TECHNICAL INSTRUCTIONS FOR HYGIENIC LATRINE CONSTRUCTION

Hoà Bình province, December 2014
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PART 1: INTRODUCTION

1. GENERAL INTRODUCTION OF THE LATRINE

1.1. UNTREATED FECES’ IMPACTS TO HUMAN HEALTH

Recent studies show that most superficial water resources in Vietnam are contaminated at microorganismal level, except for remote areas. Gastrointestinal diseases such as diarrhea, cholera, typhoid, dysentery, and parasitic infection are those with highest incidence among those common diseases, which are mainly related to water, sanitation and hygiene conditions.

It’s important to know that:

- 1 gram of human feces contains 10 million viruses, 1 million germs, 10 thousand parasitic cysts.
- Diarrhea, helminthiasis, skin and eye diseases are common illness caused by using unhygienic latrine.
- Nearly a half of Vietnamese children are infected with helminthiasis. 28 -31% children living in mountainous areas are stunted.
- Women and children are the most vulnerable if their families lack hygienic latrine
- For every 1 Dong invested in hygienic latrine, 9 Dongs can be saved from health, education and social costs.
- Children living in villages with 100% hygienic sanitation coverage will be taller, healthier and smarter

To join hands in the hygienic latrine construction and use is both right and responsibility of each individual towards the community and their children.

1.2. DEFINITION AND REQUIREMENTS OF A HYGIENIC LATRINE

1.2.1. PRINCIPLES OF HYGIENIC HUMAN FECES TREATMENT

The best human waste treatment is to use hygienic latrine, as it comply with following three main objectives:

- Collecting and isolating human feces
- Eliminating pathogens to prevent their spreading to outer environment
- Transforming waste into organic fertilizer to increase the soil’s fertility and provide safe nutrition to plants

In order to obtain these objectives, the sanitation facility must satisfy requirements such as not contaminating the soil and water in the construction place, not creating foul smells, not attracting flies or animals, facilitating the feces decomposition and pathogens elimination, being convenient and accepted by users.

As Vietnam has many regions with different geographic and biological conditions (mountains, highlands, coast, delta, islands), the feces treatment techniques also vary depending on the requirements of each region. In other hand, the economic status of most rural households is limited, together with lack of knowledge and abundance of backward and unhygienic customs and habits, etc. The human feces treatment using hygienic latrines that are suitable with natural, traditional and economic conditions is still considered a real challenge for Vietnamese rural areas.
1.2.2. DEFINITION OF A HYGIENIC LATRINE

A hygienic latrine is a latrine that ensures the total isolation of human faeces, preventing animals or insects’ contact with untreated human faeces. A hygienic latrine is also capable of eliminating the pathogens inside the faeces, not creating foul smells or contaminating the environment. (According to the National Technical Standards on Latrine – Requirements for a hygienic latrine (QCVN 01:2011/BYT) stipulated together with Circular no. 27/2011/TT-BYT dated June 24th, 2011).

1.2.3. GENERAL STRUCTURE OF A LATRINE

A hygienic latrine is made of 3 main components:

✓ The substructure: is used to collect and treat human feces. This component can be built of bricks or simply a pit dug into the soil. The size and structure of this component depends mainly on the type of latrine and number of its users. This is the most important part of a latrine.

✓ The middlestructure: is used to support the users. Can be made of bamboos, wood or concrete together with other materials such as ceramic.

✓ The superstructure: is the top and surrounding cover of the latrine that helps protecting the users from sunlight, rainwater and also provides privacy and protection to the middlestructure. The latrine walls can be built from bricks, bamboo plates or even canvas. The roof can be palm leaves, tiles or fibre cement sheets.

Of these 3 components, the substructure is the most important part. A latrine may have a very modern, well-built middle- and superstructures, but an unsealed tank that is unable of feces treatment and attracting flies and other insects still makes the latrine become unhygienic.

2. INTRODUCTION OF THE TECHNICAL INSTRUCTIONS DOCUMENT

The document “Technical instructions for hygienic latrine construction” for masons was developed by specialists of 2 NGOs CODESPA and SNV in the framework of the consultancy project “Demand creation and supply chain development for Sanitation market in Hoa Binh province” supported by VIHEMA and WSP-World Bank. This document will provide realistic, simple knowledge to local masons and households so that they can build and use hygienic latrines accordingly to the Ministry of Health’s standards. Moreover, the information provided can also be used as reference for grassroots staff, including village health workers, heads of village or village Women’s union members to instruct or advise local households to build a hygienic latrine model that is suitable with their geographical and economic conditions.

