Technology options for
HOUSEHOLD SANITATION

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Contents Pages

1. Introduction

Sanitation denotes a comprehensive concept, in fact, it is 'way of life', which is expressed in clean home, community, institutions for better health and safe environment. Moreover, safe sanitary practice is a crucial indicator for qualifying improvement in standards of living. This concern is triggered by the fact that approx 55 percent of the rural population still reported practicing open defection.

Improving this situation calls for sustained commitment and a comprehensive programme to effectively address the issues of sanitation. The Total Sanitation Campaign (TSC) is the reflection of this commitment which seeks to improve the quality of life in the rural areas through accelerated rural sanitation coverage, generation of felt need through awareness creation and health education; coverage of rural schools with sanitary facilities; encouragement for suitable, cost effective and appropriate technologies; check in absenteeism; and reduction in the incidence of water and sanitation related diseases. TSC has, therefore, developed strategic components to ensure full coverage of sanitation through financial and programmatic support in software and hardware component of household, school, aganwadi and community sanitation.

Amongst them, household sanitation is the prime importance to the TSC in order to check the practice of open defecation and ensure access to sanitary toilet to all persons. TSC aims to cover both below poverty line (BPL) families and above poverty line (APL) families. A wide range of technological choices is provided in TSC to make toilets affordable to households in different income levels with reference to customer preferences, construction materials and capacities. It also focuses on developing *back-up services such a production centre (PCs), rural sanitary marts (RSMs), and trained masons*. The individual household is at liberty to select any technological options suitable to their local and economic conditions.

Basic Low Cost Unit Cost (Rs.)	Contribution					
	GOI		State		House Hold	
	BPL	APL	BPL	APL	BPL	APL
Model 1 uptp Rs. 1500/- (single pit)	60%	Nil	20%	Nil	20%	100%
Model 1 Between Rs. 1500/- and Rs. 2000/-	30%	Nil	30%	Nil	40%	100%
Above Rs. 2000/-	Nil	Nil	Nil	Nil	100%	100%

2. Why Household Sanitation

Excreta disposal is an important part of overall environmental sanitation. Inadequate and unsanitary disposal of infected human excreta leads to the contamination of the ground water and sources of drinking water supplies. It provides shelter to breed flies to lay their eggs and to carry infection from faeces to other human beings. Man is the reservoir of infection for several diseases. Faecal borne diseases and worm infestations are the main cause of deaths and morbidity in a community where they go for indiscriminate defecation.

It is interesting to note that all such diseases are controllable or preventable through good sanitary barriers through safe disposal of human excreta.

As may be seen in fig 1, there are many ways by which disease-producing pathogen spreads or reaches the new host – the human being. Depending upon the hygiene behavior of the individual, the causative agent or pathogen from faeces takes different mode to reach the host. This is illustrated in Fig 1. The technical objective of sanitary disposal of human excreta is therefore to isolate or segregate human faeces so that the disease-producing organisms in faeces cannot possibly get into a new host through the common modes of transmission. The fig 2 shows the place at which the technology is applied to break the chain of transmission from human excreta. This technology is called **sanitary barrier or sanitation technology for safe human excreta disposal**.

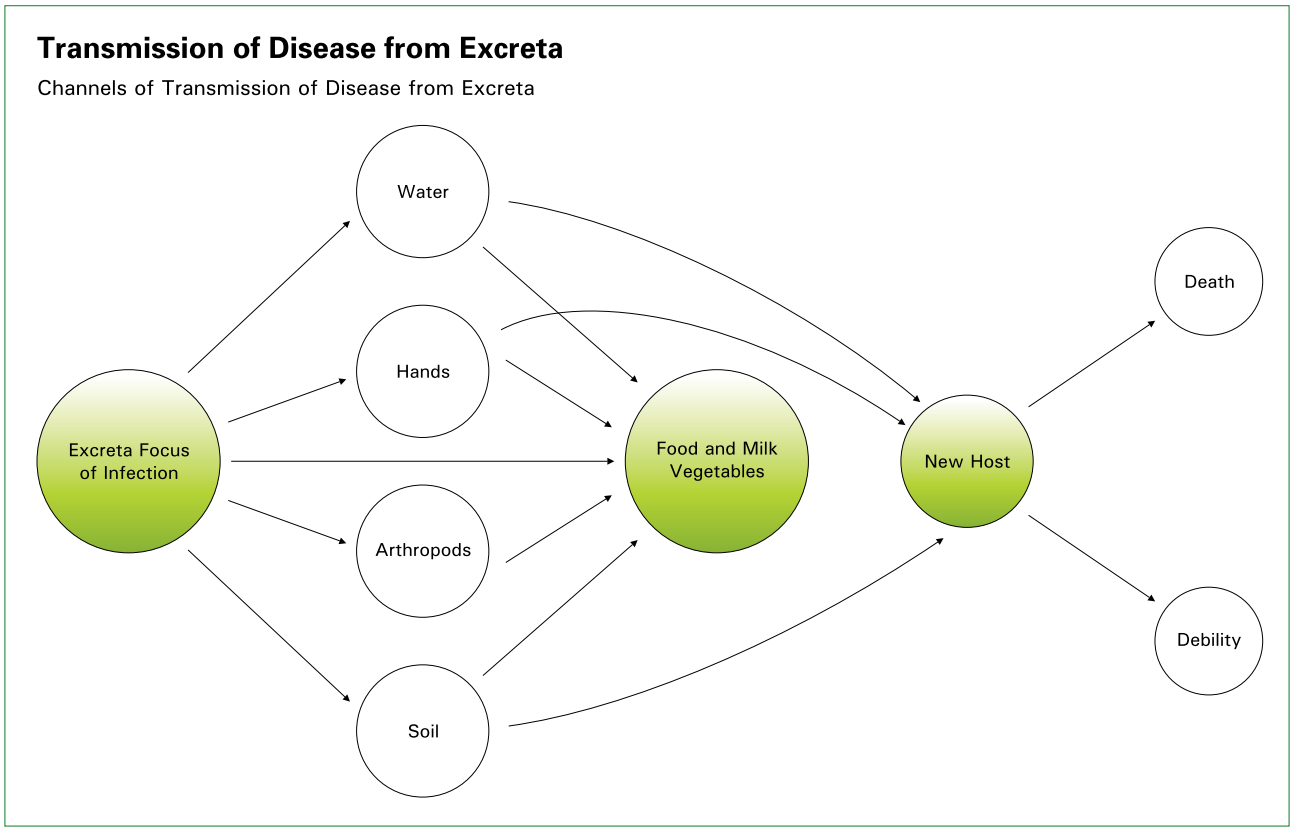


Figure 1

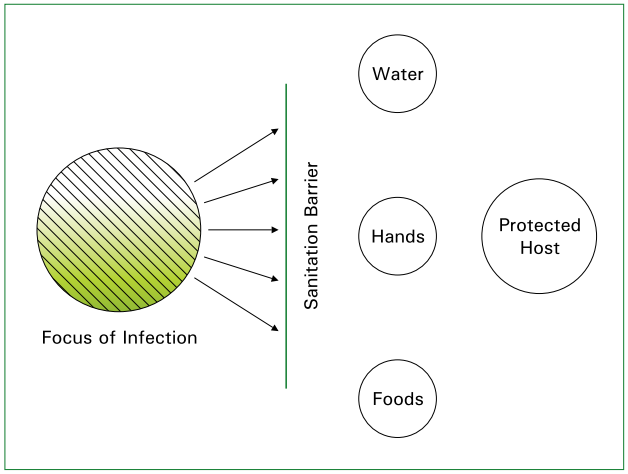


Figure 2

Faeco-oral disease cycle can be broken at various levels by:

- Segregating faeces
- Providing protected drinking water supply
- Keeping foods clean
- Improving personal hygiene
- Controlling files and
- Disposing waste water safely

These are some methods of breaking the faecal borne disease cycle. Of these, the most effective method is the segregation of faeces and its proper disposal. The method is called **"Sanitary Barrier". This barrier can be provided by a "Sanitary Latrine" and disposing the faeces into a pit**. Sanitary latrines are made to contain the entire waste material (excreta, urine and ablution water), which efficiently prevents contact, by human beings, files or any other animals or insects. Several models of sanitary latrines are now available to the people. The models and types vary from place to place and people to people. One should not forget to choose a model that fulfils the criteria of a 'Sanitary Latrine'.

Since, the households are first and primary unit of sanitary latrine system therefore, the importance of household sanitation becomes important part of any sanitation drive in order to ensure proper disposal of excreta waste as well prevent open defecation.

3. Extent of the Problem in Rural India

Several studies conducted in rural India have shown that there is high prevalence of indiscriminate defecation practices. Faecal borne diseases rank high among communicable diseases in our country. Nearly 80 of the total diseases occur due to lack of proper water and sanitation. High infant mortality and under nutrition are also attributed to the open air defecation which are high in rural areas. The high incidence of faecal borne diseases is aggravated with the people or community living in poor condition. Therefore, it becomes necessary to select and provide a suitable technology within affordable cost and the space available to them and to suit their location and place where they live. What they need is a sanitary latrine and good hygiene practices so that human excreta need not come into contact with the new host. In view of this, it is stressed that the sub-structures of the toilet is the most important element of making a good toilet.

Box 1

A sanitary latrine is one which does not

- Pollute or contaminate soil
- Pollute or contaminate ground water
- Pollute or contaminate surface water
- Act as medium to fly breeding or access to flies and animals
- Require handling
- Produce odour and give ugly sight
- Require huge amount and high technology.

4. Technology for Safe disposal of Human Excreta

There are several designs and technologies available for installing a household type sanitary latrine. But several inter-related factors play important role in installing a sanitary latrine to a rural household. This includes:

- Affordability
- Space in the home
- Geographical conditions - soil/water table etc
- Cultural habits
- Availability of water/scarcity of water
- Availability of skilled or semi skilled manpower

Therefore, it is important to give several **technological options or informed choices** to the user to choose and own and maintain a sanitary latrine without much external support. These options must help user to select the most suitable to them in terms of cost as well as design without compromising the criteria of sanitary latrine. For example, between indiscriminate open defecation and water seal latrine, one can identify several options by applying the sanitation upgradation approach - a movement from one alternative to another alternative, which is better than the previous one. This approach is taken into account of the affordability of the community and same time it is flexible to allow for upgradation. E.g. *a simple pit can be upgraded by lining the pit. A lined pit can be upgraded into a seat over the pit with a water seal. A single pit can be upgraded into a double pit. A suitable super structure can be built and upgraded.*

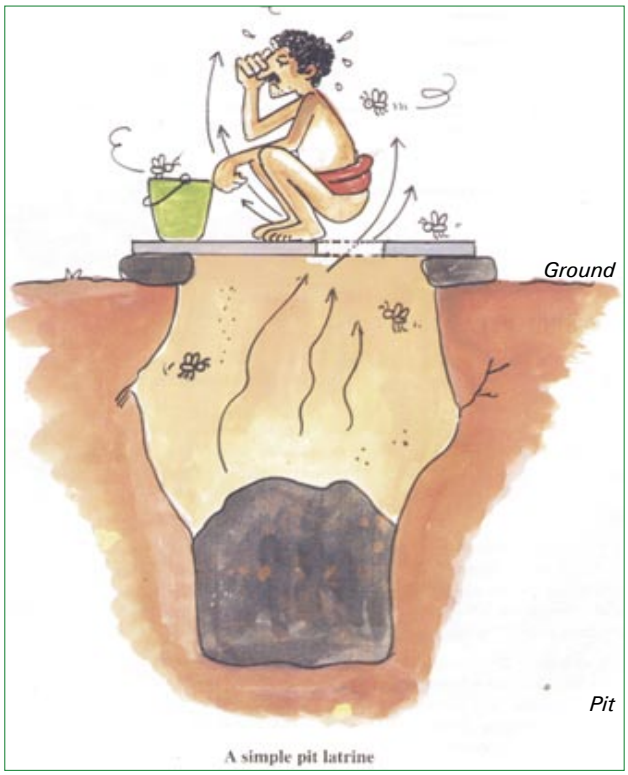
Box 2
Providing technological options/informed choices is one of the strategies of Total Sanitation Campaign. It matches with local situation and enhances the demand for owning a sanitary latrine irrespective of the socio-economic conditions and leads to sanitary way of defecation.

5. Technology Options for Rural Settings

There are minimum four components that define the sanitary toilet. They are - pan, pit/tank, superstructure and overall system (technology) in which they operate i.e. water seal or slab with hole.

As far as toilet technology is concerned, water seal, as indicated, is more prevalent in India due to the practice of anal cleansing with water. But with many other successful experiments, we now have several sanitary technological options for rural India which can be used depending upon the soil conditions, water availability and affordability of the user. Some of the key technological options are:

1. Simple Pit Toilet
2. Ventilated Improved Pit (VIP) Toilet
3. Pour Flush Toilet
4. Eco-san Toilet



A simple pit latrine

5.1 Conventional Pit latrine with cover

Conventional pit latrine is a non-water dependent latrine, which does not require water for functioning, though a small amount of water can be used to clean the squat plate occasionally. This type of latrine is suitable in water scarce areas or where community uses dry cleansing materials. Therefore, the introduction of an unlined or lined pit with a squat plate with or without a super structure can be the second option. This will be particularly applicable for those communities who have open defecation practice.

