5. How to build and manage the *Fossa alterna*

The ***Fossa alterna*** is a simple alternating pit toilet system designed specifically to make humus suitable for agriculture. It is based on a twin pit system - the use of the toilet itself alternating between two permanently sited shallow pits. The toilet is managed in such a way that the conversion of human excreta into humus takes place within 12 months. After 12 months of composting the humus is dug out and used on the garden. The pit volume is calculated so that this 12 month period is less than the filling time of the pit when used by a small to medium sized family. This means that the ***Fossa alterna*** can be used continuously on the same site, almost indefinitely, simply by alternating between one pit and the second, with the humus being excavated once a year, thus making available an empty pit - every year.

The *Fossa alterna* is designed to make humus from human excreta. It has two shallow pits protected by two concrete ring beams, a single concrete slab and a superstructure, in this case made from gum poles and reed mats. This unit is also equipped with a low cost home- made pedestal, a vent pipe and hand washing device. The system is simple and can be made at low cost. Photo taken in Marlborough, Harare.

As in the ***Arborloo***, the conversion of excreta into humus in such a short space of time (12 months) becomes possible because extra ingredients, like topsoil, wood ash and leaves are added regularly to the pit contents. These extra ingredients alter the biological makeup of the pit contents, and also make it far more aerobic than would be the case with a deep pit latrine filled with excreta alone. Adding soil (especially fertile topsoil) and leaves brings into the mix a myriad of beneficial soil organisms such as beneficial bacteria, fungi, even worms and insects which excavate the soil and help to process the excreta. The addition of leaves (and other vegetable matter) increases the air content. Unlike solid excreta alone, this combination of ingredients readily converts into humus if sufficient quantities of the extra ingredients are added. The volume of soil, ash and leaves added to the pit should be about equal to the volume of faeces added. And it should be well distributed – in other words, the various ingredients should be added regularly. The conversion is improved if the soil itself is fertile and humus like. Adding clods of wet clay soil from time to time will not result in the desired effect. Neither will the occasional sprinkling of soil or ash on a huge volume of excreta held in the pit. The proportion of soil, ash and leaves should be significant and well distributed and should make up about half the volume of the pit. These important facts should be known to those people who are being introduced to the ***Fossa alterna***. In adding this combination of ingredients the process of decomposition within the pit is quite different to the one that normally takes place in the deep pit latrine. In the deep pit latrine, it is only excreta which enters the pit, together with garbage, and this combination may takes many years to convert into a useful humus, depending on the conditions. Under such an inefficient conversion - the alternate use of twin pits on a regular basis would be impossible. Thus the process of humus formation in the shallow pit systems used in the ***Fossa alterna*** is a significant departure from the conventional system seen in conventional pit latrines, which are used world wide.

The ***Fossa alterna*** could be classified as a double vault pit latrine, but it is different in so many fundamental ways, that it has been given a specific name which distinguishes it from other twin pit systems.

* The ***Fossa alterna*** is specifically designed to make humus from human excreta (urine and faeces combined) in an efficient manner. This is achieved by the regular and generous addition of soil, wood ash and leaves together with the excreta.

* An important requirement of the ***Fossa alterna*** is to produce a relatively safe and valuable humus in the 1.2 – 1.5 meter deep composting pit within the space of 12 months. This is less than the time taken for a family of six persons to fill a shallow pit, which the ***Fossa alterna*** is designed to serve. This conversion from human excreta into humus could not be achieved within a year in a normal pit latrine, and the addition of the soil, ash and other ingredients into the pit is essential for this process. It is this feature which distinguishes the ***Fossa alterna*** from other double vault pit latrines. The aim therefore is to roughly match the rate of conversion of the excreta into humus in the one pit with the rate of filling of the second pit. When this is achieved it is possible to change sides once a year, with a regular out-put of humus being achieved each year. In practice a family should take a little more than a year to fill each pit and the conversion into humus is achieved in a little less than a year. So there is a safety margin built in.

***** The twin pits of the ***Fossa alterna*** are shallow, each about 1.2 meters deep, with 1.5 meters being a maximum. This makes excavation for the family relatively easy. The formation of humus takes place under reduced conditions of compaction (which would be the case in deeper pits). The excavation of humus is also usually easier than digging out the original pit. The shallowness of the pit also reduces the risks of contamination of underground water from the system, partly because the waste materials are contained further away from the water table and partly because the conversion of excreta into a much safer humus is accelerated.

***** The pit which has been filled with a combination of excreta, soil, wood ash and leaves is exposed in such a way that it is easy to excavate. It is important that the pit is topped up with additional soil and leaves and left to compost for 12 months. For safety reasons it may be covered with a wooden cover. Ease of excavation is important.

***** There is only one latrine slab used in the system. This is deliberate, so that only one pit can be used at one time. This avoids the problem seen in some other double pit systems which are equipped with two slabs - allowing both pits to be used simultaneously. The concept of the ***Fossa alterna*** cannot work if both pits are used simultaneously.

***** The system can be equipped with a portable structure, like the ***Arborloo,*** so that transferral of the superstructure from one pit to the other is easy and convenient. This is not an essential requirement however, and most ***Fossa alternae*** in Mozambique and Malawi house both pits within a single permanently sited superstructure.

***** The ***Fossa alterna*** is designed to use the nutrients derived from urine and faeces in combination which are composted together with the soil entering the pit. The resulting humus is rich in nutrients, derived from both the urine and faeces (see later soil analyses). The ***Fossa alterna*** concept of producing humus in shallow pits can be used in combination with urine diverting pedestals, but this increases the cost and complexity of the unit. The urine diversion concept is best used in combination with above-the-ground vaults, but it will work on shallow pits as well

***** The system is adaptable, - if overloaded by heavy use - a third or even fourth pit can and should be built and the single slab and superstructure can be used on a rotational basis between the series of shallow pits. The aim must always be to allow for at least one year of composting.

Fossa alterna **in Epworth near Harare. It has two shallow pits, a single concrete slab and single superstructure, made with a light steel frame covered with grass. The *Fossa alterna* was initially designed for per-urban use on medium sized plots, but can be used on smaller plots and also in the rural areas.**

Like the ***Arborloo***, the ***Fossa alterna*** attempts to fulfil all the basic requirements of a toilet used under the umbrella of ecological sanitation. The recycling of human excreta is achieved in a simple manner and the end product, in the form of humus, is relatively easy to excavate and introduce directly into the garden or into bags for future use or. An entirely natural process of "ambient temperature composting" takes place in the pit. Pit content temperatures rarely exceed 25 degree centigrade in Southern Africa. Where the ***Fossa alterna*** differs from the ***Arborloo*** is that the humus will be excavated from the pit, and hand contact will subsequently be made with it. Certainly when it is mixed with topsoil, and vegetables are planted, the material will be handled. Thus the health implications are important to consider.

After one year, properly composted pit humus is infinitely safer to handle than hands soiled in the toilet. It is important to wash hands after handling and this would be a normal procedure when handling garden compost before eating. It is essential that the recommended materials (soil, ash and leaves) are added to the pit regularly and a full 12 month period of composting is allowed. Without this method of management, where the excreta builds up without any, or very little additional material to help it compost, the excreta will not change in the desired way within the recommended 12 month period. Then, handling the resulting semi composted material may pose a health threat. Also ***Fossa alterna*** humus has not yet been investigated for the inactivation of viable helminth (round worm) eggs to date. Existing data shows that within 12 months the great majority of helminth eggs will have been rendered non viable for composted human sludge (Martin Strauss. 1990). Thus there is a small element of risk associated with handling the ***Fossa alterna*** humus, but this risk is infinitely less than handling many other sources of potential contamination in the environment in which the ***Fossa alterna*** was designed to work. Contact with the unwashed hands of another person who has attended the toilet or with a contaminated door or towel may constitute an infinitely greater health threat, than handling well composted excreta dug out of the ***Fossa alterna*** pit. The health threat is even greater if food is handled by the unwashed hands of those leaving a toilet. So the risks are relative. In very few aspects of human life, can one put a 100% guarantee that one will be safe and one's state of health can be assured.

The importance of placing a simple hand washing facility close by the toilet is an essential requirement if person health is to be taken seriously – and it must be. Regular hand washing is an essential component of improved personal hygienic behaviour. A number of low cost hand washing devices can be made in the home from locally available containers and materials and these are described in this book. The danger of handling ***Fossa alterna*** humus must be considered in relation to other potential contaminants related to the toilet, raw excreta itself being the most obvious.

If there is doubt about the safety of the excavated humus, for immediate transfer to the garden or vegetable bed, it can be transferred to sacks for storage for an additional length of time. Sometimes this method of "bagging" may actually be preferred by the family. In excavating and storing in bags, the material is turned and aerated, and this certainly helps to promote the composting process. This period of "secondary composting" in bags may be preferred because the time of excavating may not necessarily coincide with the time of planting vegetables. Some gardeners may on the other hand prefer to dig in the humus into the bed well before planting. Thus the humus will undergo further processing. The humus will nearly always be mixed with local topsoil before planting.

The nutrient rich humus (see soil tests later in this book) excavated from the fully composted pit is far more fertile than normal topsoil, so by mixing the "eco-humus" with existing topsoil the fertility of the topsoil is greatly improved. This is true for all the major nutrients, nitrogen phosphorus and potassium. Because the volume of eco-humus derived from a family latrine is relatively small (about 0.6 cubic meters per year), most humus derived from the ***Fossa alterna*** is mixed with soils used in vegetable gardens in the back yard. A 2:1 mix of topsoil and humus is a useful ratio to use on small vegetable beds (see later). A 2:1 or 50/50 mix results in a considerable enhancement of the nutrient value of most top soils, which can lead to significant increase in the production of vegetables (see later). Thus the "close the loop" principle is once again achieved - and this is a central requirement of ecological sanitation. What is eaten goes back into the system.

The ***Fossa alterna*** was originally designed for use in peri-urban settlements. The total area required for this toilet is quite small - about three square meters. Within this area it is possible to excavate two shallow pits lined wholly or partly with bricks or protected with two ring beams at the head of each pit. Time has shown that the simplest method – using concrete ring beams, is the most effective if the soil is moderately firm. This is because when a ring beam is used, there is maximum exposure of the pit ingredients to the surrounding soil. This improves drainage and also exposes the converting excreta/soil mix to the myriad of organisms present in the soil - and also, interestingly, of plant roots which are found in the topsoil. The conversion of excreta into humus takes place more rapidly in unlined or partially lined pits compared to those that are fully lined with bricks, or concrete rings.

The ***Fossa alterna*** also has considerable application in the rural areas as well. In Niassa Province, Mozambique (Ned Breslin, WaterAid, Mozambique) and in Thyolo District Malawi (Elias Chimulambe, COMWASH), for instance, the ***Fossa alterna*** is the preferred option because it offers a simple method of constructing a relatively permanent solution to sanitation. It is also relatively cheap to built, helps reduce flies and odours (even in the absence of a vent) and also provides a yearly supply of humus which can be used in a variety of ways

Much of what has been said in the preceding chapter on the ***Arborloo,*** applies equally to the ***Fossa alterna.*** The ring beam, slab and even superstructures can be identical in both units. The shallow pit receives regular additions of soil, wood ash and leaves in addition to excreta in both systems. The addition of garbage to the pit is not recommended in either system, but perhaps a tree will be more forgiving. It is no pleasure to excavate garbage like rags and plastic when the humus is being excavated. The difference is that in the one system the humus if left in place and a tree is planted in it. In the case of the ***Fossa alterna*** the humus is excavated, thus making available a "new" empty pit which can then be reused and refilled with a new mix of ingredients (urine, faeces, paper, soil, ash, leaves etc) again.

