

# HANDBOOK ON **TOILET OPTIONS** FOR RURAL HOUSEHOLDS IN BHUTAN

RURAL SANITATION & HYGIENE PROGRAMME



**SNV**  
Connecting People & Possibilities

Australian Government  
AusAID



Public Health Engineering Division  
Department of Public Health  
Ministry of Health  
Royal Government of Bhutan

JUNE 2011



# Acknowledgements

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གསོ་བ་ལྷན་ཁག།

ROYAL GOVERNMENT OF BHUTAN

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ཚོན་པོ།

MINISTER

Foreword

Globally 2.6 billion people do not have access to proper sanitation facility. Sanitation is defined as hygienical separation of human excreta from human contact. This kills 1.8 million people mostly children, every year. Diarrhoea also remains the second leading cause of death among children under five and it kills five times as many children in the developing world as HIV/AIDS. That is 5000 children dying every single day. The majority of the illness in the world is caused by faecal matter and the lack of sanitation.

In Bhutan there is significant improvement in the sanitation coverage over the years but there is no proportionate reduction in water, sanitation & hygiene related diseases. This is mainly due to unhygienic conditions of the latrines and no proper usage of the accessible facilities. The simple solution to prevent this from happening is to build and use latrines properly and practice hand washing. Till date only simple pit latrine technology was promoted in the rural areas.

Keeping in mind the overall goal to improve the health of the general public by reducing the incidence of water, sanitation & hygiene related diseases through the provision of safe drinking water, improved sanitation & hygiene facilities, Public Health Engineering Division (PHED), Department of Public Health under the Ministry of Health had been implementing the Rural Sanitation and Hygiene Programme (RSAHP) in selected areas in Bhutan with technical assistance from Netherlands Development Organisation (SNV). I am very happy to note that PHED is now coming up with a handbook on improved variety of toilet technology options for rural households in Bhutan.

I believe this handbook developed with field experiments would be very useful to engineers, health staff and other field workers who are promoting better sanitation and hygiene in the rural villages in Bhutan. I also hope that this handbook will be helpful in the implementation of sanitation related programmes, particularly construction of toilets in rural Bhutan, which can contribute substantially to the health and well being of people.

Tashi Delek!

(Zangley Dukpa)  
MINISTER



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## 1. Introduction

Poor sanitation is one of the leading causes of diarrhoeal diseases, which kill hundreds of people including children around the world everyday. The story in Bhutan is not any different either. The sanitation coverage in terms of presence of toilet in Bhutan is 91% and in the case of water supply, 84.5% of households had access to water supply in 2009, and 80.1% of the households had functional piped water schemes. However despite these good figures, the incidence of illness due to water and sanitation-related diseases is still high and the figure for under-five child mortality is one of the highest in South Asia (85/1000 live birth). This is thought to be due to continued poor hygiene practice and in particular the poor state of latrines and associated facilities. Although the construction coverage of latrines is relatively high, the conditions are thought to be very poor and the amount of use low.

The Rural Sanitation and Hygiene Programme (RSAHP) co-ordinated by Public Health Engineering Division (PHED) under the Ministry of Health with technical assistance from SNV Netherlands Development Organisation had been assisting the primary client in rural areas by developing new approaches to improving the overall sanitation and hygiene practices in the rural communities in Bhutan. The initial programme area starting in 2008 was in the four pilot Geogs of Nanong (Pemagatshel), Hiley (Sarpang), Laya (Gasa) and Jarey (Lhuentse). The programme was later upscaled to the whole Dzongkhag of Lhuentse covering 7 more Geogs (Kurtoe, Khoma, Gangzur, Metsho, Menbi, Minjay and Tsenkhar) in June 2010.

There were two primary objectives under the RSAHP. Firstly, to explore, adapt and pilot best international practices to develop a model that can be rolled out country-wide. The model to be explored and piloted included an approach termed Community-Led Total Sanitation (CLTS), of which the outcome is measured in a complete end to open defecation and unsanitary conditions for entire communities rather than in terms of individual household latrine construction coverage. Secondly to study, explore and pilot sustainable, affordable and appropriate sanitation technologies in the programme areas. This handbook is a result of this second primary objective of the programme.

## 1.1 Why this handbook?

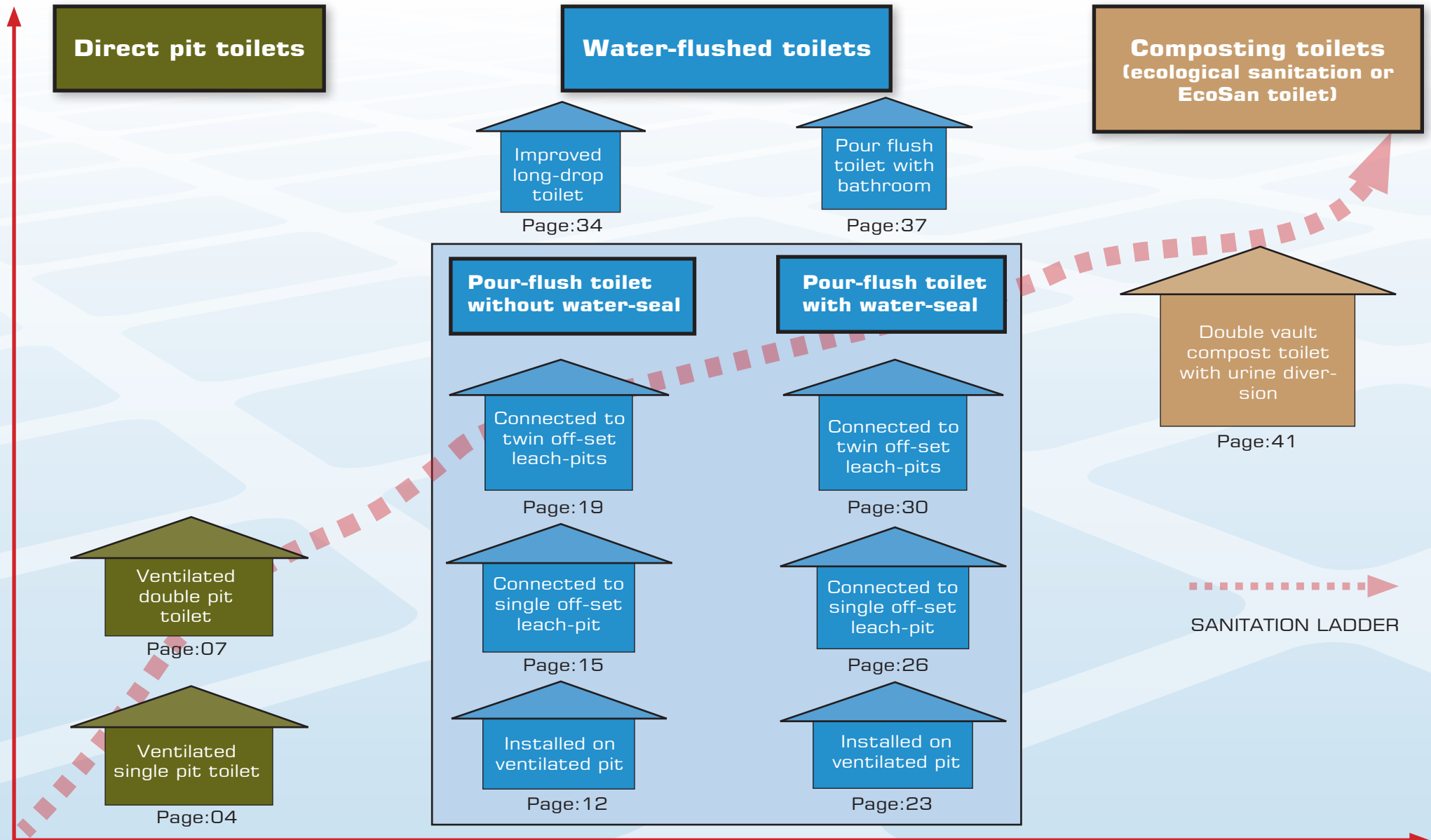
There have been several attempts in the past to document the technical details of the different types of toilets found in rural Bhutan. However, these efforts were all focused in one type of toilet or the other. This handbook has attempted to gather together in one place all the information needed for deciding which is the most suitable toilet technology for the various rural household settings found in Bhutan. All the information provided in this handbook is based on the field experiences in the RSAHP programme area. The handbook also tries to provide the technical details along with graphic illustrations of the different types of toilet. However, this manual is not to be taken as “one size fits all” since the information gathered herein may not be suitable for some situation and might need to be adapted accordingly.

## 1.2 Who is the handbook for?

This handbook is intended to be used by Dzongkhag and Geog engineers, health staff, local carpenters, masons and builders, and other rural extension workers involved with promoting hygienic household sanitation in rural Bhutan.

## 2. How to use this handbook ?

This handbook contains details about 11 different types of toilets which can be opted for depending on the different situation in rural Bhutan. It starts off with ventilated single pit toilet, which is considered as one step higher in the sanitation ladder when compared to the basic simple pit toilet. Basic simple pit toilet is the type of toilet which is very common in rural Bhutan and not necessarily hygienic in most cases. Every toilet type is described in terms of applicability, construction details, location and proper usage. Graphic illustrations are also provided followed by technical engineering details. Attempt has also been made in terms of providing approximate material and cost estimates but these are subject to deviation depending on the distance from market, geographical topography, soil type, transportation etc. A minimum estimated cost is also provided for each toilet type. This cost however, excludes the cost of locally available materials and labour. An overview of the different toilet options is provided in the next page.







### 3. Direct pit toilets





## 3.1 VENTILATED SINGLE PIT TOILET



### Applicability

- Suitable where people use solid/ hard materials for anal cleansing. These can be directly deposited into the toilet pit.
- Suitable for locations where there is scarcity of water or where the water supply is not always dependable.
- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable where there is space to excavate a new pit and move the superstructure when the original pit becomes full.
- Suitable for remote areas where transportation of imported materials is difficult and costly.
- Cheap and easy to build with local materials only.

### Construction

1. **Pit cover-slab/ floor:** This can be made out of round timber ballies with fine earth on top or RCC slab using bamboo (refer page 46) or steel reinforcement. The floor should be smoothly finished and made impervious to water and urine penetration.
2. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level will help avoid rotting of timber.
3. **Roof:** This can be made from wood shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
4. **Vent-pipe:** The vent-pipe can be PVC, HDPE, timber planks or large diameter bamboo. The top of the vent-pipe must be fitted with a fly-screen and must also allow sunlight to enter the pipe (refer page 45 for additional details).
5. **Superstructure:** The recommended superstructure is the G-shaped design (refer page 48) with an open entrance.
6. **The pit** can be lined with dry hammer-dressed stones 1'4" thick to prevent rat nuisance and collapse of the earth. The minimum depth of the pit should be 4'. (refer page 47)

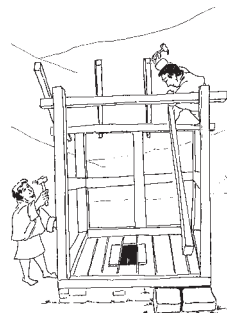




## Toilet location, proper use and hygiene

1. This toilet can be built closer to the house than the traditional basic pit latrine.
2. The location should be chosen considering wind and sunlight direction.
3. The toilet should be located at a minimum distance of 15 meters from any type of water source.
4. For the air to be able to flow, use of a drop-hole cover is not recommended during day time.
5. Once a week, sweep, wash and clean the toilet floor (preferably using disinfectant), and clean the toilet surrounding area.
6. Once a month, clean the walls, door and ceiling.
7. Once every six months check the fly-screen on top of the vent-pipe and check the pipe is not obstructed.
8. Repairs should be carried out immediately.
9. The pit must not be used for garbage disposal.

*Always leave the toilet the way you would like to find it - clean, tidy and ready to use.*



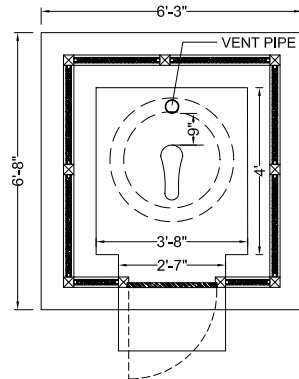
Approximate material estimate			
Sl. No.	Particular	Qty	Unit
1	Pipe 4" diameter (10' long)	1	No
2	Sliding bolt	1	No
3	Tower bolt	1	No
4	Handle	2	No
5	Nails	3	Kg
6	Hinges	3	No
7	Timber	15	cft
8	Stone	70	cft
9	Skilled labour	10	work-day
10	Unskilled labour	15	work-day

Approximate minimum cost excluding local materials and labour = Nu. 1000/-

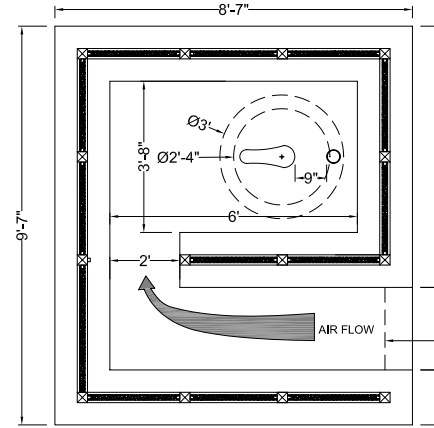




### 3.1 Ventilated single pit toilet

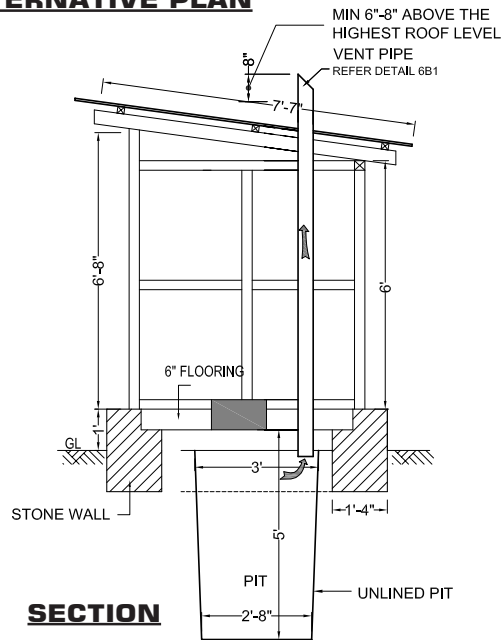


**ALTERNATIVE PLAN**

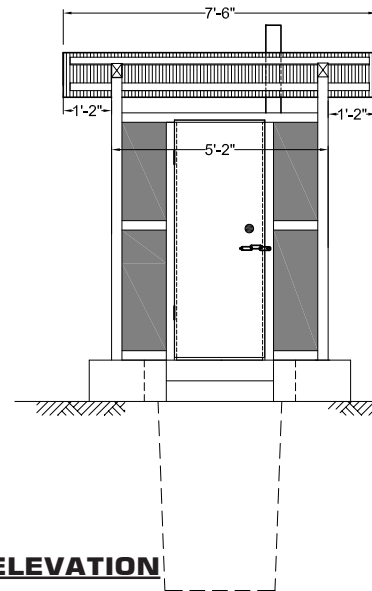


**RECOMMENDED PLAN**

SEMI CLOSED ENTRANCE, e.g. CLOTH etc, BUT ALLOWING AIR TO FLOW TO THE TOILET.