Advantages

- Affordable
- Simple technology
- Helps to develop practice use latrine
- Appropriate for low-income group who wants to use latrine initially

Disadvantages

- Not fully sanitary latrine
- Fly breeding

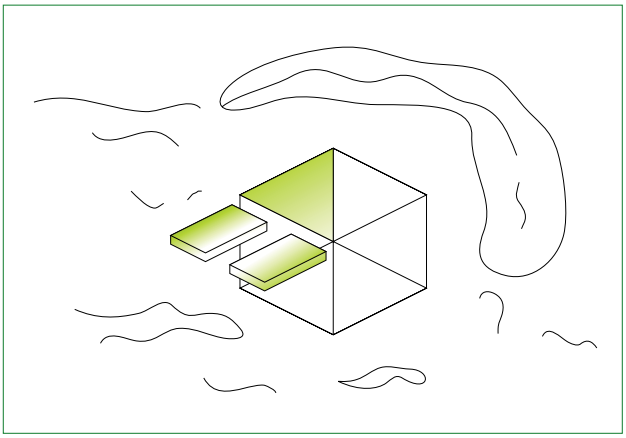


Figure 4

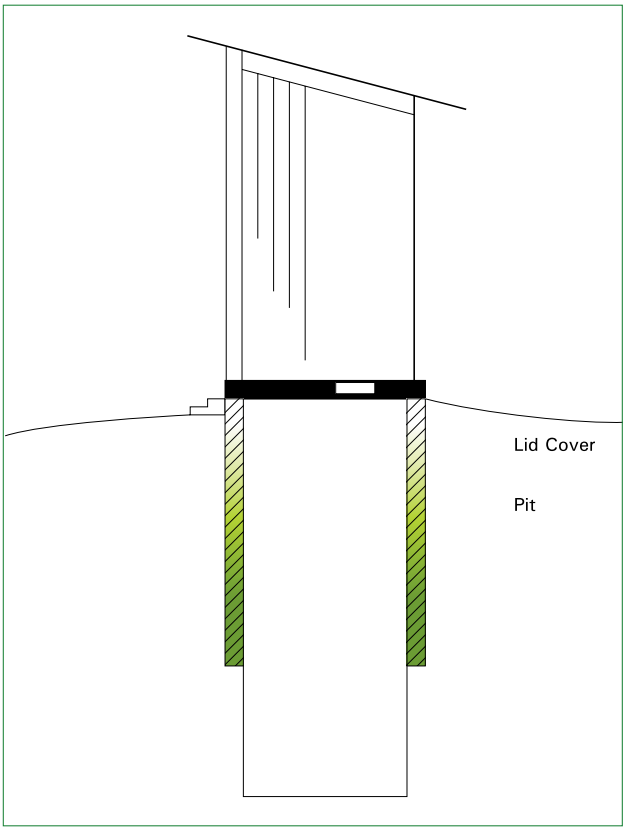


Figure 5, Lid Cover Toilet

- Odour
- Risk of falling into the pit
- Risk of ground water pollution

Materials required

- Capital cost for making squatting platform with hole. Operational cost is negligible
- Cement – 3/4th of a bag. Dry sand 70 liters. Gravel/ Jally 12 mm 100 liters and 6 mm rod for reinforcement 2 Kg.

The conventional pit can also be upgraded by adding vent pipe, superstructure and lid for covering hole and lining pit with locally available materials. This modified and improved version is called **Lid cover toilet**. This is also a non-water dependent latrine which doesn't require water for functioning, though a small amount of water can be used to clean the squat plate occasionally. These groups of latrines are suitable in water-scarce areas. This is provided with a manual closing-lid (or cover) for the squat hole, to make it as fly-tight and odour-tight as much as possible.

Working Life

2 to 3 years (depending upon number of users and pit size).

Tentative material required

Cement	1 bag
Dry sand	70 lit
Gravel (12mm)	100 lit

Important features

- Squat plate with a hole
- A lid (or cover)
- Foot rests near squat hole
- A pit below the squat hole

- House or latrine room
- No need of water to operate this system although a little water can be used, especially for cleaning
- Cross ventilation will eliminate odour inside the latrine room.

5.2 Ventilated Improved Pit Latrine

A VIP latrine is a non-water dependent latrine, which doesn't require water for functioning, though a small amount of water can be used to clean the squat plate occasionally. These groups of latrines are suitable for water-scarce areas. A ventilated improved pit latrine is an improved conventional pit latrine, slightly offset from the pit and having a tall vertical (gradually tapered towards the pit) vent pipe with a fly-screen fitted outside the superstructure to trap flies and reduce odour nuisance.

Advantages

- Little odour
- Less chances for transmission of excreta related disease than lid or cover latrine
- Good health and hygiene practice
- Can be used as fertilizer after one year of composting
- Better life and environment
- Suitable for water scarce area, no need for water except occasional cleaning of the squat plate
- Suitable for communities using dry cleansing materials
- Can be built with local materials
- Affordable
- Construction and maintenance are easy
- Can be upgraded to pour flush latrine
- Suitable for less densely populated area where space is available for relocating the latrine when it is full

Disadvantages

- Technical support required when installed as proper construction is crucial
- Risk of groundwater and surface water contamination
- Once filled the latrine has to be moved to another location
- Odour nuisance is not fully controlled.

Working life

3-4 years depending on number of users and pit size

Users responsibility

Needs maintenance for vent pipe, fly net, squatting plate and the superstructure.

Tentative material required

VIP latrine with brick lining:

Cement	88 kg
Brick	900 nos.
Gravel	0,1 m^3
Sand	0.1 m^3
Rebar	2.2 kg
PVC (150 mm)	2.5 m
Fly screen	One

Important features

- Squat plate with a hole
- Footrests near squat hole
- A vent pipe extending above roof. The vent pipe outside should be painted with black color and should be gradually tapered in bottom portion for getting effective functioning. Fly screen-covering top of vent pipe. Single pit under the squatting plate. House or latrine room should be oriented either on north or south to avoid direct sunlight. House should not be located under trees or structure to allow adequate wind flow. Ventilation for the latrine room should be always in the upper portion of the latrine room; preferably above of the entrance door (no other ventilation should be provided).

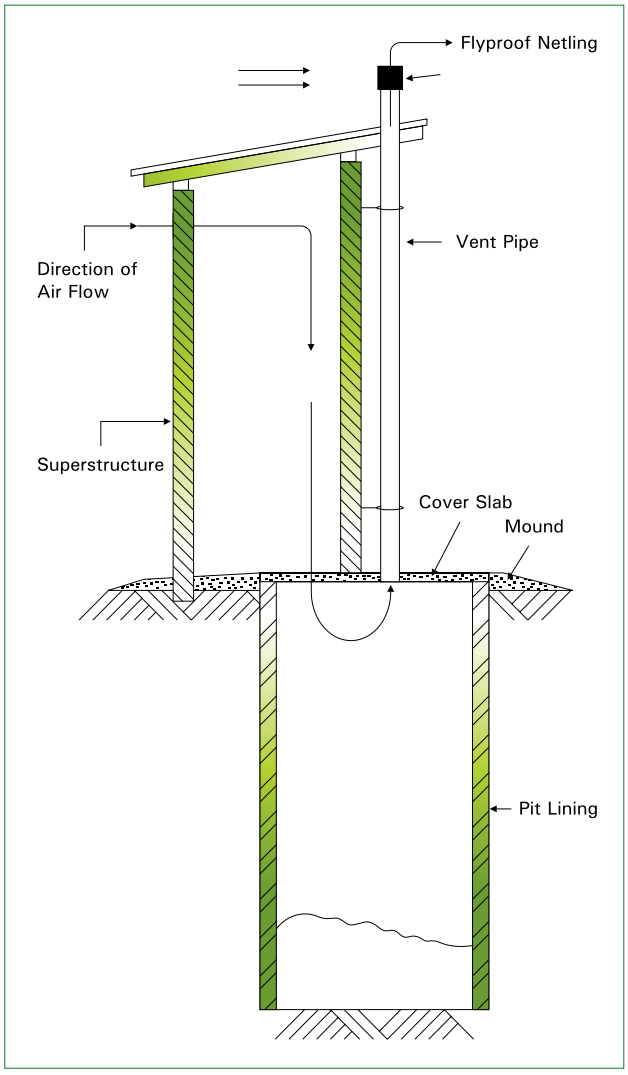


Figure 6

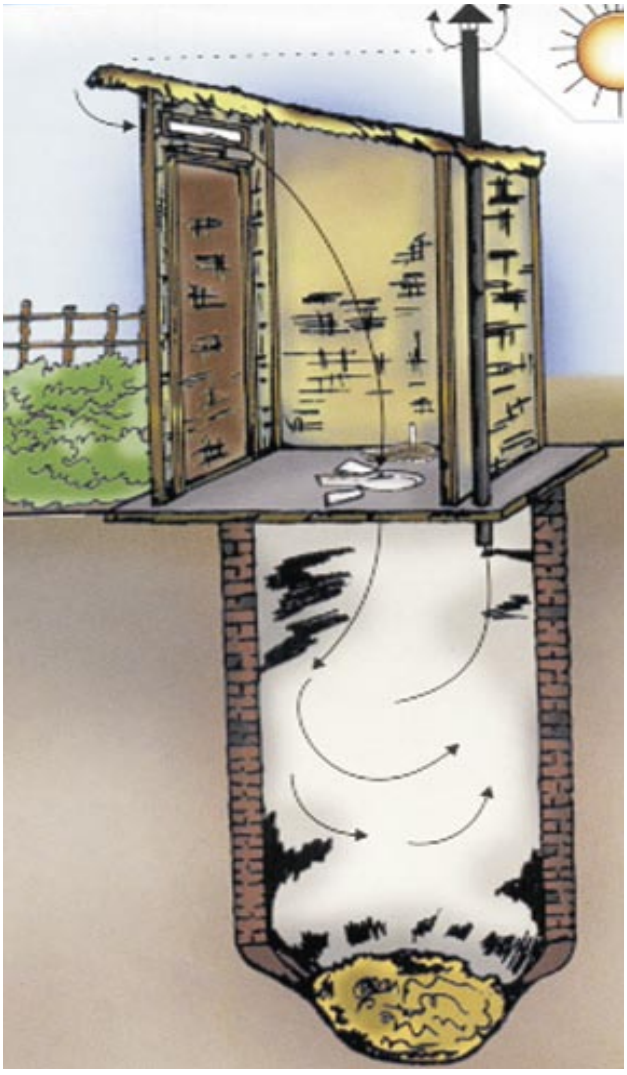


Figure 7

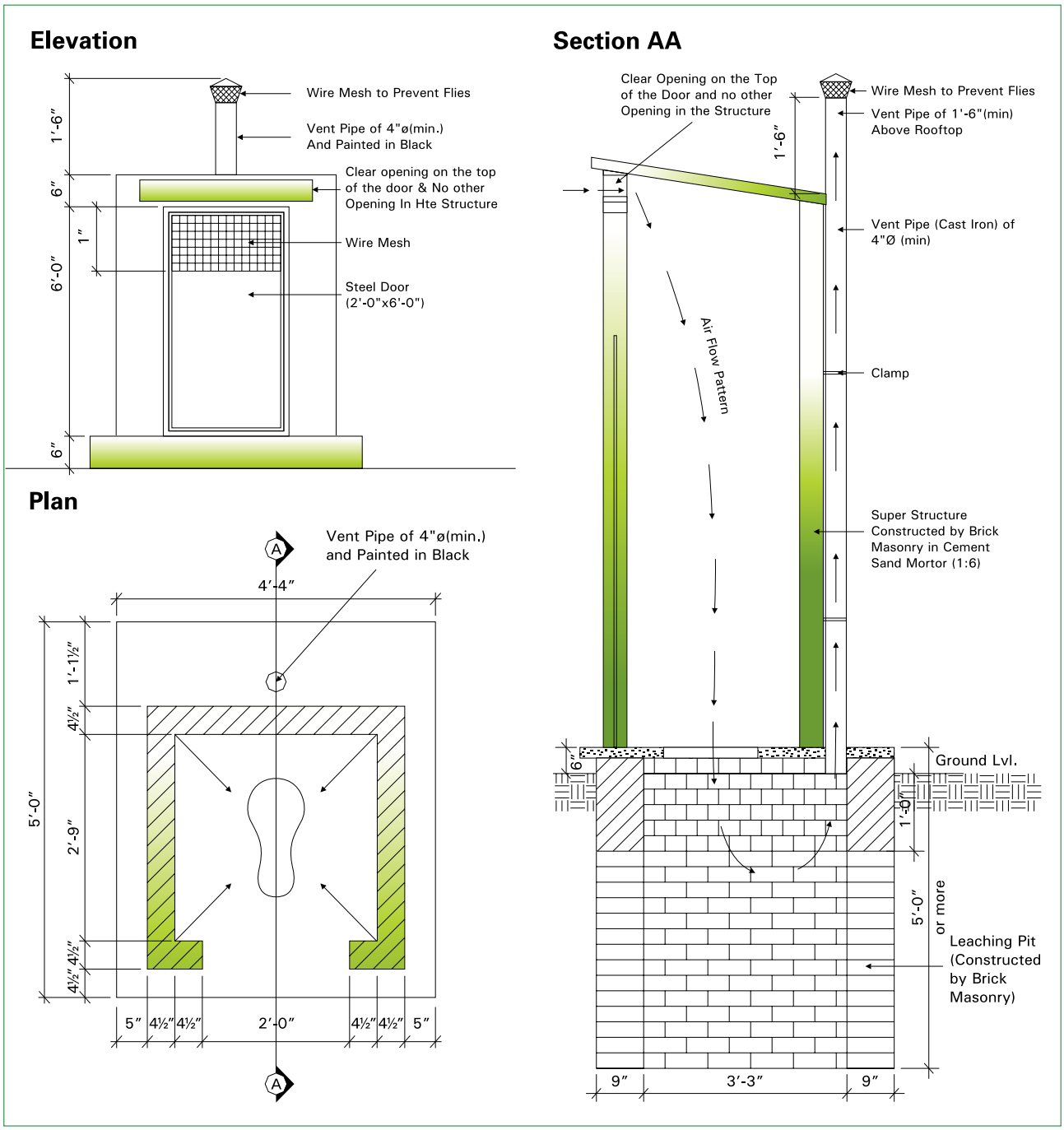


Figure 8

5.2.1 VIP toilet Model 1

5.2.2 Twin Pit VIP Model

VIP toilets can also be constructed with a double pit system. The toilet has two shallow pits, each with their own vent pipe but only one superstructure. The cover slab has two drop holes, one over each pit. Only one pit is used at a time. When one is full, its drop hole is covered and the second pit is used. After a period of at least one-year, the contents of the first pit can be removed safely and used as soil conditioner. The pit can be used again when the second pit is filled up. This alternating cycle can be repeated indefinitely. Pls refer figure 9.

