

Sanitation Marketing Programme: Masons Training Manual



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Introduction

The USAID-funded Hygiene Improvement Project's Sanitation Marketing (SanMark) Programme in the Tororo District of Uganda developed the Masons Training Manual, in partnership with Plan Uganda, the Uganda Water and Sanitation NGO Network (UWASNET) and the National Sanitation Working Group. The manual was developed as part of a broader effort to develop and stimulate local markets to provide affordable latrine technologies that respond to and incorporate important latrine 'attributes' identified by consumers in the Tororo District target area. These latrine characteristics were identified through in-depth consumer and supply-side investigations and surveys. Products developed as a result of these findings are presented in this training manual. They capture the most fundamental aspects of construction of affordable latrine slab options for a general rural African scenario. While these sanitation options provide increased hygiene and health benefits to consumers at a reasonable cost, several require construction skills and experience normally not present in rural Uganda.

The manual focuses on the construction of concrete latrine slabs and associated foundation works. These are the more vulnerable (or non-existent) components in the traditional latrines in Tororo and require specialized skills to construct properly. The products are tailored to suit the core requirements for size, strength, durability and maintainability using the most economical mix of commonly available materials, thereby ensuring the end product remains affordable to rural households. The following slab designs are featured in this manual:

- 1) Non-reinforced dome slab,
- 2) Square reinforced concrete slab, and
- 3) A double stance reinforced concrete slab.

The manual is intended for use by trainers and training institutions with limited access to formal training facilities and limited experience with advanced training methods. The trainees should have prior experience working in concrete construction and preferably be practicing masons. The manual imparts the most relevant and appropriate skills to masons to enable them to respond to consumer demand for low-cost latrine technologies.

The manual is organised in modules that logically proceed through the construction process: assembling and preparing materials, understanding designs, preparing moulds, mixing and pouring concrete, placing the slabs and completing the latrine. The latrine design also includes provision of a locally fabricated Tippy-Tap hand washing station.

Annex A features a sample training course program. The program does not follow the manual in a step-by-step manner, as much of the information conveyed to the students is through 'learning by doing'. For example, as the students are discussing and planning to construct a square slab, the instructor is providing guidance and direction with respect to concrete mix ratios, use of reinforcing bars and so forth. In the end, there is flexibility in how the material provided in the manual is presented.

Module 1: Assembling and Preparing Materials

Trainers must obtain in advance all the tools and materials needed for building the concrete slabs, foundations and hand washing stations. This requires the trainers to familiarize themselves with the local vendors for the materials listed below.

1.1 Assemble Required Tools

The tools listed below are required and should be assembled a day or two before the training takes place. This will avoid time delays of looking for tools during the training session itself. An appropriate secure storage facility for all materials and tools will be necessary.

Tools and other products needed for training (best to use a tool sack)

- | | |
|------------------------------------|---|
| 1. Two 20-lt. jerry cans for water | 11. Wrenches for dome form |
| 2. 2' level | 12. Shovels – flat face and concave |
| 3. Large carpentry square | 13. Hoes |
| 4. Hammer | 14. Two Pangas |
| 5. Wire pliers | 15. Measuring Tape |
| 6. Hacksaw with extra blades | 16. Screwdriver |
| 7. Two mason trowels | 17. String (for drawing circles) |
| 8. Steel finishing trowel | 18. 10-lt. jerry can (foot rest moulds) |
| 9. Concrete float | 19. Two 15-lt. buckets |
| 10. Wheel barrow | 20. Moulds for dome slab and drop holes |

1.2 Assemble Required Construction Materials

As with the tools, it is best that trainers purchase and assemble all the construction materials required for the training several days prior to the training. The box below identifies the required materials. (Annex B provides a bill of quantities for the needed materials to facilitate preparation for the training course.) Be sure to plan accordingly as collecting materials at the training location may take some time (e.g., ordering, collecting and cleaning sand [if necessary], and picking up and transporting the aggregate and bricks may require multiple trips over several hours, or perhaps days).

Materials Needed

- | | |
|----------------------------|-----------------------------------|
| 1. Cement | 8. One tube (200 gm) grease |
| 2. Sand | 9. Nails |
| 3. Aggregate | 10. Water |
| 4. Plastic sheets | 11. Various moulds for drop holes |
| 5. Iron Bar: 8 mm or 10 mm | 12. Wood for forms and hole cover |
| 6. Binding wire | 13. Epoxy paint |
| 7. Bricks for foundations | |

Locate sources for all materials required for casting and constructing the latrines prior to the training activity. In the Tororo District pilot activity, for example, the source and location of construction materials was obtained largely when conducting the supply-side assessments.

Masons will need to know where to locate and/or purchase the following materials in the regions where they will be working.

Table 1: Sources for Materials Required for Casting and Constructing the Latrines

Material	Location
Cement	Either in Tororo (Novo Materials) or in local shops
Iron bars	At Novo Materials and shops in larger trading centres
Aggregate	Best to go two or three days in advance and show proprietor the size and quantity to make; standard size is too large, but can be broken down to the 6-10 mm needed for dome slab and 6-14 mm for square slab
Sand	Ask local masons where pit sand can be found; river sand is preferable if economically available
Plastic sheets	Available in market in Tororo
Binding wire	Either at Novo Materials or Tororo Market
Bricks	Locate brick maker in town where training will take place
Grease	Locate automotive market in Tororo
Metal moulds for dome	Should be ordered well in advance from local metal shop
Wood moulds for drop holes	Should be ordered well in advance from local carpenter
Wood moulds for reinforced concrete slabs	Built on site during training; wood available at local shops (in the actual provision of latrines, wood may be available from the homeowner)
Wood moulds for reinforced concrete beam for double stance slabs	Built on site during training; wood available at local shops or from homeowner
Wood for fabricating hole covers for round and rectangular slabs	Built on site during training; wood available at local shops or from homeowner

1.3 Prepare Materials

Several of the materials will require some sort of preparation prior to use, e.g., sorting, cleaning. Preparing the materials takes time. Plan and prepare accordingly, so that valuable instruction time is not lost. Survey the training site with whoever is in charge of the facility to identify where the slab construction will take place. This will enable placement of the aggregate, sand and other materials close to this point, avoiding the need to relocate materials during the training.

a. Correct Sizing

Aggregate will likely need to be broken down. For circular dome slabs, aggregate stones are between 6 and 10 mm. For rectangular reinforced concrete slabs, the aggregate can range from 6 to 14 mm. It may take an extra day or so for a provider to crush the aggregate to these size specifications and it may be slightly more expensive than normal-sized aggregate. Use screens to sort the aggregate and ensure proper sizing.

Cut the iron reinforcing bars for ease of transport, as they are purchased in 12-metre lengths. It is best to cut them at the point of sale to the required 99 cm lengths, the length needed for the square slab which is 1m x 1m. Eight bars are required per slab. Be sure to take your own hacksaw with an extra blade to the point of sale.

b. Cleaning Sand

Sand is the only material that may need to be cleaned in advance. Pit sand is the easiest type to use because it can be found locally. However, river sand is much cleaner than pit sand and usually does not require extra cleaning. It is more expensive, however, and may require transport, adding to the overall cost.

When using pit sand, wash the sand since it typically contains silts and clays. Clean the pit sand by filling a bucket one-third full of the sand. Add clean water until the bucket is about two-thirds full and then stir vigorously with a strong stick for a minute or so. Pour out the dirty water and repeat once. This process does use quite a bit of water, but it is important to have clean sand for strong concrete. This also takes time, so plan accordingly.

c. Treatment

When using wood or metal moulds for slabs, drop holes and foot pads, coat the *surface that will be in contact with the concrete* with either grease or diesel fuel. Grease is recommended. This will help to remove the mould more easily after the concrete has set.

d. Handling

None of these construction materials requires special handling. However, construction waste and leftover materials must be disposed of properly, and the training site must be cleared of all construction debris and restored to its original condition.

1.4 Prepare the Moulds

Two types of moulds, sometimes referred to locally as “form work”, are required for the concrete slabs presented in this manual:

- 1) A round metal mould for the dome slab, and
- 2) A square wooden mould for the square reinforced concrete slab.

a. Mould for Dome Slab

To produce a dome slab with consistent technical dimensions, use a two-piece metal mould to ensure proper dimensions are maintained. This mould should be fabricated a few weeks before the training, and the masons should be made aware of its local availability and purchase cost. This mould can be fabricated by any reasonable metal workshops or training institutes with metal workshops for vocational training. Metal moulds are preferred, but can be costly. Brick moulds can be used, but are more difficult to work with. Mould dimensions are indicated in Table 2. Note that the mould is constructed of 2-3 mm thick steel, whichever is available and most economical.

Carefully fill the mould (see Pictures 1-4) with sand, contoured by the mason in accordance with the design to establish the shape of the arched underside of the dome slab.

Table 2: Mould Dimensions	
Inner Mould	
External ring of Inner Mould:	Diameter = 700 mm Height = 50 mm
Internal Ring of Inner Mould:	Diameter = 400 mm Height = 100 mm
Connectors (rectangular slats):	Length: 150 mm Height: 50 mm
Outer (4-piece) Mould	
	Diameter = 1200 mm Height = 40 mm

The inner piece of the mould is a round metal piece welded as shown (Picture 1). The outer piece of the mould is knocked down in to four equal arc shape pieces that can be fastened together at the different joints using nuts and bolts (Pictures 2 and 3). This design permits the masons to disassemble the moulds after casting at one site for ease of transport to another site. Note how the inner and outer moulds are placed in perfect symmetry (Picture 4).



Picture 1: Inner piece of the dome slab mould



Picture 2: Dome Slab Outer Mould in Knockdown condition



Picture 3: Assembling the outer mould



Picture 4: Fully Assembled (Outer & Inner) Mould for Dome Slab

b. Mould for Square Slab

The mould for casting a square slab is a simple wooden frame with internal measurements of 1m × 1m (1000 mm × 1000 mm) and a height of 40 mm. Picture 5 shows a mould for the square reinforced concrete slab with iron reinforcing bars cut to size (eight bars that are each 99 cm in length are required per slab).



