Teaching Ecological Sanitation in Schools

A compilation of manuals and fact sheets
(March 2010 edition)

Peter Morgan and Annie Shangwa

Table of contents

An Introduction

Education of young people is an integral part the development of all nations around the world and literacy and knowledge levels are ever on the increase. It is very clear that the school environment offers the best possible platform to become the centre of all learning and information dissemination for a wide range of disciplines, including health, hygiene and sanitation.

Firstly, the school provides a great audience platform in the sense that most families of a community are represented and the information is provided in a formalised way. The infrastructure is also quiet appropriate with chalk boards, class rooms and school gardens which are always available. In addition the pupils are always in a mode of learning and motivated. Teachers too are amongst the most motivated of all professionals. Co-operation and discipline makes the learning and dissemination process quiet efficient and effective for it provides a two way communication which enables feedback and evaluation.

The school thus offers the best possible environment for teaching pupils about sanitation in all its aspects. Toilets are needed in all schools and homes. But the practical knowledge about how to build toilets and how they work may be little known. In the world of developing Africa such a practical knowledge is all important. The new sanitation which brings with it a more ecological approach offers even greater benefits than providing just toilets alone. The possibility of using compost made from toilets and using urine to grow greater quantities of vegetables and maize and also grow a variety of trees has huge practical application within the school itself. The methods taught within the school can be replicated in surrounding communities.

We have found that children take great pride in showing their ability to build simple yet effective toilets. The pupils also take great pride in being able to show and practice how they can grow vegetables and maize in greater quantities. These personal achievements make their parents proud and involved. This pride of achievement is important to all of us. But its importance has no greater impact than in the development of the child itself.

The work which is described in this book is still being undertaken. It is not finished and there is still much to do. But the amount of information we have built up is large and useful. All these things are important in our lives and can improve the way we live. We wish to pass on what we have learned and have arranged the material in a series of manuals and fact sheets. These are preceded by a few chapters which introduce the subject. We wish to share our rich experience with others.

Above all it's the passion and love to learn you see in the pupils, which speaks lots about our hopes for the future.

Annie Shangwa
Harare
March 2010

Schools eco-sanitation in a wider context.

The ecological sanitation programme for schools described in these manuals and fact sheets reveals the early findings of a pilot study – which hopefully will lead to greater things in the future. It certainly has all the ingredients of an exciting and positive future.

Whilst this work describes how children can build toilets and how they can learn to recycle human excreta to make more food that forms just a small part of the whole story. What is important is that strong links are made between the sanitation component and many other areas of practical development and ecology.

We see direct links being made to the world of agriculture, where the use of toilet compost can enhance the quality of the soil and where the use of urine can produce spectacular increases in the yield of valuable vegetable crops and maize. These methods can be used with similar effect, not only in the school but also in homesteads in rural, peri-urban and even urban environments. The evidence for this is clear to see. The great challenge is to pass on that message so that people can understand and use the valuable technique in their own back yards. Such messages become ever more important as food becomes short and top soils deteriorate in their quality,

We can also see direct links to the tree – nature's provider of fruit, vitamins, fuel, building material, medicine, shade and beauty. The range of trees that can grow on toilet compost is endless. Exotic and indigenous alike, it will almost certainly grow and grow well if cared for. And trees have a very positive effect on our climate and environment.

Once a programme has started, planting trees of all sorts can only have a positive effect. Gum trees, bamboo, or even reeds on compost pits, will provide the timber for future toilets. As a supplier of vitamins, fruit trees can provide in abundance and once well established need little care. Think of all the mangoes that just keep providing fruit year after year. And the paw paw, mulberry, banana, guava, avocado and all the others. Then the special trees like *Moringa, Neem and Leucaena*. Nothing quite like sitting under a shade tree to see nature in all its glory. And trees help the environment and our world climate – they help to reduce erosion and desertification. Trees are indeed a treasure of Nature. They are part of our future on this precious planet of ours.

Improving diets, even in small ways like providing more vegetables and crops like tomato, pepper, onion, garlic, covo and rape together with the fruits and herbs can help people fight off infections and disease. And in this world, that's important.

Then there is the important concept of recycling, whether it be human excreta, bottles, tins or even old car tyres and sacks. The use of articles which may have been put in the garbage bin before and discarded are now being put to good use. That is an important concept. In this new world we need to recycle.

Then there is the benefit of sanitation itself –of providing a safe and effective way of isolating excreta from the open environment and containing it in such a way that the environment is protected. And as a special bonus, to turn that "waste" into something valuable and useful in the real world. In this programme, the pupils at the school have built the toilets themselves, no mean achievement and something which has developed with it a great pride in those that participated.

This programme also touches on the important subject of providing sanitation for the "girl child" at the school, where personal problems are encountered and where specialised toilets, which are private and convenient for use are urgently required.

And the benefits of personal hygiene form an important part of this story. Where the children are able and proud to make and use their own hand washing devices and show others how to make and use them in the home. That counts for much. A hand washing device made from a discarded can with three holes punched in it and fitted with a wire handle when used properly can offer immense improvements in personal hygiene. This simplest of devices can provide far reaching and most beneficial effects on health.

The concept of economy of effort and of cost is also embraced here. The imported costs of cement, for instance are low. Locally available materials and methods are used if possible to increase the indigenous ingredient and rely less on imported items. If things are relatively easy and low in cost, they save the pocket money. If there is a good return for the small investment made, then a good deal has been made.

In this programme some of the concrete toilet slabs are small yet equally effective. In one version, the children's toilet, used in the homestead, as many as ten can be made from a single 50kg bag of Portland cement. That is less than a US dollar per slab in cement. Young children can learn how to use a toilet and this can help to clean up the environment of the homestead. Such toilets can later be planted with trees or provide toilet compost. If the return is more fruit or vegetable, then that's a good deal! If Millennium Development Goals are ever to be reached in the rural areas, only low cost and effective methods can work in practice. When toilets become affordable and eagerly sought by families then we have achieved the goal of sustainability.

And there is the element of science thrown into the programme too! Special techniques are acquired and scientific principles learned. The role of different nutrients in the growth of plants and how one type of nitrogen needs to be converted into another before it can be used by plants. Vegetables and maize are weighed and measured and recorded. That is science! All these methods can later be absorbed into future curricular.

Also special skills are being taught – not least how to make and cure concrete, how to build in bricks and mortar, how to shape wood, how to use bottles, tins and plastic buckets to make useful things. These skills will always be valuable for every pupil or teacher who has been in contact with this programme.

But there is far more than that. The important roles of the “girl child” and women of all ages in this sector is vital and this programme reveals this very clearly. This programme has been based on a passing on important messages and skills from a young and talented educator to young people and their teachers who will play important roles in the future. As other studies in this area of development have revealed, the role of women in Africa is not only important but essential. This type of programme empowers women and highlights how important they are in the development of the continent as a whole.

New ideas and concepts are being learned all the time, and this project has given birth to new thoughts and developments. The school offers the best learning centre of all. What better place to form most important links between sanitation, health, hygiene, water, agriculture, the world of trees, ecology and a better Earth on which we are all privileged to live. All our lives can be improved by learning and the practical application of this knowledge. Let us see where this important project will take us!

Peter Morgan
Harare,
March 2010

Basic principles of ecological toilets

Most of the toilets described in this book can turn human excreta into compost which can either be used in the vegetable garden or can be tapped by trees growing nearby. Most are shallow pit toilets. The regular addition of soil, ash and leaves to excreta in a shallow pit helps the composting process considerably and also reduces smells and flies. The more soil and ash are added to the pit, the greater the rate of composting and greater the control of flies and odours.

The single pit composting toilet (*Arborloo*)

In this concept the pit is shallow (1m deep) and the toilet site temporary. A ring beam of bricks or concrete is made and the pit dug down inside this. A concrete slab is mounted on the ring beam and a movable or portable "house" is built around the slab or ring beam. Soil and ash are added to the pit daily and ideally after every visit to defecate. Once the pit is nearly full, the toilet (ring beam, slab and structure) are moved to a new site nearby. This movement takes place at between 6 and 12 months intervals or even longer depending on the family and pit size. The used pit is topped up with a layer of top soil about 15cm deep and left to compost. A young tree is then planted in the topsoil. Trees are best planted at the onset of the rains, but if water is available the tree can be planted in the topsoil immediately. It should be protected against goats and other animals. If a tree or vegetables are not planted, the contents of the compost pit can be dug out after 12 months and the pit used again for a toilet.

It is possible to alternate between two permanently sited pits in a toilet known as the *Fossa alterna*. It works the same as the *Arborloo*, in that soil and ash are added regularly and the pit contents turn into compost and can be dug out later. That is an alternative to planting a tree. In some programmes people start with the *Arborloo* principle and then turn towards using the compost from their pits on the garden. Pit compost is easier to dig out than soil from a new pit.

The best of both worlds

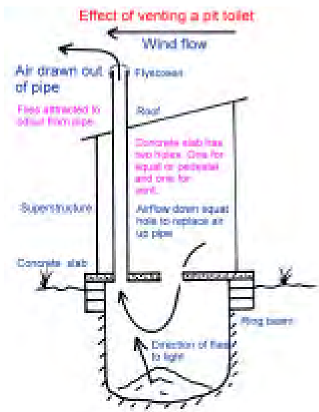
In another method for use with shallow pit toilets, a young tree is planted close to the *Arborloo* at the same time as the toilet is built. The main pit is dug down to the required depth (0.8m – 1.0m) within the ring beam. The slab and house are built and the toilet put to use. But at the same time a second pit is dug or drilled near to the toilet – about half a metre away. This pit is dug down and filled with a mix of soil and compost. A young tree is planted immediately in this “tree pit” next to the *Arborloo* pit. As the tree roots grow and penetrate the soil deeper they will search for and find the richer compost in the toilet pit and start to feed on the nutrients provided. The growth of the tree will be accelerated.

Once the pit has been filled, the parts of the toilet can be moved elsewhere and a new pit dug. The original pit is topped up with soil. Now food crops like tomato, pumpkin or squash etc can be planted in the soil over the pit. Growth can be accelerated by the addition of diluted urine (3:1 with additional watering) once the plants are established. Adding more ash (potash) helps many plants like tomato. The fertile pit can form an “organic plug” which can provide nutrients for both trees and crops. Extra food can be dug in to the soil over the pit in the form of compost or animal manure as well as urine. You see – we get the best of both worlds!


Mulberry trees planted next to toilet pits.

Ventilated improved pit toilets which compost excreta

The VIP toilet uses a screened ventilation pipe and a structure with a semi-dark interior to control both flies and odours. The concrete slab has two holes made in it, one for the vent pipe and one for the squat or pedestal hole. As soon as the pipe is fitted air will start to move up the pipe and this escaping air draws fresh air down the squat or pedestal hole. So the toilet smells much less. The air flow is caused by air flowing across the top of the pipe. The pipe, if fitted with a fly screen also acts like a fly trap and this reduced the fly problem.



