The Blair VIP Toilet

A manual for the construction of an upgradeable series of BVIP toilets adapted for both brick and tubular vents

Peter Morgan 2012
Introduction

In 2010 the Government of Zimbabwe relaxed its technical policy guideline for family toilets (the spiral brick Blair VIP) to include an additional design called an Upgradeable BVIP (uBVIP). In this version the basic requirement is for a brick lined pit and a covering concrete slab, which allows the owner to upgrade in a sequence of steps to attain the final brick built Blair VIP. The starting point is a brick lined pit of suitable capacity capped by a slab which has both squat and vent holes. The government specifies that the range of vent pipe options should include those made from bricks as well as tubes (eg PVC or asbestos etc). It is a requirement that the minimum life of the pit be at least 10 years.

Brick built pipes can be constructed at relatively low cost with traditional materials (locally made fired bricks) and cement mortar. Brick pipes must be constructed outside the superstructure and in fact form part of the brick superstructure of current brick built BVIP designs. This necessitates that the diameter of the slab must be at least 1.2m.

The method of construction of the brick lined pit has also been streamlined. The depth is shallower than older pits (2m rather than 3m), but it is also wider (1.4m rather than 1.1m). In order for the wider pit lining to connect to the small diameter slab, a method known as corbelling is used – where the upper courses of brickwork are stepped in to the required diameter that will support the slab (1.2m). This revised method of pit lining is easier to construct since the builder can stand on the base of the pit throughout the construction. Also a well tested method of using a much weaker cement mortar has been introduced for bonding the pit brickwork. This consists of 20 parts pit sand and 1 part Portland cement. This well researched revision of the construction method means that a single 50kg bag of Portland cement is sufficient to line a pit and cast a suitable concrete slab.

Acknowledgements

Several people have given me much assistance during this era. I wish to thank Annie Kanyemba, my assistant, for her efforts in training and promotion of the concept over a period of several years. Also Mr Mutisi, headmaster of the Chisungu Primary School and Mr Kano, teacher in the same school, for their support in this project, where our research was undertaken. Several skilled builders have also been trained in this concept, notably Mr Chiweshe of Epworth. I also thank members of the NAC and NCU of the Government of Zimbabwe, for their support of this new Upgradeable Blair VIP concept and technology.

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Harare
May 2012
Start simple and upgrade - an explanation

It is possible to construct the well known standardised brick built Blair Ventilated Improved Pit (BVIP) toilet in a single building operation. Hundreds of thousands of these units have been built throughout Zimbabwe, and most have been built with the generous support of donor organisations. The “Blair” is popular because it doubles as a washroom and the square spiral structure has become the most popular.

The BVIP is a pit toilet and eventually the pit fills up. The filling time varies between 10 and 15 years depending on pit capacity, the number of users and the amount of garbage which is thrown down the pit. However eventually the pit fills up and another toilet is required by the family. A standardised brick built BVIP requires several bags of cement and a trained builder to construct and this cost is beyond the means of most rural Zimbabweans. A new concept therefore had to be found which was far more affordable and adaptable and could provided a valuable starting point from which rural families could build a variety of toilets including the standardised brick BVIP. The starting point technology and the process whereby it can be upgraded is called the Upgradeable BVIP (uBVIP).

This basic unit consists of a brick lined pit and a concrete cover slab. This is the technical starting point from which a considerable range of pit toilets can be built, including the brick BVIP. A single 50kg bag of Portland cement together with about 500 bricks, river and pit sand and some reinforcing wire is sufficient to line and cover a brick lined pit which should provide at least a ten year life. The superstructure which is built on top and around the slab remains the responsibility of the owner. The structure built by the family above the slab provides just privacy at first. In the absence of a vent pipe, smells and flies can be reduced by the regular addition of wood ash and regular washing down of the slab. A loose fitting metal or wooden cover placed over the squat hole also helps

The basic aim of this new approach is provide, at relatively low cost, a system which can considerably reduce the extent of open defecation (in the absence of any toilet), and has the potential to be upgraded into the familiar BVIP over time. “Farm bricks” are common in most parts of Zimbabwe and are produced locally and at low cost. Where bricks are not easily available alternative approaches must be found.
How the Blair VIP works
The Blair VIP is a ventilated pit toilet. The toilet slab is made with two openings, one for the squat hole and one for the ventilation pipe which is fitted with a corrosion resistant fly screen. The vent pipe sucks out air from the pit and fresh air is drawn down through the squat hole. The toilet itself should therefore remain fairly free of odours if the toilet floor is kept clean and washed down.

