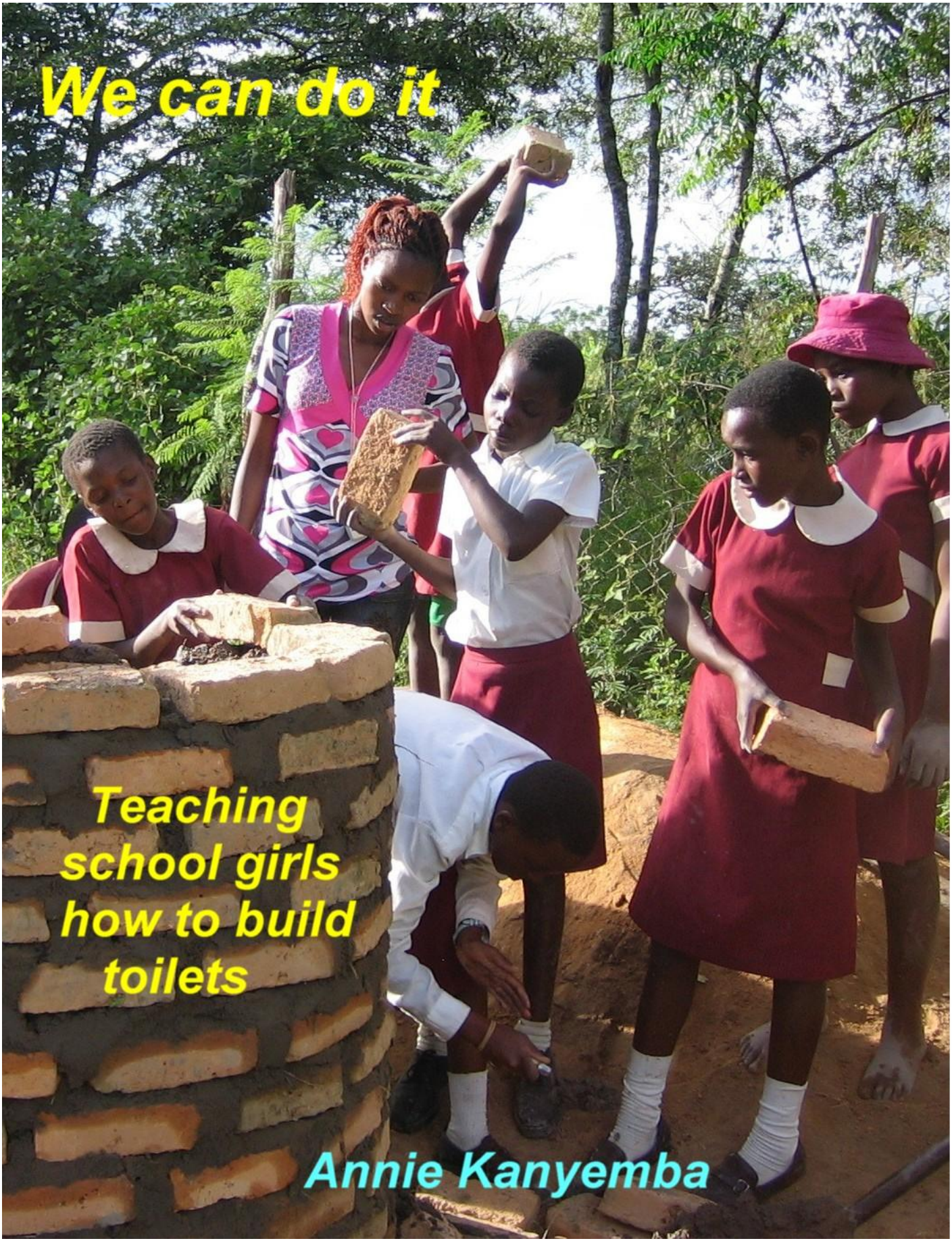

We can do it
Teaching school girls how to build toilets
Annie Kanyemba

Introduction

During the last few years we have been able to teach many people who are not artisans how to build simple toilets that are suitable for home use and even for the school. The type of toilet we use in Zimbabwe is called the Blair VIP (Blair Ventilated Improved Pit). More recently lower cost toilets have been designed, which are also simpler to make, but keep the properties of the VIP toilet.