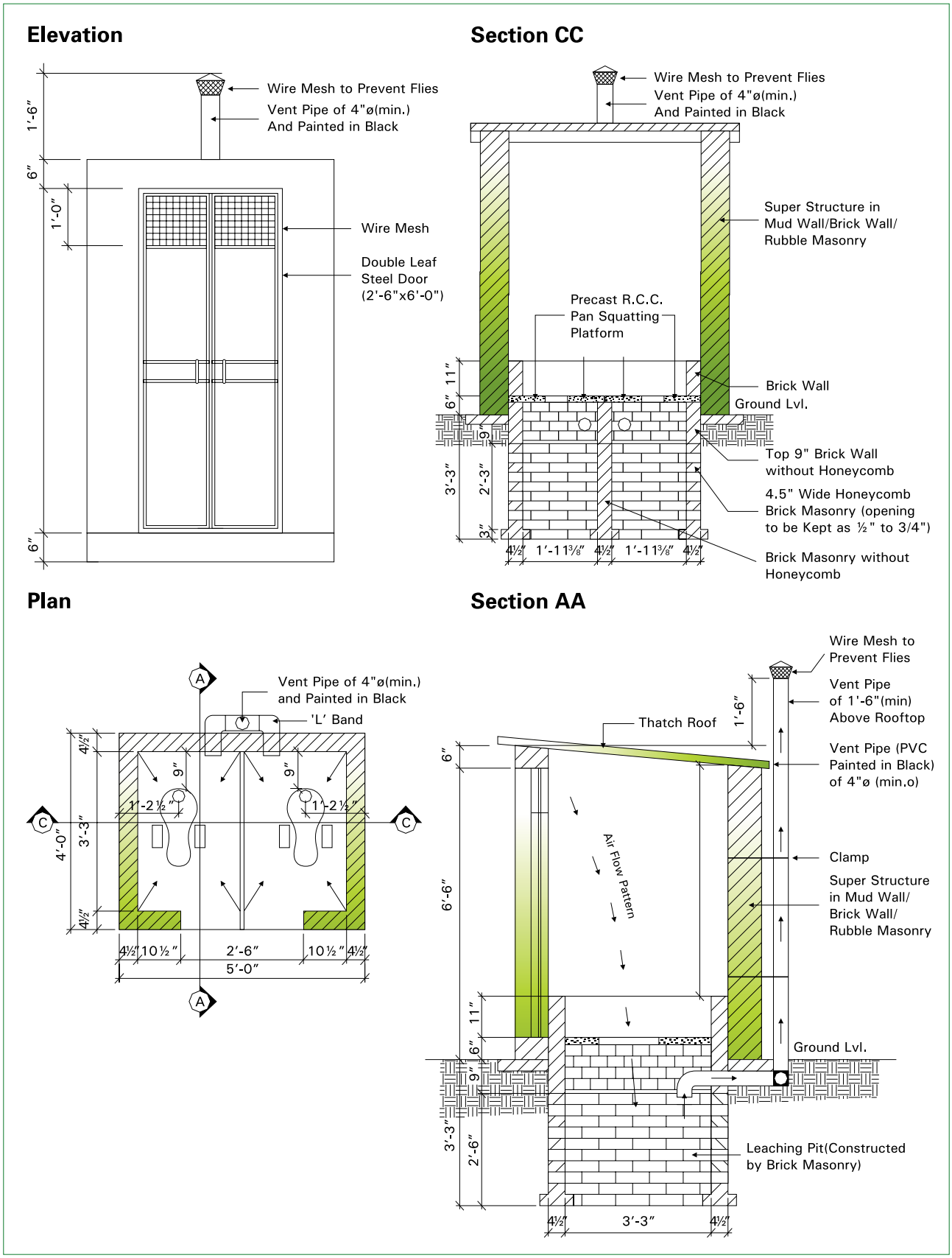

Elevation
Wire Mesh to Prevent Flies
Vent Pipe of 4"ø(min.)
And Painted in Black
1'-6"
6"
1'-0"
Wire Mesh
Double Leaf
Steel Door
(2'-6"x6'-0")
6"
Section CC
Wire Mesh to Prevent Flies
Vent Pipe of 4"ø(min.)
And Painted in Black
Super Structure in
Mud Wall/Brick Wall/
Rubble Masonry
Precast R.C.C.
Pan Squatting
Platform
Brick Wall
Ground Lvl.
Top 9" Brick Wall
without Honeycomb
4.5" Wide Honeycomb
Brick Masonry (opening
to be Kept as ½" to 3/4")
Brick Masonry without
Honeycomb
6" 11"
9"
3'-3"
2'-3"
3"
4½" 1'-11⅜" 4½" 1'-11⅜" 4½"
Plan
A
Vent Pipe of 4"ø(min.)
and Painted in Black
'L' Band
C
C
A
4½"
9"
9"
1'-2½"
1'-2½"
4'-0"
3'-3"
4½"
4½" 10½" 2'-6" 10½" 4½"
5'-0"
Section AA
Wire Mesh to
Prevent Flies
Vent Pipe
of 1'-6"(min)
Above Rooftop
1'-6"
Thatch Roof
Vent Pipe (PVC
Painted in Black)
of 4"ø (min.o)
6"
Air Flow Pattern
Clamp
Super Structure
in Mud Wall/
Brick Wall/
Rubble Masonry
6'-6"
11"
6"
9"
Ground Lvl.
3'-3"
2'-6"
Leaching Pit(Constructed
by Brick Masonry)
4½" 3'-3" 4½"

Figure 9

5.3 Pour flush latrine

This is water dependent latrine that relies mainly on the usage of water. Without water, these latrines fail to operate. The water flushes out excreta from bowl, which consists of a water-seal generally known as a trap. The water dependent latrines can be further categorized on the basis of: Flushing (pour flush or mechanical flush). Pour flush, though, is more operational and suitable to the conditions of rural areas.

The pour flush latrine is a specially designed water-sealed bowl, which requires 1-2 liters of water for flushing the excreta. Some water always remains at the bottom of the pan after it has been used. This water seal latrine eliminates the entry of odour and prevents rodents to the latrine room from pit through the bowl. This pour flush latrine consists of a single pit either just below the bowl (onset type) or may be offset from the bowl (offset type) using the pour flush type bowl (pan and trap).

Box 3
Water quantity required (pour flush latrine: where 1-2 liters of water is required for manual flushing.

Excreta disposal system (pit latrine) where excreta is collected and decomposed within a pit.

Advantages

- Odour free.
- Privacy.
- Little chance for transmission of excreta related disease.
- Good health and hygiene practice.
- Appropriate where water is available.
- Long lifetime and no need to move for many years.
- Water requirements for flushing is low (1-2 liters).
- Construction and maintenance are cheap and easy.
- Offset type can be adjusted in any type of dwelling without causing any foul smell.
- Suitable for less populated areas where space is available for relocating the latrine.
- Possible to upgrade it into twin pit pour flush system (for offset type).

Disadvantages

- Water necessary for flushing, 1-2 liters
- Risk of groundwater and surface water contamination.
- Not appropriate where water is not available
- Dislodging of toilet required every 3-5 years
- Locally manufactured bowls are often of bad quality due to lack of proper moulds.
- Difficult to construct in high ground water table area.

Working Life

5-10 years, depending upon pit size and number of users and soil etc.

Users responsibility

- Need awareness on how to use.
- Need to clean the squat plate and pan regularly.
- No paper, cotton etc. should be thrown into the pan; otherwise water seal will be choked.
- Water for flushing is a must after each use.
- Pan options.
  - Plain cement/plastic/mosaic/fiberglass reinforced/ceramic etc.
  - The pan (the trap portion) is different for onset type and offset type pits.
- For lined pit
  - A shovel to dig the pit and lining materials such as, bamboo/stones/earthen rings/ bricks/hollow blocks/Ferro-cement rings etc. In all cases the sidewall of the pit has to be perforated.
- Cover for offset pit in concrete or wood.
- Toilet floor with foot rest.
  - The bowl should be fixed into either a squat plate just on the top of the pit or to be aligned from toilet floor for offset pit. Proper finishing needs to be done of the floor.
- House for privacy made of any local materials.

Important features

- Pour Flush Bowl (the pan and trap: water seal generally 20 mm)
- Squat platform/floor where bowl and water-seal trap fixed along with foot rest
- Lined or unlined pit for on-set type; lined pit for offset type
- Perforated sidewall for lined pit
- Suitable for areas where water supply is available

Tentative material required Cement	**70 kg**
Sand	0.1 m^3
Gravel	0.15 m^3
Steel (dia 6 mm)	1.5 kg
Squatting plate	1

5.3.1 Options in Pour flush/Water seal technology

5.3.1.1 Direct Pit Water Seal Toilet

This unit consists of a squatting slab monolithically cast with a cement pan having an in-built water seal. The slab [reinforced cement concrete (RCC) or ferro-cement (FC)] can be of either a circular or a rectangular shape.

A pit is dug in the ground and the squatting slab is placed over it. Normally no pit lining is required in the case of hard and compact soil. However, in case of loose soil, the pit is to be lined in order to prevent the side from collapsing. The size of the pit should be such that it takes two years to get filled up. A superstructure may be built over it for privacy and protection.

After defecation, 1-2 liters of water is poured to flush the excreta out of the pan, which accumulates in the pit where decomposition takes place. The gas formed during decomposition escapes through the joints/ openings of the pit lining and is absorbed by the surrounding soil. The effluent is leached out and absorbed by the soil while the solid part (sludge) accumulates in the pit. Thus, on prolonged use, the pit gets filled up. When this happens, a second pit is constructed and the squatting slab and superstructure are shifted over it. The filled up pit is covered with a thick layer of soil and allowed to be stabilized for about two years. During this time the contents of the filled-up pit will have become organic humus and safe for handling. When the second pit also gets filled up, after two years or so, the first pit is cleaned, the squatting slab and superstructure is shifted back over it and thus a continuous operation of a direct pit toilet is achieved. Since the superstructure has to be shifted repeatedly, only a temporary construction is recommended for this type of a toilet. See figure 10 & 11.

Figure 10

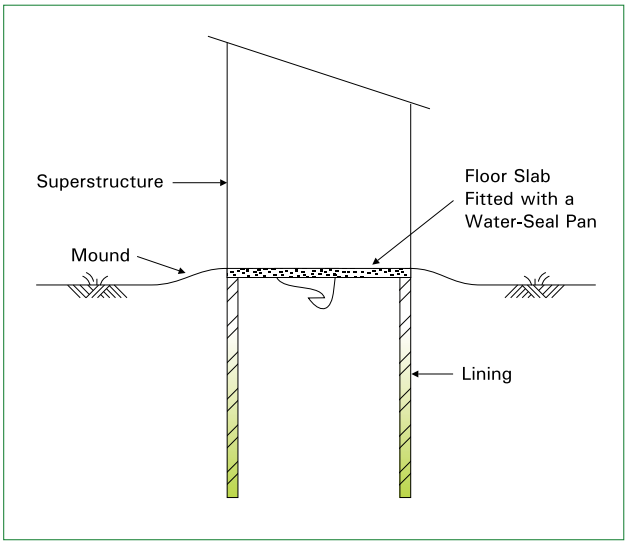


Figure 11

5. 3.1.2 Twin Pit Water Seal Toilet

The 'Twin Pit Water Seal Toilet' is a complete excreta disposal system which, on one hand fulfills all the sanitary requirements and on the other hand, provides continuous operation with minimal effort. The main components of such a toilet are the water seal pan/ trap arrangement, squatting platform, junction chamber, two pits and a superstructure (refer Figure 12 and 13).

The squatting platform is a raised pucca floor constructed with appropriate plinth and foundation. The pan has a steep bottom slope which allows easy flushing of excreta. The oulet of the pan is connected with a P-trap. On flushing, some water always remains in the trap and forms a 'water seal'. The water seal prevents the bad odour coming from (and the insects reaching the) excreta. The outlet of the trap is connected with a junction chamber either by using a pipe or by constructing a covered brick drains. The junction chamber has one inlet (connected to the P-trap) and two outlets (connected to the leach pits) which are for alternate use. A temporary or permanent superstructure is constructed over the platform for privacy and protection.

For making a twin-pit toilet operational, one of the outlets of the Y-junction in the junction chamber is blocked while the other outlet is kept open to the corresponding pit. The disposal process of the excreta is the same as in a 'direct pit toilet'. In this case, when the first pit gets filled up, the flow of excreta has to be diverted to the stand-by second pit. For doing this, one has to remove the cover of the junction chamber, open the outlet connected to the second pit, block the outlet connected to the first filled up pit and replace the junction chamber cover. The contents of the filled pit will become organic humus and safe for manual cleaning in about two years. When the second pit also gets filled up, the first pit is cleaned and the same operation is repeated to divert the flow of excreta from the second pit to the first pit as was followed earlier. Thus a 'Twin-pit Water Seal Toilet' provides a continuous operation.

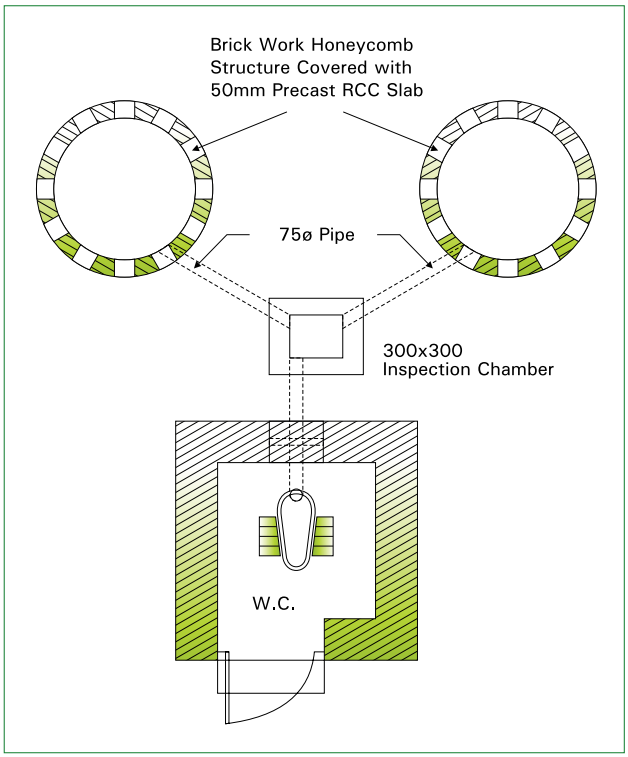


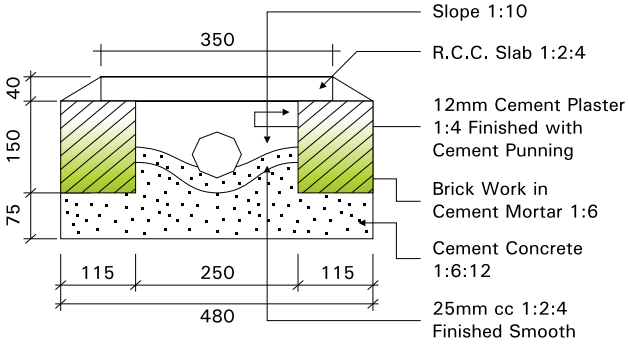
Figure 12

Box 4

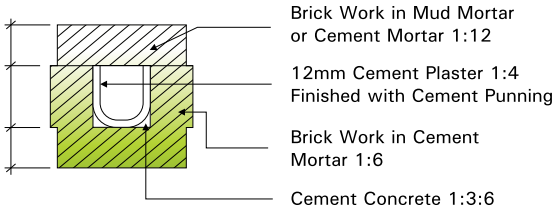
The functions of different components of two-pit pour flush toilet

- W.C. Pan: To direct excreta into water seal trap.
- Water seal trap: To prevent emission of foul smell (gases) from the leach pit and entry of flies and other insects into leach pit.
- Junction chamber: To restrict flow of excreta to one leach pit at a time and facilitate removal of accidental blockage in the connecting pipes.
- Drain pipes: To carry excreta from Junction chamber to leach pits.
- Leach pits: To facilitate leaching of liquid from excreta into surrounding soil and dispersion/absorption of obnoxious gases into surrounding soil and decomposition of excreta.

