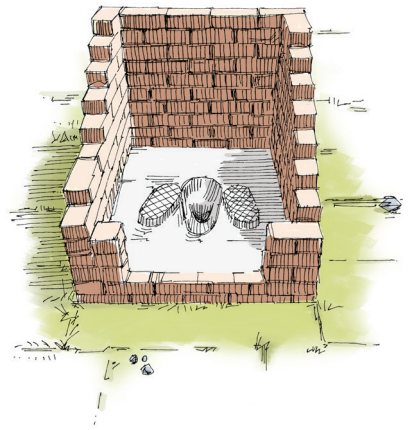


An engineer's guide to latrine slabs

Providing sanitation for all is a major global challenge involving many complex issues. The user of a latrine however, will have more local concerns such as the condition of the latrine slab. This is one of the key components of the most common type of sanitary facility. This booklet highlights the design, manufacture and maintenance features that help to improve the safety and comfort of users.

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A latrine is a structure that contains a toilet and in some cases, somewhere to bathe. It is usually separate from a residence. The latrine slab is a platform over a vault with a drop hole or a flush pan into which a user excretes. The slab may incorporate a squat-plate with footrests or a seat on a pedestal.

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Introduction

The design of a simple latrine slab is a basic structural problem for an engineer. However, as the slab forms a critical part of a sanitary facility for most people living in low-income countries, the design criteria also need to include issues relating to user preference, culture, gender, health, economics, maintenance and sustainability, as well as those related to construction where size, shape and surface finish are features that need to be considered alongside those of strength and durability.

The importance of the slab

Simple latrines are buckets, pits or tanks containing excreta. The user defecates into the vault by squatting or sitting, releasing urine and faeces through a drop hole in a slab. The user will not necessarily be able to see where the excreta are deposited, but the slab will usually be visible.

Dignity

Defecation is often a private activity and subject to cultural constraints. Being able to go to the toilet in a pleasant, private and clean location is valued by many societies and so the slab needs to meet user needs and preferences. It should be strong and secure. Additionally, people want to be able to use a latrine without getting their feet wet or their clothes dirty, so the slab should be able to be cleaned easily.

Excreta may be deposited into a pit, a cess pit, a tank, a composting chamber, a bucket, a bag, or a sewer. In this booklet, the word *vault* is used as a general term for these options.

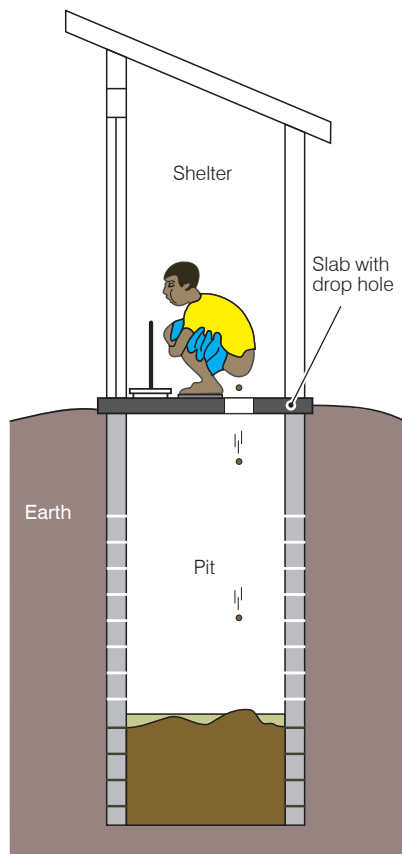


Figure 1. A simple pit latrine

Health

Excreta-related diseases, such as diarrhoea, are spread when people come into direct or indirect contact with faeces. People may come into direct contact with faeces left on the slab and ingest pathogens, particularly if they do not wash their hands thoroughly after defecation. As the slab needs to be clean, the hole must be large enough to enable people to defecate directly into the vault, and if they do miss the drop hole, enable deposits to be removed with ease.

Indirect contact with faeces can be caused by flies feeding or breeding on a dirty slab or within the vault itself and subsequently landing on food. So controlling flies will therefore reduce the transmission of disease.

Hookworms breed in moist soil and will penetrate the skin if people do not wear shoes. If people infected with hookworm foul the slabs, especially slabs with a mud surface, the parasite can be easily transmitted to other users.

Safety

People will not want to fall into the vault! They will need to be confident that the slab will not break or topple. They should also be able to use the latrine without tripping or slipping, and snakes, spiders, scorpions and other creatures should be prevented from entering the latrine too.

Two rough planks or a few logs placed over a deep hole as illustrated here are real-life examples, but they are not safe.

Culture

Cultural, religious and personal preferences are critically important. For example, Muslims will not want to face Mecca as they defecate, so the latrine and slab should face another direction. People usually prefer to face the door of the latrine rather than defecating with their back to the entrance, so there needs to be enough space to allow users to turn around in the cubicle.

To squat or sit?