Perhaps the greatest asset of the ***Fossa alterna*** is its forgiving nature. It is no more than a pit latrine - and very simple to use, with the specific requirement that the users add soil and ash and leaves to the pit regularly, and do not add various other non compostable materials like rags, bottles, rubber, plastic and all manner of other garbage. The system still works if soil alone is added, but the texture and nutrient content of the humus produced is improved if leaves are added too. Also the conversion is far more efficient if humus like fertile soil is added compared to infertile soil or clay. Ash also helps to reduce odour and fly breeding and adds potash to the mix. The addition of dry leaves helps enormously, both as a layer at the base of the pit (two sacks full), and also throughout the filling process and also on closing off the pit. So the way a ***Fossa alterna*** is used and managed is a little different from the way a normal pit latrine is used and managed. However the differences are not great and should easily be managed by those who are familiar with the pit latrine. And in the world in which we live, this accounts for most.

Digging out pit latrines, though, is not commonly practiced in Africa, or in any part of the world. This is because the process is most offensive in the extreme. Consequently the first time users of the ***Fossa alterna*** are cautious at first about this part of the management. They will need convincing. The acceptance of this excavation as part of the procedure for using this system may not be immediate. The potential users will need to have seen other ***Fossa alterna*** pits excavated without difficulty and examined the humus for themselves. After a season of use however they will be convinced. Also they will be more convinced if they have seen evidence that the mixing of the humus with poor local top soils does actually enhanced the growth of vegetables. They will need to be convinced that the system is simple to build and simple to use, and also offers many benefits in addition to the conventional pit toilet. Potential users must be made aware, ahead of time, that for the system to work well, it is important to add soil, ash and leaves to the pit, regularly, and that they must also excavate the humus once a year. Thus projects involving the ***Fossa alterna*** require an effective component of education and demonstration. It does require more attention and effort than the use of a normal deep pit latrine. Indeed all solutions involving eco-san require much more user participation than the standard pit or flush toilets systems demand.

Inspecting humus taken from the *Fossa alterna* in Mozambique.

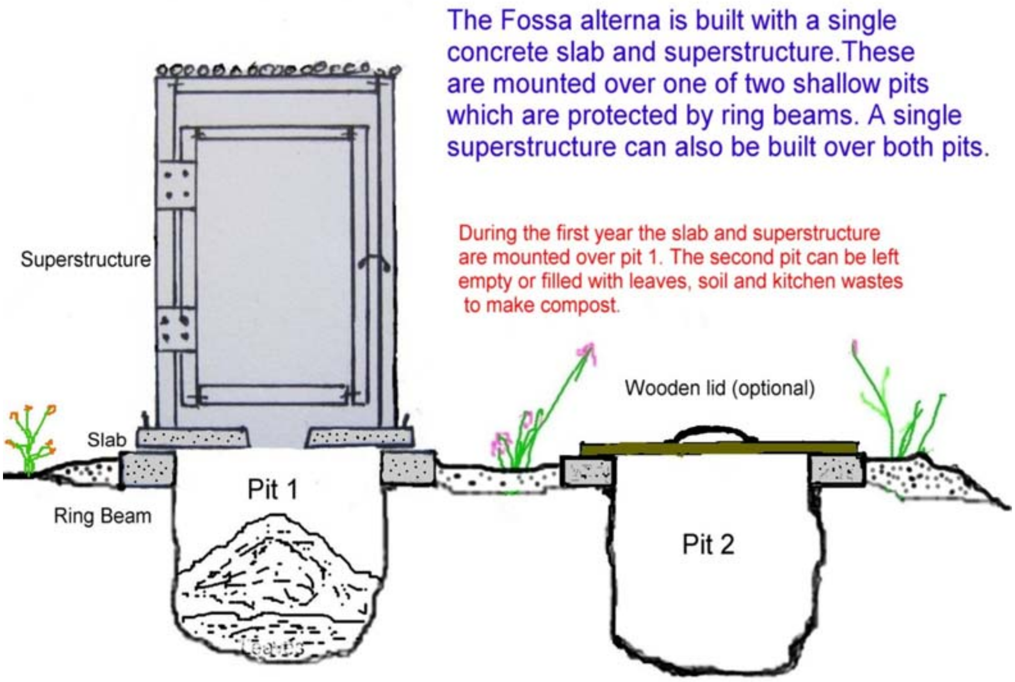
There is now much evidence that the pleasant nature and perceived value of the humus, with its ability to enhance soil fertility within the homestead, is encouraging people to excavate at the appropriate time. The excellent project in Niassa, Mozambique, which has studied various aspects of the uptake and use of the ***Fossa alterna*** has provided much evidence for the popularity of this system (Ned Breslin, WaterAid, Mozambique. See bibliography). A similar pattern of uptake is also seen in Malawi (Steven Sugden, WaterAid, Malawi). These are encouraging signs.

HOW THE *FOSSA ALTERNA* WORKS

There are two shallow pits close to one another and a single slab and superstructure. Both pits are dug and protected from the start. If this is not done, there may be confusion about how the system operates. The ***Fossa alterna*** concept cannot work with a single pit. If only one pit is dug and protected, by the time the first pit has filled the initial enthusiasm, drive or money for the latrine project might have gone. The message is simple - build the whole unit - with both pits - from the start with the slab and superstructure mounted over one of the pits. The second pit can be filled with leaves and covered with a lid for the first year.

As the first pit is being used it is filled with a combination of materials - not just excreta. These include faeces and urine and also soil, wood ash and leaves. The pit is used as if it was a composting pit filled from the top. The pit is used until it is nearly full, which for a family of up to 6 persons should be about one year or more.

During this first year period, the second (empty) pit may be covered with a wooden lid and left empty for the year. Alternatively it can be used as a “leaf composter” by adding leaves regularly throughout the year interspersed with thin layers of soil. The resulting leaf compost will be of considerable value in the garden. (see nutrient levels in following chapters).



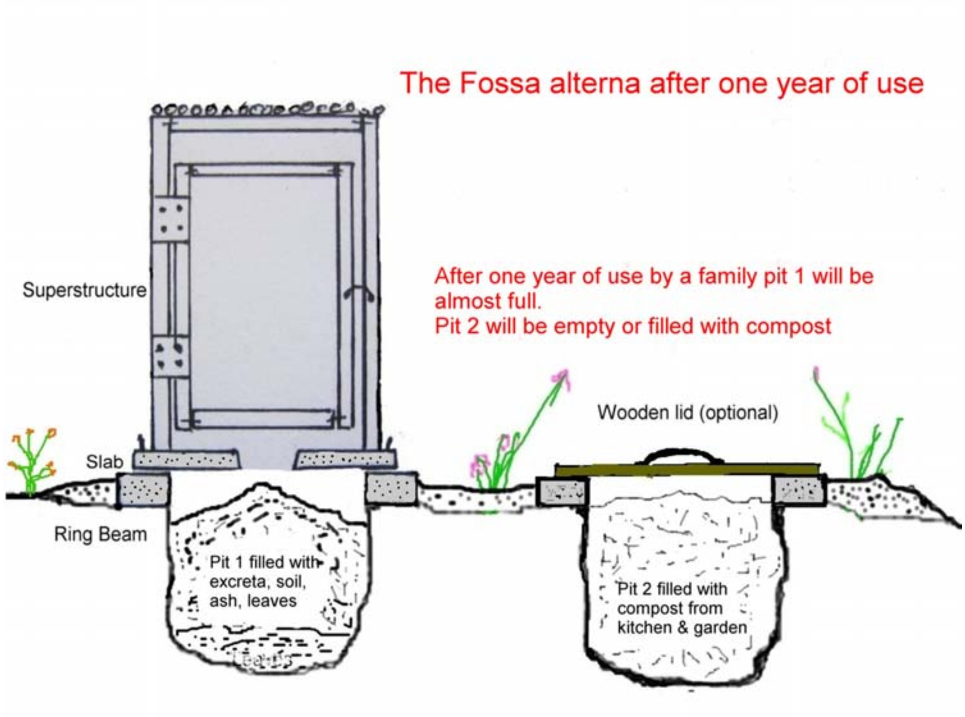
To start, two sacks of leaves are added to the base of the first pit. The slab and superstructure are fitted and the use of the toilet can begin. Buckets of dry soil, ash and leaves are placed inside the toilet. Every day, and preferably after every visit to defecate, some soil is added. Ash should be added too. Periodically leaves are added in addition.

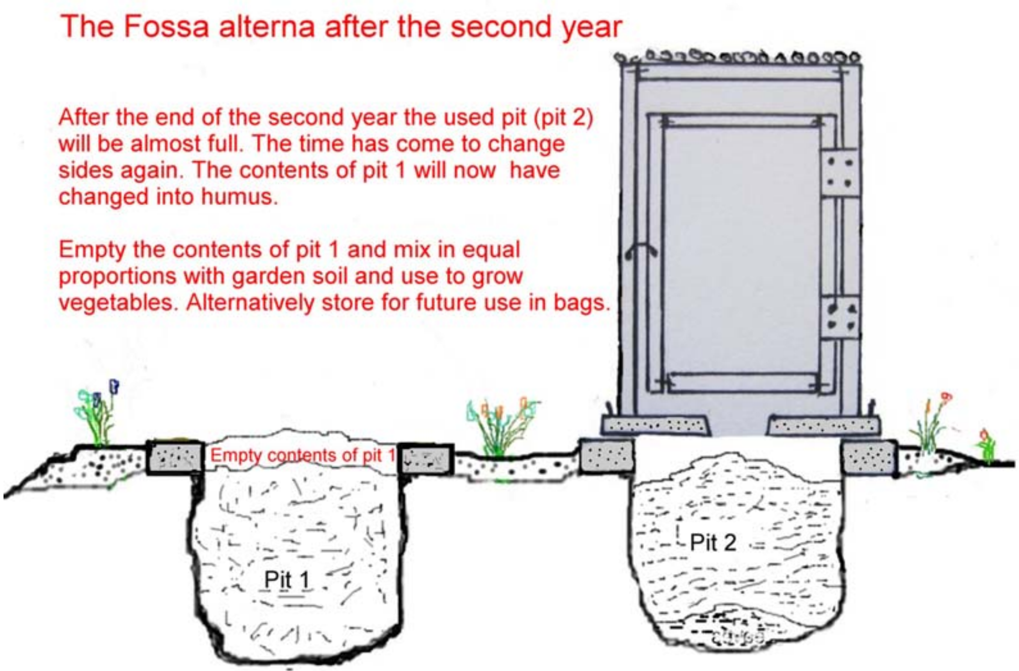
When the pit filling with excreta and other materials is nearly full (after about a year), the slab and superstructure are removed and placed over the second pit which should be empty. If it has been filled with leaves, the leaf compost is removed and used on the garden. Two sacks full of leaves are added to the base of the new pit before it is put to use. The first pit filled with the mix of materials is then "topped up" with leaves and a layer of soil at least 75mm thick and left to form humus over the following 12 months. If there is doubt about the correct proportion of leaves and soil being added to the pit, more soil and leaves can be added and rammed into the pit. The final covering layer of leaves and soil is then added. This process has the effect of increasing the proportion of soil/leaves within the mix and also distributing it more evenly throughout the pit.

