REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND FORESTRY

DEPARTMENT OF WATER AFFAIRS and FORESTRY

SELF-BUILD MANUAL FOR VENTILATED PIT LATRINES

Revision: 2

Date: 15 September 2011

PREFACE

Sanitation plays a pivotal role in economic development of Namibia because increasing the coverage of improved sanitation facilities will contribute significantly to the health of the population which in turn drives the nation's economy. The Namibia National Sanitation Strategy for 2010 to 2015 has been developed, setting out a course of actions and activities for the implementation of sanitation in a coordinated manner.

As this strategy was developed through a comprehensive consultation process with various partners and stakeholders, the previous uncoordinated approach to sanitation implementation experienced in the past has already improved through initiatives that have brought about a more uniform, consistent and higher quality approach. The major investment in sector capacity building and development that is needed to enhance the delivery of the implementation programme will in turn support the achievement of Vision 2030 and the WATSAN Millennium Development Goals.

A series of Sanitation Codes of Practice have been developed to give further guidance on the planning and implementation of alternative types of sanitation facilities. The additional Sanitation Codes of Practice have filled the gaps in the existing Water Supply and Sanitation Codes of Practice that have been developed over the past two years by the Directorate of Resource Management within the Department of Water Affairs and Forestry of the Ministry of Agriculture, Water and Forestry. The most updated list is given below:

Volume No.	Description	Originator*
1	Septic Tank Systems	DRM
2	Pond Systems	DRM
3	Biological Filtration Systems (Trickling Filters)	DRM
4	Biological Treatment Activated Sludge Processes	DRM
5	Bottled Water: Bottled Natural Waters; Processed Water; Mineral Water; Carbonated Water; Flavoured Water	DRM
6	Wastewater Re-use: Greywater, Reclaimed Domestic Effluent; Industrial Effluent	DRM
7	Disposal of Water and Wastewater Solids	DRM
8*	Dry Sanitation Systems	DWSSC
9*	Wet Sanitation Collection, Conveyance and Treatment Systems	DWSSC
10*	Re-use of Sanitation Waste Products	DWSSC

* - It is recommended that Codes of Practice 8 to 10 should be used together because of the close links between them all.

- DRM – Directorate of Resource Management
- DWSSC – Directorate of Water Supply and Sanitation Coordination

It is intended that the Codes of Practice will become obligatory for Ministries, Regional and Local Authorities, Communities, Private and Non-Government Organisations and Donors to follow to achieve the initiatives set out in the five year National Sanitation Strategy.

TABLE OF CONTENTS

Page

DEFINITIONS

General:

Aerobic treatment:	Treatment of wastewater with the help of micro-organisms that rely on oxygen;
Disposal:	Discharge, deposition or dumping of any liquid or solid waste onto land or water so that it may enter the environment;
Dry Sanitation:	Disposal of human excreta without the use of water for flushing;
Excreta:	Faeces and urine;
Groundwater:	Any water resource within the bedrock, below the surface of the ground;
Liner:	Layer of impenetrable material/sheeting placed in a waste collection pit to prevent infiltration of waste into the ground. May be made of building construction materials, synthetic materials, or a combination thereof;
Pathogens:	Micro-organisms such as bacteria, viruses and protozoa that cause disease;
Pit latrine:	A form of sanitation facility with a pit for accumulation and decomposition of excreta from which liquid can infiltrate into the surrounding soil;
Sanitation Facilities:	Interventions (usually construction of facilities such as latrines) that improve the management of excreta and promote sanitary (healthy) conditions;
Soak pit/Soak-away:	A pit usually situated to receive effluent from a septic tank, and designed so that the effluent slowly seeps into the ground through perforated sides and bottom;
Superstructure:	Screen or building enclosing latrine to provide privacy and protection for users;
Ventilation pipe:	A pipe that facilitates the escape of gases and odours from a latrine or septic tank;
VIP:	Ventilated Improved Pit latrine = dry latrine system with dark interior and screened vent pipe to reduce odour and fly nuisance;
VIDP:	Ventilated Improved Double Pit Latrine = dry latrine system identical to VIP, except with two collection pits;
Water resource:	Includes a watercourse, an aquifer, the sea and meteoric water

1. INTRODUCTION

This manual is intended for those who wish to build their own Ventilated Improved Double Pit (VIDP) latrine, with step-by-step descriptions on how to accomplish this. It should be noted that this document only provides information on how to build a VIDP. Expert advice should still be sought, especially before any large-scale or more complicated sanitation facilities are built and installed. This self-build manual should be read in conjunction with Code of Practice Volume 8: Dry Sanitation Systems. It is recommended that Volume 8 should be examined in detail before making any decisions regarding the choice of sanitation technology for any particular locality or circumstances.

