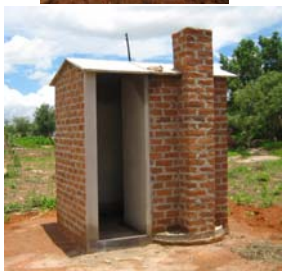
Variations on a theme .
Many variations on the uBVIP are possible
Start simple and upgrade













The Upgradeable Blair VIP

Concept explained and methods of toilet construction

Peter Morgan

Acknowledgements

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Peter Morgan
Harare
September 2011

The Primary Aim

A safe form of excreta disposal and a means of maintaining personal hygiene is an essential component to a good healthy life. Whatever system of sanitation promotion is used, some form of toilet construction will be required. The concept of starting simple and upgrading over time is a logical and practical one. In the first instance it is not necessary to build a full VIP system, but upgrading is possible. In terms of sustainability, the system should be cost effective and good value for money from the users point of view. The system should be ecologically sound and recyclable both structurally and biologically. Converting nutrients held in excreta into useful commodities like timber or fruit makes good sense. This helps the sustainable concept of the system being used. The system should provide good service over a period of at least a decade and have a multi-purpose function.

Recycling the organics

There are several ways of recycling the organic contents of the filled pit. These include:
1.. Planting a tree on top of pit contents in a thick layer (300mm) of topsoil placed over the pit contents. (or planting around the pit)
2. Alternating the use of two pits (Long Cycle Fossa Alterna) and using the compost on the garden. (see another manual).

Reduce the addition of plastic, rags and other garbage to the pit as much as possible. The life of the toilet pit will be extended if bulky garbage is added to a separate garbage pit. Also some soil, leaves and wood ash should be added to the pit during the filling stage. This will help the contents of the pit to decompose more efficiently. The soil adds soil microbes, and the wood ash adds potash to the pit contents. The leaves and any plant material will also add air and more beneficial bacteria into the mix. A pit full of compost derived from human excreta contains many vaulable nutrients.

Each method has its own merits. If there is space and the owner requires more trees (for fuel or fruit or shade) then the first method is ideal. Digging and lining a new pit and moving the structure and slab across and planting a tree in the layer of topsoil, over the old pit, is not difficult, and can bring economic benefits.

The best long term solution is to use the method of alternating between the two pits. In this case soil, ash and leaves are added to the pit during the filling stage of the pit. Since the frequency of alternating pits will be above 5 years and up to 10 years these extra ingredienes are added weekly and not daily as in the normal Fossa alterna. The slab and structure are moved to the second pit and the filled pit covered with a thick layer of soil.

With the Long Cycle Fossa Alterna technique, the contents of the first pit are dug out when the second pit is full. The superstructure is taken apart and the slab moved across to the original pit and the superstructure rebuilt. Portable structures are also valuable for this method. If the method is followed carefully this technique will ensure that the uBVIP will have a very long life and provide excellent service, and even an economic benefit.

Maintenance and use

The uBVIP should be kept clean and washed down regularly. The flyscreen should be checked from time to time to ensure it is not damaged. Since spiders can weave their webs in vent pipes, some water from a bucket should be poured down the pipe from time to time.

Do not throw garbage down the toilet pit as this will reduce the life of the pit considerably. Throw garbage down a special garbage pit which is coveed with a lid.

To accelerate composting in the pit, add soil and leaves (or other vegetable matter) from time to time. This is particularly useful if the intention is to empty the pit contents later. This method may be useful if the alternating pit system (Long Cycle Fossa alterna) is to be used. it

Recycling the hardware

The economic version of the brick built uBVIP with roof made from a treated wooden frame and corrugated tin (or asbestos or cement filled hession) sheet, is much easier to dismnantle than the convensional brick BVIP. Also if a tubular pipe is fitted, the skill of building a brick pipe as part of the structure is not required. However brick pipes may last longer and are not so easy to steal!

