NOURISH PROJECT

Manual on Latrine Design, Production and Installation

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NOURISH Project

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I. Introduction and background

The quality of products in the marketplace is important for healthy competition among producers while meeting customer demands and ensuring long term use. In the Water, Sanitation, and Hygiene (WASH) sector of Cambodia, there is a relationship between the quality of the toilets and demand of the end users. This relationship has affected private business and its sustainability. Although guidelines in the National Household Latrine Construction manual (MRD, 2010) have been established to promote quality and safety of latrine production, the actual quality of products in the marketplace remains limited. Quality conditions depend on the geographic areas where external project interventions have been implemented and private firms. Subsidies and promotion of latrines in rural areas in this context has resulted in various levels of quality of toilet products - some that do not meet customer demand and threaten sales and growth. Additionally, such conditions can create business risks associated with the loss of confidence and trust in producers and possibly risks to the environment due to dysfunctional products. The low affordability of the demand side could drive down the latrine costs and therefore low quality of the productions.

To respond to the Cambodia National Strategic Plan on Rural Water Supply and Sanitation 2018 the WASH sector aims to achieve improved rural water supply and sanitation at 100% of households by 2025. This objective requires priority and effort to support the improvement of the quality of latrines in rural areas to meet the satisfaction and the needs of rural customers. The improvement of the quality of toilet facilities should be more affordable and efficient for rural toilet demand and supply. Therefore, toilet quality can improve and strengthen the sustainability of local businesses and reliability among rural customers.

Quality standards are a worldwide tool to ensure the uniformity of products – such as toilets. The uniform production of toilet products should have the acceptable quality standards to increase confidence and satisfaction of customers. Maximum standards can increase the cost of sanitary latrines, but this can be justified as toilet products are linked to exposure to potentially disease-causing pathogens – and health problems in rural households. Constructing poor quality toilet products can household expenditures for health care costs and overall living conditions in rural households. Poor quality toilets can increase the health risks to both family and community; therefore, we must ensure that toilets product reach at least the minimum standards. Cambodia has made great progress in achieving the country's specific Millennium Development Goals (MDGs) for water supply and rural sanitation and hygiene. However, there is still more work to be done. Access to improved water supply and sanitation at the national level is only 76% and 62% respectively, which means that nearly half of the population continues to lack these basic services (MRD 2016). In addition, there is a huge gap between receiving this service in rural and urban areas, and access to services between the poor and the wealthier people. Currently, rural sanitation coverage in Cambodia is the lowest in Asia, as around 40% of the country's population is still practicing open defecation (OD).

Inadequate infrastructure, sanitation and hygiene practices and are responsible for six among ten diseases as reported in Cambodia. Sanitation and personal hygiene can cause a high mortality rate of up to 10,000 annually, most of them children due to a lack of sanitation(MRD 2016). Economic losses related to these problems are estimated at more than 7 percent of Cambodia's GDP or US $ 32 per capita (WB 2008).

Background information of Assignment Phase I

Quality is important for competition in the free market and for improved quality of products for customer satisfaction and long-lasting use. In the Water, Sanitation, and Hygiene (WASH) sector, there is a strong link between quality of WASH products (including the quality of latrines and water filters) and creating and increasing demand

from end users. This issue also influences private businesses and their sustainability in a practical sense. Even though a Technical Guideline Book (MRD, March 2016) has been established for the assurance of cost, technical and safety issues associated with WASH products, production quality remains varied - depending on the areas where different projects and private sector actors have been providing, subsidizing or supplying latrines and water filters. This context has resulted in a variety of quality of WASH products, which may not be responsive to unit quality standards for supporting sales and growth. Instead, it can create potential risks related to the lack confidence and trust from consumers, as well as pose potential risks to the environment.

In response to the Royal Government of Cambodia's strategic target for Rural Sanitation and Hygiene in 2018 and its ambitious plan for universal access to improved water supply and improved sanitation and hygiene in rural areas by 2025, SNV has implemented its program to support accelerating efforts to achieve this goal. One of its approaches is to improve the quality of WASH products to create a cost effective and cost-efficient situation for both demand and supply sides. Therefore, study and solutions that produce quality WASH products would provide benefits for supporting and improving sustainable business and trust among consumers. Also, such efforts would provide the opportunities to find out and discuss the quality of WASH products openly through the processes of developing a potential accreditation model and testing measures.

Objectives of assignment Phase I:

- Review the current approaches for ensuring quality standards and potential accreditation measures used in the sector;
- Undertake technical assessment of the current WASH products offered to communities in the NOURISH target areas;
- Identify and recommend potential quality standards and accreditation mechanisms for WASH products and services in consultation with MRD;
- Conduct national and provincial level workshops in NOURISH target areas to raise awareness and set a foundation for future tangible improvements to the quality of latrine materials (improved quality standards), water filters, and related accreditation processes;

Objectives of assignment Phase II

The objective of Phase II of this assignment is to support SNV, MRD, and the WASH sector with the implementation of training, mentoring, and monitoring related to quality improvements associated with WASH products. These activities will be conducted within the geographic implementation area of the NOURISH project. SMEs that have engaged in the NOURISH programme will be sensitised and trained on quality considerations and guidelines outlined by MRD and as agreed through a consultation process among relevant stakeholders at all levels. Lessons learned will continue to be raised to the broader WATSAN sector at national level towards policy considerations and strategic thinking on the role of standardisation and product quality in the sector.

a. National Strategic Plan

In 2014, the Royal Government of Cambodia officially approved the National Strategic Plan (NSP) for Rural Water Supply and Sanitation Hygiene (RWSSH). The goal of the National Strategic Plan (NSP) is simple will be challenging to achieve:

"By 2025, every citizen in rural communities must access to improved water and sanitation and must live in a sustainable sanitation environment."

This plan will be carried out in two phases: the first phase is from 2014-2018, within the framework of the National Action Plan (NAP) for the supply of drinking water and sanitation in the countryside.

Table 1: National action plan

Priorities	Baseline	Target 2018	2025 milestone	2016 progress
1. Access to improved water supply	46.6%	60%	100%	76%
2. Access to improved sanitation and hygiene	40.9%	60%	100%	62%
3. Hand washing with soap over specific times	46.5%	60%	100%	73%
4. Appropriate use of water treatment	70%	80%	100%	64%

Source: NAP 2014-2018 and KAP 2016

II. Summary Key findings on quality issues of latrine assessment in Cambodia

This section of the report describes the quality issues associated with toilet design, selection, construction, installation, and use – as observed from Phase I of this project. Latrine manufacturers intend to make a profit from latrine business. However, some manufacturers may reduce prices by reducing production quality. In this way, they can make more profit by attracting more customers so that they can greatly increase their revenues. Additionally, masons are responsible for installing latrines to rural families can receive more income to install more latrines in a short time for more profit. Installing toilets in a quick manner can also reduce the quality of the construction.

a. Toilet design and selection for installation

The design of toilets will not be satisfied for some families in certain geographic areas of Cambodia. Typical latrine pit rings are usually installed underground, but the installation in some areas used these typical latrine pits where the underground water level is high. this can make the latrine full more quickly than normal and can contaminate the underground water. Flooding is a common occurrence in Cambodia. This can cause sludge waste stuck or contaminated water to flow out from the pits that would affect dirty environment. In such flood-prone settings, the latrine rings must be elevated above the ground which requires added more cost compared to the normal latrine types. Specially designed toilets for floating communities are also required to avoid contamination to the environment around the water. Respondents from other communities have complained that some of the latrines constructed are too small and must be adapted for use by the elderly or the disabled.

b. Toilet construction

Many toilet manufacturers have been observed to not be producing high quality latrines – as concrete production may be incorrect and insufficient (or even absent) metal rebar reinforcement may be used. In Siem Reap, it was observed that concrete mixing is does not use sufficient water – which can affect its strength. The mixing of concrete required metal rebar in order to be strong.

In other geographical areas, rebar reinforcement is used less than that specified by MRD's Technical Manual. In Siem Reap, 4 mm diameter rebar is used for the construction of cement rings and slab. In other areas, 6 mm rebar is used. In Pursat province, 4 mm and 6 mm rebar is used for cement rings. Amongst the toilet manufacturers in Battambang, 4 mm rebar is used for toilet rings and toilet cover while 5 cm is used for slab. Chamber boxes are not fitted with rebar, and a ring diameter is 1

meter. However, some of the toilet manufacturers use 5 centimeters of steel for toilet construction. Villagers perceive that if rebar is not used, latrines are not durable. However, producers want to reduce the production cost by reducing rebar diameter and interval.

In Siem Reap, the diameter of the rings are of 0.8 cm and are perceived as being too small and quick to become full. Rebar dimension of ring requirement is big (1 to 1.2 m) and is highly preferred. Manufacturers in this province have only 0.8m ring diameter and use of insufficient water and cement were observed. Significant investment may require to create new mould that can meet customer needs. In Battambang and Pursat, customers prefer to have 1 meter rings while some prefer 1.2 m ring if they can afford it.

Slabs, in some cases, were observed to be poorly constructed, which makes them prone to cracking and breaking (and requiring repairs). In exceptional cases, the metal rebar frame is insufficiently reinforced due to the rebar being too small and at wide intervals. Sometimes the manufacturers have stopped using 6 cm metal rebar reinforcement and instead use 4 cm metal rebar reinforcement or sometimes smaller. Some villagers have reported that the rebar used is too thin and could affect the strength of the materials. In conclusion, the villagers want to have high quality slabs to avoid falling into the pit. Fortunately, there were no observed incidences of broken slabs when conducting the survey – but most latrines are still quite new.

Floor tiles used for slabs can sometimes be slippery and hazardous to users. Toilet slabs are also sometimes too small which make toilet space difficult to use – particularly for those with mobility issues. Small dimensions of rings (e.g. 0.8 m) often result in smaller slabs being produced. Such issues have generated a lot of complaints because of the narrowness of the toilet space for the user (in Siem Reap). Floor tiles for the subsidized toilets in Battambang appear to be particularly slippery.

Cement production is usually standardized among each producer and depends on the manufacturer's past habits. Different types and ratios of sand, rocks, and small stones are often used among the producers. The quantities of each component may not actually follow standards as defined in the latrine production manual. Setting and drying times (once poured into the moulds) may also vary. As toilet demand has continually increased in Cambodia in recent years, it has been reported that some manufacturers may remove products from their moulds before they are completely dry or before certain standards. Fortunately, some toilet manufacturers still follow the drying standards.