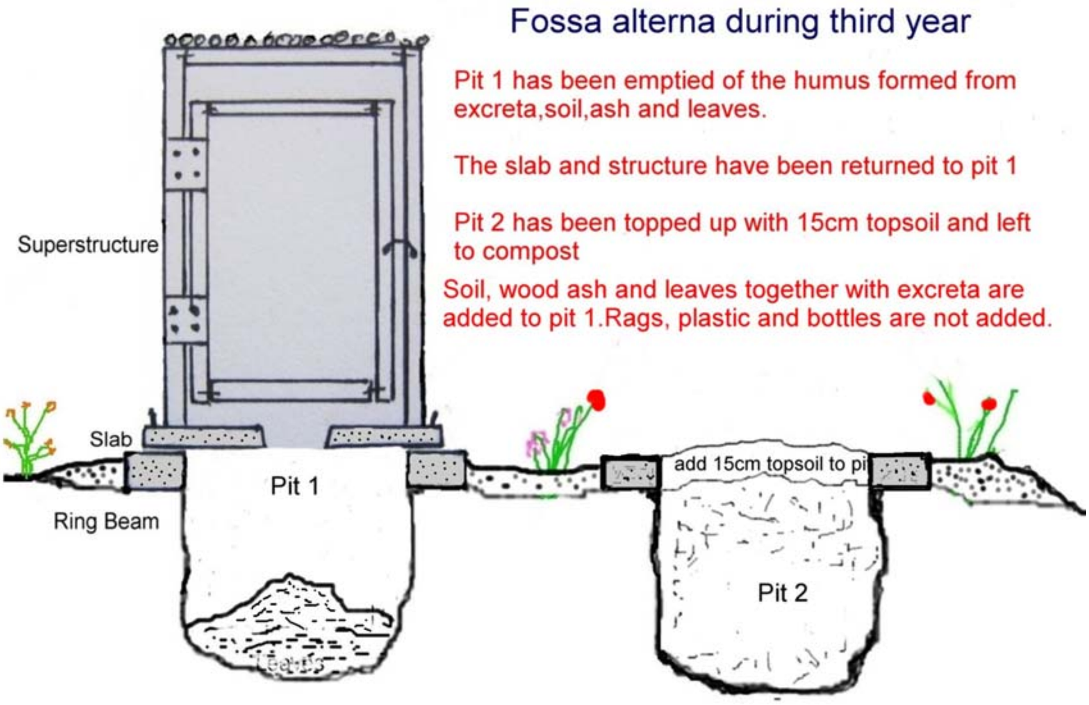
During the second year, the second pit will be filling with the mix of excreta, soil, ash and leaves whilst the first pit is composting. At the end of the second year the second pit will have nearly filled. By this time, the contents of the first pit will have already converted into humus which can then be excavated.

The excavated humus can be mixed with topsoil and dug into vegetable beds in preparation for planting (see later). Alternatively the humus can be placed at first in large sacks until the time comes to mix it with topsoil and grow vegetables. The excavated material can also be stored in a heap under the cover of a plastic sheet.

Once the humus has been excavated, the superstructure and slab are then returned to the original pit after more leaves have been added. The filled pit is covered with leaves and soil and the whole process is repeated again. Every year the process is repeated, possibly at the same time of the year. In Zimbabwe, the best months are during the latter part of the dry season (September – November). The process can in fact take place at any time of the year, but is normally easier to undertake during the dry season. The process will still work if leaves are not added, but the finally quality of the humus will be reduced. Leaves add air to the composting mix and improve the efficiency of composting. It is important to add leaves if they are available.







The *Fossa alterna* - Stages of construction

Siting the *Fossa alterna*

This will be very similar to siting the ***Arborloo,*** in terms of access and distance from a well, homestead etc. But there will be no future trees to consider in the siting procedure. In essence the ***Fossa alterna*** must be sited in the most convenient place for the family. It can backed on to a fence line. There should be room to move the structure from one pit to the next. Proximity to the vegetable garden may help but is not serious. The most important point in siting is convenience and privacy.

Methods of protecting/lining the twin pits.

Unlike the ***Arborloo*** the twin pits of the ***Fossa alterna*** are sited in permanent or semi - permanent locations. That is, they are sited in a place which may not change for some years - although of course it is very easy to re-site the pits at any time if there is space. Such pits may be fully lined with bricks or partly lined with bricks or fitted with ring beams of brick or concrete at the head of the two pits. It is an advantage that the ***Fossa alterna*** concept is adaptable and can use light and portable structures which impose a much reduced load on the soil around the pit, thus reducing the possibility of pit collapse. If a brick superstructure is used, as in Malawi, then it is essential to line both pits with mortared bricks to the base.

The ring beam method is the simplest and cheapest way of protecting the shallow pit with the ***Fossa alterna*** and also the most effective in terms of humus formation. So far this method has worked well in Zimbabwe even on moderately sandy soils under experimental conditions. But the experience of time alone will tell. With these types of structure with portable components, if there is any sign of movement, the parts of the latrine can be moved quickly to another site.

The decision as to which type of pit protection to use depends on local soil conditions. In very loose sandy soil, the pit will need lining with bricks to the base. If the soil is firmer a ring beam or part brick lining may be quite adequate, since a portable superstructure is not heavy. In most situations a ring beam will be perfectly adequate. It is also by far the cheapest and simplest method. If there is doubt about soil stability always line the pit with bricks to the base.

1. Ring beam method

Concrete ring beams

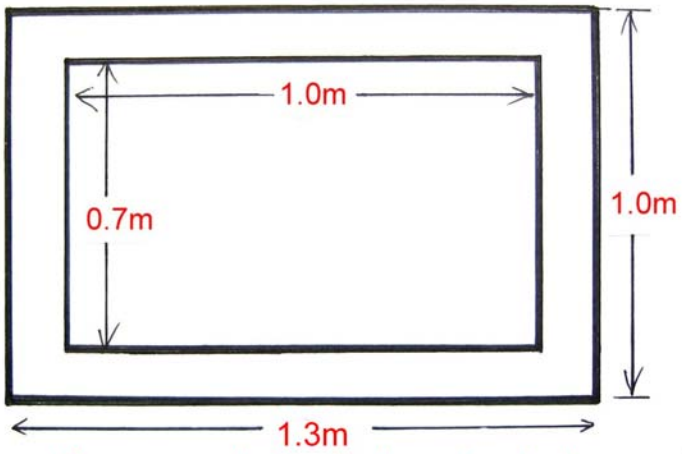
The best ring beam method uses a reinforced concrete beam which is strong and permanent. When well made, concrete structures like ring beams and slabs last almost indefinitely. They are a good investment in time and money. This is the recommended version for firm or moderately firm soils. A concrete ring beam can be laid on the surface of the ground in the same way as the ring beam for the ***Arborloo*** is laid (see previous chapter). If the ring beam is made of bricks, the soil near the head of the pit should be cut back down to about 150mm below the surface and the bricks can be built up from this level to one or two courses above ground level (see later). In both these cases the final pit is dug down within the ring beam to a depth of between 1.2 and 1.5 metres. This will provide an effective full pit volume of about 850 litres with a useable pit volume of approximately 650 litres.

Note here that the twin ring beams of the ***Fossa alterna*** can be cast in situ (ie in the final position) since they will not be moved. This is the preferred method. With the ***Arborloo*** the ring beam is best caste in another place and transferred on to site when it has cured. Since the ring beam of the ***Arborloo*** will be moved every year it must not be bonded too tightly too the soil as it may be difficult to remove at the time of the toilet migration. A tight bonding between ring beam and soil is desirable with the ***Fossa alterna***.

The internal measurement for ring beams used with the ***Fossa alterna*** should be around 1.0m diameter for round ring beams, or about 0.8m square for square ring beams or 0.7 X 1.0m for rectangular ring beams,. These will accept concrete slabs which are 1.2m in diameter, 1.0m square or 0.9m X 1.2m respectively.

Making the two concrete ring beams for the *Fossa alterna*

In those examples described here, the external measurements of the beam are 1.3 metres X 1.0 metres, the inner measurements (the size of the hole) being 1m X 0.7m. This ring beam is made for a slab measuring 1.2m X 0.9m. Wire reinforcing is used within the concrete mix, two strands of 3 - 4mm wire down each length, making a total of 8 pieces (total length approx. 9 metres). With the ring beam, the corners are a potential weak point.



Measurements for ring beam (metres)

When constructing the ***Fossa alterna***, the two ring beams can be cast on the actual toilet site directly on the ground, at least 0.5m apart and preferably at least 1.0m apart. A level piece of ground, preferably on a slightly elevated site is best. Alternatively the two ring beams can be cast away from the toilet site and moved on to site after curing. In this case a plastic sheet should be laid on the ground on which the ring beams can be made. The mould for the ring beam can be made with bricks as shown in the photo. Wooden shuttering can also be used as a mould, or a combination of bricks and wood. The ring beams are made 75mm thick, the thickness of a brick.

One 10 litre bucket of cement (weighing 12 kg) is mixed with five 10 litre buckets of sharp river sand to make each ring beam. If a 5 litre bucket is available the total mixture can be made in two batches. Half the full mixture is made first, that is 5 litres cement (6kg) and 25 litres clean sharp river sand (or if small stones are available, 5 litres cement, 15 litres sand and 10 litres small stones). A 5 litre bucket is useful for measuring, but 10 litre buckets are easier to find. Sufficient water is added to the mixture to make a thick slurry. Do not add too much water. This half mix is added to the lower half of the mould and spread out and tamped down with a wooden float. Then the wire reinforcing is added (4 lengths of 3 - 4mm wire in each direction). This is followed by the second half of the mix. If this square ring beam is used to construct the ***Arborloo***, four handles will help with the relocation. The four handles (if required) can be made from 4 steel bars about 8- 10 mm diameter and about 25cm long - four can be made from a one metre length of rod. These are bent and set in the concrete (see photo). No handles are required for the ***Fossa alterna*** ring beams as they remain permanently in position. The concrete is finally levelled off with a wooden float. The beam is covered with a plastic sheet if possible and allowed to set overnight. It is watered the following morning and kept covered and wet for at least a week before lifting. The longer it is allowed to cure the stronger it will become.

The ring beam shuttering can be made with bricks or wooden planks or a combination of both laid over a plastic sheet. Two ring beams have been cast within brick moulds over plastic sheet. After a few days the bricks can be carefully removed – watering continues. Note the handles inserted into the ring beam at the edges – these are useful if used with the *Arborloo*, but not necessary with the *Fossa alterna*, since the ring beams will never be moved. In practice handles are rarely used on the ring beam!

In the case of the *Fossa alterna* the two ring beams can be cast on the site where they will be used about 0.5m apart. In the case of the *Arborloo*, the ring beam is best made on one side and then placed in position as it will be easier to move later. Once the ring beam has been positioned and made level, the soil inside is excavated to the required depth. This is about one metre for the *Arborloo* and between 1.2 and 1.5m for the *Fossa alterna*. The excavated soil is deposited around the ring beam and rammed hard. This simple procedure will protect the pit in all but the loosest soils. Two bags of leaves are deposited on the floor of the pit before the slab is fitted. The leaves help to start off the composting process.

Here two ring beam for the *Fossa alterna* have been cast on site. On the right a completed *Fossa alterna* mounted on one of two permanently sited ring beams

Brick ring beams for the *Fossa alterna*

Ring beams can also be made from bricks which are bonded together with strong cement mortar. These beams can be built around the upper part of the pit. It is wise to start constructing the ring beam from below ground level and build up to one or two courses above ground level. The outer measurements are the same as for the concrete ring beam. However measurements for the both the slab and the ring beam are optional. A brick ring beam may be constructed from between 0.3m (shallow ring beam) to 0.5m (deep ring beam) below ground level. This leaves at least half the pit unlined but in most soils this is quite satisfactory for light weight structures placed over shallow pits.

Partly lined pits offer better drainage potential for the ***Fossa alterna*** compared to fully lined pits where the area of seepage is reduced to the base area only. There is a chance that this may become plugged if the water table does rise into the pit, or if too much water/urine is added. If the soil conditions allow for good drainage it may be best to fully line the pits. A generous layer of leaves (2 sacks full) added to the base of the pit helps drainage, as well as improving the efficiency of composting.

Deeper ring beams are normally constructed from 0.5 metres below the surface and rise to one or two courses above ground level. They can be made 100mm wide (single brick thickness) or 225mm wide (double single brick thickness) for extra stability.

If the “standard” slab size of 0.9m X 1.2m is used, the outer measurements of the brickwork for the single course should be just over 0.9m X 1.2m so the slab will fit neatly over the ring beam. Allow about 1 -2 cm all round - that is 0.95m X 1.25m for the outer measurements of the brick ring beam. In the case of the double course the outer measurements for the ring beam will be about 1.15m X 1.45m (pit excavation size about 1.2m X 1.5m).

The initial hole should be dug down about 0.5m below ground level - the hole size determined by the thickness of the brick construction (single or double course). The brick wall is build up from the base of this shallow 0.5m deep pit to one or two courses above ground level with strong cement mortar. The uppermost brick layer should be covered with a strong cement mortar for strength and protection. Once the mortar has hardened after a few days, the hole can be deepened to 1.2 – 1.5 metres within the brickwork. Two such partly lined pits are built about one metre apart.

