

The Arborloo book for Ethiopia

*How to make a simple pit toilet
and grow trees and vegetables*



*Written by Peter Morgan
with thanks to all those who made this work possible
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Introduction

Most of the rural population of Ethiopia do not have access to safe and reliable toilets. A good toilet, together with a safe reliable water supply and the practice of good personal hygiene and hand washing can do much to improve personal and family health and wellbeing.

So there is an urgent need for the construction of simple, low cost, affordable toilets that are easy to build and maintain and are relatively free of odours and flies.

This booklet describes how to make a toilet which is both low cost and easy to make. Builders and artisans are not required, once the householder has learned the basic methods of construction.

To start all that is required is 5 litres of cement (one eighth of a 50kg bag of cement) and some good river sand and 2mm wire. With this the householder can build a concrete slab 0.8m across which will last for many years. The slab is mounted on a “ring beam” of rocks bound by soil impregnated by grass reinforcing. A simple structure for privacy, made from locally available materials, is then built around the slab.

Flies and odours are controlled by regularly adding soil, wood ash and leaves into the shallow pit. By adding the soil, ash and leaves, the excreta in the pit turns into compost faster. When the pit is nearly full, soil is added to cover the compost and a tree is planted in the soil. This will later form fruit or supply timber for fuel or building. Pumpkins and other valuable food crops can be grown in the soil added to the pit. So the simple toilet has value, even after it is filled up.

This particular toilet is called an Arborloo because a tree is planted on the filled pit. The Arborloo is then moved to a new place.

Over the years it is possible to improve on the original toilet using the same concrete slab. It is a small amount to pay for something that gives so much benefit to the family.

*The **Arborloo** is the name given to this simple pit toilet.*

It is easy to construct & is cheap to build.

*The **Arborloo** is made up from 4 parts:*

- 1. The **pit***
- 2. The “**ring beam**” to protect the pit*
- 3. The **concrete slab** which sits on the ring beam*
- 4. The **toilet house** which surrounds the slab.*

*The **Arborloo** pit fills up with a mix of excreta, soil, wood ash and leaves.*

Leaves are put in the base of the pit before use and every day some soil and wood ash are added to the pit.

Dry leaves are also added to the pit from time to time. When soil, ash and leaves are added to excreta, it changes quite fast into compost. The daily addition of soil and ash also helps to control flies and smells. The more ash the greater the control.

*When the **Arborloo** pit is full, the toilet is moved to another place and a thick layer of soil is placed over the pit contents*

A young tree is planted in this soil and is watered and cared for and also protected against animals. The tree is best planted during the rainy season.

The slab and structure are moved to a new site once the pit is full and the simple toilet built again and used in the same way.

After some years trees will be growing where the toilet was before. A new orchard of fruit trees or a woodlot of gum trees will be growing, using the compost formed from the excreta.

In this way the excreta is recycled!

HOW TO BUILD THE ARBORLOO

1. How to make the concrete slab

The concrete slab is made with a mixture of cement and good quality river sand with some wire reinforcing. Slabs can be made in several shapes and sizes. Round slabs are best to fit over round holes. The slabs may be 0.8m, 1.0m or 1.2m in diameter. These can fit over holes 0.6m, 0.8m or 1.0m in diameter. The pit is usually about 1m deep.

The mould for the concrete slab can be made in several ways. Tin sheet or bricks can be used as a mould. But in Ethiopia a good method is to cut a shallow hole in the ground, 10cm deep. In the case of the 80cm slab the hole is dug 80cm wide and 10cm deep. The sides of the hole are made straight and the base made flat. The base of the hole is then levelled and a layer of sand is laid over it.



Wires are also cut. The wire can be 2mm or 2.5mm thick. 4 wires are cut to 0.7m and 4 to 0.6m. A frame for the squat hole is then made of wood. This is 20cm by 15cm. These parts are placed in the hole to test for size as shown in the photos.



The frame is placed in the centre and wire as shown.

Mixing the concrete.

The concrete is made by mixing cement (Portland) and good river sand together. The mix is 4 parts river sand to 1 part cement. It is possible also to make strong concrete with a 5:1 mix.

In the case of the 0.8m diameter slab, 5 litres of cement are mixed with 20 litres river sand. (total 25 litres).

In the case of a 1.0m diameter slab, 7 litres cement are mixed with 30 litres river sand. (total 37 litres.)