Construction of super-structures can be done in many different ways – varying from simple and cheap designs to expensive but durable designs. Use of low quality materials can result in easily damaged or broken doors, walls and roofs. However, the quality of the construction of the super-structure can make the toilets significantly more expensive. Toilet bowls are usually imported from Thailand and reportedly require excessive volumes of water. Some villagers complain that the use of excess water for flushing of stools has affected their feeling, especially in the water scarcity areas. Some masons have reported that they have cut the exit tubing of the squat toilet bowl to make it easier to push the stool into the tube that flows into the pit. However, this technique has the disadvantage that air flow in and out of the pit is increased and can create bad smells. However, these odors can be reduced by placing tubes/ventilation attached to the pit lids. So, the cut of the exit tubing is to reduce the amount of water use that can provide benefits for two reasons: 1) To reduce workload (or times) that water needs to be fetched and brought to the toilet, and 2) To ensure that the pit is easily receiving the fecal sludge. Villagers report that in some cases, to guarantee the quality of toilets, they have to examine the quality of construction by themselves at the manufacturer's sites so that they can see the rebar reinforcement and/or proportion of raw materials for cement mixing and the methods of production. In some cases, it has

also been reported that the color of the cement can confirm the quality of its production. If the cement components have a pale color, they may have more strength.

c. Toilet supply and transport

There was little concern reported about the transportation and supply of toilets to the customers. Sometimes the travel distance between the production site and the customer is far, and if road conditions are bad, this can cause breakage of some latrine components. However, producers must compensate for such circumstances at their own expense. In Battambang, the rural roads are often in poor conditions which in some cases toilet constructors have to push the rings and carry toilet products by bar hands crossing a bridge for installation to the families.

Some customers reported that an intermediary sometimes requires a deposit upfront for installing a new toilet – although this has been rarely reported. Because of the high demand of latrine construction in the interviewed areas, the delivery is sometimes delayed by two to three days between the purchasing side and latrine supply side of the business. This gap of delayed delivery can cause customers to be upset as their expectations are to have product delivered immediately.

d. Toilet installation

The toilet makers usually hire workers from the community to support the installation of latrines in the community. Sometimes the installation of latrines is of low quality because these local workers are inexperienced. It has been observed that in some cases, latrine installation does not follow the national technical manual, for example in Siem Reap, Pursat and Battambang, many toilets have been constructed at a high elevation that makes it difficult for older people, children and people with disabilities to access. In many cases, there are no hand rails to support mobility during use of the toilets. Some squat toilet bowls also do not properly connect to the outflow piping to the pit – and this can cause the faecal sludge to become stuck or can make the toilet dirty and easily attract flies. Some of the latrines have also been reportedly improperly installed, causing the stool to leak back out of the toilet. In some parts of Battambang, the earth near the ground surface also has hard rock which makes it hard to dig the pits. Sometimes it can take 1 to 5 days to install a single latrine. In areas with rock and hard soil, latrine pits can fill more quickly than those pits installed in permeable soils - where liquids can seep down the bottom of the unsealed pit into the aquifer. In addition, some pits are not equipped with enough rings due to lack of the rings or place one top ring high above the ground. These problems can be unbalanced of the latrines that can be easily overturned. Some latrine manufacturers do not supervise the work of the local masons at the construction sites. Without proper monitoring and checking, the quality of construction may be poor. Toilet construction may also be paid by total number of toilets completed – which may incentivize local masons to build latrines as quickly as possible to maximize their profit.

e. Toilet use

Some toilets are not well adapted to individuals with special needs - especially those with disabilities in relation to movement (wheelchair users) or those with poor eyesight. Most customers demand a toilet that uses water to push stools into the pit. Such designs usually require large quantities of water which may burden local water resources and time spent for fetching.

In areas where water sources are scarce, especially during the dry season, when there is no rainfall, water is not sufficient for toilet users. Gravity-fed water pipes attached to toilets are preferred, but often not feasible in rural areas of Cambodia due to affordability. As a result, water availability and re-filling of storage tanks is important for stool flushing and hand washing. Some toilets may be difficult to wash and keep clean if

no water is used – and bad odors may be generated (especially dry toilets that rely on ash to reduce smells). Depending on the capacity of the toilet pits and number of users – pits will eventually become full. Options may not be available, or households may have no knowledge about how to empty their pits safely.

All manufacturers of toilets insisted that they provide free repair services for the latrines they have built. However, the time period for this service is limited and depends on the contract and written agreement and is often within one month after the construction. However, one user noted that their toilets were clogged for weeks after installation and the manufacturer refused to fix the problem.

Some interviewees reported that the toilets had not been used after installation due to spiritual beliefs and potential for bad luck. Building latrines near a particular home or location may result in bad luck. Sometimes family members refuse to use latrines for such reasons. This is a particular obstacle for households with less space for toilet

III. Methods for latrines construction

This section presents the whole process of latrine products, installation and latrine use and maintenance. Each process is the instructions of mixed materials and step-by-step of producing the latrine components. The other is to instruct about the latrine installation—the length and width of pit for insertion of ring, the distance installation from well-water source for consumption, and other types of latrines which suit to different geographical locations and social context.

Figure 1 presents a diagram of a typical single-pit latrine in rural Cambodia with a high quality superstructure.

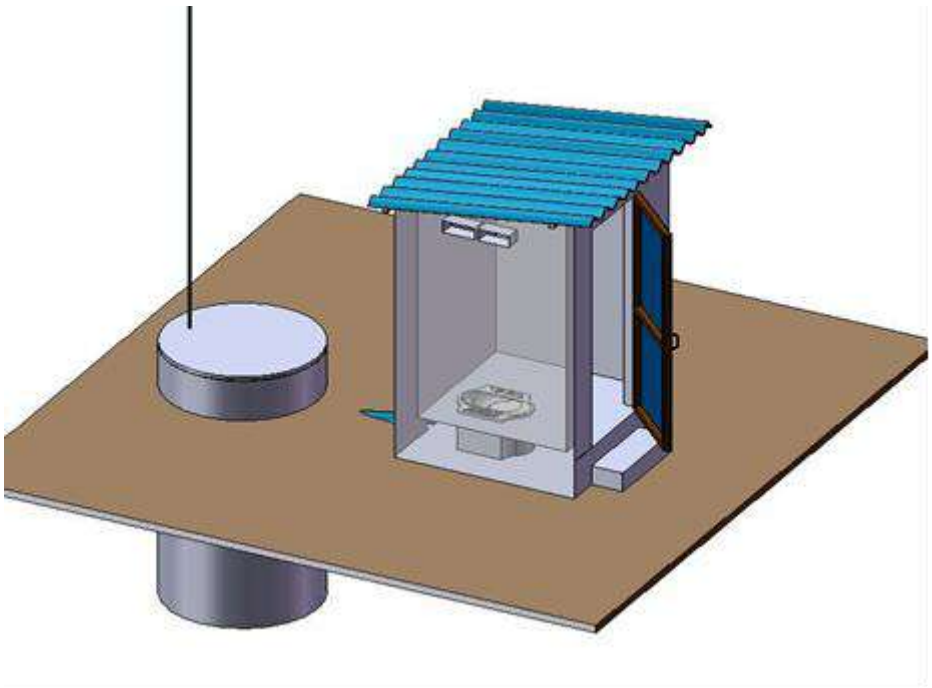


Figure 1 – Typical single-pit latrine in rural Cambodia with strong super-structure

Figure 1 presents a diagram of a typical single-pit latrine in rural Cambodia with a high-quality superstructure. The figure demonstrates the two main components of a latrine – the pit which holds faecal sludge and the superstructure which protects and gives privacy to the user.

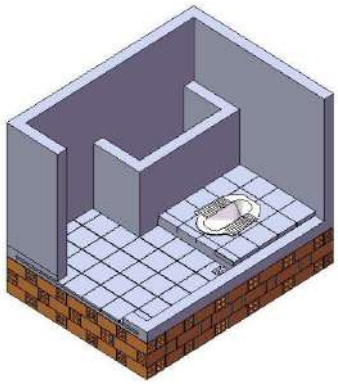
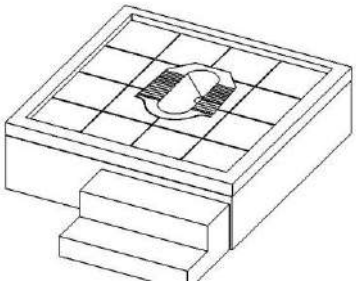
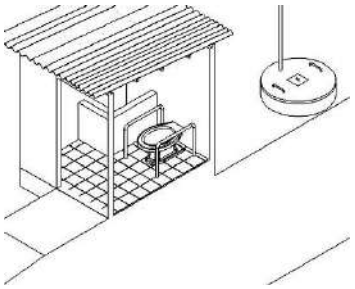
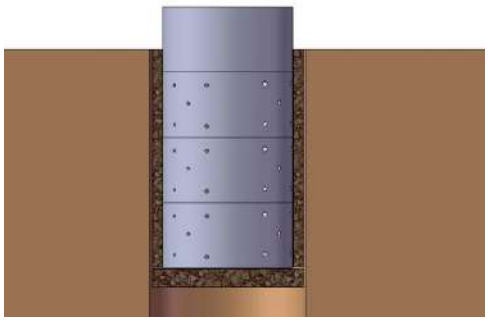
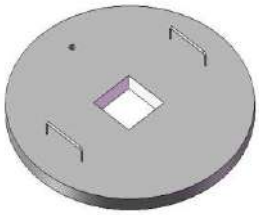
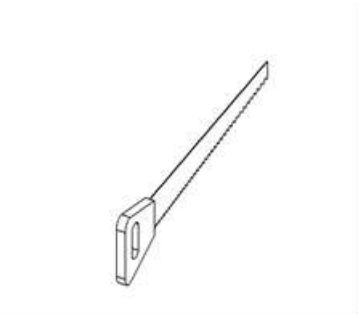
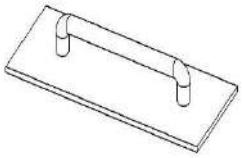
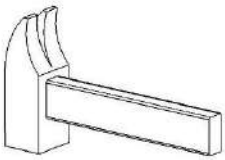
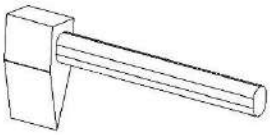
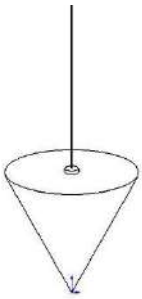
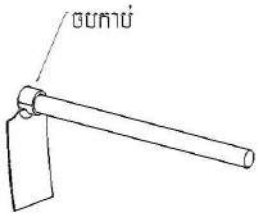
A. Toilet super-foundation 	B. Toilet super-foundation 	c. Toilet super-structure 
D. pits and ring insertion 	E. Slab 	F. Sitting pan  G. Lid 

Figure 2 – Individual components of a typical latrine in rural Cambodia

a. Tools and equipment for toilet production

Figure 3 presents the equipment and tools required for latrine construction in rural Cambodia.