Since concrete slabs will be taken off and placed back on the ring beam/upper pit lining at yearly intervals with the ***Fossa alterna***, it is desirable that the working surface of the uppermost concrete/plaster layer be durable. This should be made of high strength mortar or concrete which is well cured. It should be well formed and left to cure under wet conditions under a cover for a week to develop a good strength. Often this final plaster layer is thin and made in weak mortar, just for appearances. The brick work of this vital working layer may fall apart when put to use if not properly made.

Arrangement of brick ring beams for the *Fossa alterna* with permanent structure

In Mozambique the slabs and pits are square and the brick ring beams are also made square and built up about four courses, three below ground level and one above. There is a little variation depending on the type of soil. In Mozambique, as in Malawi, the two shallow pits, which are dug up to 1.5m deep are “housed” within a single, permanently placed, non movable superstructure, made of grass and poles in Mozambique, and often bricks in Malawi (see later). In these cases the ring beams are built about 0.5m apart to conserve space.

Examples of brick ring beams for the *Fossa alterna*


Prototype *Fossa alterna* being built at Woodhall Road. Each ring beam was constructed with three courses of cement mortared brickwork. The two pits were only 0.3m apart. This distance was later increased to 1m. The experimental prototype had a shallow pit only 0.6m deep. Later pits are dug over 1m deep, and normally at 1.2metres. 1.5 metres is a maximum depth for the *Fossa alterna.*


***Fossa alterna* ring beams being constructed in Lilongwe, Malawi. Here the soil is firm. In this case the pit is first dug down to about one metre. The upper end has then been widened to allow for the 2 course brick ring beam to be constructed from one brick course below ground level. Two brick courses have been built above ground level. Soil taken from the pits is then built up around the two ring beams. This raises the site of the toilet above the surroundings, which helps divert rainwater from the site.**


On the left two brick ring beams have been built for a *Fossa alterna* in Lichinga, Niassa Province Mozambique. On the right two brick ring beams have been built in Kusa, near Kisumu, Kenya. The ring beams are permanently sited and are best bonded with strong cement mortar.

Brick ring beams for the *Fossa alterna* at the Friend Foundation in Harare. On the left three ring beams have been built in a line. This communal unit is heavily used and in order to attain the one year composting period, three pits, each one metre deep have been built. The slab and structure rotate between the three pits. On the right the brick ring beam is shown. It has been built with four courses of bricks. The pit is first dug down 0.5m and about 1.3m X 1m wide. The brick beam is then built up to one course above ground level. The brick mortar is allowed a day or two to cure and then the pit is dug down deeper to the required depth (1m – 1.5m). Note the layer of strong cement mortar covering the upper surface of the brickwork. This mortar is also extended outside the beam above ground level. This makes a strong and durable ring beam unit for the *Fossa alterna.* It is intended to last for many years.

Fully brick lined pits for *Fossa alterna*

These are required for the ***Fossa alterna*** if the soil is very loose. A full brick lining is used in all cases where a brick superstructure is built. Fired bricks and cement mortar should always be used underground. The brick lining is built up to at least one course above ground level. Always use cement mortar for bonding and fired bricks. When pits are lined from top to bottom with cement mortared bricks, it is only the bottom surface which allows for drainage. In clay soils the drainage will be poor and not entirely suitable for the ***Fossa alterna.*** The brick lining is built up to at least one course above ground level. The bottom should be cleaned of cement and a very generous later of leaves placed in the pit before use.

A fully brick lined *Fossa alterna* pit in Epworth close to Harare. The pit was 1.1metres deep. The soil is sandy and less stable. On the left the base of the pit is being cleared of cement mortar dropped during the brick work stage. On the right a layer of weak cement mortar is applied on the brick ring beam before the toilet slab is mounted on the ring beam. This weak mortar forms a good air tight base on which the slab can sit. This is important as it makes a good foundation for the slab and also an airtight seal for the best functioning of the vent pipe(when fitted), which draws air through the system, reduced pit humidly and also controls flies and odours. The ring beams in this case are about one metre apart.

On the left a permanent brick *Fossa alterna* structure is built around two brick lined pits in Thyolo, Malawi (COMWASH Project). The brick lined pits are shown on the right.

Proximity of twin pits/vaults

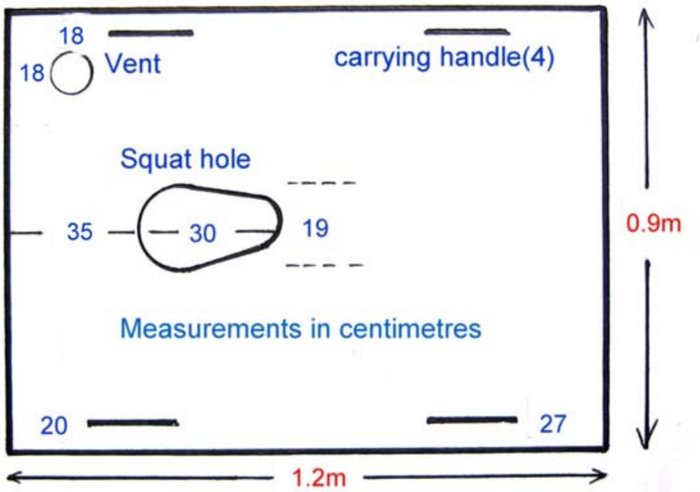
In the first prototype *Fossa alterna*, built in June 1999, the two pits were placed side by side only 300mm apart. These pits were protected with brick ring beams. By placing the pits slightly apart the possibilities of seepage of digesting excreta from one pit to the other were reduced. If some space is available it is best to place the twin pits one metre apart to avoid any contamination passing from one pit the other. If space is really restricted 0.5m is adequate. The pits can be dug close together for convenience of movement of the superstructures, but far enough apart to reduce the potential of one pit being influenced by the other in terms of leakage of contents. Thus two separate pits, dug about one metre apart is recommended. If the two pits are located within a non portable structure, as is the case in Mozambique and Malawi, then the pits cannot be far apart. Normally 0.5m is adequate.

Making square or rectangular concrete slabs

These slabs are made with either a 3:2:1 mix of river sand, small stone, and cement or a 5:1 mix of clean river sand and cement. They use the same amount of materials as the concrete ring beam described earlier – that is one quarter 50 kg bag of cement. If small stones are available, then this will be stronger, but usually small stones are not available so river sand alone must be used. The river sand should be clean and sharp, with little dust and small chips included. As with the ring beam, half the mix is made up first and added to the mould and levelled off. The wire reinforcing is now added (same as ring beam – 4 pieces of 3 - 4mm wire in each direction).The final half of the mix is now added, levelled and finished off with a steel float. Four handles should then be added.

The concrete slab described here is 0.9m wide and 1.2m long and about 40mm thick. The mould in which the slab is cast can be made with bricks or wooden planks or a combination as shown in the photos below. Most slabs are made with squat holes as this is the preferred position, but slabs can also be prepared for fitting a pedestal. In the case of the squat hole a suitable hole can be made by taking a 20 litre bucket, cutting off the bottom and bringing together the base into a pear shape with wire. A squat hole size of about 30cm X 19cm is required. If a pedestal is fitted the hole is 30 cm across and can be formed by a plastic basin. A hole can be made for a vent pipe also in the slab. This is made by inserting a short length of pipe (75mm long) in the slab at the appropriate position (see diagrams). The vent hole size should match the pipe which will normally have a diameter of 110mm. It is possible to make a low cost home made vent pipe using hessian and cement.

One 10 litre bucket of cement (weighing 12 kg) is mixed with five 10 litre buckets of sharp river sand to make each slab. If a 5 litre bucket is available the total mixture can be made in two batches. Half the full mixture is made first. That is 5 litres cement (6kg), 15 litres sand and 10 litres small stones (or 5 litres cement and 25 litres clean sharp river sand). A 5 litre bucket is useful for measuring, but 10 litre buckets are easier to find. Sufficient water is added to the mixture to make a thick slurry. Do not add too much water. This half mix is added to the lower half of the mould and spread out and tamped down with a wooden float. Then the wire reinforcing is added (4 lengths of 3 - 4mm wire in each direction). This is followed by the second half of the mix. The four handles can be made from 4 steel bars about 8- 10 mm diameter and about 25cm long - four can be made from a one metre length of rod. These are bent and set in the concrete (see photo). The concrete is levelled off with a wooden float and finished off with a steel float to make smooth. The slab is covered with a plastic sheet if possible and allowed to set overnight. It is then watered the following morning and kept covered and wet for at least a week before lifting. The longer it is allowed to cure the stronger it will become. 10 days is even better.



Measurements for 1.2m X 0.9m concrete slab

Where generous quantities of soil and wood ash are added regularly to the pit contents, there may be little need to fit a vent pipe, as these additions greatly help to reduce fly and odour nuisance. But the vent does help to reduce any odours that are present and controls flies as well if the required volume of ash and soil is not added. Vents also carry away excess moisture from the pit, which will almost certainly help the composting process. They also ensure that a fresh supply of air is being circulated through the pit, which will also help composting. Because the slabs of both the ***Arborloo*** and ***Fossa alterna*** will be moved at approximately one year intervals, it helps greatly to fit four carrying handles to the slab. These can be made by cutting 4 lengths of 8 - 10mm steel rod each about 25cm long and bending them and inserting in the fresh concrete towards the edges. The concrete is levelled off with a wooden trowel and finally smoothed down with a steel float. Once the concrete has begun to harden, the moulds for the squat or pedestal holes and the vent pipe hole can be carefully removed. The slab should be covered with plastic sheet if possible and left for a week to cure.

During this period it should be kept wet continuously. If plastic is not available it can be covered with sand which is kept wet. For all concrete work, good curing is essential.

Photo of slab mould made of bricks and wooden shuttering. The eight pieces of 3mm reinforcing wire have been cut and laid on the plastic ground sheet. Four carrying handles have also been prepared. A 10 litre bucket with the base removed has been shaped by drawing in the two sides with wire. A 75mm length of 110mm pipe has also been cut to make the hole for the vent pipe. Thus all has been prepared for the addition of the concrete.

The addition of concrete is complete. Half the mix is added first, the reinforcing wire is laid, followed by the remaining concrete which is smoothed down. The handles are added by pushing them into the concrete mix. A little extra cement can be added around each handle to increase the strength of the concrete at this point. Finally the slab is smoothed down flat with a steel float and left to cure.

In many latrines, the slope of the slab is made so that washing water will flow into the squat hole. However if no roof is fitted to the structure the slab will act as a rainwater harvester and water will collect in the pit, which is undesirable. It will be remembered that for the natural breakdown of excreta into humus suitable for tree growth, the pit contents should not be too wet, but should be moist. It is undesirable therefore to have too much water entering the pit. One option is to make the slab flat or to slightly raise the central area around the squat hole including the foot rest area. In this case most drainage water from the slab will flow onto the ground around the slab. This might undermine the ring beam or pit head during the rains. However since the slab will move from one pit to the next, undermining of the ring beam within in a season may be unlikely. The simplest method is to make the slab flat – most rainwater will run away from the squat hole. The ideal is to fit the toilet structure with a roof.

Preparing the pit before use

Before the slab is fitted it is a very good idea to add two sacks full of dried leaves to the base of the pit. This will help the composting process from the moment fresh excreta is added. This composting process will take longer if the excreta falls on barren soil at the base of the pit.


Adding dry leaves to the base of a pit helps the composting process A full sack full or even two sacks full works well. The pit is ready – ring beam in place and leaves at bottom

Adding the concrete slab

The concrete slab is now mounted on top of the ring beam. It is wise to bed down the slab on the beam in a layer of very weak cement mortar (20 parts pit sand + 1 part cement). This makes the slab firm and stable. If a vent is fitted to the system it is very wise to seal any gap between the beam and the slab. This will improve venting of the pit and fly control. If there is a gap between the slab and the ring beam, odours may be released and this attracts flies. Also the efficiency of venting is reduced. A very weak mix of sand and cement can be used as a sealer (20:1) or soil cement or termite mortar. If cement is not available at the time, termite mortar could be used. The slab is now fitted centrally over the ring beam.