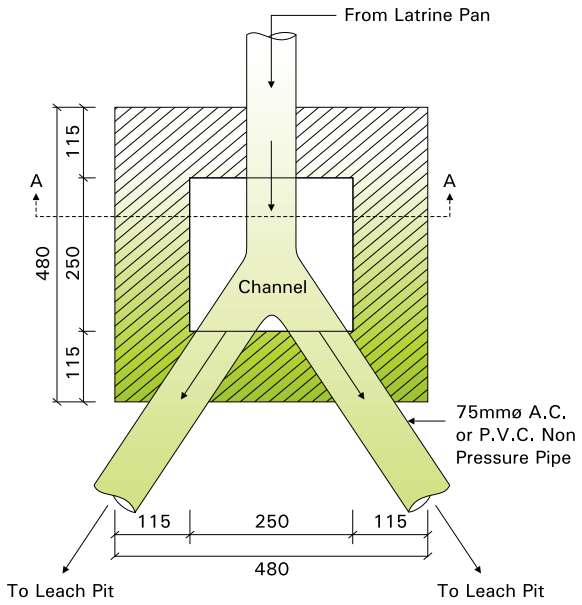
Section A-A



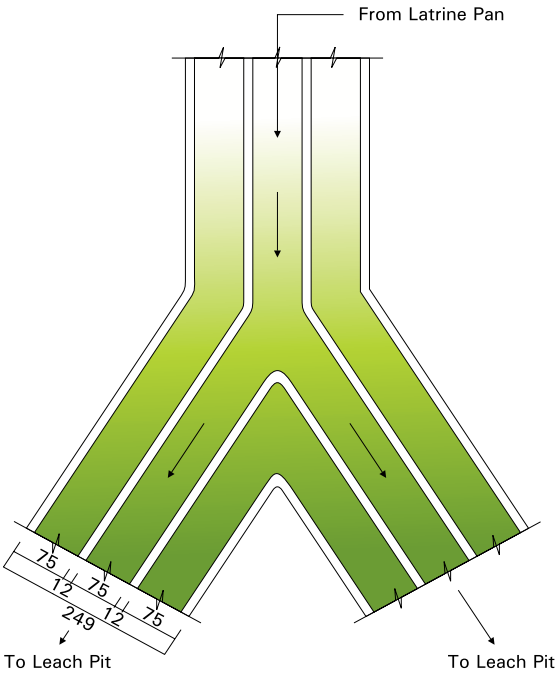
Section B-B



Plan

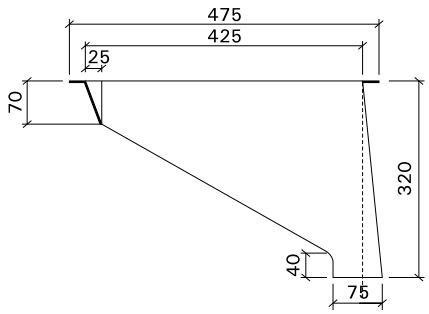


Plan



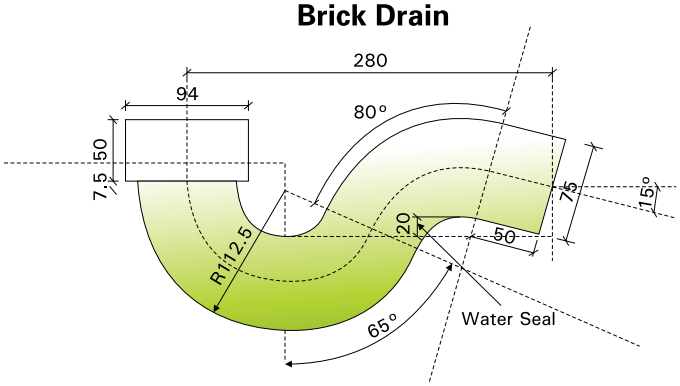
Section C-C

Junction Chamber

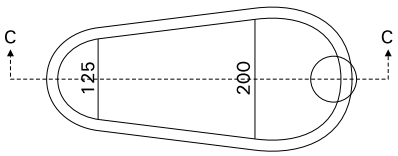


Trap

Brick Drain



Plan



Squatting Pan

All Dimensions In Mm

Figure 13

5.3.1.3 Single Offset Pit Water Seal Toilet

A 'Single Offset Pit Water Seal Toilet' consists of water seal pan, a squatting platform, a junction chamber, a temporary/ permanent superstructure and a single pit instead of two pits as described above. The pit is constructed away from the squatting platform and connected to the same by a pipe through a junction chamber. A single offest pit toilet functions in the same manner as a twin-pit one. Once the single offset pit gets filled up, another one is dug nearby and connected with the junction chamber by a pipe. The flow of excreta is diverted to the new pit by blocking the outlet of the first pit at the junction chamber. The contents of the first pit are left undisturbed for two years after which it is safe for manual cleaning. When the second pit also gets filled up, the first one is cleaned and the flow of excreta is diverted to the same. Thus, a single offset pit toilet eventually turns into a twin-pit over a period of time.

Figure 14

5.4 Eco-san toilet

Ecological sanitation (Double Vault Compost Latrine) is based on recycling principles. In this

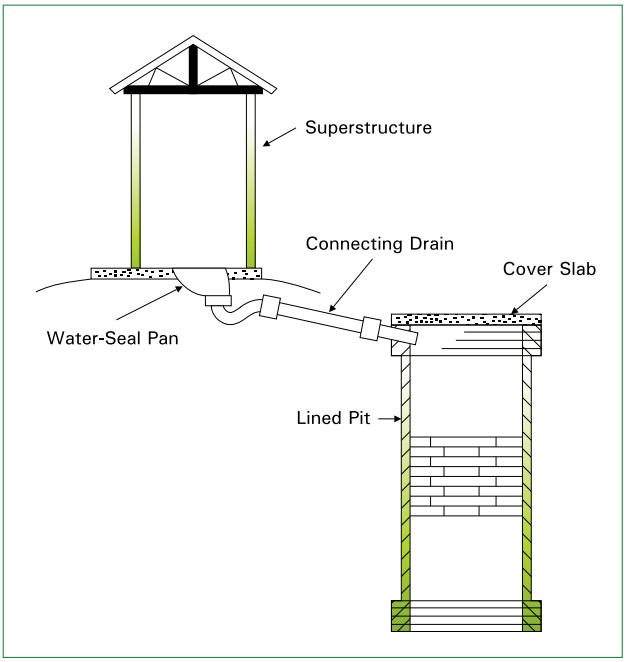


Figure 15

approach, the excreta and urine are separated for disposal. The eco-san model consist the double-vault compost latrine consists of two water-tight chambers (vaults) to collect faeces. Urine is collected separately as the contents of the vault have to be kept relatively dry. Initially, a layer of absorbent organic material is put in the vault and after each use, the faeces is covered with ash (or saw-dust, shredded leaves or vegetable matter) to deodorise the faeces, soak-up excessive moisture and improve carbon/ nitrogen ratio, which ensures that sufficient nitrogen is retained to make a good fertilizer. When the first vault is three quarters full, it is completely filled with dry powdered earth and sealed so that the components can decompose anaerobically. The second vault is used until it is also three quarters full and the first vault is emptied by hand, the contents are used as a fertilizer (Refer Figure 16). The vaults have to be large enough to keep faeces for at least a year in order to become pathogen free. The superstructure is built over both the vaults with a squat-hole over each vault which can be sealed-off. The latrine can be built everywhere as there is no pollution coming from the water-tight chambers to pollute the surroundings.

Advantage

- It is most ideal for areas where water is scarce and pour-flushing implies water to be carried from source, or areas where water table is high such as flood plains or coastal areas and densely populated areas where risks of ground water pollution from pits to drinking water sources is assessed high.

Disadvantage

- Proper operation needs full understanding of the concept, lack of which makes the system dyfunctional.
- Where people are eager to use the contents as fertilizer, they may not allow sufficient time for the contents to become pathogen free.
- This system is only to be used where people are motivated to use human excreta as a fertilizer.
- Inadequate number of trained masons impact the quality of construction.

Working Life

- 5-6 years, depending upon pit maintenance and numbers of users.

User's responsibility

- To ensure that the system is well-designed and quality constructed
- O&M should be done properly otherwise, the system would fail and become breeding ground for many diseases.

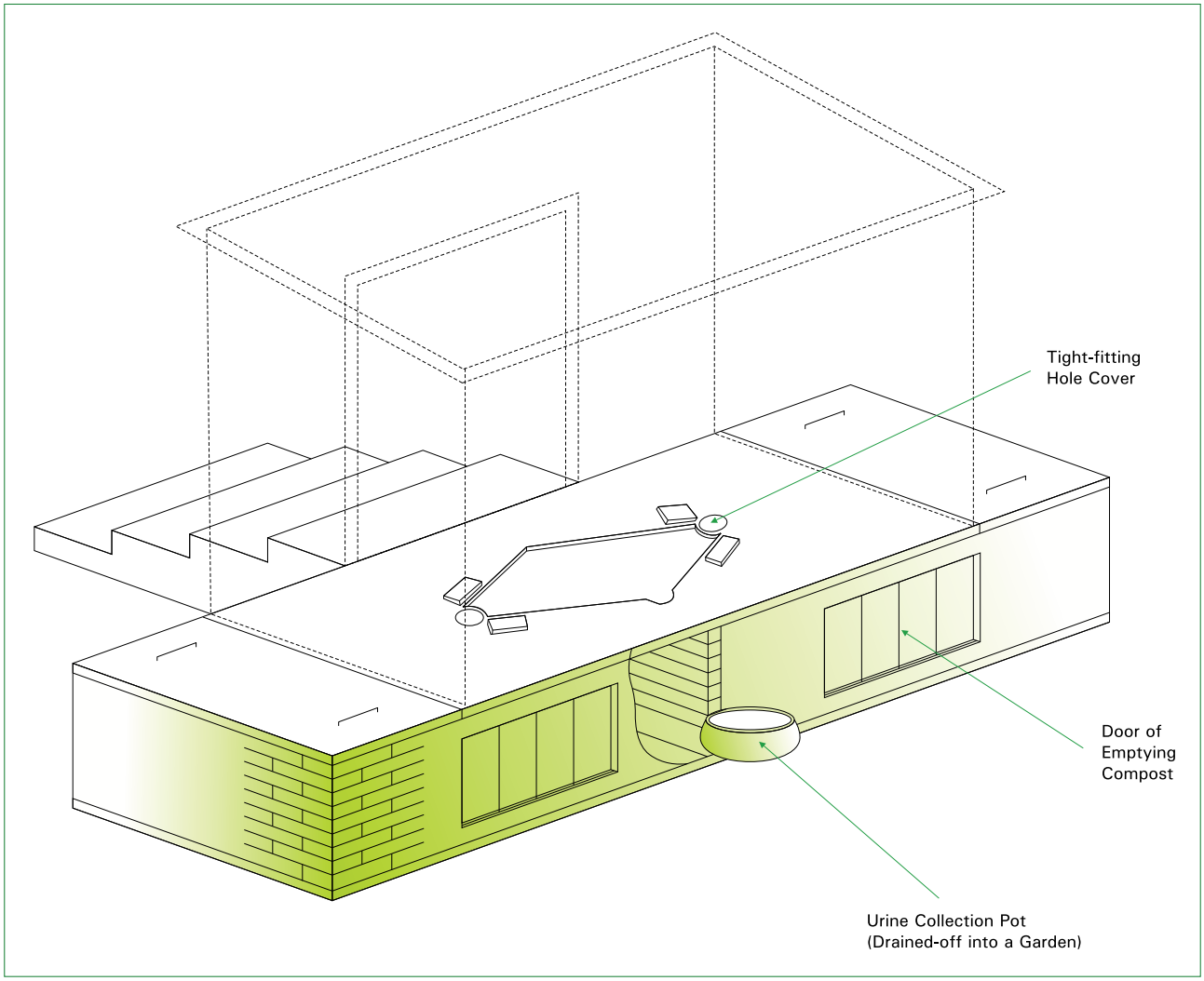
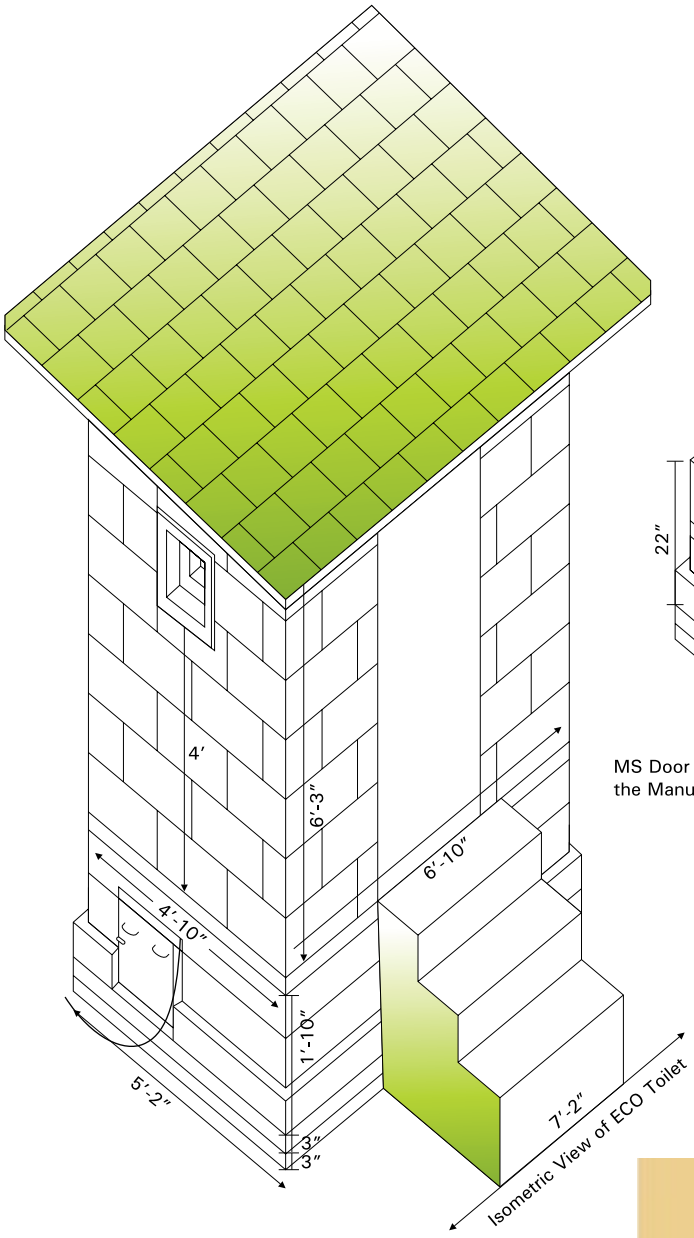
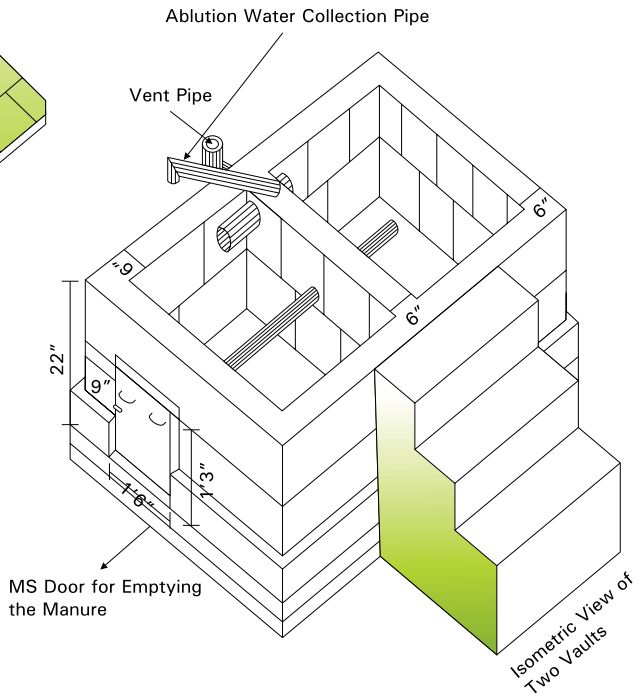