In the uBVIP, once the pit is full, after about 10 + years, a new pit can be dug nearby using the same dimensions as the first pit (2m deep with corbelled brick lined pit. The slab extension can also be built. This will require less than a bag of cement and bricks. The structure can then be taken apart. The roof is removed first (the vent pipe can also be removed, if tubular). The weak cement mortar mix used for the brickwork should make the bricks of the structure easy to separate and clean. The concrete slab is then transfered to the new pit. Using the same roof and bricks (and pipe if in good condition) an identical superstructure can be built over the slab and slab extension. A new floor can be laid from the same bag of cement and sand. The content of the old filled pit is then covered with a thick layer of soil and left to decompose and change into compost.

An Introduction to the Upgradeable Blair VIP

The existing policy requirement for rural family sanitation is based on the construction of a standardized brick Blair VIP. However the GOZ, through its National Action Committee and National Co-ordination unit has now accepted a simpler and upgradeable sanitation technology known as an Upgradeable Blair VIP, which is now on trial and being monitored by the Government. This unit, which initially consists of a brick lined pit capped by a versatile concrete slab, requires the use of a single bag of Portland cement and fired bricks for its construction. This is the starting point of an upgradeable series of toilet technologies which can lead to the construction of a standard brick BVIP. Once the pit has been dug, lined and capped with a concrete slab, the owner is responsible for the construction of the superstructure which it can afford and suits its requiremens. A step by step process of toilet upgrading and improvement is possible.

The toilet ascends up a sanitation ladder which can lead to the standardized brick BVIP. This means that the initial cost is low, but a range of upgradeable structures can be built on top of the pit. Various methods of recycling the organic and constructional components of this unit are also possible. Various manuals related to this and the construction of the standard BVIP are also available. The acceptance of this new approach in Zimbabwe is a bold new move to make sanitation technology more flexible and sustainable with the aim of attaining a much broader coverage for a wide range of recipients.

Peter Morgan

Harare

September 2011

Types of toilet in the range of options

Extra refinements

The basic uBVIP can be improved in several ways. An important part is the construction of a sloped toilet floor from a strong mix of PC 15 cement and river sand (5:1) A strong mix of river sand, pit sand and cement may be best. The internal walls of the toilet can be plastered. This may be important if the toilet is also to be used as a bathroom. However plastered brick walls are more difficult to dismantle if reuse of the bricks is considered. After ten or more years of use, when a new pit will be dug and lined, and capped by the existing slab, the owner may choose to use new bricks to build a new structure. The concrete slab and easily removable roof, if made of tin over treated timber, should also be reusable.

Hand washing

No improvements in health linked to sanitation can be expected without the regular use of a hand washing device linked to the toilet. Many simple hand washing devices have been designed. One shown here can be made from a used old alloy can with holes punched in it. The can is placed over a log or pole which makes the holes easy to make with a nail. Two holes are made on either side of the can at the top. Then a single hole is punched into the base of the can in a position between the two holes at the top of the can. A good nail diameter is 3mm.

A length of wire about 30cm long is then taken and passed through the two holes at the top of the can. The wires are twisted together behind can. A loop is made at the end of the wire. The hand washer is hung from another wire attached to the toilet roof.

A container of water (like a bucket or gourd) is required as a source of water. The hand washer is dipped into the water and then hung up on a wire hook suspended from the toilet. Then hands can be washed. Used water can drain on flowers.

Adding the tubular vent pipe

In this design, a tubular vent pipe made of PVC or other material is used. This has a diameter of 110mm and is fitted with a corrosion resistant aluminium flyscreen. The pipe is fitted into the adaptor. A slot is made in the tin roof sheets so the pipe can be erected vertically. Once the pipe is fitted it is held in place by strands of wire placed through the brickwork and around the pipe. The pipe must rise above the roof level.

Adding a concrete toilet floor

It is desirable to add a sloped concrete floor inside the toilet, so that the floor is easily washed down and can be used for bathing. This can be sloped down from a line of bricks laid at the entrance.