The human body is best suited to squatting for defecation but sitting to go to the toilet may be preferred, particularly

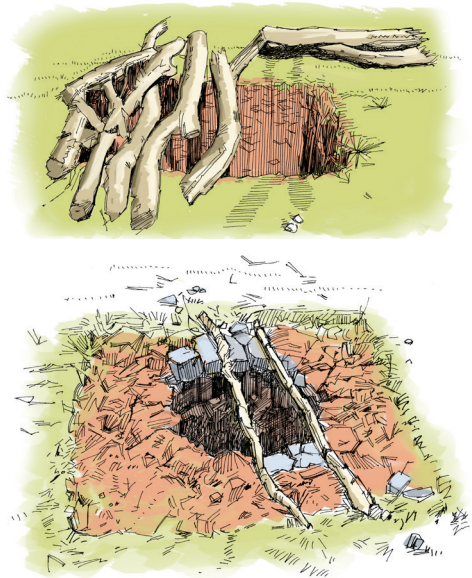
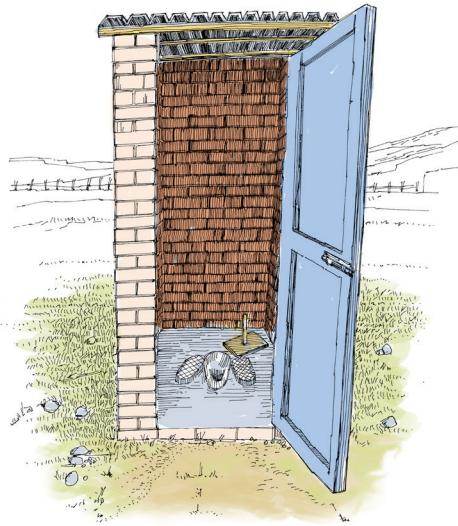


Figure 2. Open pits with logs and sticks are unsafe options



for people with limited mobility who may be unable to squat. Footrests need to be provided for those who squat so they are elevated from the floor and draining fluids. For people who prefer to sit, a pedestal and seat should be provided and placed directly over the drop hole or pan.

Design of slabs

Different designs of latrine slab have evolved to suit local preferences, conditions, uses and users. The platform, drop hole and footrests all need to be considered carefully.

Size and shape

Clearly, a slab forming a platform over a vault will have to be larger than the void underneath. It should be large enough to allow the slab to rest on a solid foundation. The size and shape of the slab will also relate to the dimensions of a 'superstructure' – the building, shelter or screen that gives privacy to the user. The dimensions of the superstructure may be larger than those of the vault, to allow people space to manoeuvre easily and for the assistance of children or infirm people.

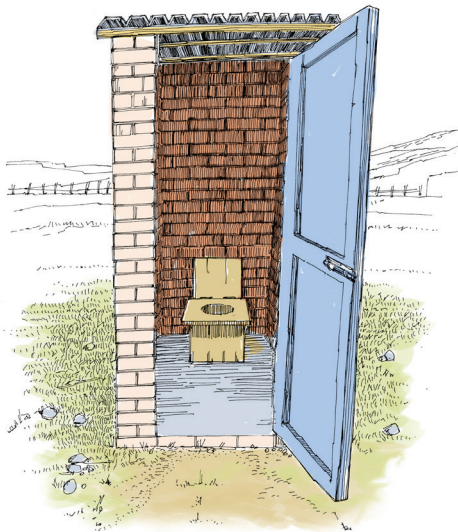


Figure 3. Squat plates and seats will suit different users

Rectangular slabs may suit the design of many different types of superstructure and some methods of slab construction. They may be easier to transport and store. However, it is easier to excavate a circular pit and a circular excavation is more stable.

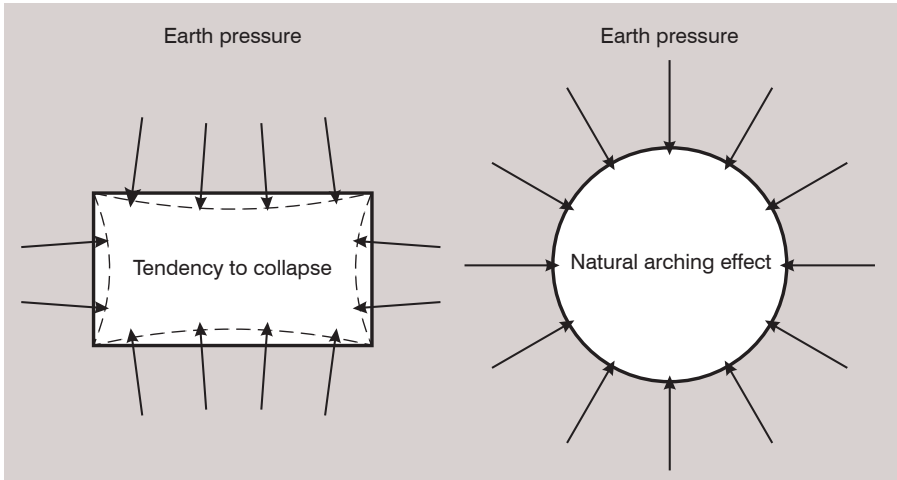


Figure 4. It is easier to excavate a circular pit and a circular excavation is more stable

The slab needs to be easy to move, so it should be made as light as possible and no bigger than it needs to be. To make it easier to move, the slab can be made in sections and fitted together on site.

Cost

The type of slab will be heavily influenced by what people are able and willing to pay. It may be necessary to raise people's awareness of the importance and value of latrine use and maintenance to encourage them to pay for a suitable facility.

Time

Durability. The choice of slab may depend on how long it needs to last. A simple slab can be made from mud and poles, but it will not be as durable

as those made from more substantial materials, such as concrete. A concrete slab may last for many years, even beyond the life of the vault that it covers.

Construction. One factor in choosing a slab will be the length of time it takes to make. Some concrete slabs can be made in a few hours but take two or three weeks before they are strong enough to use. Wooden slabs may be used sooner, though they may require painting to protect them from rot. As plastic slabs are made in a factory, the time it takes for delivery will be more significant than the time it takes for manufacture. It is important to plan for the time it takes to make a slab; a concrete slab may need to be cast before the vault is constructed, to allow

time to for it to gain maximum strength so that it is ready as soon as the vault is complete. If many slabs are required, then stockpiling will mean that they can be delivered as required.