This design uses a 2m deep pit lined with bricks which is narrowed at the top (corbelled) to accept a smaller diameter (1.2m) and more economical concrete slab. This has two holes cast into it, one for squatting the other for a vent. The vent draws out odours from the pit. These corbelled pits have also been constructed by school pupils.

For schools and homesteads we prefer to build toilets without a door, with a spiral shape which also provides privacy. That has been a standard method in Zimbabwe for some time. The spiral shape of the toilet house gives it strength. And there is no door to be left open or fall off!!!

The method I describe in this manual shows how the girls can build the spiral shaped toilet house (superstructure) in bricks. In this case we have employed a builder to dig the hole and line the pit beforehand. A concrete slab has also been prepared. Also the builder adds an extension to the slab so that the spiral brick "house" can be built on top. The girls are taught how to make a slab, make the house (superstructure) and also how to make a roof. Learning how to build in bricks is useful and the toilet which is built reminds the girls that they too can do anything a man or a boy can do. They enjoy this building and are very proud of their achievement.

I thank Peter Morgan for all his help and encouragement. Peter also took the photos for this booklet. Parts of this manual are taken from his own booklet. I also thank the Headmaster and staff of the Chisungu Primary School, Epworth and the pupils of the school, especially the girls who became so proud of their building work. I also thank the Epworth Community for supporting this work.

Annie Kanyemba
Harare
June 2012

A publication by Aquamor

Materials required

1.The pit lining and concrete slab stage

Portland cement (PC15) – 1 X 50kg bag
River sand – 60 + litres (for slab)
Pit sand – about ½ cu.m. (for making cement mortar for brick work)
Reinforcing wire – 14m of 3 – 4mm or barbed wire (for slab)
Bricks (fired). 500 (standard size is 225mm X 112mm X75mm)

2. Brick structure (new economic spiral configuration)

Bricks for slab extension (100+) and superstructure (500) = 600 (approx)
Portland cement. An extra 50kg bag for slab extension, brick wall bonding and floor
River Sand. 60 litres for slab extension and toilet floor
Pit Sand. For brick foundation, wall bonding and plastering **(500li)**
Roof . Wooden frame: (40mm X 60mm timber: 2 x 1.4m, 2x 1.5m and 2x 1.6m. Nailed together and treated with mix of old engine oil and carbolineum.
Corrugated tin sheet 2 X 2.1m X 925mm wide
Vent (tubular) 1 X 2.5m X 110mm PVC fitted with aluminium fly screen