In Namibia, a significant number of people living in the rural communal areas still have no access to improved sanitation facilities and often have no other option but to practice open defecation. A situation report that was prepared as part of the development of a five-year National Strategy for Sanitation in Namibia (Italtrend, 2009) revealed that 67% of the population living in rural areas do not have access to improved sanitation and practice open defecation. Widespread evidence exists of the causal links between lack of safe sanitation and public health problems including diseases such as diarrhea, typhoid, giardiasis and cholera, amongst others. In addition, poor sanitation has a negative impact on the environment, in particular causing contamination of water sources particularly at times of flooding. Such contamination in turn increases the risk of disease for people who use this water untreated, especially in informal urban communities where population densities are high. With water availability in Namibia already limited, it is imperative that available water sources are protected and used wisely. It is thus important that the available water resources are managed and protected in such a way as to achieve sustainable water supplies for the future.

Possible risks and hazards related to poor sanitation and hygiene include:

- Water-borne diseases such as diarrhea and cholera, etc;
- Diseases caused by helminth eggs, bacterial spores, and/or protozoa infections;
- Aesthetic issues like odour pollution and attraction of flies, due to improper waste management;
- Environmental issues including groundwater contamination, endangering of marine life and pollution of water bodies used for recreational purposes;

To minimise the risks mentioned above, proper awareness about the dangers of poor sanitation must be communicated through community health promotion campaigns and improved household hygiene practices are encouraged. Access to hand washing facilities must be obligatory for all recommended dry sanitation system designs.

It is often believed that good sanitation is synonymous with water-borne (wet) sanitation. This is not the case and even highly developed countries with an abundance of fresh water such as Norway and Sweden are now increasingly implementing dry sanitation systems (Jenssen, 2005). However, effective sanitation should focus not only on infrastructure but also on human hygiene behaviour change through health promotion to ensure long-term improvement and protection of public health. Water-borne systems require large capital investment, a reliable supply of water and a high level of expertise for operation and maintenance.

Capital investment for water-borne collection, conveyance and treatment systems can range from N$ 30,000 to N$ 80,000 per household connection (based on 2011 estimates, capital investment) depending on circumstances compared with a range of N$ 3,000 to N$ 8,000 per household connection (based on 2011 estimates, capital investment) for dry sanitation facilities. In addition, community water-borne systems take a long time to implement and are often not the most suitable technology option offering a sustainable solution for either urban but more especially rural agricultural communities in Namibia. In the urban context, a combination of wet and upgradable dry sanitation technologies are often the most practical and economically sustainable solution for Namibian circumstances.

In addition to promoting access to acceptable sanitation facilities, the need to ensure that such facilities are durable, affordable and within the operation and maintenance capabilities of the local authorities is of utmost importance. In areas where water availability and/or resources for operation and maintenance are limited, various dry sanitation options can be considered to provide a viable solution for the provision of safe and effective sanitation. The use of such dry sanitation systems must provide a high level of human dignity, as well as prevent adverse effects on public health and the environment. Globally, awareness about the need to provide safe, healthy and affordable sanitation is increasing with initiatives such as the Water, Sanitation and Hygiene Programme funded by the Bill and Melinda Gates Foundation investing vast resources in the development of effective solutions to try to address global sanitation issues (Bill and Melinda Gates Foundation, 2011).

Throughout the guideline, the term “waste” does not exclude the possibility of re-use of residual material.

2. TECHNICAL REVIEW

The technical description of dry sanitation systems is contained in Code of Practice Volume 8: Dry Sanitation Systems. Only if, after reading above document, the reader comes to the conclusion that a ventilated pit latrine is the preferred option, is this self-build guide to be used as a guide on how to build a VIDP. Special precautions should be taken to ensure that the conditions are suitable for VIDP toilets, with emphasis on soil infiltration (section 2.2 of Volume 8: Dry Sanitation Systems) and groundwater protection. The technical description of the VIDP Latrine as contained in Volume 8 is repeated here for convenience.