In the case of the 1.2m diameter slab 12 litres cement are mixed with 50 litres cement. (total 62 litres)

If gravel or stones are available these can be added to the sand and cement. This saves on the use of cement. In the case of the 0.8m slab the mix will be 3 litres of cement with 9 litres of sand and 12 litres of gravel. (total 24 litres). For a 1.0m slab 5 litres of cement can be mixed with 15 litres river sand and 20 litres gravel. So if gravel is available it can save on the amount (and cost) of cement.

The amounts of cement, sand and gravel can be measured exactly in a one litre tin or jug.

The ingredients are thoroughly mixed together first and then water is added to make a thick slurry mixture. This must not have too much water to make it loose. But it must have enough water to make the concrete stick together when made into a ball in the hand.



Mixing the concrete and cutting the wire

When the concrete has been thoroughly mixed it is divided into two equal parts.

Half the mix is added to the base of the mould and levelled off. This is placed around the squat hole frame. Then the wires are added two in each direction if 2mm wire is used. Finally the second half of the concrete is added and smoothed down.



The wooden squat hole frame is removed and the edges of the hole are made neat with a trowel. Wire handles can be added, but with small slabs they are unnecessary. The slab is made neat and smooth using the steel trowel.



CURING

It is important to cure the concrete so it becomes strong. The slab should be covered with paper and left overnight to harden. It is then watered down 3 times a day to keep it wet. It is best kept wet for 7 days before lifting. The longer the curing time (keeping wet) the stronger the slab will be. The slab can be lifted out of the hole with a pole and carried to the site where the toilet is being built.

Digging the pit

The site for the pit must be on slightly raised ground if possible to avoid flooding during the rains. It should be 30m from a well.

The pit is dug 20cm less in diameter than the slab. The 80cm slab will fit over a 60cm diameter pit. The 1.0m diameter slab will fit over a 80cm pit and a 1.2m diameter slab will fit over a 1m diameter pit.

Most pits for the Arborloo are dug down to one metre deep. It is possible to make pits shallower or even deeper. 1.5m is normally a maximum depth for these ecological pits.

The pit diameter must be measured very accurately. The walls must be dug down straight. A combination of local tools can be used to dig the pit.



The larger the diameter of the hole and the deeper the pit, the longer the pit will last. Some people may prefer smaller holes if they want to plant more trees, but this means moving the slab and “toilet house” more often. The larger the pit is, the longer it will take to fill up and moving the slab and house does not need to take place so often.

Pit volumes (for one metre deep pits)

<i>Slab diameter</i>	<i>Pit diameter</i>	<i>Pit volume</i>
<i>0.8m</i>	<i>0.6m</i>	<i>280 litres</i>
<i>1.0m</i>	<i>0.8m</i>	<i>500 litres</i>
<i>1.2m</i>	<i>1m</i>	<i>780 litres</i>

This means a 1m diameter pit will last about three times as long as a 0.6m diameter pit. In firmer soils pits can be dug down to 1.5metres, which extends their life further.

Making the ring beam

The ring beam is a circle of material laid at the head of the pit. This helps protect the pit from collapse and raises the slab above ground level. Thus flooding is avoided during the rainy season. The ring beam can be made of bricks, concrete or a combination of stones and soil as in this case. Grass can be added as reinforcing for the mud.



The mix of mud and grass is made up and laid around the rim of the pit. Then flat stones are found and laid around the pit. These can extend for up to 30cm around the pit. The stones are bound by the soil. The reinforced soil is smoothed off ready to add the slab.



FITTING THE SLAB



The slab is then moved on to the ring beam so it is supported equally all round. It is bedded in so the slab is well supported all round. Extra mortar is made and placed around the slab.

Making the “toilet house” (5 post design)

Many types of superstructure can be made to fit over the slab. The main aim of the house is to provide privacy. But a roof can provide shade and protection from the rain.

In Ethiopia many simple structures are made by digging holes for 4 corner posts and adding the poles to each post to make a square structure. Wood ash is added to the base of the holes before the pole is added to help protect against termites.

Then additional poles are added to secure the tops of the corner posts and also poles across the top of the structure to support the roof. Once the basic poles have been put in place and the soil around the base of the hole rammed in place a 5th pole is added between the two poles on the entrance side. A door of material can then be added to one of the half section at the front of the toilet house. Walling material of varying types can then be added around the walls and on the roof to provide protection and privacy.



The corner posts being dug. Ash being added to the holes before poles inserted. Soil is rammed in the holes around posts to secure.