Delivery. The slabs have to be transported from where they are made to where they are used. Heavy or fragile slabs will have to be made near the latrine (cast in situ). Slabs can be cast directly over the vault, but this requires temporary formwork to shape the slab and support it until it is strong enough to be used. It may be easier to cast the slab next to the vault and then position it once it is ready.

Where slabs are prefabricated or precast, they need to be robust enough to withstand transportation to the site but light enough for people to lift them. Some plastic slabs are designed to stack on top of each other to make transport and storage in warehouses more efficient.

Place of manufacture

Locally-made slabs do not need transporting very far and can be tailored to the needs of the local population. This can limit the type of slab produced, however.

Making and selling latrine slabs can be a good way of generating an income for local people.

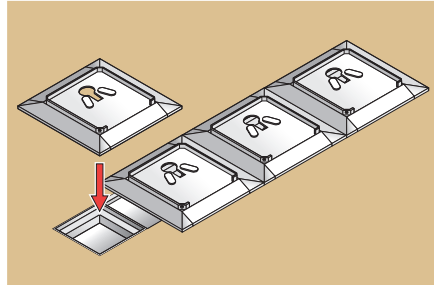


Figure 5. Prefabricated plastic slabs are useful when responding to an emergency



Figure 6. Circular slabs can be rolled into position, making them easier to move over short distances

Slabs may also need to be moved once a vault is full and needs emptying. Handles to facilitate removal can be installed during manufacture.

Drop holes or pans

Faeces can either drop directly into a pit or can be flushed into a tank or sewer with water. A pour-flush pan includes a water seal, which helps to control smells and flies, and screens the user from the



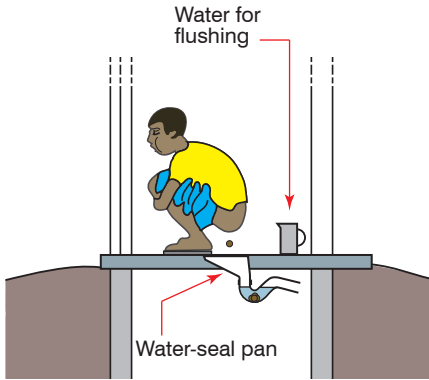


Figure 7. A pour-flush pan

contents of the pit. Although pans require water for flushing, a small quantity is sufficient. Nevertheless, a water supply has to be provided in or near the latrine. The pan is often made separately from the rest of the slab and later inserted into the hole. This allows different materials to be used for the slab and the pan.

Some latrine designs have two holes; one for faeces and one for urine. This requires a more complex slab design. In public latrines, separate urinals can be provided for both men and women.

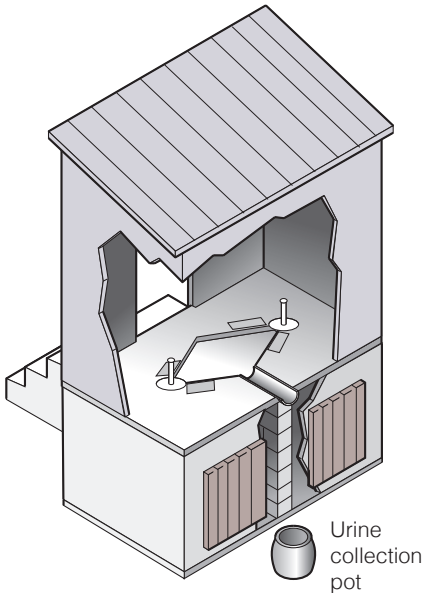


Figure 8. Urine diversion toilets require specific slab designs

Drop hole size and shape

The size of the drop hole is a critical feature. If it is too large, people (especially children) may fear falling into the vault. If it is too small, users may find it difficult to deposit faeces and urine directly into the vault and foul the slab instead. In shared latrines, providing an alternative slab with a small hole would cater for the needs of children.

There are many variations in the shape of the hole. A 'keyhole' that is 160 – 180 mm in diameter and 250 - 400 mm long is often recommended, but circular, triangular and rectangular drop holes



Figure 9. Keyholes are usual, but alternative hole shapes can also be used

can also be used, depending on user preference and the skills of the person making the slab. Pour-flush pans tend to be oval and pedestals are often circular.

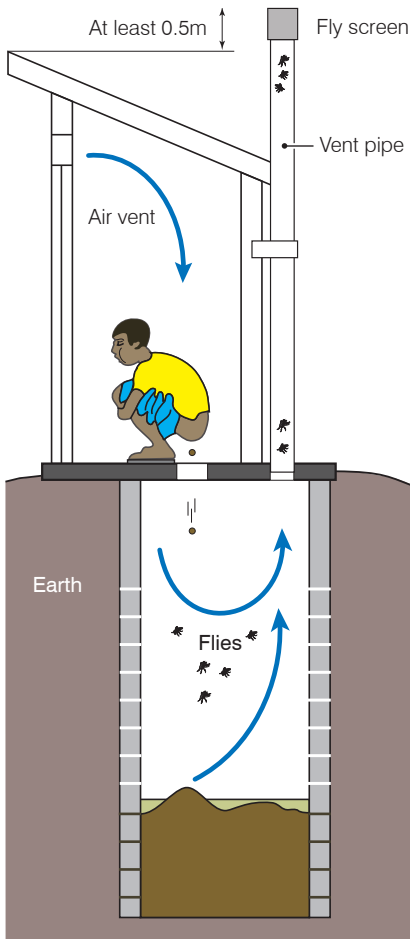


Figure 10. The design of the slab can direct the flow of air

Ventilation

Some latrine designs incorporate a vent pipe, to draw foul smells out of the latrine cubicle and divert flies away from the latrine to the top end of the pipe. This requires another opening in the slab.