**SECTION**

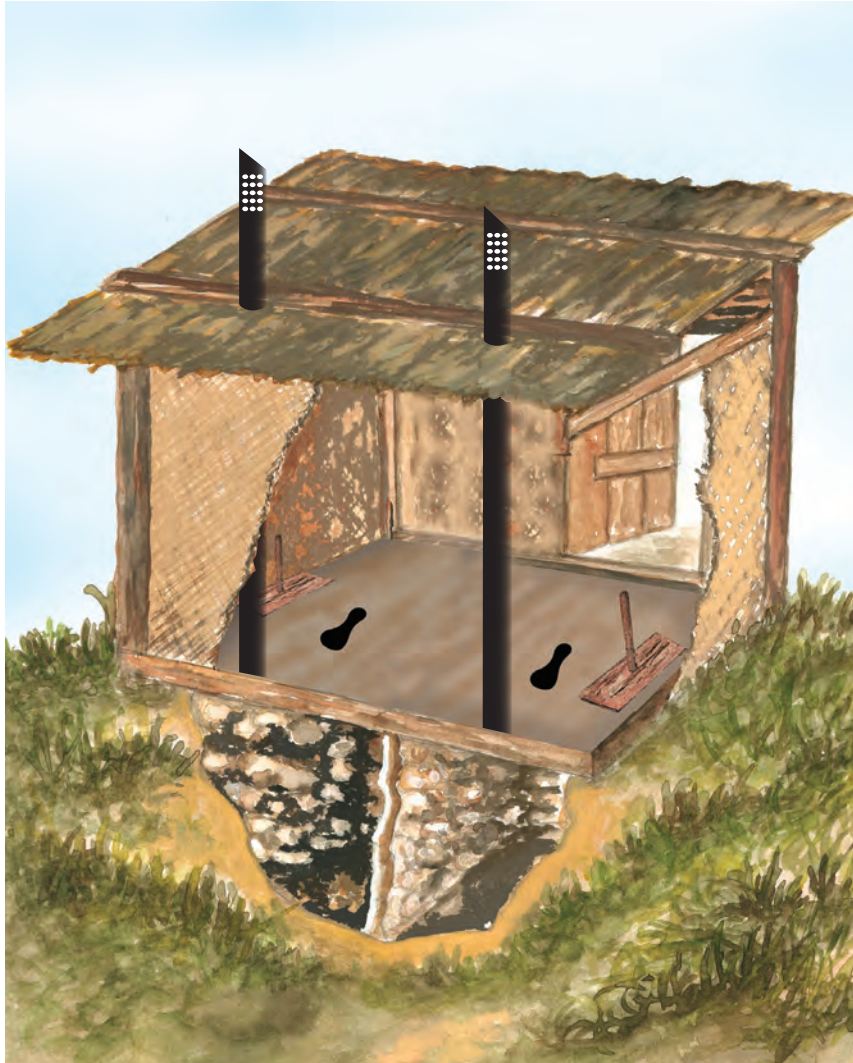


**FRONT ELEVATION**

Scale: Not to scale



## 3.2 VENTILATED DOUBLE PIT TOILET



### Applicability – same as 3.1

- The double pits make this design a more permanent toilet than the single ventilated pit toilet.
- When one pit becomes full it is closed and the other pit is put into use. When the second pit becomes full it is closed and the first is emptied and put back into use. After remaining in the closed pit for at least 1 year, the decomposed contents are safe to use as a plant fertiliser if desired. The alternating use of the two pits avoids the need for excavating new pits.

### Construction

1. **Pit cover-slab/ floor:** This can be made out of round timber ballies with fine earth on top or RCC slab using bamboo or steel reinforcement. The floor should be smoothly finished and made impervious to water and urine penetration.
2. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level will help avoid rotting of timber.
3. **Roof:** This can be made from wooden shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
4. **Vent-pipe:** The vent-pipe can be PVC, HDPE, timber planks or large diameter bamboo. The top of the vent-pipe must be fitted with a fly-screen and must also allow sunlight to enter the pipe (refer page 45).
5. **Superstructure:** The recommended superstructure is the G-shaped design (refer page 48) with an open entrance.
6. **The pits** can be lined with dry hammer-dressed stones 1'4" thick to prevent rat nuisance and collapse of the earth. Cement mortar should be used for the wall between the pits to prevent seepage between the pits.





## Toilet location, proper use and hygiene

1. This toilet can be built closer to the house than the traditional basic pit latrine.
2. The location should be chosen considering wind and sunlight direction
3. The toilet should be located at a minimum distance of 15 meters from any type of water source.
4. For the air to be able to flow, use of a drop-hole cover is not recommended during day time.
5. Once a week, sweep, wash and clean the toilet floor (preferably using disinfectant), and clean the toilet surrounding area.
6. Once a month, clean the walls, door and ceiling.
7. Once every six months check the fly-screen on top of the vent-pipe and check the pipe is not obstructed.
8. Repairs should be carried out immediately.
9. The pits must not be used for garbage disposal.

*Always wash your hands with soap after using the toilet.*



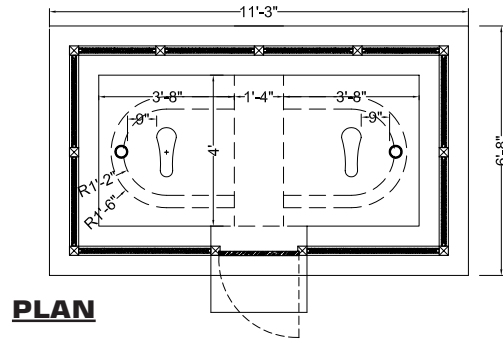
Approximate material estimate			
Sl. No.	Particular	Qty	Unit
1	Cement (50 Kg bags)	3	bags
2	Pipe 4" diameter (10' long)	2	No
3	Sliding bolt	1	No
4	Tower bolt	2	No
5	Handle	2	No
6	Nails	6	Kgs
7	Hinges	3	No
8	Timber	25	cft
9	Stone	140	cft
10	Sand	15	cft
11	Skilled labour	15	work-day
12	Unskilled labour	25	work-day

Approximate minimum cost excluding local materials and labour = Nu. 3000/-

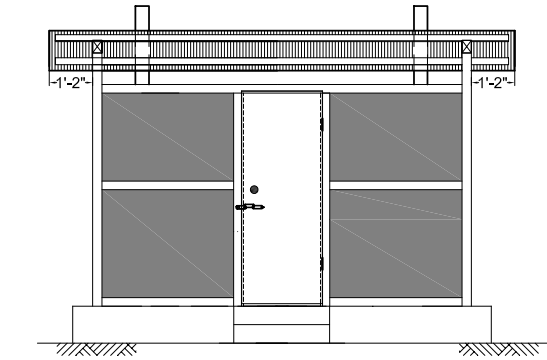




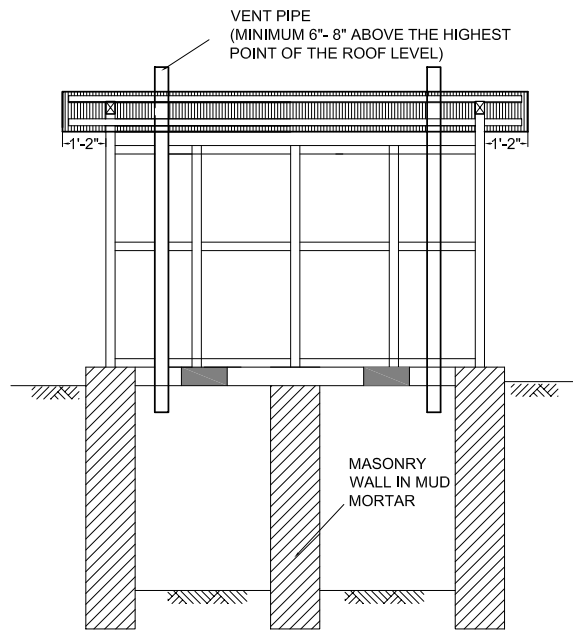
### 3.2 Ventilated double pit toilet



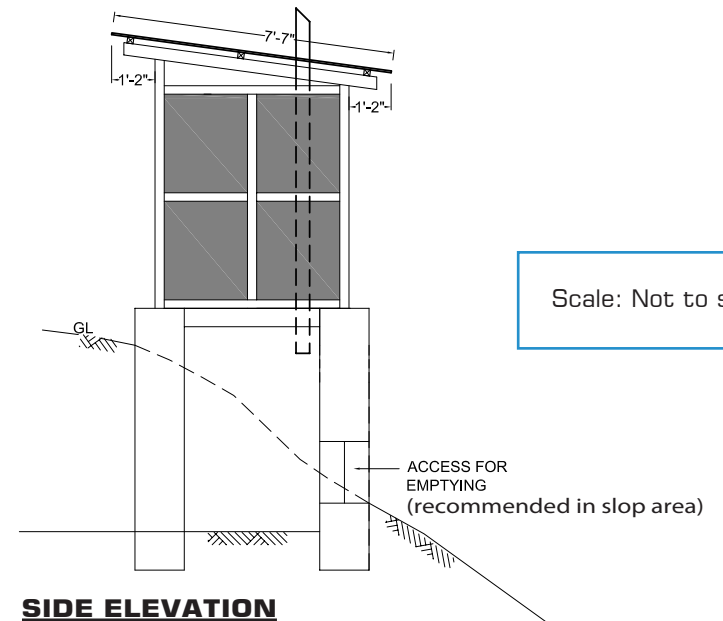
**PLAN**



**FRONT ELEVATION**



**SECTION**



**SIDE ELEVATION**

Scale: Not to scale



## 4. Water-flushed toilets







## 4.1 POUR-FLUSH TOILET WITHOUT WATER-SEAL

### 4.1.1 POUR-FLUSH TOILET WITHOUT WATER-SEAL, INSTALLED ON VENTILATED PIT



#### Applicability

- This design is a slightly upgraded version of 3.1, achieved by installing a pour-flush squatting pan instead of the drop-hole
- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable only if there is dependable water supply (requires at least 1 or 2 liters per use).
- Suitable where users are accustomed to using water for anal cleansing. Where people use solid/ hard materials, these can be directly deposited into the toilet pit.
- Suitable in places where water in the P-trap is prone to freezing.

#### Construction

1. **Pit cover-slab/ floor:** This can be made out of round timber ballies with fine earth on top or RCC slab using bamboo or steel reinforcement. The floor should be smoothly finished and made impervious to water and urine penetration.
2. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level will help avoid rotting of timber.
3. **Roof:** This can be made from wooden shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
4. **Vent-pipe:** The vent-pipe can be PVC, HDPE, timber planks or large diameter bamboo. The top of the vent-pipe must be fitted with a fly-screen and must also allow sunlight to enter the pipe.
5. **Superstructure:** The recommended superstructure is the G-shaped design (refer page 48) with an open entrance.
6. **Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
7. **The pit** can be lined with dry hammer-dressed stones 1'4" thick to prevent rat nuisance and collapse of the earth.(refer page 47)



## Toilet location, proper use and hygiene

1. This toilet can be built closer to the house than the traditional basic pit latrine.
2. The location should be chosen considering wind and sunlight direction.
3. The toilet should be located at a minimum distance of 15 meters from any type of water source.
4. For the air to be able to flow, use of a squatting pan cover is not recommended during day time.
5. Pour some water on the pan before using the toilet to avoid sticking of faeces on the pan.
6. Once a week, sweep, wash and clean the toilet floor and squatting pan (preferably using disinfectant), and clean the toilet surrounding area.
7. Once a month, clean the walls, door and ceiling.
8. Once every six months check the fly-screen on top of the vent-pipe and check the pipe is not obstructed.
9. Repairs should be carried out immediately.
10. The pit must not be used for garbage disposal.

*Hand washing with soap is among the most effective ways to prevent diarrhoeal diseases*



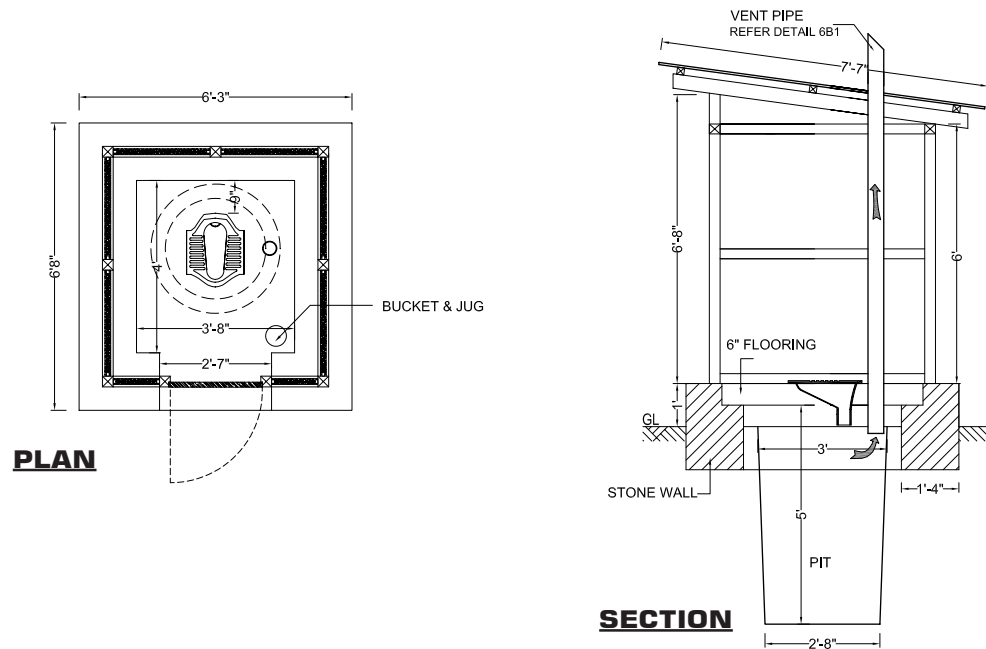
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Pour-flush squatting pan	1	No
2	Pipe 4" diameter (10' long)	1	No
3	Sliding bolt	1	No
4	Tower bolt	1	No
5	Handle	2	No
6	Nails	3	Kgs
7	Hinges	3	No
8	Timber	15	cft
9	Stone	70	cft
10	Skilled labour	10	work-day
11	Unskilled labour	20	work-day

Approximate minimum cost excluding local materials and labour = Nu. 1500/-



#### 4.1.1 Pour-flush toilet without water-seal, installed on ventilated pit.



Scale: Not to scale





## 4.1.2 POUR-FLUSH TOILET WITHOUT WATER-SEAL, CONNECTED TO SINGLE OFF-SET LEACH-PIT



### Applicability

- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable only if there is dependable water supply (requires at least 1 or 2 liters per use).
- Suitable where users are accustomed to using water for anal cleansing. Where people use solid/ hard materials, these must not be put into the toilet. Instead they should be put in a covered container kept inside the toilet, and disposed off each day by burning and/ or burying.
- Suitable in places where water in the P-trap is prone to freezing.