Flies approaching the toilet are attracted to odours coming from the pipe, but cannot pass the fly screen to enter the pit. Any flies escaping from the toilet are attracted to light coming down the pipe. But these will be trapped in the pipe. All Blair VIPs are fitted with a roof and are semi dark inside. The ideal shape for the structure is a spiral without a door.
Materials required
The Upgradeable BVIP is constructed in two stages. The first stage is the pit lining and the construction and fitting of the concrete slab. The second stage is the construction of the superstructure. The superstructure is in fact the upgradeable component. It can start as a pole and grass structure and then be upgraded to a brick structure. Or it can start as a brick structure. At least 2 types of spiral brick structure can be built – a more economical slightly smaller structure which uses 1 extra bag of cement or the standard slightly larger superstructure which uses 2 - 3 extra bags of cement. The larger structure uses more bricks and has a larger roof area, and is therefore more costly to build.

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 bricks)
Reinforcing wire – 14m of 3mm or barbed wire (for slab)
Bricks (fired). 500 (standard size is 225mmX 112mmX75mm)
(There should be enough cement left (5litre) to make a small slab extension

Stage 2. The superstructure
2a. Brick structure (new economic spiral configuration)
Bricks for slab extension (50) and superstructure (550) = 600 (approx)
Portland cement. 1 (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: (cross section: 60mm x 40mm (2X1.6m + 2X 1.5m+ 2X1.4m) .Preferably treated with a mix of carbolinium and old engine oil.
Corrugated tin sheet 2 X 2.1m
Vent (tubular) 1 X 2.5m X 110mm PVC fitted with aluminium fly screen
Flyscreen: 150mm diameter or 225mm X 225mm aluminium fly screen

2b. Brick structure (larger spiral)
Bricks for foundations (100+) and superstructure (800+) = 1000
Portland cement. 2.5 bags if cement is used for wall bonding.
2 bags if traditional mortar is used for wall bonding
River Sand. For roof and floors (250litres)
Pit Sand. For brick foundation, wall bonding and plastering (750li)
Chicken wire (for roof). 2m X 1.8m 25mm chicken wire.
Flyscreen: 225mm X 225mm Aluminium flyscreen
## Measurement of Portland cement for larger spiral brick BVIP superstructure

<table>
<thead>
<tr>
<th>Part of toilet</th>
<th>cement</th>
<th>sand</th>
<th>mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick foundation</td>
<td>10litres</td>
<td>150li (pit)</td>
<td>15:1</td>
</tr>
<tr>
<td>Floor</td>
<td>10litres</td>
<td>50li (river)</td>
<td>5:1</td>
</tr>
<tr>
<td>Walls (bonding)</td>
<td>20litres</td>
<td>400li (pit)</td>
<td>20:1</td>
</tr>
<tr>
<td>Walls (plaster)</td>
<td>10litres</td>
<td>150li (pit)</td>
<td>15:1</td>
</tr>
<tr>
<td>Floor surface</td>
<td>8litres</td>
<td>32li (river)</td>
<td>4:1</td>
</tr>
<tr>
<td>Roof</td>
<td>36litres</td>
<td>144li (river)</td>
<td>4:1</td>
</tr>
<tr>
<td>Finishing off</td>
<td>6litres</td>
<td>60li (pit)</td>
<td>10:1</td>
</tr>
<tr>
<td><strong>Total cement used</strong></td>
<td><strong>100litres</strong></td>
<td><strong>(2.5 X 50kg bags of cement)</strong></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE** if traditional mortar is used for bonding the brick walls of the superstructure this reduces the amount of cement required from 100 litres to 80 litres. A 50 kg bag of cement contains about 42 litres of material. Thus if traditional mortar (a mix of anthill soil and river sand) is used for bonding the walls of the superstructure **2 extra bags** of PC15 cement are required in addition to the single bag required to line the pit and make the concrete slab. This makes a total of 3 bags of Portland cement required to complete the whole structure. The revised method of pit lining and slab construction and the use of traditional mortar makes possible these reductions of costs of the standard BVIP.

