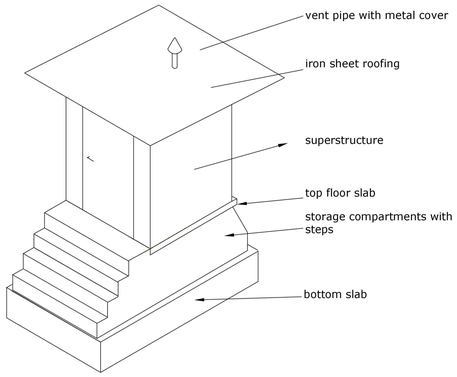
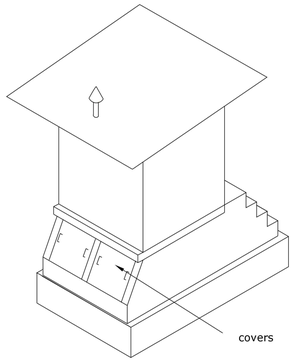
How to build an Ecosan Latrine "Flower toilet model"





Introduction

A Urine Diversion Dry Toilet (UDDT) is an ecological sanitation latrine in which the urine and excreta are separated.
During its use the faeces fall into storage compartments under the slab with the defecation holes,
while the urine is discharged separately by a pipe connected to a reservoir or jerry can. Flies and odours are controlled by regularly adding ash and soil to the faecal matter stored in the compartments.
The heat of the sun dries the faecal matter in the compartments, making it easier to handle and transport.
The urine, that is stored in the jerry cans, and the dried faecal matter are used as fertilizer in agricultural crops.

The Urine Diversion Dry Toilets have the following advantages:

- They are easy to maintain and relatively odourless;
- They do not pollute the environment or the water table if properly designed;
- They must not be moved when they are full;
- They do not consume water;
- They do not require digging deep pits;
- They can be built anywhere;
- Urine and faecal matter can be used as manure for crops.

However, these latrines are relatively expensive compared to pit latrines.
They are most appropriate in areas where:

- There is a shortage of land, so it is impossible to dig a new pit when the pit is full;
- The water table is high with a risk of contamination the groundwater by the excreta;
- The soils are rocky, making it almost impossible to dig pits;
- The soils are very soft and the pits collapse easily.

Preface

The purpose of this manual is to describe in detail the various stages of the construction of an Urine Diversion Dry Toilet. It is intended for masons who wish to build such a latrine. The proposed model is the one built by JESE and Protos in the village of Kayinja in Uganda. This latrine was developed taking into account the contribution of the villagers of Kayinja. The objective was to design a latrine adapted to local conditions (shallow water table, soft soil, ...) and at a low cost. The "Flower toilets" built in Kayinja cost 2,275,000 Ugandan shilling or 600 €. One part was paid by the villagers (130 €), the rest was subsidized by the project of JESE and Protos.

The latrines are called "Flower Toilets". They were promoted using a social marketing approach, and this name supported the positive image of the toilets.

The proposed latrine allows anal cleansing with water. It is provided with a pipe that collects the water used for this purpose. In situations where toilet paper is used, for example, it is not necessary to install this pipe.

How to make a good quality concrete?

Quality of the gravel

The gravel should be hard. The granulates should not exceed a thickness of 25 mm.
They must be sharp-edged and not rounded They should be clean and free from dirt and soil.

Quality of the sand

The ideal is river sand, but other types of sand can also be used.
The sand must be clean and free from leaves or other impurities.

Quality of the water

The water must be clean. Salt water is not appropriate.

Procedure

Clean the surface where the concrete will be mixed.
Use a mixture of 1 wheelbarrow of 1 cement, 2 wheelbarrows of sand and 3 wheelbarrows of gravel. Before loading the wheelbarrow with the sand, sieve it.
The surface of the sand, cement or gravel in the wheelbarrow must be flat and level with the top of the wheelbarrow.

Mix 2 wheelbarrows of sand with 1 wheelbarrow of cement.
Turn the mix until the colour of the sand-cement becomes uniform.
Usually this happens after a minimum of three turns. Always mix from the bottom up.

Spread the sand-cement mixture on the surface and spread on top of it 4 wheelbarrows of gravel.
Add water, but not too much, and mix.
A concrete that contains too much water is twice as fragile as a well-proportioned concrete.
Ensure that the concrete mix is always used within 30 minutes from the moment of the addition of the water.