2.1 VIDP Latrine (Ventilated Improved Double Pit Latrine)

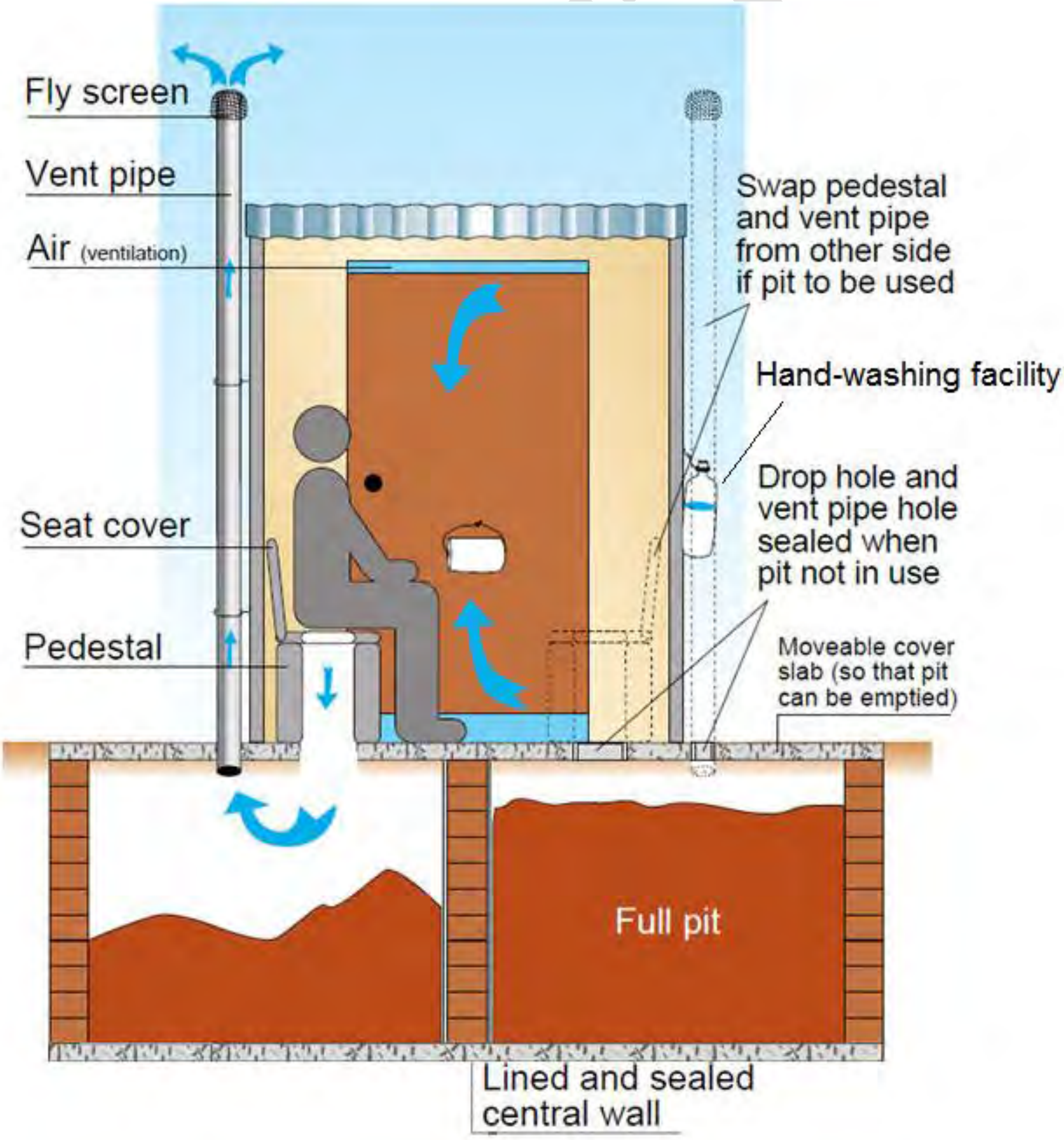


Figure 1: VIDP Latrine System (National Sanitation Task Team, 2002)