Seats and pedestals

A seat on a pedestal can be provided for both drop holes and pour-flush pans. The sides of the pedestal need to be wider than the hole to prevent fouling. The seat could be square or circular and around 350mm high, depending on user preferences. People may want to tuck their feet back or to the side slightly so a square box, though simple to make, may not be the most comfortable option.

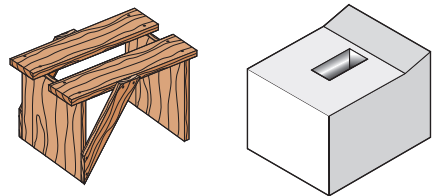


Figure 11. Seats made of wood or concrete

Seats can also be removable, allowing people the choice of squatting or sitting.

Defecation may not always be a private activity, especially when small children are trained to use the toilet. Latrine slabs can have more than one hole. Even if children go to the toilet by themselves, they may prefer using a smaller drop hole.

Surface finish

The surface of the slab should not be slippery but should be easy to clean. Painting the slab can improve the surface, filling holes that would otherwise trap dirt, stopping urine soaking into the slab and generally making the latrine more attractive. It could also be covered with ceramic tiles or a plastic floor covering. Some concrete slabs are decorated with patterns, but these can be more difficult to clean especially if the pattern is etched into the concrete.

The surface should also slope towards the hole, to channel splashed urine or water into the pit.

Footrests

Raised footrests have several purposes:

- They allow users to locate the correct position as the squat down
- They help users to position themselves correctly over the drop hole if they go into the toilet in the dark or if they have limited vision or restricted mobility.



Figure 12. Consider local preferences before adopting standard designs

- As they are raised, users do not have to stand in any water or excreta present on the slab. This reduces hookworm transmission.
- The surface of the footrests can be rendered less slippery than the remainder of the slab.

The recommended height of the footrests varies between 10 and 100 mm high. Finding the best position and size for the footrests should be established in consultation with users. The angle people squat at can vary. School latrines should be designed to suit children's requirements.

Lids and covers

Lids are used to control flies and smells. To ensure that it fits tightly, a concrete lid can be cast using the drophole as a mould (lining the hole with a plastic sheet so it can be moved once it has set). A handle can be cast into the lid to make it easier to lift.

Some people do not want to touch the lid, so a rope or longer pole can be used to lift it, or it can be opened by foot.

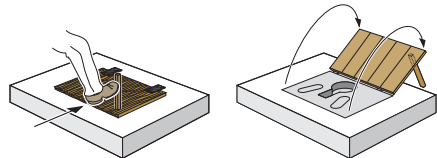


Figure 13. Simple lids can keep out snakes and other creatures

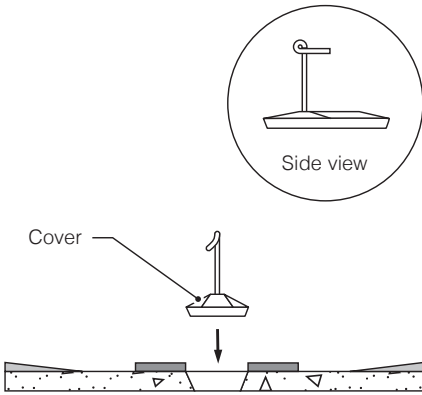


Figure 14. A close fitting lid can control flies and smells

Provision for use by people with disabilities

Latrines can be adapted to meet the specific needs of people with disabilities. Making latrines larger or providing supports and adapted seats may be required.

It is important that the user is assisted to select and adapt the latrine for their own needs rather than an 'expert' deciding this for them. The best option, however, is to ensure that the needs of disabled people are considered before the latrine is built in the first place.

Good advice on this is available from Jones and Reed (2005).

A hinge also helps position the lid. This can be made from the inner tube of an old car tyre.

People will be more confident that snakes, spiders, scorpions or other creatures are being kept out of the hole if lids are used. They will need to replace the lid in the hole once they have finished, so some level of promotion and instruction may be necessary. Some latrines (such as ventilated improved pit latrines) do not have a tight-fitting lid, as the air is directed in such a way to reduce the number of flies present in the latrine and to reduce odour. Pans with a water seal do not need a lid either.

Other features

Handles may be included for lifting all or part of the slab, especially if the slab will need to be moved to empty the vault (or transferred to a new site when the original vault is full).

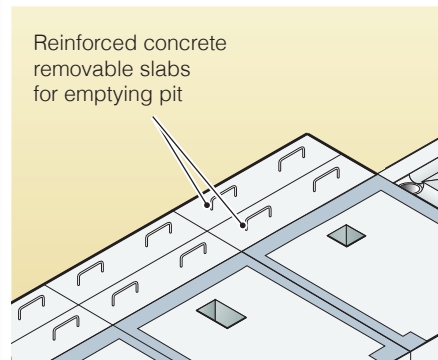


Figure 15. Handles can make removing the slab easier



Figure 16. Handholds to support the user

Handholds and supports. Whilst not strictly part of the slab, many users will find a handhold or bar useful to steady themselves and to help them to squat and stand up. Pregnant women and people with reduced mobility should be consulted to ensure that they are able to use the slab with ease. The support may be attached to the wall of the latrine, be fixed to the slab or set into the ground.

Brushes and buckets will need to be provided so the slab can be cleaned. These need to be stored somewhere secure and accessible.