### Construction

1. **Floor:** This can be made of compacted earth covered by concrete, smoothly finished and made impervious to water and urine penetration.
2. **Squatting place:** If a pour-flush squatting pan is not available, the squatting place can be home-made using cement mortar.
3. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level will help avoid rotting of timber.
4. **Roof:** This can be made from wooden shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
5. **Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
6. **The leach-pit** can be lined with dry hammer-dressed stones 1'4" thick. The cover can be made with concrete (1:2:4) with either bamboo or steel reinforcement (8 mm dia @ 200 mm c/c b/w). It can be made in two pieces for easy handling. A gas-pipe should be fitted in the leach-pit cover. (refer page 47)





## Toilet location, proper use and hygiene

1. This toilet can be built close to the house.
2. The location of the leach-pit should be chosen considering wind direction.
3. A good fitting lid for the squatting pan is recommended.
4. Once a week, sweep, wash and clean the toilet floor and squatting place (preferably using disinfectant), and clean the toilet surrounding area.
5. Once a month, clean the walls, door and ceiling.
6. Once every six months check the fly-screen on top of the gas-pipe fitted to the leach-pit cover and check the pipe is not obstructed.
7. Repairs should be carried out immediately.

*Lets aim towards ZERO open defecation*



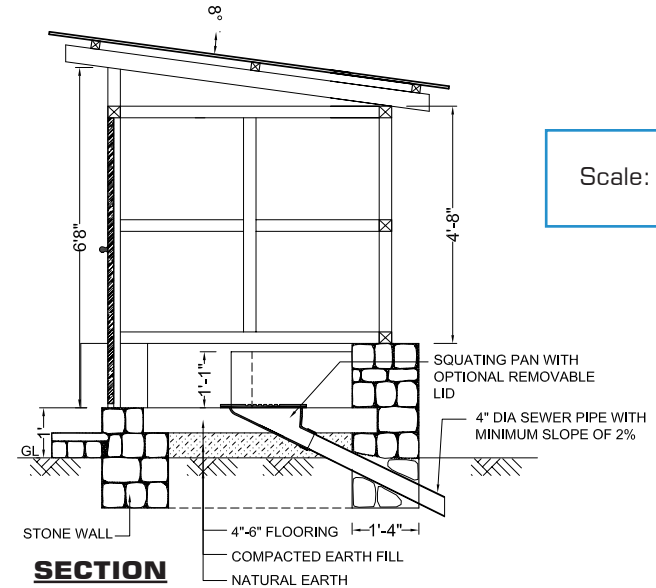
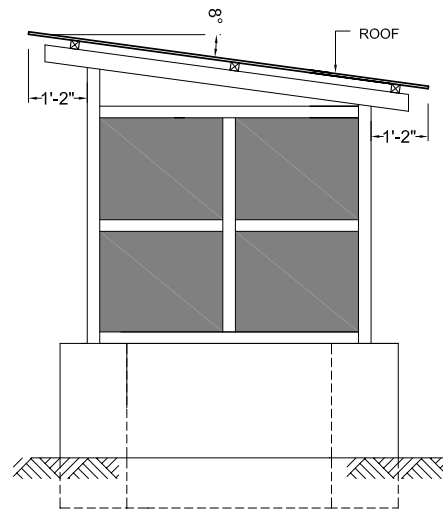
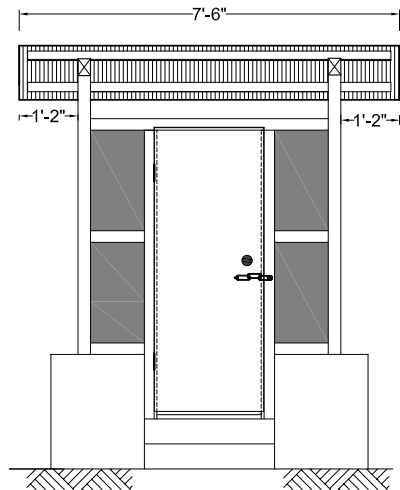
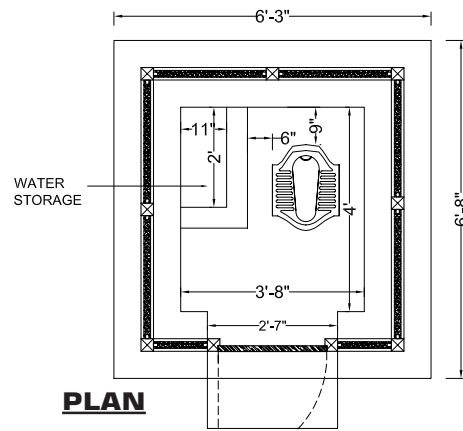
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Cement (50 Kgs bags)	6	bags
2	Pour-flush squatting pan	1	No
3	Pipe 4" diameter (10'long)	2	No
4	Sliding bolt	1	No
5	Tower bolt	1	No
6	Handle	2	No
7	Nails	3	Kgs
8	Hinges	3	No
9	Timber	15	cft
10	Sand	50	cft
11	Gravel	20	cft
12	Stone	100	cft
13	Skilled labour	15	work-day
14	Unskilled labour	20	work-day

Approximate minimum cost excluding local materials and labour = Nu. 4500/-



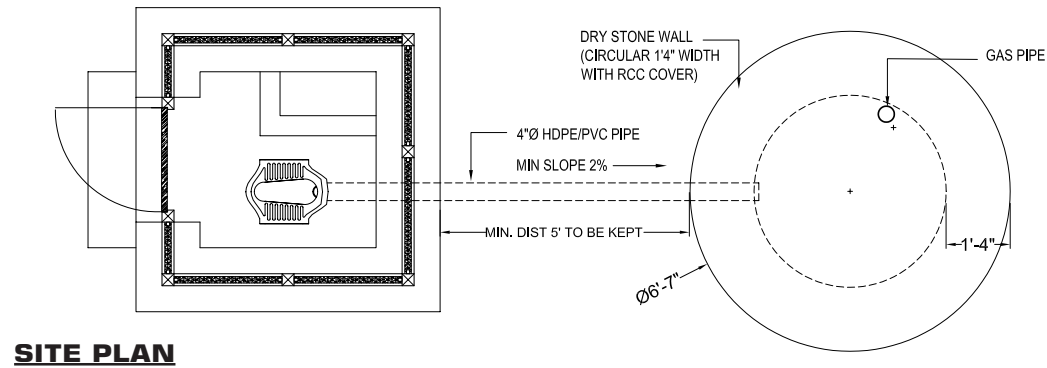
### 4.1.2 Pour-flush toilet without water-seal, connected to single off-set leach-pit.



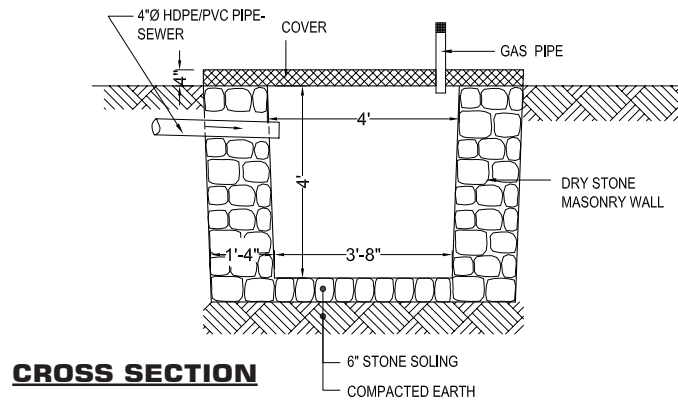
Scale: Not to scale



### 4.1.2 Pour-flush toilet without water-seal, connected to single off-set leach-pit.



Scale: Not to scale







### 4.1.3 POUR-FLUSH TOILET WITHOUT WATER-SEAL, CONNECTED TO TWIN OFF-SET LEACH-PITS



#### Applicability

- This design is the same as 4.1.2 but has an additional leach-pit. The alternating use of the two leach-pits allows the toilet to be used continuously without any interruption.
- When the first leach-pit becomes full, the pipe from the junction box is closed and the second leach-pit is put into use. When the second leach-pit becomes full, the first leach-pit is emptied and put back into use.
- The decomposed contents of the leach-pits are safe to use as a plant fertiliser if desired.

- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable only if there is dependable water supply (requires at least 1 or 2 liters per use).
- Suitable where users are accustomed to using water for anal cleansing. Where people use solid/ hard materials, these must not be put into the toilet. Instead they should be put in a covered container kept inside the toilet, and disposed of each day by burning and/ or burying.
- Suitable in places where water in the P-trap is prone to freezing.

#### Construction

1. **Floor:** This can be made of compacted earth covered by concrete, smoothly finished and made impervious to water and urine penetration.
2. **Squatting place:** If a pour-flush squatting pan is not available, the squatting place can be home-made using cement mortar.
3. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level **will help avoid rotting of timber.**
4. **Roof:** This can be made from wood shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
5. **Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
6. **The leach-pit** can be lined with dry hammer-dressed stones 1'4" thick. The cover can be made with concrete (1:2:4) with either bamboo or steel reinforcement (8 mm dia @ 200 mm c/c b/w). It can be made in two pieces for easy handling. A gas-pipe should be fitted in the leach-pit cover. (refer page 47 for details)



## Toilet location, proper use and hygiene

1. This toilet can be built close to, or attached to the house.
2. The location of the leach-pits should be chosen considering wind direction. There should be enough space to allow at least 4-5 feet between the two pits.
3. A good fitting lid for the squatting pan is suggested if smell is found to be a nuisance.
4. Once a week, sweep, wash and clean the toilet floor and squatting pan (preferably using disinfectant), and clean the toilet surrounding area.
5. Once a month, clean the walls, door and ceiling.
6. Once every six months check the fly-screen on top of the gas-pipe fitted to the leach-pit covers and check the pipe is not obstructed.
7. Repairs should be carried out immediately.

*Children faeces must be disposed off properly*

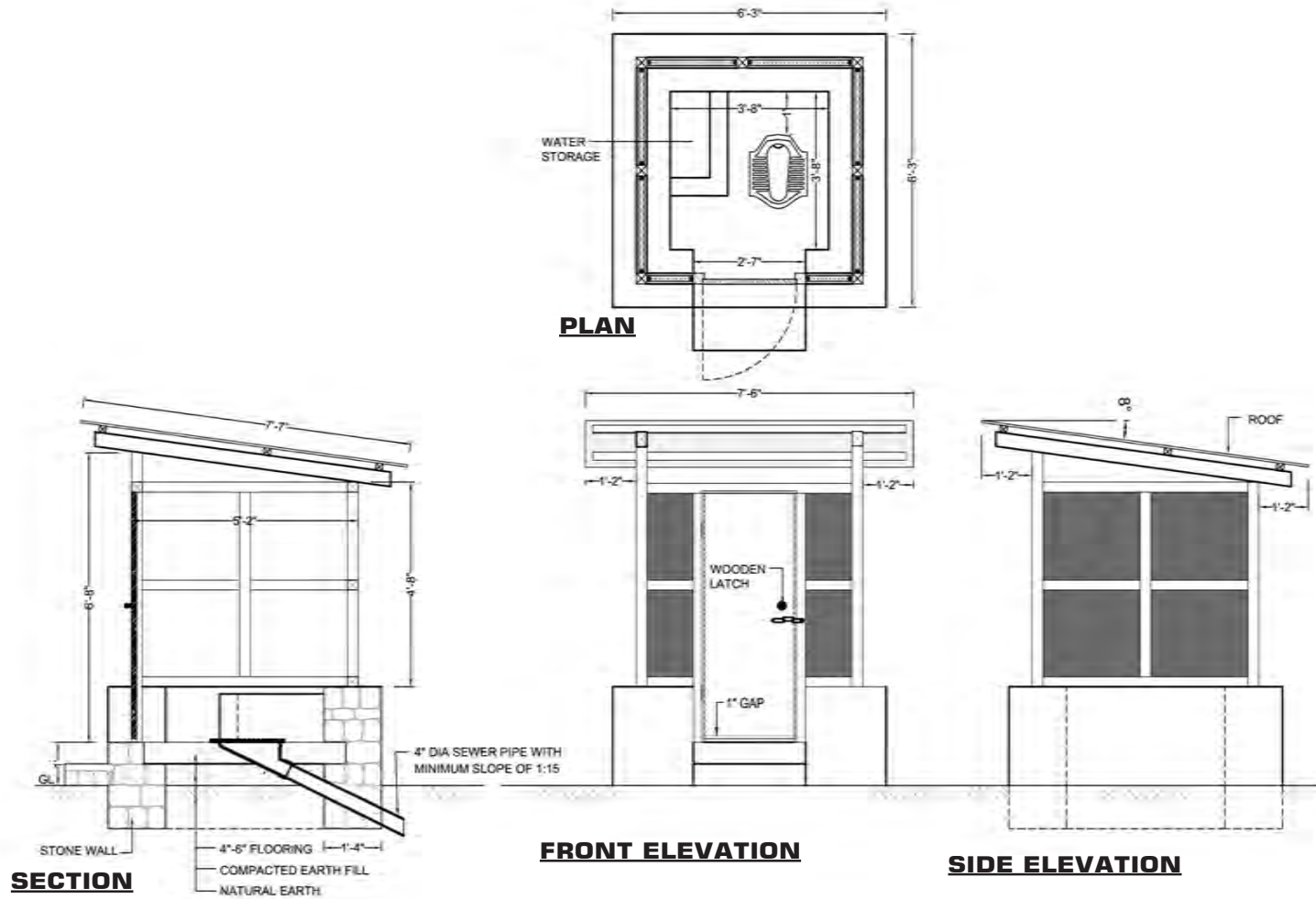
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Cement (50 Kgs bags)	8	bags
2	Pour-flush squatting pan	1	No
3	Pipe 4" diameter (10'long)	2	No
4	Sliding bolt	1	No
5	Tower bolt	1	No
6	Handle	2	No
7	Nails	3	Kgs
8	Hinges	3	No
9	Timber	15	cft
10	Sand	80	cft
11	Gravel	30	cft
12	Stone	160	cft
13	Skilled labour	15	work-day
14	Unskilled labour	25	work-day