2.2.1 System Description

VIDP systems are a development of the original VIP system and have been used successfully on a global scale in urban and peri-urban areas (see Figure 1). The toilet consists of two pits dug either mechanically or by hand above which the toilet hut is situated. A ventilation pipe that leads from the pit to above the roof of the hut allows odours to escape and minimises the attraction of flies. The ventilation pipe also allows air currents to flow through the pit, thereby allowing waste to dry quicker. The effectiveness of the pipe can be increased by painting it black. This will cause a temperature difference between the air in the pipe and its surroundings, which will lead to induced air currents. A fly screen at the top of the ventilation pipe will prevent flies and other insects from entering or exiting the pit. VIDP toilet systems generally require a concrete slab to be placed on top of the pits so that the hut structure has a solid foundation on which to stand on. The toilet itself can consist of a raised pedestal or a squat pan.

VIDP systems are very flexible and can be built with many different modifications and additions, according to the user's preferences and resource availability. For example, urine diversion toilets can be installed if re-use of urine is desired. Sanitation waste re-use is discussed in more detail in Code of Practice Volume 10 (DAWF, 2011). This would decrease the volume of waste entering the pit and would therefore extend the system's life before cleaning is required.

The VIDP system has two pits so that whilst one pit is in use, the contents of the other pit can dry and degrade to produce sanitised humus, which can then be re-used for composting purposes. Dry faeces can easily be identified as an odourless, flaky and soil-like material. A double-pit system will in effect function like a composting toilet (see Code of Practice 8 (DWAF, 2011). If there is no demand for re-use of waste products for composting purposes, the pit contents can be emptied and disposed of so that the pit can be used again. Alternatively, a full pit can be covered with earth and a new pit then dug. Hand-washing facilities should always form part of the system, irrespective of what other additions or modifications to the system are made.

2.2.2 Advantages and Disadvantages

The advantages of VIDP toilet systems are as follows:

- VIDP toilets do not need water for flushing. Water, a scarce natural resource in Namibia, is therefore preserved;
- VIDP toilets are simple to construct and can be built and repaired with locally available materials. Units do not have to be purchased pre-manufactured and can be assembled using cheap materials that are freely available at the envisaged site. Also, top structures can be constructed in such a way as to blend into the environment or to blend in with the local architecture;
- Capital and operation costs are relatively low. The only operating cost incurred with VIDP toilet systems is to empty the pit when full. The emptying process needs to be done mechanically and the waste transported to a suitable treatment or disposal site;

VIDP latrines can be fitted with any type of user interface such as a raised pedestal or a squat pan and any form of anal cleansing can be used.

The disadvantages of VIDP toilet systems are as follows:

- The fact that waste is collected in the pit and accumulates over time means that the excreta pile will be visible when the toilet seat is lifted, except where a very deep pit is used;
- Unpleasant odours will normally be present to some degree, even where ventilation shafts are installed;
- In areas where flooding can occur or where shallow rock is present, the pit must be built above ground. This structure needs to be water tight and will be much more costly to build. Figure 2 shows such a system, where a watertight pit is built above ground. It is essential that the VIDP is always built above the maximum flood line.
- In areas where the water table is high or where water resource contamination might occur, the pit must be lined to prevent leakage into the ground.

Figure 2: Fossa Alterna Toilets above Ground (Stagl, 2010)

2.2.3 Recommendations

It is highly recommended when installing a VIP, that wherever possible a double pit (VIDP) toilet system is designed. VIDP toilet systems are the most widely used dry sanitation system due to their simplicity. To save costs, households are encouraged to construct their own systems (or at least partially) with locally available materials as far as possible. When a pit is full it either needs to be emptied or another pit needs to be dug. Full pits can be left to dry out or can be used as a fertile site for the planting of a tree (ArborLoo concept). For more information the reader is referred to Morgan (2004).

In areas where flooding or groundwater contamination can occur it is strongly recommended that the pit is lined and raised above the maximum flood line because it represents a large source of point pollution. The maintenance required on VIDP systems is very limited. The toilet pedestal or pan will need to be cleaned regularly, but the pit itself requires no maintenance until it is full. Toilet users may not need to receive much special training with regards to toilet use (unlike, for example with urine diversion toilets) and therefore improper use of the toilet will not have adverse effects on the system.

Hand-washing facilities should always form part of the system, irrespective of which other additions or modifications to the system are made.