Picture 5: Wooden Mould and reinforcing bars for square slabs

Module 2: Physical Site Conditions and Latrine Placement

The mason must work with the household to identify the optimum spot for their latrine to ensure the latrine will be properly used, but will not create nuisance conditions for residents, threaten water sources or be vulnerable to damage or collapse. The mason must also be able to recommend a latrine slab that is appropriate to local soil conditions, which can impact the shape and depth of the pit. Likewise, for purposes of this training, the trainers and organizers must confer with the property owners to select the most suitable location for constructing the demonstration latrine.

2.1 Latrine Sizing and Placement in the Household Compound

The slab dimensions provided in this manual (1m x 1m square slabs and 1.2 m diameter circular slabs) provide latrines that balance interior room for user comfort with efficiency in the use of construction materials. For example, these slabs require only half a sack of cement and the latrine only one sheet of metal roofing.

The following are internationally accepted recommendations for placing household latrines. They take into account the physical site conditions including topography, geology, shade or sun, prevailing winds, location of water sources, location of neighbouring houses and organization of the household lot. The guidelines also balance the facts that even the best-maintained latrines can smell and attract flies with homeowners' convenience of use. In general, a latrine should be:

- Located within 30 metres of the house to provide easy and secure access at night and in inclement weather conditions;
- Easily accessed by a path;
- Located in a culturally appropriate part of the household plot—front or back depending on preference of household;
- Located in a spot where prevailing breezes do not carry smells into living areas of household or neighbours;
- Located so as not to cause problems with neighbouring houses;
- Located in a spot that is not subject to surface runoff flows or ponding during rains;
- Situated at least 15 metres away from any well or surface water source;
- Located in a spot that facilitates easy excavation of the most stable and deepest pit; and
- Constructed so that the pit is at least two metres above the highest seasonal water table. (Note: Ugandan regulations require a pit depth of at least 15 feet, which may be difficult to attain in some areas.)

2.2 Soil Types and Structure

Soils vary in composition and structure and the decision of where to construct a latrine will be influenced by the type of soil. Soil types and their implications on pit excavation (diameter, shape, depth) and slab choice are presented in the table below. In soils that exhibit stability problems, it is best to use circular pits rather than square or rectangular pits. Lining pits with brick or stone may be required through unstable sandy or clay layers. The mason must tap local knowledge about the stability of soils to make proper choices in pit shape, depth, and the construction of slab foundation and pit lining.

Table 3: Types of Soil and their Technical Implications

Soil Type	Soil Characteristics	Technical Implications
Loam	High organic content, best for agricultural production; typically on the surface and rarely exceeds 500 mm in depth, with different material below	Not stable for deep pit excavations, but acceptable up to 300 mm, sufficient for constructing a foundation for a slab
Clay	Hard when dry, sticky when wet, expands during wet season; typically stable when dry, problematic when wet	Expansion and contraction over course of several wet and dry periods can cause foundation problems; if clay layer is on surface, attempt to extend the foundation so that base rests on less expansive soil below
Rocky	Can be solid, fractured, weathered—impacting ease of excavation	Excellent for foundations, difficult to excavate; fractured or weathered rock can be excavated with picks and digging bars; very stable pits once excavated
Sandy	Depending on presence of other particles (silts and clays), can be relatively stable or very unstable with respect to excavation	Pits can be very unstable in soils with high sand contents; circular pits are recommended; depth of unlined pit is minimized; lining with brick or stone recommended in unstable clay soils
Manmade (Fill Material)	These soils are excavated from other sites and placed and compacted—often poorly compacted and unpredictable	Avoid excavating in and building on these soils if possible, otherwise extend foundations to better soil layers, or line the pit
Decomposed	High organic content—decomposed and decomposing waste or organic matter	Remove, and do not excavate in or build upon

Module 3: Latrine Slab Designs

Designs for the three slabs models presented in this manual are provided in the following sections, together with the materials required for each. Additional technical design drawings for other latrine elements, such as foundations, are provided in Annex C. These designs also are repeated in Annex C in full size. As noted previously, these slab dimension result in a latrine size (pit and superstructure) that are economical, yet comfortable and functional.

3.1 Design for Dome Slabs

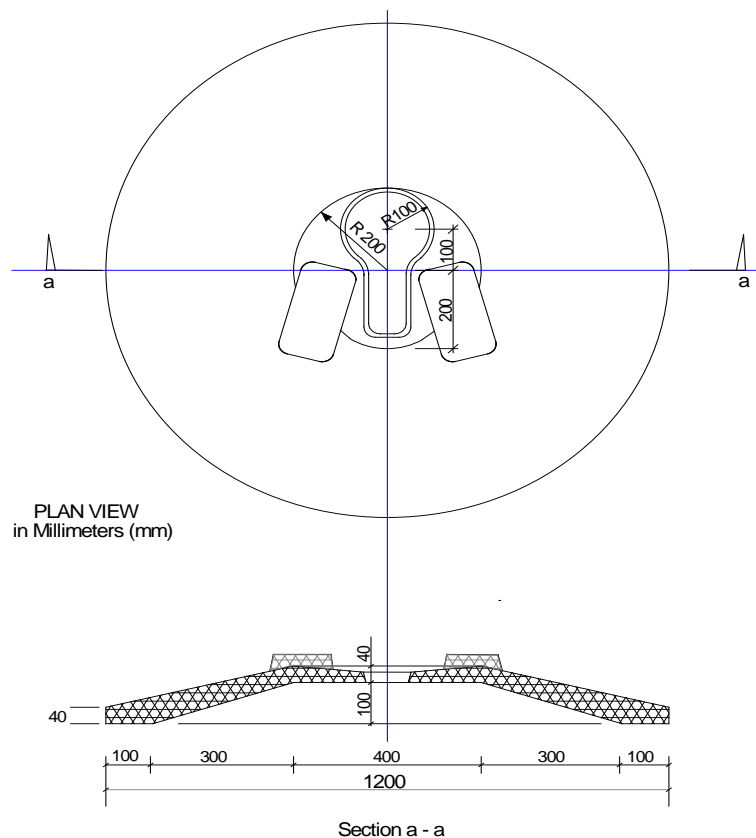


Figure 1. Dome Latrine Slab

Materials needed

Cement	One 15-lt. bucket
Washed pit sand or river sand	Three 15-lt. buckets
Small aggregate (6-10mm)	Three 15-lt. buckets
Water	13 litres (no more!)

Technical notes

- Note that the thickness of the slab decreases from the base to the top, but this can be difficult to maintain during construction. Ensure that slab thickness is measured perpendicular from the base of compacted wet sand and that it is 70 mm. A marked piece of straight wire or steel can be used.

- Cross section 'a-a' indicates an inward slope for the slab within the 400 mm diameter inner ring to facilitate drainage of urine and cleaning water to the drop hole.
- Placement of the drop hole mould must be done according to this design.

3.2 Design for Reinforced Square Slabs

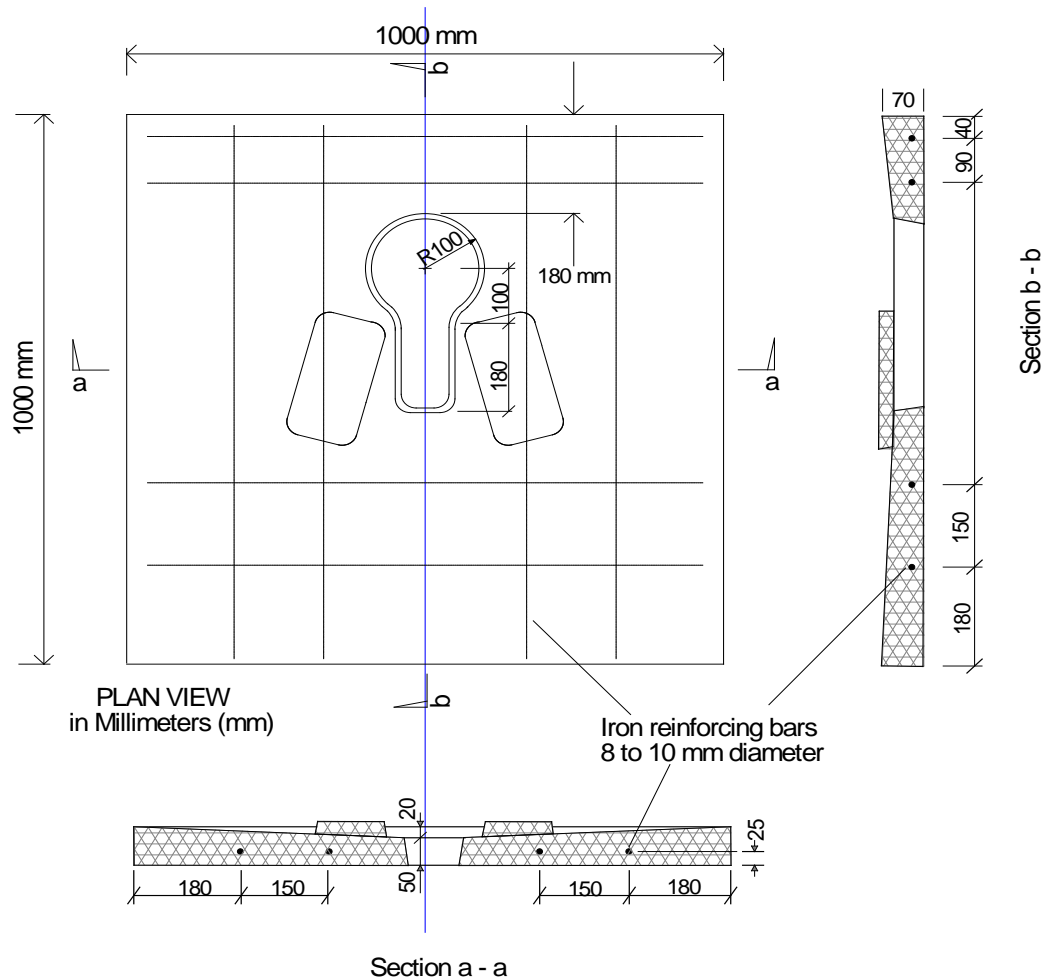


Figure 2. Square Latrine Slab

Materials needed

Cement	One 15-lt. bucket
Washed pit sand	Three 15-lt. buckets
Small aggregate	Three 15-lt. buckets
Water	13 litres
8 or 10 mm iron bar	Cut into eight pieces of 99 cm (990 mm) each

Technical notes

- Placement of the drop hole mould is critical. Note the 180 mm offset.
- Cross section 'a-a' indicates an inward slope for the slab to facilitate drainage of urine and cleaning water to the drop hole.