Materials required

The Upgradeable BVIP is constructed in two stages. The first stage is the substructure—a brick lined pit capped by a concrete slab. The slab is designed with both a squat and vent hole. The second stage is the construction of the superstructure. Many variations of the superstructure are possible. In pre– VIP designs, when a pipe is not fitted, the vent hole is covered with a small disc shaped slab of concrete. This can be removed later when a pipe is fitted.

Stage 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 – 12m of 3 – 4mm or barbed wire (for slab)
Bricks (fired). 500 (standard size is 225mmX 112mmX75mm)

Stage 2. The superstructure

The materials for the superstructure vary considerably depending on the type of structure built.

1. Simple grass and pole structure (spiral).
The minimum will be about 10 treated gum poles and grass and wire and binding string. Poles, plastic sheeting and grass for simple roof.

2. Brick structure (new economic spiral configuration)
Bricks for slab extension (100+) and superstructure (500) = 600 (approx)
Portland cement. Allow an extra 50kg bag for slab extension, brick wall bonding and floor. 20 litres (**0.5 bag)** if traditional mortar is used for bonding.
Traditional mortar: 1 part ant hill soil and 2 parts sandy soil.
River Sand. 60 litres for slab extension and toilet floor
Pit Sand. For brick foundation, wall bonding and plastering **(500li)**
Roof . Wooden frame: (2 x 2m x76mm x 50mm + 5 x 76mm x 50mm
Corrugated tin sheet 2 X 2.1m
Vent (tubular) 1 X 2.5m X 110mm PVC fitted with aluminium fly screen

Measuring the cement
The 12 litres of cement required for making the concrete slab is one level 10litre bucket full. Each bucket is filled with material which is tapped down and leveled off.. It is wise to use a heaped bucket full of cement and river sand. There will still be enough cement left for mortaring the bricks of the pit.

The 20:1 cement mortar used for bonding brickwork is best measured using a 5 litre container. 5 litres of cement is mixed with 100 litres of pit sand to make the mortar. Two full wheel barrows contains about 100 litres of sand.

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 is cut and laid beforehand to ensure correct size. This should take about 12m of wire. The vent pipe and squat hole moulds are placed within the shuttering at the appropriate places – see diagrams. A mix of 12litres of cement (one level 10litre plastic bucket) and 60 litres of clean river sand (five level 10 litre plastic buckets) is thoroughly mixed and water added to make a slurry-like concrete. At first it may be wise to make these heaped buckets, reducing as experience is gained. The sand should be clean, sharp river sand and the cement fresh PC15 (Portland).

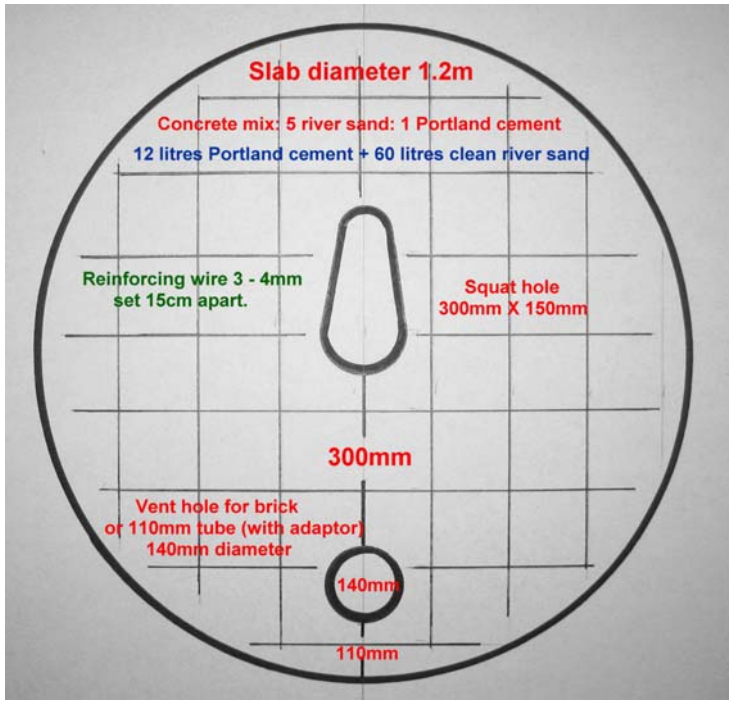
This concrete mix is added into the shuttering around the vent and squat hole moulds first, which are held in position whilst the concrete is added. Half the concrete mix is added first and levelled off. Then the lengths of 3 - 4mm reinforcing wire or barbed wire are added in a grid formation about 15cm 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.