Moulds

Moulds are a method of improving construction that can be used by local craftsmen with only basic training, enabling them to improve the quality of locally-made concrete slabs and sanplats. These can be wood or plastic with plastic moulds enabling a suitable surface-finish to the concrete.

Anal cleansing materials vary and include paper, leaves and water. A dry place to store these may be needed.

Drainage. If people use water in the latrine for anal cleansing or for cleaning menstrual cloths, wastewater needs to be directed into the pit and not outside the latrine which would pose a health risk and cause offence and embarrassment. The slab, however, should be raised above the surrounding ground level to ensure that surface runoff during rainstorms does not flow into the vault.

If the latrine has a facility for bathing, water should be directed away from the drop hole in dry toilets, to avoid filling the vault with water.

Construction materials

Various materials can be used to make latrine slabs. There are benefits and disadvantages for each. Properties of a slab to consider are:

- **Cost:** The slab can be the most expensive part of a latrine, especially when people dig the hole themselves and use local materials for the shelter. Factors that influence the cost of the slab include the type of materials, the skill level required to make it and transportation from where it is made to the latrine site.
- **Strength:** The slab needs to be strong enough to support the weight of the user, and perhaps someone to assist them. It needs to look strong to give people the confidence to use it.

- **Rigidity:** If a slab is too flexible, it will move under the weight of the user, which is unnerving and may discourage people from using it. This is a problem with some plastic slabs.
- **Durability:** If the slab is going to last and not collapse suddenly, it needs to be resistant to rot and termite attack. It should also withstand repeated washing.
- **Cleanliness:** The slab needs to be suitable for cleaning. Rough wood or rough concrete quickly becomes dirty and difficult to clean.
- **Surface texture:** A smooth slab may be easy to clean, but if it is too smooth, then it may be slippery when wet. The inner surface of a pour-flush pan needs to be very smooth, so the faeces can be easily washed away.
- **Water resistance:** Urine, water for anal and menstrual cleansing and water for washing the slab will make the slab wet, so it needs to be able to withstand this and allow excess water to drain away, normally into the vault.
- **Colour:** To see if the slab is clean and to check for spiders, snakes or other creatures, users may prefer particular colours. Cultural and religious affiliations may influence such preferences too.
- **Transportation:** A heavy slab may be too difficult and expensive to move far. A brittle slab may break

in transport, requiring increased packaging and cost.

- **Ease of manufacture:** Some materials, such as plastic, require complex machinery. Concrete or wood require fewer skills and less equipment.
- **Use of local materials:** Availability of local materials can reduce the cost of manufacture and transport.
- **Reuse:** Once the pit is full, the slab may have to be moved, either to gain access to the vault so it can be emptied, or moved to a new site.
- **Environmental impact:** In areas where wood is scarce, using timber may not be a sustainable option.

Concrete

Concrete can be used to make strong, durable slabs with a smooth, easy-to-clean surface. The tools needed are readily available but training is required to ensure that the concrete is mixed and laid correctly. The slab can be made near the site of the latrine to reduce transportation problems, where often only cement and reinforcement are required to be brought on-site.

Concrete is made from a mixture of sand, stones, cement and water. Cement has to be stored carefully or it will start reacting with moisture and degrade. The mixture should be made with minimal amounts of water as excess water in the mix reduces the strength of the concrete

once it has cured and set. It needs to be compacted well to eliminate air bubbles. Once made, the slabs have to be kept damp for several days or even weeks (depending on the climate) as concrete takes time to reach its full strength. Slabs cannot be used immediately for this reason. Flat concrete slabs cannot normally span vaults and require internal steel reinforcement and be supported by external beams.

Ferrocement is another form of reinforcement that can be used to make slabs that are thinner (and therefore lighter) than traditional reinforced concrete slabs. Ferrocement is a combination of cement and wire which is used to provide tensile strength. Two, three or four layers of chicken wire are plastered with several layers of a rich cement mortar to make a slab about 20mm thick. The mortar is mixed using

Domed slabs

Reinforcing bars for concrete can be expensive and difficult to fix in place correctly. Plain concrete is strong when compressed (squashed) but not so strong in tension (pulled or bent). If the slab is domed, the weight of the user pushes down on the slab, compressing it. The same weight on a flat slab could cause the slab to bend and then crack, so such a slab would need to be reinforced.

Making slabs in a domed shape requires training but these skills are easier to teach than the more precise techniques required for reinforcement. Material costs are also less.

Domed slabs have a flat section around the circumference to provide a stable contact with the foundations. They are about 40mm thick and rise about 100mm from the ground.

Covers should be provided as shown.

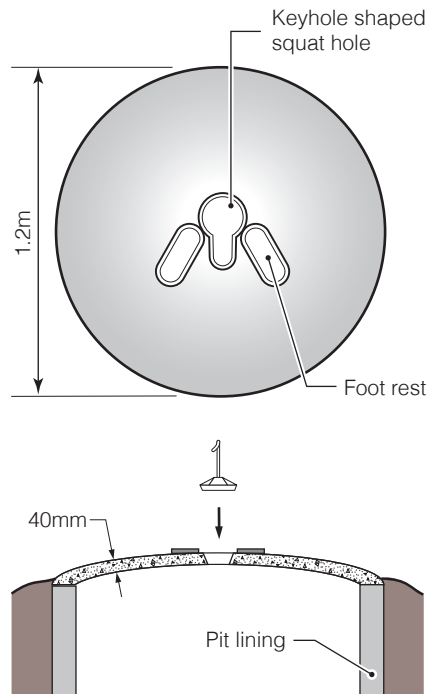


Figure 17. A domed slab

one part cement to two parts sand, and adding enough water to obtain a thick, creamy consistency.