**Total cement used for superstructure (using traditional mortar for bonding of wall bricks is 80 litres = (2 x 50kg bags of cement).**

**Measuring the cement**
The 12 litres of cement required for making the concrete slab is a slightly heaped 10litre bucket full. 10 litre buckets are used for measuring the river sand used in slab making. Each bucket is filled with material which is tapped down and slightly heaped. 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 barrow contains about 100 litres of sand.
SITING THE uBVIP

The site should be chosen by the family with assistance from the Environmental Health Technician and should be at least 30 metres from a well. The toilet site should be:

* **Down hill from a well or borehole** – to reduce possible underground contamination of the water supply.
* **Where the soil is firm** – to avoid possible latrine collapse
* **On slightly raised ground** – so that rainwater can drain away from the site of the toilet
* **Near the house** – for the convenience of the householders
* **Away from trees** – so that air can flow easily over the pipe
* **The orientation of the structure** - to provide the best privacy for the users

**Stages of construction**

The stages of construction are as follows:

1. Dig the pit.
2. Make the concrete slab
3. Line the pit with bricks and fit the cured slab
4. Build the slab extension
5. Build the superstructure

**Stage 1. Dig the pit**

Dig a round pit 2m deep and 1.7m in diameter. Dig the pit with straight sides and a flat bottom.

The pit is dug 1.7m wide and 2m deep. Walls are straight and bottom flat. Bricks for lining the pit are laid around the rim of the pit
Stage 2. Making the concrete slab

The concrete slab for the uBVIP is 1.2m in diameter and made with a mix of 12litres of Portland cement and 60 litres of clean river sand (1:5 mix). The hole for the vent is 140mm in diameter and the squat hole measures 300mm X 150mm. The vent hole can accept both brick and tubular pipes (with concrete adaptor). The 140mm hole is placed 110mm from the edge of the slab and the vent and squat holes are 300mm apart. The holes are placed down the centre line of the slab. The vent hole is made by using a short length of PVC pipe as mould (140mm) or a one litre empty paint tin (130mm). The squat hole in this case is made using a specially designed steel mould. About 14m of steel wire or barbed wire is required for reinforcing per (5 X1.1m + 5 X 1m + 4 X 0.6m). The slab is cast over plastic sheet or on levelled ground covered with sand which is wetted down. One slightly heaped 10 litre plastic bucket contains 12 litres of material. One slightly heaped 10 litre bucket of cement and 5 slightly heaped buckets of river sand are used. The moulds can be made of steel shuttering or bricks.

Details of concrete slab for uBVIP
Making the concrete slab

A mix of 12 litres of cement (one slightly heaped 10 litre 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. This is added into the shuttering around the vent and squat hole moulds which are held in position whilst the concrete is added. Half the concrete mix is added first and levelled off. Then the lengths of 3mm reinforcing wire or barbed wire are added as shown. The wires are added in a grid formation about 15 cm apart. About 12 m of wire is required and cut up. A total of about 14 m of 3 mm wire is used per slab (5 X1.1 m + 5 X 1 m + 4 X 0.6 m). After about 2 hours the squat hole and vent hole moulds are removed. The outer shuttering is also removed. The slab is covered with plastic sheet and left overnight to harden. The following morning it is carefully watered and covered again. To gain the proper strength before moving the slab should be kept wet and covered for at least 7 days.