A. Saw 	B. Rectangular trowel 	B. Plumb rule level 
C. Hammer 	D. Axe 	E. Spirit level (plumb bob) 
F. Mason square 	G. Hand hoe 	H. Spade 
I. Cement bucket (small)	J. Cement bucket (Large)	K. Steel tape

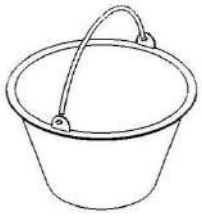
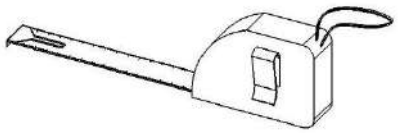
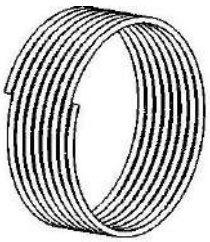
		
L. Hose pipe spirit level 	M. Chisel 	N. Compactor hand tamper 
O. Plastering hawk 	P. Bucket trowel 	

Figure 3 – Latrine production equipment

This latrine production equipment is for the phase of the production and installation stage. In Cambodia, there is no specific measurement for mixed water, cement, and sand to produce concrete. Mostly masons use cement bucket (both small and large) to measure their level of quantity of those mixed water, cement, and sand.

b. The use of cement

The quantities and ratio of materials required for cement latrine components is presented in the following table:

Table 1 – Materials and ratios for cement mixture

No	Component	Quantity of cement (50kg)	Quantity of sand	Quantity of stone	Ration	Types of sand[1] (Lake)
1	Concrete rings	1 bag	3 cement large buckets	6 cement small bucket	1:3:6	Level 3 (coarse grains of sand)
2	Mortar for concrete foundations/ footings	1 bag		8 cement small bucket	1:0:8	Level 2 (in between coarse and fine grain of sand)
3	Mortar for concrete wall	1 bag		6 cement bucket (small)	1:0:6	Level 1 (fine grain of sand)
4	For mixing with other materials/ general purpose	1 bag		10-14 cement bucket (small)	1:0:10-14	Level 3 (coarse grain of sand)

Source: SME in the Nourish project agreed on this material and ratios of cement mixture

The ratios an estimated amount of mixed row materials for latrine productions; the following table:

Table 1 can be adapted for any amount of cement needed, and the quantities for each latrine component are estimations only. Correct cement materials and ratios will ensure that the cement composition is optimized for strength.

[1] This level tells the different types of sand (both coarse and fine grains of sand) taking out from the lake for different latrine productions

c. Toilet parts production

i. Ring production

To produce pit rings, 3 round steel rings (6 mm diameter) should be produced along with 8 steel stands (also 6 mm diameter) with pre-rolling holes before inserting the mixed concrete into the metal mould (Figure 4)

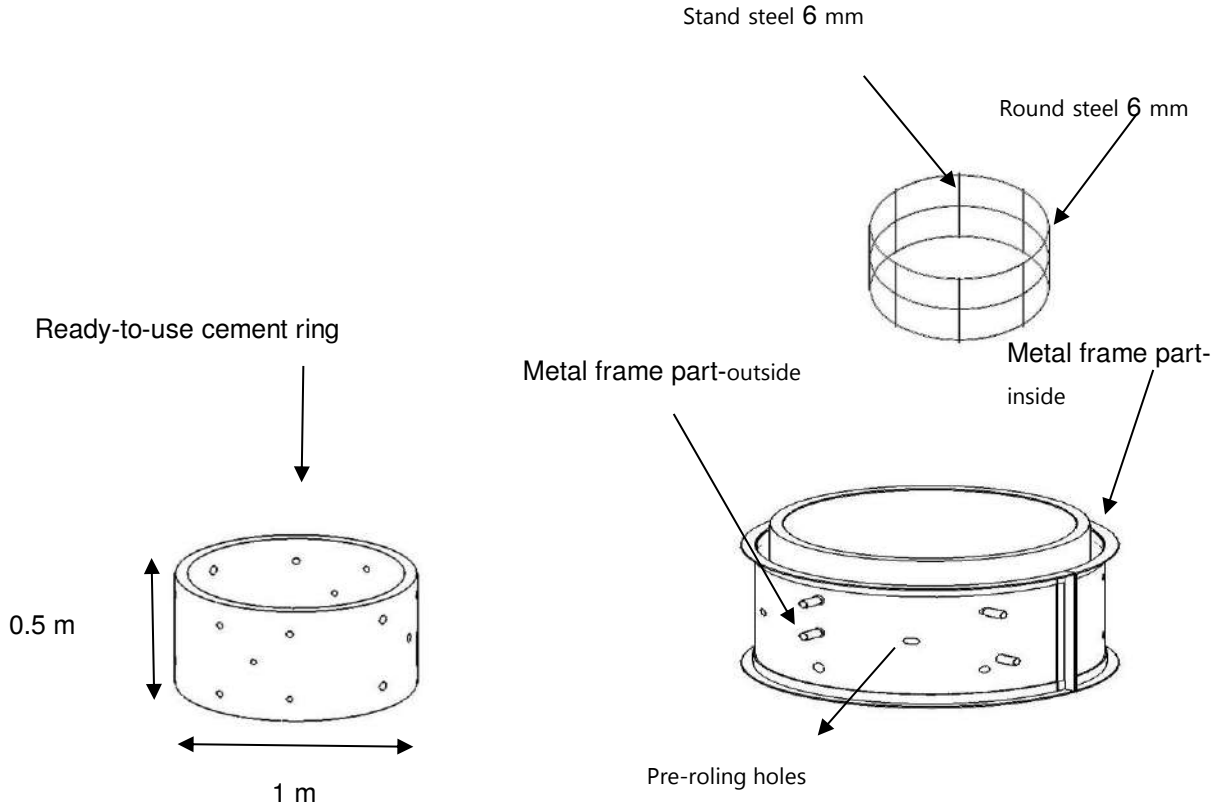
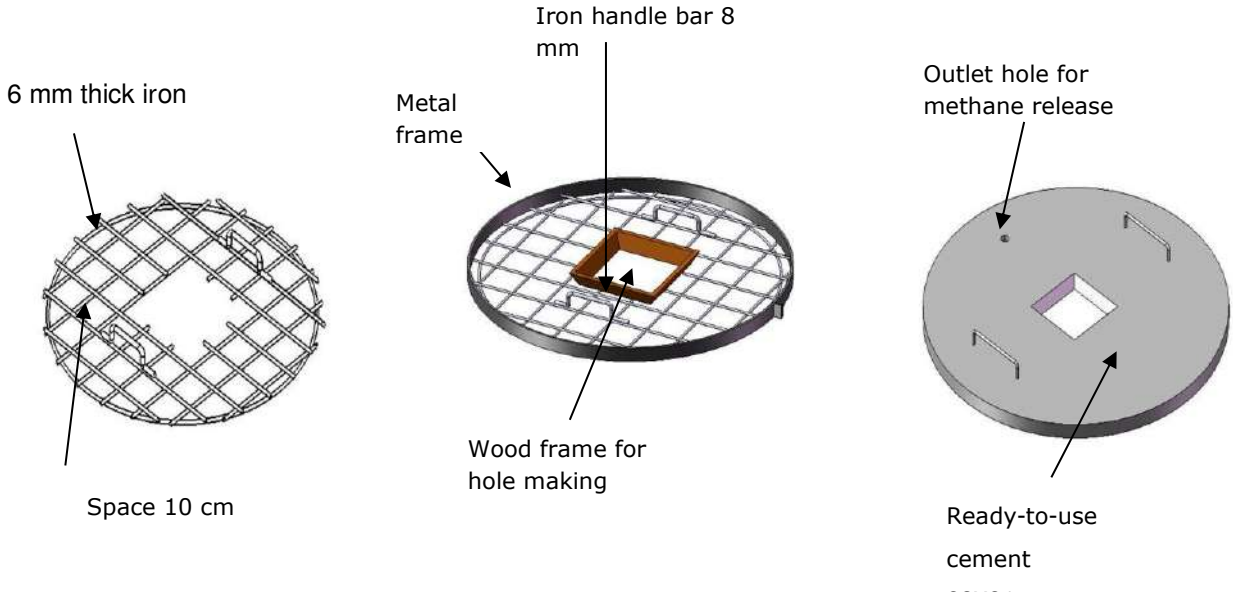


Figure 4 – Production of cement rings for latrine pit

When placing concrete into the mould, it should be left for 24 hours before removal from the mould. Sprinkling water on the sack to new concrete rings for 3 days before it can be transported to the site of installation.

ii. Cement cover production

Steel reinforcement (6 mm diameter) should be used for the latrine lid with an interval of approximately 10 to 15 cm (Figure 5).



iii. Slab production

Figure 5 – Production of latrine pit cover

The lid should be configured with metal handles, a hole to release methane gas (preferably through a long PVC tube), and a window to easily inspect faecal sludge elevation in the pit (to know when to empty the pit before it overflows).

iv. Latrine slab construction

Latrine slabs should be constructed with 6mm diameter rebar to approximately 10cm intervals. Once the cement foundation is constructed, non-slip tiles should be fitted to the slab along with the toilet bowl (Figure 6).