How to test if the concrete mixture contains the right amount of water ?

Test the concrete mixture to know if there is enough water by using a shovel to make ridges in the concrete.
If the mixture is too dry, you will not be able to make distinct ridges. If the mixture contains too much water, the ridges will not be able to maintain their shape and you may notice water seeping out from the pile.
In a good mix, the ridges will hold most of their shape.

Stage 1 : Siting and construction of the bottom slab

Choice of the site

Identify a suitable place to build the latrine.
The site for the latrine should be chosen according to the following factors:

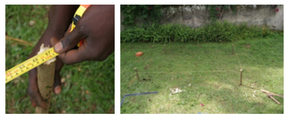
- The location has been decided according to the preference of the owner.
- Water logging/collection should not occur at the site.
- The location should be relatively flat and in case of a sloping site, ensure that the site is levelled before construction.
- The site for the latrine should receive a lot of sunshine. The storage compartment doors should be positioned in such a way that they are exposed to the sun and away from the direction of the wind.

Preparation of the site

Clear the site of any bushes and thickets.

Drive demarcation pegs into the ground using a hammer in an excavation area of 3.00 m by 1.90 m.

Ensure that the pegs are at a right angles to each other by tying a builder's line around the pegs and comparting the angle the rope makes at the peg with a 90° construction square.



Excavation of the foundation

Demarcate the boundaries of the excavation area on the ground following the length of the builder's line. Remove the soft soil / vegetation soil form the excavation area to a depth of 15 cm. In case of a raised or sloping ground, dig and level a horizontal space in the hill for the latrine.

Load the excavated soil on a wheelbarrow and deposit it at a suitable location away from the site area.

Laying the hard core stones and sand blinding

Fill the excavated area with 9.5 wheelbarrows of medium sized hard-core stones.

Compact and level the hard-core. These stones must be flat with the top of the excavated area.

Deposit 3.5 wheelbarrows of river sand on top of the hard core and spread it to form al 5 cm sand blinding layer.

Compact and level the sand blinding.

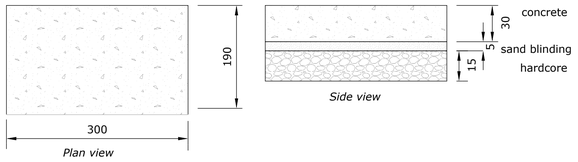
Casting concrete for the bottom slab

Lay the polythene sheet on top the sand blinding layer.
Make and place the formwork box for the bottom slab on top of the polythene sheet.
The formwork box should be a rectangle and have inner dimensions of 3.0 m by 1.90 m, and a height of 30 cm.

Pour the concrete up to a height of 30 cm.
Spread the concrete in the formwork with shovels or trowels.

The concrete must penetrate everywhere.
Tamp the concrete to remove air voids.

Finish the surface of the bottom slab with a wood float and then a steel float before the concrete hardens.
During the rainy season, cover the slab to protect it from rain.
Cure the concrete slabs for a period of 2 days by wetting the surface at least 3 times a day.
In a warm and dry climate, it may be necessary to wet the slab for a longer time. Cover the surface of the concrete to prevent it from losing a lot of moisture.
The concrete must nog dry too quickly.
Remove the formwork after two days.



Stage 2 : Construction of the storage compartments and the steps

Layout of the brickwork for the storage compartments and the steps

Remove the timber formwork from the bottom slab after 2 days.

Set out the exterior dimensions of the storage compartments and the staircase on the bottom slab.

There is a distance of 5 cm between the edges of the bottom slab and the outer walls of the storage compartments.

Preparation of the mortar

As with the concrete, the quality of the sand, cement and water is very important. Use a fine sand and sieve it.
Use a mixture of cement and sand with the following: 1 wheelbarrow of cement to 3 wheelbarrows of sand.
Pour the entire sand onto the floor and then the entire cement.
With a shovel, lift the sand from below on the cement heap.

Mix well and when the colour of the sand-cement mixture becomes uniform, add water in small quantities.
Do not add too much water, because the mortar will become too thin and unusable.

