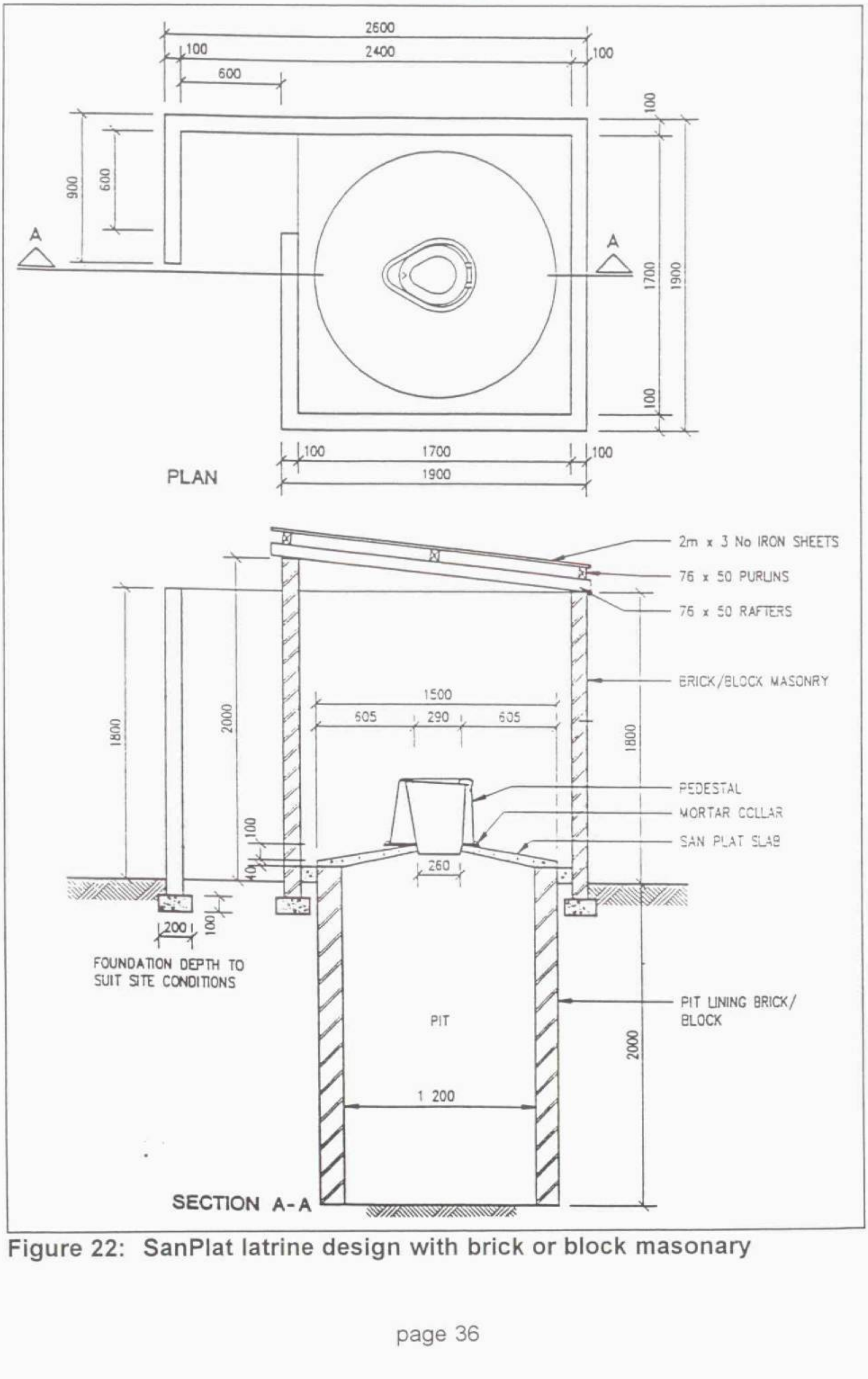


Figure 22: SanPlat latrine design with brick or block masonary