This document will introduce each of the hygienic latrine model recognized by MoH, including:

A. Dry latrine: (doesn’t use water)
   1. Ventilated improved pit latrine
   2. Double vault latrine
B. **Wet latrine:**

3. Soakage pit latrine with concrete ring
4. Soakage pit latrine with brick tank
5. Septic tank latrine with concrete ring
6. Septic tank latrine with brick tank

The contents for each of the mentioned types of latrine consist of: (1) structure, operating mechanism, advantages and disadvantages of the latrine; (2) instructions for the latrine construction; (3) estimated principal materials. This structure will help masons and other users easily understand the type of latrine as well as their construction steps. Moreover, there is also a separated section for the instructions of concrete ring production. Local masons can alternatively produce concrete rings on-site, directly in the customers’ place when working in the mountainous area, to avoid wasting efforts and costs from transporting the pre-built rings.
PART 2: INSTRUCTIONS FOR HYGIENIC LATRINE CONSTRUCTION

1. VENTILATED IMPROVED PIT LATRINE

1.1. STRUCTURES, OPERATING MECHANISMS, ADVANTAGES AND DISADVANTAGES

1.1.1. STRUCTURE
- Consists of 3 main components: The pit – The slab – and the Ventilation pipe
- The slab will be placed on top of the dug pit (normally there is one pit). The ventilation pipe is placed behind the slab, outside of the latrine and 40cm higher than the roof. The pipe includes an anti-fly net. Without the ventilation pipe, the latrine will be filled with foul smells.

1.1.2. OPERATING MECHANISMS
- The feces in the pit will be decomposed by bacteria. The moisture and gas partly will permeate into the soil and partly escape to the outer environment through the ventilation pipe.
- Once the pit is full, cover it with soil and move to a new pit.
- The VIP is suitable for areas where there is a lack of water for flushing, or has low population density and the local people don’t have the habit of using human feces as fertilizers.

1.1.3. ADVANTAGES
- Cheap, can be built with locally available materials
- Easy construction, the household can build it by themselves with health staff’s instructions
- Clean if follow instructions

1.1.4. DISADVANTAGES
- Should be built in a wide place, well ventilated due to the foul smells
- Can’t be built near the house or in sinking or prone-to-flood places
- Short-term use
1.2. CONSTRUCTION TECHNIQUES

1.2.1. SITE SELECTION
- Be wide and well-ventilated
- Be far from the kitchen and house
- Avoid prone-to-flooding places so that rain water won’t enter the pit
- Be at least 10m away from any underground or superficial water sources

1.2.2. THE PIT
- The pit’s volume is calculated basing on 2 factors:
  - Number of users
  - Number of years for use
- The pit has a trapezoidal form, with the bottom smaller than the top. The top can be reinforced with bamboo or wooden plates to avoid erosion.
- The pit is 1.2 – 1.5m deep, with a 1.2m-wide top and 1m-wide bottom.
- The top should be higher than the surface for at least 10-20cm, reinforced with a few rows of bricks which work as the basement for the concrete slab.

Image 2: Pit of the Ventilated-improved pit latrine

Image 3: Technical drawing of the VIP latrine’s pit

1.2.3. THE CONCRETE SLAB AND VENTILATION PIPE
- The slab should be made of reinforced concrete, or bamboo or wooden plates, etc. The slab should be 20 -40cm bigger than the pit’s entrance to avoid collapsing the wall.
- The slab should be wide enough to avoid being broken or vibrated when someone enters the latrine. If it’s made of bamboo or wood, the slab should be made tight and covered with a layer of soil to block the pit’s view and smells.
- The slab should be of square shape to facilitate the superstructures’ construction. The drop-hole’s lid can be made of cement or optionally, wood. It comes with a handle for easier removal and placement.

![Image 4: The slab for VIP latrine with the urine ditch](image)

- The ventilation pipe is made of bamboo or PVC tube of 6cm diameter. The pipe’s top is 40cm higher than the latrine’s roof and comes with antifly net. The tube can be perforated.