Adding a layer of weak cement mortar for the slab to rest on. This helps the slab to rest on the ring beam without strain. Also if a vent pipe is used, the pit should be air tight, thus allowing the suction of the pipe to draw air down the squat hole or pedestal. This leads to odourless conditions in the toilet. On the right a slab is mounted over the ring beam. This stab has a larger hole intended for a pedestal caste in it.

Adding dry leaves to the base of the pit in Epworth

The concrete slab is bedded into a layer of weak cement mortar on the ring beam. The photo on the left shows one being fitted at Epworth. The photo on the right shows the prototype fitted in Woodhall Road. Carrying handles are useful when moving the slab from one pit to the other

Superstructures for the *Fossa alterna*

Fitting the superstructure (with optional vent pipe and pedestal).

A great variety of superstructure designs are suitable for the ***Fossa alterna***. The main purpose of the structure is to provide privacy – the functioning of the ***Fossa alterna*** is not much influenced by how the structure is made. However a roof is very desirable, as this helps to control flies and helps to keep rain out of the pit. Very wet pits do not compost well. The various photos in this chapter and the previous chapter on the ***Arborloo*** show the great variation in superstructure design. Not all ***Fossa alternae*** are built with a single portable superstructure however. Most of those in Mozambique built under the WaterAid and ESTAMOS programmes, and also in Malawi under the WaterAid, CCAP and COMWASH programmes use a single larger permanent superstructure which surrounds and is built around both pits. The WaterAid funded work on promoting ecological sanitation in Mozambique and Malawi has been very successful. The ***Fossa alterna*** concept has become very popular because the regular addition of meaningful quantities of soil and ash to the pit have noticeably reduced fly and smell nuisance. The permanent location of the twin pits is attractive to the users since it seems to offer a longer term solution to their sanitary problems. Equally as important is the realisation that within a year, excellent humus can be extracted easily from the shallow pits (up to 1.5m depth). The value of this humus when applied to vegetable gardens is thought to be considerable. All these features make sense to the users. For once the toilet has a value of its own, apart from the disposal of excreta. The ***Fossa alterna***, like the ***Arborloo***, may have come at a time when the sanitation world is in need of a new approach.

Examples of *Fossa alterna* superstructures

On the left the prototype *Fossa alterna* used a wooden structure and two shallow pits with brick ring beams. On the right a *Fossa alterna* in a low density suburb in Harare. This unit used two concrete ring beams, a structure made with a steel frame overlaid by grass and a 75mm PVC vent pipe.

***Fossa alterna* at Woodhall Road, Harare. Note hand washing facility, waste water falling into a flower pot. Second pit during the first year was filled with leaves and compost. It was also used to grow comfrey (see later). Inside a home made pedestal has been fitted. The yellow bucket contains a mix of soil and wood ash and a dispenser. Leaves are also added occasionally.**


Fitting the portable superstructure to one of the twin *Fossa alterna* pits in Epworth, close to Harare. During the first year the second pit was filled with leaves and thin layers of soil to make leaf mould. After 12 months the leaf mould was dug out and the slab and structure moved to the second pit (as shown). The pit filled with excreta, soil, ash and leaves has been topped up with soil (see right of picture).


***Fossa alterna* in Niassa Province, Mozambique built under the WaterAid funded programme. The twin pits are enclosed in a single pole and grass superstructure which is permanently located. A washing area is also constructed as part of the system. These are very popular units, as they are almost odour and fly free, unlike many earlier toilets built in the area. They are also relatively low cost. The pits are each 1.5 metres deep and protected by brick ring beams. Here one of the pits is being excavated for humus.**


On the left a *Fossa alterna* with portable structure being constructed in Kusa Village, Kisumu, Kenya. On the right a permanent brick and thatch *Fossa alterna* built at Kufunda Village, Ruwa, Zimbabwe

Management of the *Fossa alterna*

1. Daily management

Add soil, wood ash and leaves regularly

Two sacks of dry leaves are added to the pit base before use. Then the ***Fossa alterna*** is used much like a normal pit latrine. Urine, faeces, and anal cleansing material, preferably paper are added every day. In addition and in order to build up the mix of ingredients which assist in the conversion of faeces into humus, it is important to regularly add dry topsoil and wood ash to the pit, preferably after every visit made, and also leaves from time to time. At the very least a small cup full of the soil should be added after every visit made to the deposited faeces. It is unnecessary to add the extra ingredients after urination only - this may result in the pit filling up too quickly with soil. If this soil is mixed with ash the resulting mixture will improve, as it will be slightly more alkaline and some potash will be added. Wood ash also helps to reduce odour and flies. The final texture of the humus formed in the pit will be improved greatly if leaves are also added regularly. At least a sack full should be added before the pit is put to use. These compact a great deal and the volume of leaves added should be generous. The leaves may have a considerable nutrient value of their own, as described for leaf compost in the gardening chapter. So they will improve not only the texture, but the overall nutrient value of the final humus. The final quality and usefulness of the humus will also be improved by the addition of organic vegetable matter from the kitchen like fruit skins and vegetable peelings. This will increase the volume of added materials and a balance must be struck between volume added and final quality of the humus. The more soil and vegetable matter (like leaves and vegetable/fruit cuttings, the more crumbly and valuable the produce will be in agriculture.

Ideally a premix of soil and wood ash can be made in the dry state and stored for use in bags. Such a mix is best prepared in the dry season. Dry leaves, even when crushed, do not mix well with soil as the heavier soil tends to fall deeper into the mix with the lighter leaves being concentrated on top. Hence the leaves must be added separately to the pit – taken from a separate container, like a sack, within the latrine. The dry soil and wood ash can be mixed beforehand - mixing 4 parts of dry soil to one part of wood ash. This is best mixed in bulk, stored in a larger container or sack and then brought to the latrine in smaller lots. Similarly the dried leaves are stored in bags and also brought into the latrine in smaller lots. The leaves once dry can be crushed to reduce their volume before storing in bags. They can be crushed by treading, by beating with a stick or rake, so that the leaves break down in to smaller units. The volume of dry leaves can be reduced considerably in this way and make for more efficient storage. The leaves will compact a great deal once in the pit and the soil will provide microbes which greatly assist the conversion of the excreta.

Pit filling rates

A little mathematics is required here. The volume of soil and ash added to the pit should be thought out beforehand and a suitable container such as a mug, or the upper part of a plastic milk bottle, with handle attached used for dispensing the soil/ash mix. If a family of 6 persons defecates once a day each into a pit and adds soil/ash after each deposit is made, it is possible to roughly calculate the resulting volume of soil. In a pit of cross section 0.7 X 1m X 1.2 m deep the volume to the top is 0.84 cu.m. or about 850 litres. The actual available space may be slightly less, since the upper part of the pit will not be used. If each member deposits 0.2 litres of soil/ash per day that means that approximately 1.2 litres of soil/ash will be deposited each day into the pit. That amounts to 450 litres of soil/ash per year. The leaves (about a hand full) should also be added, but once composted they will occupy a very small volume indeed - but they will be absorbed into the soil to improve its texture and also add more nutrients. The initial volume of faeces added by the family of six to the pit will be at least equal to this volume if not more - say 600 litres. That is 100 litres per person per year. But about 80% of this initial volume is water. After composting and absorption into the soil, the resulting solid fraction of faeces from a small family may amount to about 250 - 300 litres per year. A much greater volume of urine will be deposited in the pit. Some of this will be absorbed into the pit soil and leaves and later into the resulting humus, but much will seep away into the surrounding ground. This loss of potential nutrients from the urine, particularly nitrogen, must be accepted in shallow pit systems of sanitation like the ***Fossa alterna***. That is unless the excellent practice of storing urine, by urinating into containers is also carried out by the family (see chapter on urine). Such storage of urine is highly recommended. In the ***Arborloo*** not all the nutrients available in the urine are lost from the "loop" as they are absorbed into the surrounding soil and will later be taken up by the tree which is planted on the pit. The accumulation of the stable phosphorus in these shallow pits is particularly valuable.

Thus the combined annual volume of ingredients added to the pit may approximate 450 litres soil/ash/leaves plus a processed volume of faeces amounting to 250 - 300 litres, plus urine which will be absorbed into the humus and leaves or drain into surrounding soil. Thus an annual total of approximately 700 – 750 litres of humus can be expected. In practice a 1.2 metre deep pit will fill up in about one year for an average family. A 1.5 metre deep pits provides more latitude and should be aimed for.

It is accepted that in the real world such additions may not follow these recommendations exactly. In practice the soil may be added less frequently, resulting in a lower proportion of soil to excreta. The concept will still work quite well if soil alone is added without ash, but will not work so well if wood ash alone is added. The combination of human excreta and "any" soil will make a "new" soil which is greatly enhanced in terms of nutrients. The addition of a humus-like topsoil makes a better product than poor sandy or barren or clay like soil. Leaves provide extra nutrients, but equally as important they improve the texture of the final product considerably and also allow more air into the mass which helps the composting process. Also urine combines well with leaves to make compost. So the best is fertile topsoil, wood ash and leaves in combination. This combination will turn into excellent humus.

However the easiest way may be the only way at first - and this will be to use the soil which has been excavated from the pits or surrounding topsoil, whatever is available. Such soil may be very poor - both in texture and in nutrient content, but remarkably, once combined with excreta, the nutrient levels of the soil rises significantly (see chapter on soil tests).

Sources of fertile soil and compost in the garden

Sources of fertile soil can be found in most gardens to add to the used pit and also to add on top of the leaves which are added to the second pit. A good place to look for fertile soil is under trees where leaves may have fallen and begun to make "leaf compost." Leaf compost is the final product of decomposed leaves. Look around the garden for places where compost may have been made before and vegetables grown. Often the soil is barren in dry areas. Therefore the search for fertile soil will be more difficult. It is always a good idea to start making a compost heap to enrich the garden soil for planting vegetables. Sometimes it may be necessary to import some compost or fertile soil (on a Scotch cart for instance) from some other place where the soil is more fertile. Once the ***Fossa alterna*** is working properly, a yearly supply of humus for the garden will be available within the homestead from the composted pits. It is worth making the effort in the early years. The greater the proportion of these compostable materials added to the pit, the better will be the final humus excavated.

Finding fertile soil or leaf litter in barren environment

The question will be asked: where do we find fertile soil in a barren environment? The answer lies in looking under trees where humus may have been accumulating - or even going farther a field to find it and bring it back to the homestead in bags. Leaves may accumulate in pockets or depressions and may have partly converted into leaf mould over the seasons. The search for a living soil will often come up with something. The best soil which is available should be used first time around. Second time around the humus excavated from the first pit can be added to the second pit which will now be filling

No garbage please!

Since the humus will eventually be dug out, it is doubly important to ensure that garbage (rags, plastic, bottles, wire, glass, rubber, etc) is not tossed down into the pit. Such garbage can make later excavation tedious, difficult, unpleasant and even embarrassing. Thus plastic, rags, bottles and various other non compostable items should be disposed of elsewhere, like shallow garbage pits. They should NOT be placed down the ***Fossa alterna*** pit.

Not too much water either!

The conversion of excreta into humus will not take place if the pit is flooded with water. This means that only limited amounts of water should be added to the pit. Good pit drainage very much dependent on soil type and area of soil in the pit available for drainage. Where the ring beam method of pit protection is used a large surface area of soil will be available for pit drainage. Where the walls of shallow pits are lined with bricks to the base - only the base will be available for drainage. There will be a lot of variation depending on soil type, pit volume, pit protection type and the material content of the pit. But it is wise to add some water to the pit from time to time to keep the content moist. It is an excess of water that is not required. So eco-latrines should not be used as bathrooms.

Take a look from time to time!