Adding the pipe and roof

Once the walls have been built up to the correct height (normally 21 or 22 courses) the roof and vent pipe can be added. The treated wooden frame (external measurement 2m X 1.6m) is laid on the ground and 2 X 2.1m long thin corrugated iron roofing sheets are nailed to the frame. The roof is then

lifted on to the structure, the timbers being laid on the brickwork. The roof timbers are secured to the brickwork with wires. One side of the roof is raised slightly on bricks to provide a slope.

The brickwork is built up course by course using the weak (but durable) 20:1 pit sand and PC15 cement. The curves in the design of the structure help its stability. A spirit level can be used to keep the wall upright. The pre-made pipe adaptor is added over the larger vent hole using strong concrete to bond it to the slab. The 110mm hole completely covers the larger 140mm hole in the slab.



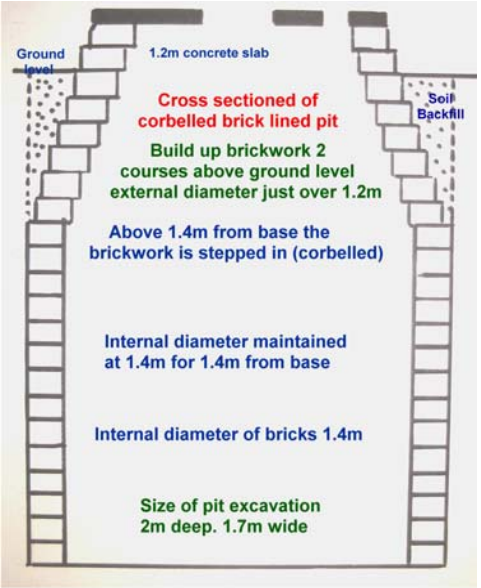
Dimensions of the concrete slab

Making the concrete slab for the uBVIP. Half the concrete mix is added first. Then the wire reinforcing is added. 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.

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.



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.

Building the superstructure wall (tubular vent pipe)

Allow for 500 bricks. The mortar is made with a mix of 5 litres of Portland cement and 100 litres of pit sand (20:1). About 4 to 5 mixes will be required to make the wall. The wall has 21 - 22 courses of bricks. The entrance to the toilet cubicle is 500mm in this economic version. The distance between the front of the squat hole and the curved wall in front is 500mm. Special wooden templates can be used to make the construction of the spiral structure easier. This method was introduced so school children could construct the spiral toilet more easily. But tthe templates are also valuable guides for all builders. The templates are erected as shown in the photos and made upright using a spirit level. The templates are made of hardwood, with angled supports.

The roof

Once the superstructure is complete a roof must be fitted. There are several ways of making a roof to cover the uBVIP. At first the roof may be made of wooden poles or wooden lenghts like brandering, covered by wires or pig or chicken netting. This can be covered with plastic sheet and grass. The preferred method is to make a wooden frame, treat with old engine oil or carbolinium and cover with tin sheet. This tin sheet method is very durable and the roof can be taken off the structure when the pit is full and used again.

The wooden frame can be made from lenghts of 76mm x 50mm timber and nailed together. In this case the length is 2m and the width 1.6m. The timber frame is painted with a mix of carbolinium and old engibe oil. The covering of the frame can be corrugated iron or asbestos. In this case 2 lenghts of corrugated iron were used (length 2.1m). The sheets are nailed on to

the frame and a slot cut into the sheeting to accept the vent pipe. The shape of the slot depends on the type of pipe. The roof frame is held in place by wiring to the brickwork.