Screeds: The surface of the concrete slab can be left rough at first and then an additional thin layer of mortar (sand, cement and water) called a 'screed' can be applied soon after the slab is cast. This can be smoothed with a metal trowel to give a highly-polished surface.

Wood

Wood and bamboo are often available locally. Ideally, the harder the wood the better. The 'soft' timber from some tree species is susceptible to rot and termites. Such timber would require chemical treatment. A simple treatment would be to soak the timber in used oil, for example.

Planed planks will give an even surface, but the grain may trap dirt. As an emergency solution, they are often readily available and are easy to fit. Water resistant plywood is more durable and smooth, but it is more expensive and not so readily available.

Slabs can be made from poles or bamboo tied together to form a platform, with the gaps between each pole filled with clay and smoothed to make a level surface.

Plastic

Plastic slabs can be made in various shapes that are light and durable, making them a popular choice at an

Sanplats

Some slabs are designed to be manufactured using both a prefabricated mould and in-situ construction.

A high quality, but small prefabricated slab is used for the area where people squat to defecate, but the rest of the slab is made locally, from whatever materials are available.

The defecation slab is called a sanplat (short for sanitary platform) and provides a good method of upgrading a simple latrine, improving hygiene and appearance.

Sanplats are often about 600mm square and weigh about 35kg, so they can be lifted by two people or transported on a bicycle.



Figure 18. Lifting a sanplat

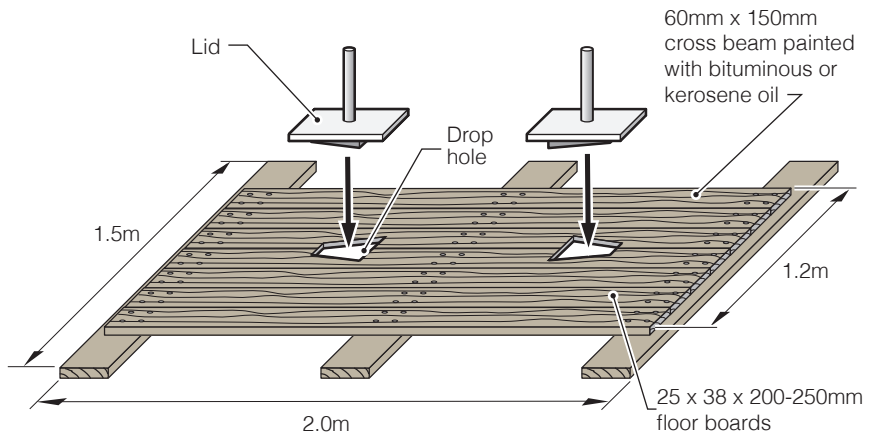


Figure 19. Slabs can be made of wood, but should be treated with preservatives



Figure 20. The glazed surface of a porcelain pan is hygienic, but expensive

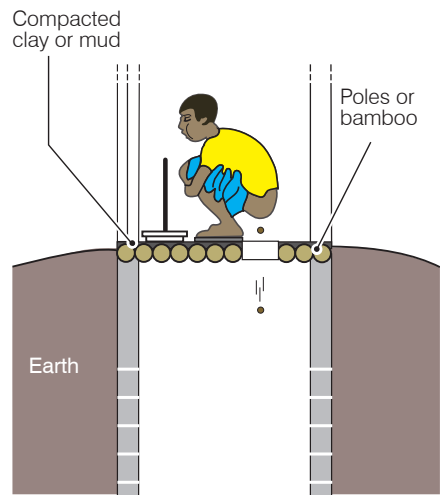


Figure 21. A slab is supported by logs, poles or bamboo with clay to fill the gaps

industrial scale of manufacture. Plastic can have a smooth finish for easy cleaning and ridges in the plastic can provide grip. Plastic slabs can flex though, so they require ribs on the underside to provide rigidity. If they are too thick, they can be heavy to carry.

Other materials

Porcelain is expensive, fragile and requires specialist manufacture, but the quality of the glazed surface provides a hygienic, easy-to-clean and attractive product. Its use is restricted to pour-flush pans and pedestals that are attached to a less-expensive and more robust slab, which could be tiled for ease of cleaning.

Clay or mud may be used over a framework of poles to make a smooth surface. Mud can be mixed with animal dung or compounds produced from plants such as cassava to improve the consistency. It is cheap and does not require specialist skills. Although it may not be durable, it can be repaired and replaced easily. It is hard to clean, however, and is damaged by wastewater and rain.

Plastic bags: Where the slab is formed from clay or mud (either offset or over a framework of poles), parts of the slab can be lined with plastic bags to waterproof the area. Basic pour-flush pans can be constructed in this way.

Metal: Scrap metal from cars or old road signs can be recycled to form the basis of a slab.

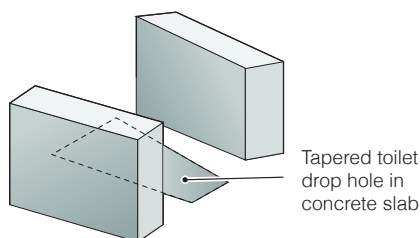


Figure 22. Concrete blocks can form a simple pedestal

Pedestal and seat materials

Many of the preceding comments apply to pedestals and seats as well as slabs. However, for sitting, wood can be warmer and smoother than concrete but perhaps more difficult to keep clean. Wooden seats are simpler to make locally. Plastic can be easy to clean but, if flexible, can be disconcerting to use. Concrete blocks are strong but not very comfortable. Painted blocks are easier to keep clean.