3.3 Double Stance Latrine

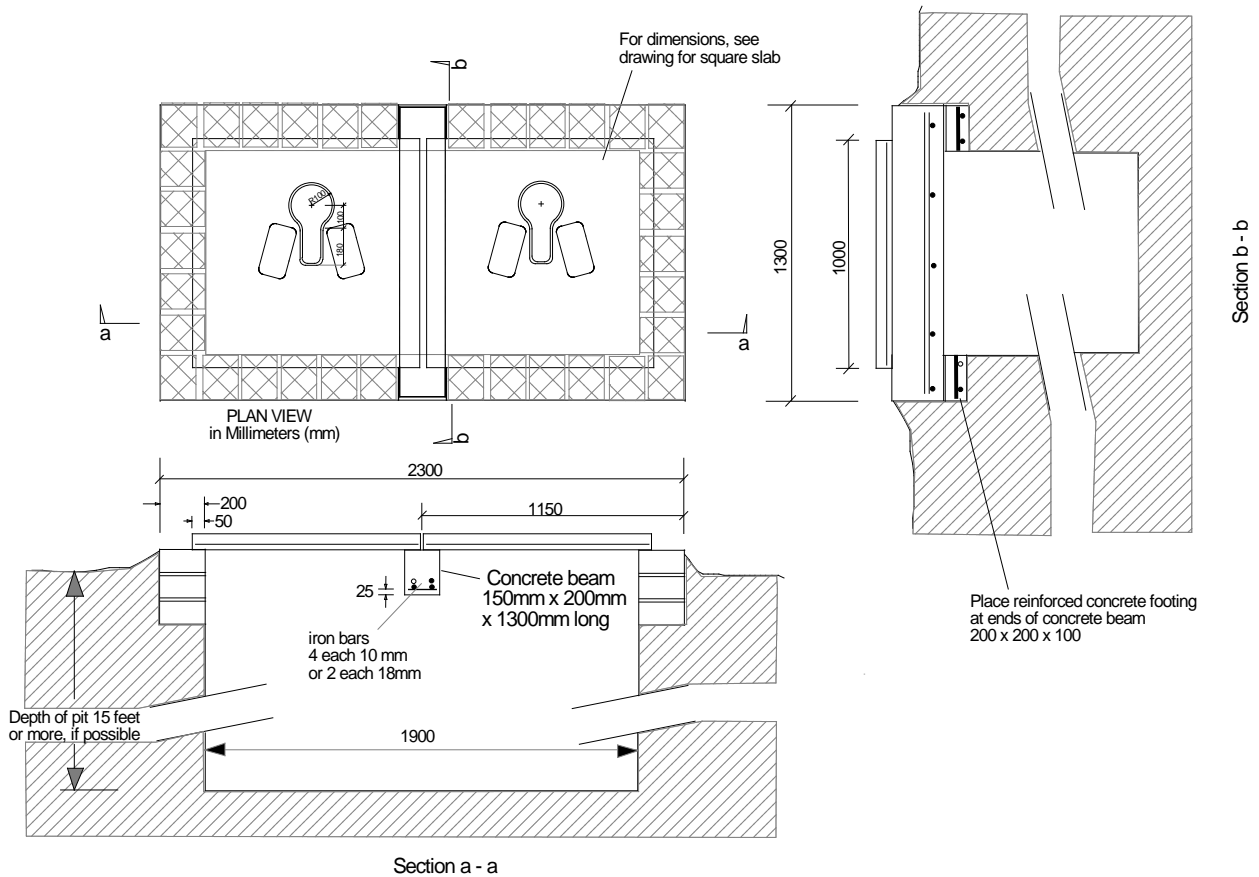


Figure 3: Double Stance Latrine – Foundation Details

Materials needed

The double stance latrine requires two square slabs and a central support beam. In addition to the materials required for the square slab in Figure 2, additional reinforcing iron bars and concrete are needed for the beam. While the design in Figure 3 provides an option for using either 2-18 mm bars or 4-10 mm bars, it is recommended that 10 mm bars be used (10 mm in 4 pieces 126 cm long). In this way, only 10 mm bars need to be purchased, as the square slabs also use 10 mm reinforcing.

The double stance latrine is fitted with two square slabs resting on the foundation and supported by a concrete beam in the middle. Construct the concrete beam separately and only lay it on the foundation when the concrete has properly cured.

Module 4: Building the Concrete Slabs

Steps for building a concrete slab include levelling the ground, mixing the concrete, assembling the moulds, pouring the concrete into the moulds and then curing the concrete slabs.

4.1 Preparing the Site

Slab construction is best done on flat ground and under natural shade, if possible. This will require cleaning and levelling the site for the slab as well as for mixing the concrete.

a. Levelling the Ground

When building a concrete slab, it is important to prepare the ground:

- Remove the grass over a 2 m x 2 m area; and
- Level the site using a *straight* board and a 2-foot level as shown in Picture 6.



Picture 6: Preparing the ground for slab construction



Picture 7: Mixing concrete for slabs

b. Concrete Mixing Ground

Choose a separate adjacent site for mixing the concrete. This ground also should be cleared of grass and debris and be relatively level. Take care when mixing the concrete so that no dirt is unintentionally dug up to avoid adulterating the concrete. It may help to use a flat spade or hoe instead of a curved shovel (Picture 7).

4.2 Placing and Preparing the Moulds

a. Laying Mould for Dome Slab

Slabs are best build on plastic sheeting (2 m x 2.5 m) to help with moisture control during curing. When using the metal circular mould, leave the bolts a bit loose so that the mould lays flat. Place the inner mould in the exact centre of the outer mould. Use wet sand to form the dome shape to the dimensions of Figure 1. Compact the wet sand well with a small block of wood.

Refer to Picture 8 and section a – a of Figure 1 for proper placement of the wet sand, noting that the sand pile begins at a 100 mm offset inside the outer mould ring and just touches the tops of the inside mould rings. Picture 8 demonstrates the use of a piece of wood cut with the dimensions required for the sand pile. This will help ensure a symmetrical and properly

dimensioned slab. The completed sand pile, prior to placing the drop hole mould, is shown in Picture 8a. The drop hole mould, typically fabricated from wood, is then placed on the sand as indicated in Figure 1.



Picture 8: Circular mould with wet sand placed, compacted and smoothed



Picture 8a: Completed sand pile, prior to placing the drop hole mould

b. Laying the Mould for Square Slab

The mould for the square slab is made of wood with inner dimensions of one square metre and fitted together by hammering nails at the corners; alternatively, screws could be used to facilitate assembly and breakdown. The mould is easy to assemble and dismantle for portability and is re-usable over a long period of time. The 8 or 10 mm iron bars are tied together using binding wire pieces according to the dimensions in Figure 2. Use steel banding wire to make a mat of the bars. In Picture 9, a wooden mould is ready to receive the concrete to fabricate a reinforced square slab.



Picture 9: Finished mould for square reinforced concrete slab, with reinforcing bars and drop hole mould

c. Laying the Mould for a Double Stance Beam

The double stance latrine requires two square slabs and a concrete beam across the pit to support them (Figure 3). The beam is fitted in the foundation by leaving a gap in the middle of either side of the length of the pit (see Picture 22). The beam is cast separately and positioned on the foundation when the concrete has set. Picture 10 shows the mould for casting a beam.

The beam is then cast using concrete prepared in the same ratio as for the slabs (1:3:3) and requires four round or twisted 10 mm iron bars held together by another short piece of iron bar tied with binding wire (see Figure 3 and Picture 11).



Picture 10: Mould for casting concrete beam for a double stance latrine



Picture 11: Preparing iron bars for the concrete beam for a double stance latrine

4.3 Mixing and Pouring Concrete

Mix the concrete according to the ratios provided in Module 2 (1:3:3). When mixing concrete by hand, mix the sand and cement well, and then add the aggregate. A hole should then be created in the middle of the pile of dry materials. Fill it with approximately 50% of the water, which should be as clean as possible. After mixing thoroughly, create another hole in the middle and add the rest of the water. Mix until consistency is achieved. It must be stressed **that keeping the mix as dry as possible will produce the strongest concrete. Too much water weakens concrete mix.** Compact the wet concrete to remove any air pockets. Float the surface while the concrete is wet, then smooth with a steel trowel when the concrete is almost dry.

a. Pouring Concrete for the Round Dome Slab

The concrete must be thoroughly mixed as directed above—remember that aggregate must be from 6 to 10 mm for the dome slab and the mix must be kept dry. The drop hole mould must be greased and placed, and the inner face external ring mould greased as well.

Place the concrete first around the base of the outside mould (the 100 mm band that does not have sand) and then carefully place it on the compacted sand base, moving around in rings



Picture 12: Moulding a dome slab

working upward on the dome and finishing at the top. Placing the concrete in this fashion helps prevent collapse or movement of the wet sand base. Compress and tamp the concrete as it is placed to ensure there are no voids in the slab. Check the slab depth with a marked wire, thin iron bar or measuring tape. Slab thickness must be measured perpendicular to the face of the mould base. Maintain the 70-mm thickness by placing the concrete in small amounts and working it quickly to the proper thickness, and then do not change this thickness during compaction and finishing (see Picture 12 for the nearly completed slab). After pouring the concrete, leave the mould in place for at least three days to avoid breaking the uncured slab.

b. Pouring Concrete for the Square Slab

Placing the concrete in the moulds of the square slab is more straightforward than for the dome slab, because thickness of the slab is easily maintained. In both cases, the drop hole mould must be greased and put in place prior to pouring the concrete, according to Figures 2 and 3 for the square and double stance slabs, respectively. First, place the concrete to a depth/thickness of 25 mm. Then place the reinforcement bars. Make sure that the ends of the iron bars are completely covered by concrete, ensuring that they will not be exposed in the finished slab. Then place the final 45 mm of concrete. The concrete must be “vibrated/tamped” or “rodded” to ensure that it completely covers the reinforcing bars (Picture 13).