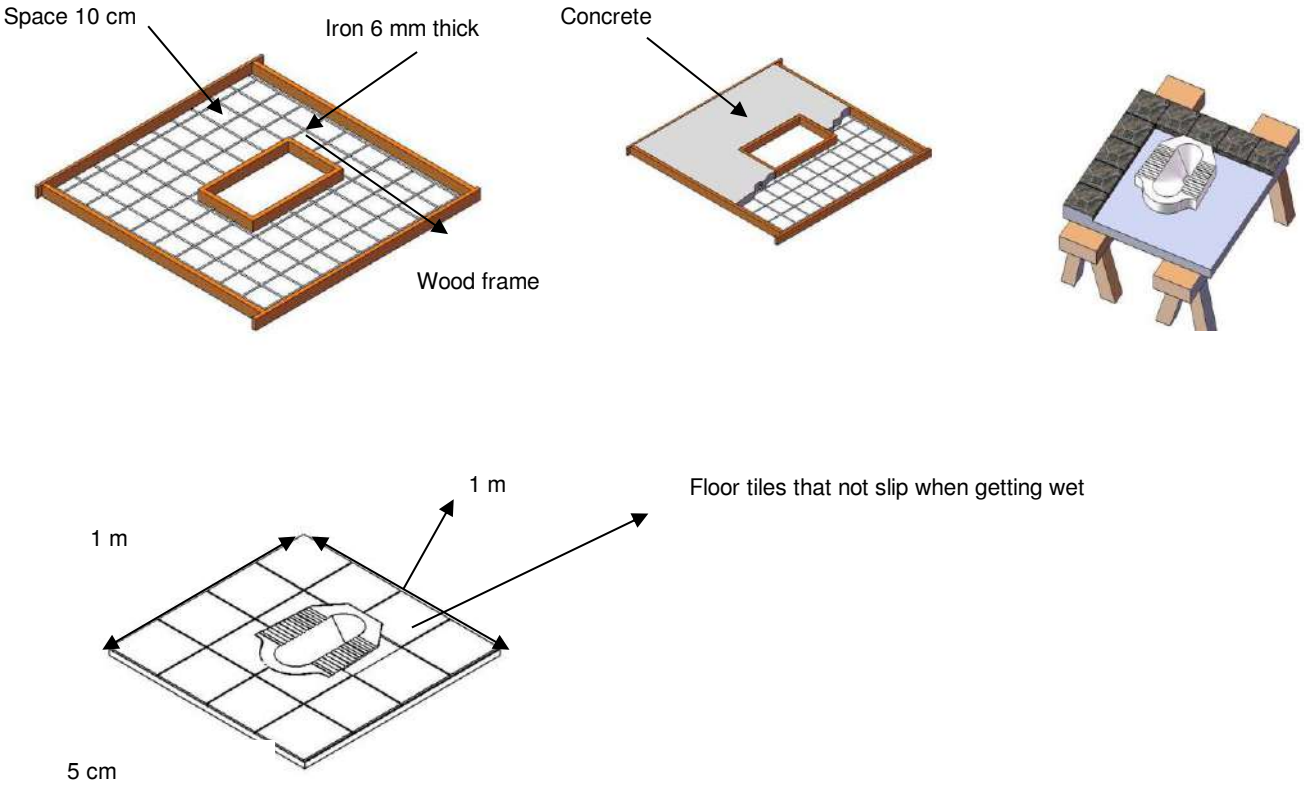


Figure 6 – Production of latrine slab

v. Distance for toilet installation

It is suggested that toilets should be built near the home (for convenience) but at least 20 meters away from drinking water sources such as wells, rivers, and ponds (Figure 7).

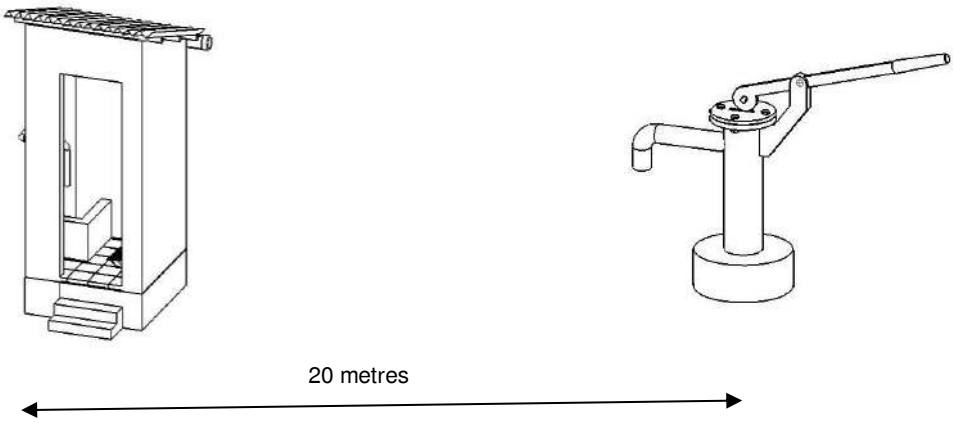


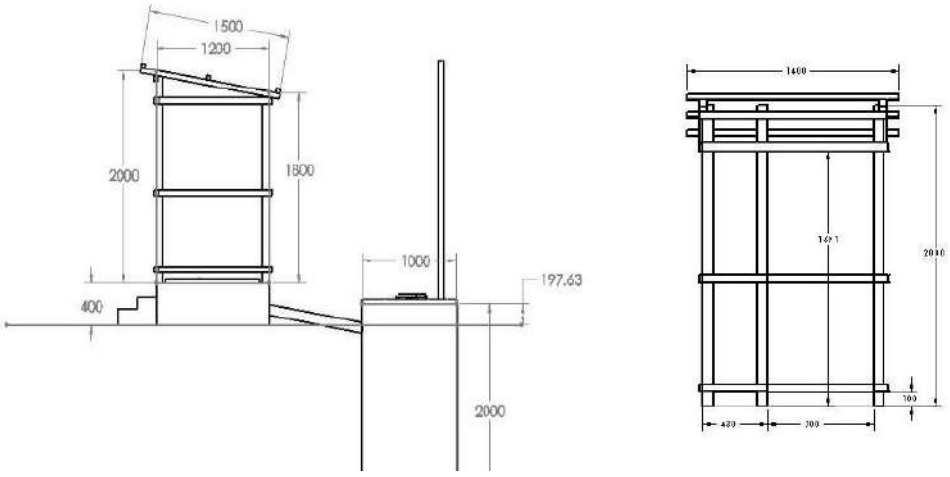
Figure 7 – Minimum distance between latrine and water supply

IV. Special designs

Various designs and options may be appropriate for some geographical areas and customer demands – and these are presented in more detail in this section.

i. Toilets on mainland with high speed water absorption (permeability soil)

The toilet has a storage tank and there are 4 rings in one pit. It can be filled with water once there is high water level, such as in the rainy season, so we take the water out when the to re-use the toilet (see picture below). This type of latrine is constructed for a rocky type soil.



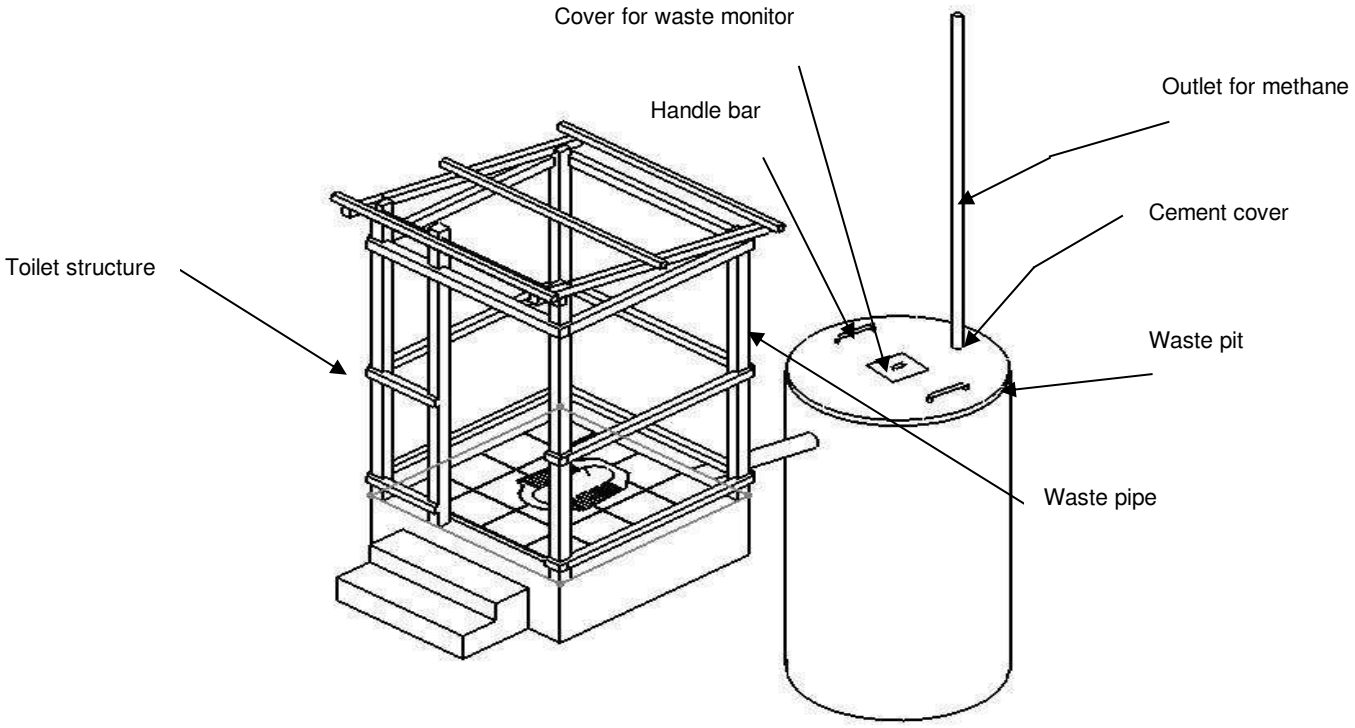


Figure 8 – Latrine design suitable for soils with high permeability

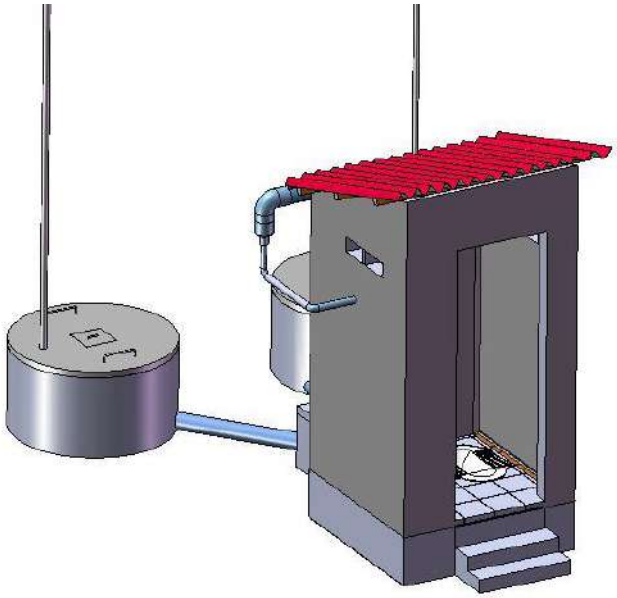


Figure 9 – Alternating twin pit latrine structure reduces difficulties of emptying pits full of sludge

ii. Toilets on mainland with slow speed water absorption (Underground contains stone)

Toilet has one or two pits. There is a pipe for releasing wastewater when it fills without pumping. This type of toilet can be built in soils that are quick or slow to absorb water.