Approximate minimum cost excluding local materials and labour = Nu. 5000/-



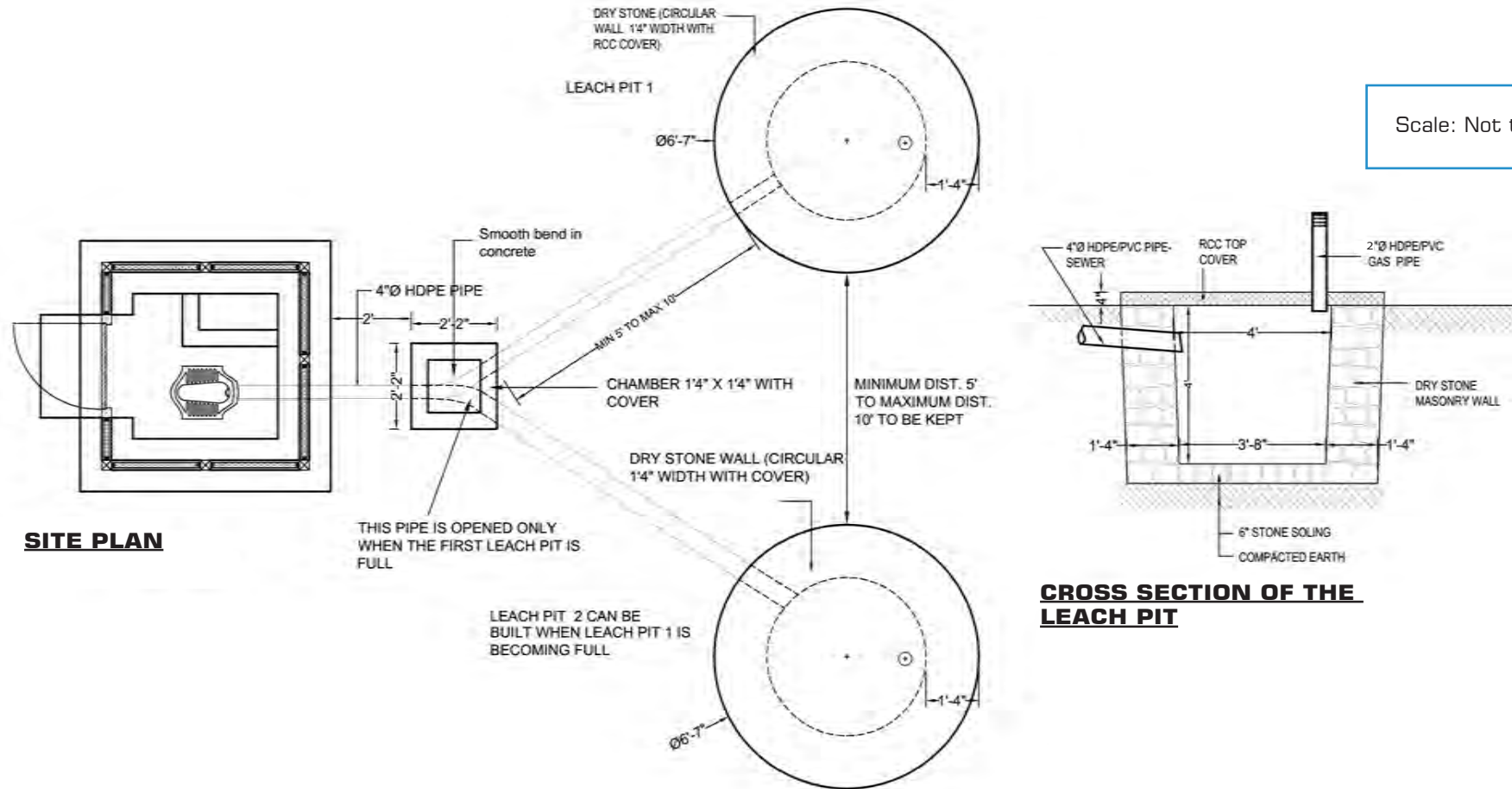
### 4.1.3 Pour-flush toilet without water-seal, connected to twin off-set leach-pits



Scale: Not to scale



### 4.1.3 Pour-flush toilet without water-seal, connected to twin off-set leach-pits







## 4.2 POUR-FLUSH TOILET WITH WATER-SEAL

### 4.2.1 POUR-FLUSH TOILET WITH WATER-SEAL, INSTALLED ON VENTILATED PIT



#### Applicability

- This design is an upgraded version of 3.1 achieved by installing a pour-flush squatting pan with water-seal instead of the drop-hole.
- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable only if there is dependable water supply (requires at least 3 or 4 liters per use).
- Suitable where users are accustomed to using water for anal cleansing.
- Where people use solid/ hard materials, these must not be put into the toilet. Instead they should be put in a covered container kept inside the toilet, and disposed of each day by burning and/ or burying.

#### Construction

1. **Pit cover-slab/ floor:** This can be made out of round timber ballies with fine earth on top or RCC slab using bamboo or steel reinforcement. The floor should be smoothly finished and made impervious to water and urine penetration.
2. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground-level will help avoid rotting of timber.
3. **Roof:** This can be made from wood shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
4. **Vent-pipe:** The vent-pipe can be PVC, HDPE, timber planks or large diameter bamboo. The top of the vent-pipe must be fitted with a fly-screen and must also allow sunlight to enter the pipe.
5. **Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
6. **The pit** can be lined with dry hammer-dressed stones 1'4" thick to prevent rat nuisance and collapse of the earth.



## Toilet location, proper use and hygiene

1. This toilet can be built closer to the house than the traditional basic pit latrine.
2. The location should be chosen considering wind and sunlight direction.
3. Once a week, sweep, wash and clean the toilet floor and squatting pan (preferably using disinfectant), and clean the toilet surrounding area.
4. Once a month, clean the walls, door and ceiling.
5. Once every six months check the fly-screen on top of the vent-pipe and check the pipe is not obstructed.
6. Repairs should be carried out immediately.

*Do not defecate in the open in any circumstances*

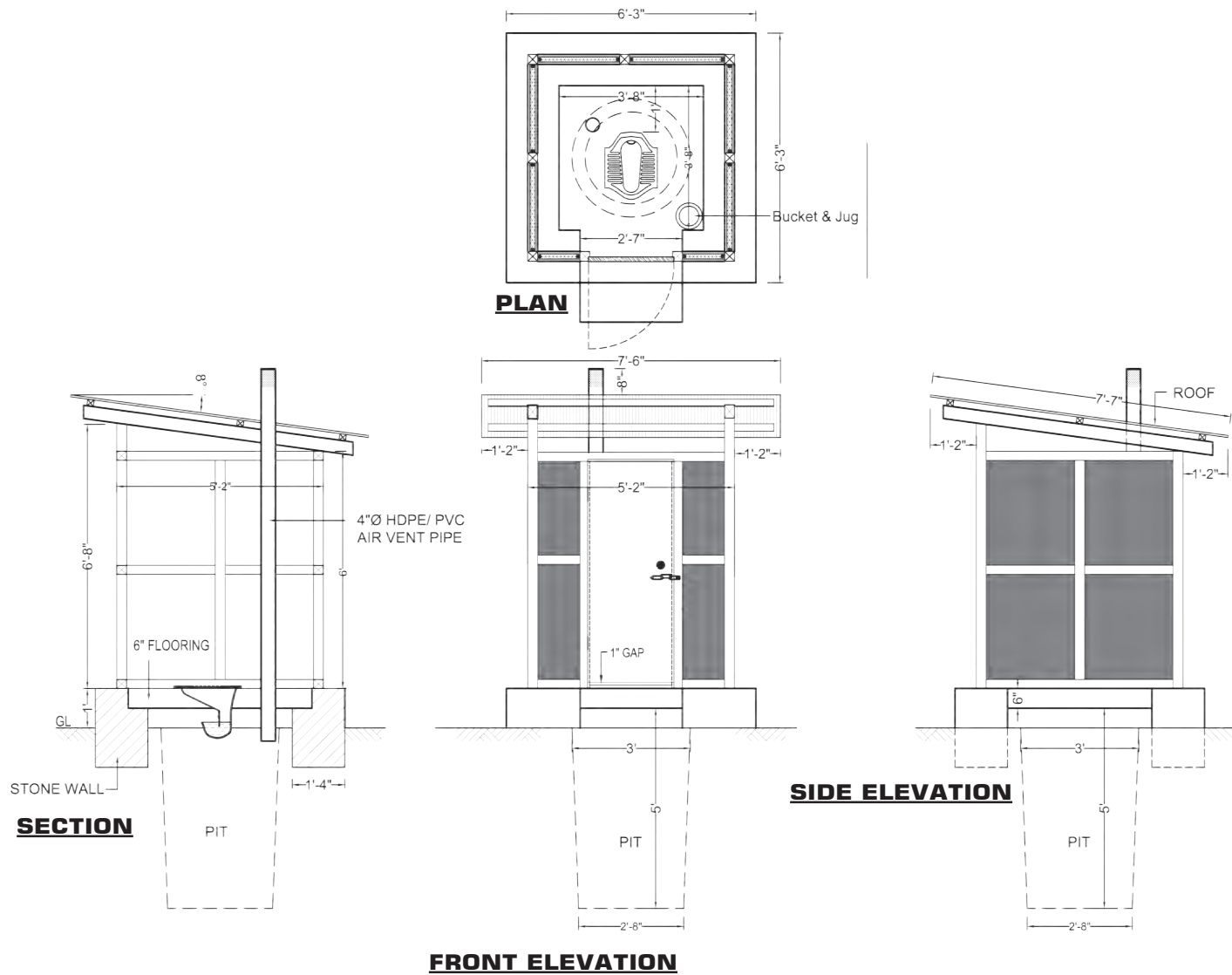
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Pour-flush squatting pan (with water trap)	1	No
2	Pipe 4" diameter (10' long)	2	No
3	Sliding bolt	1	No
4	Tower bolt	1	No
5	Handle	2	No
6	Nails	3	Kgs
7	Hinges	3	No
8	Timber	15	cft
9	Stone	70	cft
10	Skilled labour	10	work-day
11	Unskilled labour	20	work-day

Approximate minimum cost excluding local materials and labour = Nu. 2000/-



## 4.2.1 Pour-flush toilet with water-seal, installed on ventilated pit



Scale: Not to scale



## 4.2.2 POUR-FLUSH TOILET WITH WATER-SEAL, CONNECTED TO SINGLE OFF-SET LEACH-PIT



### Applicability

- This design is an upgraded version of 2.2 achieved by the addition of a water-seal to the pour-flush squatting pan.
- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable only if there is dependable water supply (requires at least 3 or 4 liters per use).

- Suitable where users are accustomed to using water for anal cleansing. Where people use solid/ hard materials, these must not be put into the toilet. Instead they should be put in a covered container kept inside the toilet, and disposed of each day by burning and/ or burying.

### Construction

1. **Floor:** This can be made of compacted earth covered by concrete, smoothly finished and made impervious to water and urine penetration.
2. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level will help avoid rotting of timber.
3. **Roof:** This can be made from wooden shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
4. **Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
5. **The leach-pit** can be lined with dry hammer-dressed stones 1'4" thick. The cover can be made with concrete (1:2:4) with either bamboo or steel reinforcement (8 mm dia @ 200 mm c/c b/w). It can be made in two pieces for easy handling. A gas-pipe should be fitted in the leach-pit cover. (refer page 47 for details)





## Toilet location, proper use and hygiene

1. This toilet can be built inside, attached to, or close to the house.
2. The location of the leach-pit should be chosen considering wind direction.
3. Once a week, sweep, wash and clean the toilet floor and squatting pan (preferably using disinfectant), and clean the toilet surrounding area.
4. Once a month, clean the walls, door and ceiling.
5. Once every six months check the fly-screen on top of the gas-pipe fitted to the leach-pit cover and check the pipe is not obstructed.
6. Repairs should be carried out immediately.

*Washing hands with water alone is significantly less effective than washing hands with soap*



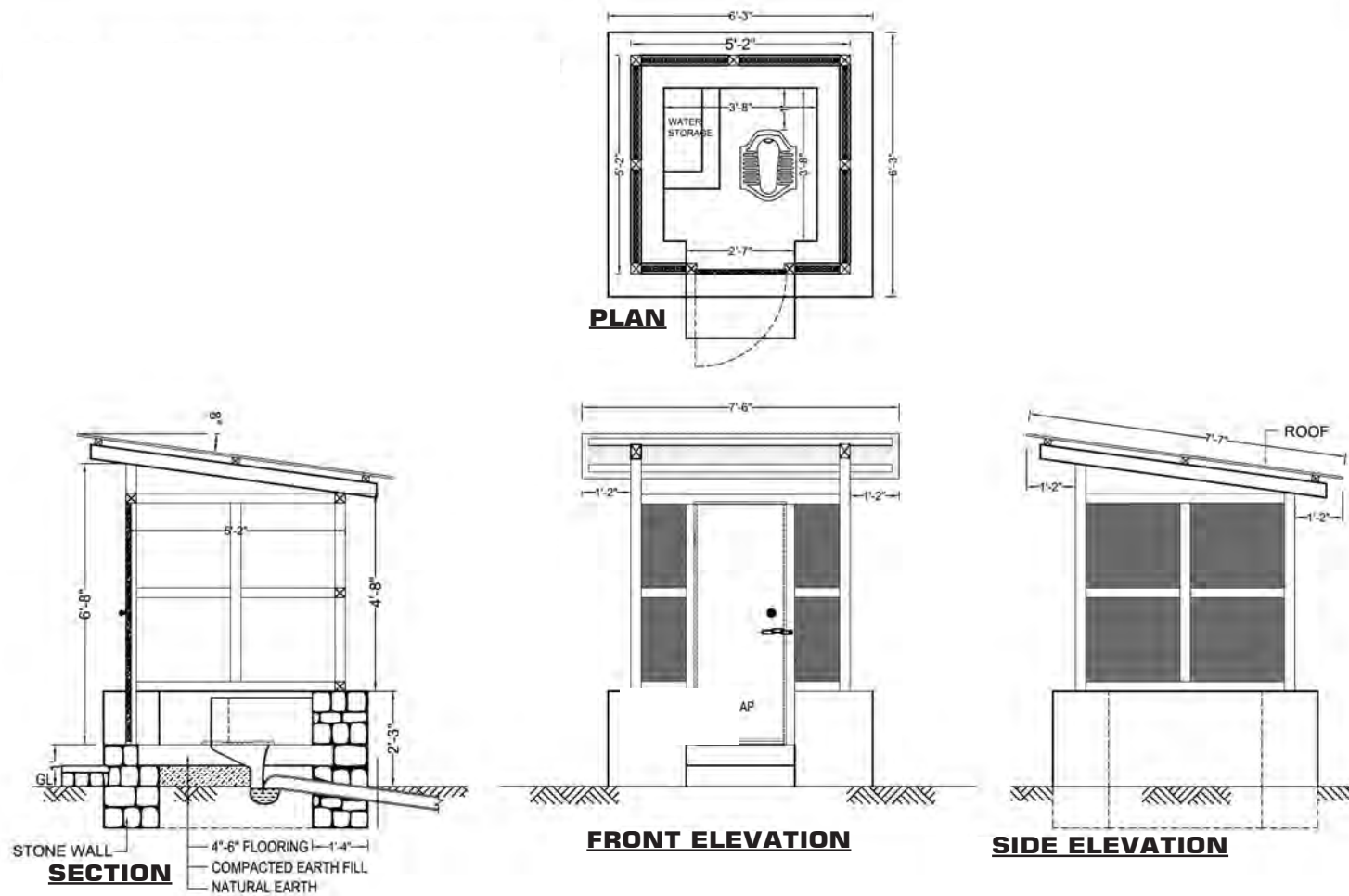
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Cement (50 Kgs bags)	6	bags
2	Pour-flush squatting pan (with water trap)	1	No
3	Pipe 4" diameter (10'long)	2	No
4	Sliding bolt	1	No
5	Tower bolt	1	No
6	Handle	2	No
7	Nails	3	Kgs
8	Hinges	3	No
9	Timber	15	cft
10	Sand	50	cft
11	Gravel	20	cft
12	Stone	100	cft
13	Skilled labour	15	work-day
14	Unskilled labour	20	work-day