Picture 13: Moulding for a square slab with drop hole mould

c. Pouring Concrete for the Concrete Beam

Follow the instructions for the square slabs above. Note that after placing the reinforcing bars at 25 mm above the bottom of the beam, according to Figure 3, an additional 175 mm of concrete should be placed on top. Rod and vibrate/tamp the concrete to ensure that reinforcing and concrete are in optimal contact and that voids are eliminated in the beam.

d. Casting Foot Rests

Foot rests are fabricated by cutting through a 10-litre jerry can to produce “rings” that are about 30 mm thick. Heat the knife prior to cutting to make the job much easier. Place the pieces on the moulded slab as shown in Figures 1, 2 and 3 and in Pictures 14 and 15 for a dome slab. This is done most appropriately during the initial setting period for the concrete, which is anywhere from 45 minutes to eight hours after casting.



Picture 14: Filling moulds for foot rests on dome slab



Picture 15: Completing a Dome Slab

4.4 Curing and Handling Slabs

a. Curing Concrete

The old saying about producing maximum strength concrete is “fresh concrete should be as dry as reasonably possible, and dry concrete should be kept as wet as possible”. Too much water when mixing can make a concrete slab weak. After the first day, if a slab is kept moist for one to two weeks, the hardened concrete potentially doubles its strength.

Concrete cures in three stages: initial setting after casting, which takes between 45 minutes to eight hours; final setting, for seven to 14 days; and hardening, which takes up to 28 days. At a minimum, keep the slab in one place while curing for the final setting period and only move it after the fourteenth day. It is recommended that the slab be left for 28 days before laying on the pit, although this can be done after 14 days.

The easiest way to keep a slab moist is to pour the concrete for the slab on a heavy black plastic sheet (2 m x 2.5 m). This will stop moisture from being absorbed into the ground. Cover the slab with sand, and keep the sand reasonably watered, with the plastic sheet folded over the top of the wet sand to retain moisture. This way water is only applied every few days. Designate someone to check the slab regularly to ensure the sand is still moist and the plastic is sealed.

b. Handling

It is best not to move the slabs for the first five days after pouring. However, since the concrete needs up to 14 days for curing, the best practice is not to move the slab at all until this period is over.

The slabs weigh between 150 and 170 kg! Use at least four people to carry one. The dome slab can be rolled but still requires **one person on each side** to keep it from falling. (See Picture 16, this slab was heavier than expected and cracked when it was dropped.)



Picture 16: Cracked dome slab that was dropped

c. Retrieving Mould

For a dome slab, shaped using the metal moulds, a minimum of five days are necessary before lifting the dome slab to retrieve the inner mould. It is **very important to remove the moist sand placed atop the slab to keep it moist before lifting the slab** as it adds a significant amount of weight, which can also cause breakage. However, it is recommended that the mould be left in place until the final setting period is completed. The square slab does not use an inner mould, so this is not applicable, although for best results even the outer moulds should be kept in place for at least five days.

4.5 Constructing Raised Seat Latrine Floors

The raised seat latrine slab (Picture 17) is an option available primarily for households with either a handicapped member or an elderly person no longer capable of getting up from a squatting position over a traditional latrine slab. Constructing the raised seat is not a straightforward task and requires the skills of a qualified mason and a welder to prepare the



Picture 17 Raised seat on square concrete slab

metal framework. The raised seat can be cast into a square concrete as shown in the picture. A design schematic is presented in Annex C.

Module 5: Foundations and Pits

It is strongly recommended that brick or concrete foundations (also known as footings) be provided for all latrine slabs. Foundations offer a solid underpinning for the slabs and help stabilize the pit, reducing the possibility of pit collapse. It follows that square slabs will have square foundations and pits, double stance slabs rectangular foundations and pits, and round dome slabs circular foundations and pits. Foundations are constructed on stable soils, which may require some digging to remove the top layers of unstable soil. The pit is dug within the dimensions of the foundation. This allows the mason to control the size of the pit, ensuring that pit dimensions are appropriate for the slab. When utilizing corbelled brick foundations, the volume of the pit can almost be doubled, thereby extending usable life of the latrine.

5.1 Constructing the Foundations

a. Round Pit Foundation

Picture 18 shows the construction of a concrete foundation for a dome slab. The 1200-mm diameter dome slab will rest on a concrete foundation with an external diameter of 1400 mm and an internal diameter of 1000 mm; the ring is 200 mm wide and will be 75 mm high. The pit will be 1000 mm in diameter. In Pictures 18 and 19, note that bricks are used as the mould for the concrete foundation ring.



Picture 18: The concrete foundation with metal rings



Picture 19: Ring foundation curing

To begin, etch a 1400-mm diameter circle in the soil and excavate 75 mm of soil from within the circle. Place bricks with mud mortar to make internal and external moulds as indicated in the pictures above. Bend an iron or metal ring (6 mm) into the circular shape and place it between the two brick moulds where the concrete will be poured. The metal provides sufficient support to the concrete rings, and it can be removed when the pit is full, and rolled and reused at another site.

Build the foundation ring by laying about 30 mm of concrete between the inner and outer brick moulds, placing the metal ring in the centre of the concrete ring, and then place the remaining 45 mm of concrete. The concrete foundation should set for at least 12 hours before digging the pit.

b. Single Stance Square Pits

Standard brick foundations for square pits require basic masonry skills and are straightforward to build. The corbelled brick foundation presented here is a bit more complicated to construct, but offers the advantage of a pit with a larger diameter for the standard slab size. “Corbelled” means that the top course of bricks is offset slightly inward from the course below it (see Figure C.6 in Annex C.) To begin, clear the site and dig until reaching stable soil. Lay the foundation as indicated in Figure C.6 in Annex C and shown in Picture 21, adding as many courses of brick as necessary to bring the top of the foundation to ground level. For a square slab, the pit dimensions are the same as the slab dimensions, 1000 mm x 1000 mm. The internal dimensions of the lower brick courses are 1400 mm x 1400 mm, and the top course is 1000 mm x 1000 mm. Use cement mortar. After completing the foundation, let it set overnight and begin digging the following day.



Picture 20: Constructing a brick foundation for a rectangular pit



Picture 21: Constructing a corbelled brick foundation (Notice the offset of the upper course of bricks)

c. Double Stance Rectangular Pits



Picture 22: Corbelled foundation for a double stance latrine pit

Double stance rectangular pits are designed to fit two square slabs. The dimensions, however, vary to allow for fitting the beam that supports the two slabs in the middle. Picture 22 shows a double stance foundation constructed in sandy soil (loose soil), which required a deeper foundation (i.e., additional courses of bricks). Depending on the circumstances, another course or two of brickwork may be needed to raise the foundation to surface level. The gap seen in the middle of the foundation is for the concrete beam and should be 200 mm deep and 150 mm wide to match the beam dimensions.

5.2 Digging the Pits

Latrine pits can be built using circular, square or rectangular perimeters. The circular pit is the least likely to collapse and thus provides the most stable latrine pit, especially for deeper excavations. The pit should not be dug until the slab-curing period is just about complete. This will help prevent accidents from having the open pit exposed to children and people walking in the dark. At night, cover the open pit with thorny bush branches until the slab is placed atop.

In Tororo, soil conditions are such that deep unlined pits are possible. Unstable soils, such as loams and sands are typically found in shallow surface layers. The slab foundation serves to stabilize these layers, and the pits can then be dug into the stable underlying soils (Picture 23).

Following are important points to consider when digging and constructing a pit:

- Round pits are only for dome shape slabs, while square and rectangular pits are for one and two square slabs, respectively.
- National guidelines for latrine pits require at least a 15-foot pit depth (this can be very difficult in certain areas).
- Provide a pit with a reasonable volume at the time of construction. A family of six will produce approximately 360 litres of solid waste in a year. Using a circular pit with a depth of five metres with a diameter of one metre should last for 9.5 years. This pit uses a 1.2-metre external diameter and one metre internal diameter slab.
- **If a corbelled brick foundation** is used, a pit diameter 16 inches (0.4 m) larger than with an ordinary foundation and using the same slab dimensions, will double the pit volume, providing about 20 years of service.
- In unstable soils consider a circular pit lined with fired brick with open spaces at the joints. This will allow a deep pit in unstable soils.
- For rocky soils where excavation is extremely difficult, in very sandy soils where pit collapse is likely, or in areas with high water tables that limit pit depth, the arbour-loo latrine could be used. The arbour-loo uses a shallow pit, about 1.5m deep. When the pit is full, a new pit is dug, the slab and superstructure are moved to the new site, and the old latrine is covered with soil. A tree is planted over the old pit, benefitting from the nutrients in the composting excreta.



Picture 23: Digging a circular pit within the brick foundation

Module 6: Completing the Latrine

Completing the latrine involves placing the slab over the pit and foundation, building the superstructure, fabricating a wooden hole cover and installing an appropriate hand-washing station.

6.1 Placing the Slabs

Where the slab and the foundation are built the same day (as in these training sessions), the contractor should return after the 14-day curing period (and after pit has been dug) to install the slab on the foundation (Pictures 24 and 25).

Finished concrete, no matter how smooth, will absorb some urine and result in odours. An option for addressing this is to paint portions of the slab most likely to be splashed with urine using a two-part epoxy paint to seal any pores in the concrete. One litre of epoxy paint costs around 25,000 shillings; however, this is enough to cover the area around the drop hole and the space in front of the drop hole (most likely to be splashed by urine) on about 10 slabs. This “extra” might take a while to catch on as people are used to the smells associated with a latrine, but is something that masons may want to offer.