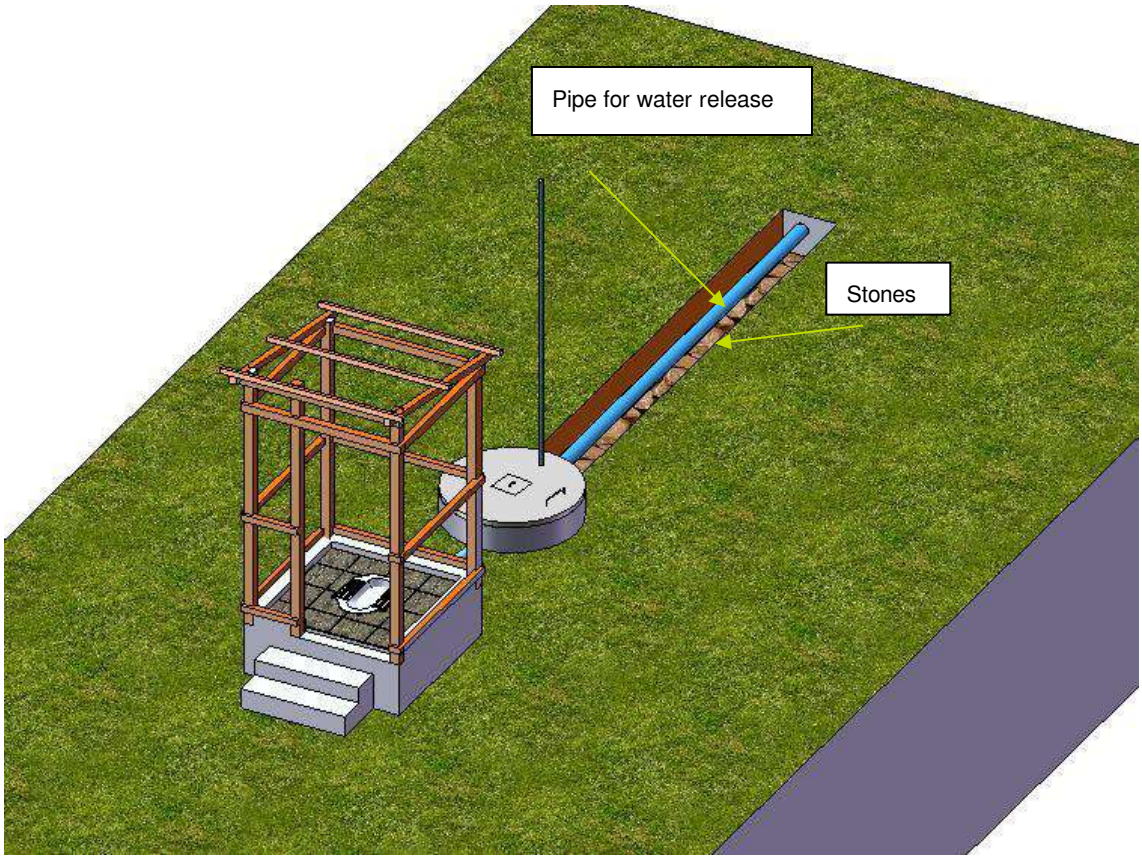


Figure 10 – underground prolonged-pipe and grounded stone for seepage of water from the ring that reduces sludge full empty difficulty

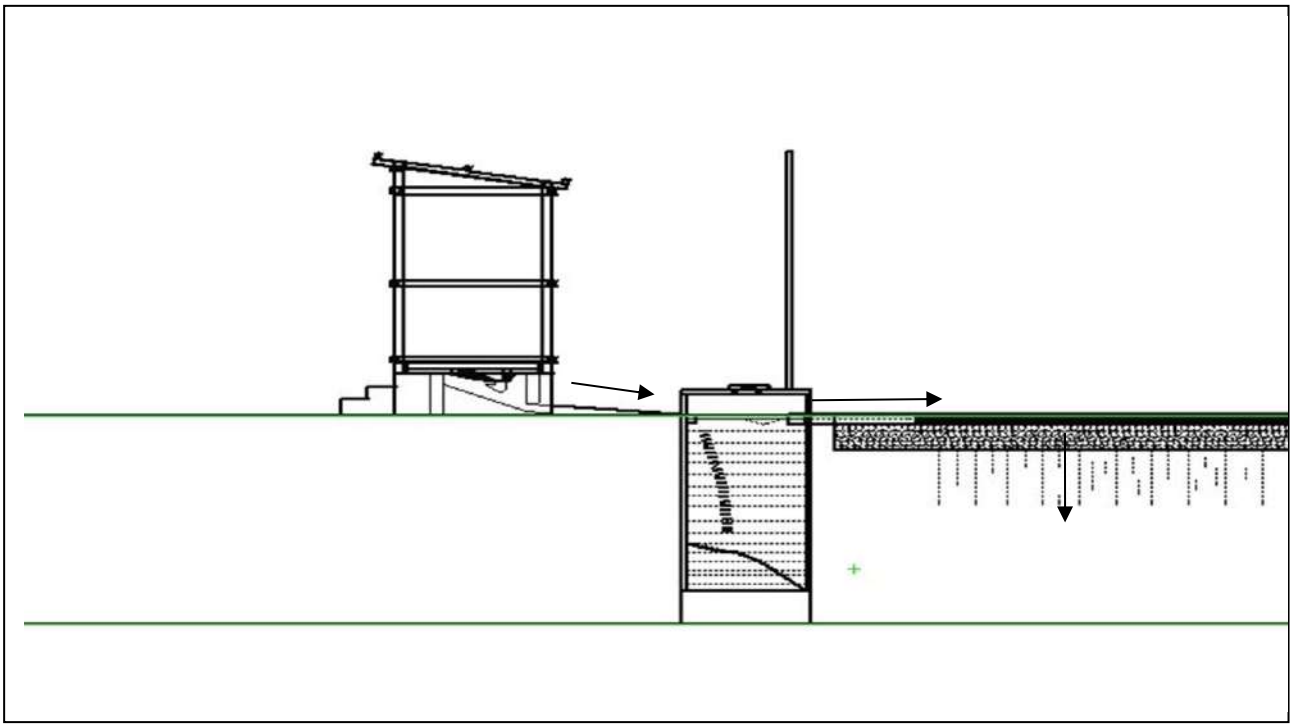


Figure 11 – Underground pipe and gravel for seepage of wastewater

iii. Alternating twin-pit latrine

This type of toilet is built on land, but it has twin storage pits for alternating use. It has the advantage that faecal sludge can be managed safely and the household can produce fertilizer from human waste that is safe to use. Only one of the two pits is used at a time. When the first pit (Pit A) is fully filled, then the user changes the direction of flow inside the control box so that the toilet flows to Pit B. Then the faecal sludge in Pit A is left inside the pit for at least 1 year. After this time, the sludge should be dewatered and can be used for fertilizer. The fertilizer will be much safer because most of the pathogens will be dead. This design is suitable for areas where the groundwater table is lower than the pit.

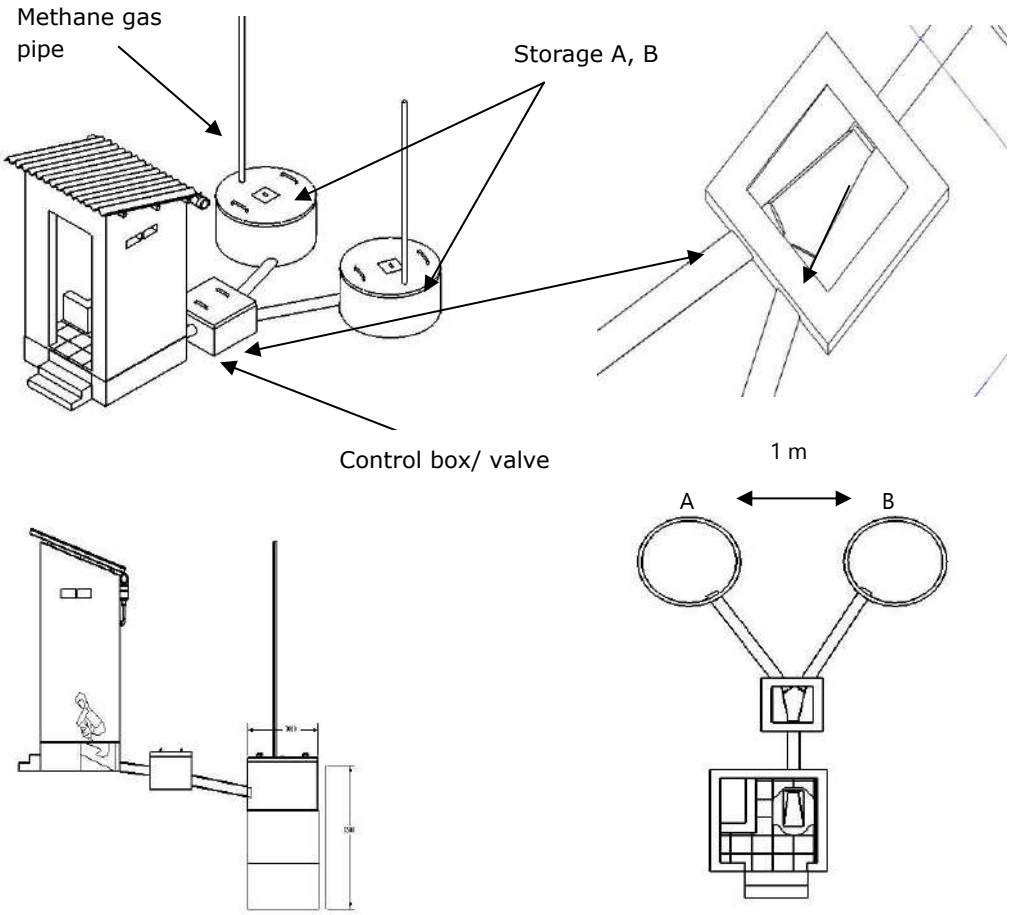


Figure 12 – Alternating twin pit configuration

iv. Toilets in flooded areas

Toilets constructed in flooded areas need to be designed so that their contents will not escape the pit during floods. Pits must therefore be extended above the ground level, and the toilets themselves must be elevated even higher than the pits so that they can continue to gravity feed into the pits.