Approximate minimum cost excluding local materials and labour = Nu. 4500/-



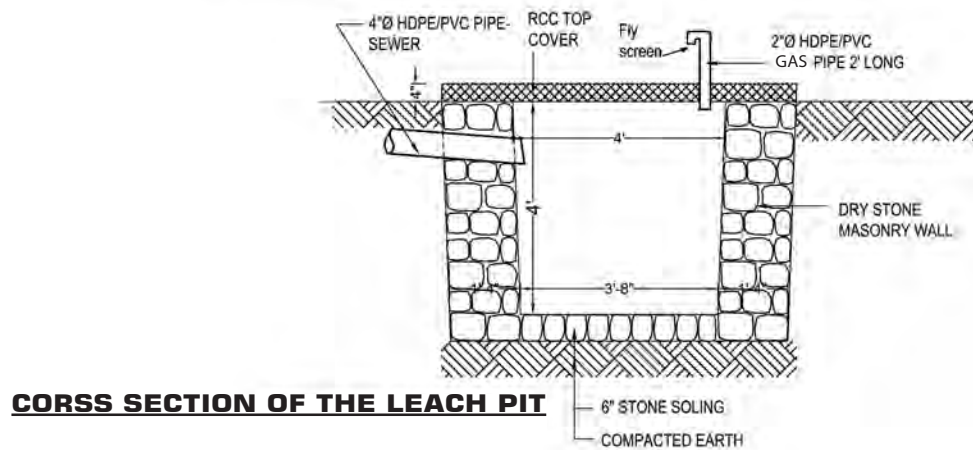
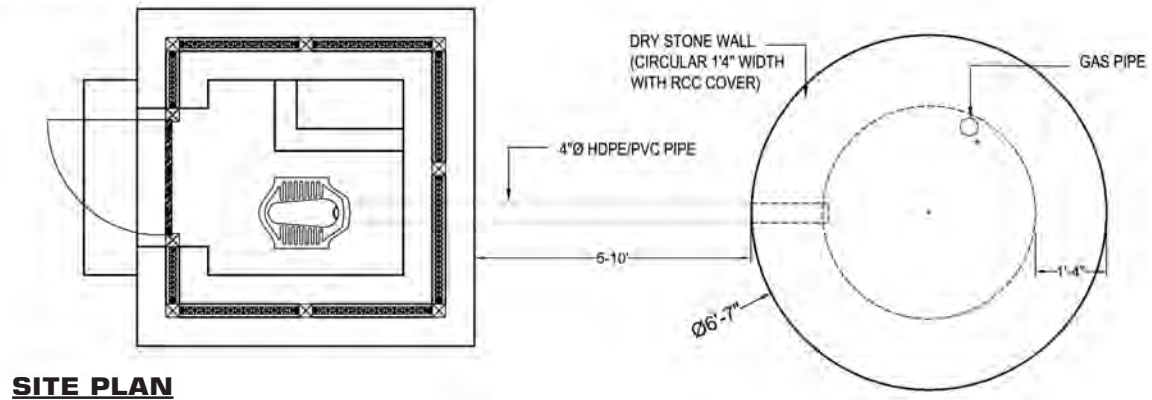
## 4.2.2 Pour-flush toilet with water-seal, connected to single off-set leach-pit



Scale: Not to scale



## 4.2.2 Pour-flush toilet with water-seal, connected to single off-set leach-pit



Scale: Not to scale



### 4.2.3 POUR-FLUSH TOILET WITH WATER-SEAL, CONNECTED TO TWIN OFF-SET LEACH-PITS



#### Applicability

- This design is the same as 4.2.2 but has an additional leach-pit. The alternating use of the two leach-pits allows the toilet to be used continuously without any interruption.
- When the first leach-pit becomes full, the pipe from the junction box is closed and the second leach-pit is put into use. When the second leach-pit becomes full, the first leach-pit is emptied and put back into use.
- The decomposed contents of the leach-pits are safe to use as a plant fertiliser if desired.

- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable only if there is dependable water supply (requires at least 3 or 4 liters per use).
- Suitable where users are accustomed to using water for anal cleansing. Where people use solid/ hard materials, these must not be put into the toilet. Instead they should be put in a covered container kept inside the toilet, and disposed of each day by burning and/ or burying.

#### Construction

1. **Floor:** This can be made of compacted earth covered by concrete, smoothly finished and made impervious to water and urine penetration.
2. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level will help avoid rotting of timber.
3. **Roof:** This can be made from wooden shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
4. **Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
5. **The leach-pits** can be lined with dry hammer-dressed stones 1'4" thick. The covers can be made with concrete (1:2:4) with either bamboo or steel reinforcement (8mm dia @ 200mm c/c b/w). They can be made in two pieces for easy handling. Gas-pipes should be fitted in the leach-pit covers. (refer page 47 for details)





## Toilet location, proper use and hygiene

1. This toilet can be built inside, attached to, or close to the house.
2. The location of the leach-pits should be chosen considering wind direction. There should be enough space to allow at least 4-5 feet between the two pits.
3. Once a week, sweep, wash and clean the toilet floor and squatting pan (preferably using disinfectant), and clean the toilet surrounding area.
4. Once a month, clean the walls, door and ceiling.
5. Once every six months check the fly-screen on top of the gas-pipe fitted to the leach-pit covers and check the pipe is not obstructed.
6. Repairs should be carried out immediately.

*Please do not forget to wash your hands.....always!*

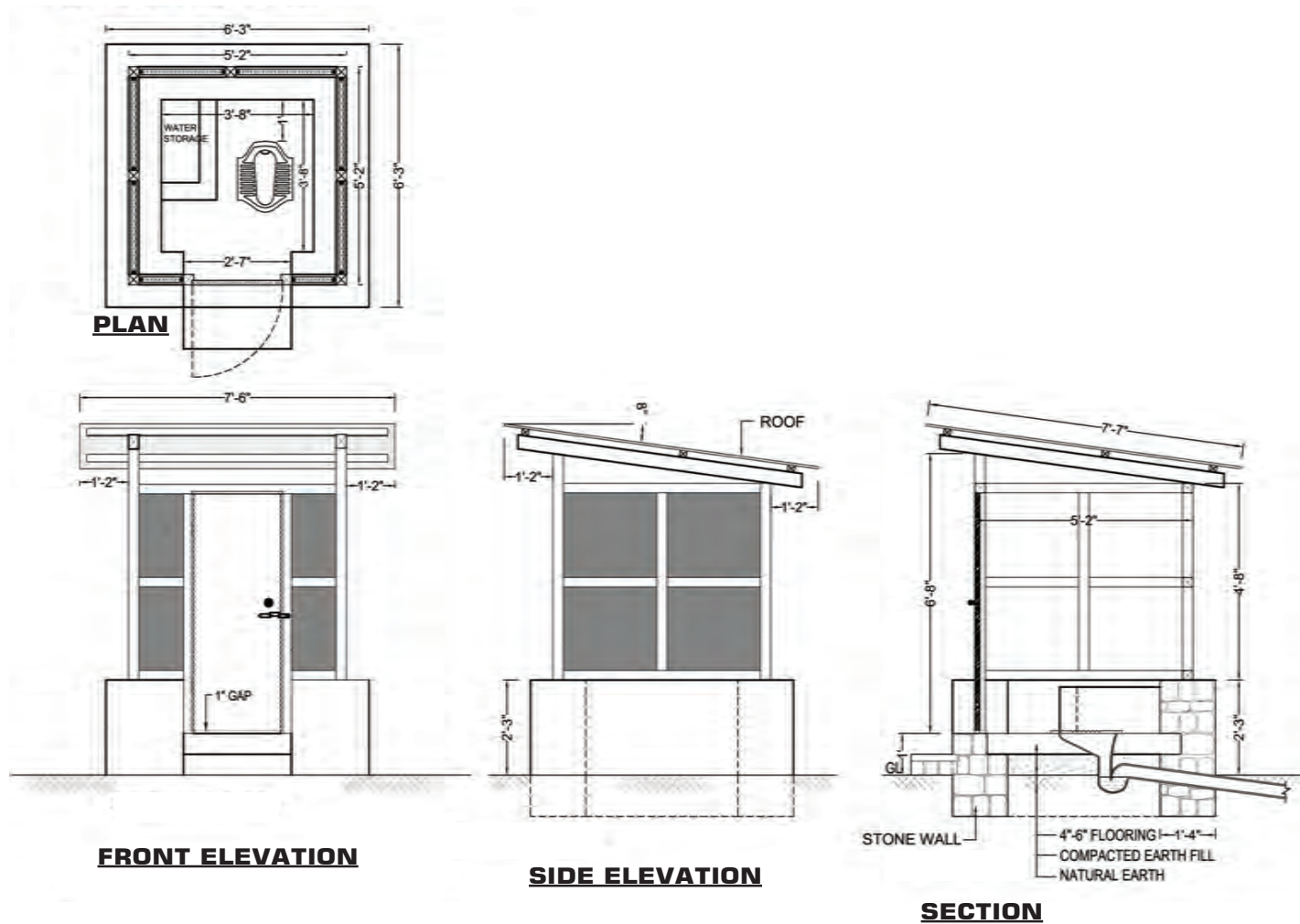
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Cement (50 Kgs bags)	8	bags
2	Pour-flush squatting pan (with water trap)	1	No
3	Pipe 4" diameter (10'long)	2	No
4	Sliding bolt	1	No
5	Tower bolt	1	No
6	Handle	2	No
7	Nails	3	Kgs
8	Hinges	3	No
9	Timber	15	cft
10	Sand	80	cft
11	Gravel	30	cft
12	Stone	160	cft
13	Skilled labour	15	work-day
14	Unskilled labour	25	work-day

Approximate minimum cost excluding local materials and labour = Nu. 5000/-



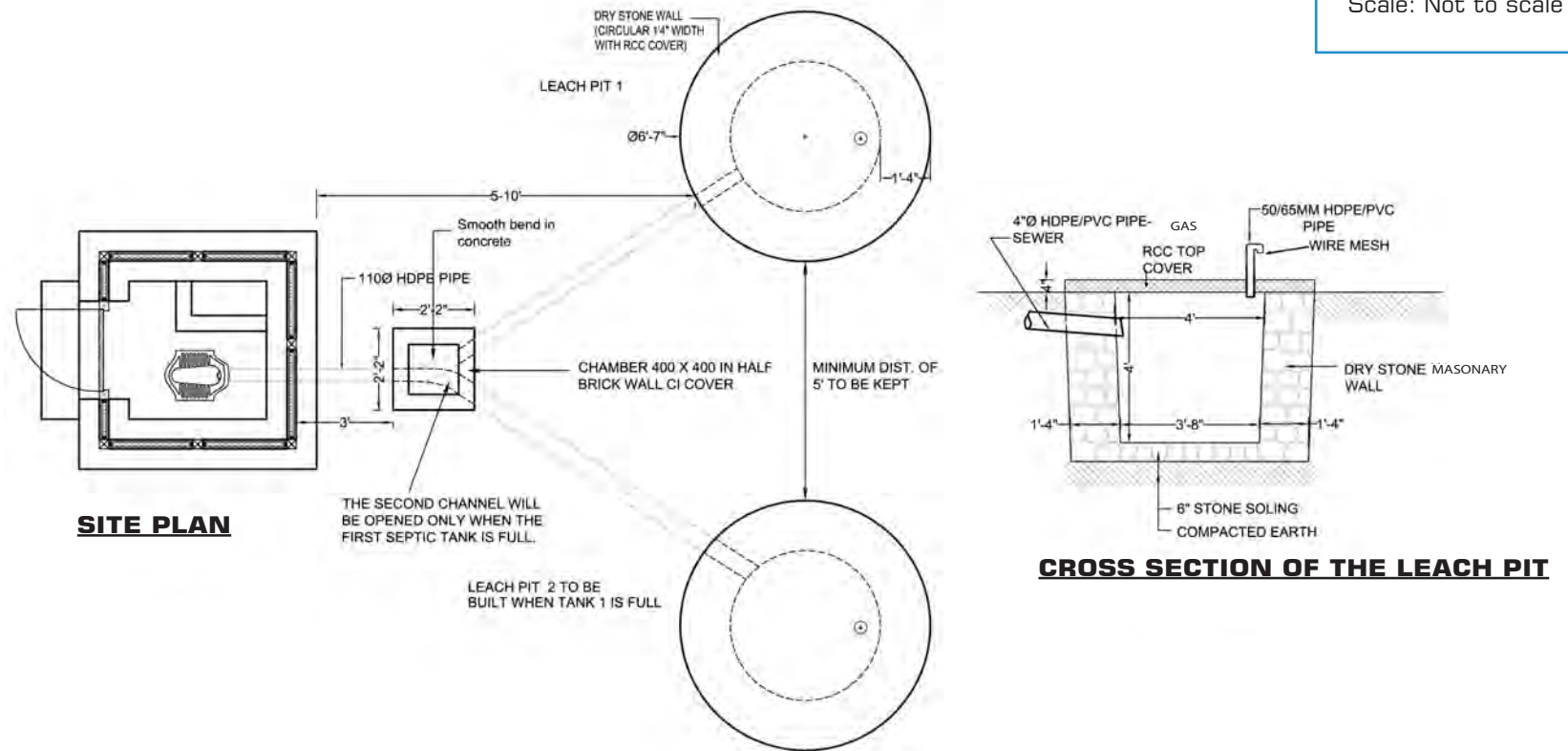
### 4.2.3 Pour-flush toilet with water-seal, connected to twin off-set leach-pits



Scale: Not to scale



### 4.2.3 Pour-flush toilet with water-seal, connected to twin off-set leach-pits





## 4.2.4 IMPROVED LONG-DROP TOILET



### Applicability

- Suitable for houses that already have a traditional long-drop toilet.
- Suitable where users are accustomed to using water for anal cleansing.
- Suitable only if there is dependable water supply.
- Pour-flush without water-seal requires at least 1 or 2 liters per use; with water-seal requires at least 2 or 4 liters per use.