For the best results, it pays for the user to look down the pit from time to time. One feature of adding soil and ash into the pits of eco-toilets, which is rarely mentioned, is the formation of mounds of excreta rising directly beneath the pedestal/squat hole. This is the result of adding dry soil/ash to the excreta directly after defecation. A piling results, which can look like an ant turret - it can be called “turreting.” When this happens, any soil or ash added tends to fall to the sides of the turret and the best mix of excreta/soil/ash cannot result. Thus it is advisable from time to time for the user to take a stick or pole and try to level off the pit contents so that more of the available pit space can be used. Normally this involves moving the pile forwards towards the “front end” of the pit to level out the pit contents. This will help to some extent to mix the ingredients and assist the conversion process. This is very desirable in the ***Fossa alterna*** so that the greater part of the pit can be occupied with excreta/soil mix – and pit life can be extended. This means “spreading the load” a bit. The family should aim to fill the pit up in a year or more, and not less than a year. Thus the spreading out of the pit contents is an important part of routine ***Fossa alterna*** management.

Adding more soil and leaves to pit contents.

The routine of adding soil and ash after every visit, and preferably leaves as well, is important. This will help the conversion process. The soil mix is best stored in bags and then placed within the toilet in smaller containers for daily use.

The ratio of soil/leaves to excreta is increased by adding of leaves to the base of the pit before the concrete slab is fitted. This layer helps start off the composting process. It may also help to add an additional 30 litre bag of leaves to the pit half way through its one year cycle. Thus a good layer of "living soil" can begin to act on the raw excreta during the filling stage. Once the pit is filled and the slab and structure moved over, the final layer of leaves followed by fertile soil is added to cover the excreta. Once again the process is helped along if extra soil is rammed into the pit contents. A good layer of leaves followed by topsoil should be left on top of the pit contents and even these can be covered with leaves again. The overall aim is to get as much living soil and leaves into the pit mix as possible to help the conversion.

Effects of venting

The dry soil, wood ash and leaves do help to remove excess moisture from the excreta and this is desirable, since the conversion of excreta into humus will not take place in wet conditions. The addition of a vent pipe also helps to circulate air through the latrine system and also assists in the removal of excess moisture and condensation from the pit chamber. Vent pipes help to remove odour and if fitted with a corrosion resistant fly screen, reduce fly nuisance as well. However the production of humus will not take place in very dry conditions either. Toilet paper and leaves for instance will remain little changed in a very dry vault. The composting process needs some moisture, just as a compost heap requires moisture. So washing down with water will help from time to time.

Management of the second pit in the *Fossa alterna*

It is essential to dig and protect both ***Fossa alterna*** pits during the initial building stage. Whilst the second (and as yet unused) pit can be left empty and covered with wooden lid, it can also be used to the best advantage, whilst the first pit is filling.

The second pit can be used to make leaf compost by the addition of leaves, interspersed by thin layers of soil which is watered regularly. Since ecological sanitation concerns recycling in all its aspects and the development of a recycling habit within the homestead, it makes good sense for the concept of "pit composting" to be introduced. The aim is to develop the interest of composting as a sound gardening practice in combination with the use and management of the eco-toilet. The ***Fossa alterna*** system makes this possible. Even adding leaves and some local soil to the second pit during the first year of operation can be very valuable. The leaf compost formed in a second a pit in Epworth near to Harare was considerably more fertile then the surrounding soil and proved to be valuable in growing vegetables and maize. At times of heavy rain it is best to cover a composting pit to avoid flooding. If the second pit is not used for growing plants like vegetables or comfrey, it should be covered with a wooden lid.

On left, comfrey being grown on second pit of *Fossa alterna* during the first year. Comfrey is rich in potassium and makes an excellent mulch for vegetables, especially tomatoes. On right leaf compost being made in the pit – a mix of leaves and a little soil – should be kept moist.

Time to change sides!

"Changing pits" on the *Fossa alterna*

Once the used ***Fossa alterna*** pit is nearly full the time has come to change pits. For a family this should be after one year or more. If the latrine is heavily used, and the pit filling time is less than 12 months, it is best to make an additional ring beam and use 3 pits which are filled in rotation. If the pits are used more heavily 4 pits may be necessary. The time of conversion of excreta into humus is dependent on several factors which include moisture content, temperature, mixture within the pit etc - the more topsoil and leaves the better. The pit must not be flooded, neither should it be very dry. Temperature will depend on altitude and season. In warm/hot areas under the right conditions, humus can be formed in a few months. The higher the ratio of soil/ash/leaves in the pit the more effective the conversion will be. Also the more varied the ingredients - the higher the fertility of the humus will be.

If the second pit has been filled with leaf compost during the past year, this should be emptied - thus making available the empty pit. The excavated compost can be used on the garden, but it is also usefully added to top up the pit filled with excreta and soil etc. The same material can be used to add to the new pit as it fills up.

Changing sides involves first remove the superstructure and slab and placing these to one side. Add plenty of leaves into the empty pit. Now place the slab on the ring beam above the empty pit and also seal this off with a weak cement mortar or termite mortar. Now add the superstructure back on the slab (and any pedestal if used). The procedure for latrine management is now started on the second pit, just as before.

Dealing with the pit filled with excreta etc.

The pit filled with excreta/soil/ash/leaves etc is now levelled off and fertile soil is added. The best results are obtained if extra soil and leaves can be rammed into the body of the pit with a gum pole. This ensures that more soil and leaves are added and well distributed. This may appear to be a most unpleasant task at first. But it pays off. In any event, even if new soil is added just to cover the existing pit contents, this will break down within the year. A layer of about 100mm - 150mm is best. The soil is best fertile and can be taken from the compost pit or from a layer of good topsoil if available. A final layer of leaves can also be added as a leaf mulch. The pit is watered a little to make the contents moist. The pit can now be left to convert for one year. Occasional watering is required, even if plants are not added to keep the contents moist. The pit must never be flooded.

Excavation of the humus

After one year of composting the pit humus can be removed. The pit contents will have considerably shrunk after one year, perhaps to about two thirds of the volume, as the water content of the faeces is absorbed by the soil and into the walls and floor of the pit. Normally this pit humus is easy to excavate and usually much easier to remove than the original soil when the pit was first dug. A shovel and pick are used. The pick can be used to loosen up the humus, especially nearer the bottom. The humus should be quite dark in colour, but the colour and texture of the humus depending on what has been added to the pit.

The humus removed from the ***Fossa alterna*** pit is best stored in bags at first, where it will get more time to compost further. It can also be dug into the garden soil, also in preparation for planting. The process of biological breakdown will continue. It can also be mixed with local topsoil and placed in containers or shallow trenches for growing vegetables. These methods are described in another chapter. As with all gardening practice, it is wise to wash hands after doing the gardening and handling compost or the humus from these shallow pits.

After the pit has been excavated and the humus stored in bags etc, two sacks of dry leaves are added to the base of the pit and the process is repeated. The slab and structure are moved onto the empty pit. The pit filled with of excreta, soil, ash and leaves is topped up with soil and leaves and allowed to compost for another year.

This same process is undertaken once a year, every year. Excavating a shallow pit does not take long (about 30 – 45 minutes) and if the right ingredients have been added through the year the process should be easy and not offensive in any way. It is quite remarkable how the foul human excreta can change into a pleasant material. It will change into humus if there is enough soil, ash and leaves in the mix to help the process along. Seeing it for the first time most people are very surprised to see this miraculous conversion of Nature.

Ephraim Chimbunde excavates humus from a *Fossa alterna* pit in Hatcliffe, a project of Mvuramanzi Trust. The humus, or compost, as it is often referred, to is placed in bags for storage and later transported to the vegetable garden of choice.

Variants of the *Fossa alterna*

A number of experimental variants of the ***Fossa alterna*** have been designed and studied in Harare. These include two fully brick lined double vault units, one which operates under a slab which slides on a rail, the other built with a brick superstructure.

The double vault substructure with sliding slab

In this case the two fully brick lined pits are built as one unit, one third below the ground, two thirds above the ground. The convenience is that space is conserved, and most of the vault space lies above ground, which may be useful in high water table areas. The upper brick rim of the double vault was fitted with a steel "runner" on which the slab can be pulled from one pit to the other (the slab is caste in a steel frame). In this case the slab and structure can be pulled from one pit to the other without removing either.


The "sliding slab" *Fossa alterna*. Most of the double vault is above ground. A steel rail made of angle iron is cement bonded to the upper rim of the vault. The slab is also cast in a frame of angle iron. The slab runs inside the steel rail. The superstructure is mounted on the slab. A rope attached to a steel handle cast in the side of the slab is pulled and the slab can be moved from one pit to the other. It is an elaborate way of moving the structure, but it works. A little grease helps to lubricate the rails.

An "above the ground unit"


In this design the vault is built almost entirely above ground with a single course of brickwork below ground level. This unit was built in an area which can experience a high water table during the rains. It can alternate with a concrete ring beam placed at ground level.

The "long cycle" *Fossa alterna (alternating compost VIP toilet)*

In the ***Fossa alterna*** unit so far described the period of alternating is about 12 months. The pit is relatively shallow (max 1.5 metres) which has several advantages. These advantages include ease of digging, reduced compaction, better composting, more distant from water table etc. However it is also possible to build shallow pit toilet of this type where the pit is wider or deeper (max about 2 metres) so the period of alternating can be extended to between 2 and 5 years. Composting is encouraged as before by the regular addition of soil, ash and leaves. Experimentation with this method is being conducted in Zimbabwe (Harare) and South Africa (Maputaland). When fitted with a vent pipe, this can be considered a variant of the VIP toilet.

Where the alternating period is longer, recyclable superstructures made of brick can be used. These are best linked to a steel frame fitted with "sprags" which are bonded into the brickwork. Such frames can be fitted with standard doors and hinges, but may be more durable if fitted with hinges made with car tyres. Also the option of fitting lighter doors mounted on the door frame (such as thinner wooden plywood or sacking material) is possible. In this case the bricks are mortared together with a weak cement mortar (20 parts pit sand to 1 part cement). Experience has shown that such brickwork can hold firmly for years, but is also easy to take apart and rebuild. Roofs and vent pipes are best built in materials which will last for a very long time and can cope with being dismantled and reconstructed. The ideal is asbestos. Asbestos vent pipes last much longer that PVC pipes. With good bricks and asbestos roofing and vent, a brick superstructure can be recycled periodically for many years.

The pit size can be increased partly by digging deeper. But since the composting process is still being encouraged, this should not be too deep. 2.0m may be a good depth. Pit volume can be increased by enlarging the cross section of the pit from 0.7 sq.m. (in the model described earlier) to 1.2 sq.m. A pit with an upper cross section of 1.2 sq.m. and a depth of 2m will have a total volume of 2.4 cu.m. This is nearly three times the capacity of a pit with a cross section of 0.7sq.m and a depth of 1.2m (0.84 cu.m.). The larger ring beam (external measurements 1.2m X 1.4m and internal measurements 1m X 1.2m) will require a larger and heavier slab. This will have dimensions of 1.2m X 1.4m and will be 1.5 times as heavy again as the smaller slab(1.2 X 0.9m) and will use 1.5 times the volume of cement and sand to make (15 litres cement + 75 litres river sand).

Once again the type of superstructure mounted over one of the two pits is optional. But where the recycling time is longer, bricks can become a serious option. Where the steel frame version with sprags is used, the entire structure can be taken apart, bricks cleaned, slab relocated and structure completely rebuilt within 6 hours by an artisan. This relatively easy process is possible because the entire brickwork is mounted on the slab itself and no separate foundations are required. The brickwork for this system is built on edge, to reduce weight and the number of bricks required.

It is desirable to dig and line both 2m pits at the same time, using one immediately and retaining the other for future use. The second, as yet unused pit can be filled with leaves to make leaf compost. Whilst this procedure (digging and lining both pits at the same time) may seem unnecessarily laborious, experience has shown that if both pits are not built at the time of the toilet programme, a second pit may never be dug and lined, or dug and lined poorly. For the ***Fossa alterna*** to be successful it is essential that both pits be available for use from inception.

Photos of a fully recyclable "alternating compost VIP toilet"

Sequence of building/dismantling and rebuilding the recyclable brick superstructure.