Termites often attack poles from the cut ends. So adding ash at the base of the post hole will help delay any attack. Mixing ash with the soil rammed around the pole may also delay termite attack. Old engine oil can also be used to reduce termite attack. This can be added to the hole or into the rammed soil.



The four corner posts are placed in holes around the slab and ring beam. Smaller poles are placed over the roof and on the side walls of the structure. Suitable traditional walling and roofing material is found and added to the structure.



The fifth post is added in between the two front posts and half of this is also filled with walling material. The opening is for the door which can be covered with a cloth hanging down from the upper beam. A simple door on rubber hinges (car tyre etc) can also be added.



The slab inside the structure. On right a structure made in Malawi.

HOW TO USE THE ARBORLOO

The Arborloo is used like a pit toilet, but soil and ash are added regularly to the pit. The slab should be kept clean and the toilet tidy.

Add soil and ash regularly to the pit - a small cup full of ash and soil after every visit to deposit faeces will be enough, but not after every visit to add urine. Sometimes add extra leaves. The ash, soil and leaves will help reduce odours and flies and also make the pit contents composting faster. Be generous with added ash and soil.

It is best not to put too much rubbish down the pit as this will make it fill up more quickly. Use the toilet until the pit is nearly full.

Wash the hands regularly with a simple hand washer.

MAKING A SIMPLE HAND WASHER



There are several types of simple hand washer. This one uses a plastic bottle. Cut the bottom off about one third up. Make a hole in one corner of the base.



Wrap some thin wire around the bottle and hook up to part of the toilet. To use the washer it can be dipped into a container of water on the ground or some water from another bottle can be added to the washer. The water comes out slowly, but it is sufficient to wash the hands. It uses water economically. It is best to use soap to wash the hands but wood ash works well too.

MOVING THE TOILET

When the pit is nearly full it is time to move the Arborloo to a new place.

Take away the house or take it apart.

Remove the concrete slab

Cover the contents of the pit with soil and level off. Then cover the contents of the pit with a thick layer (150mm deep) of good soil. This can be left to compost before tree planting which is best done during the rainy season. Or a tree can be planted immediately.

On the new site dig a new pit to the correct size (depends on slab size) Rebuild the brick ring beam around the pit.

Add the slab and rebuild the house.

Then start to use the new toilet as before.

For the old pit

The pit contents have been covered with plenty of soil

*This pit can be left to settle and wait for the rains
before planting a young tree*

OR

A young tree can be planted in the soil directly and look after it. It will require protection from animals and frequent watering.

Many types of tree will grow on these shallow organic pits including banana, mango, guava, mulberry, avocado, paw-paw, Mexican apple, various citrus (eg orange and lemon), Eucalyptus, shade trees, indigenous trees. Also Pumpkin, tomato and passion fruit will grow.

Try any tree or vegetable!

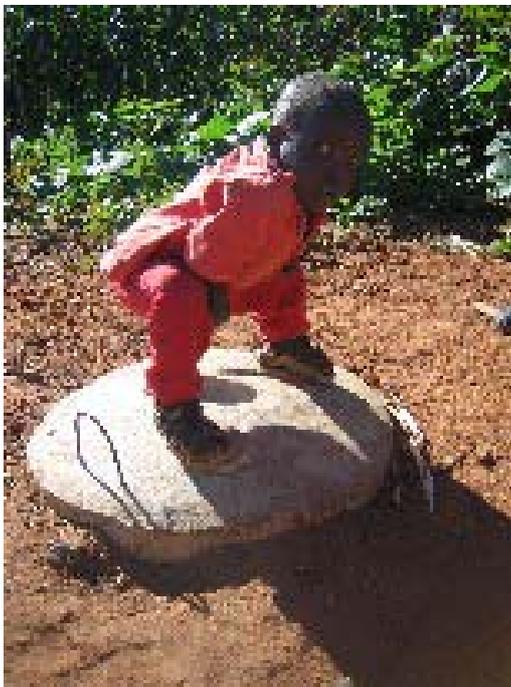
If it does not grow – try again

The Children's toilet

This idea was thought up in Malawi. It is a simple slab usually 0.6m in diameter mounted over a small shallow pit (0.4m in diameter and 0.5m deep). The toilet slab has no house structure and no ring beam and is intended for children to use in the garden. The little 0.6m diameter slab can be made with 3 litres of cement and 12 litres of river sand and some 2mm wire for reinforcing.

The benefits are many. The child learns how to use a toilet slab early in life, and this also keeps the garden cleaner. The child can also help to dig the small pit and later, when the slab is moved to another place, plant his or her own tree on the pit. It is a simple and very low cost way of introducing children to hygiene and use of the toilet.