![Image 5: Ventilation pipe](image)

1.2.4. **THE SUPERSTRUCTURES**
- Has door and ventilation windows in the upper part of the walls.
- The walls can be built with red bricks or cement bricks. The roof can be made of fibre cement sheets or local materials such as bamboos, reeds, palm leaves, etc.
1.3. USE AND MAINTENANCE
- Before starting using the latrine for the first time, cover the pit’s bottom with a layer of ash or lime powder to reduce the humidity.
- After each use, scatter ashes or soil into the pit.
- The drop-hole should be closed when not in use.
- The urine ditch should lead to a container placed outside the latrine.
- Used toilet paper should be tossed into a trash bin with cover and regularly burnt.
- Regularly clean the latrine’s slab
- When the pit is full (the feces pile’s top is 20cm from the pit’s top), cover the pile with soil and move the slab and superstructures to a new pit.

1.4. ESTIMATED CONSTRUCTION MATERIALS
(VIP latrine with concrete slab)

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2. DOUBLE-VAULT LATRINE

2.1. STRUCTURES, OPERATING MECHANISMS, ADVANTAGES AND DISADVANTAGES

2.1.1. STRUCTURES
The double-vault latrine consists of:
- The superstructures
- The feces composting container, divided into 2 chambers, one for using and one for composting
- The ventilation pipe

2.1.2. OPERATING MECHANISMS
- On-site composting latrine with 2 chambers, alternating their function. 1 chamber is for use and 1 for composting.
- The urine must be separated to avoid creating moisture in the chambers
- The drop-hole must have a lid to prevent animals or flies from entering the chambers
- The chamber doors must be sealed
- The composting chamber’s drop-hole must be sealed.
- The minimum composting time is from 3 – 6 months.

Image 7: Drawings of the double-vault latrine

2.1.3. ADVANTAGES
- Durable, safe and clean use. Reasonable price as the latrine can be built with locally available materials
- The composted feces for more than 6 months can be used as fertilizer
- The latrine can be self-built with health staff’s instructions

2.1.4. DISADVANTAGES
- Still requires mixing materials (ashes, lime powder)
- Exudes bad smells (from feces, urine) with improper maintenance
2.2. CONSTRUCTION TECHNIQUES

2.2.1. PRINCIPAL CONSTRUCTION REQUIREMENTS
- The structure must be solid and waterproof.
- The chamber must be clean, dry and tightly sealed
- Locally available materials are preferrable to reduce the construction costs

2.2.2. THE LATRINE BASEMENT
- The basement should be solidly built, without cracks, sinking in order to keep the feces dry and keep the worms from entering the soil. There are different options for the basement:
  - Concrete basement: use shattered bricks, gravels of 5-7cm and mix with cement and sand at a ratio of 1:2:3. Ram well then pour a layer of mortar of 2 – 3 cm high. This basement is very solid and durable albeit costly; it should only be used for moisture soil and in case of building a solid latrine.
  - Brick basement: Use bricks of 5x10x22cm or squared brick 20x20cm, or even broken bricks. Mortar can be used for bricks lining.
  - Soil/clay basement: For places without bricks and stones, clay can be used to make the latrine’s basement. After removing the superficial soil layer, mix the clay with water to make mortar and ram heavily the mixture. Alternative materials like clamp shells, bottles’ or bowls’ broken pieces can be mixed with clay to make a basing layer of 10 – 15 cm before applying the mortar.

2.2.3. THE VAULT
- The wall, as the main force-bearing structures of the latrine, is required to be solid, waterproof, without cracks.
- Dimension of the vault (including the walls)
  - Length: 1.7 – 1.9m
  - Width: 0.9 – 1.2m
  - Height: 0.7m
- The wall can be made of bricks, reinforced concrete, with a waterproof coating inside the chambers.
- Commonly built of bricks, in which case, the bricks’ linings should be sealed.