Picture 24: Dome slab ready to be placed on foundation (in background covered with branches to cover pit)



Picture 25: Completed Square Reinforce concrete slab with foot rests and epoxy paint

6.2 Building the Superstructure

Usually time will not be allocated during the training to construct the latrine superstructure. Typically, however, local building techniques and materials are used and masons are experienced with these. The superstructure can be built using any of the following materials:

- Packed mud (a very common technique in Tororo District);
- Mud and wattle;
- Sun-baked brick with mud mortar and mud-plastered walls (can be made by homeowner—possibly the cheapest option);
- Fired brick;
- Frame with wood poles or timbers, using natural local materials such as papyrus reeds or grass; and
- Door built with wood frame and any available material for door face.

It is best to discuss the different ideas for the superstructure with the homeowners, giving advantages and disadvantages of each, but let them make the decision about which materials to use depending on what they can afford. They can always improve their latrine using more permanent materials later when and if they have the resources.

6.3 Adding the Roof

Roof options include iron roofing sheets, thatched grass roofing and plastic sheeting. A metal roof lasts the longest, and if the latrine sizes recommended in the catalogue are used, only one sheet is needed. Thatched roofing is cheaper and cooler, but needs more maintenance. Plastic is a temporary measure.

6.4 Adding a Hole Cover

A properly dimensioned and used drop hole cover can reduce the presence of flies and help control odours. The cover can be made of poured concrete or of wood. Wood covers are recommended because they are easier for children to use; concrete covers can be too heavy and break if mishandled). Covers are typically trapezoidal in shape, dimensioned to easily cover the drop hole completely and have a 300-mm handle extending straight up from the cover. Alternatively, the hole cover handle can have an upside-down “U” shape. This allows the user to slip their foot into the “U” shape and move the drop hole cover using their foot, hence avoiding having to handle the handle with your hands.

6.5 Including a Hand Washing Facility



Picture 26: Hand-washing station

A hand washing station should be provided free with **every** latrine built. For training purposes introduce at least two designs to let trainees choose the design they are comfortable building. The cost for materials for the type shown in Picture 26 are negligible and are largely available free if the homeowners request them in advance of construction. Instructions and several options for assembling a tippy-tap hand-washing station are provided in Annex D.

Module 7: Personal Selling and Marketing Tips

Selling latrine products in a rural setting to low-income persons is a function of the masons' abilities to convince households of latrine usefulness, and a payment structure that satisfies both the masons and the household budget. Latrines may be products when completed, but latrine construction is a service provided by masons to households. Accordingly, masons need to be trained in technical construction skills **and** in marketing skills.

Among the things that masons need to know is how to approach potential customers. This is done through two main approaches: direct marketing and personal selling.

7.1 Direct Marketing

Direct marketing is concerned with establishing an individual relationship between the business offering a product or service and the final customer. Direct marketing can be defined as:

**The planned capture, analysis and tracking of customer behaviour
to develop a relational marketing strategy**

The process of direct marketing covers a wide range of familiar promotional activities; however, the ones relevant to masons are physical visits and telephone calls. These methods require masons to establish who the decision makers in households are, approach them and discuss the problems they face with existing latrines or the absence of a latrine and offer solutions using latrine options available in the product catalogue. It is systematic, as shown in the following steps:

a. Establish the decision makers and influencers in household transactions

It is commonly held that male household heads make decisions on expenditures. While this is largely true and widespread, it may not be the case for all households. The mason's duty is to use their knowledge of the village to understand who makes the decisions and who influences those decisions. This will help them to determine whom to approach.

b. Establish customer relationships

Once the mason knows who the decision maker is, he/she can then approach them and introduce the subject of discussion. This subject should not be the products they intend to provide but rather try to understand what the problems households have with their existing latrines or with the lack of a latrine if the household does not have one.

c. Introduce the product options

After the masons understand the household's problems, they can now proceed to introduce the product options, explaining to their potential customers how the options they provide will solve the problems identified. Among these will be latrines that are **long-lasting, convenient and easy to clean, resistant to termite-infested conditions and are, above all, affordable.**

d. Negotiate the Sale

Masons should appreciate that not all households have the same ability to pay and should negotiate terms with each household as they deem fit. Fixed prices may appear attractive but in a setting where people are used to negotiating over prices, it may be useful to adopt this approach. Where households can provide some of the materials required, they should be

encouraged to do as it reduces the burden from both the mason and the household, in which case the mason may only negotiate labour charges.

The masons must also appreciate that incomes in rural areas are seasonal. There can be great demand for latrine construction right after a harvest when people have money. It is not unusual that the mason cannot satisfy the demand for slabs, pit excavation and superstructure construction during this period. Numerous sanitation sales can be lost as households spend their income on other needs instead of waiting for the mason to become available. Masons must be creative in selling their services in a way that takes advantage of these periods of peak demand. This can include prefabricating slabs during low demand periods for later sale; negotiating deferred payment terms to do the work in low demand periods and receive payment later; negotiating barter or in-kind payments for periods when households lack disposable income; and working with local micro-credit providers to facilitate cash loans to households to improve their sanitation.

e. Conclude or Close the Sale

Once agreement has been reached on the product option and the price, the mason can now arrange to start assembling the necessary tools in presence of the household head or decision maker to assure them that there is progress on providing the service. It may or may not be necessary to ask for an advance on labour charges, but it is advisable to do so in order to secure commitment and encourage part payments to ease the household's ability to comply when the latrine has been built.

f. Follow Up After the Sale

The direct marketing activities do not end with provision of the latrine. The masons are encouraged to visit their customers to find out their appreciation of the product. This gives further confidence to the household and helps the masons to understand whether there are any aspects of the product they would improve. It also provides the masons with an opportunity to access new customers through their old ones. Throughout this process from initial contact for after sale follow-up, it is important to keep in constant contact with the customer answering their questions, concerns and doubts.

7.2 Personal Selling

In a service provision business like that of masonry work, the quality of the product is part and parcel of the perception of the mason. This makes it important for the masons to present themselves in a confident and courteous manner. The following are important points to consider:

a. Knowledge of the Product Options

To achieve the level of confidence required, the masons should read the catalogue many times until they are able to describe the products without hesitation or mistakes. They also should practice presenting the products to colleagues, friends or family before approaching potential customers. They need to practice until they are comfortable with the catalogue and describing all the products. When they practice, they need to get feedback from their practice "buddies" by asking questions like, How was my presentation? Was there anything that was not clear? How could I improve? Is there anything else you would like to know about the products or services? This confidence derived from knowledge of the products also gives the potential customer the confidence to select a given product from the mason. It also guides and shortens the decision making process for the customer/household.

b. Physical Evidence

Physical evidence refers to the tools of the trade. These are the items used in any specific service provision, e.g., a doctor's overcoat and stethoscope. For masons these tools range from measuring tapes, moulds, shovels, etc. Some may be easy to carry around all the time, while others are not. The masons should ensure that at all times when approaching potential customers, they must look like the service provider they are by having at least one of these tools. Physical evidence for this purpose will also include the catalogue and certificate which will be identifiable with every trained mason.

Annexes

Annex A. Model Training Programme

Annex B. Bill of Materials Required for Training Workshop

Annex C. Detailed Design for structural elements

Annex D. Instructions for Building a Tippy-Tap Hand-washing Station

Annex A. Model Training Programme

Day 1

- 1 Hour Opening remarks and introduction to Sanitation Marketing and role of the masons in project
- 1 Hour Introduce products and how to use the catalogue
- 3-4 Hours How to build concrete ring foundations for dome slab
- 1 Hour Lunch break
- 1-2 Hours Build dome slab
- 1 Hour Discuss what to do in bad conditions; loose soils, rocky soils
- Break for the day

Day 2

- 1 Hour Review and questions from day 1 activities
- 4 Hours Build corbelled foundation for square slab
- 1 Hour Lunch break
- 2 Hour Technical discussion – materials, concrete mixing and curing
- 1 Hour Build square reinforced slab
- Break for the day

Day 3

- 2 Hours Marketing Tips (Discussion of marketing, how to ensure payment, etc)
- 1 Hour Build “Tippy-tap” Hand washing apparatus
- 1 Hour Review of training, program, catalogue
- Lunch, closure