One of the two pits is dug and lined with cement mortared fired bricks. The steel frame (with door frame) is erected at the "door" end of the slab and the brick walls are built. "Sprags" of steel welded to the frame link the steel component with the brick and mortar work.

The roof is fitted after completion of the brickwork and door fitting. An asbestos pipe will also be fitted. Photo on right shows first stage of dismantling. The pipe, pedestal and roof have been removed. Now the brickwork is taken apart.

All the brickwork has been taken apart. The bricks are cleaned up. This is easy because the mortar is weak (20:1 sand and cement). On the right the same slab, having been removed from the original pit, is relocated on the second pit and mounted over a bed of weak cement mortar.


The steel frame is mounted again on the slab and the same bricks are used to rebuild the structure.


After the brickwork is complete, the roof, asbestos pipe and pedestal can be put back in place. The operation takes about 6 hours. If the pits are changed once every 3 – 5 years, this is not a huge expenditure of time and effort. Everything is recycled, even the material in the pit, which is dug out once the time has come to change sides again.


Closer views are parts of the frame. In this case the frame is made from 40mm X 40mm X 5mm angle iron. In this case the hinges are steel, but a more durable hinge can be made from car tyre. This is shown in the chapter on special construction techniques later in this book.

The double vault brick substructure with brick superstructure

In this model the twin vaults are built as one unit below ground level, with one course of brickwork above ground level. The pit depth is 1.5 metres or more. A single slab is fitted and a brick superstructure is built on the slab. The brick superstructure is designed specifically so that it can be dismantled and rebuilt within a few hours. The structure has a wooden door which is built within a steel door frame. This is hinged to a larger steel frame fitted with "sprags" which can be bonded into the brickwork of the side walls. The bricks are bonded with a weak cement mortar being made of 20 parts pit sand and one part cement. The roof is removable being made of asbestos. The vent pipe is preferably made of asbestos which lasts longer than PVC. The pedestal is a low cost home made unit, being fabricated completely from concrete (see later chapter).

The outer brick lining of the vault is made as a single layer of bricks, with the central dividing wall a double layer as shown in the photo. The external dimensions of the brickwork are 1.3m X 1.9m. The pit depth is 1.5m or more in depth. It is desirable to plaster both sides of the pit dividing wall to reduce seepage from one pit to the other. It is also desirable to add a strong mortar to cover the uppermost course of bricks to strengthen this section as the latrine slab will be moved many times on this course. The uppermost course of bricks must lie above ground level to avoid flooding of the pit during the rains. The pit base should expose soil to allow for drainage of the liquid fraction of the excreta. Cement falling on the base of the pit should be cleaned out. In these fully brick lined structures, it is essential that dry soil and ash are added regularly, and preferably leaves also.

The strongly built double vault substructure is built up to about two courses above ground level. The dividing wall is a double thickness of bricks and should be plastered on either side. Once the slab is mounted, a specially designed "easy to dismantle" brick superstructure is built (see above). During the first year, the second vault can be filled with leaves and soil to make leaf mould.

This neat and durable pedestal is constructed entirely from concrete with an internal plastic lining which is in fact a bucket. The vent pipe is fitted inside the structure. On the right, the humus from the composted vault is being removed. It was this humus that was used in the plant trials described later on in this book.

Upgrading the *Fossa alterna* to urine diversion?

The ***Fossa alterna*** was designed for simplicity. It is a modification of the pit toilet and is used much like a pit toilet with two changes in the way it is used – add more soil and ash etc and please – add no garbage to the pit. This allows the mix of faeces, urine, soil, ash and leaves to compost in the shallow pit. And shallow pits filled with this humus are easy to dig out.

The urine diverting unit is a pedestal or squat plate which separates the urine from the faeces. This method is described in more detail in a later chapter. Its advantages are that in separating the urine from the faeces, the faeces, which are mixed with dry soil or ash become easier to manage because they are semi dry. Also the urine, which is an excellent source of nitrogen, can be collected and used to enhance the growth of green vegetables and maize.

The ***Fossa alterna*** was designed specifically to operate without the use of a urine diverting unit which requires a lot more care and attention. It also costs more money. Unless great care is taken with a urine diverting unit it can give trouble. The urine must either be collected in a container or at least disposed of safely in a soakage pit. Normally faeces drop into a vault beneath the toilet and are covered with ash or soil and allowed to dehydrate. They are then later removed from the vault in an almost dry state. But men and boys may also urinate down the "dry side" where the faeces should go, and this can cause trouble with the dehydration process. Also if care is not taken in adding ash or soil, or even the faeces, the urine pipe may become blocked and require attention. Such problems cannot occur if there is no urine diverting unit present in the system. And this is why the ***Fossa alterna*** was conceived and designed, for its simplicity, lack of pipes and specialised pedestals. It can cope more easily with a certain amount of poor management.

However when urine diverting toilets are managed properly, they provide an excellent system, which is described later in this book. It is technically possible to add a urine diverting pedestal to a ***Fossa alterna*** unit (or to an ***Arborloo*** or any pit toilet in fact). Ideally the pedestal unit should be one where the urine pipe separates from the pedestal above the base so that the piping can be taken above ground to a suitable container or soakaway (see chapter 13). By doing so, the pedestal can still be mounted at ground level, above the pit. The urine diverter will allow urine to be collected for later use on nitrogen hungry crops or trees like banana. And it will be faeces alone which will drop into the pit with soil and ash added. The occasional addition of urine to the pit will not cause any malfunction. Indeed the ***Fossa alterna*** operates effectively with the full addition of urine to the pit without malfunction in almost every case. Only if the soil is incapable of accepting liquids, like clay, or if large quantities of liquids including urine are added to the pit will there be a problem, and this may be an instance where the use of a urine diverter is justified with the ***Fossa alterna***.

In fact one of the secondary composting systems which can be used with a urine diverting toilet, is itself a twin pit system (see chapter on urine diverting toilets). In this case the faeces together with dry soil and ash which are added to a bucket contained in the dry vault, are actually transferred into a twin pit system to compost. The same end result would take place if the urine diverter was fitted directly over the pit itself.

The ***Fossa alterna*** was specifically designed to operate without a urine diverting system. But the various eco-toilets described in this book are interlinked in many ways, and there is nothing to stop the enthusiastic homesteader from adding a urine diverter to his own system.

Training and demonstration

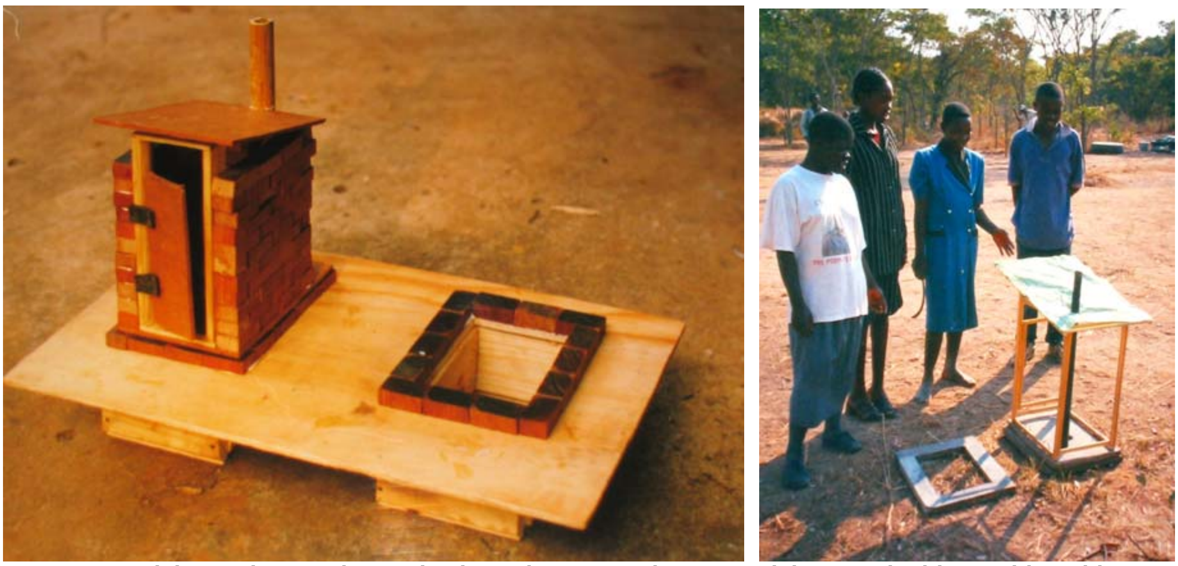
The success of the ***Fossa alterna*** system depends on the users understanding the concepts involved and being willing to put the simple management principles into practice. A good educational programme is therefore essential. Ideally the unit should be used by a family of about 6 persons. The pit may then take about one year to fill. If the size of the family (and visitors) remains the same, then the second pit should also take about one year to fill, which means that the pit of converting contents will have about one year to convert from excreta into humus, which should be ample time. In order to work well in practice the system of management must be made as simple as possible. The aim should be to get a pit which fills up in about a year (or more) - this includes the volume of additional ingredients like soil, ash and leaves. Pit depth can vary a little but should normally lie between 1.2 and 1.5 metres. The area of the pit will depend on the slab size and thus the size of the ring beam.

Use of demonstrations

The potential owners of new ***Fossa alternae*** are best advised to see units which are already in use and talk to the owners about how they find them. Questions can be asked about the management and how useful the resulting humus is. Clearly not all people are interested in gardening - particularly those living the urban areas. There will be some variation in the uptake of this “composting system.”

The use of models

Models can also be used to demonstrate how the ***Fossa alterna*** works and is used. It is often difficult for people to visualise what goes on before they see it with their own eyes. This can be done “ahead of time” by doing a demonstration with small models which are small replicas of the full size ***Fossa alterna*** and its double pit. Different coloured soils and sands can be used to depict the different ingredients added to the pit. People can start to understand if they see the process with their own eyes. Seeing is believing! The spoken word alone is often not convincing or effective enough to pass important messages, especially about delicate issues like the reuse of human excreta.



Two models used to teach people about the *Fossa alterna*. Models are valuable teaching aids.

Potential problems of the *Fossa alterna*

No account of the ***Fossa alterna*** would be complete without a discussion of problems that may be encountered and how they can be overcome**.**

1. Pit overused.

Use of three or more "alternating" pits!

If the "family" size is very high (including visitors, lodgers and tenants etc) a 1.2m deep pit will fill up in much less than a year. Under these conditions the rate of composting will not keep pace with the rate of new additions to the pit. It will be essential in this case to dig another pit or even another two pits to cope with the loading. In this case the structure rotates around the three or four pits, thus allowing each pit of contents more time to "convert." Making each pit deeper, say to 1.5m will also help. By doing so the same conversions can take place in the pits, but the need to evacuate a pit "ahead of time" will be unnecessary. There will be more time for the full formation of humus. The longer the period of humus formation the higher the quality of the end product, and also the safer it will be to handle. So with a little extra space being allocated for the inclusion of a third or fourth pit, there will be increasing flexibility. This may be the preferred option in some locations where there is some space but where the households are very full and the "family" is extended. Thus a family of 6 will find the double alternating pit entirely suitable for its needs at the pit depth of 1.2m – 1.5m. But if the number of users rises to 15 or 20, two shallow pits or vaults will not be adequate. A third or fourth must be built.

This *Fossa alterna* is actually used in a heavy duty communal setting. Three pits have been built to cope with the use.

2. Inadequate soil added to the pit.

Adding soil into a pit is not the most natural way of using a pit latrine. Many users may think the pit will fill up very rapidly and may reject the idea. In fact much of the volume of excreta is made up of water and a proportion of this can be absorbed into the dry soil which is added. ***Fossa alterna*** pit filling rates are often less than anticipated by users unaccustomed to these ecological latrines. If too little soil (or no soil at all) has been added to the pit, the conversion from excreta into humus will take a long time - even years. Adding just a small sprinkling of soil from time to time will not help the process at all. Fortunately it is possible to compensate by adding bulk soil/leaves/humus from time to time to the pit. And soil can be rammed into the pit at the time of changeover to increase the proportion of soil to excreta. These various methods help. It is far better, however to add the soil, ash and leaves as the pit is filling up.