Since a full pit can represent a large source of point pollution, care must be taken when siting the VIDP to ensure that it is above the maximum flood line.

3. SELF-BUILD INSTRUCTIONS

3.1 The Pit

As mentioned previously, only pit latrines with two pits and a ventilation shaft are recommended. Deciding where to dig the two pits is a very important aspect when it comes to building a VIDP latrine. As a matter of principle, VIDPs should be built downstream of any water sources to avoid any likelihood of groundwater contamination. The VIDP should be at least 40 m away from any water sources. This minimum distance is, however, site specific and should be determined by a professional hydrogeologist. In addition, the pits should be at least 2 m above the water table to prevent fecal contamination of the groundwater. It is recommended that the pits are dug at least 6 m from the house to minimise odour nuisances inside the house.

The lifetime of a pit depends on the size of the pit as larger pits will allow excreta to accumulate over longer periods of time. Pits should be at least 1.5 m deep with vertical sides. Pits can be round, square or rectangular, depending on the construction capabilities of the builder. Round pits are usually more difficult to build but are much more structurally robust.

A volume of at least 0.1 cubic metres per person per annum for the anticipated usage lifetime of the toilet should be the minimum allocation used in the design. For example, if a family of ten people wishes to use a pit for 5 years the pit size would have to be at least as follows:

$$\text{Size } [m^3] = 10 \text{ [persons]} \times 5 \text{ [years]} \times 0.1 \text{ } [m^3/\text{person/year}] = 5 \text{ } m^3$$

In areas where there is loose, sandy soil or clay soil, the pits should be supported to prevent them from caving in. Even in stable soil, the top 0.5 m should be lined to support the floor of the superstructure.

In rocky areas or in areas where the water table is high, excavation of the pits to a depth of at least 1.5 m might be impossible or very difficult to achieve. In such cases the latrine can be built on a mound. This means that a mound of at least 1 m height needs to be built on top of which the latrine is then constructed. This means that the pit will need to be dug to at least 0.5 m below the normal ground level, as shown in Figure 4. The mound needs to be compacted to ensure stability so that the pit and toilet superstructure do not collapse over time. The pit should be fully lined with brick, stone or concrete masonry and this lining should be continued to the top of the mound to give stability. Steps should be built on the outside of the mound, leading from the normal ground level to the entrance of the superstructure. In areas where flooding is likely to occur, a mound will also prevent floodwater from entering the pit, thereby preventing contaminated surface water run-off.

Various different materials can be used to line the pits of a VIDP toilet. Materials such as bricks, stone rubble, masonry, concrete blocks, cement-stabilised soil blocks, perforated oil drums and rot-resistant timber can be used to stabilize the pit. The pit should be lined with a water-proof liner if the soil is unsuitable for wastewater infiltration. The top 0.5 m of the pit should be fully mortared if bricks, masonry, blocks or stones are used. Below this height, vertical joints should be left un-mortared to ensure that liquid excreta can infiltrate into the ground.