Making the concrete slab for the uBVIP. Half the concrete mix is added first. Then the wire reinforcing (about 14 m plain 3 mm or barbed) is added in a grid formation (see photo). Then the remainder of the concrete is added and smoothed down flat. The final slab should be close to 50 mm thick.

The slab can be made before digging and lining the pit with bricks. The slab requires at least 7 days to cure after it is made. It is essential that the slab is kept wet throughout this period to allow it to cure properly. During this time the pit can be dug and lined with bricks.
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. If extra cement is easily available the pit can be dug deeper to prolong pit life.

![Cross section of lined pit](image)

Cement mortar mix for bonding brickwork
20 parts of pit sand (100 litres – 2 wheel barrows full) 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 to 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 depending on brick size.

**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.
The slab extension

The concrete slab has been made with a squat hole and a vent pipe hole in it. The position of the squat hole slab is slightly forward of the centre, and it is important to add a slab extension to extend the slab in front of the squat hole. This slab extension which increases the floor area can be in 3 different sizes.

The small slab extension (for one bag version)

The medium sized slab extension (for lower cost brick structure)

Larger slab extension for standard structure
Superstructures

Simpler structures first
Once the pit has been lined with bricks and capped by a durable concrete slab and a slab extension made, the construction of the superstructure can begin. The family must decide what it can afford. At first this may be a simple grass and pole structure built for privacy only and not fitted with a roof or vent pipe. The preference is for superstructures which have no moving parts, like doors. Doors can be left open, and this will reduce fly control if the unit is upgraded to a BVIP. However in the first instance, the superstructure should be designed to provide privacy. In this way, the unit provides a start off structure, which can help to reduce open defecation at low cost. Over time the same substructure and slab can be upgraded in a series of steps to become the standard brick built Blair VIP, which doubles as a washroom. Wood ash can be added to the pit to reduce odour and flies if no roof and pipe are fitted. Also a tin or wooden cover plate fitted over the squat hole can reduce flies. This cover can be moved by foot.

Pole and grass structures
In the first instance the most easily structures designed for privacy may be made with poles and grass. These are temporary structures but will provide suitable privacy for a period of time. Such structures can be built with doors but preferably in a spiral (door-less) form without doors. Gum poles may be the best poles to choose, but they are vulnerable to termite attack. The best gum poles will be pressure treated, but these will normally only be available in the city centres. Treatment of the poles can be undertaken by painting the poles, or the lower parts of the poles with old car engine oil, carbolineum or creosote or a combination of these. However, even these materials may not be available in the rural areas. Wood ash added to the soil around the poles may help. Poles made of hardwood can be used if available. However depletion of natural woodlands is also not advisable. The burning of bricks also uses wood fuel, and these pose problems in terms of the negative effects of toilet building on the environment. A compromise can be sought by growing trees nearby the toilets. The growth of such trees, such as gum, can be enhanced by the application of diluted urine and also once the roots have penetrated more deeply can absorb nutrients provided by the composting excreta held in the pit. These aspects will be described later in further literature prepared for this development.
Construction of pole and grass spiral structure
The simplest structure is made of poles and grass in a spiral shape. Structures with doors can be made – they are described in another manual. But the spiral version has no moving parts and is the easiest to maintain. It is designed to provide privacy only and, at first, is not fitted with a roof or vent pipe. These can be added later. First the concrete floor is extended in front of the slab within a mould of bricks. With care, there should be enough cement left over (from the single bag provided) after the construction of the concrete slab and pit lining to make a small extension in front of the squat hole. This should be about 5 litres of PC 15, which is enough to make a extension of bricks and a strong concrete capping.

The vent pipe hole is at first covered with a small concrete plate which is secured in position with cement mortar. This is removed when a vent pipe is added. Adding a vent pipe to an open structure will stop odours coming from the squat hole, but will not control flies. A roof must be added to obtain fly control from the pipe.

The vent hole cover
Sequence of making the vent hole cover with a small amount of river sand and cement. A handle has been mounted but this is not essential.