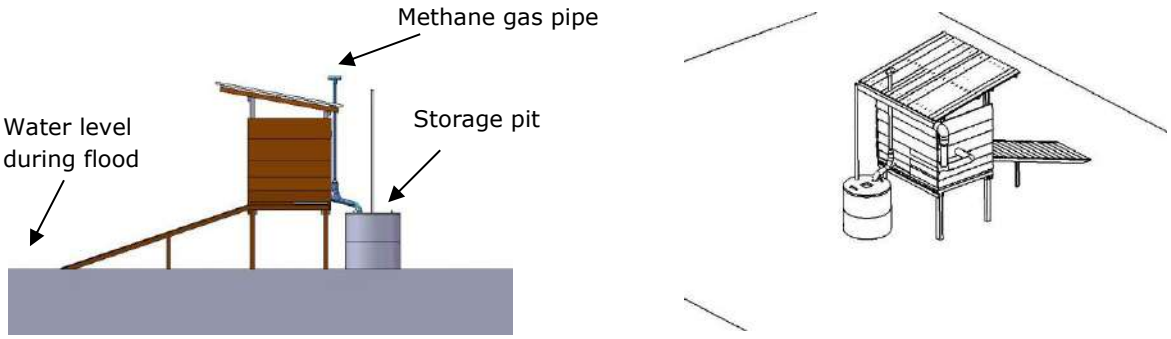


Figure 13 – Toilet design for flood-prone areas

v. Toilet for those with mobility issues

Those with restricted mobility (i.e. children, elderly, those using a wheelchair, those with physical disabilities) often struggle to use typical latrines. Ramps, handrails, and lighting may be features that can improve accessibility to such persons (Figure 14).

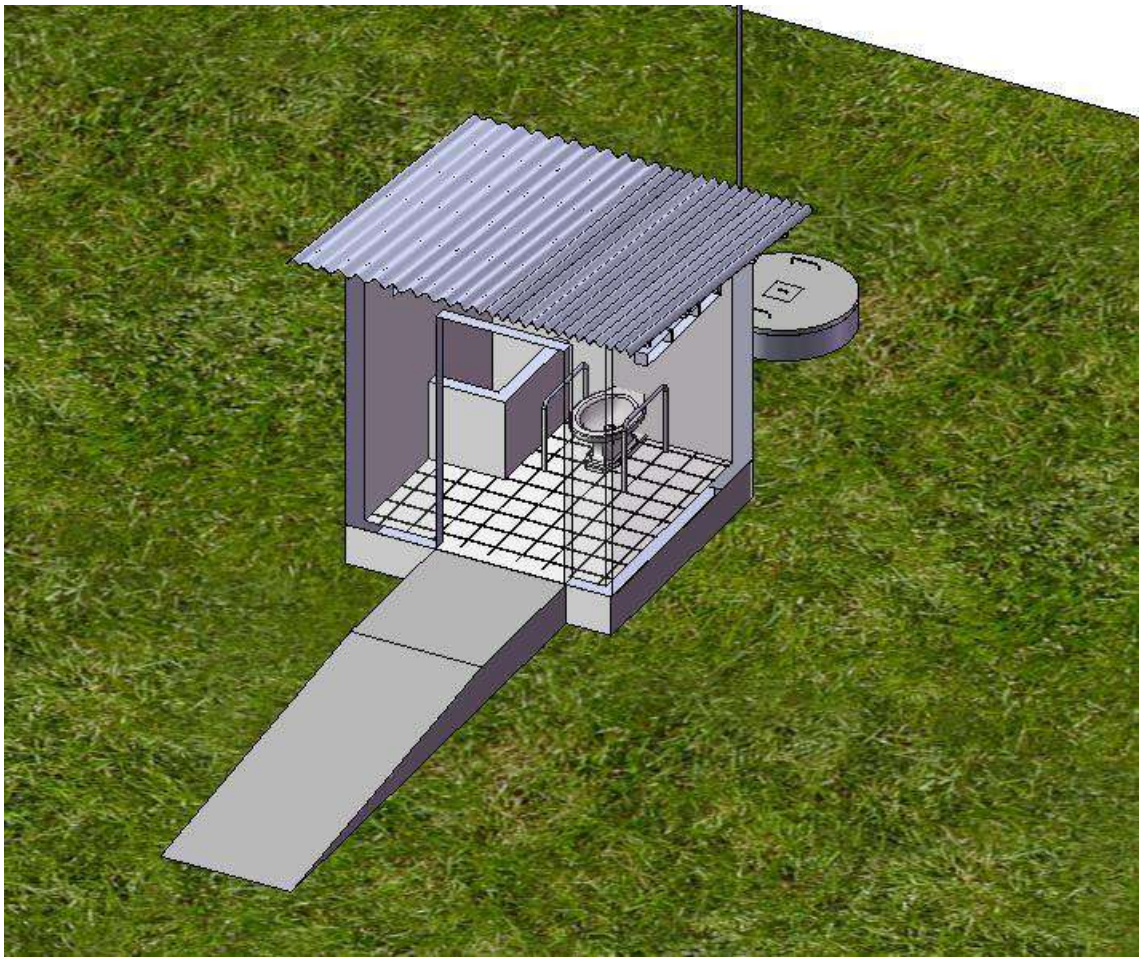
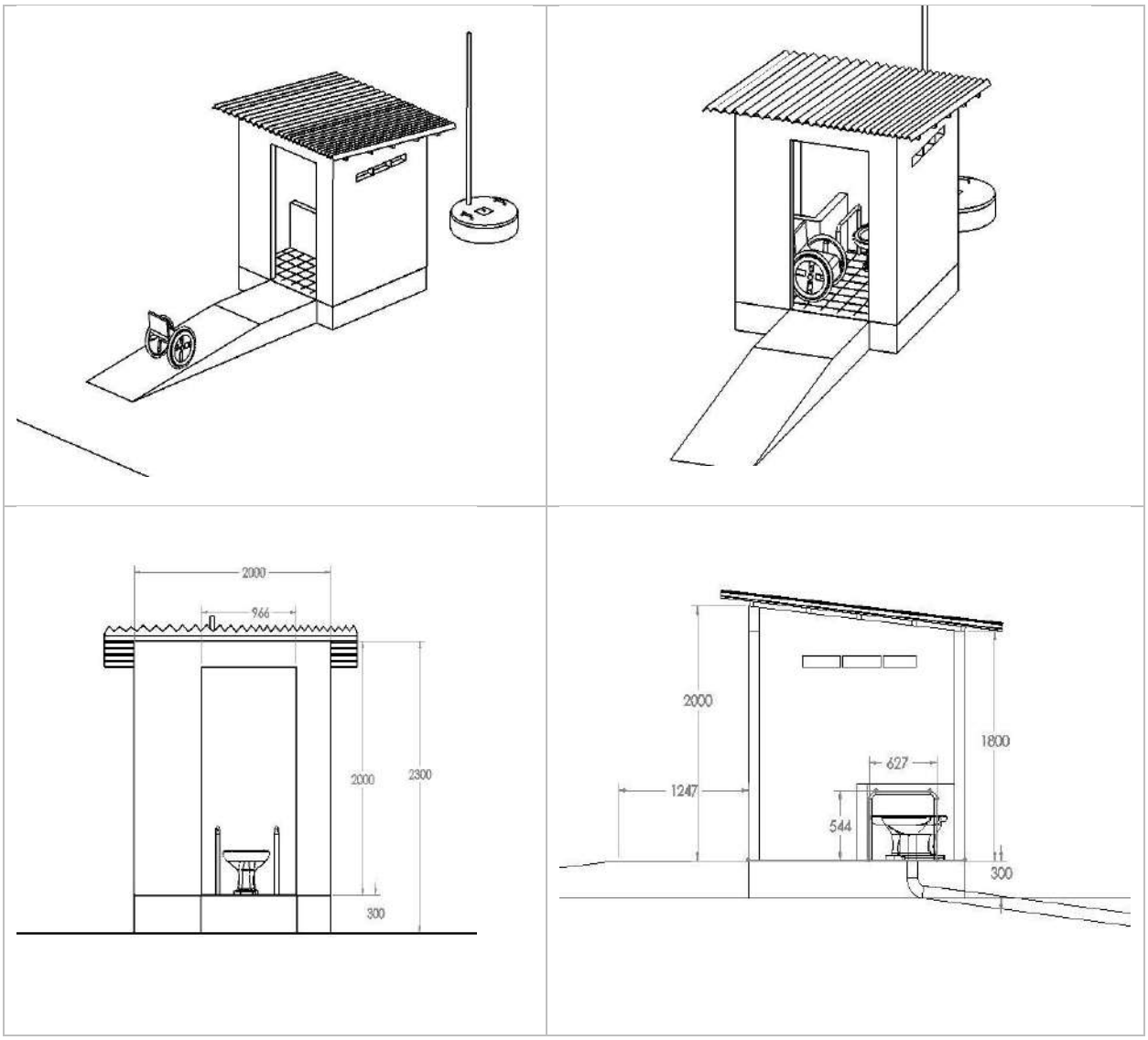
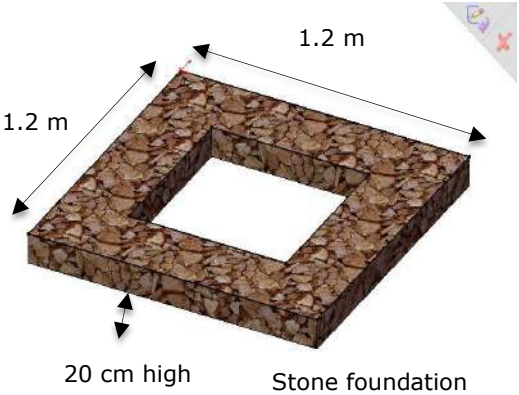


Figure 14 – Toilet for those with mobility issue



v. Toilet foundation construction procedure

This section details how the foundation of the latrine superstructure can be constructed.



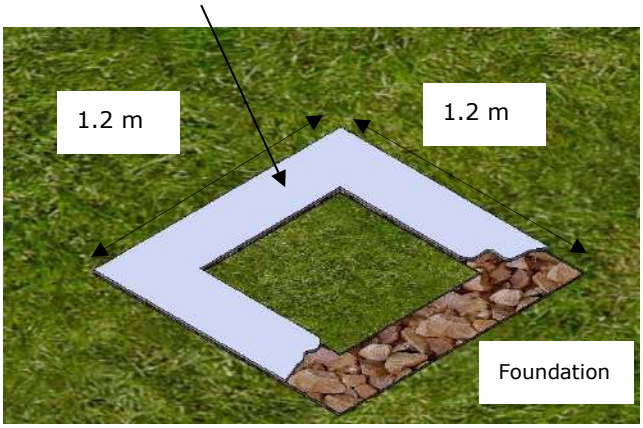
Step 1: The foundation must be grounded in strong and firm soil, and then firmly grounded soil for strong foundation before putting arranging brick wall.