Figure 16





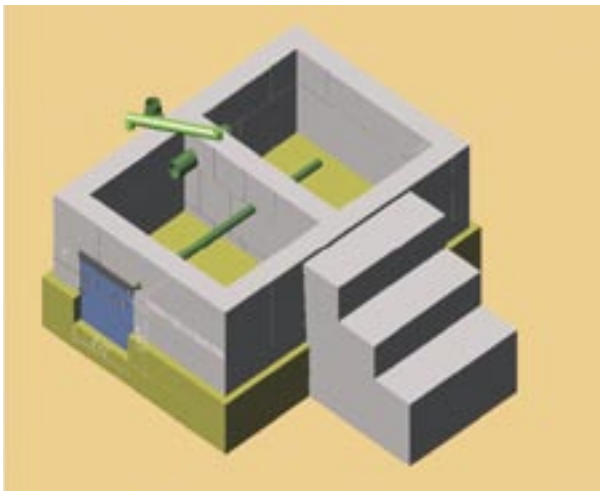
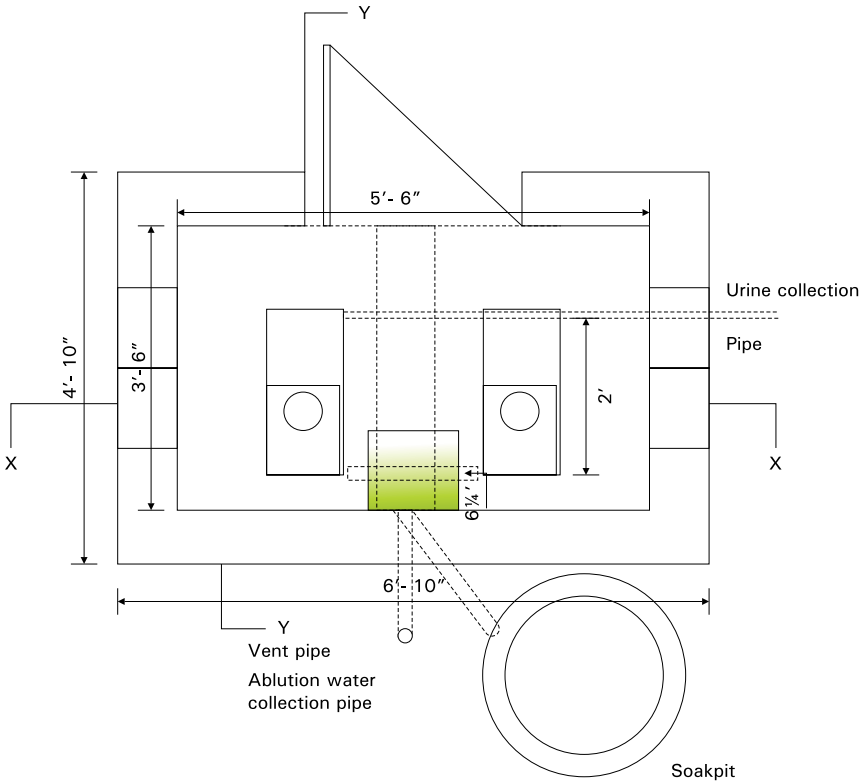
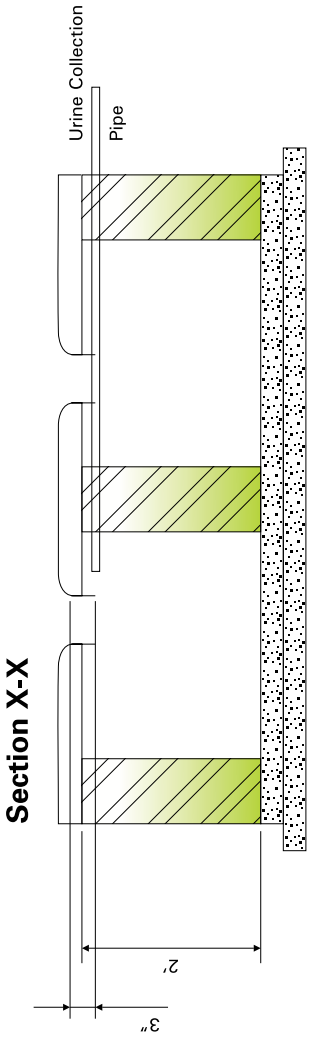


Figure 17

Figure 18 - Base demo of eco-san toilet

Plan





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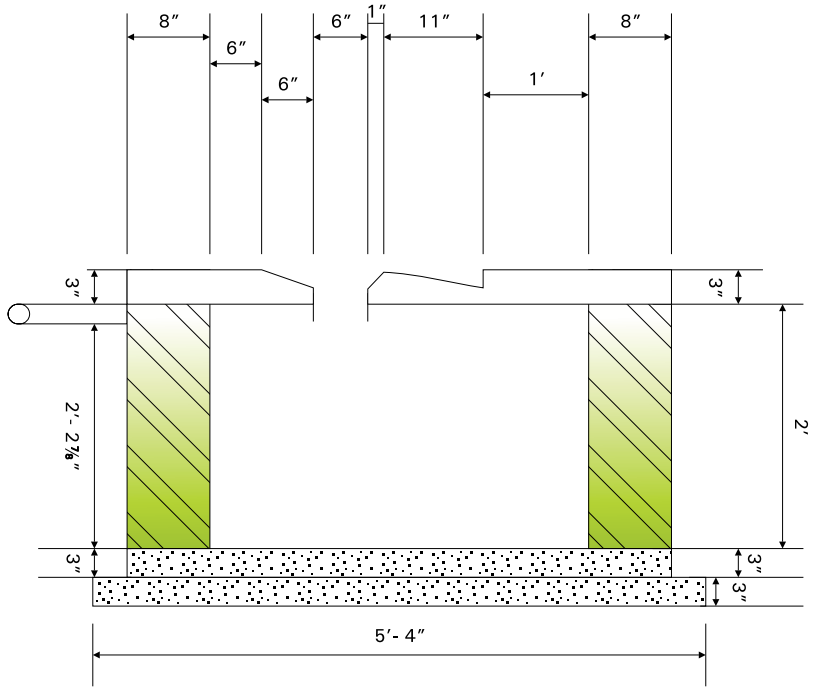


Two vault eco toilet
All dimensions are in foot-inch

Figure 19

Various stages of eco-san toilet during construction and after construction

Construction of eco-san base

Eco-san Toilet - Vault opening door

Soak pit

Inside Ecosan Toilet

Construction of eco-san platform

6. Selection of technology in different conditions

A particular technology can't be applied in all conditions; therefore, it really becomes a challenge to select a suitable technology. Many technological options have been discussed but for the initial selection of a suitable disposal system technology, the following box 5 may be useful.

Box5

Technology Differences								
Latrine type	**Suitable for High Ground Water table**	**Suitable for areas prone to floods, tidal floods or flushes**	**Suitable for loose soils**	**Suitable for soils of low permeability**	**Water requirement**	**Ease of construction**	**Ease of maintenance**	**Remarks**
Direct Single pit Latrine Without Pour-flush	Yes, if raised	Yes, if raised	Yes, if fully clay soils lined	Not for	No	Easy	Easy	Sludge unsafe
Direct Double pit Latrine Without Pour-flush	Yes, if raised	Yes, if raised	Yes, for fully lined	Not for clay soils	No	Easy	Easy	Safe sludge
Offset Single pit Latrine with Pour-flush	Yes, if raised and with soak away	Yes, if raised	Yes, for fully lined	Yes, with soak away	Yes	Easy	Easy	Sludge unsafe
Offset Double pit Latrine with Pour-flush	Yes, if raised and with soak Away	Yes, if raised	Yes, for fully lined	Yes, with soak away	Yes	Fairly Easy	Fairly	Safe sludge easy
Solar Heated single-vault ecological latrine with urine separation	Yes	Yes	Yes	Yes	No	Easy	Difficult	Safe dehydrated material
Single-vault ecological latrine with urine separation	Yes	Yes	Yes	Yes	No	Easy	Difficult	Safe dehydrated material
Urinal	Yes	Yes, if raised	Yes	Yes	Yes a bit	Easy	Easy	

7. Components of Toilet

7.1 Pan and trap

Pan forms a very important item in toilet construction. There are various designs of pans available in the market. In this context, the quality and design of pan is a very important. Rural pans having higher gradient with less water consumption for flushing are technologically superior to flat pans which require more water for flushing. Flat pans are not suitable for leach pit toilet due to its requirement of low gradient. They need lot of water and pit fills up early as a result affecting the longevity of the pit.

The key specifications are.

- The bottom slope of rural pan is very steep that is less than 25 to 40 degrees
- The inner length of the pan is 425 mm and the outer length is 475 mm.
- The depth of the rural pan is 320 mm

The design of the rural pan with water seal is given below:

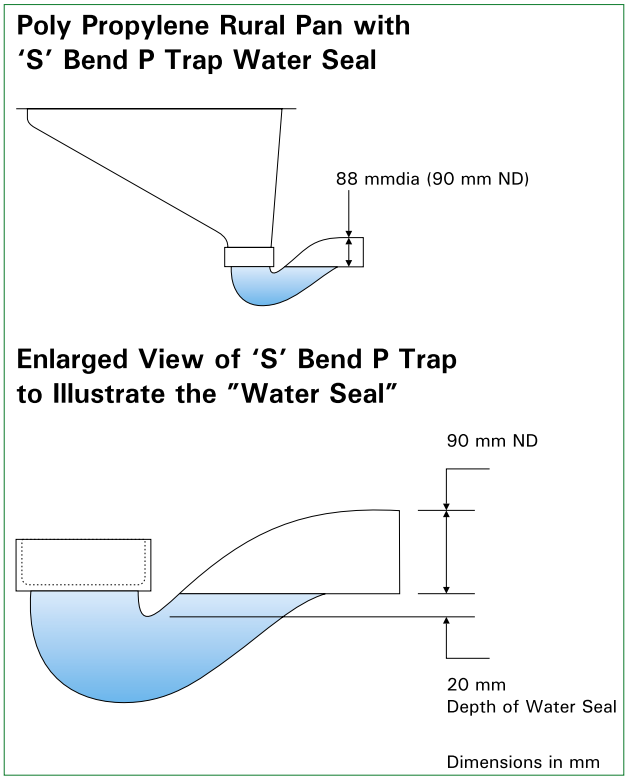


Figure 20

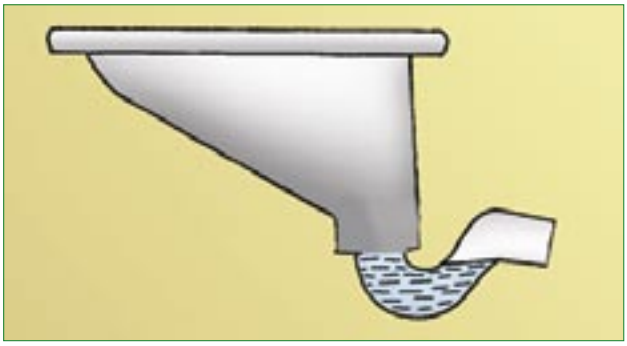


Figure-21, Rural pan with water seal

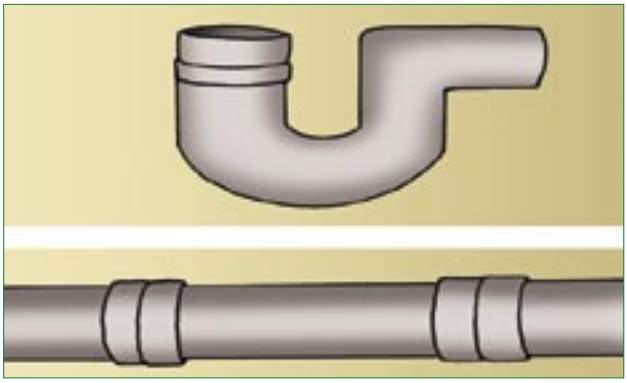


Figure-22, P-trap and pipe

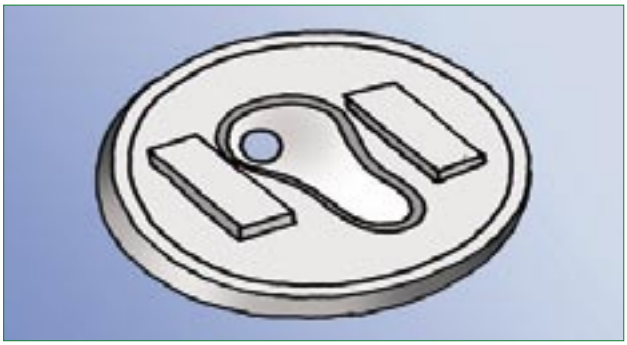
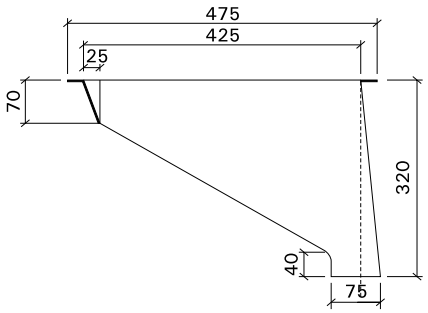


Figure-23, Pan and floor slab

The advantages of rural pan over commercial or flat pan are:

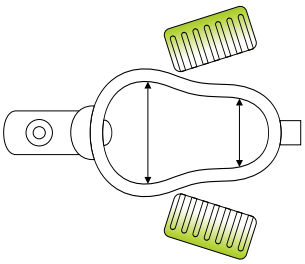
- The rural squatting pan spout diameter is less than the commercial pan (68m) so that the curvature of the trap is comparatively lesser and requires minimum quantity of water for flushing the faecal matter.
- Bottom slope of the rural pan is very steep resulting in high velocity of water and excess flushing.
- The cost of the rural pan is $^{1}/_{2}$ of the commercial pan.
- The width of the squatting pan is comparatively less, which enables children to use them without fear and discomfort.
- The depth of the rural pan is more than the commercial pan so that the spillage can be avoided.