Most uBVIPs built in the new Zimbabwe rural sanitation program may start off by being built in this way. The main aim is to get increased coverage with a strong and durable substructure which can be upgraded at any time. A great variety of structures, using local innovation are likely to be built. The following photos show methods which describe basic principles, which can be used in many ways in different settings.
Making the small slab extension

The cement left over from slab construction and pit lining can be used to make this small extension. This will be about 5 litres. About half of this is used to make a 20:1 pit sand and cement mix to make mortar to bond the bricks laid in front of the slab. This can be laid as shown in the photo. The brickwork extends about 30cm in front of the slab. A wall is built up to nearly the same level as the slab. The aim of this extension is to provide more area for the toilet floor.

Bricks are laid in a semi circle in front of the elevated slab and built up to near slab level.

The space between the slab and the brick extension is filled with rubble or rammed soil. The remaining cement is then mixed with about 6 parts of cement to make a concrete capping which is then added over the cement and brick work. This makes an extension. This is left to cure and is kept wet for several days to gain strength.
Mounting the gum poles around the slab and extension

In this example 10 treated gum poles are mounted around the slab and extension in a spiral shape. A small post auger is used to drill the ten holes. Each pole was 2.4m long with a 50mm to 75mm diameter. At first the structure is open and provides privacy only.

Holes being drilled with a post auger down to about 30cm below ground level. If cement is available the treated poles can be mounted in concrete, but this will not be the standard method.

The ten poles are mounted in a spiral shape. The entrance is made with two poles 50cm apart. A brick walkway is laid within the entrance corridor. The user steps up onto the slab. Wires are then attached to the poles, pulled tight and held by nails or staples. Dried and combed grass is added and attached to the wires with binding wire. At first this simple grass and pole structure will have no roof or vent pipe. A small concrete cover plate is added over the vent hole. A roof can be added. There several traditional methods of making a suitable simple superstructure around the concrete slab and extension.
Adding the grass
Wires are placed at 4 levels around the poles and fixed by nails or staples. The dried grass is then attached to the wires by string.

Attaching the grass to the wires. The interior of the toilet with vent hole cover plate in place. The floor area is quite large.

Adding the vent hole cover

An alternative pole and grass method

Another configuration of the slab extension and spiral structure. The concrete floor is extended in front of the slab and also within the entrance.

The alternative arrangement for a spiral grass superstructure
Blair VIP brick superstructures

Brick built spiral designs are best as they require little maintenance, have no moving parts and guarantee semi-darkness within, if fitted with a roof. 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. Research in the area of recycling of both hardware and organic materials has moved on significantly in recent years.

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 more economical. Even the method of building brick superstructures have been refined to make dismantling and rebuilding easier. All these make cost savings. For the superstructure, money used to buy cement 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.

Different types of brick BVIP superstructure

Economy brick BVIP structures

Standardised BVIP structures
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 economize 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.

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

![Structure built with brick vent](image1)

![Structure built for tubular vent](image2)

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.
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.
Details of the brick and plastic vent pipes

With this design, both brick and tubular vent pipes can be used. The brick pipe is an extension 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.

The concrete adaptor for use with tubular pipes

The adaptor fitted to slab

The arrangement of the brick vent
Building the superstructure wall (with 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.

Stages of construction
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 lengths like brandering, covered by wires or pig or chicken netting. This can be covered with plastic sheet and then grass. The preferred method is to make a wooden frame, treated with a mix of old engine oil and carbolinium and covered 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. An ideal wooden frame can be made from lengths of 60mm x 40mm timber (2 pieces each of 1.6m, 1.5m and 1.4m) and nailed together. In this case the length is 1.7m long and the 1.5m wide.

After cutting and nailing the timber frame is treated

The covering of the frame can be corrugated iron or asbestos. In this case 2 lengths of thin corrugated iron sheet were used (length 2.1m). The sheets are nailed on to the frame with greater overlap of tin sheet on the pipe side. A slot is 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.

The two sheets of corrugated tin are nailed to the frame. A slot is cut in the sheet to match the vent pipe.
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 the 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.

![Wooden templates help the spiral brick construction](image1)

The wooden templates make the spiral toilet easier to build

This method is used by school pupils to build spiral structures
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.