Note: There are two types of toilet foundation

Option 1 – Brick foundation

A firm foundation is first needed to protect the double wall bricks or brick 20x (See picture)

Stone mixed with cement



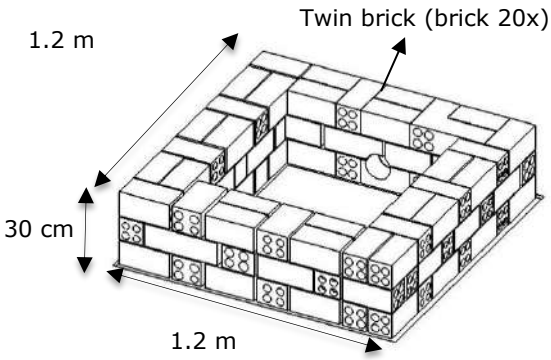
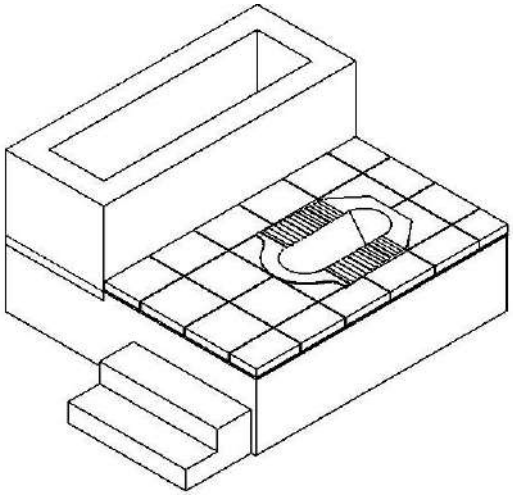
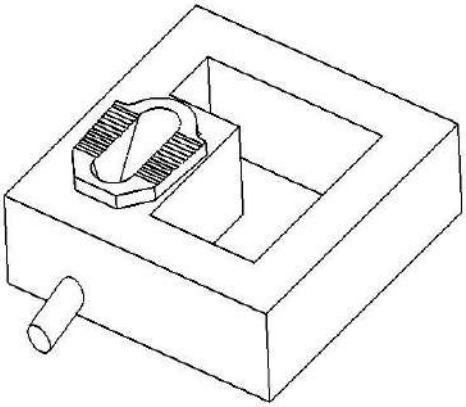


Figure 15 – Double-layer foundation design





Option 2: Toilet is made of thatched or zincs wall which is cheaper than option 1 but later can be upgraded to brick which require foundation of 10 cm deep, 120 cm width and 120 cm long. Later on the mixed stone put into the pit with cement. (See pictures)

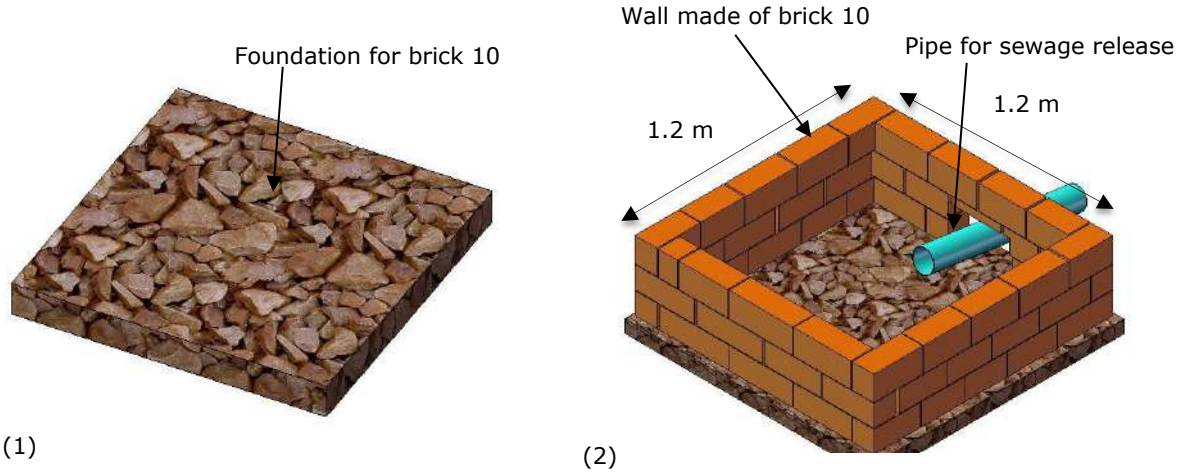


Figure 16 – Single-layer foundation design

Step 2: The chamber box must fit inside the foundation prepared in Step 1. Inside the chamber box, 2 cm of cement should be used to slope the top of the box down to the exit tube (so that waste exits by gravity) as shown in Figure 17.

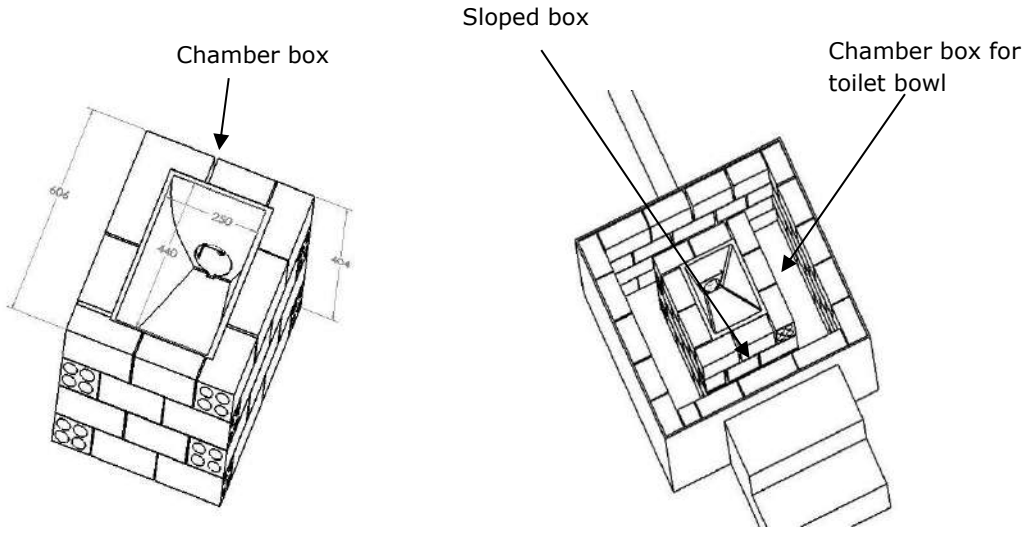


Figure 17 – Chamber box design

Step 3: Connecting the toilet bowl with the chamber box

When connecting the chamber box to the toilet bowl, the space between exit tube of the squat pan (bulb) and the slope of the chamber box should be 10 cm. This gap is required to make sure that that stools can easily flow out and the water used for flushing can be minimized.

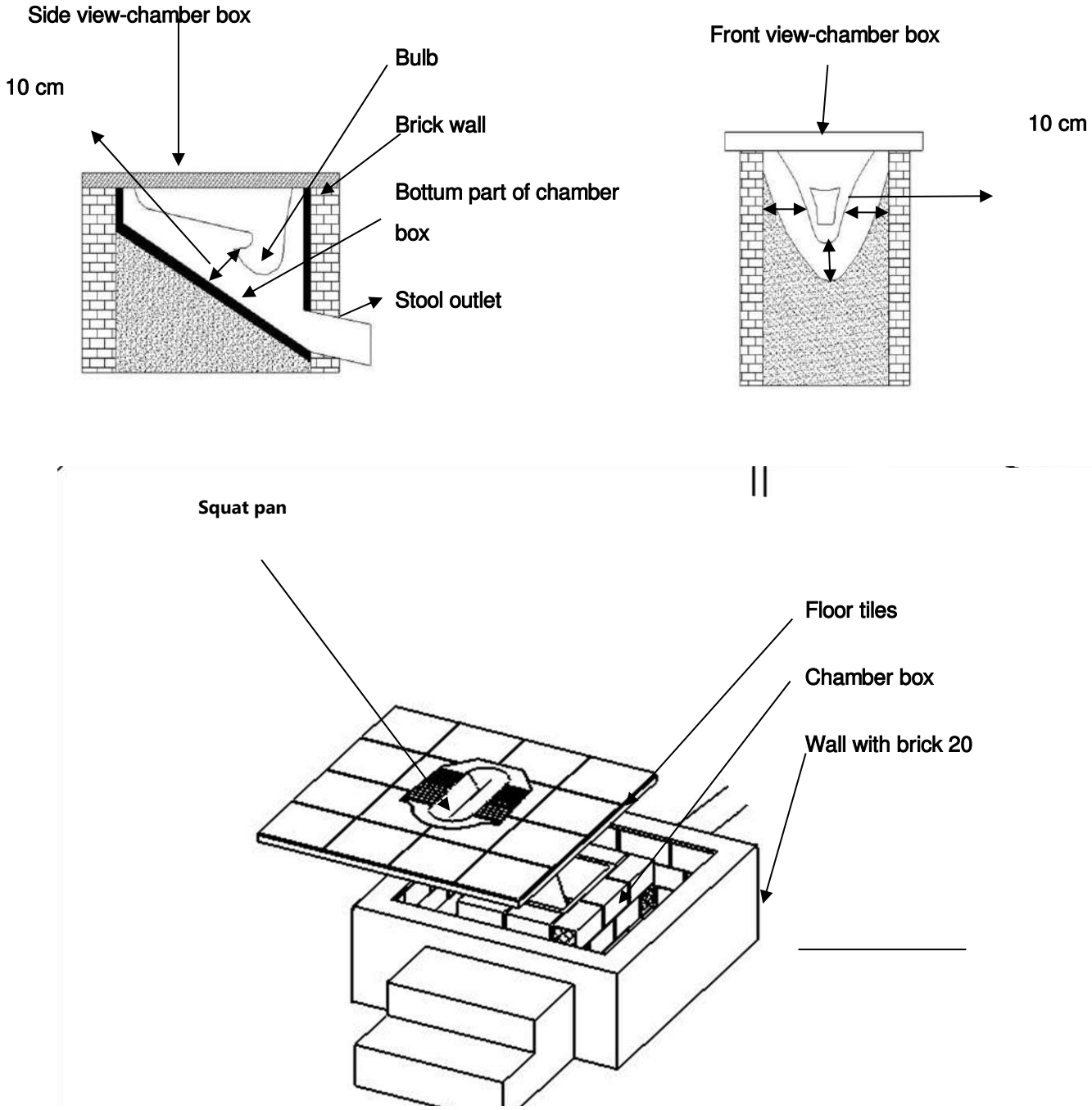


Figure 18 – Chamber box and toilet bowl connection

Step 4: Stool pit

The pit should be larger than the toilet rings to facilitate the placement of the rings into the pit (Figure 19). Before adding the rings to the pit, the bottom part of the pit should be covered with sand or stone to about 20 cm. The first ring needs to be balanced at the bottom of the pit before adding additional rings. Once in place, the area between the pit and the rings should be back-filled with coarse sand and/or stone.