*Image 8: Drawings of the Double-vault latrine’s vault*
2.2.4. **THE LATRINE SLAB**
- The slab should be made solidly and can withstand user’s pressure when using the latrine.
- The floor/slab should be made of concrete, or gravels, coals, depending on the availability. If it’s made of reinforced concrete, the iron net should have 20 x 20 cm grids, and covered with a 5-6cm layer of concrete. The slab’s mark can be made with old bamboo sticks of 1.2 – 1.5cm wide and 0.8 – 1cm thick by placing them into a square and using bamboo strips or rattans to tie them together.
- In the latrine slab,
  - There are 2 drop holes of diametre of 16cm
  - Distance between the drop-hole and the bricks as foothold : 4 – 6cm
  - Distance between 2 bricks: minor margin: 12cm; major margin: 22.5cm
  - The lid should seal well, and has long handle.
  - *The urine ditch* should be sufficiently sloped for the urine to escape but shouldn’t be too big and deep; the shorter it is, the less smells it exudes.

![Image 9: The double-vault latrine’s slab](image)

2.2.5. **DOOR FOR FECES REMOVAL**
- Often placed in the rear wall of the latrine. However, it’s recommended to place the doors in the front side of the latrine, where they can be observed and fixed and sealed if necessary.
- The doors don’t need to be too big, normally is 25x30cm.

2.2.6. **THE SUPERSTRUCTURES**
- Has door and ventilation windows in the upper part of the walls.
- The walls and roof can be made of bricks or local materials such as bamboos, reeds, palm leaves, etc.

2.2.7. **THE VENTILATION PIPE**
- The ventilation pipe is made of bamboo or PVC tube of 6cm diameter. The pipe’s top is 40cm higher than the latrine’s roof and comes with antifly net. The tube can be perforated.
2.3. USE AND MAINTENANCE
- Don’t use 2 chambers at the same time. One is for composting when using the other.
- Before starting using the latrine, scatter a layer of ash or lime powder at the bottom to reduce the humidity.
- After each use, scatter a layer of ash or soil into the chamber.
- Used toilet paper should be put into a trash bin with lid and burnt regularly.
- The drop-hole should always be closed when not in use.
- The 2 doors for feces removal should be sealed with clay or cement.
- The urine ditch should lead to a container placed outside the latrine.
- Regularly clean the latrine’s slab, especially the ditch to reduce the bad smells. Scatter ash to the feces that fell on the drop-hole before wiping them with broom.
- When the pit is full (the feces pile’s top is 20cm from the pit’s top), cover the pile with soil and seal the drop-hole. Start using the 2nd chamber.
- The feces should be composted for at least 6 months before using as fertilizer.

2.4. ESTIMATED CONSTRUCTION MATERIALS
(For double-vault latrine with red-brick vault and concrete slab)

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3. **SOAKAGE PIT LATRINE WITH CONCRETE RINGS**

3.1. **STRUCTURES, OPERATING MECHANISMS, ADVANTAGES AND DISADVANTAGES**

3.1.1. **STRUCTURES AND OPERATING MECHANISMS**

The soakage pit latrine with concrete rings is a wet latrine, using water to flush the feces from the pan away. The water from the pit will enter the soil through to the holes created on the rings and the tank’s open bottom. This is a cheap and simple latrine, which is very suitable with the rural area. The feces inside the tank will go through a bio-chemical process to gradually become unhazardous sludge.

3.1.2. **ADVANTAGES**

- Clean, modern. Can be built inside the house or combined with a bathroom.
- Convenient use
- Can only be built in the sandy or heavy soil with high absorbent rates. The pit should be at least 10m away from any water source.

![Image 12: Drawing of the soakage pit latrine](image)

3.2. **CONSTRUCTION TECHNIQUES**

3.2.1. **CONSTRUCTION PLACE SELECTION**

- High and dry place. Avoid low places where it’s often got inundated. This will affect the tank’s absorbing capacity
- The latrine can be built near the house for more convenience as it has little bad smell.
- For the fine soil area, the minimum distance from the latrine to the water sources is 10m and much farther for rocky, basalt soil

3.2.2. **DESIGN AND DIMENSIONS**

- The tank is made of 2 pre-built concrete rings, one placing above of another. Each ring is 50cm-high and has an outer diameter of 100cm and inner diameter of 90cm. On the rings there are holes for water absorbing.
3.2.3. RINGS INSTALLATION TECHNIQUES

a. Prepare the pit: Dig a pit for the rings, of 1m deep and 1.2m wide.

b. Rings installation: The installation process is quite simple, as the soakage pit only has 2 rings and 1 lid (no bottom).