STAGES OF CONSTRUCTION

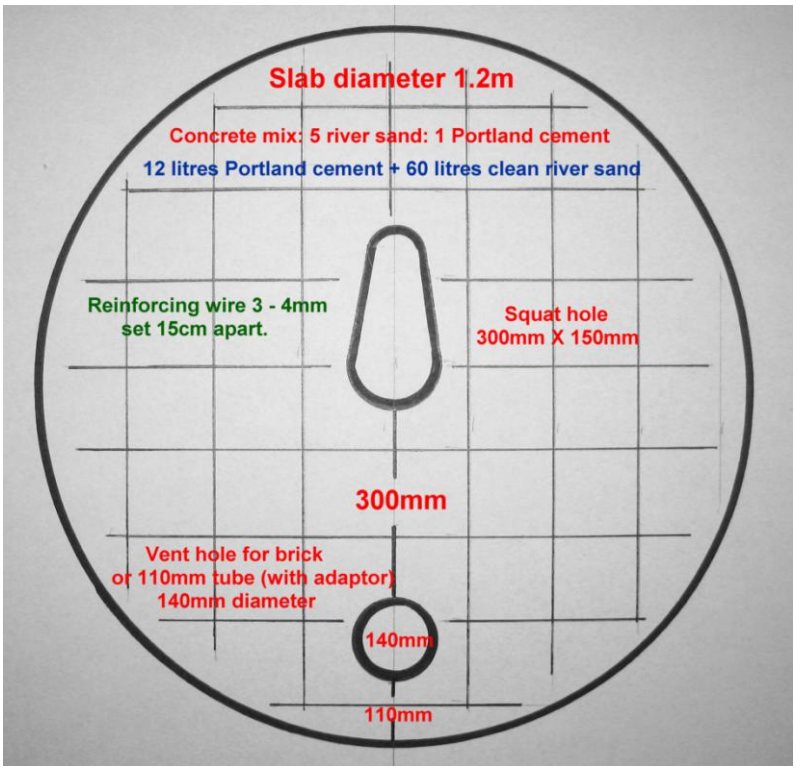
Stage 1. Dig the pit


The pit is dug 1.7m wide and 2m deep. Walls are straight and bottom flat

Stage 2. Make the concrete slab

The concrete slab is 1.2m in diameter and made within shuttering of brick or steel. It is best laid over plastic sheet. The 3mm – 4mm reinforcing wire (or barbed wire) is cut and laid beforehand to ensure correct size. This should take about 14m of wire. The vent pipe and squat hole moulds are placed within the shuttering at the appropriate places – see diagrams. A short length of 140mm PVC can be used for the vent hole, but a one litre paint tin (diameter 130mm) can also be used. A mix of 12litres of cement (one slightly heaped 10litre plastic bucket) and 60 litres of clean river sand (five slightly heaped 10 litre plastic buckets) are thoroughly mixed and water added to make a slurry-like concrete. The sand should be clean, sharp river sand and the cement fresh PC15 (Portland).

This concrete mix is added into the shuttering around the vent and squat hole moulds first, which are held in position whilst the concrete is added. Half the concrete mix is added first and levelled off. Then the lengths of 3 - 4mm reinforcing wire or barbed wire are added in a grid formation about 15cm apart. Extra wires are added between the vent hole and the slab rim. The remainder of the concrete mix is added and smoothed down. After about 2 hours the squat hole and vent hole moulds and the shuttering are removed. The slab is covered with plastic sheet and left overnight to harden. The following morning it is carefully watered and covered again. The slab should be kept wet and covered for at least 7 days. It can then be lifted carefully and place on the upper course of the pit lining brickwork in a bed of weak cement mortar. It must be level.



Dimensions of the concrete slab

Half the concrete mix is added first. Then the wire reinforcing is added (about 14m of 3mm or barbed wire cut and laid in a grid formation (see photo). Then the remainder of the concrete is added and smoothed down flat. The curing of the slab is important. After construction it should be covered with a plastic sheet and left to harden overnight. Then it should be watered daily for at least 7 days to develop strength before lifting. The longer it is left to cure in the wet state the stronger it will be. The slab should be close to 50mm thick.

Photos of girls making a concrete slab

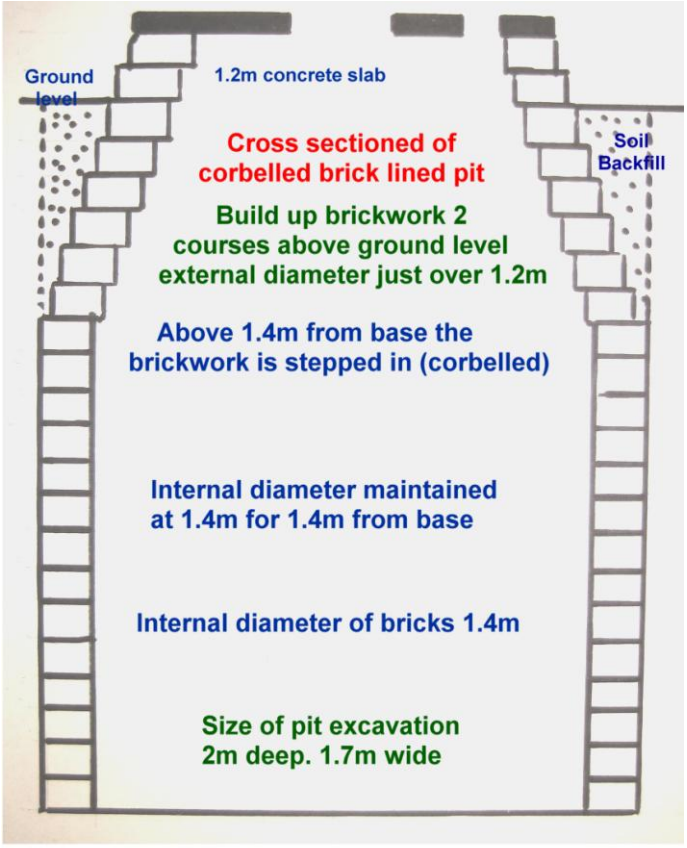

The concrete slab is an important part of the toilet. It is made of a mix of clean river sand and Portland cement. The ratio of sand to cement is 5 parts sand (60 litres) and 1 part cement (12 litres. The sand and cement are first mixed and then water is added to make a slurry like mix.