3. Right type of soil

The best soil to add is humus like soil which is fertile and healthy. This will contain humus and a high content of living organisms like beneficial bacteria and fungi which will help to break down the faeces. Less fertile soil like sand or clay will not be so effective at converting the excreta. During the first year of operation it is wise to look around for good soil to add to the pit. After this period, some of the humus taken out of the first pit can be used to help convert future pits. However it is accepted that for most areas where the ***Fossa alterna*** will be put to use, the soil will be naturally poor. This is where the addition of leaves will help. The best ingredients for the ***Fossa alterna*** pits are excreta, soil and leaves. Ash also helps to control flies and odours and adds potash.

4. A good distribution of soil

The soil should be added often so it is well distributed in the pit and some soil is near to the excreta wherever it may be in the pit. By adding lots of excreta without soil and then adding a bag of soil later is not the ideal. Add soil often to get a well distributed mix.

5. Pit Flooding

This can happen if rain flows into the pit if there is no roof on the structure. In this case a roof will solve the problem. It can also happen if the water table rises very high in the ground on a regular basis. In this case the problem may be solved by building the pits above ground level. That means basically converting them into brick lined vaults. This method involves raising the vault completely above ground level as shown in the picture below. In this case the above-the-ground vault is used in the wet season and the latrine is placed on a ring beam placed at ground level during the dry season. Two above-the-ground vaults might also be used. It is not the ideal - then areas which are permanently flooded are not the best for human occupation, let alone the proper functioning of toilet systems.

Vault above ground and pit below the ground – used alternately.

6. Too much bathing!

Too much water from bathing can also lead to flooding of a pit. In fact it is not recommended that either the ***Arborloo*** or the ***Fossa alterna*** be used as a bathroom as this adds an excessive amount of water in to the pit, which disrupts the composting process. If bathroom facilities are attached to the eco-toilet, the wash water should be drained away to a separate soak pit.

7. Adequate pit drainage

Adequate drainage is important to the ***Arborloo*** and ***Fossa alterna*** concepts. The conversion of excreta into humus will not take place in flooded conditions. Where flooding is known to take place regularly, shallow pit methods of eco-san may not be suitable. If the soil has a high clay content and the seepage of water and excess urine from the pit will be slow, a difficult situation is created. The addition of larger amounts of dry soil and leaves from above will help. But if the pit is permanently wet with water or urine, a "dry system" like the urine diverting method (described in the next chapter) may be more successful.

8. Climate

The ***Fossa alterna*** was designed to work in a warm climate and specifically for countries in East and Southern Africa. It's operation does depend on ambient temperatures in the pit being in the range 15 – 24 degrees Centigrade for most of the year. In colder climates the rate of humus formation will be slowed down and the system may not be effective. As always when a new technology is used for the first time in a new country, it must be built somewhere on an experimental basis and examined closely for a period of at least one year, and preferably more. Only after successful trials in a new country should more wide spread promotion begin.

A sunny climate is ideal for the *Fossa alterna*

Examples of the *Fossa alterna* from different countries

The *Fossa alterna* in Kenya

Delegates at eco-san workshop in Mombasa construct concrete ring beams within wooden frames for *Fossa alterna* at the Mtomondoni Primary School (left). On the right the two pits of a *Fossa alterna* are lined with coral limestone blocks from the base in very loose sandy soil near a beach site at Mombasa.

School children at the Mtomondoni Primary School learn how to make concrete slabs for eco-toilets

On the left adding semi composted "makuti," the leaf of the palm tree, to the base of a *Fossa alterna* to promote composting. On the right a finished *Fossa alterna* at Bengala Village. Both pits, dug down to 1.5m are fully lined with coral limestone blocks in loose soil. The second pit has been left empty and covered with a tin lid. The addition of soil, wood ash and leaves to excreta promotes composting in the pits. It is this promotion of the composting process which makes the *Fossa alterna* concept possible.

The *Fossa alterna* in Malawi

The ***Fossa alterna*** is becoming very popular in Malawi and is being promoted by WaterAid in Salima and also in Embangweni by CCAP with WaterAid Assistance. It is also being promoted by COMWASH in Phalombe and Thyolo districts. The Malawians as well as the Mozambicans have chosen to enclose both ***Fossa alterna*** pits within a single permanent superstructure rather than move a portable superstructure from one pit to the other. All these units use round slabs and ring beams or pit linings mounted over circular pits. In Embangweni and Thyolo the soil is firm, whereas in Salima and Phalombe the soil is loose and unstable. These areas require different approaches to construction.


Round concrete slabs are commonly used on pit latrines in Malawi and the *Fossa alterna* also uses a round slab. Many of these are domed and use on reinforcing. Some are flat and use a small amount of reinforcing. The flat slab on left is 1 metre in diameter using a 3 to 1 mix of sharp river sand and cement and 2.5mm or 3mm wire as reinforcing. It is left to cure for 10 days. The twin pits are normally lined with fired bricks and bonded with traditional mortar. Photo taken in Phalombe district. On the right two pits dug prior to brick lining. Photo taken in Thyolo district. Thanks to COMWASH.


Simple grass superstructure for the *Fossa alterna* on the left in Njerema Village, Salima. On the right a view through the entrance showing one pit covered with a squatting slab and the second pit awaiting a cover. The *Fossa alterna* pits in loose sandy soils are lined from the bottom with bricks. Thanks to WaterAid.


On the left a grass structure for the *Fossa alterna* in Salima district. Both pits are placed within the superstructure. On the right a permanent brick structure is built over two pits lined with bricks in Thyolo.


The interior of the structure shown above on right showing the two brick lined pits within the brick structure. On the left a demonstration structure showing one pit covered with a squatting slab and the other covered with a plain slab. Photo on left taken in Thyolo, photo on right taken in Phalome. Thanks to COMWASH


Very neat *Fossa alterna* constructed in peri urban settlement near Lilongwe. The roof has still to be added. On the right a view of the interior with round domed slab.


Excavation of *Fossa alterna* pit in Embangweni. In this case the structure is a simple bamboo portable unit which is moved from one pit the other. The ground is very firm in this locality and no ring beam or pit lining was used. The pit took less than 30 minutes to excavate and the entire operation of excavating and moving the slab and structure to the newly excavated pit took less than one hour. On the right dried leaves are being placed down the new pit. These help to compost the excreta like the soil which is added.


Using the *Fossa alterna* humus. On the left the pile from the *Fossa alterna* has been brought to the vegetable garden. A shovel is used to spread the humus over the vegetable bed. On the right a hoe is used to dig in and mix the new humus into the topsoil prior to planting vegetables at the onset of the rains.

An example from South Africa

A *Fossa alterna* built at Mbaswana, Maputaland, Kwazulu Natal, South Africa, by Partners in Development. Thanks to Dave Still and Stephen Nash.

Some work on recycling the existing pit contents of VIP toilets is also being carried out in Maputaland. On the left a previously full pit toilet, to which soil and leaves were added from the top is being dug out three years later. Previously it would have been impossible to dig out by hand. In Maputaland and elsewhere in South Africa, large numbers of VIP toilets were built years ago and many are now full.

In a new series of experiments leaves are added to the bases of dug out pits and the users asked to put plenty of soil, ash and leaves into the pit as they use it. And not to use the pit as a garbage dump. It it thought that this refinement in the way pits are used will make hand excavation easy in the future. Where twin pits are used, the family alternates the use from one pit to the other. The pits under investigation are lined with concrete rings. Each concrete ring is 1m in diameter and 40cm deep. Up to 6 rings are used to line a pit. Pits of this size (1.8 cu.m.) can last a family up to 5 years.

An example from Zimbabwe
Changing pits in the Epworth peri-urban settlement near Harare

This ***Fossa alterna*** was constructed in September 2001. It is used by a family on a plot in Epworth, where the soil is very poor. When the toilet system was first built, the second pit was filled with leaves and soil to make leaf compost. In September 2002 the leaf compost was removed from the second pit and added to a trench in which maize was late planted. The slab and structure were moved from the almost full first pit onto the empty second pit. The pit filled with a mix of excreta, soil, ash and leaves was topped up with more leaves and soil. This was left for another 12 months. In September 2003, the second pit change was made. This involved excavating the composted excreta from pit 1, adding leaves to the base of this pit and moving the slab and structure from pit 2, which was almost full, back to pit 1. The second pit was topped up with leaves and soil in preparation for a 12 month composting period. The photos below show the sequence. The pit excavation took 30 minutes and was easy work since the composted pit soil was loose. Moving the structure and topping up the used pit with leaves and soil took less than 20 minutes. The whole operation was completed in less than on hour. This attention is required once a year. The humus removed was completely converted and is a valuable resource in places like Epworth where the soil is very poor. (see later plant trials and soil analyses)


Starting to excavate the pit which has been composting for 12 months. This pit was brick lined in loose sandy soil. It was 1.1 metres deep with a cross section of about 1m X 0.7m. The pit was filled with a mix of excreta (faeces and urine) together with local soil, some wood ash and some leaves. At first the soil and leaves added on top of the excreta is removed. Further down the soil becomes darker and richer as the effect of the excreta on the soil becomes more visible. On the right photo, the richer soil is being removed.


The used pit has now been fully excavated and the compost can be seen on the side. The now empty pit has a generous layer of leaves added to the base. This helps to start of the composting process in the new pit. The addition of leaves helps a great deal to improve texture and nutrient value to the final compost.

The layer of leaves at the base of the pit. Note that small roots have invaded the pit, even through the brickwork to find the nutrients available in the composting excreta. On the right, the superstructure is now moved from the now almost full pit and placed on one side. The home made pedestal can be seen.

The concrete slab is now removed using the four handles and this is immediately placed over the now empty pit nearby. The slab is levelled and best laid on a bed of weak cement mortar laid over the pit lining brickwork.

Finally the superstructure (with pedestal and vent pipe in this case) is placed over the slab. The toilet can now be put to use immediately. On the right the pit used during the previous 12 months is not yet full, but a 12 month cycle of change is easy to remember. The pit contents are now covered with a generous layer of leaves and then topsoil is added. The mixed contents of the pit are then allowed to make compost for a further 12 months, while the used pit fills up again with a mix of ingredients. The whole process is then repeated every year. With this technique the pits are re-used repeatedly and every year a valuable supply of humus is produced. It is a simple technique which has great value.

It is wise to leave some written instructions on the inside of the toilet to remind the users how to manage the *Fossa alterna*. The regular addition of soil is essential if the process is to work properly, and also some leave and ash help to improve the compost. It helps if the time of changing pits is earmarked for a particular month of the year. In this case it is September, a good month as conditions are very dry. On the right, the composted pit contents can be bagged in preparation for the rainy season and planting. Alternatively they can be dug into the soil of vegetable gardens. A mix of half pit compost and half local topsoil is best. This mix enhanced the growth of vegetables considerably.

Satisfied customers at Epworth!

The *Fossa alterna* - a summary

The ***Fossa alterna*** is a relatively new concept introduced into the world of low cost sanitation and experimentation is still continuing with this principle. Clearly there is still a lot to learn of the process of excreta conversion in shallow pits and also how this concept will be accepted by communities in Southern and Eastern Africa and possibly elsewhere. It is possible that the ***Fossa alterna*** concept may represent an important step forward in sanitation technology and a valuable addition to the eco-san concept. Whilst low in cost and simple and adaptable in concept, it provides a system that is easily built by the family. It controls flies and odours, and also reduces the risks of ground water pollution. Because the pits of humus are easily excavated it offers potential for a permanent solution to home sanitation, whilst at the same time providing an annual supply of valuable fertile humus for the home vegetable garden. The testing and application of the pit humus is described in a later chapter. For these reasons the ***Fossa alterna*** may have widespread application throughout Africa.

Fossa alterna **or** ***Arborloo*** **?**
The two concepts are related – both make humus to enhance the growth of trees or vegetables. Both are specialised pit toilets – the link has been made between sanitation and agriculture.