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—3 courses above ground level.

The brickwork is stepped in at each course. The brickwork should rise about 2 to 3 ourses 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.

The orientation of the slab

(The direction the slab faces)

The orientation of the slab depends on the type of structure to be built. The most durable structures are built without a door in a spiral shape. In a more recent development the orientation of the slab has been changed so the squat hole faces the entrance. This configuration makes the spiral wall easier to construct and also uses fewer bricks. Special wooden templates can be used to make the construction easier and faster. This method is described later in this manual. Note also, before a vent pipe is fitted the vent hole should be covered with a concrete disc. This is shown later in this manual.

Building the superstructure wall (brick vent pipe)

Allow for 600 bricks. The mortar is made with a mix of 5 litres of Portland cement and 100 litres of pit sand (20:1). About 5 mixes will be required to make the wall and the vent pipe. The wall has 21 - 22 courses of bricks and the vent pipe an extra six courses. The entrance to the toilet cubicle is 500mm in this economic version. The distance between the front of the squat hole and the curved wall in front is 500mm.

Details of the brick and plastic pipe

With this design, both brick and tubular vent pipes can be used. The brick pipe is an extention of the brick wall as in all earlier Blair VIP toilets. A plastic pipe can also be fitted (110mm diameter). This will require a special concrete adaptor to be made so that the 110mm pipe can be placed over the 140mm diameter vent hole in the slab. This is made with very strong concrete with 3mm wire reinforcing within. Bricks can be used as a mould and a short length of 110mm pipe. Note the thickness of the adaptor wall next to the brickwork is 20mm






Superstructures

1. Simple start with grass and pole structures

The concept behind the uBVIP is that once the first stage is complete **(the construction of a lined pit and cover slab)**, the further construction of the superstructure should be responsibility of the owner/user. The slab used in the first stage is very versatile and can be used to make a range of simple toilets with the superstructures made of poles, grass or reeds. However at not much greater cost a more durable brick structure can be built on the same slab. This section shows some designs of grass and pole structures which can be built with locally available materials.

The grass spiral superstructure


Treated poles are placed around the slab in a spiral shape. Wires are fitted to the poles and a grass wall attached. Cement left over from the pit lining and slab construction can be used to make a cement floor in front of the slab. In this case the vent hole has been filled with concrete. A concrete disc can also be used. It can later be knocked open and fitted with a pipe. A roof can also be fitted.


The pole and grass superstructure is built around the slab for privacy. A roof can be fitted and even a pipe and sloped floor later. Flies and odours can be controlled by adding wood ash down the pit and covering the vent hole with a plate.

NOTE

In these simple structures constructed without a vent pipe, the vent pipe hole is covered with a disc of concrete which is cast separately and then mortared in position over the vent hole.. This is removed when a pipe is fitted.

Upgrading the simple grass and pole superstructure

The simple grass spiral superstructure can be upgraded in several ways. A grass roof supported by poles with plastic sheet placed between the poles and the grass covering protects the users from rain and also shades the interior of the toilet. Many simple and attractive and traditional designs are possible. A roof helps to reduce fly access into the pit. A roof is essential once a vent pipe is fitted. Wood ash can also be added to the pit to reduce odour and fly breeding. A squat hole cover-plate also helps to reduce odours and flies. If the toilet is not fitted with a vent pipe, the vent hole must be closed off. A disc of strong concrete 150mm in diameter is caste, cured and then cement bonded over the vent hole. This can be removed if a vent pipe is fitted later. Keeping the slab clean also helps. A screened vent pipe can also be fitted as an upgrade even to simple grass structures to reduce odours in the toilet and also to trap flies. Toilet floors can be sloped to assist in washing down with water. The next upgrade would be to replace the grass structure with brick and fit a more permanent roof and vent pipe if one has not already been fitted.