The concrete pipe adaptor

The spiral shape of the structure gives it strength
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 roof is made up of a treated wooden frame covered by 2 sheets of thin corrugated iron sheet. The wooden frame is 1.5m wide and 1.7m long. The frame can be made up from 40mm X 60mm timbers – 2 pieces X 1.4m, 2 X 1.5m and 2 X 1.6m, nailed together and treated with a mix of carbolineum and old engine oil. The treated wooden frame is laid on the ground and the two 1.1m 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. A slot is cut into the tin sheet to accept the vent pipe.

The treated frame ready – the tin sheets being nailed to the frame

The roof being lifted on to the structure.
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 fly screen. 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.

The sloping concrete floor
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 the standard brick square spiral superstructure

The construction of the superstructure consists of laying the brick foundation for the walls, laying the concrete floor within the superstructure, building up the walls and brick vent pipe, making the roof, plastering the internal walls and laying the final sloped floor of the toilet cubicle.

The slab is made level on the elevated brickwork above ground level and the weak cement mortar smoothed down around the slab so the slab and brick lining are airtight. The slab and pit must have an airtight fit of the vent pipe is to work properly. A trench is cut down in the soil around the toilet. The brick foundation for the walls will be laid in this following the dimensions below,

Dimensions of the brick square spiral BVIP in mm.
The brick walls are laid on the foundation so the outer dimensions of the brick walls are close to 1.45m X 1.85m. The walls are built up to slab level. The toilet floor area is then backfilled with brick rubble to lower slab level. This is then filled with a concrete mix (10 litres cement + 50 litres river sand).

Building the brick walls and vent pipe
The mortar mix for the brick walls is 20 parts pit sand and 1 part Portland cement. This is mixed in lots of 100 litres of sand and 5 litres of cement. 4 mixes are required to mortar the brickwork of the structure and vent pipe.

Use of traditional mortar
The walls of the structure can be bonded together with traditional mortar made from anthill soil and river sand mixed together. This material is commonly used in the rural and peri-urban areas and has a long life. In earlier programs anthill mortar has been used for the walls but not for the pipe. However anthill mortar can be used for the vent if the uppermost course of bricks is covered with cement mortar. The screen is in fact bonded onto the brick vent with cement mortar which fulfils this function.
Stages in building the brick walls

Walls and vent come up together. The walls are built up to 1.8m in height and the pipe to about 2.4m. The internal surfaces of the brickwork inside the pipe must be kept smooth.

The walls are built up. The end walls and mid wall which will support the roof are built up so the roof will slope outwards.

Elevating the vent pipe

The vent pipe is raised 6 courses above the wall level. Later it is fitted with a corrosion resistant fly screen.
Making a concrete roof.

Roofs can be made of concrete or asbestos or tin sheet. The concrete roof is made in 4 sections to make lifting on to the structure easier. The structure is measured and 10cm or more are added to this measurement to form an overlap for the roof. In this case the total roof area measured 2m X 1.8m. A 2m length of 1.8m wide 25mm chicken wire was purchased to act as reinforcing. The mix of cement is 4 parts river sand to 1 part PC15 cement. To make the roof 3 mixes of 12li cement and 48li river sand (4:1) were used.

An area of ground is levelled and a mould made with bricks to suit the size of the roof required. In this case the total area was 2m X 1.8m. The chicken is laid within the mould and cut up into four pieces (900mm x 870mm (2 pieces) and 900mm x 1130mm (2 pieces). The exact measurements should be taken from the structure, which varies slightly in each case. A recess was made in one of the four panels for the vent pipe.

A sheet of plastic is best laid on the ground to cover the soil within the brick mould. The cement will lose less moisture when laid over plastic and will develop more strength. The mix of cement is laid in sections. The mix of cement is 4 parts river sand to 1 part PC15 cement. To make the roof 3 mixes of 12li cement and 48li river sand (4:1) were used.
Each section is covered with a layer of cement about 20mm thick and the wire is laid over this to cover the section. The wire is then covered with another layer of cement. Later on the concrete will be cut with a trowel when still soft. The sections of wire in the concrete must be separated clearly so the trowel cuts through concrete only. The concrete is then covered for the night. It is watered the following morning and kept wet and covered for a week before moving on to the structure.