Pits of intermediate depth

Pit composting can also be made to work in pits of intermediate depth – say 2 metres if the pit contents are a mix of ingredients (excreta, soil, ash and leaves). The pits of this depth should be lined with bricks. Using a brick laying technique known as “corbelling” (see later) it is possible to construct a brick lined pit with a wider diameter but reduced in depth compared to a normal deep pit. If a pit of this type is used in an ecological way (ie no garbage, little water and plenty of ash, soil and leaves) it becomes easier to excavate than a normal pit toilet. Since the pit is lined, a house made of brisk can be built on top. Remarkably, brick superstructures can be dismantled and rebuilt if the bricks are of moderately high quality and the cement mortar used to bond them together is weak. Also by planting trees with soft wood, like paw paw, in the filled pit (planted in a layer of soil), the tree itself can be removed later when the time for pit excavation comes. The roots will have taken up nutrients and the paw paw provided fruit. But after a few years the tree can be dug out. This would not be possible with trees which establish themselves more permanently. The pit compost can then be dug out to gain access to the original pit and the compost used on the garden. Thus toilets can become a long lasting asset and not just a useful facility with a limited life span.

In fact the various parts of the toilet can be made in such a way that they are also recyclable. Using weak cement mortar in brickwork, fired brick walls can remain stable, but can be taken apart easily. The bricks can be cleaned and used again. Roofs, vents, slabs, pedestals etc can be taken away and reassembled to make new toilets. So every part of the toilet structure above ground can be recycled. If the pit contents turn into compost, then even that part can be used again.

Urine diverting toilets

The urine diverting toilet uses a special pedestal or squat plate which separates the urine from the faeces. The urine is fed through a pipe to a plastic container to direct to a tree like a banana. The faeces fall into either a pit below ground or into a vault or even a plastic bucket or sack held in a brick vault above ground. Soil and ash are added to the pit, vault or bucket/sack after every deposit is made. The solids can be removed from time to time and mixed with more soil to compost. This material can be added to shallow pits or into compost heaps. Many urine diverting toilets use two vaults where the faeces are drying out in one whilst the other is filling up. Most urine diverting toilets are built above ground level and therefore are useful if the ground water is high or if the ground is rocky.

An introductory lecture

What is ecological sanitation?

Ecological sanitation can be defined as a system (usually a toilet) which makes use of human "waste" (faeces and urine) and turns it into something useful and valuable, with minimum pollution of the environment. It consists of using toilets which are safe and designed in such a way that the end products can be easily used in agriculture and forestry. Thus the worlds of sanitation and agriculture become partners. In ecological sanitation the so called waste products (both faeces and urine) are not thought of as a waste, but rather as a valuable resource. Human excreta can turn into valuable compost for instance and urine is rich in nitrogen which many plants can benefit from greatly. Urine treatment on green vegetables can increase the yield by many times. Because excreta (faeces) contain bacteria and other organisms that can cause disease, some care is required in the design and use of the toilets. And also some care is required in the methods of transferring the products into agriculture. The aim is to improve the health of the users and also provide simple systems where the products can be used with great benefit for growing fruit, trees and vegetables. Faeces when mixed with soil and completely decomposed come to look like and smell like humus, a pleasant soil which plants like to grow in.

Thus ecological sanitation involves at least three basic parts.

1. The toilets themselves which are ecologically sound and make the collection of the products (compost and urine) possible.
2. A good method of transferring the products (compost and urine) into agriculture in an easy and hygienic way.
3. Methods which best allow the compost and urine to be absorbed by the plants in a safe and effective way that leads to increased yields of the trees, vegetables and other food products.

Initial approaches with the school

After an agreement has been made at the school with the headmaster and staff to introduce the extra curricular training course in ecological sanitation, plans are drawn up to start off the course with an introductory lecture. This is followed by practical toilet demonstrations and building and garden experiments. Selected pupils are chosen from the upper classes of the Primary school (grades 6 and 7). Those pupils in the top class will move on to a secondary school, so there is some continuity in choosing pupils from at least two senior classes. In this early pilot course 16 pupils were chosen from two classes.

The introductory lecture

An introductory lecture was given by Mrs Annie Shangwa using the **flip chart** and **models** (attached to this chapter) and other teaching aids. Various methods of making simple hand washing devices were also taught during the introductory lecture to add practical interest. These methods and many others, including gardens trials and classroom experiments are also described in this book.


Introducing the concept of ecological sanitation and eco-toilets to the pupils

The Ecological Sanitation FLIP CHART

"Eco-san" in brief – an introduction

How to build simple toilets and use the toilet compost and urine formed to grow healthy vegetables and trees

Peter Morgan and Annie Shangwa

How we can benefit from ecological sanitation

1. We get a family toilet!

2. The toilets are simple and relatively cheap

3. The simple "eco-toilets" are almost fly and odour free

4. The parts of the toilet can last for many years

5. It is possible to upgrade and improved the simple toilet over time

6. Valuable products come from the toilets such as toilet compost and urine

7. Toilet compost is rich in nutrients and can enrich poor soils

8. Urine is very rich in nutrients especially nitrogen and can be mixed with water to make a good plant food

Types of toilets used in Eco-san

1. Arborloo

The toilet that becomes a tree

2. Fossa alterna

The toilet that makes compost

3. The ecological Blair VIP toilet

The Blair toilet that makes compost

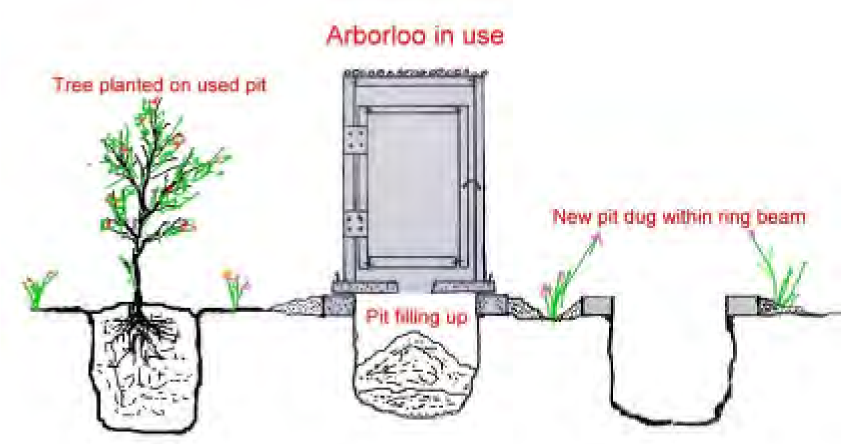
4. Urine diversion toilets

These separate urine and faeces

The simplest and cheapest are the Arborloo and the Fossa alterna. Both can be made into Blair VIP toilets by upgrading.

The Arborloo

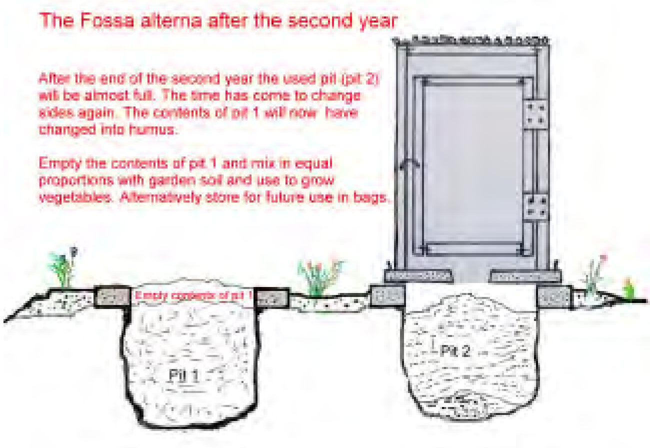
This toilet moves from one shallow pit to the next on a never ending journey. A young tree is planted in each shallow pit filled up and topped up with soil



**** The pit is shallow – about one metre deep***
**** Soil and ash are added to the pit with the excreta. This helps to make compost and helps to control flies and odours***
**** Once the toilet is nearly full move the parts of the toilet (structure, ring beam and slab) too the next site.***
**** Cover the pit contents with a thick layer of good soil and plant a tree***

The Fossa alterna

This uses two shallow pits which can be protected with "ring beams" or lined with bricks. The toilet slab and "house" alternate between one pit and the other at yearly intervals. Only one pit is used at one time. The toilet house is designed so it can be moved easily.



****Dig and protect two pits at time of construction. Pit 1 is dug about 1.2m deep. Pit 2 is dug shallow***

**** As the pit is used add soil, wood ash and leaves.***

**** do not add rubbish into the pit***

**** Once Pit 1 is nearly full, dig down the second pit to 1.2m deep and move the toilet slab and house to the empty pit.***

**** Cover the contents of Pit 1 with soil and leave to compost for one year.***

Use of the toilet compost

The compost from the Fossa alterna can be dug out after a year. There are several ways of using it.

1. Dig and new pit for a tree ("tree pit") and move toilet compost into this pit and plant a tree.

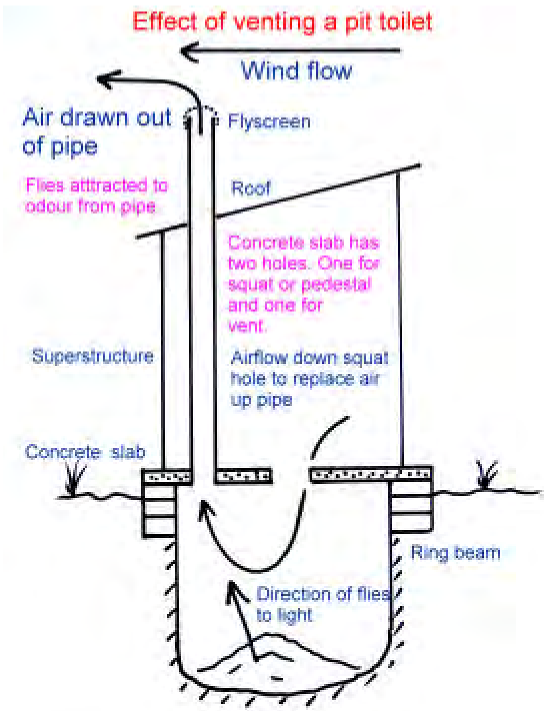
2. Mix the toilet compost with equal volume of poor soil in a container and plant vegetables

3. Mix the toilet compost with the topsoil of vegetable and flower beds

4. Place the toilet compost in sacks ready for use. It can be dug into maize plantations during the rainy season.

The Ecological Blair VIP Toilet

A Blair VIP (Ventilated improved pit) toilet is a pit toilet fitted with a ventilation pipe. The pipe is fitted with a fly- screen to trap flies. This is how it works. Ecological VIP toilets have pits 2m deep and a tree is planted close by.



Both the Arborloo and Fossa alterna can be upgraded to a Blair VIP.

What is important for the Blair VIP

1. The toilet house should have a roof and the inside should not be too light. If a door is fitted it should be self closing. Or a spiral (door-less) structure should be used.