The slab is cast inside a mould which can be made of steel shuttering or a circle of bricks. The moulds for the vent hole and squat hole are laid inside the shuttering. Half the concrete mix is added first. Then the reinforcing wires are added. These can be made of barbed wire or 3 to 4mm thick wire. The wires are cut into lengths so they make a grid covering the area of the slab. The wires should be about 150mm apart.

The remaining concrete is added above the wire layer and leveled off. Then the concrete is left to harden overnight. The following morning it is soaked in water. It is best to caste the concrete over a sheet of plastic and also to cover the wet slab with plastic sheet. The slab should be kept wet at all times during the curing process. The slab must be allowed to cure (get stronger) for at least 7 days before it is moved. If the slab is not cured properly or is left to dry out it will not become strong and may crack when it is lifted. CURING IS VERY IMPORTANT.

Stage 3. Line with pit with bricks

A technique known as corbelling is used where the upper courses of brickwork are stepped in, so the diameter of the pit is reduced nearer the top of the pit. This allows a large diameter pit to be used together with a smaller concrete slab which fits over the pit. The pit is shallower (2m) and wider (1.4m internal) compared to earlier Blair VIP pits (3m X 1.1m) which makes it easier and faster to built, whilst keeping the same pit volume. Corbelled pits have been made by the boy pupils of the school, but in this exercise we decided to ask an artisan to dig the pit and line it with bricks first.



Cross section of lined pit

Cement mortar mix for bonding brickwork

20 parts of pit sand (100 litres) and 1 part Portland cement (5 litres) are thoroughly mixed first and then water added to make the mortar mix. About 5 mixes (25 litres) are required to mortar all the bricks. The mortar is laid thin between bricks.

Building up the brickwork

The inside diameter of the first 1.4 m of brickwork must be 1.4m diameter (about 19 bricks per course). Retain this internal diameter (1.4m) diameter for 1.4m above the pit bottom and then start to step in the brickwork. Each additional course above 1.4m should be stepped in by about 20mm above the lower course. The brickwork should be built up above ground level by about 2 – 3 courses so the full pit depth is about 2.2m. This will take about 24 courses of bricks depending on brick size. The outside diameter of the uppermost course should be 1.2m. The total number of bricks is about 500.

Photos of lining pit structure


Lay the bricks against the edge of the pit wall. The mortar is quite thin but sufficient to bond the bricks together. The internal diameter is 1.4m. Continue with this diameter for 1.4m from the bottom.

After 1.4m each brick course is stepped in (corbelled) by about 20mm per course. This corbelling continues till the brickwork is about 2 to 3 courses above ground level.


The brickwork is stepped in at each course. The brickwork should rise about 2 to 3 courses above ground level with a final external diameter of just over 1.2m


The space between pit wall and brickwork is filled in with soil and rammed hard.

Stage 4. Fitting the slab on top of the lined pit


The 1.2m diameter slab is carefully raised and washed and then rolled on to site. A bed of weak (20:1) cement mortar is laid on the brickwork, so that the slab can be bedded in it. The slab must be level.


The slab is lowered down on to the brick work in the correct orientation that will suit the structure. The slab is made level by adding small stones under the slab where it is low and filling with cement mortar.