### Construction

- 1. Floor:** Can be made out of timber or RCC slab and should be smoothly finished and impervious to water and urine penetration.
- 2. Walls:** Can be of same material as the walls of the house.
- 3. Roof:** Can be made from CGI sheets, wooden shingles, or same material as the roof of the house.
- 4. Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
- 5. Toilet waste-pipe:** Can be of HDPE or PVC with glued socket firmly fixed. Toilet waste-pipe could be connected to a septic tank or an off-set leach pit. Septic tank is a water-tight two compartment tank with the second compartment twice the length of the first. (Septic tank details not included in this handbook)



## Toilet location, proper use and hygiene

1. This toilet is traditionally built on the first floor of the house, protruding from the side.
2. If the toilet waste pipe is connected to a septic tank, it should be located at a minimum of 10 feet from the house.
3. If the toilet waste pipe is connected to a soak-pit, it should be located away from the house considering wind direction.
4. Once a week, sweep, wash and clean the toilet floor and squatting pan (preferably using disinfectant).
5. Once a month, clean the walls, door and ceiling.
6. Once every six months check the fly-screen on top of the gas-pipe fitted to the septic tank cover or soak pit and check the pipe is not obstructed.
7. Once a year check if the septic tank needs emptying. The sludge from the septic tank must be further composted before using as a fertilizer or safely buried.
8. Repairs should be carried out immediately.



### Approximate material estimate

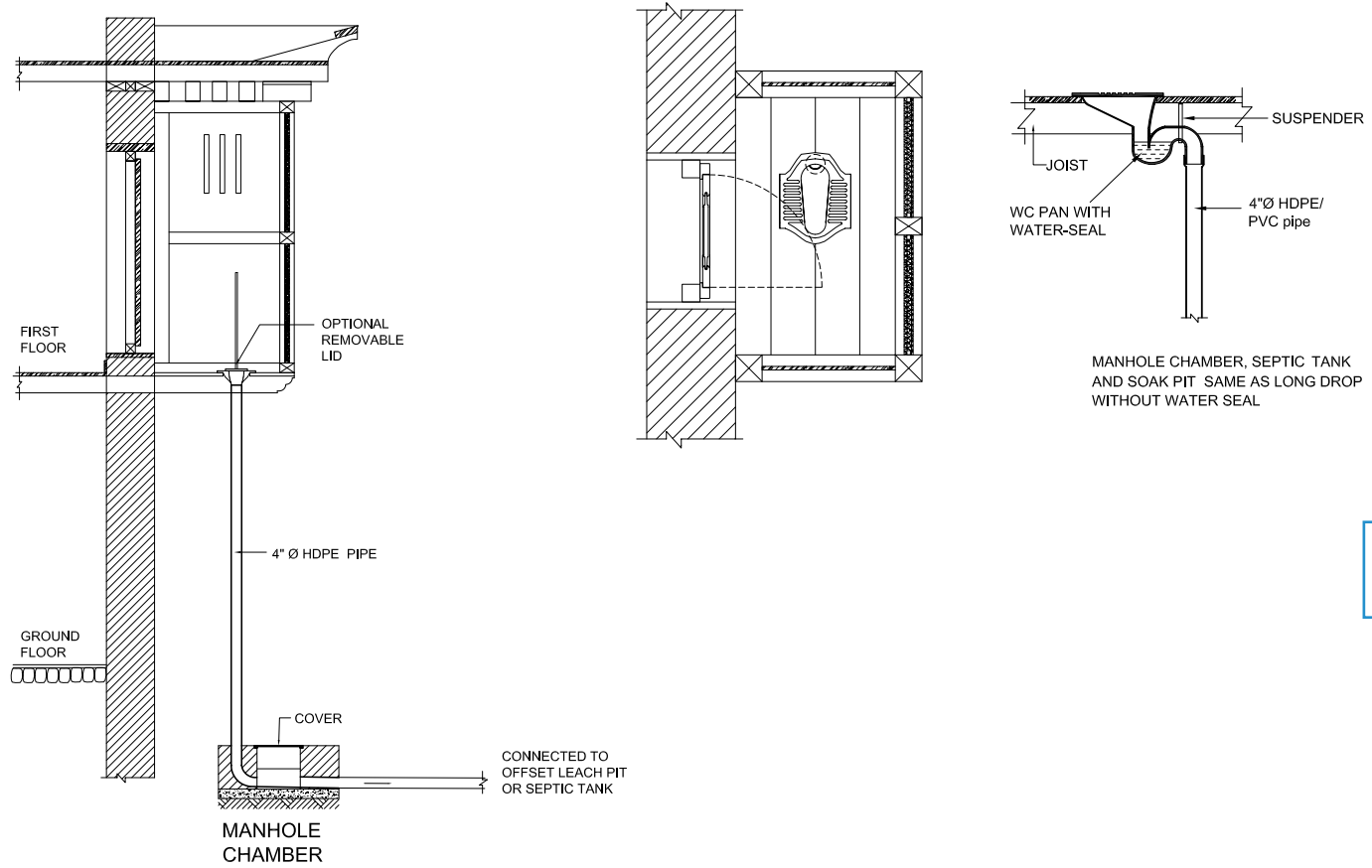
Sl. No.	Particular	Qty	Unit
1	Cement (50 Kgs bags)	10	bags
2	Pour-flush squatting pan	1	No
3	Pipe 4" diameter (10'long)	4	No
4	Sliding bolt	1	No
5	Tower bolt	1	No
6	Handle	2	No
7	Nails	3	Kgs
8	Hinges	3	No
9	Timber	15	cft
10	Sand	80	cft
11	Gravel	30	cft
12	Stone	120	cft
13	Skilled labour	15	work-day
14	Unskilled labour	25	work-day

Approximate minimum cost excluding local materials and labour = Nu. 7000/-





## 4.2.4 Improved long-drop toilet



Scale: Not to scale



## 4.3 POUR-FLUSH TOILET WITH BATHROOM COMBINED

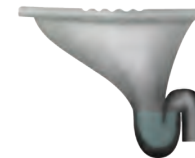


### Applicability

- This design is the same as 4.2.3 but has a bathroom attached.
- Suitable where the ground is easy to excavate and where there is no high water-table, water-logging, or flooding.
- Suitable where users are accustomed to using water for anal cleansing.
- Suitable only if there is dependable water supply. The addition of the bathroom increases the toilet water requirements by at least 50 liters per bather.
- The bathroom waste-water must be properly drained off and not into the leach pit.

### Construction

1. **Floor:** This can be made of compacted earth covered by concrete, smoothly finished and made impervious to water and urine penetration.
2. **Walls:** Walls can be of ekra on 3"x3" ballies/ battens with mud/ cement plaster. Stone walling built up to 1' above ground- level will help avoid rotting of timber.
3. **Roof:** This can be made from wood shingles, bamboo matting, CGI sheets, or old bitumen sheets over timber/ ballies rafter and purlins (size of rafter is 3"x4" and purlins 2"x3"). The roof should be firmly secured to prevent wind damage.
4. **Water storage:** The toilet must have inbuilt water storage of 75-80 liters or a water storage container (with a lid in mosquito-prone areas).
5. **The leach-pits** can be lined with dry hammer-dressed stones 1'4" thick. The covers can be made with concrete (1:2:4) with either bamboo or steel reinforcement (8mm dia @ 200mm c/c b/w). They can be made in two pieces for easy handling. Gas-pipes should be fitted in the leach-pit covers. (refer page 47)





## Toilet location, proper use and hygiene

1. This toilet and bathroom can be built inside, attached to, or close to the house.
2. The location of the leach-pits should be chosen considering wind direction. There should be enough space to allow at least 4-5 feet between the two pits.
3. Once a week, sweep, wash and clean the bathroom, toilet floor and squatting pan (preferably using disinfectant), and clean the toilet surrounding area.
4. Once a month, clean the walls, door and ceiling.
5. Once every six months check the fly-screen on top of the gas-pipe fitted to the leach-pit covers and check the pipe is not obstructed.
6. Repairs should be carried out immediately.

*Always leave the toilet the way you would like to find it - clean, tidy and ready to use - and always wash your hands with soap after using the toilet.*



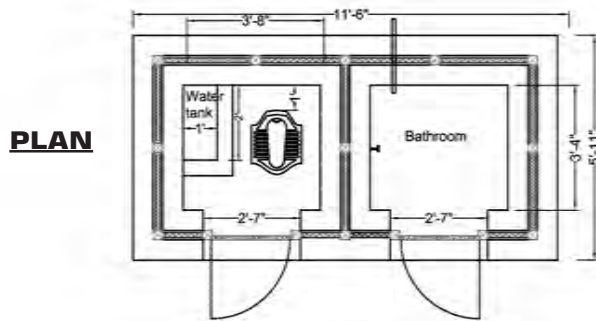
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Cement (50 Kgs bags)	12	bags
2	Pour-flush squatting pan	1	No
3	Pipe 4" diameter (10'long)	2	No
4	Sliding bolt	2	No
5	Tower bolt	2	No
6	Handle	4	No
7	Nails	6	Kgs
8	Hinges	6	No
9	Timber	20	cft
10	Sand	80	cft
11	Gravel	30	cft
12	Stone	120	cft
13	Skilled labour	15	work-day
14	Unskilled labour	25	work-day

Approximate minimum cost excluding local materials and labour = Nu. 7000/-

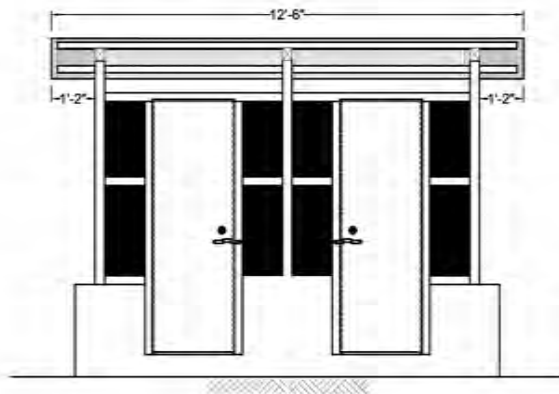


### 4.3 Pour flush toilet with bathroom combined

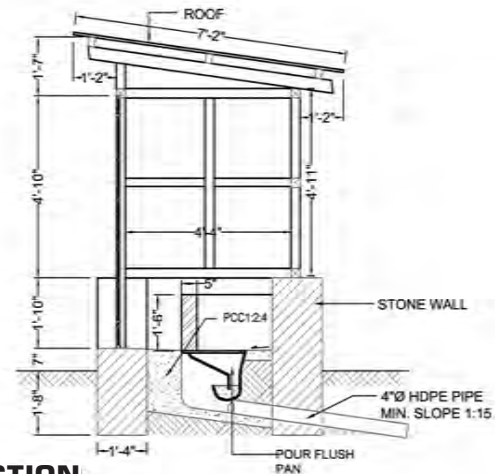


Scale: Not to scale

**SIDE ELEVATION**



**FRONT ELEVATION**



**SECTION**

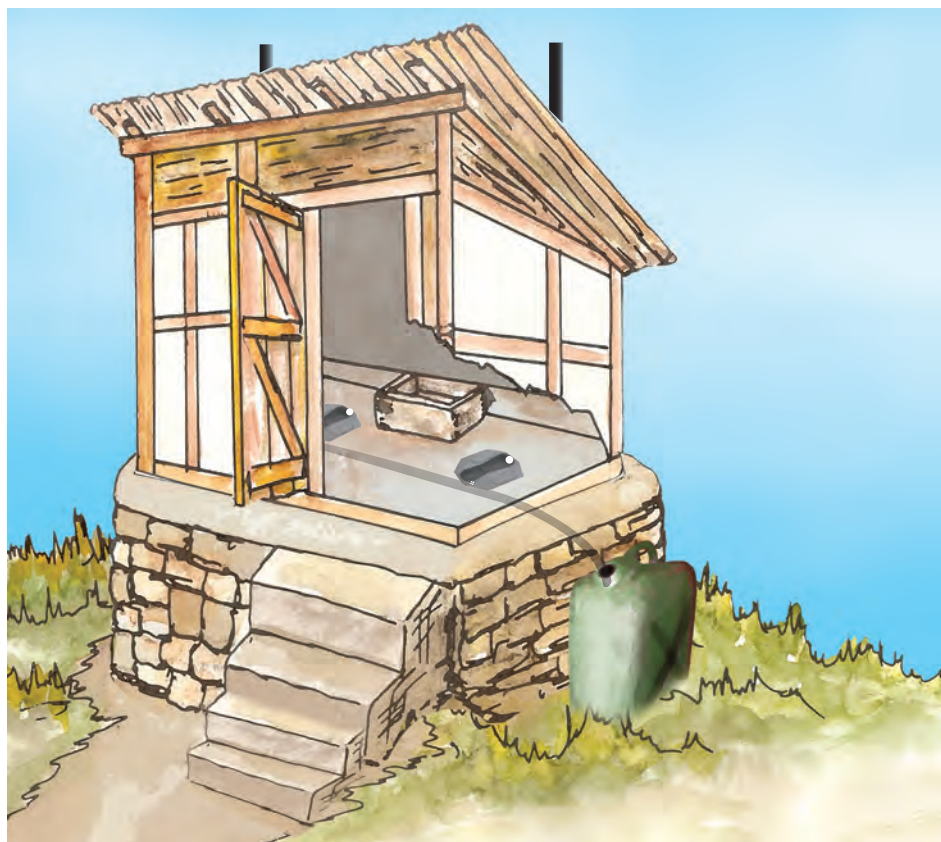


## **5. Composting toilets (ecological sanitation or EcoSan toilet)**





## 5.1 DOUBLE VAULT COMPOST TOILET WITH URINE DIVERSION



### Applicability

- Suitable if the household is interested in using the decomposed faeces and separated the urine as plant fertilisers.
- Does not require water. Therefore suitable for locations where there is scarcity of water or where the water supply is not always dependable.
- Suitable for hard-rock areas and high water-table areas because the whole structure is above ground-level. No risk of ground-water contamination.
- The alternating use of the two pits allows the toilet to be used continuously without any interruption.
- When the first pit becomes full, the drop-hole is closed and sealed and the second pit is put into use. When the second pit becomes full, the emptying hatch of the first pit is dismantled and the decomposed contents can be removed and safely used as a plant fertiliser. The emptying hatch is then re-closed and the pit put back into use while the second pit is sealed.

### Construction

1. **Walls:** Walls can be timber, ekra, bamboo mats or bitumen sheets.
2. **Roof:** The roof cover can be CGI sheet, wooden shingles, bamboo mats or bitumen sheets.
3. **Pits:** The pits can be made of stone masonry with cement mortar 1:6. The emptying hatches should be closed with stone masonry with mud-cement mortar to allow dismantling for removal of the pit contents.
4. **Vent-pipe:** The vent-pipe can be made of PVC or HDPE pipe 90mm diameter. The top of the vent-pipe must be fitted with a fly-screen.
5. **Superstructure:** The superstructure and roof must be firmly secured to the foundation to prevent damage by wind.