2. A vent pipe should be used and fitted into a hole in the toilet slab. There are several ways of making low cost vent pipes.

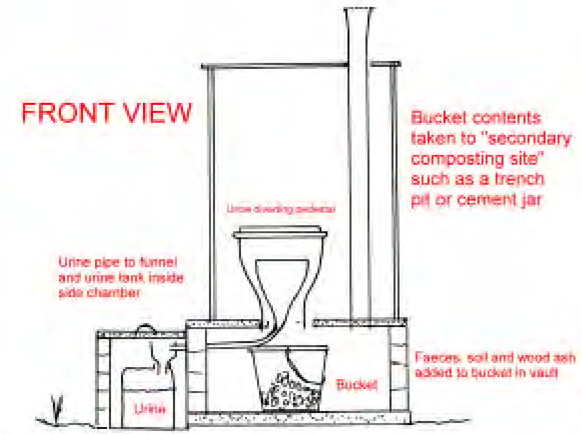
3. The vent pipe should have a screen to trap flies. This is best made of aluminium which does not corrode.

4. The ecological Blair VIP toilet can be used in the same way as the Arborloo and Fossa alterna.

5. If a long life is required the pit can be made much larger and lined with bricks. Then a brick house can be fitted. There are economical ways of lining pits with bricks and fitting the same concrete slab as used on the Arborloo.

Urine diversion toilets

These are special toilets where the urine and faeces are separated from each other. The faeces fall into a bucket or vault together with soil and ash which are added. The urine is led off through a pipe into a plastic container.



The container of feaces and soil and ash is removed when full and placed in a composter with more soil. It turns into good compost.

Urine which contains a lot of nitrogen can also be collected in plastic bottles or "eco-lilies" a plastic container with a funnel at the top. The boys can pass urine into the funnel (Lily) and the urine is collected in that way.

How to use urine as plant food

There are several ways of using urine to make plants grow faster and larger. Normally the urine is diluted 3 parts of water to 1 part urine for use on vegetables. Ways of using urine:

****Add diluted urine to young green vegetables planted in buckets, basins, ring beam gardens or vegetables gardens.***

****For a 10 litre bucket add about 400mls urine + 1200mls water once or twice a week. Also water at other times.***

**** For a ring beam garden add about one litre urine with 3 litres of water once or twice a week. Water at other times.***

**** For maize add diluted or neat urine to each plant in hole nearby. About 100mls urine per plant per week during the growing season.***

Parts of the ecological toilet

Simple eco-toilets can be made with a few basic parts:

1. ***The concrete slab made from cement, river sand and wire.***
2. ***The "ring beam" made from cement, river sand and wire***
3. ***The "toilet house" made from many materials. Simple structures made from poles and grass or reeds can be very neat.***
4. ***Vent pipe for the Blair VIP toilet. There are several ways of making these pipes.***
5. ***Pedestal for sitting can be made for more comfort.***
6. ***Brick lining of pit. For large pits which last for many years the pits are best lined with bricks. A method known as "corbelling" where a wide pit can be fitted with a small slab is a useful technique.***
7. ***Hand washing devices. These are essential parts of any toilet. Improvement of personal hygiene is very important for health.***

Making the parts of the eco-toilet

1. The concrete slab

The amount of cement used depends on the size of the slab For a larger slab 1.1m in diameter 10 litres of cement (Portland) is mixed with 50 litres of river sand. This is added to a round mould made of bricks 1.1metres in diameter. Holes are made for the squat hole and ventilation pipe hole. Half the mix is added first, then some reinforcing wires (3mm thick) is added. Then the remainder of the concrete is added, smoothed off and left to cure and get strong by keeping wet for 7 days. Smaller slabs use less cement.

2. The Ring beam

This is a ring of concrete which is used to protect the shallow pit and raise the slab above ground level. Two circles of bricks are made for the mould. For the larger 1.1m diameter slab, the inside diameter is 1 metre and the outside diameter 1.3metres. The concrete is made by mixing 10 litres of cement with 50 litres of river sand. Half of this is added to the mould first and levelled off. A circle of wire is placed on the cement and the rest of the concrete is added and levelled off. This is left to cure for 7 days. Smaller slabs use smaller ring beams and use less cement.

3. The "toilet house"

There are many ways of making a toilet house from many materials. The simplest are made from poles, reeds and grass. These structures can be improved over time.

4. The "pedestal"

Pedestals are useful for elderly people and also for those who are used to sitting when they go to a toilet. Simple pedestals can be made using cement and a plastic bucket. They make going to the toilet more comfortable. Pedestals can be made in several ways. Some pedestals can separate the urine from the faeces.

5. The "hand washing device"

The washing of hands is so important and essential if we are to be healthy A hand washing device should be fitted to every toilet and also in the kitchen. There are many ways of making a hand washing device from bottles, tins and cups.

6. The "vent pipe"

If a vent pipe is fitted to a toilet (like the Blair VIP toilet) it can carry away smells and make the toilet more pleasant to use. With a little bit of training it is possible to make a good vent pipe in the home using simple materials and some cement and sand.

7. Container of soil and ash

All these eco-toilets need soil and ash added to the pit. It is best to dry out soil taken out from the pit and mix it with wood ash and keep in a dry place in a sack. Then it can be placed inside the toilet in a bucket or container together with a small cup which can be used to put some of the soil and ash down into the pit after the toilet has been used.

Conclusions

During this course we will learn how to make simple compost making toilets (eco-toilets).

These include the Arborloo, the Fossa alterna and the ecological Blair VIP toilet.

We will learn how to make concrete ring beams, concrete toilet slabs, simple "toilet houses," hand washing devices, simple vent pipes, and simple pedestal seats.

We will also learn how to use "toilet" compost and urine to increase the growth of vegetables in our gardens.

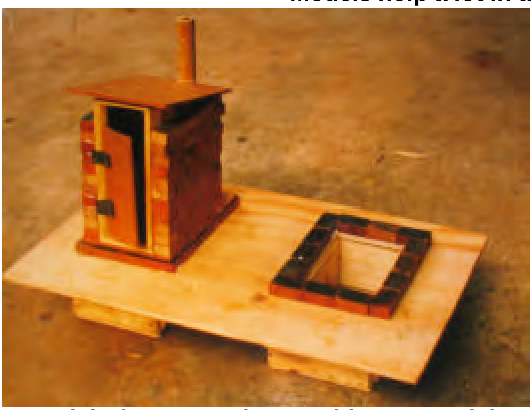
We will also learn how to plant and raise important trees in our gardens using toilet compost.

All these things are important in our lives and can improve the way we live.

Training methods – using models

Many of the ideas relating to ecological sanitation (and many other things) can best be explained by the use of models – small replicas of the real thing. By using models one can explain the sequence of building and upgrading easily and repeat it time and time again and not necessarily at the site where the real live technology is being put to use. This section explains the sequence of upgrading the sanitation technology using a series of models.

Models help a lot in training



A model of a *Fossa alterna* with square slab and ring beam – 2 versions!

The challenge is to explain the sequence of upgrading in a simple and understandable way using visual stimuli and where people can touch and experiment with the models. The models shown in these photos are made of high strength concrete (usually a mix of one part PC 15 cement and 2 parts clean river sand), wooden bricks, wood, grass and wire.

The basic elements – slab and ring beam and house.

The slab and ring beam are cast in high strength concrete as miniature replicas of the full size components

Slab and 1 ring beam, slab and 2 ring beams. These are the basic elements of the series together with a suitable superstructure (toilet house) and vent pipe.

House without vent and with a vent. When a vent is fitted without a roof, flyscreen and semo darkened structure, odours will be removed but there will be no fly control. Many types of model superstructure can be made.

Sequence describing the *Arborloo*

The ring beam is placed on the ground and a hole dug inside it. The slab is mounted on top on a bed of termite mortar or weak cement mortar to make a seal and cope with any uneven surfaces. A suitable structure is placed on top. Ideally this should have a roof. Small leaves are then added to the base of the pit. A mix of excreta (eg pellets) is added followed by some soil and ash and some leaves occasionally. The pit is filled up in this way (quickly). When nearly full the structure, slab and ring beam are removed. The ring beam is moved to another site. The near full pit is filled up with soil, a hollow made and a tree planted (this is a miniature tree).

The ring beam has been caste on ground allowed to cure and a hole dug down inside. The slab has been fitted.

The simple structure is now fitted and the *Arborloo* put to use

The hole has been nearly filled and topped up with soil. a young tree is prepared.

The tree is watered and protected. The ring beam is moved to a new position.

The hole is dug down, leaves added and the slab added. The structure is fitted and the *Arborloo* put to use.

Sequence describing the *Fossa alterna*

Here the same applies with 2 ring beams and one slab. The first sequence should show using unlined pits with ring beams. This is effective in many cases where the soil is moderately firm. Later also a model showing the brick lined pit with corbelled upper brickwork should be shown. Also the method of alternating between two pits of the same size and two pits of different sizes. One of these may be brick lined and the second unlined (The Earth and Moon Principle).

In this case model structures can be shown with and without a roof and pipe. In all cases a roof is preferred and a vent pipe helps to reduce odours. In all ecological toilets the generous addition of both soil and ash helps to reduce odours and encourages composting in the pit. Adding leaves improved the quality of the compost. A combination of adding soil, ash and leaves and using a vent is best.

Two ring beams used in the *Fossa alterna.* Caste ring beams in place and when hard dig inside both down to 1.2 to 1.5m. Add a sack of leaves to the pit which be used. Fit the slab on one ring beam and cover the second for safety. The second can be filled with leaves and soil to make compost.

Add structure to the slab and use the toilet, filling the first pit with a mix of excreta, soil ash and leaves. When the first pit is nearly full (after 12 months) remove the structure and move the slab to the second pit (after removing any compost). Fill up the first pit with soil.

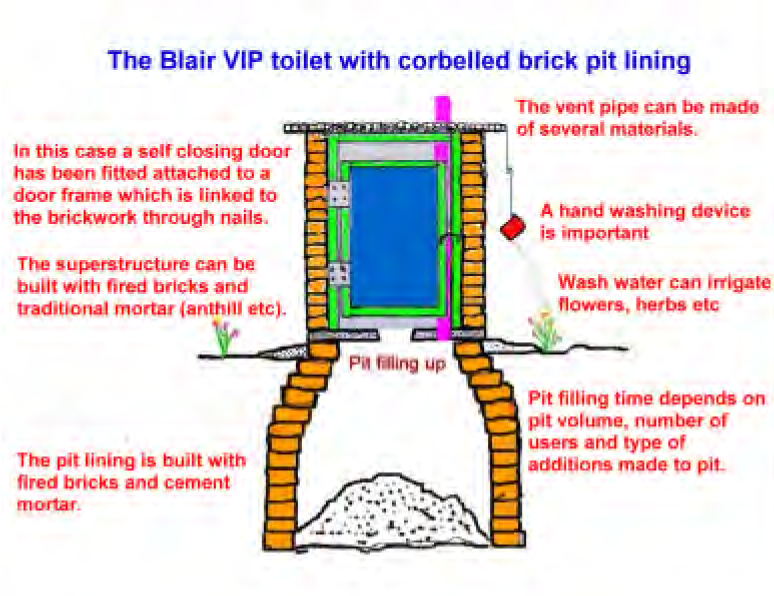
Fit the portable structure back on the slab and use the second pit, adding excreta, soil, ash and leaves. When the second pit is nearly full dig out the compost from the first pit and move the slab and structure back on to the first pit. Repeat this process once a year. The model shows the process clearly. The pit compost can be bagged for storage or used in gardens.