Annex B. Bill of Materials Required for Training Workshop

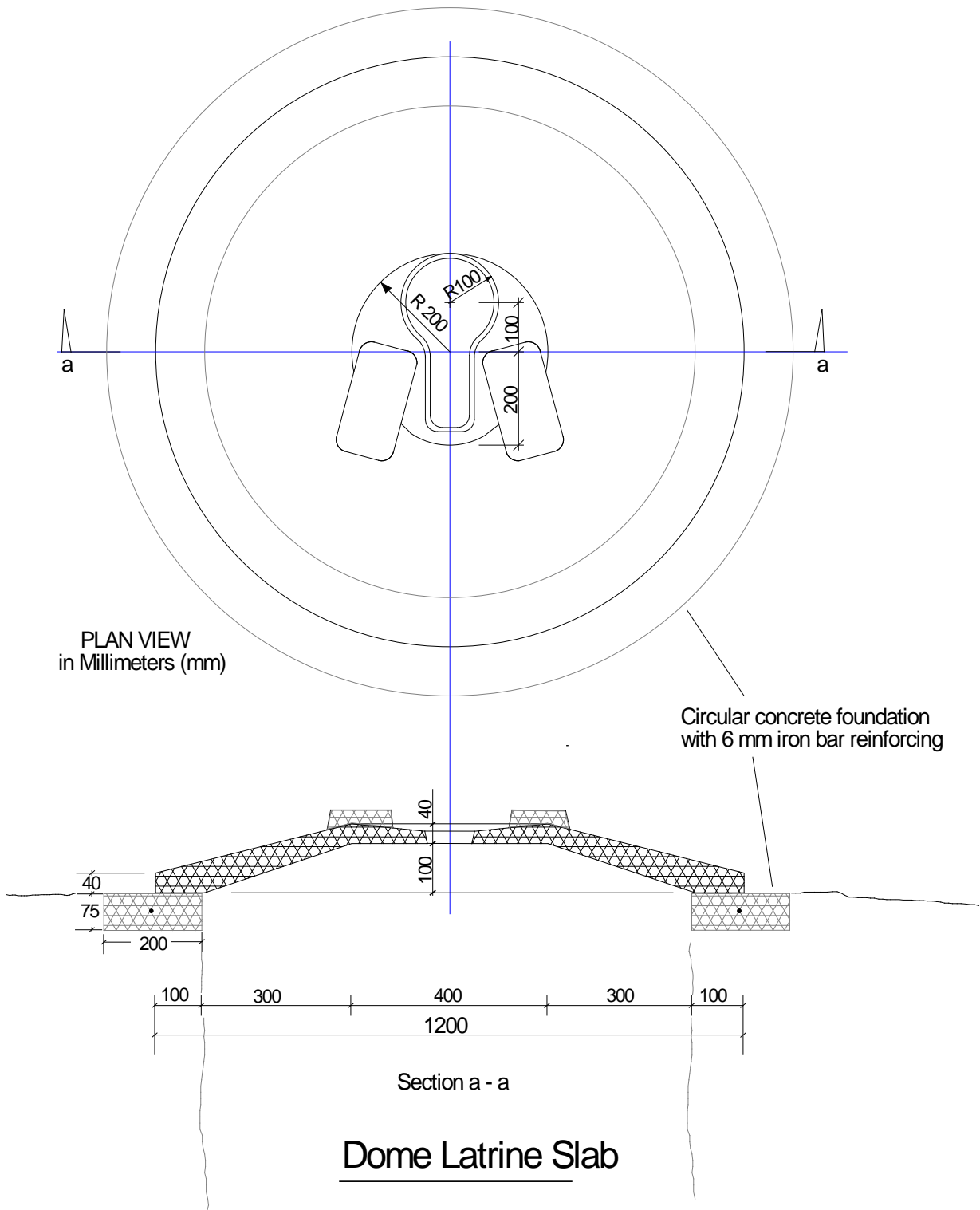
ITEM	UNITS	QTY	UNIT COST	AMOUNT
Wooden board	pcs	2"x6"x6'		10,000
Sand	pick-up	0.5		20,000
Bricks	pcs	200	100	20,000
Aggregate	jerricans	8	2000	16,000
Jerricans	pcs	2	4500	9,000
Jerricans (slit)	pcs	2	1500	3,000
Basin	pcs	1	6500	6,500
Bucket (20 litres)		1	10000	10,000
Cement	bags	2	26500	53,000
Iron bars (10mm twisted)	pcs	1	15000	15,000
Wire net	pcs	1	3000	3,000
Ringwire	pcs	2	3000	6,000
String	pcs	1	2000	2,000
Trowel	pcs	1	5000	5,000
Nails	1/2kg	1	2500	2,500
Binding wire	pcs	1	4000	4,000
TOTAL				185,000

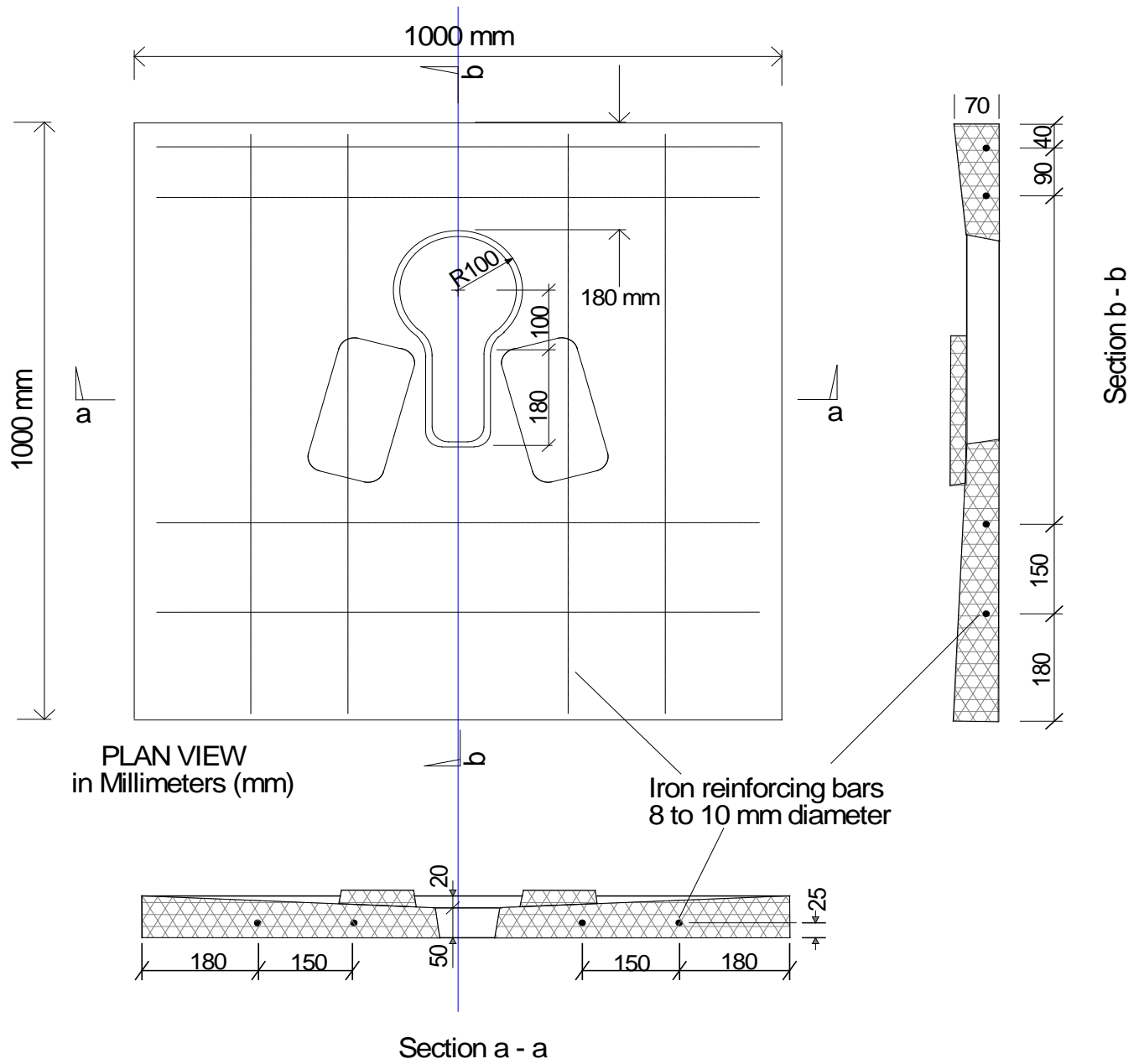
This is the exact receipted amount for materials used on the training. Other reusable materials like the moulds are not included as they had already been paid for in the product development. Costs of the super structure (roofing, wall, door) are also not included as these activities were not part of the training

Metal moulds for the dome slab cost about UgS 200,000–250,000, as they need to be manufactured by a metal worker. The training centre may be able to provide these.

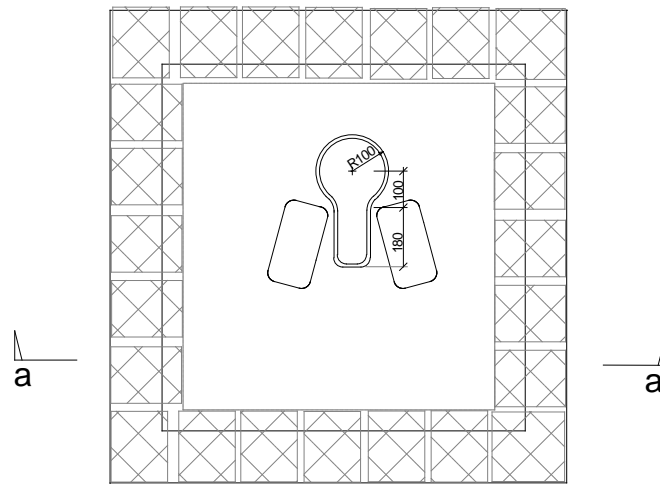
Annex C: Selected Design Drawings

- Figure C.1 Dome concrete slab (copied from Module 3)
- Figure C.2 Dome unreinforced concrete slab with foundation
- Figure C.3 Square reinforced slab
- Figure C.4 Single stance latrine foundation details
- Figure C.5 Double stance latrine foundation details
- Figure C.6 Corbelled foundation for square and dome slabs
- Figure C.7 Details for raised seat