Rural Pan

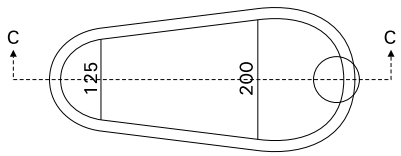


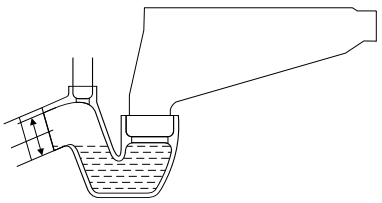
Commercial Pan

Size: 580mm. Box Rim, with Front Inlet.
Also Available in Sizes 450mm, 500mm & 630mm.



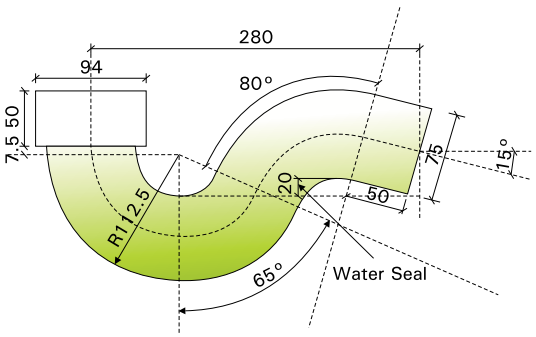
Section A-B

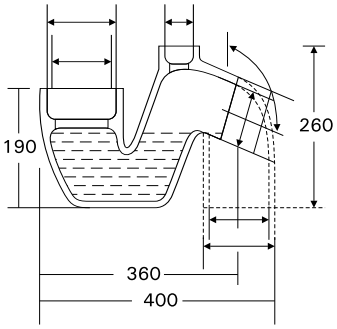


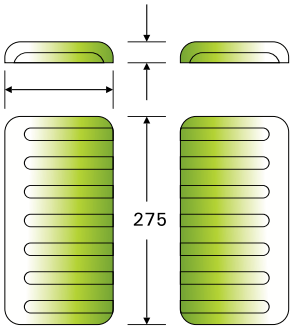


Trap

'P' Trap Also Available in Small Size







Advantages of rural pan over commercial pan

Figure 24

7.2 Pits/tanks

The function of the pit or tank is to isolate and store human excreta in such a way that no harmful bacteria is carried to new host. Though there is marked difference between pit technology and tank technology as there is practically 'nil' daily maintenance in pit technology for disposing of sewage (water mixed with excreta) as it percolates in to the soil every day, continuously. The digested solid removal needs to be attended to once in 2 to 3 years only and not daily. The dirty solid excreta are rendered harmless as humus which can be used as beneficial manure. This technology is popularly known as leach pit technology which has many advantages over tank generally known as septic which will be discussed later.

7.2.1 Leach Pit

According to this technology, the water and gas of the excreta gets absorbed through the pores of the pit and the solid gets decomposed into manure. This technology maintains the system under hygienic condition that is free from odour and insect nuisance. Pits may be circular, square or rectangular and squatting slabs may be circular (refer Figure 25) or rectangular (refer Figure 26). These are preferably lined as it holds the soil and prevent the pit from collapsing; lining may be done with honey-combed brick wall or perforated concrete rings, apart from twigs, split bamboo matting, an old drum, stone masonry, etc. Leach pits are generally provided at the back of the squatting pan. For circular pits, the minimum distance between the two pits should not be less than the depth pit while for rectangular pits; both the pits can be clubbed together with common partition wall plastered on both the sides. The area for percolation shall have to be adequate and the dimension shall have to be slightly increased as per soil condition.

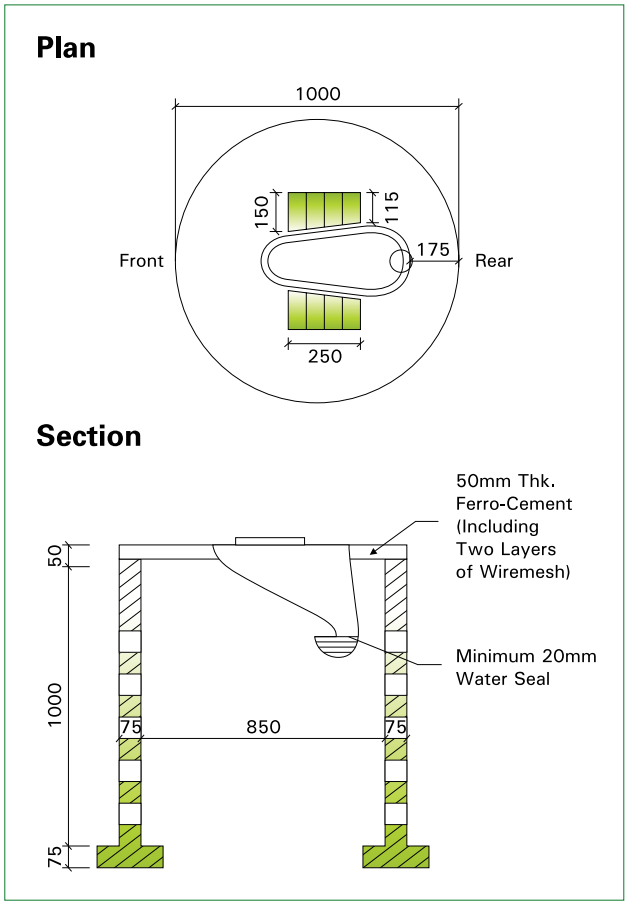


Figure 25

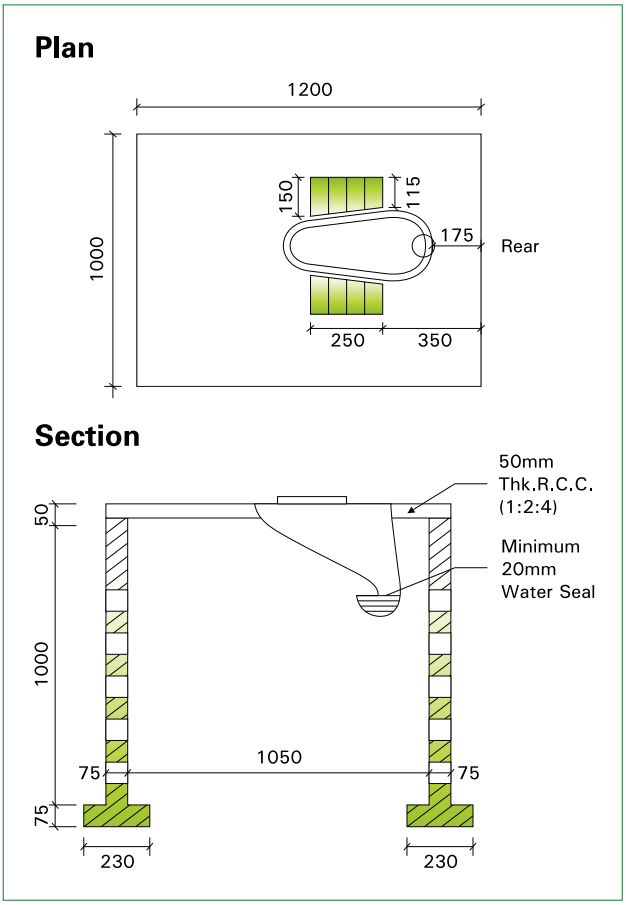


Figure 26

7.2.1.1 Selection of pit

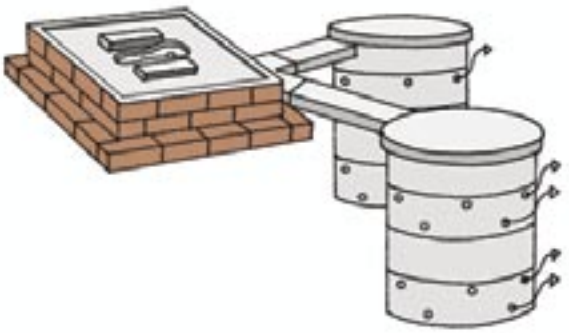
In India, according to published data, the amount of human waste is 400 gram faeces and 2200 gram urine per person per day. For selecting a type of pit, an amount of 1kg of wet weight per person per day is taken into account for calculating the pit design. Based on this, for effective depth or capacity of wet latrines a provision of 37 liters (1.3 cu.ft) per person per year should be sufficient. For dry type (where if mud/soil stones are used as cleansing material), 50 liters (2 cu.ft) per person per year is acceptable.

The pit may be single or double depending upon the need and choice. The pit may be direct or Indirect with connected with pipes or lined and unlined. Refer figures 27,28,29,30 & 31for more details.

Box 6

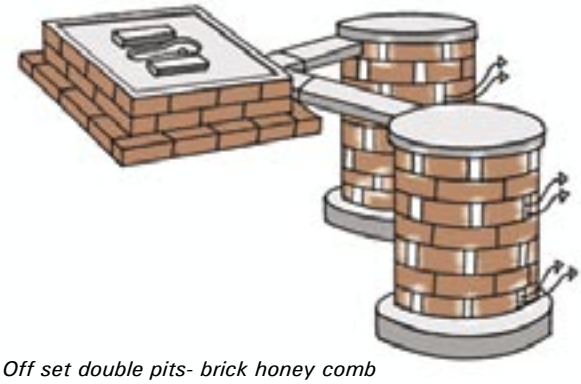
Key Points

- Remember a dry pit latrines/compost latrine fills quickly than a wet pit like leach pit.
- A minimum of 3 feet effective depth is a must for all leach pits
- Pit should be located below and away from the water point
- Pit size and location varies from soil to soil
- Pit should have life period of minimum 4 years