Upgrading to lined pit

These models show how the pit can be lined with bricks and the brickwork **corbelled** at the top to reduce the pit diameter. This allows the same ring beam and slab (1.1m) to be fitted on the top. This technique can be used with the *Fossa alterna* technique (using two lined pits) or with the Blair VIP. Pit capacity can be increased significantly by using this technique.

The model was made in this case with wooden bricks bonded together the cement mortar on a firm base. A miniature concrete ring beam was placed on top of the brickwork as it would be at real size. The miniature concrete slab (with vent hole) was then fitted on the ring beam.

The superstructure if then fitted to over the slab on the ring beam. The wooden door has self closing rubber hinges. The vent pipe (made of plastic pipe) is then fitted together with a miniature roof made of cardboard and reeds. This technique can be used with a single deeper pit (2m – 3m deep) to make a Blair VIP or with 2 shallower pits 1.5+m to make an alternating shallow pit system like the *Fossa alterna*.



The single pit VIP system

Making a urine diverting toilet with the same building blocks

In this case two ring beams are used. One is mounted in the ground and a brick wall of 3 courses (on edge) are built up on the ring beam and the second ring beam mounted on top. A gap in the brickwork is left for the vault access panel. The slab is fitted with a squat or pedestal hole enlarged to suit the type of urine device fitted. A miniature urine diverting pedestal or squat plate can also be made as shown below. A structure is fitted on top, with or without a vent pipe. A bucket or bag can be placed in the vault for collection of solids.

The low brick vault wall has been built on a ring beam. A second ring beam has been fitted on the brickwork and vault access door added.

The slab has been added and hole enlarged to suit the urine diverting device used. A miniature urine diverting pedestal is shown.

Photo showing interior of the model after the roof and pipe have been fitted. The rear of the model showing structure and vault access panel.

Models are excellent tools for showing how toilets and other structure are built. They can also be used to show how ecological and other toilets can be used and maintained. Once made well and solidly they can be used many times over to train many people.

Demonstration of venting in VIP toilet

Models can also be used to show how the VIP pipe works. A slab with a vent hole and squat hole is placed over the brick lining model and the interface between the slab and the ring beam sealed with sand or soil. Some grass or dried leaves are placed down the squat hole and followed by some small pieces of newspaper lit with a match. Soon smoke will appear at the head of the pipe and not from the squat hole. It is a memorable demonstration and helps to show how the VIP toilet works.

This remarkable demonstrations shows how the vent of a VIP toilet works. A small smoky fire is lit in the miniature pit structure. The pipe draws up air and fresh air passes down the squat hole.

Teaching Ecological Sanitation in Schools

How to build an Arborloo with a spiral superstructure which can be upgraded to a VIP toilet

Peter Morgan and Annie Shangwa

How to build an *Arborloo* which can be upgraded to a VIP toilet.

In this chapter we describe how to make an *Arborloo* which has both vent and squat hole. Thus it can be upgraded later to a VIP toilet. The pit is shallow, about one metre deep and fills up with a mix of excreta, soil and ash. Leaves can also be added. These help composting in the pit and also reduce flies and smells. The simplest *Arborloo's* which cannot be upgraded with vent pipe were described in the last chapter. These are easier to make, but it is essential that soil and ash are added regularly to the pit to reduce odours and smells. If the slab is made with a vent hole as well as a squat hole, the option is open to fit a vent pipe later which will control odours. The *Arborloo* made up of 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 provides privacy.

Locating the site for construction

A suitable site must be found for the toilet which is convenient for use and the ground should be levelled. Then a ring beam is constructed on the ground in concrete or bricks and also a slab is made nearby. These are left to cure for at least a week. The pit is dug down within the ring beam to a metre depth. The slab is then carefully placed over the ring beam and should be placed on top of some weak cement mortar or traditional mortar (anthill) so the support for the slab is equal all round. If this is not done the slab may crack when people stand on it. Once the slab is fitted with the squat hole facing in the correct direction, then the toilet house can be made. There are many ways of making a toilet house. It is mainly for privacy and is best made with a roof. It can be made in the shape of a spiral without door or a round shape fitted with a door.

Stages of construction

1. Concrete slabs

Concrete slabs can be made of many sizes. The smaller slabs of 0.7 and 0.8m in diameter cannot be fitted with vent hole, but the slightly larger 0.9m diameter slab can be fitted with both a squat (or pedestal) and vent pipe hole. With the smaller slab the interior is a bit small, and the resulting pit is smaller, but they can work well and suit small children best. In this manual we describe how to make both the larger and smaller slabs which have both a vent and squat hole.

1a Making a 1.1m diameter concrete slab

The larger slab is 1.1m diameter slab fitted with squat hole and vent hole (110mm). The concrete slab is made with a cement and good quality river sand (sharp feel and clean) with some wire reinforcing (3mm wire or barbed wire). The best cement is called Portland cement which is intended to making concrete. But this is often not available. In that case the weaker masonry cement must be used but with a higher proportion of cement to sand. If Portland cement is available a mix of 5 parts river sand (50 litres) to 1 part cement (10 litres

The mould for the concrete slab is made from a ring of bricks laid on levelled ground. The bricks are laid around a circle 1.1 metres in diameter (radius 55cm). If plastic sheet is not available a layer of river sand laid down and levelled off. Using a centre mark, bricks are laid around in a circle. The circle can be marked with a stick 55cm in length or a string radiating from a nail placed in the ground. The bricks are laid on the sand around the marked circle. The sand is wetted and made flat

A suitable mould for the squat hole can be made using bricks, wood or a shaped plastic bucket. This should measure about 30cm long and 15cm wide at the rear, and should taper down towards the front. This squat hole mould is then laid 30cm from the rear end of the slab. The vent hole is 110mm in diameter and is made by using a 75mm length of 110mm PVC pipe. This is laid to one side of the squat hole, 10cm in from the edge.

The concrete mix can be made in two halves using 5 litres of Portland cement mixed with 25 litres river sand. Mix thoroughly in the dry state and then add water to make a thick slurry and mix again. Add this mix to the mould and level off. Add carefully around the squat and vent hole to ensure the moulds do not move. After the first half of the mix has been added, place the 3mm wire or barbed wire in a grid formation 20cm apart. Add wire also between vent and squat hole and in between the slab edge and the two holes. Then make another mix of 5 litres cement and 25 litres river sand and add on top of the reinforcing wires. Smooth flat with a wooden float. After two hours carefully remove the squat hole and vent hole moulds and smooth off edges of the squat hole. Cover with plastic sheet or plastic bags leave overnight. Once the concrete is hard add water and cover again with plastic sheet. If a ventilation pipe is not going to be used immediately the vent hole can be filled with a small weak mix of sand and cement (15:1). This forms a plug which can be knocked out when the pipe is fitted later.

If Portland cement is not available a higher proportion of masonry cement must be used. This will be 12 litres of cement to 50litres of sand if the masonry cement is fresh or up to 15 litres of masonry cement to 50 litres of sand if the cement is older and starting to form lumps.

The slab is left to cure for at least 7 days. It is kept wet under plastic sheet or paper all the time. It can also be covered with sand which is kept wet. The curing process (where the slab is not allowed to dry out) is very important. Slabs only develop strength when cured properly. If they are allowed to dry out once made, they never develop strength. Curing is essential for a long life concrete slab.

The slab is the most important part of the toilet and the part which can be used over the years. It is very important to use the cement provided wisely and ensure that the concrete work is made strongly, and cured correctly. Once a concrete slab has been well made and cured it will last almost indefinitely and can be used on a whole range of toilet designs from the simplest to more sophisticated models.


The concrete slab is 1.1m in diameter and made with 10 litres cement (PC15) and 50 litres clean river sand. The concrete mix is laid inside a mould of bricks on a plastic sheet or on sand. The squat hole is positioned 30cm from the rear of the slab and the vent hole 10cm from the edge at 45 degree angle.


Half of the concrete mix is added first, then the reinforcing wire. Then the second half of the concrete mix is added and levelled off with a wooden float. Remove squat hole and vent pipe moulds when the concrete is stiff after about 2 hours. Allow to harden overnight. Add water the following morning. Keep wet for at least 7 days under plastic.

How to make a brick ring beam

Get some fired bricks and mark a circle on the ground 90cm in diameter (radius 45cm). Lay the bricks around the circle. The diameter of the ring beam should match the slab. Ideally the slab should lay over half the length of the brick. Bricks are about 22.5cm long, so about 11cm of the rim off the slab should sit on the ring beam. The vent hole in the slab is normally made between 11cm and 12cm from the edge so that the vent hole will lie directly over the pit. One course of bricks can be laid in a circle to support the slab and can be bonded together with weak cement mortar. A stronger ring beam can be made with two courses of bricks as shown below. Traditional mortar can also be used. This is normally made by mixing anthill soil with river sand. Using a trowel add the anthill mortar between and above the bricks. Then add a second layer of bricks on the first layer. The upper layer of bricks should sit on the joint between bricks of the first course. Use the anthill mortar to hold all the bricks together. The pit is now dug down inside the brick ring beam. The soil from inside the pit is heaped around the ring beam and rammed hard in place. This will help to secure the ring beam and protect the beam and the pit during the rains. Brick ring beams must be taken apart when the pit is full and rebuilt in the new *Arborloo* site. The advantage of the concrete ring beam is that it can be moved as a complete unit from one site to the next as a complete unit.


The bricks are laid in a circle to make the ring beam and bonded with anthill mortar (Ivhu re pa churi) or cement mortar. The anthill mortar is made up by breaking up ant hill soil and mixing with river sand and water.

How to make concrete ring beam for 1.1m slab.

The ring beam is a ring of bricks or concrete which is caste on the ground at the top of the future pit. The ring beam is made first then the hole dug inside later. The concrete slab is laid on the ring beam. The ring beam helps to keep the top of the pit from falling in. It also supports the concrete slab, which is raised above the ground level. The ring beam also diverts rainwater away from toilet site. The pit is dug down inside the ring beam once it has been laid. The soil taken from the pit is rammed in place around the ring beam to make the toilet safer and raise the ground level around the toilet.

The ring beam can be made of bricks and anthill mortar or it can be made from wire reinforced concrete using a mix of cement and clean river sand. It is important to raise the toilet base above ground level to avoid flooding during the rainy season. The ring beam is made on slightly raised ground where the toilet is to be built. The ring beams works if the soil is moderately firm, but will not work on looser sandy soils.