## Toilet location, proper use and hygiene

1. This toilet can be located attached to or close by the house.
2. The separated urine is collected in a suitable container such as a 15-20 liters plastic jerry can and used as liquid manure. The container should be emptied every day or two and the urine diluted before use. Alternatively the outlet of the urine pipe can be connected to a soak-pit and the urine dispersed off into the soil.
3. A small amount of wood-ash or other suitable material like sand or saw dust should be added through the drop-hole after each use and the lid for the drop-hole replaced.
4. Once a week, sweep and clean the toilet floor (preferably using disinfectant), and clean the toilet surrounding area. Do not use excess water.
5. Once a month, clean the walls, door and ceiling.
6. Once every six months check the fly-screen on top of the vent-pipe and check the pipe is not obstructed.
7. Repairs should be carried out immediately.
8. The pit must not be used for garbage disposal.

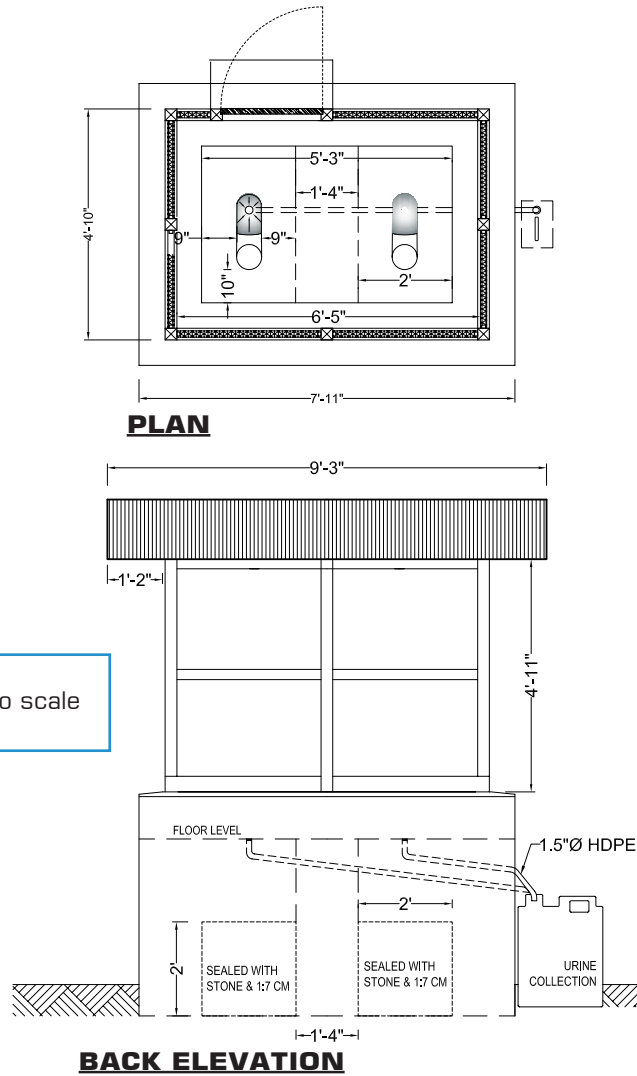
### Approximate material estimate

Sl. No.	Particular	Qty	Unit
1	Cement (50 Kgs bags)	12	bags
2	Eco-san squatting pan	2	No
3	Pipe 4" diameter (10'long)	3	No
4	Sliding bolt	2	No
5	Tower bolt	1	No
6	Handle	1	No
7	Nails	5	Kgs
8	Hinges	3	No
9	Timber	15	cft
10	Sand	80	cft
11	Gravel	30	cft
12	Stone	120	cft
13	Skilled labour	20	work-day
14	Unskilled labour	30	work-day

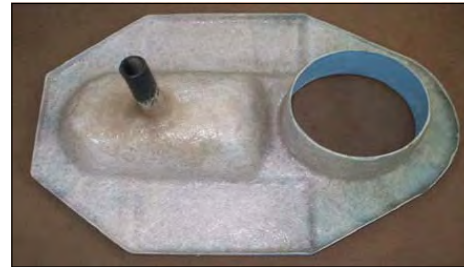
Approximate minimum cost excluding local materials and labour = Nu. 8000/-



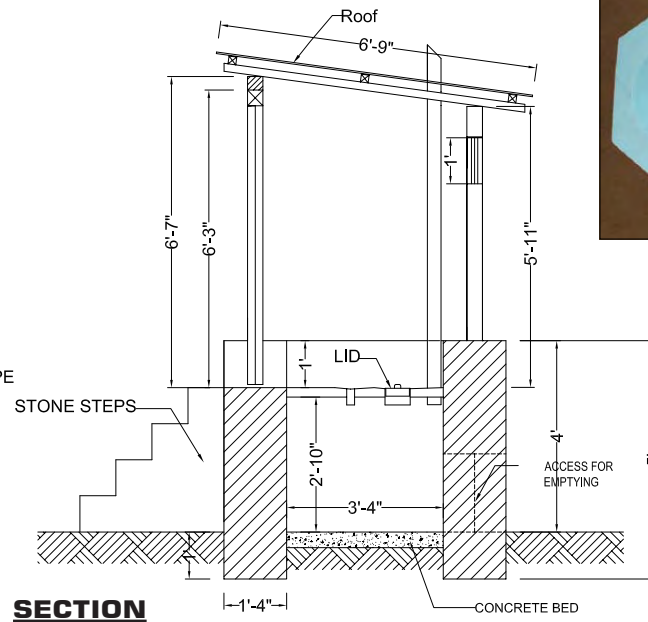
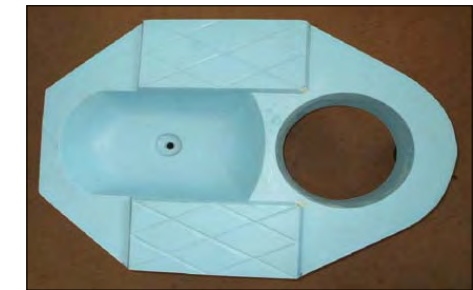
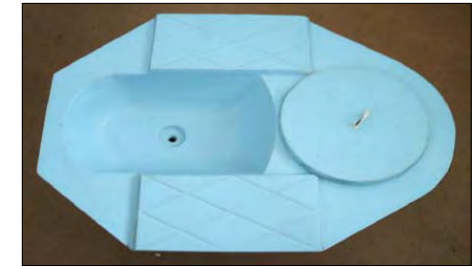
## 5.1 Double vault compost toilet with urine diversion



Scale: Not to scale



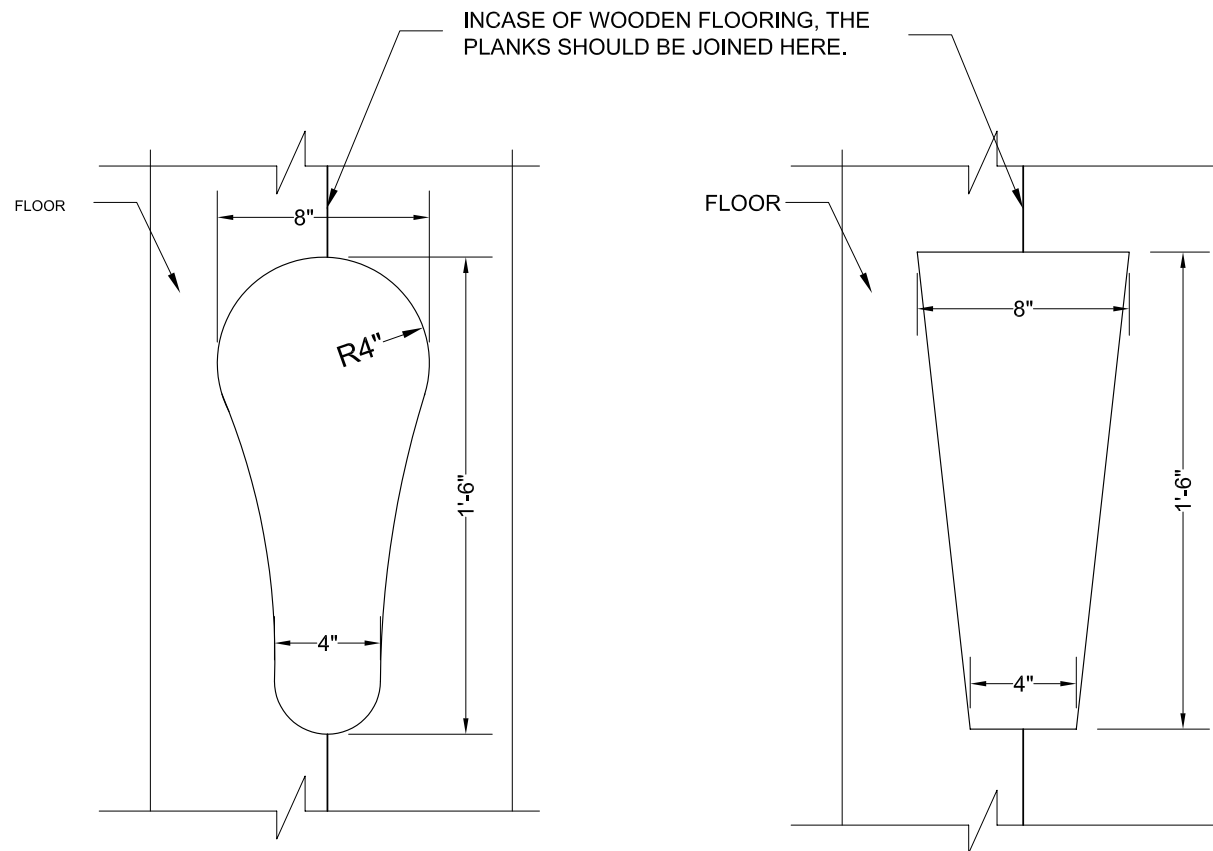
FIBRE GLASS/ GRC ECOSAN PAN WITH LID





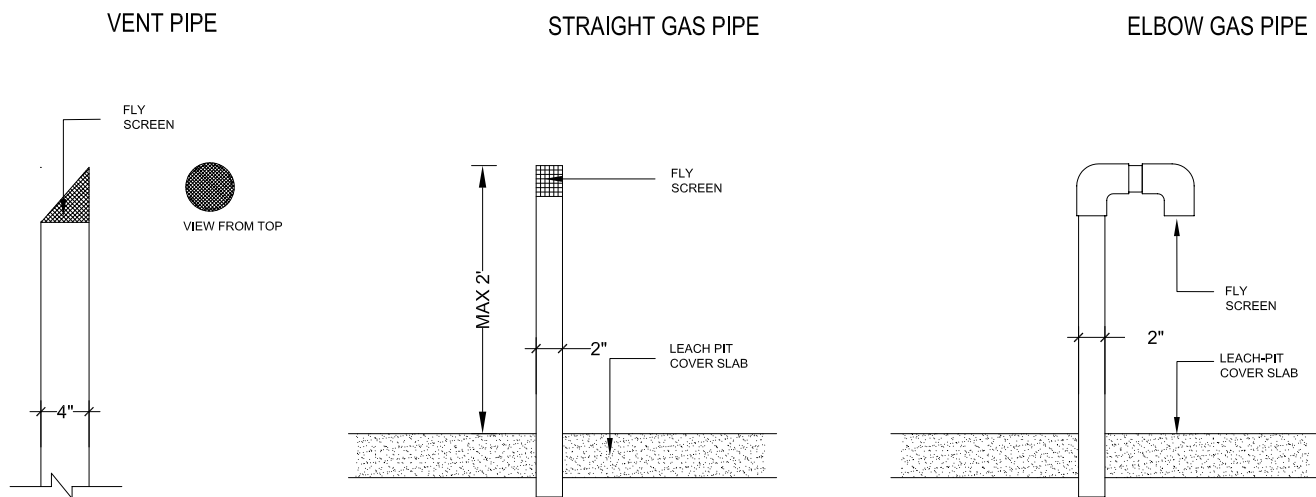
## 6. Additional technical details

### 6.1 Drop hole designs





## 6.2 Vent and gas pipes

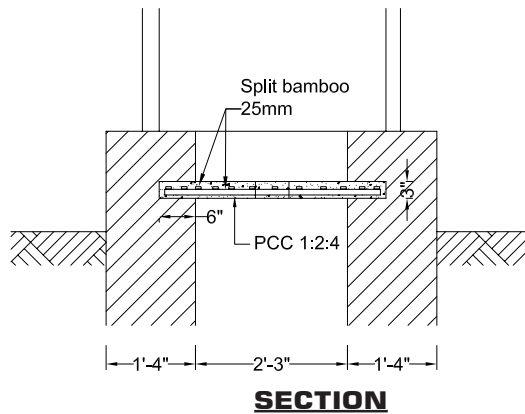
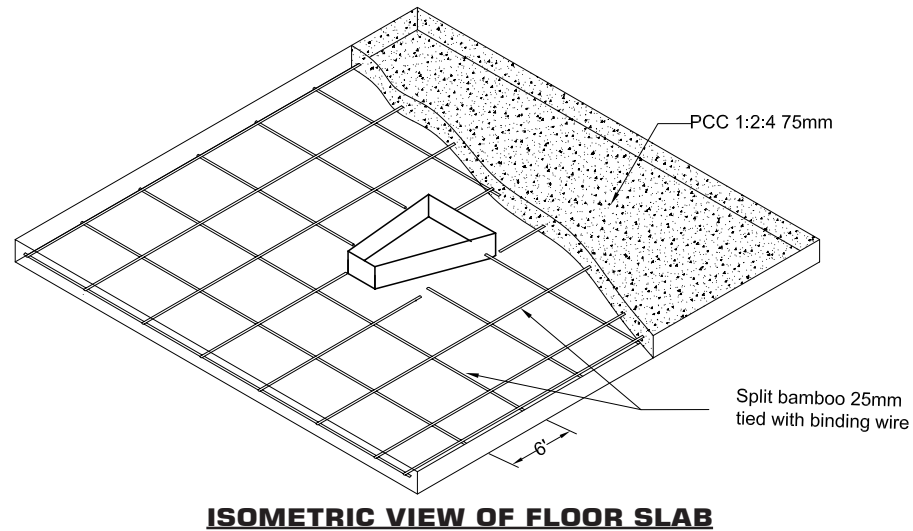
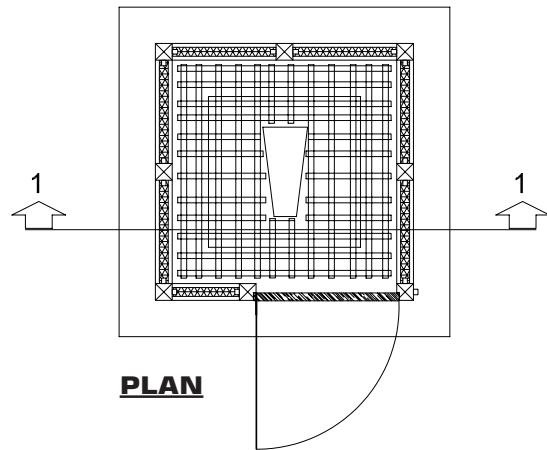


- The main purpose of having a vent pipe is for eliminating flies and smell.
- Vent pipe is fitted in direct pit toilets and it extends above the roof of the toilet.
- Vent pipe should be fitted facing direct sun light.
- The addition of a vent pipe draws air currents into the structure and through squat hole.
- The squat hole is kept open during the day, through which the air passes into the pit. During the day, the black vent pipe is heated up which sucks the bad smelling gases out of the pit. During the night, squat hole is kept closed to prevent smell coming out.
- Any flies attracted to the pit through the squat hole will try to escape by heading towards the strongest light source, which comes from the vent pipe. The exit is blocked by a wire mesh so the flies eventually die and fall back into the pit.
- Water should be poured down the vent pipe every now and then to clean spider webs.