Structural considerations

Often the slab is positioned over a vault and it has to support its own weight and the weight of the user. If the vault is rectangular, a series of slabs may be designed to span across the width of the vault. If the vault is round or square, the slab can be supported all the way around, and so can be thinner.

Ideally, the superstructure or shelter should be placed so that it does not rest on the slab, as this will add extra load. The slab will have to be stronger if it

does have to support the superstructure. It would also mean that the whole structure would have to be demolished to gain entry into the vault.

Poles and beams. These can be placed underneath the slab and span the vault. The slab still needs to be strong enough to span the beams but the load will not be so great so the slab can be thinner and lighter. The beams can be made of reinforced concrete, metal or wooden poles.

Integral supports. If the slab is made strong enough to support itself, it can be placed directly onto the foundation.

Placing steel reinforcing bars in a concrete slab during construction can provide such strength. For plastic slabs, increasing its overall thickness would make it stronger but it would also make it very heavy. It is possible to make just some areas thicker with a 'waffle' or 'ribbed' pattern on the underside of the slab.

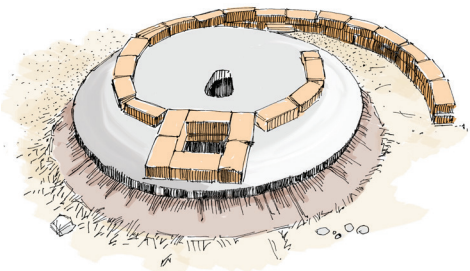


Figure 23. A round slab providing the foundation for part of the wall of the superstructure

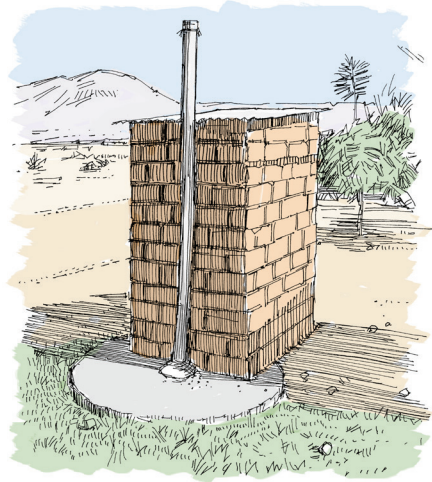


Figure 24. An partially offset latrine

Offset latrines. The squatting slab does not have to be situated directly over the vault if the pit is offset. Connected with a pipe, the squatting slab can be placed directly into the ground and would not have to support the weight of the user. The vault can be covered with a cheaper slab or even just a board covered in soil, provided people are prevented from walking over it.

Foundations

If a slab is to span a vault, it needs to be laid on a firm foundation. Slabs must overlap the edge of the vault by a sufficient amount to provide support and a seal. The foundation should extend below the ground level to firm ground, perhaps connected to the lining of the vault. If the lining is strong and secure, made out of bricks, for example, the

overlap can be about 50mm all around. If the vault is not lined at all and the slab just rests on the earth, then at least 200 mm is required. A 1,100mm diameter hole would therefore need a 1,200mm diameter slab if it was lined and structurally strong, but a slab would need to be 1,500mm in diameter if there was no lining.

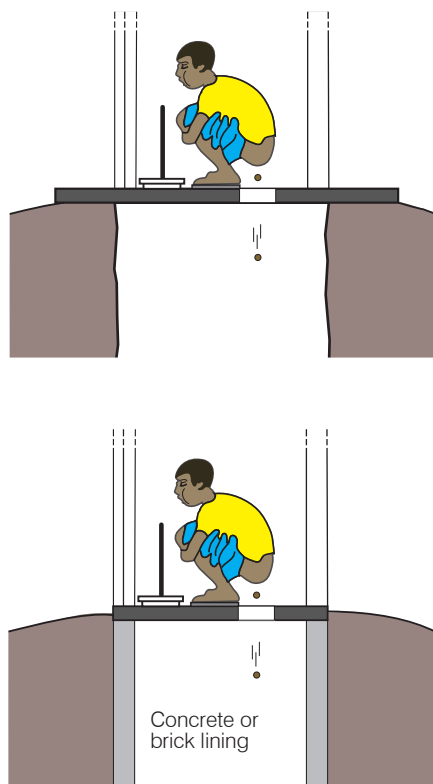


Figure 25. Well-supported slabs can be smaller

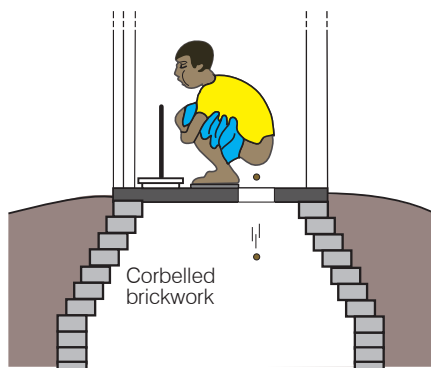


Figure 26. Corbelled brickwork lining

One form of foundation is 'corbelling', where the lining of the vault is built to reduce its diameter, creating a cone shape. The slab has only to span a reduced diameter, therefore, so it can be smaller and thinner.

Foundations need to be level to ensure that slabs are level as well. This allows for proper draining and continuous support. If parts of the slab are unsupported it may rock and be placed under unnecessary strain. Gaps between the foundation and the slab allow flies and vermin to enter the pit and odours to escape, so these should be avoided.