Preparation

Locate the site for the toilet and level the ground. The site should be well away (30m) from wells. Make two circles of bricks on the ground. The concrete for the ring beam will be laid within the two circles of bricks. Lay the bricks so the inner diameter of the ring beam is 1metre and the outer diameter 1.3 metres. Thus the width of the ring beam is 15cm all round. This will take the same volume and mix of cement as the slab ie. 10 litres of cement and 50 litres of river sand (for PC 15 cement). Use a mix of 12+ litres cement and 50 litres river sand if masonry cement is used. A ring of 3mm wire is laid half way up the mix as in the slab. The procedure of mixing and adding the concrete is the same as for the slab. If ordinary bricks are used for the inner ring mould the spaces between the bricks must be filled with wet river sand to get a smooth wall all around.

In this case special bricks have been used for the inner brick mould. Lay on ground with 1 metre for internal diameter of ring beam and 1.3m for external diameter. This makes the beam 150mm wide. In these photos pupils from a primary school are making the ring beam and mixing half the mix at a time. That is 5 litres cement and 25 litres river sand mixed and added to the mould followed by a single ring of 3mm wire then a second mix is added. The concrete is levelled and hardened with a wooden float. The ring beam is covered with plastic sheet and left to harden overnight. It is then kept wet for several days to cure. The bricks can be removed after a day or two.

2. Making the smaller 0.9m diameter slab

The smaller slab and ring beam may be particularly useful for small children in the homestead garden. The slab is cast on a plastic sheet or a levelled bed of sand which has been wetted. A circle of bricks is laid so the diameter of the slab will be 0.9metres. A hole is made for the squat hole using a special mould. The hole for the vent pipe can be made of a short length of 110mm PVC pipe. The squat hole mould is laid so that it is 27cm from the back of the slab and the vent hole laid so that it is 9cm from the edge of the slab and at an angle of 45 degrees from the centre line through the middle of the slab. 10 pieces of 3mm wire are cut, 5 of 85cm, 3 of 70cm and 2 of 30cm. The smaller pieces are for the lifting handle. The concrete is made by mixing 6.5 litres Portland cement with 32.5litres of quality river sand. Half is added to the mould first, then the wires are added. Then the second half of the mix is added and smoothed down. If masonry cement is available the concrete is made by mixing 10 litres of cement with 30 litres of quality river sand. It is often easier to mix these as half measures. A one litre tin can be used for measuring.


Arrangement of bricks, wire, squat hole & vent pipe moulds to make the 0.9m slab. On the right a half mix of 15 litres river sand and 5 litres masonry cement (3:1). If Portland cement is used the mix can be 5:1


Half the concrete mix has been laid and the wires added. The second half of the mix is then prepared and laid on top and smoothed down. Wire handles are added on either side to assist lifting.


The vent and squat moulds should be removed after a few hours before the concrete has set. The slab is covered with a plastic sheet and left overnight. The following morning it is watered down and kept wet for at least 7 days before lifting. The small handles help a great deal in the first lift.

3. How to make concrete ring beam for 0.9m slab.

In this example the ring beam is not caste on site, but prepared for moving to a site after curing. The ring beam is cast on a plastic sheet or a levelled bed of sand which has been wetted. Two circles of bricks are laid so the internal diameter of the ring beam is 75cm and the external diameter 105cm. Thus the ring beam is 15cm thick all round. Special bricks may be required to make the inner brick mould. The same mixes of cement and sand are used as for the slab. If Portland cement is available the concrete is made by mixing 6.5 litres cement with 32.5litres of quality river sand. Half the mix is added first to the mould. A loop of 3mm wore is then laid half way across the beam. Then the second half of the mix is added and smoothed down. If masonry cement is available the concrete is made by mixing 10 litres of cement with 30 litres of quality river sand. Two handles can also be fitted to make lifting easier.

When the ring beam is caste off site, it is rolled on to the site and the soil must be loosened first a little to ensure the ring beam lays level and is held firmly all round. Once the ring beam is firm and level then the digging of the pit can proceed.

Method of making the concrete ring beam. This is left to harden overnight, watered the following morning and then kept wet under plastic for at least 7 days to cure.

4. Dig the pit

After the ring beam has hardened the pit can be dug down inside it with some of the soil placed around the ring beam and rammed hard in place. The pit rim is thus raised above ground level. The pit is dug down one metre deep. But is can be dug deeper if the soil is firm. It is a good idea to add leaves to the base of the pit help composting. Ring beams are suitable only for light weight structures.

Pit being dug down to one metre depth and soil rammed around the ring beam

4. Building the toilet house (superstructure)

There are many ways of making simple low cost toilet houses from locally available materials. A roof provides shade and keeps the rain out. It also helps to control flies. Where ring beams are used the “house” is made of light materials and built around or on top of the ring beam. Some structures may be fitted with simple doors and others built in a spiral (round or square) shape so that a door is not required. Wooden poles or bamboo can be used as the frame of the structure. Wood ash or engine oil can be placed in the holes made for the poles to reduce attack by ants and termites.

The main purpose of the toilet house is to provide privacy. If the unit is to be upgraded to a simple VIP toilet, then the house should not only provide privacy but should also be semi dark inside. An important feature of superstructures made for Arborloos is that they are either portable or can easily be dismantled and rebuilt on a new site.

Making a traditional square spiral structure

The photos below show one method built at the Chisungu School Epworth by School children. Nine upright poles 2.1m long are found and a roofing frame made. The roofing frame measures 2.2m long and 1.4m deep. The roofing frame is laid over the slab/ring beam and holes drilled around the ring beam in such a way to form a structure with opening at one end. There is no door in this version.


Nine poles 2.1m in length are used. The hole locations are determined from the roof frame. The poles are dug in at certain depths so the roof slopes backwards slightly. Wires are used to attach uprights to roofing poles. Holes have been drilled at the top of each upright. A wire is passed through each hole and around the roof frame. Reeds are laid across the top of the roof frame and secured in position with string.


Plastic sheets can be laid over the roof frame and covered with grass. These can be secured by adding more reeds on top.


The square spiral unit has no moving parts which is an advantage. At this stage no vent has been fitted. A hand washing device has been fitted.


A home made vent pipe can be fitted to make it a low cost VIP toilet. The inside of the house fitted with a vent pipe.

The final structure fitted with hand washing facility and vent pipe. This is a low cost Blair VIP. These can be very effective units.

How to use the single pit compost toilet

If the toilet is not fitted with a vent pipe it will smell and breed flies unless soil and ash are added regularly. So in those *Arborloo's* which are not fitted with pipes, it is very important to add soil and ash to the pit very often. The ideal is to add a small cupful of dry soil and ash to the pit after every defecation. This will ensure the faces are covered and does help a lot to reduce the smells and flies. It also helps to add dry leaves to the pit from time to time. The ash, soil and leaves all help to make the excreta in the pit compost more quickly and prepare it for tree planting later. A bucket of ash and soil should be placed in each toilet and a small dispenser (cup) placed nearby so the soil and ash can be added regularly. Keep the inside of the toilet clean as this will also help to stop flies getting in the pit. The pit is used until it is nearly full. The length of time this takes depends on the size of the pit and the number of users. Small pits may last for only 6 months, larger pits much longer.

What to do with the filled pit

When the pit is nearly full it is time to move the toilet to a new site. The house must be moved or taken apart and the slab and ring beam removed and plenty of soil added on top of the pit contents. This should come up to the level of the ground. Then leave the pit to settle for a while. The ring beam should now be moved to a new site, the pit dug down inside it and the slab and "house" added to make a new toilet. Add a sack of leaves to the bottom of the pit.

1. Leave this pit to settle. Add more soil and compost and wait for the rains before planting a new young tree. OR
2. Plant a young tree immediately in the added soil and look after it. It will require protection from animals and frequent watering. OR
3. Allow the pit contents to turn into compost and dig the compost out later (after 6 – 12 months) for use on the garden or for trees.

A later chapter describes how to plant and look after trees.

Teaching Ecological Sanitation in Schools

Building an Arborloo with door and surrounding ring of trees

Peter Morgan and Annie Shangwa

Introduction

This *Arborloo* was built on ring beam over a shallow pit. In this case the superstructure was built with treated gum poles and grass with a roof made of cement impregnated hessian laid on a wooden frame. A variant in this case was that the slab was a newly designed unit made of fibreglass. This unit is expensive and has been designed in Zimbabwe to serve emergency areas where cholera is a serious health problem. The toilet was constructed using the same basic principles as other *Arborloo's* – that is make the ring beam, dig the pit, place the slab, build the structure and fit a roof. In this particular case the unit was also surrounded by a ring of gum trees – a variant on the concept of planting a tree after the toilet is full, as is the standard practice with *Arborloos.*


The ring beam shuttering diameter in this case was 0.9m inside and 1.3m outside.10 litres of PC15 cement was mixed with 60 litres river sand. 3mm wire was placed inside the concrete as reinforcing.


The shuttering was removed and ring beam levelled off and allowed to cure for a few days being kept wet

Once the ring beam was cured the pit was dug down inside the ring beam to one metre depth. The ring beam was covered with weak cement mortar and the special fibreglass slab fitted and made level.

The area around the toilet was cleaned and a series of 8 holes drilled with an earth auger. The treated poles were placed in these holes.

MAKING THE DOOR FRAME

The door frame was made next on site to match the distance between the two gum poles placed at the front of the toilet. Rubber hinges were fitted.

Making the roof frame


The roof frame was also made from thin gum poles to match the size of the structure. In this case the poles were nailed together. A roof sheet of cement impregnated hessian was made separately at the school see other manual) and allowed to cure for several days.


The two front poles (king posts) were placed in the holes drilled for them and made level. Soil and stones were placed in the holes to make the posts firm. The roof frame was then added on top and nailed in position.


The ring beam extended a little and made neat. Then thatching grass added all round to make the wall. This was attached to three wires wrapped around the poles and secured with thatching twine.


The grass structure being built. A hessian sheet was added as a door panel. This can be coated with cement slurry to make stronger. Also heavy duty shade cloth can be used or thin plywood.


The hessian impregnated roof panel being taken to the toilet. It is laid over the roof frame and secured with wire.


The completed toilet is surrounded by gum trees placed in holes drilled by a large earth auger (see detail in other manuals). The A hessian cement vent pipe has been added and the completed unit inspected by health officials.

Teaching Ecological Sanitation in Schools

How to build and manage a Fossa alterna

Peter Morgan and Annie Shangwa

Introduction

The *Fossa alterna* is a double pit composting toilet. There are two shallow pits about 1.5m deep each and placed about 1m apart. These are pits are protected with by two ring beams if the soil is moderately firm or by two brick lined pits if the soil is unstable. A single slab is mounted on one of the pits and a portable toilet house. The pit which is used fills up with a mix of excreta and soil and ash. The pit which is not used can first be filled with leaves to make leaf compost. The conversion of excreta into compost takes far less time if lots of soil and ash to the pit. Once the first pit is full the leaf compost from the second pit is removed and the slab and toilet house from the first pit are moved to cover the second pit. The contents of the first pit are covered with soil and left to compost for a year. By the time the second pit is full the contents of the first pit will have changed into compost and can be dug out. This compost can be used in various ways in the garden. The slab and house are then transferred back on the first pit. This alternating of pits continues for as long as the pits remain stable.