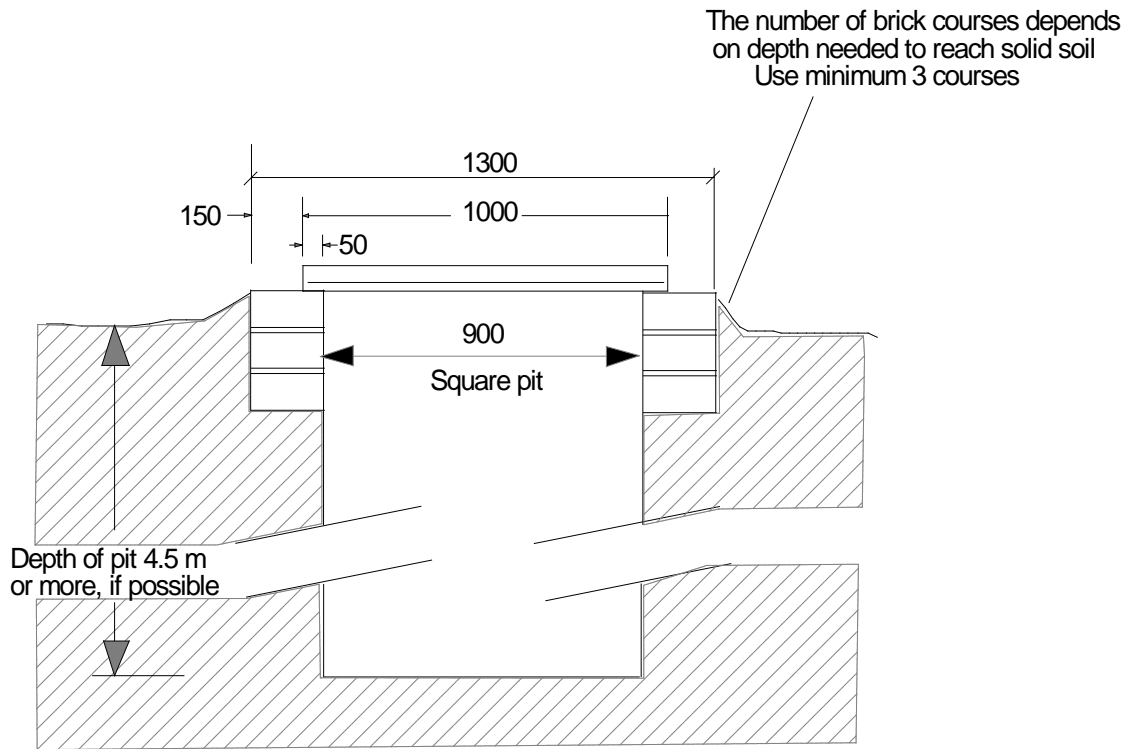




Square Latrine Slab

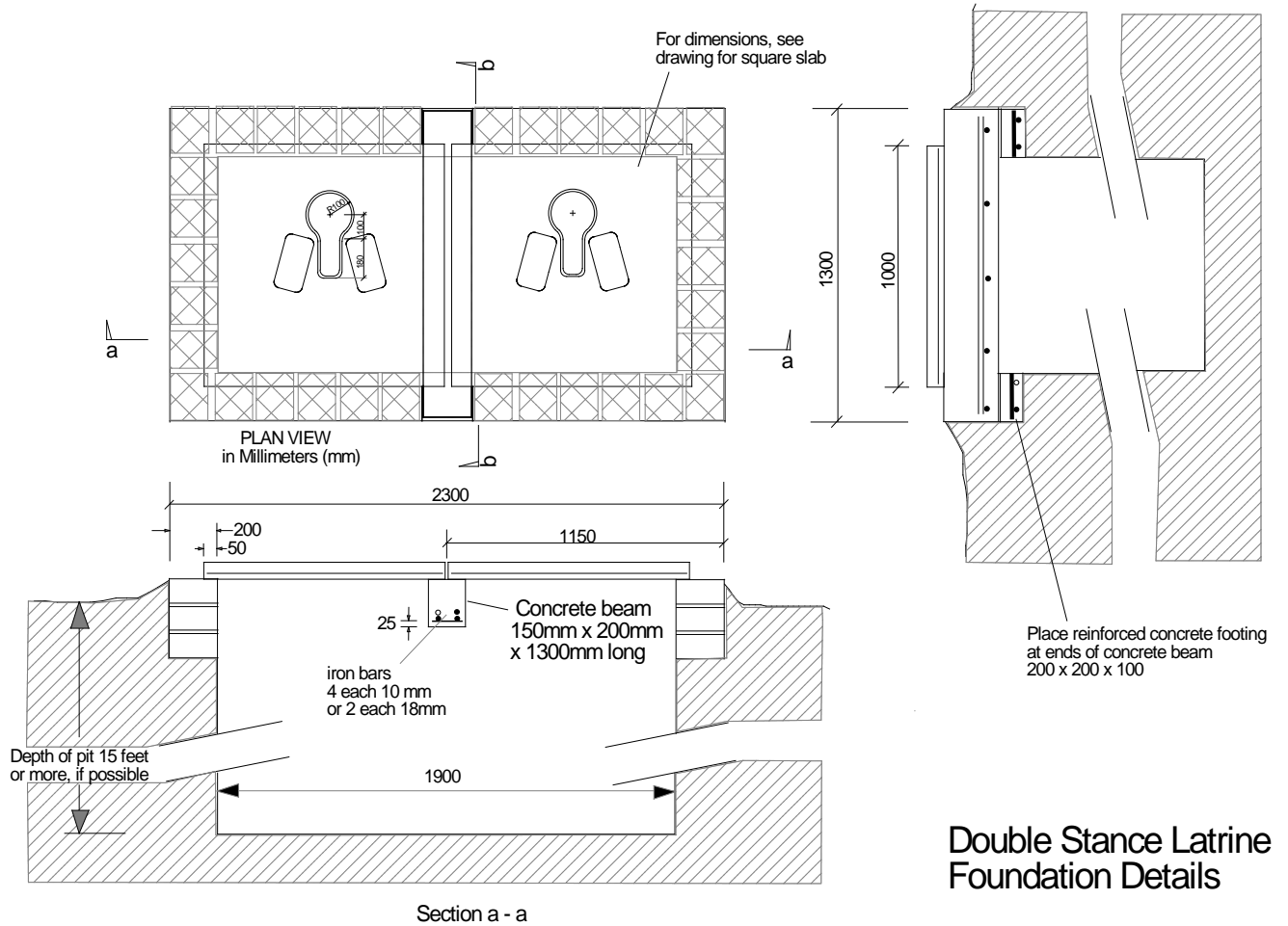


PLAN VIEW
in Millimeters (mm)

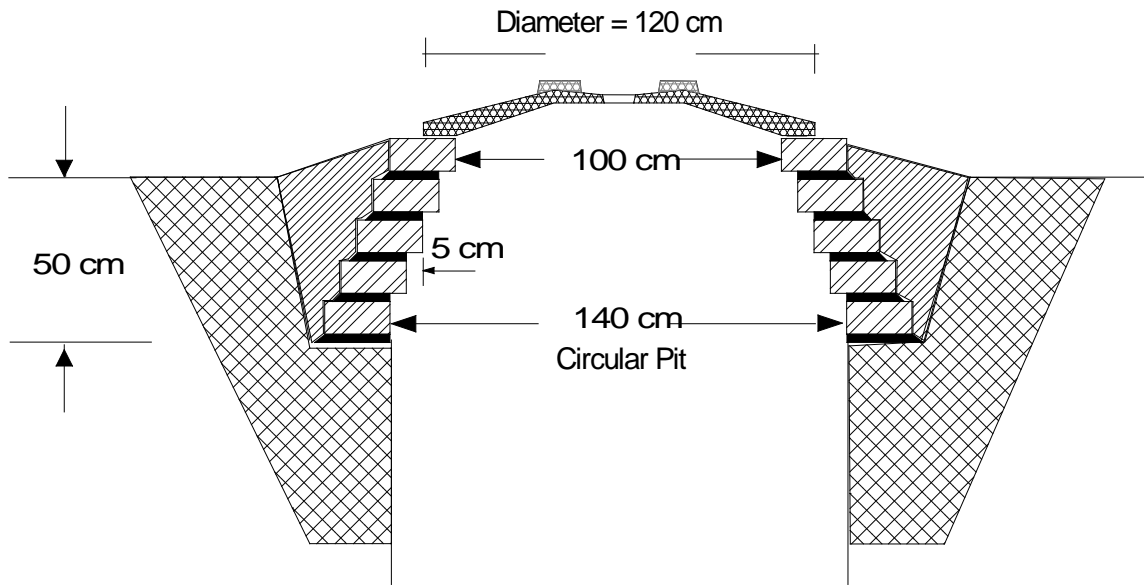


Section a - a

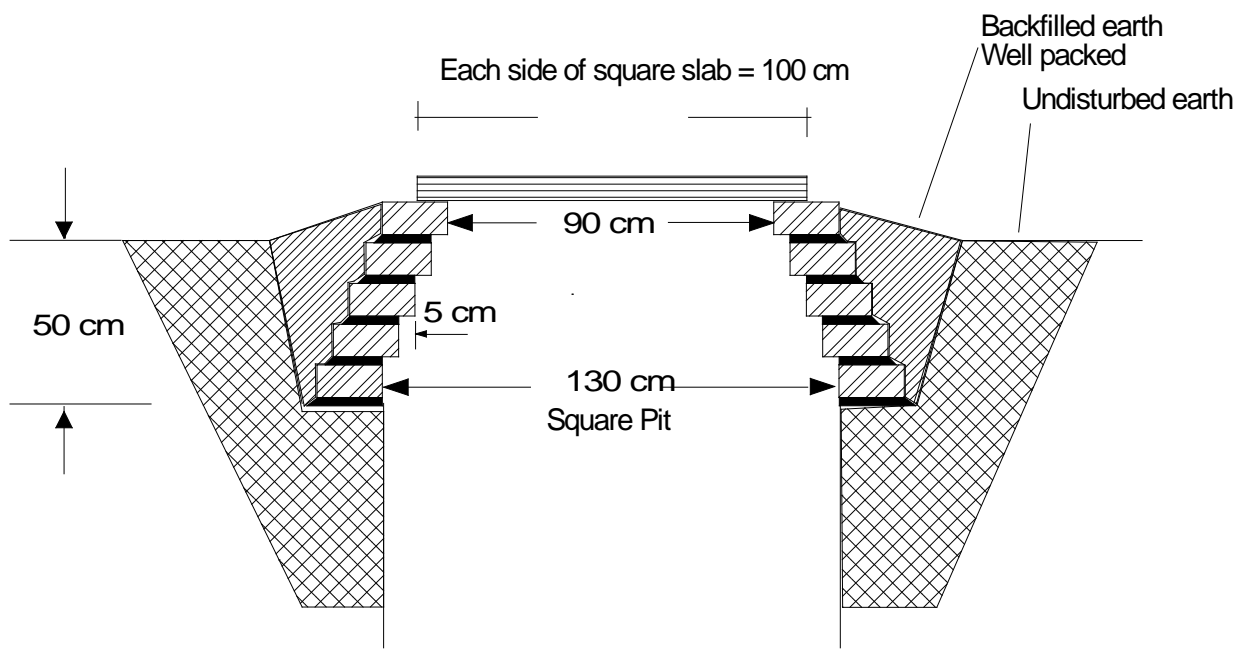
Single Stance Latrine Foundation Details