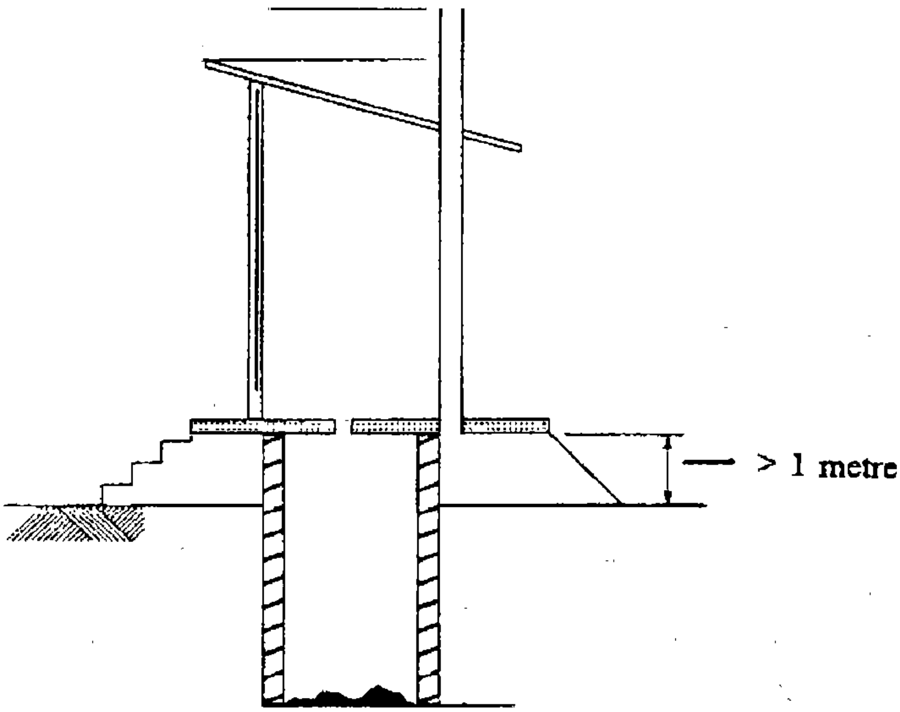


Figure 4: Mound-built Latrine (WHO, 1996)

3.2 The Base

In order to prevent the superstructure of the toilet from collapsing when the surrounding soil softens during rainy periods, a base or foundation needs to be built for the superstructure. This base should be at least 15 cm higher than the level of the ground surrounding the superstructure to prevent surface water from running into the pit. (Site specific conditions will determine the height).

The base can be constructed from concrete, brick or rough-cut logs. Figure 5 shows an example of how a base can be constructed. Note that the base can be round or square, depending on the shape of the pit.

Figure 5: Latrine Base or Foundation (WHO, 1996)

3.3 The Floor

The floor slab is required to support the toilet pedestal, or squatting plate, and the user while covering the pit. The slab rests on the base and must be larger than the pit to avoid the possibility of collapse. Materials used for the construction of the floor must be very sturdy so that it can easily support the weight of the toilet user. Materials such as concrete, rot-resistant wood or bamboo covered with a layer of mud and cement mortar can be used.

The opening in the floor should not be larger than 250 mm in diameter to prevent small children from falling into the pit. The squatting pan or toilet pedestal is then placed over the hole so that excreta can fall into the pit.

Below are instructions on how to make a simple floor slab from concrete (adapted from WHO, 1996):

- Dig a square, shallow pit, about 200 mm wider and longer than the pit and 50 mm deep. Be sure that the bottom of the pit is level and smooth (see Figure 6).

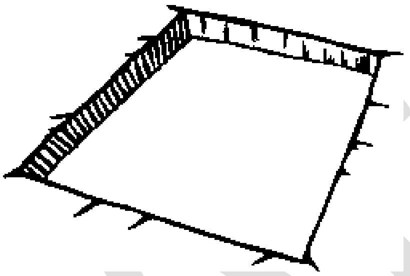


Figure 6: Pit for Cover Slab Casting (WHO, 1996)

- Make or cut a wire mesh or grid to lie inside the pit. The wires can be 6 to 9 mm thick and about 200 mm apart (see Figure 7). Cut a hole about 250 mm in diameter in the middle of the grid.

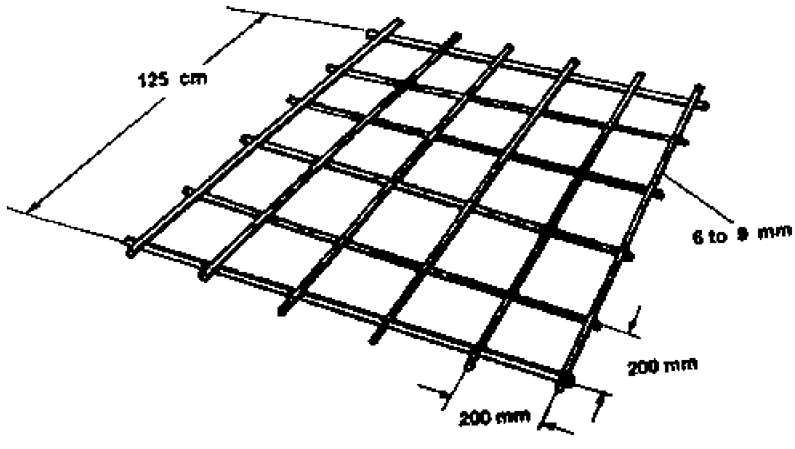


Figure 7: Reinforcement Grid (WHO, 1996)

- Put the grid in the pit. Bend the ends of the wires, or put a small stone at each corner, so that the grid stands about 20−30 mm off the bottom of the pit (see Figure 8).