Making the *Fossa alterna* at the school.

1. Laying the two ring beams and digging the pits

In this case two ring beams were made in concrete (see other manuals) and laid on the levelled ground about one metre apart. Most times ring beams are made on site but this time they were made elsewhere and brought to the site. Once located, the pits were dug down inside both ring beams. The ideal depth for a *Fossa alterna* pit is 1.5m

Lay 2 ring beams and dig 2 pits inside

2. Adding the slab

The soil was levelled off around each ring beam. A matching concrete slab was made (see other manual) and placed over one ring beam in a bed of weak cement mortar.

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The slab is added to one of the ring beams.

Slab fitted ready for toilet house

3. Making the toilet house

In this case the toilet house was made with 6 treated gum poles (fitted with a door on rubber hinges) and a roof made of roof timbers and a sheet of cement treated (impregnated) hessian. The roof is attached to the poles with wires. In this case the walls were made of grass mounted on wires. The toilet house in this case is moved by taking it apart, removing the poles and erecting the structure again on the second pit.

Making the door

The door is made by cutting "brandering" timbers. The door is made 1.5m high and 0.5m wide with a cross piece for support. The door panel timbers are held together with triangular pieces of plywood. Rubber hinges cut from car tyres connect the door panel to the gum pole which supports it.

"Brandering" timber was used to make the door. The timber lengths were held together using triangular shaped pieces of plywood.

Attaching the door to a treated gum poles with rubber hinges

Making the roof

The roof frame is also made with "brandering" 1.4m wide and 1.5m long. It is also possible to make the roof frame with gum poles. When made with brandering, 7 timbers are cut as shown. These timbers can be wired together as shown in photos or nailed together. A cement impregnated hessian sheet (2 layers) is fitted on top of the roof frame.

Making the roof frame

Making the roof sheet

In this case the cement impregnated roof sheet was made 1.4m wide and 1.5m long. 2 layers of hessian were used. 8 litres of Portland cement mixed with 5 litres of water to which 300mls salt had been dissolved. The salt was first dissolved in the water and then this was added to the cement and thoroughly mixed using rubber gloves. The first hessian sheet was laid on a large piece of plastic sheet and the cement paint rubbed into the hessian all over. The second sheet of hessian was then added and more cement paint rubbed in all over. For extra strength and durability a third sheet could be added. Finally the roof sheet was covered with another sheet of plastic and left to cure for several days before being lifted in position.

The cement paint is prepared and the hessian sheet laid on plastic sheet,


The cement paint is thoroughly rubbed into the first hessian sheet. Extra cement is added and the second hessian sheet is placed over the first. More cement paint is rubbed in all over. Then the sheet of covered with plastic sheet to cure.

Making the toilet house

In this case the toilet house was made by erecting 6 treated gum poles in a circle (one fitted with a door frame) and covered the walls with grass mounted on wires.

Locating the holes for the poles

The roof frame is used to mark the positions where the holes for the treated gum poles will be placed. The erected gum poles (6) will be attached to the roof frame with wires.


Locating the positions for the holes. Drilling the holes with an earth auger. Adding water to make the soil softer

The holes being drilled. The two main poles ("king posts") on either side of the door frame are placed carefully in the drilled holes so they are the correct distance apart.

The two main poles in the front of the toilet are mounted first. The door is attached about 60cm above the bottom of the pole and about 30cm below the top of the pole. The pole is 2.4m long and the door 1.5m high. The door is 0.5m wide. The roof timbers are secured to the poles with wires.

General view of *Fossa alterna* with two pits and a single structure

Adding the grass walls on wires placed around the poles

Three wires are attached around the poles in an upper, mid and lower position for attaching of the grass. Then bundles of grass are added both from the top and the bottom being attached to the wires with thatching twine. The erection of the walls is quite rapid and the appearance neat.

Bundles of grass are built up as walls for this toilet.

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Adding the door panel

The frame off the door has already been made. The panel to cover the frame is now added. This can be made of hessian sheet, cement impregnated hessian, heavy duty shade cloth or other materials. In this case it was made from hessian sheet.


The hessian door panel is nailed to the door frame. This could be treated with cement paint later to make it more durable.

Adding the roof

The cement impregnated hessian roof sheet is then added to the roof frame. As can be seen from the photos it is flexible.


Carrying the roof sheet to the toilet.


The roof sheet is added to the roof frame and secured with small 25mm nails


The roof sheet must be secure otherwise the wind will blow it off the structure. The second pit is filled with soil and leaves to form compost whilst the pit in use is being filled with excreta, soil and ash.

The slab inside the toilet house. At first a pipe may not be fitted. The pipe can be fitted later. When plenty of soil and ash are added to the pit smells and flies are reduced.

Use and management of the *Fossa alterna*

The used pit is filled with a mix of excreta, soil and ash which are added regularly. When the first pit is full, the toilet slab and structure are moved on to the second pit. If the second pit is filled with compost this is dug out first. A layer of top soil 15cm deep is placed over the contents of the first pit which is then left to compost. It is best to level off the contents of the pit first. The second pit is then put to use as the toilet pit whilst the contents of the first pit are composting. The composting pit can be topped up with soil to the rim of the ring beam. It can be used as a miniature garden.

After a year or more of use (for a small to medium sized family) the second pit will become full (with excreta, soil, ash and leaves). By this time the contents of the original pit will have changed into compost and will be ready to dig out. If there is doubt about the quality or safety of this pit compost it can be placed into another pit (tree pit) nearby, and a tree can be planted in it. If it is considered safe it can be dug into the top soil of the vegetable garden. After the original pit is emptied the toilet slab and structure can be placed back again over the empty pit and the recently filled pit covered with soil and left to compost for a further year. This ritual of changing pits every 12 months can continue for many years in the same site if the soil remains firm. Otherwise the pit can be lined with bricks. Each year the family gains a rich and valuable form of compost.

Teaching Ecological Sanitation in Schools

How to build a simple VIP toilet with bricks and door

Peter Morgan and Annie Shangwa

Building a brick VIP toilet

It is possible to use the same slab we used to make the simple Arborloo described in the last chapter to build a more permanent brick toilet, which can operate like a Blair VIP. The best size of slab for this is 1.1m or 1.2m in diameter, but smaller slabs can be used, as small as 0.9m, but they provide less space inside. If a toilet is to become a VIP the slab must have a hole for the vent as well as for the squat hole or pedestal hole. When bricks are used to make the "house" it is essential that bricks are used also to line the pit. Otherwise the house will collapse into the pit as it is very heavy.

Digging and lining the pit

The pit should be dug wider than the final pit diameter because bricks will be used to line it and this will reduce the diameter. So if the final pit diameter is to be 1.3metres, then the pit must be dug at least 1.5metres in diameter. For most households the pit should be dug at least 2 metres deep. With care it is possible to line a pit down to 2mettres and also make a good concrete slab with one bag of masonry cement, providing the cement is fresh. In the example described here, built at the Chisungi school, the pit was dug only to one metre deep as an example of what could be build by the pupils themselves. But when the pit is dug in the homestead, it is best to dig to at least 2m in depth and better 3metres of a long life is required.


In this case the pit was dug 1.5m across and 1m deep. A mix of one part cement and 15 parts pit sand was used to make the cement mortar.


The bricks are laid in a circle as close to the pit wall as possible. See how the bricks are laid on top of one another. Half way up the pit, each course of bricks is stepped in a little so the diameter starts to get less. This method is known as "corbelling." This allows for a small slab to be fitted on a larger pit – so it is a useful technique.

The bricks are laid as shown in the photos, so that the joint between two bricks is made in the middle of the brick below. This method of bonding bricks together makes the structure very strong. The roundness of the structure also makes the pit lining strong. A technique known as "corbelling" is used in this technique. This means that half way up the pit lining each course of bricks is stepped in a little so that the diameter is reduced as we get nearer to the top of the pit. The uppermost course sho uld be the same as the diameter of the slab which will be placed on top of the brick lining. In this case that is 1.2metres.


The top of the brick ling comes above the ground level as shown in these photos. The outside diameter of the final layer of bricks should be the same as the diameter of the concrete slab.

Soil from the pit is then placed down inside the space between the bricks and the pit wall and built up to ground level. Then a layer of weak cement mortar (16:1 sand and cement) or traditional anthill mortar is laid over the bricks. The concrete slab has already been made (see earlier chapter) and laid on top of the bricks in a bed of cement mortar. It is important to get the orientation of the slab correct with the vent hole at the back of the toilet. Laying the slab in a bed of mortar helps to avoid cracking as neither the slab or the top of the brickwork is perfectly level.

Once the slab is laid solidly on the bricks some cement mortar is plastered around the slab to seal it nicely with the bricks.

Making the brick "house" (method one)

In this case the house (superstructure) will be round and made of bricks fitted with a door. The doorframe is made up first in wooden poles or other timbers. The frame is linked to the brickwork through a series of nails which are hammered into the door frame. The

4

position of the nails is made by laying the doorframe on the ground and placing bricks along side it, so the nails will find their way into the cement mortar placed in between bricks.


Nails are hammered into the door frame so that they can be held by cement mortar placed between the bricks. Once the two upright frames have been fitted with the nails a wooden plank is placed between the two upright poles both at the top and the bottom. These act as spacers. The wooden frame is held in place by a long wooden timber to ensure it is straight and upright whilst the bricks are being laid.


A circle of bricks is laid on top of the slab. The lowest course of bricks is laid in cement mortar placed on the slab. the mix of mortar is about 10 parts pit sand to one part cement. Where the mortar is placed around the nail some extra cement is added to make the mortar stronger at that point.


Most of the brickwork was carried out by two very skilled school boys, but each pupil on the course was given a chance to lay bricks. Some girls were very good as this task.


Most of the brickwork was undertaken by these two skilled pupils, who had great talent. The brickwork continued to near the top of the wooden doorframe upright.


The roof frame was then made in small poles being wired together and sheets cut from plastic sacks attached with thin wire.


The roof timbers are secured with wire which passes through the brickwork and over the roof poles.


Grass this then laid over the plastic sheeting and this is secured by laying reeds across the top of the grass. It is possible to fit other types of roof to a brick structure such as tin, asbestos or ferro-cement. A hole is made in the roof to fit the vent pipe once it has been made.


The timbers of the door are cut to fit inside the doorframe, now connected to the brickwork. The various timbers can be wired or nailed together. To make the door more rigid struts are made in each corner of the door to make triangles which make the unit stronger.


The hinges for the door are made from car tyres which are cut in the shape shown and then screwed into the door and door frame timbers. These hinges are very durable and have the additional effect of making the door self closing.