To ensure the slab is supported all round the edge of the vault, and to close gaps, the slab can be bedded on a layer of mortar or at least softer soil. If a cement-based mortar is used it will form a basic foundation as well as seal the pit, preventing water and vermin

from entering. If the slab will be moved sometime in the future, this mortar could be made from a weak mix, to make its removal easier.

Testing slabs

Wherever slabs are made, they should be tested to ensure that they are strong enough to support the load they are designed for. They should be able to carry a load greater than that expected during their use. This is called a 'factor of safety'. One method is to ask several people to stand on a slab at the same time, with the slab supported on bricks over safe ground to simulate the span of a vault.



Figure 27. Testing the slab

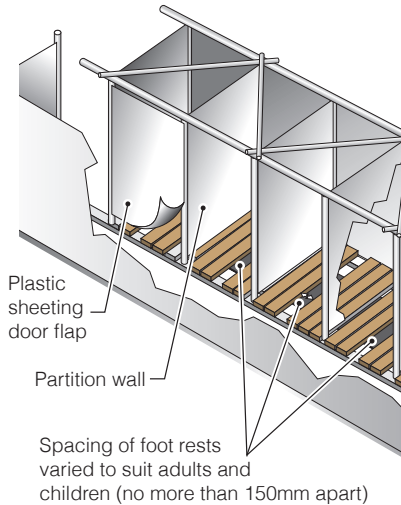


Figure 28. Temporary wooden slabs may only be acceptable in the initial stages of an emergency

In addition, the slab can be supported in just a few places during testing. Most slabs are designed to be supported all round their edge or by beams underneath the slab. Reducing the amount of support, the slab is under extra strain, providing a further factor of safety for testing.

The slab should not be too strong however, as this is wasteful and can make the slab too heavy to move.

If the design of the slab is new, people may be wary of using it, anxious that it might break. Testing should take place publicly, to demonstrate its strength. A plastic slab should also be trialed to see that it is acceptable to the users.

When to test

Concrete takes time to gain strength. The cement in the concrete reacts with the water to bind sand and stones together firmly. This reaction takes about a month for the concrete to gain maximum strength, so testing should not take place until the slab has cured for a few weeks.

Curing is the process of maintaining the concrete in a damp stable state for this period.

Maintenance

Slabs must be kept clean to make them pleasant to use. Faeces and urine need to be removed as soon as possible to prevent odours, the attraction of flies, and to prevent it becoming unsightly.

Apart from regular cleaning and occasional repainting, slabs will need periodic inspection, repairs and maintenance to ensure that they remain structurally sound.

Conclusions

The latrine slab is the interface between a person going to the toilet and the technology that disposes of the excreta safely. For this reason, the design has to meet both technical and social requirements.

Consulting with users is as important as checking that the slab is structurally sound. If people do not use the latrine because they do not like it then all investment will be wasted.

References

BRANDBERG, B., 1997. *Latrine Building: A handbook to implementing the SanPlat system*. London: IT Publications

FRANCEYS, R., PICKFORD, J. and REED, R., 1992. *A guide to the development of on-site sanitation*. Geneva: WHO

HARVEY, P., BAGHRI, S. and REED R., 2002. *Emergency Sanitation, Assessment and Programme Design*: Loughborough, UK: WEDC, Loughborough University

JONES, H. and REED, R., 2005 *Water and Sanitation for Disabled People and Other Vulnerable Groups: Designing services to improve accessibility*. Loughborough, UK: WEDC, Loughborough University

Design checklist

The following checklist can provide a basis for gathering information to inform the designer.

Have the range of users been identified?

- Consider people with specific needs, such as children, the elderly, pregnant women and nursing mothers, people with restricted sight or mobility
- Is the latrine going to be used for bathing (including washing during menstruation?)

Are there cultural and religious considerations relating to who is allowed to use or share the latrine?

- Who is going to clean the latrine and how?

How much are people willing and able to pay for the slab

- for building it?
- for using, operating and maintaining it?

Are people being given a choice of design?

- Do people prefer to squat or sit to defecate?
- Which way do people want to face when defecating?
- What is used for anal cleansing?
- What size hole and foot rests are preferred?
- Is a lid needed and will it be used?

What building skills and materials are available now – and in the future?

- How many slabs are needed locally?
- What transport is needed or is available?
- What materials are available and preferred?
- Will the slabs be of good enough quality – relating to strength and surface finish?
- When and where are they required?
- Are they temporary or permanent?
- Can the slab be moved or reused when the vault is emptied?

What are the ground conditions?

- Is the pit lined? Are foundations needed?
- Where does surface water flow? – consider flooding, drainage and erosion

Maintenance checklist

The following checklist can provide a basis for monitoring the use of the latrine.

Have there been any complaints about the latrine?

- User comments are the most important indicator to record

Is the latrine being used? A worn path shows it is, spiders' webs over the hole shows it is not.

- If it not being used, there may be an underlying problem

Is the slab clean?

- If it is dirty, investigate if this is due to poor design, lack of cleaning, lack of cleaning materials or user behaviour

Is the slab wet?

- Is this due to urine, anal cleansing water, bathing water, rainwater or because it has just been cleaned?
- Does the slab drain properly?

For pour-flush toilets, is a water seal present?

- Is water for flushing available?
- Are solids present in the U bend/ trap/ water seal?

Are there signs of flies or vermin either in the latrine or around the hole?

- Is this due to poor design or poor cleanliness?
- Is a stopper or lid used?

Is the slab structurally sound?

- look for cracks, surface damage (e.g. to the screed or paint), excessive flexing of the slab, rocking of the slab. Check the foundations for signs of erosion

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