Masonry of walls and stairs

Raise the walls of the storage compartments and stairs.
The walls have a thickness of about 15 cm. This thickness may vary according to the bricks available, but may not be less than 15 cm.
Lay polyethylene paper underneath the first course of bricks.
In this way, you avoid bricks absorbing water from the soil.
Place hoop iron after each three courses of bricks.

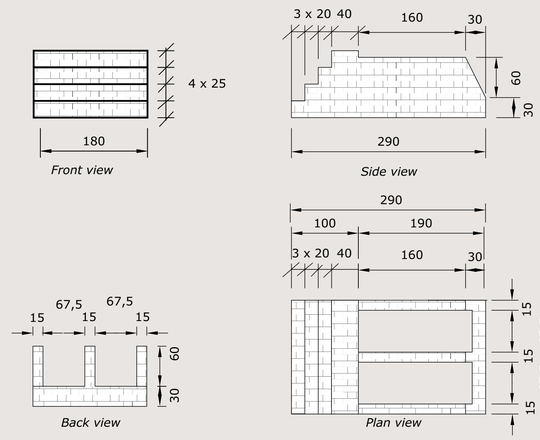
All the walls of the compartments have a height of 90 cm except the back wall which has a height of 30 cm.
This wall will serve as the base for the covers of the storage compartments.
The side walls of the compartments will be constructed with a slope to allow the covers to rest at an inclined angle at the back of the toilet.

The bricks for the walls of the compartments should be laid in stretcher bond while those for the steps should be laid in header bond.
The steps are completely made of masonry.
Allow two days for this brick work to set and gain strength before continuing.

Plastering the inside of the compartments

Use a cement-sand mixture ration of 1 quantity of cement and 3 quantities of sand.
Mix the cement and sand with water.
Apply this mortar to the inside walls of the compartments. Finish the plaster with a wooden float.

Mix cement with water to form a cement paste.
Apply this paste on the wet plaster with a steel float to give the walls of the compartments a smooth finish.

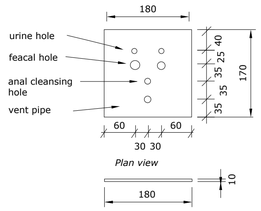


Stage 3 : Casting of the top floor slab

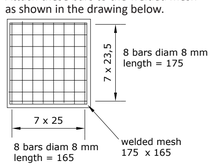
Putting the formwork and the reinforcement

Prepare a wooden formwork to hold the upper reinforced concrete slab (1.70 m long by 1.80 m wide and 0.10 m deep). The formwork consists of planks of a length of 1.70 m and 1.85 m which are sufficiently supported to remain immobile when the concrete is poured. The upper side of the planks is flush with the upper side of the compartment walls. The formwork will slightly protrude over the covers of the storage compartments. This protrusion is for preventing rainwater from entering into the storage compartments. On the walls and planks, a rectangular formwork of 1.70 m by 1.80 m (interior dimensions) is placed and with a height of 10 cm. The timber of the bottom slab formwork can be reused.

Place the pipes to create holes for the vent pipe, urine holes and faecal holes, and possibly a hole for anal cleansing according to the plan below.



Place welded mesh on stones 3 cm in size on the formwork. Cut eight pieces of iron bar 1.75 m long and eight pieces of iron bar 1.65 m long. Attach these bars to the welded mesh as shown in the drawing below.



Casting of the concrete

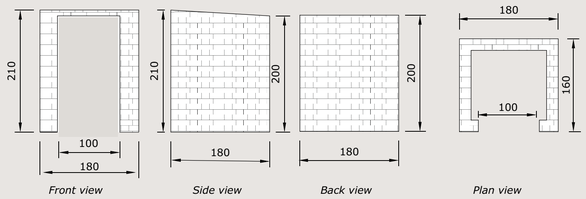
Mix and cast the concrete as described for the bottom slab. Keep the slab wet and allow two days for the slab to rest before continuing with the superstructure. Wait 7 days before removing the formwork.

Stage 4 : Construction of the superstructure

Set out the brick work for the superstructure walls on top of the slab (1.80 m by 1.60 m). Prepare the mortar, as described here above, in a cement-sand mixture ration of 1 quantity of cement and 3 quantities of sand. Raise the walls in bricks to a height of 2 m at the back at 2,1 m at the front. Place hoop iron after each three courses of bricks.