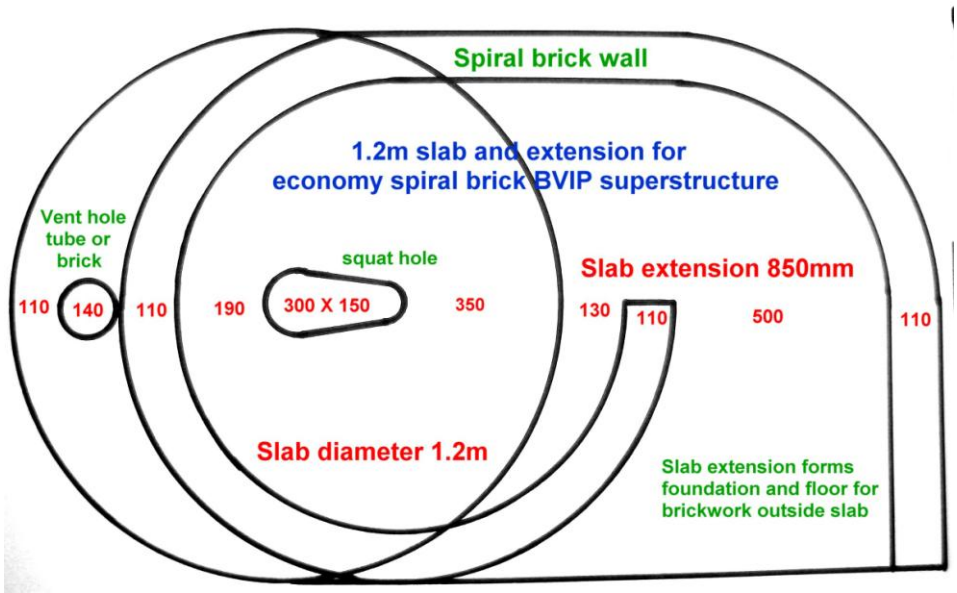
Stage 5. Making the slab extension

Before the spiral structure can be built on top of the 4 slab a slab extension must be made 85cm to one side. To make things easier a special wooden template has been designed to lay over the slab so that the outline of the extension can be made.


The wooden template has been laid over the slab and the outline of the slab extension made. A brick foundation is laid followed by bricks which show the shape of the wall.


The brick are built up to slab level and the space inside filled with brick rubble and soil which is rammed hard. The slab extension is built 850mm to one side of the slab.


A strong mix of concrete (one part Portland cement and 5 parts river sand) is then laid over the rubble to form a floor.



The slab extension is built to one side of the slab extending 850mm. The spiral structure is built on top of the slab and extension.

Building the brick spiral superstructure (“house”)

The “house” or superstructure is built using fired earth bricks or concrete bricks. These are mortared together with a mix of Portland cement and pit sand. The mix is weak for economy (20 parts sand to 1 part cement), but this provides sufficient strength for the structure. To assist in the building of the spiral brick structure two wooden guides have been designed. These are erected at each end of the spiral brick wall. Using spirit levels they are made vertical. They guide the young builders as they mortar the bricks together.


The slab extension is allowed to harden and cure. Then the first course of bricks is laid down on the slab and extension to show the shape of the structure. The opening of the entrance is 500mm wide. The diagram shows the measurements. Once the bricks are laid down in the right shape the two wooden “guides” are erected. They are supported by side poles (aluminium or wood) placed at an angle.


The mix of pit sand and cement is prepared. The first course is built by an artisan who stands by to watch and coach the girls in the technique of laying bricks. Practice makes perfect. This is a good opportunity to learn about building in bricks. It is a very valuable technique to learn and can be fun


An artisan are builder shows the method first and then stands on one side whilst the girls start to build. Several classes of pupils have been trained in this technique and some older pupils can teach younger ones.


The skills are acquired quickly.


The girls can build from both ends of the spiral wall. The spiral shape gives the structure great strength even if the walls are not built perfectly straight.


The spiral shape rising above the slab and extension.



A total of 20 or 21 courses of bricks are built for the superstructure.



As the wall gets higher the girls must stand on chairs or drums.


The brickwork rises and is now complete. The walls may not be perfectly upright, but the special spiral shape provided the strength. It was the first times the girls had built a toilet in this series of photos. Practice makes perfect.

Making and fitting the pipe adaptor.

The basic concrete slab is made with a vent hole that can be adapted to fit either a 110mm diameter plastic (PVC) pipe or a brick pipe. When a PVC pipe is fitted a concrete adaptor is made to fit over the larger (140mm) hole.


The concrete adaptor is cast in strong concrete (4 parts river sand to 1 part cement) in a mould made of bricks. A short length of 110mm PVC pipe is inserted in the middle of the mould. One of the walls should be about 20 - 25mm thick. Some reinforcing wire is placed within the concrete. This is allowed to cure for a few days being kept wet.