## 6.3 Floor slab using bamboo reinforcement

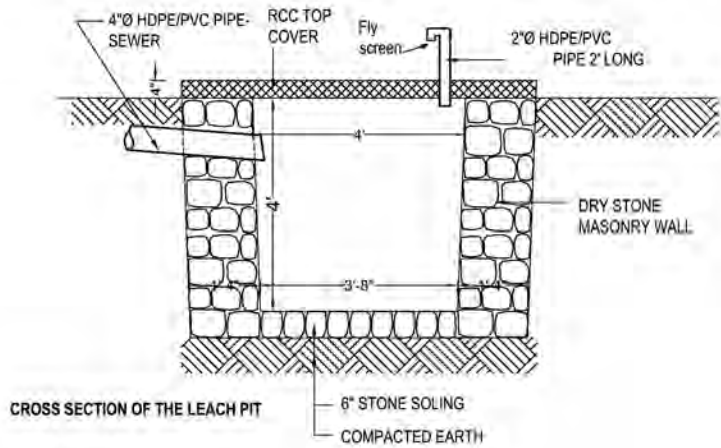


### Notes:

1. The concrete floor slab can be made cast-in-situ with plain concrete of ratio 1:2:4.
2. Bamboo can be used as reinforcement. The bamboos should be dry and split to about 25mm size and cut into required length.
3. A clear cover of 25mm should be provided all around and bottom. The thickness of slab should be at least 75mm.
4. The bamboo splits should be provided in both directions at 150mm centers, tied securely with binding wire.
5. The knots should not be smoothened which will act as anchorage.
6. A cut out of required size should be kept which will fit the toilet pan or act as excreta drop-hole.

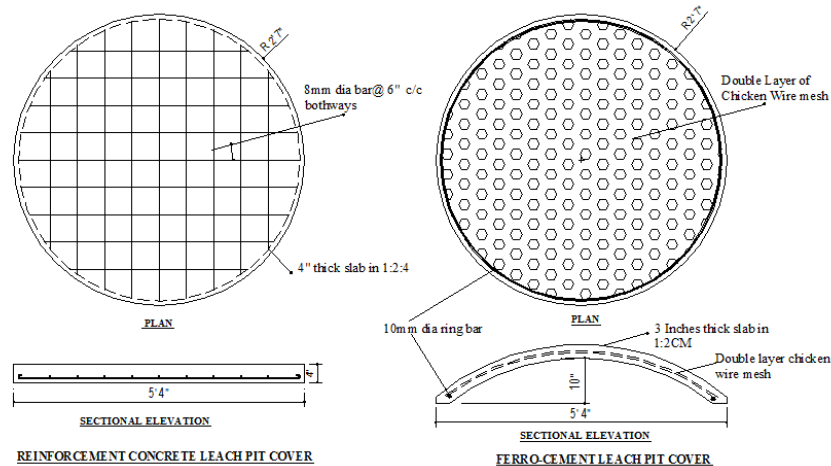


## 6.4 Leach pit and cover



Most important function of the leach pit is to sanitize the excreta by removing the pathogens and other harmful products. In the absence of water and air, the bacteria digest the excreta into compost. The other features of a leach pit are:

- To allow water and gases to escape.
- The water used for anal cleansing is absorbed by the surrounding soil.
- Only the solid parts remains and volume reduces.
- The bacteria decompose the sludge and convert it into compost.
- The gases generated during the decomposition process are also absorbed by the surrounding soil.
- After 3-5 years the used pit gets filled up. The pit is covered by top soil and sealed. Within 20-25 months, the sludge gets converted into manure or which is safe for human handling and can be used in kitchen garden and fields if desired.





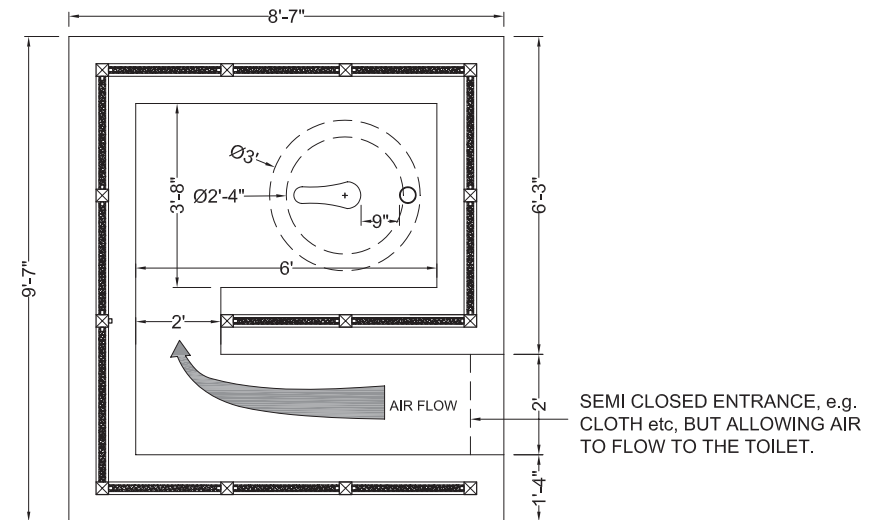
## 6.5 G-shaped/Spiral Plan



The recommended G-shape or spiral structure of the toilet prevents too much light entering the toilet while allowing a free flow of air.

The entrance must face the prevailing wind direction.

The open entrance ensures air-flow into the toilet space, down through the squat hole and up the vent pipe, which helps control smell and flies in the toilet.





## 7. Disability considerations

This section on disability considerations is added here keeping in mind the importance of social inclusion and humanitarian approach to any sanitation related programme. Bhutan Building Rules 2002 Section 8 clearly states that all buildings should be accessible to those with disabilities and particularly refers to latrines. Although rural household latrines are not subject to the Building Rules, Royal Government of Bhutan has clear responsibilities in supporting the inclusion of disabled people. However, the technical details of disability considerations are beyond the scope of this handbook and are not included herein.

### For whom?

- People who are not fully mobile or may have difficulty walking or squatting.
- Other people who may have trouble using the latrine include small children or the elderly, those with poor eyesight, sick people, pregnant women or the disabled.

### What can we do?

Make the toilet easy to access and use by making SIMPLE changes in terms of:

- Reaching the latrine
- Using the latrine

### Handrails

- Handrails can be placed along the path to make the toilet easy and safe to reach, especially when it is dark or when the path is wet.
- Handrails inside the latrine can also help people who cannot see well find the pan without having to use their hands or falling in.
- Handrails inside the latrine on any of the walls can help a person balance when squatting or getting up, but they must be close enough and at the right level that they can be reached when sitting.
- Handrails on the inside or outside of the door are easier to grip than a small door handle and makes it easier to shut the door from inside.
- Handrails can be made of any material, but should be easy to clean.
- An alternative to a handrail is to provide a knotted rope tied to the ceiling which they can use to balance themselves and get up when they have finished.





## Raised seats

Raised seat is helpful for people who have trouble squatting or keeping their balance. It also helps people with stiff legs, people who cannot bend them as well as the elderly, someone who is injured, have missing limbs or people with weak legs as a result of an accident or illness such as polio. If a person has difficulty supporting themselves when seated, the stool should have a back to it and arm rests, more like a chair.

A permanent stool can be made of stones, brick or concrete. If it has a lip around the top edge, this will help excreta to fall straight into the pan.

If the stool is made of cement or concrete this may be difficult to clean compared with ceramic tile. If possible paint the concrete to stop it absorbing water and urine and making it easier to clean.

A removable stool can be a wooden chair or stool, or a plastic or metal stool with a hole cut in it or it can be a purpose made stool of two planks slightly apart making the gap.

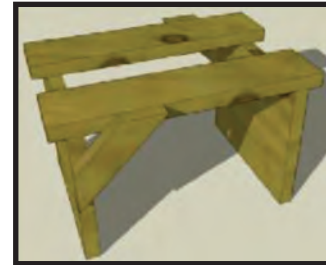
Removable stools need to be light so that the user can move them into place, but also stable so they do not slip or slide when sat on.

If the stool is made from a single wooden plank you can cut a slot at the front which allows a person to wash themselves after defecating without having to get up.

Alternatively a plastic toilet seat can be fixed on wooden legs which will be easier to clean, but the hole may be too big for a child or someone who is skinny.

If the person is not too heavy, you can cut a hole in the bottom of an upturned bucket which can be sat on.

The legs of the stool should be wide enough so it clearly fits over the pan. To make it more stable the legs should be connected together to stop them spreading when sat on. A wooden removable stool should be painted or varnished if possible to make it easier to clean.







### Entrance and door adjustments

For people who are not very mobile, it can sometimes be difficult to get through a narrow door or close the door once they are inside. Doorways should be at least 100cm wide if catering for wheelchairs or people using crutches or other supports.

The recommended spiral or 'G' shaped toilet arrangement does not require a solid door which makes it easy for people who cannot grip well or are not strong enough to close a heavy door. Spiral shaped latrines also do not require the user to turn around to use the latrine. They can just walk in as long as you remember to turn the pan around.

If privacy is required a light cloth or plastic sheet door hanging can be installed which can be used by children and the elderly alike.

If a solid door is preferred strips of car tyre can be used to make the door hinge which act as a spring to shut the door after it has been opened. This is useful as it means you don't need to touch the door after you've finished using the latrine.

If none of these is suitable, a rope attached to the corner of the door and run through some loops in the wall or roof can allow the door to be pulled shut from inside.

### Anal cleansing materials

For people who are not mobile, it is important that their anal cleansing materials are readily available inside the cubicle. This is also true for people who are sick, particularly with diarrhoea or other stomach problems. Water, paper, sticks or leaves should be stored permanently inside the toilet and refilled each day. This can be done at the same time as the hand washing water is filled up.

### Larger cubicle

To allow for handrails, permanent or removable stools and space for people to turn or clean themselves, it is likely that the cubicle will need to be a little bigger than for an able bodied person. If the person needs the help of someone else you need to make the latrine bigger to accommodate both of them.

For people who have difficulty bending their legs, you may also need to make the cubicle bigger so that the door can still be closed if they sit with their legs straight. Older people, small children or someone using crutches or a stick may not like to straddle the pan when turning around as they are afraid to fall in or slip.

Having the latrine in the corner rather than the middle of the latrine may help them. They can turn around away from the pan and as it is in the corner the person can use the walls for balance.

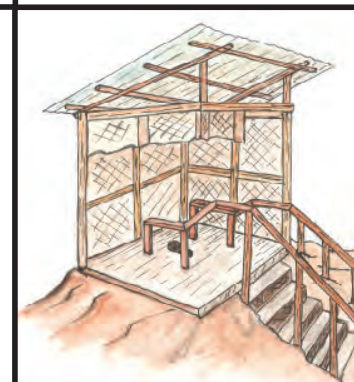
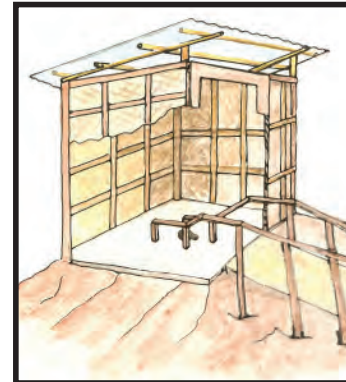
### Simple adaptations for Children

- Guide rope or handrail to the latrine enables children to go by themselves
- Handrails inside the latrine will give children something to hold onto
- A raised stool with a smaller hole can be used by children to place over the pan. The legs of the stool should be wide enough to clearly span the hole. If they are afraid about falling in this can help a lot.
- Locate toilet closer



### Access to the latrine

- For older people or anyone who has trouble walking, it is important that they feel safe getting to the latrine. Walkways and ramps must not be too steep. If a ramp is provided for wheelchair users it should be wide enough and there should be a flat section outside the door so people can stop and open the door and also at the bottom of the ramp.
- Ramps can be made of wood if the earth is likely to get muddy or unstable, but they should be well secured to prevent them tipping over or falling off their supports. A footpath will also help them find it, made of stones or gravel and stops the path getting muddy.
- The door should open outwards unless space is provided inside to enable the door to be shut.
- If a ramp is not possible and steps are needed, try and make sure all the steps are the same height. Provide a handrail as well to help people use the steps.
- Where a person is totally unable to go outside and space allows, we can use the traditional Bhutanese long drop. This places the latrine inside the house on the upper level.
- The floorboards around the pan must be well fitted and varnished if possible to stop the wood from rotting. A cement plaster can be applied around the squatting pan to enable the floor to be kept clean. Water for cleansing and hand washing must be maintained in the house.





## Annex 1. Source of useful information/references

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- 2. Ecological Sanitation.** Revised and enlarged edition 2004. Uno Winbald and Mayling Simpson Hebert. Stockholm Environment Institute
- 3. Rural Sanitation Technology Study.** Anthony Waterkeyn, December 2008. SNV Bhutan with Public Health Engineering Division, Ministry of Health, Royal Government of Bhutan
- 4. The Composting Toilet System Book.** Version 1.2 Updated. A practical guide to choosing, planning and maintaining composting toilet systems, a water-saving, pollution preventing alternative. David Del Porto and Carol Steinfeld. Published by: The Center for Ecological Pollution Prevention (CEPP), 2000
- 5. Smart Sanitation Solutions.** Examples of innovative, low cost technologies for toilets, collection, transportation, treatment and use of sanitation products. NWP, Netherlands Water Partnership, 2006



- 6. Compendium of Sanitation Systems and Technologies.** Elizabeth Tilley, Christoph Luthi, Antoine Morel, Chris Zurbrugg, Roland Schertenleib. WSSCC and EAWAG, 2008
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- 9. How to Build a Simple Pit Latrine,** PHES, Public Works Division. Royal Government of Bhutan
- 10. Technical Guideline for Latrine of Differently Abled People.** WaterAid Bangladesh, March 2009