The bricks should be laid in stretcher bond.

Ensure that the walls are straight using a plumb bob and a water level.
Make a scaffold to enable you to build up the wall to the required height.

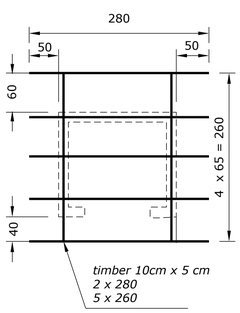


Stage 5 : Roofing

One day after the finalization of the superstructure, one can start with the roof.

Cut 5 pieces of 10 cm by 5 cm timber into length of 2.80 m,
and 2 pieces of 10 cm by 5 cm timber into length of 2.60 m.

Fasten them to the superstructure of the latrine using hoop iron.
Make sure to leave a 0.40 m overhang at the front and 0.60 m at the rear, and a 0.50 m overhang at the sides.



Cut three iron sheets to a length of 2.60 m.
Lay the cut sheets on the timber ensuring that the ends are on a line.
Also make sure the sheets overlap by 5 cm.
Use roofing nails to fasten the iron sheets.

Stage 6 : Installing the urine and anal cleansing pipes

The choice of installing a pipe for anal cleaning with water depends on the preferences of the users of the latrine. In the case where the users do not use water to clean, it is not necessary to Install this pipe.

Chisel a hole through the outside compartment wall, and through the partition wall between the two compartments, where the urine pipe is going to pass.

Connect a 40 cm and 50 cm long 2" pipes to the two vertical urine drain pipes in the upper slab using a bend and a Tee. Make sure the pipes have a slope of at least 2 cm to ensure that the urine flows to the collection container. After obtaining a gradient, connect the pipes together using PVC glue.

In the case of anal cleansing with water, do the same for the drain of the anal cleansing water.

Chisel a hole in the wall between the two compartments and insert a 50 mm pipe with an L-bend. Connect a pipe to the L-bend. Make a hole in the outside wall. Pass a 50 mm pipe through this hole and connect to the L-bend. Make sure the pipe has a slope of 2 cm.

Fill the openings in the walls around the pipes with mortar.

Stage 7 : Construction of the soak pit

(only in case of anal cleansing with water)

Dig a soak pit 1 meter away from the latrine. The pit should have a diameter of 0.50 meter and should be 1 meter deep. Put one wheelbarrow of gravel at the bottom of the pit, and then 1 wheelbarrow of hard core stones.

On the outside of the latrine, connect a 2" T to the anal cleansing drain pipe.
Extend this pipe up to the soak pit. Ensure that the effluent pipe drains in the middle of the soak pipe and is at least 30 cm below the surface of the ground.

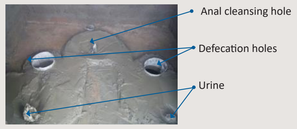
Fill the pit with 1 wheelbarrows of hard core stones up to a height of 10 cm below the surface.
Ensure that the stones do not block the pipe. Place a sisal bag on top of the stones and cover it with soil.

Stage 8 : Plastering the inside and outside of the superstructure and steps

Prepare a sand-cement mix (mortar) of a ration 1 quantity of cement : 3 quantities of sand.
Apply this mortar to the inside and outside walls of the superstructure, and to the outside walls of the compartments.
Use a wood float to finish the surfaces.

Stage 9 : Shaping the defecation holes, the urine hole and the hole for anal cleansing

Prepare a rather dry mortar mix (1 quantity of cement and 3 quantities of sand).
Apply this mortar on the top floor slab to shape the defecation hole, the urine hole and the hole for the anal cleansing (if needed).
Finish the inside surface of the toilet by creating a slope towards the urine hole and the anal cleansing hole.



Stage 10 : Casting of the covers of the storage compartments

Prepare a rectangular wooden formwork to cast the reinforced concrete covers, with interior dimensions:

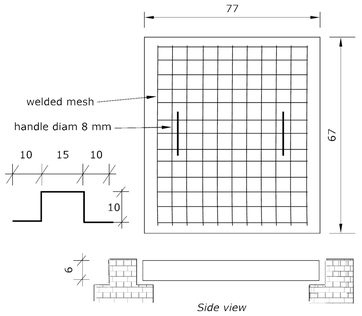
- Length 67 cm
- Width 77 cm
- Height 6 cm

It is advisable to check the openings in the compartments and, if necessary, to adapt the dimensions of the covers according to the actual dimensions of the openings.