**Fitting the roof**

The thin concrete roof panels are cured for at least a week. They are kept wet at all times, preferably under plastic sheet. These sheets are durable and cheaper than asbestos or tin sheets, but they must be handled with care. They should be lifted from the ground on to the toilet structure with great care.

**Stages in fitting the roof sheets**

The four panels are allowed to cure for at least 7 days being kept wet at all times. Each panel is carefully lifted from the plastic sheet and placed on the superstructure in the appropriate place, embedded in cement mortar.
Each panel is supported by the dividing wall in the centre of the structure as shown.

**Plastering the walls and adding the sloped concrete floor**
The toilet walls are then plastered with a mix of 15 parts of pit sand and 1 part of cement (10 litres of cement and 150 litres of pit sand). When the toilet is used as a bathroom it is important to plaster the inner walls of the toilet. Another important requirement of the Blair VIP is that the floor is sloped towards the squat hole. This makes washing down easier and drains the cubicle effectively after bathing. The river sand/cement mix should be strong. 1 parts cement and 4 parts river sand. A mix of 8 litres of cement and 32 litres river sand is used. The floor surface is sprinkled with cement and smoothed down with a steel float.

All the internal surfaces of the Blair VIP are plastered. The floor is also dished to allow drainage of water into the brick lined pit. A fly screen made of aluminium is then embedded in cement mortar to the top of the vent pipe.

**Adding the fly screen**
A piece of corrosion resistant fly screen made of aluminium (225mm x 225mm) is then embedded in cement mortar on top of the brick vent pipe.
Operation and Maintenance of the Blair VIP
The basic maintenance requirement of all Blair VIPs is that they are kept neat and clean with washing water being used to clean down the slab regularly. Also the ventilation pipes should be washed down with water every month or two to clear any spider webs that develop inside. A pipe filled with cobwebs will not ventilate. Also the fly screen should be inspected from time to time. A broken or damaged screen cannot trap flies and fly control is lost. The ideal BVIP has no moving parts (spiral shape without door) and should provide a long almost trouble free service to the family if it is well made and well maintained. Once the pit eventually fills up, a new pit can be built and several parts of the superstructure recycled.

Extending pit life
Pit life is reduced considerably if a lot of garbage is added to the pit. It is far better to put garbage into a separate garbage pit and keep the Blair VIP toilet pit for excreta and anal cleansing materials alone. A garbage pit can be built using a concrete ring beam and covering slab (with lid) with the pit being dug within the ring beam. It does pay to build a pit with large capacity for long life. The cost per person served per year is reduced as the pit volume is enlarged. Using the corbelling technique pits lasting 20 years or more could be built using a single bag of Portland cement to make the brick mortar.

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 hessian) sheet, is much easier to dismantle than the conventional 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 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
transferred 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.

**Recycling the organics**

There are several ways of recycling the organic contents of the filled pit. These include 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). Also 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 valuable 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.

A well made Blair VIP can provide long and trouble free service for many years if well maintained.
Making a simple hand washing device

If improvements in health are ever to be achieved in programs linked to sanitation then hand washing should be an essential part of the program.

Many hand washing devices cost almost nothing to make and add very considerably to the hygienic component of the toilet and the sanitation program. Hand washing devices can be made from plastic bottles and alloy cans.

Making a hand washing device with an alloy can

The can is placed over a log or pole which makes the hole 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 the can as shown. 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 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.

A variety of hand washers – alloy can – mukombe – plastic bottle

Soap or wood ash?

Soap can be drilled with a hole and hung on a wire from the toilet roof. Also a tin container can be attached to the side wall of the toilet and filled with wood ash. The fingers are wetted first, dipped into the ash and then washed again. It is a very effective and simple method of washing hands.