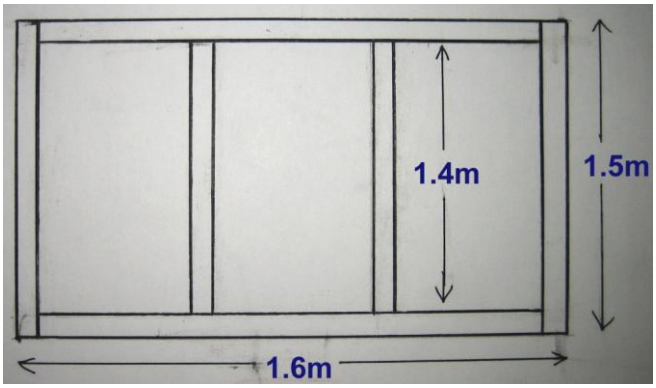


The adaptor is held in place with cement mortar. The smaller hole in the adaptor is placed directly over the larger hole in the concrete slab.

Making and fitting the roof

In this case the roof is made with a wooden frame with thin corrugated tin sheet nailed to it. However simpler roof case be made with poles, overlaid with plastic sheet and grass. But it is best to start with a good roof, especially when building at a school. The wooden frame is made first. In this case timbers were purchased and cut to the following lengths. 2 X 1.6m, 2 X 1.5m and 2 X 1.4m. They were placed together and nailed in position with 125mm long nails. The whole wooden frame was painted with a mix of engine oil and carbolinium as treatment against rot and ants. This was prepared first by an artisan.

The wooden frame is nailed together and treated with wood preservative



Measurements of the wooden frame

The thin corrugated tin sheets being nailed to the wooden frame. The sheets are 1.1m long. The sheets are sold in two widths, 762mm and 925mm. If the wider sheets are available, they are best as two sheets are required. Three sheets will be required if 762mm wide sheets are used. Small nails are used. They seem to work well.

Fitting the roof to the superstructure


The roof lifted up and placed on the superstructure


The roof must be laid square and the timbers placed on the brick wall for support.


Bricks can be placed between the timbers and the wall where there is a space.
Wires are used to hold the roof in place. These are passed through the brickwork about 3 courses down and then over the wooden timbers. The wires are twisted and secured tight.

Fitting the vent pipe

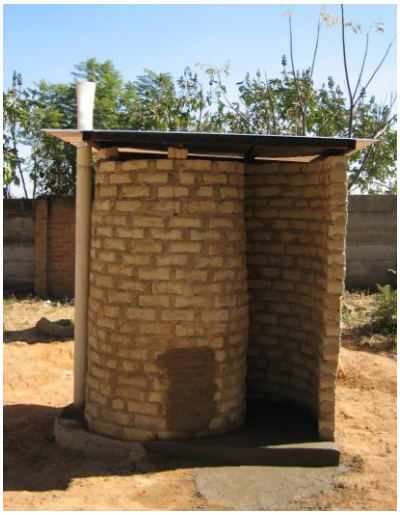
The vent is made from a 2.5m length of PVC pipe fitted with an aluminium fly screen. A slot is cut in the tin roof with tin cutters for the pipe. The base of the pipe is fitted into the adaptor. The pipe is wired in place to make it secure. The pipe must be upright.

Cutting slot in tin roof for the vent pipe. The base of the pipe is fitted into the adaptor.

Making the floor

The floor of the toilet is made by the artisan. This is made with a strong concrete mix (about 4:1 with river sand and Portland cement) and sloped towards the squat hole. This must also be left to cure for a few days to get strong. The floor will wear and must be strong.

The toilet floor is laid so it slopes towards the squat hole. It is made in strong concrete and made smooth. It can be painted with a epoxy bitumen paint to reduce urine absorption.



The completed toilet. The girls have great pride in building and carved their names in the cement plaque made on the front wall.

Some other photos of “girls” making the toilet

The former Miss Zimbabwe, Malaika Mushandu, and me building a toilet!

Washing hands

Washing hands is so important after visiting the toilet and also before eating


The Zimbabwean "tippy tap" known as the Mukombe.

Learning how to make hand washers at school


Alloy cans can make very good hand washers


The very simple home-made hand washer – from an alloy can!

WE BUILT IT OURSELVES!

The team of proud girl builders who constructed the toilet shown in this booklet *IT WAS FUN! and IT WAS PRACTICAL*

Ready for use – by the girls!

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