**Step 1:** After leveling the pit’s bottom, place the 1st ring. Ensure that the ring is balanced on the ground. Sprinkle a layer of sand and gravels in the bottom of the tank to increase absorbent rate (about 5cm high)

**Step 2:** Continue to place the 2nd ring above of the 1st ring. It’s not necessary to plaster cement between the rings

**Step 3:** Cover the tank with the lid. Use mortar (1 cement: 4 sands) and cement to plaster a thin layer between the lid and the ring’s rim.

3.2.4. PAN INSTALLATION

- Estimate the pan’s height in comparison with the ground by connecting the siphone and the pan with the tank. Normally the pan should be 30 – 40cm high to create enough slopes for the feces to enter the tank easily.
- The drop-hole’s center should be 35cm away from either latrine’s walls. The pan will head to the latrine’s door to offer comfort.
- Pour water into the siphone and adjust the height of the water seal to 1.5 – 2.0cm. Fix the siphone’s position with mortar and bricks.
- If the pan is placed right upon the slab, place the connecting tube perpendicularly to the floor.
- If the pan is not placed directly upon the slab, the connecting tube should be placed at a 45-degree angle with the ring’s wall for the best flushing rates.

3.2.5. SUPERSTRUCTURES
- Depending on the household’s economic conditions, the latrine can be built in combination with the bathroom, or having big superstructures. The minimum dimension for the superstructures is as follows: 100cm long, 90cm wide, 200cm high for the front wall and 180cm high for the rear wall. The basement’s height depends on the soil, normally is 15-20cm.
- The superstructures are made of bricks, lime, sand, cement. The outer walls are plastered with a waterproof cement coat. The inner wall can be enameled with tiles or plastered with a waterproof cement coat.
- The latrine’s floor should be sloped into the pan. Plaster a polished 2cm-high cement coat.
3.3. USE AND MAINTENANCE
- There is enough water for flushing. The water container should be clean and have lid to avoid mosquito larvae.
- Used toilet papers can be tossed into the pan if it’s self-decomposing paper, or tossed into a trash bin with cover to be regularly burnt.
- The door should shut tightly to provide privacy.
- Don’t toss hard things into the pan, they may clog it. When the pan is clogged, use a flexible stick or a small hook to pull the obstacle out. Don’t use a hard stick, which can break the siphone.
- Flush water after each use
- Regularly clean the latrine
- When the pit’s full, open the ring’s lid and pour lime into it. After 6 hours, take out the sludge, seal the lid and continue to use the latrine. The sludge should be composted for at least 6 months before using as fertilizer.

3.4. ESTIMATED CONSTRUCTION MATERIALS
(For a soakage pit latrine with pre-built concrete rings and concrete floor)

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The superstructures can be built solidly or with temporal materials such as bamboos, wood, palm leaves, etc.
4. **SOAKAGE PIT LATRINE WITH BRICKS**

4.1. **STRUCTURES, OPERATING MECHANISMS, ADVANTAGES AND DISADVANTAGES**

4.1.1. **STRUCTURES AND OPERATING MECHANISMS**

The soakage pit latrine with concrete rings is a wet latrine, using water to flush the feces from the pan away. The water from the pit will enter the soil through to the holes created on the rings and the tank’s open bottom. This is a cheap and simple latrine, which is very suitable with the rural area. The feces inside the tank will go through a bio-chemical process to gradually become unhazardous sludge.

4.1.2. **ADVANTAGES**
- Clean, modern. Can be built inside the house or combined with a bathroom.
- Convenient use
- Can only be built in the sandy or heavy soil with high absorbent rates. The pit should be at least 10m away from any water source.

4.2. **CONSTRUCTION TECHNIQUES**

4.2.1. **CONSTRUCTION PLACE SELECTION**
- High and dry place. Avoid low places where it’s often got inundated. This will affect the tank’s absorbing capacity
- The latrine can be built near the house for more convenience as it has little bad smell.
- For the fine soil area, the minimum distance from the latrine to the water sources is 10m and much farther for rocky, basalt soil

4.2.2. **DESIGN AND DIMENSIONS**
- The pit can has square or circular form, as long as the minimum volume is 0.7m³.