Later the child can be proud that he or she started off the life of another tree which will grow for years and will hopefully be alive and growing when the child reaches adulthood. Many trees outlive humans. They are a legacy of earlier times, when trees have been planted for the future benefit of families and humankind.



The children's toilet – ultra low cost with significant effect.

Planting trees – wonders of Nature!



Plant the young tree in the layer of soil above the compost. The young trees must be cared for. They must be protected from animals with a cage made of thin poles and must be watered often. In time the tree will grow big and provide many fruits.

Once the tree is established it can be fed with extra compost or manure. The nutrients in the original Arborloo pit will not provide enough food for the tree as it grows larger. A mix of urine (2 litres) with water (10 litres) will help the vegetative growth of the tree. Adding a mug full of wood ash every few weeks will help fruiting.

*The Arborloo toilet will move about in the garden and will help to make many new trees. It can be used to make a new **orchard** of fruit trees or a **wood lot** of gum trees. It can also be used to make shade or ornamental trees. Vegetables like pumpkin and tomato can also be grown.*

The time to fill the Arborloo pit depends on the width and depth of the pit and the number of users. It will be between 3 and 12 months

TREES GROWING ON PITS IN ETHIOPIA



Fine avocado in Wonje



A variety of fruit trees in Wonje

Trees in other countries



Trees like orange and lemon and banana are popular in Malawi

UPGRADING THE ARBORLOO

The system which has been described is designed to be simple and low cost. The slabs and ring beams are small and are mounted over pits which have a small capacity (about 0.5 cu.m.). This is ideal for the Arborloo concept.

The ring beam concept works well on a great range of soils, but obviously it will not work in very loose sandy soils. Ring beams of this type must be used with light weight toilet houses, like poles and grass or other light materials. It is very unwise to build a brick house around a pit lined with a ring beam only. The weight of the bricks may lead to pit collapse. Pits should be fully lined with bricks if a brick structure is used. This method however will be unsuitable for the Arborloo which is moved often from one location to the other.

However once a strong concrete slab has been made, it is possible to use this on a larger brick lined pit in the future. A method known as corbelling can be used where the brickwork is stepped in around the upper courses is useful. Here a small slab can be mounted on a much wider pit. This is method is described elsewhere. Using a single bag of cement it is possible to line a wide 2m deep pit with cement mortar and fired bricks (if available) and make a 1.2m diameter concrete slab.

When pits are dug with greater capacity they take longer to fill, and thus the movement of the slab and toilet house needs to take place less often. This may be seen as an advantage to many families. Pits can be dug deeper as well as wider to increase capacity. The conversion of excreta to compost will still take place if generous amounts of soil, wood ash and leaves are placed down the pit together with excreta.



Participants on a training course!

ALTERNATING BETWEEN TWO PITS

If the pits are wider in diameter (one metre) and dug deeper (1.5 metres), a family will take a year to fill the pit, even when soil, ash and leaves are added. In this case it is possible to make two permanently sited pits and alternate between them at yearly intervals. Fertile compost can be dug out and used on the garden once a year.

*This is a system called the **Fossa alterna**.*

*A pit 1 metre in diameter and 1.5 metres deep has a capacity of just over one cubic metre, about twice the capacity of an **Arborloo** pit 0.8m in diameter and one metre deep. This capacity is ideal for the use of the **Fossa alterna**.*

*With the **Fossa alterna**, it is only necessary to dig two pits (1m diameter and 1.5m deep), and these two can be used alternately for many years on one site provided the soil is stable. Once a year the compost is dug out of one pit and the slab and toilet house placed back on the emptied pit. In some cases the two pits can be dug and enclosed inside a single permanent toilet house. However the pits are best dug a little apart to avoid cross contamination of bacteria from one pit to the other.*

Once again, plenty of dried leaves are added to the base of the pit before use. Dry soil and wood ash are added to the pit daily and leaves quite often. This mixture, together with excreta, composts well. The compost dug out of the pit can be mixed with top soils to increase its fertility and humus content. When mixed with poor soils in equal proportions the compost can increase vegetable growth considerably.

If there is any doubt about the safety of compost taken out of a pit, the compost can be directly transferred to another pit in which a tree will be planted (tree pit). This will act like an Arborloo pit.

Using the systems described here it is possible to start off in a very low cost and simple way and over the years upgrade the system to suit the needs of each family.