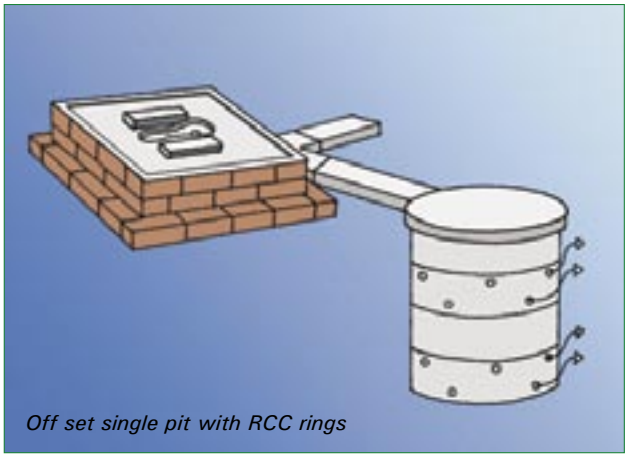
Off set double pits with RCC rings

Figure 27



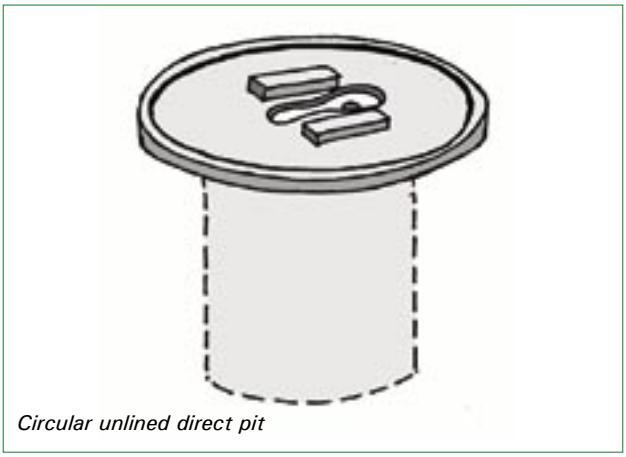
Off set double pits- brick honey comb

Figure 28



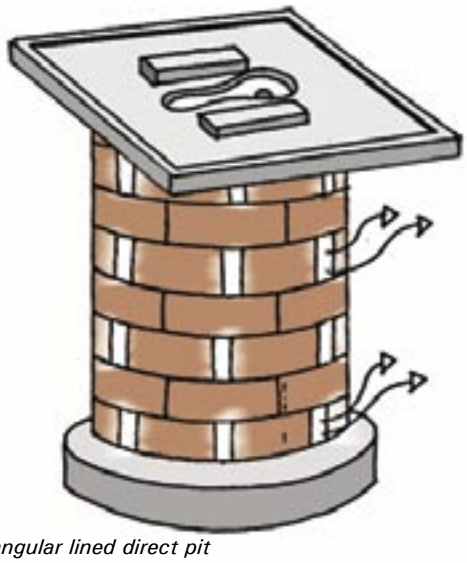
Off set single pit with RCC rings

Figure 29



Circular unlined direct pit

Figure 30



Rectangular lined direct pit

Figure 31

7.2.1.2 Leach pit in water logged and stressed areas

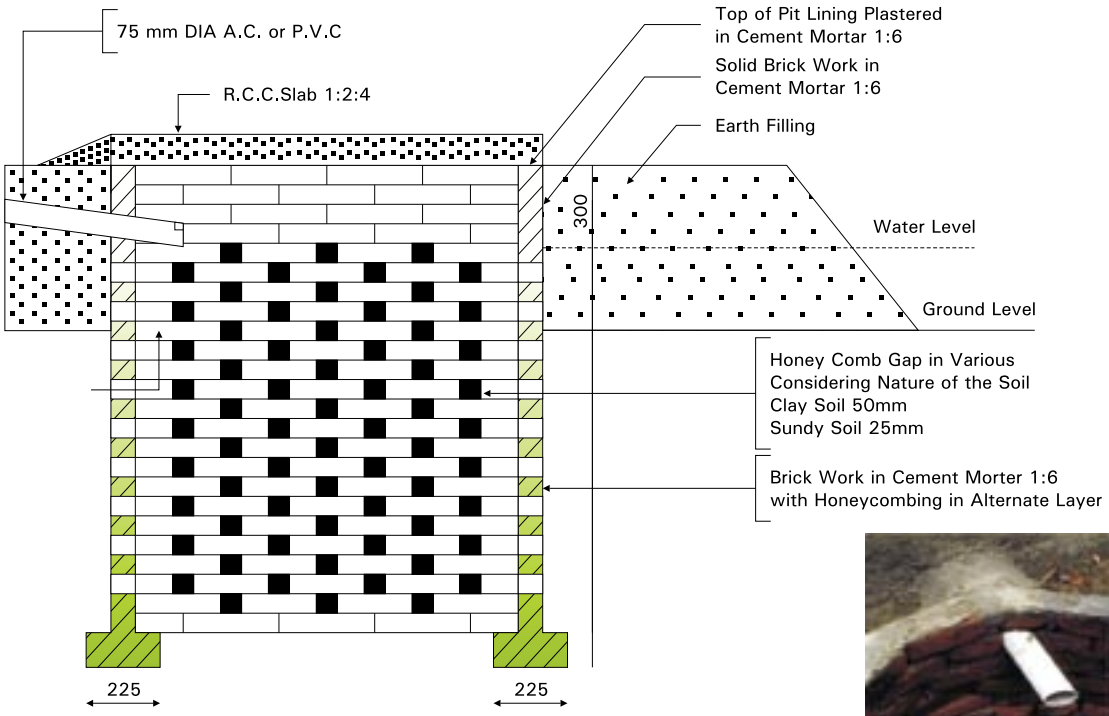
The pour flush based leach pit technology can also be used in even water stressed and water logged areas with slight modification in the design and material. Though, leach pits when constructed in the area having high water table or depression around them, the height of the pit should be raised by 60 to 80 cm above the ground together with the squatting pan and earth filling (with pervious soil) is done around the leach pit for at least 50cm length, throughout the vertical depth on the outer face and the bottom of the pits is sealed with impervious material for preventing the sub-soil water from entering through the bottom. Such arrangement provides the necessary waste water absorption zone. Pls refer figure 32.

7.2.1.3 Leach pit in clayey areas

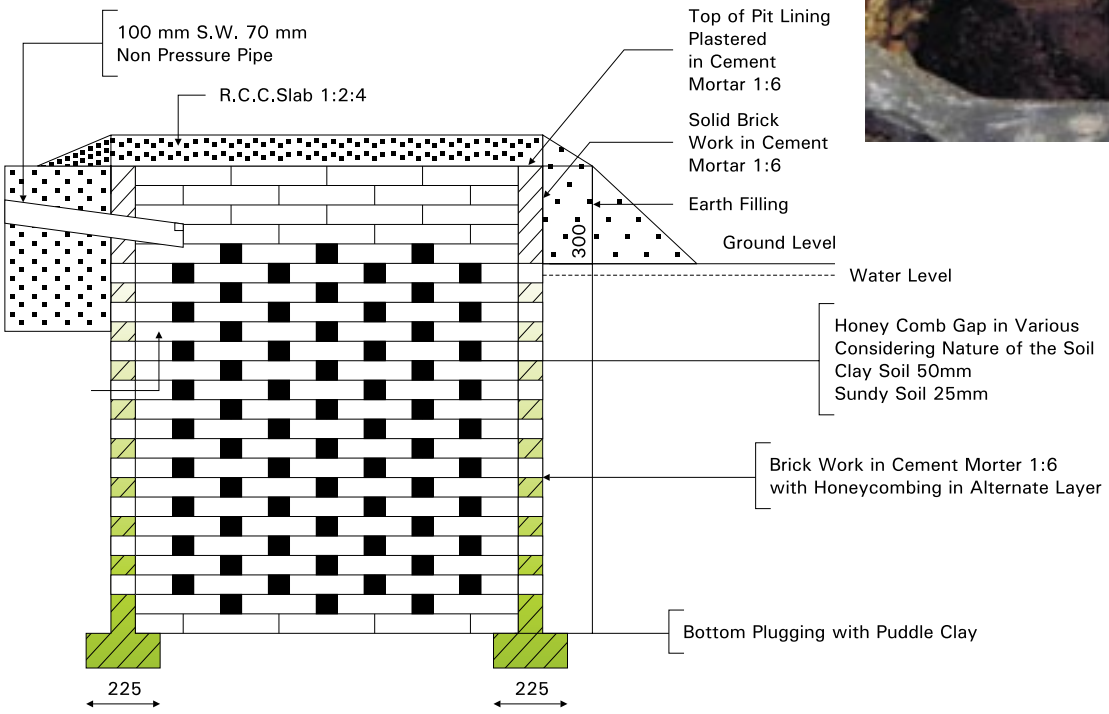
Leach pits have been found successful even in the black cotton and clayey soils. Since the quantity of water drained out of the leach pit is so little that black cotton soil poses no absorption problem but adjustment to be done for increased area of surface for percolation are given below:

- Honey-comb masonry wall structure, circular or rectangular with 30 to 40% openings constructed in half brick wall (7.5 cm thick) with 1.2 cm lining in C.M. 1:6 and the bottom most layer of 22.5 cm. (i.e. one brick wall) is provided.
- Top three layers below ground level are constructed without any honey-comb openings.
- For pits located in the depression or high water table zone, the bottom is sealed with impervious material and height of pit is raised above ground level by 60 to 80 cm and pervious soil for 50 cm length is filled up around the pit. This is necessary throughout its vertical depth of staining.
- The pit is covered with a R.C.C. slab. Locally available material can be used like stone, wooden plank etc.

Leach Pit in Water Logged Areas



Cross Section of Leach Pit



Leach Pit in High Sub Soil Water Area

Figure 32

7.2.2 Septic Tank

Septic tanks provide an excreta treatment system in locations where a sewerage system is not available. For rural areas, the septic tanks offer a limited use, especially for locations with high water table. However, institutions like schools, dispensaries or families who can afford the cost and manage the quantity of water required, a septic tank system for excreta disposal could be considered.

The system consists of a water-tight settling tank with one or two chambers/ compartments, to which waste is carried by water flushing down a pipe connected to the toilet which usually has a U-trap (refer Figure 33).

However, this system does not dispose of wastes; it only helps to separate the solid matter from the liquid. Some of the solids float on the surface, where they are known as scum, while others sink to the bottom where they are broken down by the bacteria to form a deposit called sludge. The liquid effluent flowing out of the tank is, from a health point of view, as dangerous as raw sewage and remains to be disposed off, normally by soaking into the ground through a soak-pit or with a connection to small bore sewers.

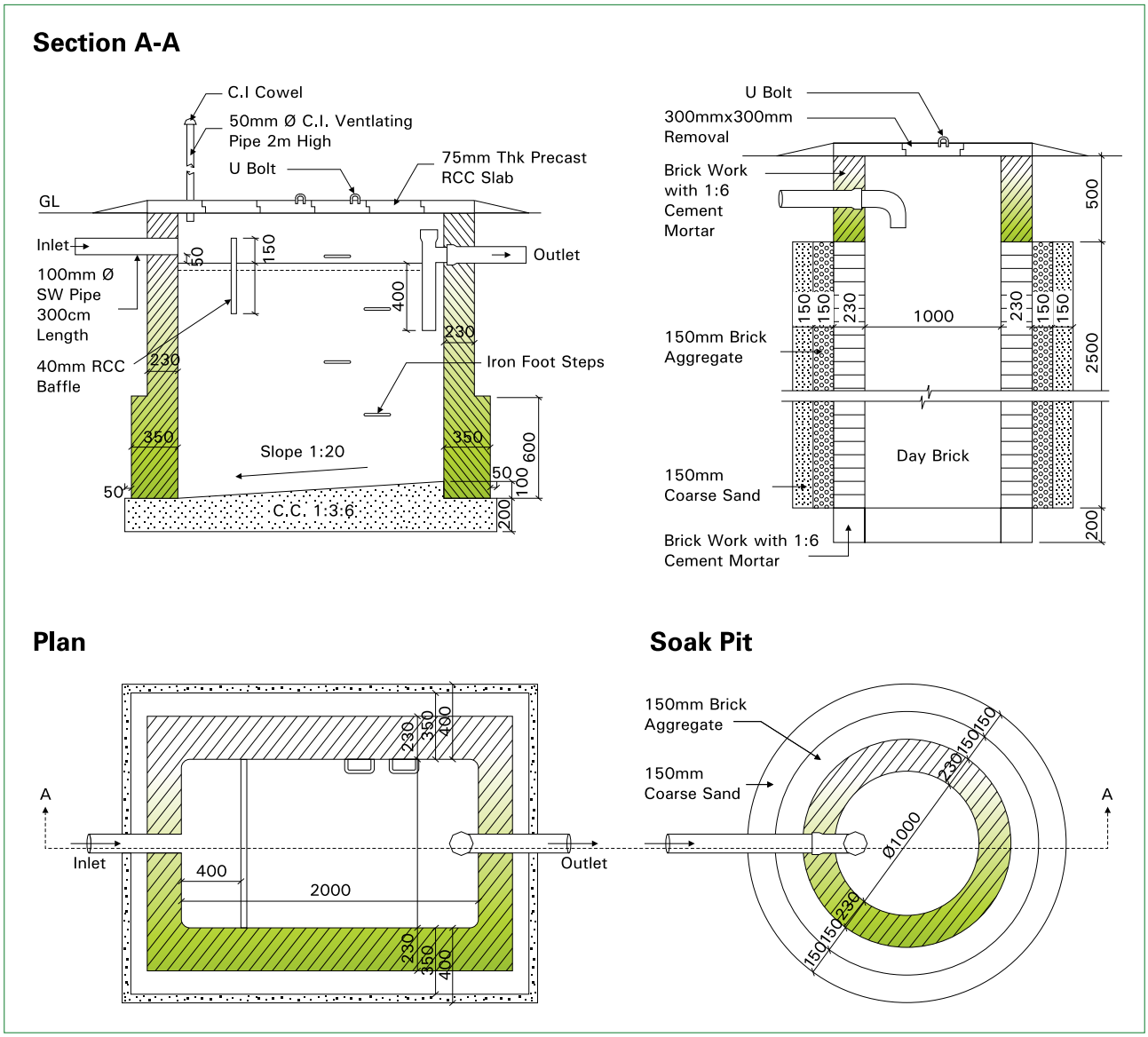


Figure 33

7.2.3 Difference between Leach pit and Septic tank

Leach Pit

- Low cost Less space
- Needs little water
- Sludge handling easy- manure
- No recurring cost
- Pit emptying easy
- No mosquitoes

Septic Tank

- High in cost
- More space
- Needs more water for flushing
- Sludge handling difficult
- Recurrent costs for emptying
- Safe disposal of effluents- pollution
- Mosquito menace

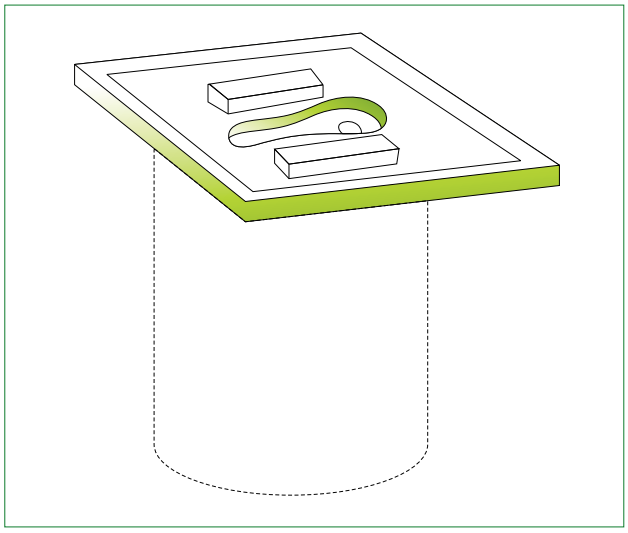


Figure 34-Leach Pit

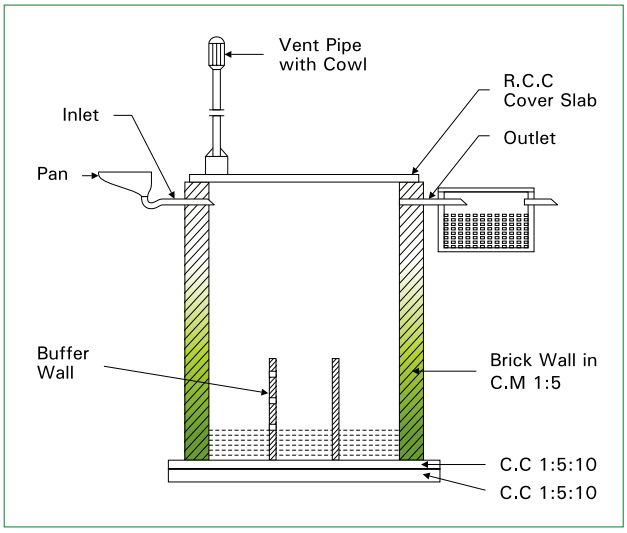


Figure 35-Septic tank

7.2.4 Environmental factors: Important considerations

There are different environmental factors, which play important role in deciding on the type of technology for the construction of the latrines, which need to be considered. Some of the considerations are depicted below in box 7:

Box 7

Specific topic on which information/data is needed	Considerations
• **Type of soil-stability**	
Loose, sides of wall collapse	Line the pits. In very sandy soils, sink cement rings that are perforated or set on top of each other without cement.
Hard to dig	Use the pour flush design rather than VIP, as the pits are less deep.
• **Permeability** (how water is absorbed by soil)	
Clay soil	Test by pouring water into a hole and measuring how long it takes to be absorbed. Pits in dense clay may need back filling about 1.2 meters with more sandy soil.
Coarse sand	Back fill around the rings with denser soil and/or locate the latrine pipes far (for example, 40 meters or more) from a well used for drinking.
Hard laterite	If there might be cracks in the laterite, the latrine pits can pollute nearby drinking water sources. Place the latrine far from these sources
• **Ground water level in wet season** (deepest level)	
Water rises higher than one meter from bottom of the latrine pit, but never completely floods the latrine pits	Locate the latrine pit far from any well used for drinking purpose and should be away for example, 40 meters or more
Water rises to or above the ground level and sludge comes out the latrines	Raise the latrines above the ground level so that the top third of the pit is always above the water level. Place latrines far from drinking water sources.
• **Distance to water sources**	
Distance from latrines pit to drinking water sources	At least 15 meters
Children or teachers may be spent extra time, for example, more than 15 minutes going one-way to collect water	VIP latrine is preferred as it uses less water.