Simple grass spiral superstructures can be upgraded step by step
Vent pipes can also be fitted to simple grass structures

In this case the pole and grass structure is fitted with a self closing door using strong rubber hinges. Polyurethane hinges are stronger. Spiral door-less structures are more durable and preferred. At first the toilet may be constructed without a vent pipe. In this case a strong concrete disc can be cast and cemented over the vent hole. If a vent is fitted later the disc is removed and the vent fitted. A roof is essential in combination with a vent pipe.

Stages of construction of the economic spiral BVIP

The slab extension

An extension is built to one side of the slab in bricks and cement. This is built up on a brick foundation and extends 850mm to one side of the slab. This extension is built up to the level of the slab with bricks. The space between the slab and extension is filled with brick rubble and capped by a layer of strong concrete. This is left to cure overnight. The spiral brick wall is then constructed on top of the slab and the extension. This requires an extra bag of cement for making the extension, cement mortaring the bricks, making a hard sloped floor (for bathing) and for finishing off.

The curved extension to the 1.2m slab is built up in bricks to the height of the slab 85cm away from the slab. The brickwork also built up across the entrance as shown.

Stones, broken bricks and rubble are rammed into the extension within the brick wall. A layer of strong concrete is laid over this extension so the level of the slab and the extension is the same. The spiral brick superstructure is built up on top of the slab and on to the extension.

The configurations of the superstructure

A slab extension is built to one side of the slab to allow a spiral brick superstructure to be built as shown in these photos. The extension extends 850mm to one side of the slab. The slab extension is shaped as shown so that the brickwork will sit on the rim of the slab and extension. These photos show a demonstration unit. Note that the squat hole faces towards to the slab extension.

The superstructure is built in the shape of a spiral without a door on top of the slab and extension. In this technology a choice of vent pipe is possible, made from either bricks or from PVC or other materials.

A tubular pipe can also be fitted in the same position as the brick pipe. In this case a special concrete adaptor must be made so that the 110mm diameter pipe can fit over the 140mm vent hole. The chosen vent pipe depends on family choice. A brick pipe will require more skill to make but can be made from local materials (bricks). The plastic pipe is more efficient as a vent and fly trap, but is less durable.

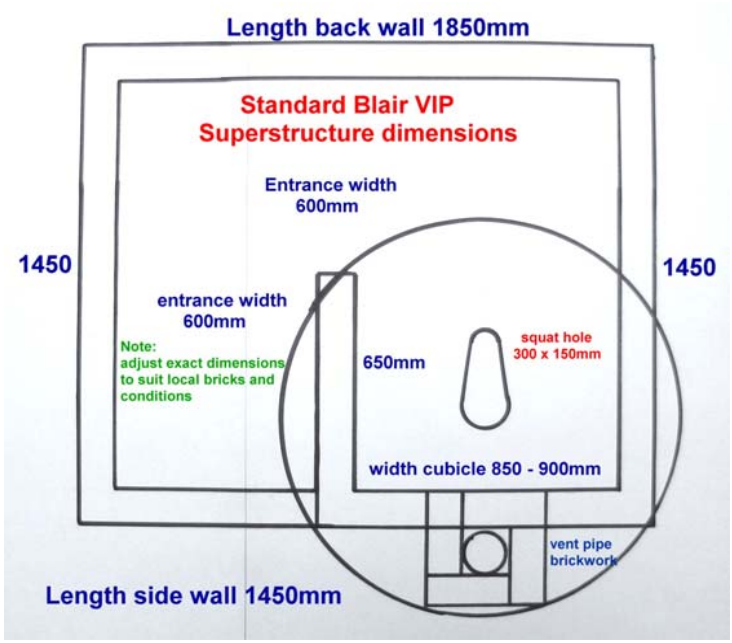
The entrance to the toilet is 500mm wide. After the toilet walls have been built it is wise to add a sloped floor to make washing down easier.

uBVIP Brick Superstructures

Brick built spiral designs are best as they require little maintenance, have no moving parts and guarantee semi-darkness within. This toilet design has been thoroughly tested in Zimbabwe for over 30 years. Once the pit is full however they are difficult to dismantle and the pits almost impossible to empty. It is easier to start again and build another if there is space. And in the situations where most Blair VIP's are built, in the rural areas, there is space. In more recent BVIP designs, the structure is more easily dismantled and rebuilt.