A sheet of stout plastic sack is cut and painted with enamel paint in this case for the door. A latch of screws and wire is made inside for privacy.

The pupils are also given lessons on how to make vent pipes from reeds and cement and other methods (see in another part of this book for details). A suitable pipe is fitted over the vent pipe hole and through the roof.

The interior of the Blair VIP toilet showing the cement pipe fitted to the vent hole in the slab and how it passes through the roof.

The proud pupils now make a garden around the toilet they have built.

The parents, teachers and members of the community can now see what can be achieved with a little help, good training and support.

Method 2: Making the brick house with door
The "*horseshoe Blair*" VIP

This is a method where two treated gum poles are placed in holes in the ground in front of the slab. The pit is lined with bricks and the slab is mounted over the lined pit as before. Then the bricks are laid in a horseshoe shape around the rim of the slab and forward to join the poles. A door can be made from wooden poles or (as in this case) with wooden "brandering." The roof is made with the same material. The door is rugged has a cross piece to make it rigid and is attached to the main treated gum pole with stout rubber hinges cut from old car tyre. These make the door self closing, which is important in the Blair VIP toilet.

The special feature of this design is that the brickwork is easy to construct and makes a good starting point for those who have no experience or little experience at brick laying. The upright poles guide the less experienced builders and the horseshoe shape provides a natural strength to the structure. Also the aim of this part of the project was to demonstrate that the more experienced brick layers could teach the less experienced pupils how to lay bricks. The roundish horseshoe shape of the structure makes this method of laying bricks much simpler than those which have a free standing wall. The following pages show the stages of construction.

Dig and line the pit

The pit is dug down to the required depth (1m – 2m) and lined with bricks as described earlier.


The pit is lined with bricks so the lining stands at least one course above ground level.

Make and fit the concrete slab


The concrete slab can be made 1m or 1.1m in diameter and is caste within a circle of bricks laid over plastic sheet or sand. 10 litres of cement is mixed with 35litres to 50 litres of river sand depending on slab size. A special mould is used to make the squat hole and a 110mm PVC pipe to make the vent hole. 3mm wire is used for reinforcing in this case 4 lengths of 0.9m and 4 lengths of 0.7m. Half the mix is added first, followed by the wire and then the second half of the mix. The moulds are removed about 2 hours after casting the concrete. The concrete is left to set overnight. It is then watered in the morning and kept wet for at least 7 days to cure and strengthen. The curing process is very important for concrete slabs. Stronger slabs can be made with Portland (PC 15) cement compared to masonry cement. The river sand should be clean and sharp to the touch. A well made concrete slab will last for generations and is a good investment in time, money and energy.

The slab is carried to the lined pit and mounted in a bed of very weak cement mortar. It must be laid level. Sometimes small stones are required, placed between the brickwork and the slab to make it level. The cement mortar is then packed between the slab and the brickwork.

The configuration of the horseshoe toilet

The name horseshoe toilet is derived from the shape of the brickwork as shown above. The two long lasting treated gum poles are mounted in holes drilled in front of the slab. The brickwork is easier to erect than toilets which have free standing walls like the standard spiral Blair VIP. This unit is fitted with a door with self closing car tyre hinges made from car tyres. The door is attached to the left hand gum pole (king post). The brickwork is mounted around the rim of the slab and then forward to connect to the posts. It is this design which has been used to train less experienced pupils how to construct the toilet in bricks. The rounded shape of the brickwork gives the unit strength and relatively few bricks are used compared to the open spiral. Also the bricks can be built on edge which reduced the number of bricks further. Whilst a Blair VIP fitted with a door has a moving part (the door) which is prone to damage, the advantage is that far fewer bricks are used in the construction of the superstructure and the roof area is much smaller.


The roof and door frames are placed above the slab to ensure they are the correct size. The door must lie between the two posts which will be mounted in front of the slab.


Two holes are drilled with an earth auger (or with a pick) in front of the slab about 0.5m apart. The door is used to check the distance between the two pole holes.


The holes are drilled down in the soil so the 2.4m long treated gum pole will stand 1.8m above the slab level. The door is used to check for distance between poles.

The second pole is placed in position. Once correctly placed the holes are filled with stones and soil which is rammed hard in place.

The bricks are then laid in a circle to form the horseshoe shape. Cement mortar is made. This can be 16 parts pit sand to 1 part cement. The bricks are laid with plenty of mortar between them.

The brickwork is then built up course by course.


Wire loops can be placed around the poles and into the cement mortar every 5 courses up. These help to bond the brickwork to the poles.


Photos showing the arrangement of the bricks and the bonding technique used.


Girl pupils built the entire structure under the tuition of the boy pupil. Higher up a chair is required to lay the bricks.

The arrangement of the slab and brickwork. Also the arrangement of the squat hole and the vent hole.

The roof and door

Wooden brandering is used to make the frames for door and roof. The door is 0.5m wide and 1.5m in length. The roof is 1.6m wide and 1.35m wide (the 5 wood lengths between side timbers being 1.3m each in length, The door timbers are held together with plywood triangles which are nailed to the timbers. The roof timbers are wired together.

The door frame is covered with heavy duty shade cloth attached with small nails or drawing pins. The roof is covered with chicken wire which is covered with black plastic sheet and then grass.


The door covered with heavy duty shade cloth. A later design has a single diagonal wooden strut and can be covered with hessian (sacking) material painted with cement paint.

The rubber hinges

The rubber hinges are cut from the sides of a used car tyre. The rubber hinge is nailed to the door frame as shown. Since this door is heavier than the one shown earlier in this chapter, two pieces of rubber have been used. Two sets of hinges are fitted per door.


The hinges fitted to the lower part of the door frame with nails. The part of the hinge which is attached to the post is best held with screws or suitably sized bolts. This method makes it easier to remove the door if it requires repair. The door can be replaced or upgraded and will require maintenance. It is best if it can be detached by unscrewing or unbolting. Removing long nails may damage the link between bricks and pole.

Placing grass to the roof and fitting to the structure


The roof frame is covered in plastic sheet and grass and mounted on top of the two gum poles and rests on the brickwork at the rear of the toilet house.


Wiring the roof in position. In an upgrade the roofing material can be made with cement impregnated hessian.

Fitting the vent pipe

A range of possibilities exists for the vent pipe. This can be made of PVC, tubes of cement made with sacking, hessian or reeds, paper cement pipes or pipes plastered on to the walls (see school-girls toilet). However when considering the concept of re-use of the parts, it is best to fit a pipe which can later be removed and refitted to a new toilet. Lower cost pipes made of cement slurry and hessian may be best.


In this case a pipe made of paper and cement paint has been chosen as a trial. Cement filled hessian make stronger pipes. This has been fitted with a screen. A hole is cut in the roof material and the pipe pushed through from beneath.


The pipe above the roof. The base of the pipe is cement mortared in place.

The girl - builders and their teacher (the boy on right) stand proudly by the toilet they built themselves.

Teaching Ecological Sanitation in Schools

How to build a spiral brick VIP toilet

Peter Morgan and Annie Shangwa

Building a brick VIP toilet with spiral structure

We have described how to make a brick Blair VIP with a door. But the type without a door is the normal way Blair VIPs are built, because there are no moving parts and the inside never gets too light. The same concrete slab is used -1.1m or 1.2m in diameter. Once again the slab for a Blair VIP must have a vent hole as well as a pedestal hole. Brick superstructures must be supported by brick lined pits.

Digging and lining the pit

The pit should be dug down about 2 metres or more if possible. And it should be dug at least 1.5m wide, so that the inside diameter is 1.3m after the bricks are laid. Better to dig wider if possible. It is possible to make the cement mortar for the brickwork and a good concrete slab with one bag of cement, providing the cement is fresh. The photos here show a pit dug down only to one metre deep as an example of what could be build by the pupils themselves. But when the pit is dug in the homestead, it is best to dig to at least 2m in depth.


In this case the pit was dug 1.5m across and 1m deep. A mix of one part cement and 16 parts pit sand was used to make the cement mortar.


The bricks are laid in a circle as close to the pit wall as possible. See how the bricks are laid on top of one another. Half way up the pit, each course of bricks is stepped in a little so the diameter starts to get less. This method is known as "corbelling." This allows for a small slab to be fitted on a larger pit – so it is a useful technique.

The bricks are laid as shown in the photos, so that the joint between two bricks is made in the middle of the brick below. This method of bonding bricks together makes the structure very strong. The roundness of the structure also makes the pit lining strong. A technique known as "corbelling" is used in this technique. This means that half way up the pit lining each course of bricks is stepped in a little so that the diameter is reduced as we get nearer to the top of the pit. The uppermost course should be the same as the diameter of the slab which will be placed on top of the brick lining. In this case that is 1.2metres.


The top of the brick ling comes above the ground level. The outside diameter of the final layer of bricks should be the same as the diameter of the concrete slab.


Soil from the pit is then placed down inside the space between the bricks and the pit wall and built up to ground level. Then a layer of weak cement mortar (16:1 sand and cement) or traditional anthill mortar is laid over the bricks. The concrete slab has already been made (see earlier chapter) and laid on top of the bricks in a bed of cement mortar. It is important to get the orientation of the slab correct with the vent hole at the back of the toilet. Laying the slab in a bed of mortar helps to avoid cracking as neither the slab or the top of the brickwork is perfectly level.

Once the slab is laid solidly on the bricks some cement mortar is plastered around the slab to seal it nicely with the bricks. At this stage a very stable pit and slab structure has been formed. Many types of superstructure can be fitted on this slab as it will be very stable with a reasonable pit capacity.

4

Making the brick “house”

In this case the superstructure will be built in a spiral (door-less) shape. This overcomes the need to have a door, which is the preferred method with the Blair VIP. With this shape some of the brickwork for the “house” will come outside the slab area and a special brick foundation needs to be built to support the walls.


These photos show how the foundation is built. The soil is dug down a little and the brick laid in weak cement mortar. The foundation is made so the space between the outside entrance and the inner entrance is at least 45cm. Two courses of bricks have been laid for the foundation 22cm wide. The brick wall, which is 11cm wide is built in the middle of the foundation as shown. At first the bricks are laid around the outside of the slab as shown. Then the back of “house” is extended beyond the slab and onto the foundation. The space between the slab and the outer wall is filled with soil which is rammed hard.


These pictures show the first course of bricks and the third course. The bricks are built up straight using a straight piece of wood to get it straight up.


The brickwork continues upwards


At about the 15th course some glass bottles are introduced into the brickwork. These will later act as windows allowing a little more light into the toilet house. They are cement mortared in position and the brickwork then continues upwards.


Photo showing glass bottles in wall. The full height of the superstructure is about 19 courses of bricks.

A wooden roof frame is then made. Reeds can be laid within the main frame for more support to the plastic sheet which is laid on top. In this case white bags have been used. Later a black plastic sheet will be laid over this lower sheet and then grass will be laid on top.

The roof is then laid down on top of the brick structure. The front is raised slightly so that rain will tend to run off the back. It is possible to fit other types of roof to a brick structure such as tin, asbestos or ferro-cement. A hole is made in the roof to fit the vent pipe once it has been made.