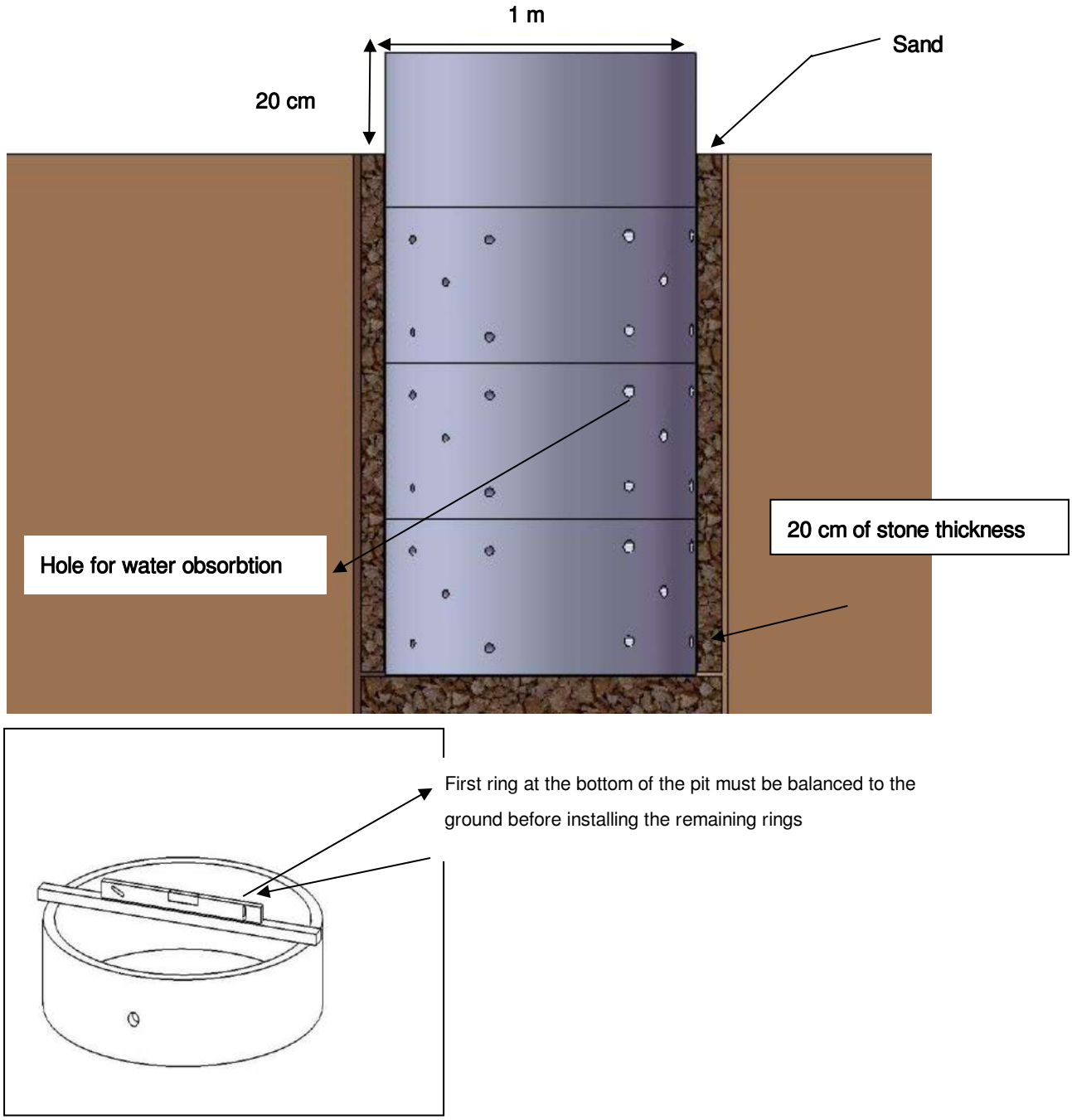
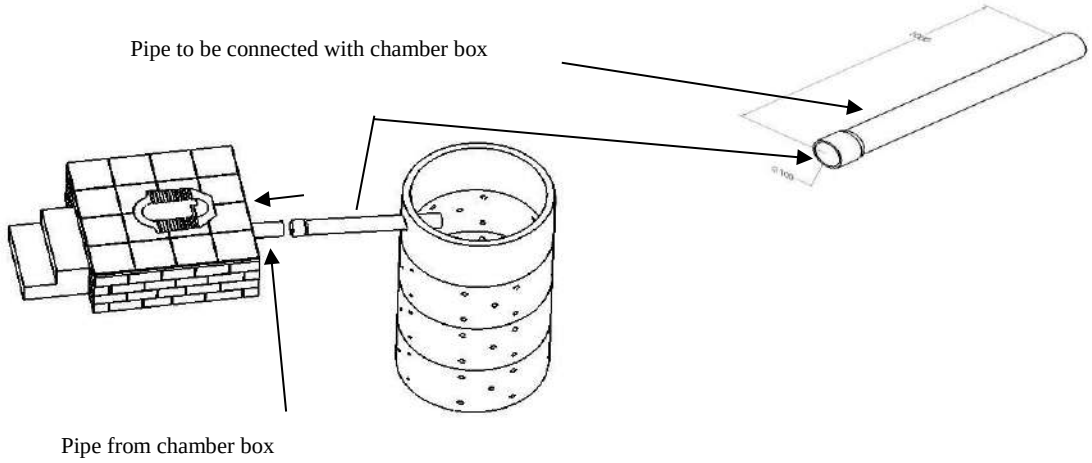
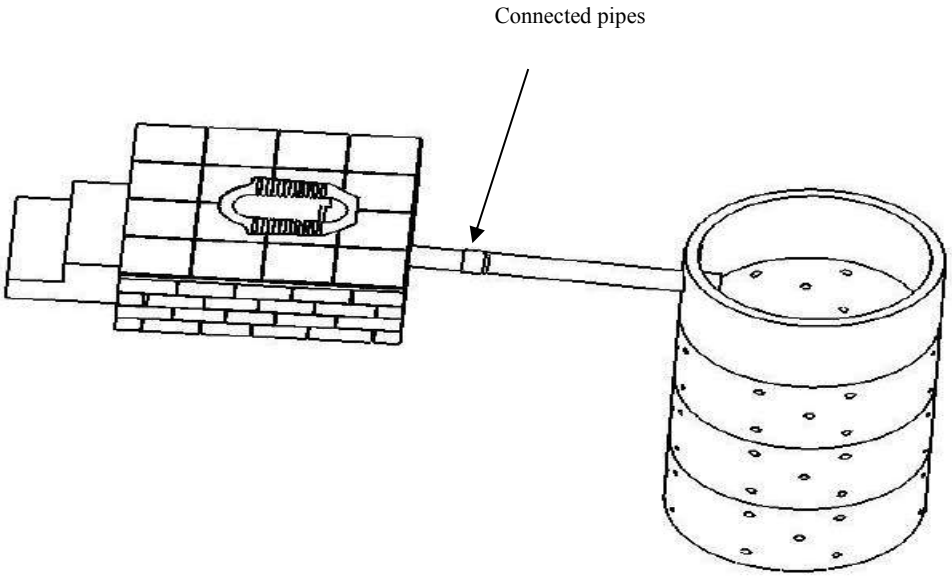


Figure 19 – Chamber box and toilet bowl connection

Step 5: Connecting pipes from chamber box to the pit





V. Toilet maintenance

Inside the toilet, there must be enough water and cleaning materials and equipment for maintaining a clean and sanitary environment at all times. These materials and equipment are shown in Figure 20.

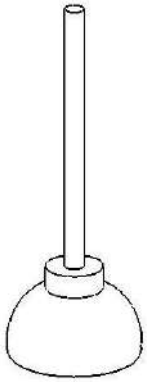
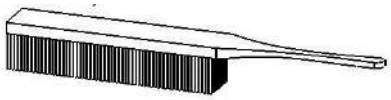
A. Long-handed toilet brush 	B. Plunger 
C. Brush 	D. Bleach toilet cleaner 

Figure 20 – Cleaning and maintenance materials and equipment

These are mostly use for daily cleansing the toilet especially the long-handed toilet brush and brush; while, the plunger will be used when the toilet is blocked.

VI. Additional notes for all masons, latrine constructors, and users to be aware of:

Note 1: Underground water level
The underground aquifer must be more than 2 meters below the bottom of the pit to help reduce the spread of viruses into the water. Otherwise, faecal sludge in the pit may spread throughout the environment and could cause health problems for people, especially in areas where shallow wells are used as sources of water (MRD 2010).

Note 2: Production of quality rings
When making rings you have to make sure: 1. Steel reinforcement shall be wrapped in a frame wall of three rounds of at least 6 mm vertical and at least 8-12 steels combine around the walls. The two metal circles should be put on top and the bottom be 5 cm from the top and bottom of the edge of the ring. 2. Concrete mixing should be proportional to 1: 2: 4 (1 cement, 2 sand, 4 stone).
What is proportion 1:2:4 stand for? This stands for the proportion of cement, sand and stones mixed together to ensure optimum strength. This means cement 1 proportion, sand 2 proportion, and stone 4 proportion. For example, if we use 10 liters of cement, we need to use 20 liters of sand and 40 liters of stones.
3. Use sufficient water to make the mixture liquid. 4. Avoid poor-quality cement. 5. When placing concrete in a mound, put only 10cm of concrete at a time and compress before adding more concrete. 6. The mound can be removed after 24 hours, but it is best to wait 3 days before removing the mound. Rings should remain in the same location to dry for at least 3 days. 7. When removing cement molds, leave the rings in the shade for at least 1 week and wet them with water to prevent them from cracking. After making them wet, cover them with a wet sack to keep the moisture contained (MRD 2010).

Note 3: How to monitor the liquidity of the mixed concrete?

The correct amount of water in the cement mix is important because the incorrect amount of water use will weaken the concrete strength:

- If you use too little water, it will cause tiny air holes in the concrete mix.
- If there is too much water, the cement will come up to the surface of the concrete mixture when dry, resulting in a weakened concrete mix at the bottom (MRD 2010).

Note 4: Slab size for accessing by the disables

For disabled or mobility-impaired people, the latrine should be at least 92cm for those who carry a crutch or 150 cm for those that ride on a wheelchair. However, it is good practice to measure the particular wheelchair heights in advance to ensure that the minimum size recommended above is suitable and comfortable for the user because the wheelchairs may be different from one another. (Jones and Reed 2005)

VII. References

Jones, H. and B. Reed (2005). Water and sanitation for disabled people and other vulnerable groups: Designing services to improve accessibility, WEDC, Loughborough University.

MRD (2010). Guidelines on the National Household Latrine Construction Manual.

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