The method of building the standard BVIP has been refined several times over the last three decades. Pits are now made more economically, slabs are smaller and mortar mixes weaker yet durable. All these make cost savings. For the superstructure cement money can be saved by using traditional termite mortar in place of cement mortar. At first grass roofs can be fitted and then upgraded to tin or asbestos sheet or cement slabs.

Standard BVIP dimensions



Standard "square" spiral BVIP design and dimensions

The standard brick “square spiral”

The constructions can be made in a step by step way, starting with a brick wall and a grass roof and then adding a more permanent roof later. Concrete, tin or asbestos roofs can be fitted. Cement or traditional ant hill mortar can be used for bonding the bricks.

This design is normally made with a brick vent pipe, but can be made with a tubular 110mm vent pipe, normally PVC. A more detailed manual is available for the construction of this unit, which is best made by a skilled artisan.

Selected photos of construction

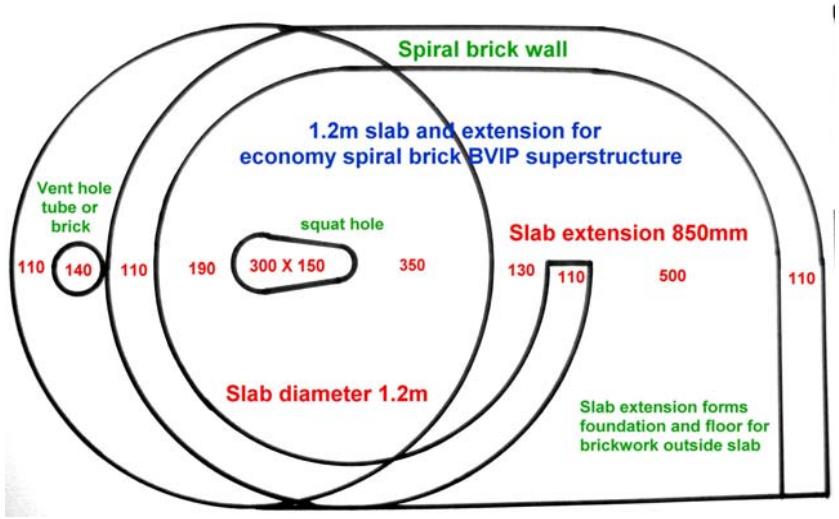
Using the same concrete slab, the foundations are laid in front and to one side of the slab and the brick wall built up. In this case the brick pipe is built up with the wall.

Completed Blair VIPs constructed on the basic slab with brick and tubular vent. The vent pipe screen is made from non corrosive aluminium.

This design of the Blair VIP is the style to aim for. It can be used as a toilet and a washroom. It requires little maintenance. It is a valuable asset to any family.

Building an economical spiral brick superstructure

More recently a new configuration of the spiral BVIP has been placed on trial in Zimbabwe. In order to economise on bricks and make the construction easier and faster, the orientation of the slab within the structure has been changed. The vent can be made with bricks or a 110mm tube (PVC or other material). The roof area is also smaller. The unit has been specifically designed so that it can be built and taken apart more easily than the original BVIP. In other words the parts can be recycled. The original pit as described in this manual will take 10 or more years to fill, in a family situation, especially if garbage is not thrown down the pit. Once filled, the pit can be abandoned or used to grow trees, and a new pit dug and lined at minimal cost. The slab, roof, pipe, and even bricks can be taken apart and rebuilt on the new pit. After some years, the contents of the original pit will compost and can be dug out, but a more effective method may be to recycle pit nutrients by planting trees on the old pit. The pit contents will compost faster if soil and some leaves are added to the pit periodically.



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

The spiral shape of the new BVIP. The orientation of the slab has changed within the structure. The shape is in the form of an almost continuous curve which provides strength. There are no moving parts. The unit provides privacy and semi darkness for fly control. The unit can be used as a bathroom.