**Double Stance Latrine
Foundation Details**

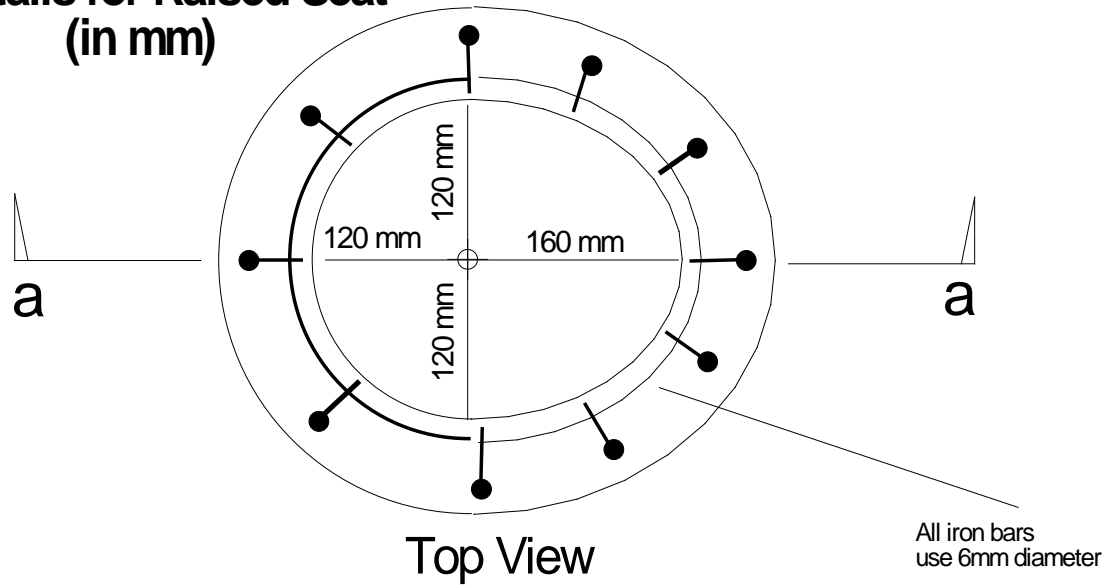


Corbelled Foundation for Dome Slab

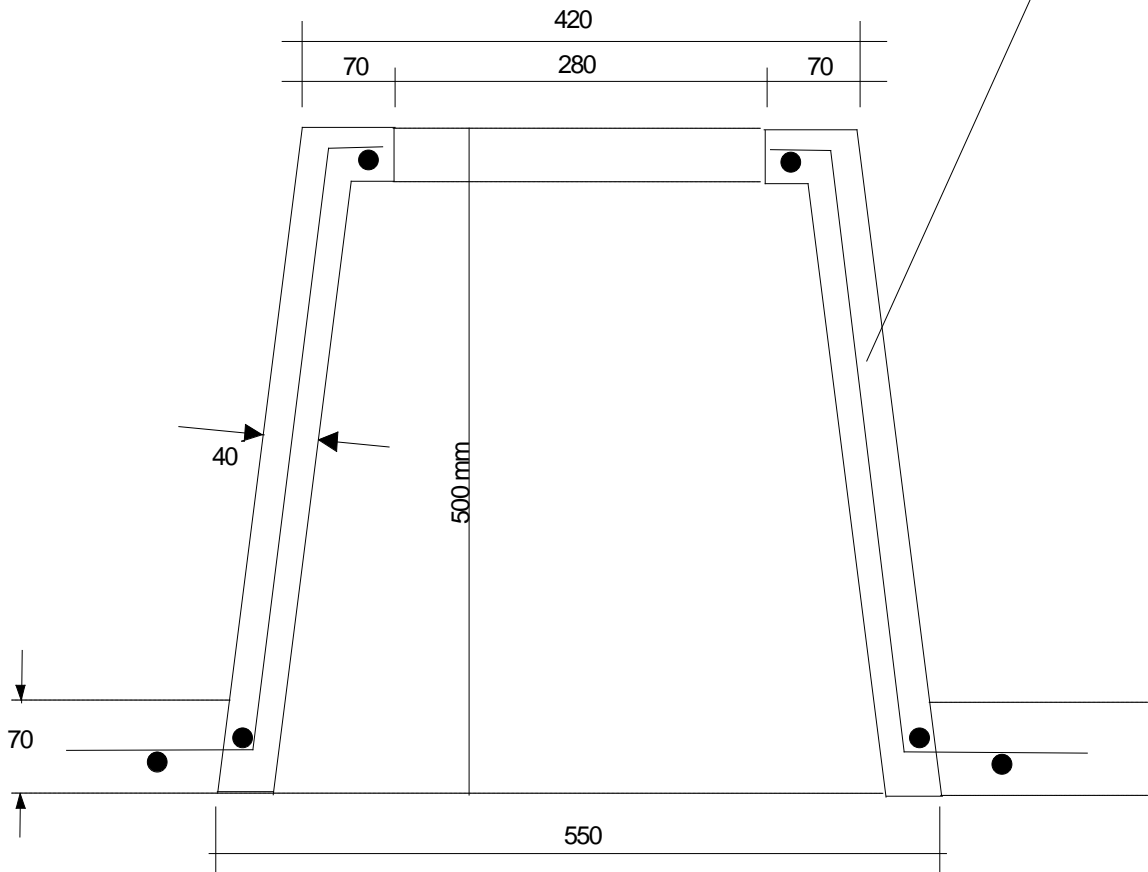


Corbelled Foundation for Square Slab

Details for Raised Seat (in mm)



Top View



Section a - a

Annex D. Instructions for Building a Tippy Tap

HOW TO BUILD A TIPPY TAP FOR HAND WASHING

Counselling Card

Materials Needed:

1. Two wooden branches (2 metre length, Y-shaped end)
2. Two thinner sticks 1 metre long (one for Tippy Tap handle, one for foot pedal)
3. Saw to cut wood
4. 8 to 11 cm length nail
5. Piece of cloth or nail pliers
6. Heat source (flame)



7. Spade or shovel
8. Two pieces of rope (0.5 metre for cap; 1 metre for foot pedal)
9. 3- or 5-litre jerry can
10. Soap
11. Piece of wood same length as piece of soap
12. Screwdriver or tool to make hole through soap
13. Rocks, gravel for soak pit

How to Build a Tippy Tap:

- 1 Mark hole.** Select clean, empty 3-litre or 5-litre plastic container. Mark location for hole, about 12 cm below cap.



- 2 Heat the nail.** Hold the nail with a pair of pliers or a cloth, and heat the nail with any flame.



- 3 Make holes.** With hot nail, make hole in container, and second hole in cap.



- 4 Insert rope.** Put longer piece of rope (1 metre) through hole in cap. Start by putting end of rope through outside surface of cap so loose end of rope ends up on inside of cap.



- 5 Knot rope.** Make a knot in the rope that rests on inside surface of cap. Make knot big enough that knot cannot be pulled back through cap. Screw cap back on container. Knot should now be inside container with remaining long, loose end of rope hanging outside container.



- 6 Attach stick (foot pedal).** Tie end of rope to 1 metre stick. Stick is now connected to container with rope. This is foot pedal for Tippy Tap.

Note—You can adjust the length of the rope, if needed, during Step 11.



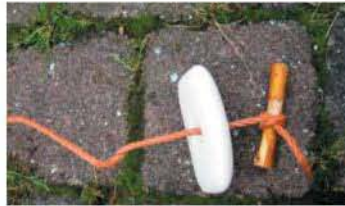
Instructions adapted from, "How to Make a Tippy Tap – A hygienic handwashing device with running water." Authors/Photos Mark Tiele Westra. Werkgroep OntwikkelingsTechnieken (WOT); University of Twente, the Netherlands; Henk Holtslag Connect International.



7 Make hole through soap. Using tool (e.g. screwdriver, stick), make hole through soap by slowly rotating and pushing tool through the soap.



8 Insert rope. Put shorter, second piece of rope (.5 metre) through hole in soap and tie to short stick or piece of wood.



9 Fill container. Fill container with water, up to level of hole.



10 Put poles in ground. Decide best place to put Tippy Tap. Should be where frequent hand washing should take place (near a latrine or kitchen). With shovel or spade, make two holes in ground to depth of 50 cm. Place poles about 70 cm apart. Put poles in holes and pack soil around them.



11 Hang jerry can, foot pedal stick, and soap rope.

- Put stick through handle of jerry can, and put stick between two poles. Jerry can should now be hanging from stick.
- Tie rope with soap near jerry can so it is hanging from stick. (If no soap available, use container to hold ash).
- Make sure rope for foot pedal is adjusted so that one end of stick/foot pedal hangs about 15cm above ground and other end of stick rests on ground.



12 Make soak pit. Make hole (40x40cm and 20cm deep) under jerry can where water will fall). Fill hole with rocks. This is a soak pit that keeps Tippy Tap from becoming mud hole, mosquito breeding place.



To Use:

Push stick down with foot. This tips container, which makes water run out of hole. Wet hands and release stick. Apply soap (or ash) to hands. Push stick down again and rinse hands.



How to Maintain Tippy Tap:

1. Keep Tippy Tap full of water by refilling so it is always ready for use.
2. Wash inside and outside of tippy tap weekly or sooner if it looks dirty.
3. Replace soap (or ash) when used up.
4. Replace wooden sticks over time to prevent collapse.

DIFFERENT KINDS OF TIPPY TAPS

Counselling Card

Tin Can

- Make hole on side of tin can near bottom
- Hang can
- To start water flow: pour cup of water in can
- To stop water flow: let water run out



Hollow Tube

- Make hole in container
- Insert hollow tube (pen casing, pawpaw stem...) in hole
- Find plug/cover for tube (pen cap, stick, ...)
- To start water flow: remove plug/cap
- To stop water flow: cover/plug tube



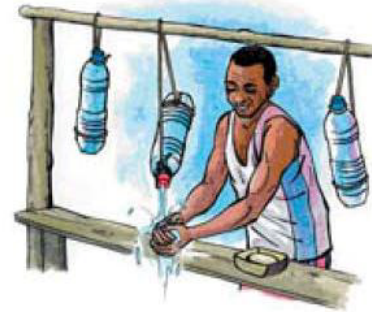
Screw Top with Hollow Tube

- Make hole in side of screw top bottle
- Insert tube into hole
- To start water flow: loosen screw top
- To stop water flow: tighten screw top



Hole in Cap

- Make hole in container cap
- Hang container so can tip over
- To start water flow: tip container
- To stop water flow: put container upright



Tilting Jug

- Make hole in jug side or handle
- Hang so can tilt
- To start water flow: tilt container
- To stop water flow: put container upright