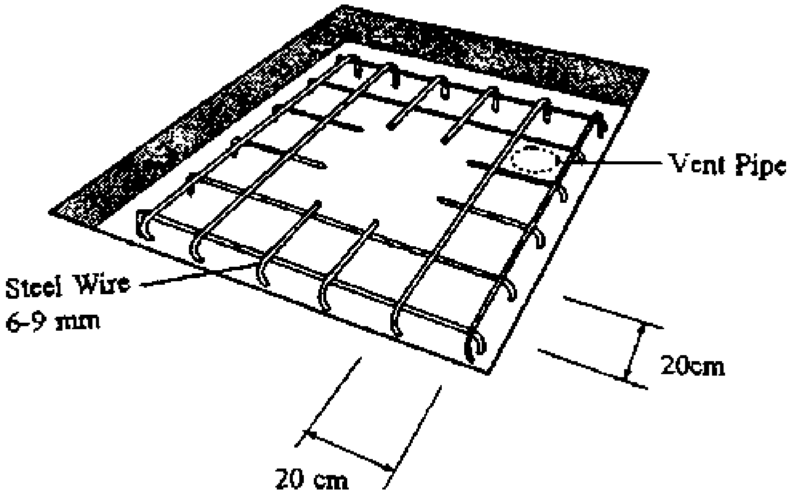


Figure 8: Place Grid in Pit (WHO, 1996)

- Put an old bucket or other round object with a bottom about 200 mm across or a template in the shape of a keyhole in the hole in the grid (see Figure 9). Where a raised toilet pedestal is used make sure that the size and position of the hole corresponds to the size of the opening at the bottom of the pedestal unit. Use at least a 100 mm pipe to make the hole for the ventilation pipe.

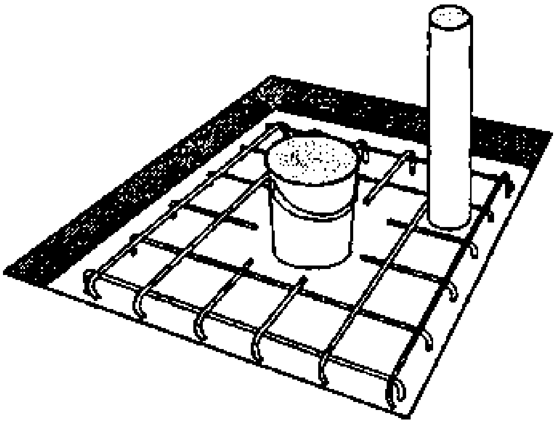


Figure 9: Making a Squat Hole (WHO, 1996)

- Mix cement with sand, gravel and water (with each shovel of cement, mix 2 shovels of sand and 4 shovels of gravel) mix well and pour it into the pit until it is about 50 mm thick (see Figure 10).

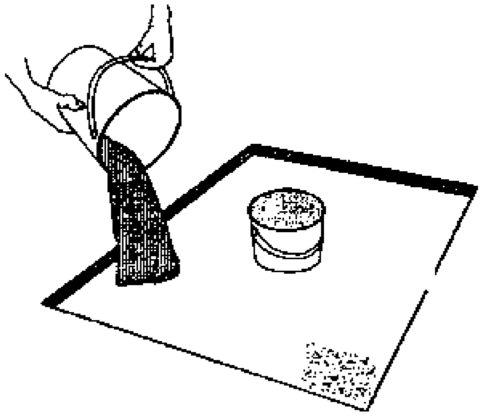


Figure 10: Pouring the Slab (WHO, 1996)

- Remove the bucket and pipe when the cement begins to harden (after about three hours). Then cover the cement with damp cloths, cement bags, sand, hay or a sheet of plastic and keep it damp. It is important that the cement is kept damp for five days to reach its full strength. Remove the slab after five days and place it over the base.