Place the formwork on flat levelled ground.
If necessary, level the area. The place must be out of the sun.
Place a polyethylene paper in the formwork.

Prepare the reinforcement for the covers made of welded mesh. Include stirrups,
made of an iron bar, that will serve as a handle. Prepare the concrete as described above (mix of 1 quantity of cement, 2 quantities of sand and 3 quantities of gravel).
Spread the concrete in the form with a trowel and tamp it to remove air voids.

Leave the covers to dry for seven days.
Cure them regularly by addition of water.



Stage 11 : Final finishes

The finishing work consists of:

- installing the ventilation pipe and installing the metal cover 90 mm with fly trap;
- sealing the vent pipe connection with the iron sheet;
- inserting a pipe into the T of the urine drain pipe, so that it drains the liquid into a jerry can placed underneath that pipe, and placing the jerry can;
- place the covers on the compartments;
- install the metal door (you can choose wooden doors as an alternative, but these doors are often damaged by climate, insects, etc. and are therefore not sustainable).

Tool list

- trowel
- steel float
- wooden float
- shovel and/or spade
- hoe
- hack saw
- bow saw
- chisel
- plumb bob
- water level
- wheelbarrow
- tape measure
- sand sieve
- hammer
- paint brush
- 90° construction square
- bucket
- builder's line

Materials


Burnt bricks

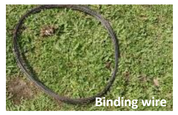

Hard core medium size


Gravel


River sand


Hoop iron


Polythene paper


Binding wire


Cement


10 cm x 5 cm timber


30 cm x 2,5 cm timber


Iron sheets


Welded mesh


50 mm PVC Tee

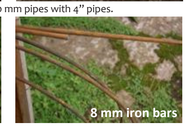

50 mm PVC plugs

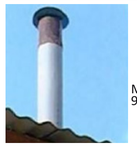

50 mm PVC bend

The 50 mm pipes can be replaced with 2 "pipes and the 90 mm pipes with 4" pipes.

PVC glue


50 mm and 90 mm PVC pipe


8 mm iron bars



Metal rainstopper
90 mm with ventilation and flyscreen

Roofing nails

Summary of materials — Quantity

Summary of materials	Quantity
Hard core stones medium size	± 9.5 wheelbarrows
Cement	26 bags
Sand	± 31 wheelbarrows
Gravel	± 18 wheelbarrows
Polythene sheet, width 2.00 m	3 m
Welded mesh, 1.55 m by 1.75 m	1 piece
Welded mesh, 0.62 m by 0.72 m	2 pieces
8 mm iron bar, length 1.65 m	8 pieces
8 mm iron bar, length 1.75 m	8 pieces
8 mm iron bar, length 0.65 m	4 pieces
Binding wire	1 kg
Bricks	± 1,160 pieces
Hoop iron	68 m
Timber 30 cm x 2.5 cm, length 1.95 m	2 pieces
Timber 30 cm x 2.5 cm, length 3.00 m	2 pieces
Timber 10 cm x 2.5 cm, length 1.85 m	2 pieces
Timber 10 cm x 2.5 cm, length 1.60 m	2 pieces
Timber 6 cm x 2.5 cm, length 0.77 m	4 pieces
Timber 6 cm x 2.5 cm, length 0.72 m	4 pieces
Poles to support the formwork, length 0.90 m	8
PVC Tee 50 mm	4 pieces
PVC Bend 50 mm	4 pieces
PVC Pipe 50 mm	5.0 m
PVC Pipe 90 mm	3.0 m
PVC glue	1 tin
PVC plug 50mm	2 pieces
Metal door	1 piece
Iron sheet (2.60 m x 0.90 m)	3 sheets
Roofing nails	45 pieces
Timber 10 cm x 5 cm, length 2.60 m	5 pieces
Timber 10 cm x 5 cm, length 2.80 m	2 pieces
Metal rain stopper 90 mm	1 piece
Nails 4 inch (12 cm)	2 kg

protos
it all begins with water

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