The vent pipe is cement mortared in place on the slab. A sheet of black plastic is laid over the roof and a hole made in it for the vent pipe. Later grass is laid over the black plastic to protect the plastic sheet from the sun and to make the inside cooler.


Some cement mortar is then laid on the soil placed


The final structure looks smart. The pipe is fitted with a fly screen.


In this case a mulberry tree has been planted in a pit dug about half a metre away from the toilet on the entrance side. This is filled with fertile soil and the young tree is planted. Later the tree will grow and use the nutrients in the pit to make it grow faster and larger and provide more fruit.

Teaching Ecological Sanitation in Schools

How to build a school-girls VIP toilet

Peter Morgan and Annie Shangwa

Building a school-girls toilet

This facility is a very important part of any schools programme. In the past toilets have not been designed with the specific requirements of school girls and young women in mind. This has been and remains a major failure of both the Zimbabwe and also many international sanitation programmes. School girls and young women have very specific requirements in terms of privacy and the need for hygiene in relation to their menstruation. The existing multi-compartment VIP toilet never catered for this need and thousands of young lives have been adversely affected by this deficiency.

School girls require a toilet that provides safety as well as privacy. The need to be able to dispose of sanitary pads or cloths is important. The need to be private and safe is important. The door-less multi-compartment system is inadequate. Units for school girls should offer space and privacy as well as security. A door which can be closed off is important. Also there is a requirement for being able to sit rather than squat. And of no less importance, the requirement of being able to wash or cleanse using water, and preferably inside the toilet. There is also a need to have enough light within the structure to wash. So we need space, a seat, water, a door and enough light.

The method of construction of the toilet for the "girl child" can vary. Used wash water can drain away through a pipe from the washing facility within the toilet to a drainage area outside the toilet. This can be planted with a tree, so the water is used for a useful purpose. Since sanitary pads or cloths will be thrown down the pit, it is unlikely that the pit compost will be suitable for excavations. But recycling of the nutrients can still take place by placing a tree near the main pit. The structure is best made of bricks built over a brick lined pit. The roof can be upgradeable, starting off as a wooden frame covered with grass and progressing to a more permanent roof made of asbestos, tin sheet or ferro-cement. The type of vent pipe can also vary from PVC, cement/fabric pipes or as in this case pipes fabricated in cement mortar on the internal walls of the toilet house.

Building a toilet for school girls

This toilet is based on a ventilated pit toilet principle. The pit is lined with bricks, covered with a concrete slab and a brick structure is built and fitted with a door which can be latched from the inside. For convenience and comfort a pedestal fitted on the slab and this will require a slab which has a round hole made in it. The pit is lined with bricks using a corbelling technique as described in the last chapter. This photo series shows school girls and boys building a brick toilet and highlights some important aspects of the design.

Once trained and offered suitable support school children are able to build very good toilets. The pit is lined with bricks bonded together with cement mortar.

The upper course is made the same diameter as the concrete slab. The slab is fitted over the lined pit. In this case a circular hole is cast in the slab in place of the squat hole as a pedestal will be fitted.

3


The round slab is used in this case about one metre in diameter with hole for the vent pipe and pedestal. The space inside the toilet can be enlarged to suit the specific requirements. A brick foundation is laid on the ground outside the slab area. The brick wall will be built on top of this foundation.


The brick wall is built up layer by layer. The vent pipe hole is positioned quite close to the brick wall.


A line of bricks is laid at the entrance on the same level as the slab. The brick wall is supported by a foundation along its full length.

The brick wall is almost complete. The roof frame made of wood has been prepared in two parts to fit the structure. The hole for the pedestal and the vent pipe. The vent pipe type is optional.

The upper courses of brickwork are high and a chair is required to stand on for the primary school builders. Preparations for making a pipe plastered on the internal wall of the brick structure. In this case a 2.5m length of 90mm PVC pipe is covered with a plastic sheet. This will form the mould around which the cement mortar is applied.

The plastic sheet is wrapped around the pipe and held in place with tape.

The plastic covered PVC pipe is taken into the toilet and its lower end placed in the vent pipe hole. If the wall has already been plastered as in this case, the plaster should be removed to reveal the brick work. It is best make this pipe against brickwork which has not yet been plastered. A strong mortar is made up to make the pipe. This is made with one part PC15 cement and 3 parts pit sand. In this case bricks are piled up around the pipe with a space between. The space is filled with mortar course by course.

The pipe is held in place by placing a wire around the pipe and hanging down outside the toilet. The strong cement mortar is applied around the pipe course by course. This was an experimental technique only.

6

The mortar fills the space between the bricks and pipe. On the right the pipe is almost complete.

The cement mortar is allowed to cure overnight. The pipe is then removed with a twisting motion and completely removed from the toilet. Next the plastic sheet is twisted and pulled out of the cement plaster tube.

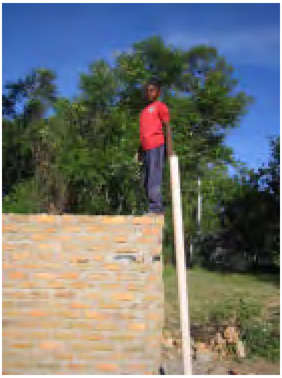
 

The bricks are then removed from the plaster pipe

The mortar is then scraped down to a smooth rounded shape. The pipe is then inserted again.

During the scraping process weakness or holes in the mortar tube will be revealed. These can be filled with new mortar. The pipe is then completed smoothened off with cement mortar and left to cure.

8

The pipe is removed again. The top of this internal mortared pipe is set at the same level as the wall. An extra length of pipe about 50cm long will be added on top later.

The hand washing device (water dispenser and basin)

Many designs of a water dispenser are possible. In this case a 5 litre plastic bottle has been cut and drilled as the photos show. In this case holes have been cut at the top of the bottle as shown and two small holes drilled near the bottom. Water is carried by the girl child into the toilet and this is poured in to the dispenser. The water can be held in bulk within the toilet in a larger plastic container. Water is added to the dispenser and then pours out slowly through the holes.

The water dispenser is held up with a stout wire which passes through the handle of the bottle and through the brick wall. Water is poured in from another bottle.

The wire holding the bottle. Two small holes have been drilled through near the bottom of the bottle. Sufficient water for washing flows out.

Making the basin support

The basin support is made of bricks as shown.

The water outlet pipe.

A hole is cut through the brick wall and a 25mm plastic pipe is inserted. The upper end is fitted to a funnel which will receive water from the basin. In this case the funnel is made from a plastic milk bottle.

Making a concrete basin

The concrete basin is made by applying a very strong mix of PC15 cement and sharp river sand (ration 1:2) to a mould covered with thin plastic sheet. In this case the mould is a metal basin. A short length of pipe is placed in the casting to act as a water outlet.


The strong concrete is added all over the metal basin mould covered with thin plastic film.


The concrete replica of the basin is removed from the mould

Fitting the basin


The basin is fitted in position on the basin holder and mortared in place.


A paint made of neat cement and water is made up and applied with a brush over the surface of the basin. This makes it smooth. The facility is then neatened up. The facility is valuable for girls when placed inside the toilet.

Drainage water to irrigate a tree outside the toilet.


The wash water passes out of the 25mm plastic pipe into a seepage area planted with a tree. In this case a 1m deep drilled hole is being made with an earth auger. The girls drill down through the soil with the auger.


The hole is then filled with a mix of garden compost and soil. The tree (in this case a mulberry) is planted in the rich soil. The soil around the tree is covered with a mulch of leaves to cover up the drainage water.

Making the short vent pipe

The mortar pipe made inside the toilet is fitted with an extra 0.5m length of pipe which will pass through the roof. This length can be made of PVC to match the size of the mortared tube. In this case the pipe is made with paper bonded with a paint made of PC15 cement and water. The method is described in this book.


In this case a short mould has been used about 0.6m long. The mould is made of 90mm PVC pipe which has been cut along its length into 3 pieces. These three pieces are wrapped around two tin cans (one at each end) with their bottoms removed. The 3 section of PVC pipe are held in place around the cans with pieces of rubber car inner tube.


The two cans have been removed and the 3 pieces of PVC pipe removed from within the cement pipe. A piece of fly screen (in this case PVC coated fibreglass has been cut and wrapped around one end of the pipe and held with string. This type of screen will last 5 years. The best fly screens are made of aluminium or stainless steel. Aluminium is cheaper.


The top end of the pipe is then plastered with a string 2:1 mix of sand and cement to hold the screen in place. It is kept in the shade and left to cure and harden.

Fitting the upper section of pipe on the structure


These photos show the pipe being fitted after the roof has been fitted. For details of the roof see below. A hole is made in the roof wires, plastic and grass to allow the pipe to pass through. The short length of pipe is fitted and made vertical. This may require a short length of PVC pipe to be used at the junction.


The pipe is cemented in position using strong cement mortar. The pipe emerges well above the roof level as shown.

The roof.

The roof in this case has been made with lengths of wood fitted together with wire. The timber used is called brandering – it is used in roof construction in standard housing to support tiles etc. The roof area is large and in this case the roof has been made in two sections. The timber frame is covered first with chicken wire and then with black plastic and finally with grass.

The two wooden roof frames being assembled. The measurements vary and are made to fit the specific superstructure. In this case the two frames were of different sizes. Front frame (2m X 1.2m) rear frame (2m X 1m)

The two frames have been covered with chicken wire. This is followed by a layer of black plastic sheet and then the grass is added on top.

Finishing off one roof panel. Carrying the roof panel to the toilet.

Fitting the front panel to the toilet. Additional bricks are added to the walls of the structure to support and raise the centre of the roof to give it a slope. Grass roofs can be smart, although they require more maintenance than asbestos, tin or concrete roofing sheets.

Roof in position

Making the pedestal

The construction of the simple pedestal is described in another chapter of this book. In this case a 10 litre bucket (with base cut off) has been built up with a concrete sheath. The surface of the seat is files down and made smooth. It is painted with enamel paint. A better method is to apply an additional coat of strong mortar to which red oxide has been added. This can be made very smart and even polished with wax to provide a neat and easy to maintain unit. To make the pedestal higher, the unit can be mounted on bricks or a concrete collar mounted on the slab around the pedestal hole.


Pedestals can be made very smart using a combination of a bucket and strong concrete.

Making and fitting a door

In this case the door is made about 1m high and 0.6m wide from lengths of wooden “brandering” which are nailed together with triangular supports at the corners. The door frame itself is attacked to a wooden post through car tyre rubber hinges. The post is attached to the brick walling with lengths of 3mm wire. The door frame can be covered in a variety of materials which include heavy duty shade cloth, cement filled hessian, thin plywood and sacking etc.

The door frame is made with wooden "brandering" and triangular plywood corners. A single diagonal strut supports the frame. Some form of covering is added to the frame. In this case sacking material called hessian.

The school girls toilet complete with door and its own mulberry tree fed by washing water from inside.