3.4 The Vent Pipe

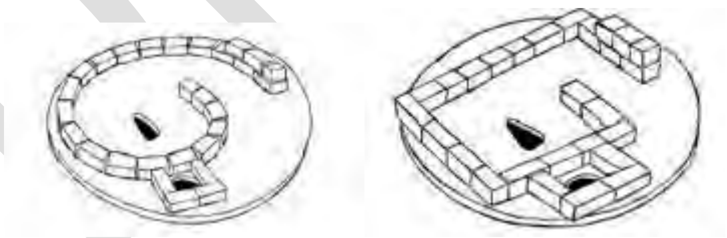
In order to provide sufficient ventilation in the pit so that the collected waste can dry out, as well as for removal of objectionable odours, a ventilation pipe needs to be installed with the latrine. This pipe should have a minimum diameter of 100 mm and should be dark-coloured so that it can heat up when receiving sunlight. This will enhance ventilation. The pipe can be made out of PVC or fibre-cement.

A fly screen should be fitted to the top of the screen to prevent insects from entering the pit. Aluminium, copper or stainless steel screens should be used with openings no smaller than 1.2 mm by 1.5 mm so that air circulation is not inhibited. It is important that the ventilation pipe extend at least 0.5 m above the superstructure to ensure that odours are carried away and do not cause a nuisance to the toilet users.

3.5 The Superstructure

The superstructure of the toilet provides the user with privacy and serves as protection from the elements. The structure can be made from any type of suitable material and must be placed on the floor of the latrine. To ensure sufficient ventilation and odour removal a gap of about 150 mm should be left between the structure walls and the roof. The roof should have a large overhang and should be sloped to prevent water damage to the mound and walls.

The structure does not necessarily need to have a door and can be built in such a way as to still provide privacy to the user even without a door. Figure 11 shows how the superstructure should be constructed to achieve this.



a) spiral b) square

Figure 11: Latrine Superstructure Configurations (No Door)

The superstructure can also be made from mud walls and thatch, bricks or blocks with a tin roof, a simple grass screen, ferro cement walls with thatch or tin roof or any other available material that is suitable. Figure 12 shows an example of how such a superstructure might look.

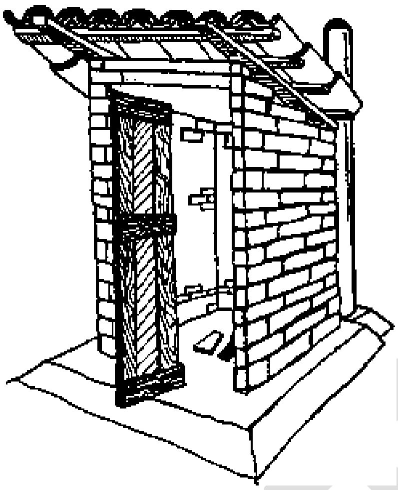


Figure 12: Example of Latrine Superstructure

3.6 Operation and Maintenance of a VIDP Latrine

VIDP toilets require very little maintenance and are very easy to use. The following aspects, however, need to be taken into consideration regarding the operation and maintenance of the latrine:

- The latrine should be kept clean and hygienic at all times. A toilet pedestal or squat pan that is soiled with excreta will cause users to avoid the latrine and is a health and hygiene hazard. The pedestal or squat pan must be cleaned daily using water or ashes.
- When one pit is full (0.5 m from the top) is must be filled with soil. As mentioned in section 2.2.3 it is highly recommended that only double pit systems are used. As soon as one pit is full it should be filled with soil and left to dry while the other one is in use.
- The pedestal or squat pan cover must be kept open to ensure that adequate air circulation can occur via the ventilation pipe.
- The fly screen should be checked regularly for damage and replaced if necessary. The screen should also be cleaned at least once a month by pouring water down the pipe from the top. This will ensure that cobwebs and dead flies are removed and the screen does not become blocked.
- The contents of the pits should be kept as dry as possible to prevent insect breeding. Addition of ash, saw dust or dry animal dung will help to absorb liquid.
- Non-degradable matter like plastic, tins and glass should not be deposited in the pit.

3. CONCLUSIONS

Water and sanitation availability in Namibia is very limited and many settlements are forced to make due without any sanitation facilities whatsoever. It is with this in mind that the construction of latrines for individual households by the users themselves is recommended. Interested parties can easily and cheaply build their own ventilated improved pit latrines so that they too can enjoy safe and hygienic sanitation.

The purpose of this document is to provide information for interested parties that wish to build their own VIP latrines. The document outlines a step-by-step approach to this process so that readers will be able to build their own VIPs without the need for professional construction resources.

It should be noted that this document should be seen as a guideline only and large-scale or more complicated installations should still be approved and performed by professionals.

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