7.3 Super-structure

In order to ensure safe disposal of excreta, the superstructure of the toilet is of least importance. Its primary function is to provide privacy and protection to the user from the natural elements. Undue emphasis on costly super-structure in the design of the toilet is not required. The norms of super-structure are purely restricted to the choice of the user though it should be built in order to ensure privacy and sustainability of the system especially for VIP latrine. The cost may vary depending upon the affordability of the user that can be built using bamboo, mud, bricks, woods, plastic cover, etc according to the atmospheric conditions, rainfall and locally available material. In some cases a temporary super structure can also be erected which can be replaced afterwards with a permanent one. Though, it should be noted that irrespective of the type, a super structure must have following minimum characteristics:

- The super structure should be properly closed from all sides to ensure safety and privacy to every user and should not have chinks and holes in it.
- The super structure must have at least one ventilator of appropriate size for light and aeration.
- It must have a proper roof; otherwise the latrine will be out of use in rainy season. Similarly the rain water will accumulate in leach pits through exposed W.C. pan and may choke the system.
- The fixtures of door like latches should operate properly.

Figure-36, Superstructure-jute made

Figure-37, Superstructure-brick made

Figure-38, Superstructure-plastic made

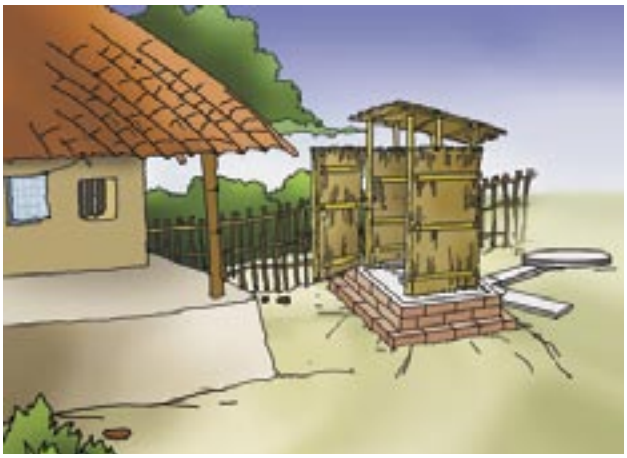


Figure-39, Superstructure-wood made

8. Operation and Maintenance - Do's and Don't's

For proper operation and maintenance of the toilets following Do's and Dont's should be explained to the users:

DO's

- Keep a bucket full of water outside the toilet.
- Keep a 2 liters can in the toilet filled with water for flushing.
- Before use, pour a little quantity of water to wet the pan so that excreta can slide smoothly into the pit.
- Flush the excreta after each use.
    - Pour a little quantity of water, say half a liter, in the squatting pan after urination.
    - The squatting pan should be cleaned daily with a soft broom or soft brush with a long handle after sprinkling a small quantity of water and detergent powder/soap.
    - Use minimum quantity of water in washing the pan and toilet floor.
    - Wash hands, using soap or ash, after defecation at the assigned place.
    - If any construction defect is observed during the defect-liability period, report the matter to the local authority or the construction agency.
    - When the pit in use is full, divert the flow to the second pit as described above in Para
    - If the trap gets choked, rodding should be done from the pan side as well as from the rear side by means of a split bamboo stick, after removing the cover of the drain or junction chamber.
    - Care should be taken while desludging the pits located in water-logged or high water sub-soil water areas and in case of combined pits, as humus may not be safe for handling.

DONT's

- Do not use both the pits at the same time.
- Do not use more than 2 litres of water for each flushing (if the waste is not flushed with 2 litres, pour more water at the specific spots for flushing the waste).
- Do not use caustic soda or acid for cleaning the pan.
- Do not throw sweepings, vegetable or fruit peelings, rags, cotton waste, and cleaning materials like corn cobs, mud balls, stone pieces, leaves, etc. in the pan or the pits.
- Do not allow rain water, kitchen or bath waste to enter the pits.
- Do not provide water tap in the toilet.
- Do not throw lighted cigarette butts in the pan.
- Do not desludge the pit before 1½ years of its being in use.

9. Summary

In view of widespread practice of open defecation, the technological options presented above will help in accelerating the sanitation drive in rural India. Not because they are cheap or easy to use but also suitable to the respective conditions, environment friendly as well as addressing the needs of the people. The sustainability, therefore, of the sanitary system if created, increases manifold which helps in improvement and reinforcement of hygiene practice. It is expected that with support of TSC Programme, this note will help watsan practioners in their efforts to make India open defecation free by 2012 and achieve the Millennium Development Goal much ahead of the UN timeframe.

Annexure -1

FAQs-Beneficiary Queries

1. **Since ages nobody in our village had household latrines, why we should have when everyone in our family is not suffering from any disease**
   Open defecation is one of the age-old behavioral practices in the rural areas. The sanitation- health link is weak in people's minds. Studies have shown about two thirds of the rural population think that exposed excreta are harmful to health, yet less than a quarter understand the faecal oral danger. Most people think that children's faeces are not harmful, which explains why they are often disposed of close to the household.

   Though open defecation involves no cost and is very convenient and everyone in the family is not suffering from any disease in densely populated rural areas, lack of privacy and need to walk long distances to find a suitable spot to defecate is being recognized as a problem. Many women have to go early in the morning before it is light or wait till night time to urinate or defecate to ensure privacy. A latrine provides convenience and privacy for all specially women and children, sick and old. It also provides safety and protection during dark night/early morning, hot afternoon, rainy and cold winter days. A household latrine offers all convenience with no bad odour, no ugly seen of fly nuisance or of excreta itself. So one should construct a latrine even if everybody in a family doesn't suffer from diarrhoea or any other disease at a particular point of the time. There is a risk of suffering from these diseases. Statistics reveal that on an average, 30 million persons in rural areas suffer from diseases related to poor sanitation. About 0.4-0.5 million children annually die of diarrhoea alone in our country. There is indication of annual loss of 180 million man-days and Rs. 12 billion to the economy owing to sanitation related diseases. Even if due to internal body resistance a person himself doesn't fall sick, his practice of open defecation is certainly a health risk for other people so it needs to be curbed and eliminated. Villages, which have been able to eliminate the practice of open defecation, are usually very neat and clean and there is no bad smell, which creates a good ambience for people to live.

2. **We do not have money to meet both ends meet, how can we construct an Individual Household Latrine (IHHL)?**
   The cost of Individual household latrines is economical and affordable. These can be built by the beneficiary within their means in spite of limited financial resources. The minimum cost for construction is as low as Rs. 400 and the cost increases with better model. A minimum amount of incentive is provided to BPL families for construction of individual latrines. Households can invest partly now to build economical toilets and gradually upgrade to construct better facility. Very little money is required to be contributed by a BPL family. In case they donot have enough money, they can even contribute labour.

3. **Why don't administration build IHHL for us?**
   Earlier administration used to provide high subsidy for the construction of latrines. However most of the latrines were not put to use, or the latrine was used as store room or puja space etc. Lack of involvement of the beneficiary led to poor construction,

maintenance and use of the toilet, which failed the very objective of the programme. So there has been a paradigm shift in TSC and now each household is encouraged to construct its own toilet by contributing money or labour. Households choose their own model, design and technology. Wherever people have played active role in constructing toilets they have used it properly and when government has constructed, in many case the use has been minimal. That is why in TSC, government doesn't build toilets for individual households.

4. **I am in favour of constructing IHHL but elders in my family are against it?**
   Some of the elders may be of the opinion that Individual household latrine is very costly, produces bad odour and creates fly nuisance etc. Usually they think that septic tank is the model to be constructed which is very costly. There are wide ranges of technology options suiting to different pockets, which can be constructed. Elders need to be explained this. The pour flush leach pit toilets are very good and do not produce bad odour.

   In addition the slope of the pan is so designed that it does not require much water after use, especially in water scarce areas. On the other hand they provide many benefits like convenience during rainy season, safety and dignity of women, children and old, reduced water borne disease like diarrhoea, dysentery, typhoid etc. There is practically 'nil' daily maintenance for toilet. So such toilets should be constructed

5. **I want to construct IHHL but do not have space in my house for the same.**
   Constructing an IHHL does not require much space. It can be constructed in a small area of about 1.5 sq meters wherein a single pit is constructed and a squatting plate is placed over it. The pit can be used for 5-7 years depending on the size of the family and proper maintenance.

   In addition most of the households which do not have adequate space in the house for the construction of latrines can come together to construct and use community or group sanitary facilities.

6. **I constructed an IHHL but it soon became dirty and unusable.**
   A single pit IHHL if properly constructed and maintained can be used for about 5 to 7 years with a family size of 5-10 persons. Water should be poured after use regularly and pan should be cleaned regularly.

Annexure -2

FAQs-Leach Pit Technology

1. **What is the longevity of a leach pit toilet?**
   In a leach pit toilet, two pits are supposed to be constructed. When the first pit is in use, the other pit is closed. A pit having 4ft. depth and 3 ft. diameter can get filled up in about 4-5 years if used by a family of 6-8 persons. Once this pit is filled up, the other pit is opened and the filled pit is closed. Within 15-18 months, the excreta gets totally decomposed and become a good bio-fertilizer. There is neither any bad odour nor any pathogen in the fertilizer (decomposed excreta). This can be easily used in the fields. Even if the number of persons using the toilet increases, the pit having a size of 4 ft. deep and 4 ft diameter is sufficient to meet the requirement.

2. **Will it be useful if the depth of the pit is further increased?**
   Not at all. If we dig deep, there is likelihood of contamination of the ground water. Since this size of pit is sufficient for meeting the requirement of normal size of the family, there is no necessity of making deep pit, which will cost more, and there will be also difficulty in extracting fertilizer after decomposition. So there is no necessity for digging more than 4 ft. deep pit, is not necessery.

3. **Do we need to use vent pipe in a leach pit toilet?**
   No, we don't use vent pipe in leach pit toilets. Even though vent pipe are required in septic tank latrines, it is not required in case of leach pit pour flush toilets. This is because, the leach pit has a series of holes in the side walls through which the gases pass into the soil and gets absorbed. Because of this, there is no danger of bursting of the cover or the wall of the pit. Gas pipe is used in septic tank because such tanks are closed completely from all sides and some outlet for escape of the gas is required.

   In addition, in leach pit an-aerobic decomposition of the excreta takes place in absence of air. The decomposition takes place with the assistance of the bacteria. In this process, very limited quantity of methane gas is produced which is absorbed in the soil through its pores. In addition to this, due to absence of vent pipe, the smell cannot get out of the pit and mosquitoes and flies cannot go inside the pit using the vent pipe. So in leach pit toilets vent pipe should not be installed.

4. **Is it possible that in rainy season, rainwater can enter the pit through the pores in the soil?**
   If water level increases too much in the rainy season, water may go inside the pit through the pores. However, it will again recede after the rainy season. In flood-affected areas, it is suggested that the squatting place should be constructed on a raised platform.

5. **Is it possible that the insects may come outside the pit wall through its pores?**
   In such toilets there are no insects inside the pit. Only such bacteria surviving in absence of air, which is not visible to naked eyes, survive which decomposes the excreta into fertilizer. As a result there is no question of insects coming out of the leach pits.

6. **What should be the thickness of the wall inside the pit and is it possible that the pit wall may collapse if the thickness is less?**
   If the pit is of circular shape, 3-inch thickness of the wall is sufficient. If a 3 inch

brick honey comb wall is made, it is not easy to collapse and such types of construction have been made in large number throughout the country and are easily surviving.

7. **If 6-8 persons in a family are using the toilet, is it possible that the water may overflow from the pit?**
   No, it is not possible. Such toilets can easily absorb 60-70 liters of water in a day. Even if a person uses 5-6 liters of water daily, there is no chance of water overflowing from the pit. However, it is advisable that water use should be minimal.

8. **What is the safe distance between a water source and a toilet?**
   Normally, average life of bacteria in the sub soil is not more than 10 days. It has been observed that the hydrological gradients in the sub-soil is less than 1:100 and average size of sub soil is not more than 0.2 mm, due to which these bacteria cannot travel more than 1m in a day. As a result, in a leach pit toilet, if the distance from the water source is more than 10 mtrs or 30 ft. it should be safe. However, depending upon the soil conditions this distance may also vary.

9. **What is the cost of constructing a leach pit toilet?**
   There are various designs of leach pit toilet, which cost from Rs.400 onwards upto Rs.5,000/-. These toilets can be constructed with single or twin pits. The pits may be lined or unlined. Depending upon the individual's financial capacity, appropriate design may be selected.

10. **If the sub soil contains stone, will it be possible to construct leach pit toilets?**
    If the stones are below 5-6 ft. deep from the soil level such toilets can be constructed without any problem. If the soil can absorb water, such leach pit toilets can be constructed.

    Sometimes it is noticed that the sub soil contains black soil. Black soil has less pores and water absorption capacity. Is it possible to construct leach-pit toilets in such black soil?
    All types of soil have small pores to absorb water and black soil also has such pores. It is true that the pore size of the black soil is smaller than the sandy soil leading to less absorption. It is expected that average 60 liters of water per day may be in used a leach pit toilet and that much water can be absorbed by black soil also.

    However, if it is noticed in a particular area that absorption capacity of water is low, it is advisable that a sand lining can be given all along the pit to increase its absorption capacity.

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