4.2.3. **PIT CONSTRUCTION TECHNIQUES**

*Step 1:* Dig a pit of 1.0m x 1.0m x 0.7m (the pit can be bigger, depending on the household’s economic conditions).
Step 2: Place the bricks surrounding the pit. Mix cement with sand at 1:3 or 1:4 ratio. Rotate the bricks at the bottom row to make a solid basement.

Step 3: If the pit is made of red bricks, place the bricks vertically. The 4 bottom rows are built tightly and start leaving holes on the walls from the 5th row. The absorbing hole is of 6x8cm. There are holes every 2 rows (at the 5th, 7th, 9th, and 11th rows). From the 12th row, continue to place the bricks tightly until the pit’s top. Plaster the pit’s walls with mortar. In case of using cement bricks, only place the bricks tightly at the 2 bottom rows and leave holes at the 3rd, 5th, and 7th rows.

4.2.4. SIPHONE PLACEMENT, SLAB AND BASEMENT CONSTRUCTION
- The recommended dimension for the superstructure is 0.9m wide, 1m long, 2m high for the front wall and 1.8m high for the rear wall.
- Estimate the pan’s height in comparison with the ground by connecting the siphone and the pan with the tank. Normally the pan should be 30 – 40cm high to create enough slopes for the feces to enter the tank easily.
- The drop-hole’s center should be 35cm away from either latrine’s walls. The pan will head to the latrine’s door to offer comfort.
- Pour water into the siphone and adjust the height of the water seal to 1.5 – 2.0cm. Fix the siphone’s position with mortar and bricks.

4.2.5. PIT’S LID CONSTRUCTION
- The pit’s lid should be made of reinforced concrete at 6cm high. The lid should only cover 2/3 of the pit’s walls to offer better mounting and sealing.
- The iron bars should be placed 10cm away from each other. This means 10 bars for a lid of 80cm long.
- Let the concrete dry for 10 days before installing onto the pit.

4.2.6. WATER TANK CONSTRUCTION
- The tank’s dimension: 0.3 x 0.4 x 0.5m. Can be built inside or outside of the latrine.

4.2.7. SUPERSTRUCTURES
- Depending on the household’s economic conditions, the latrine can be built in combination with the bathroom, or having big superstructures. The minimum dimension for the superstructures is as follows: 100cm long, 90cm wide, 200cm high for the front wall and 180cm high for the rear wall. The basement’s height depends on the soil, normally is 15-20cm.
- The superstructures are made of bricks, lime, sand, cement. The outer walls are plastered with a waterproof cement coat. The inner wall can be enameled with tiles or plastered with a waterproof cement coat. The ventilation hole is made at the height of 1.4m.
- The latrine’s floor should be sloped into the pan. Plaster a polished 2cm-high cement coat.

4.3. USE AND MAINTENANCE
- There is enough water for flushing. The water container should be clean and have lid to avoid mosquito larvae.
- Used toilet papers can be tossed into the pan if it’s self-decomposing paper, or tossed into a trash bin with cover to be regularly burnt.
- The door should shut tightly to provide privacy.
- Don’t toss hard things into the pan, they may clog it. When the pan is clogged, use a flexible stick or a small hook to pull the obstacle out. Don’t use a hard stick, which can break the siphone.
- Flush water after each use
- Regularly clean the latrine
- When the pit’s full, open the ring’s lid and pour lime into it. After 6 hours, take out the sludge, seal the lid and continue to use the latrine. The sludge should be composted for at least 6 months before using as fertilizer.

4.4. **ESTIMATED CONSTRUCTION MATERIALS**

*(For a soakage pit latrine with brick pit and concrete floor)*

<table>
<thead>
<tr>
<th>No</th>
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<td>11</td>
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**For pit made of cement bricks and 1m³ volume**

<table>
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<td>Antifly net</td>
<td>Unit</td>
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</table>

*The superstructures can be built solidly or with temporal materials such as bamboos, wood, palm leaves, etc.*
5. SEPTIC TANK WITH CONCRETE RINGS

5.1. STRUCTURES, OPERATING MECHANISMS, ADVANTAGES AND DISADVANTAGES

5.1.1. STRUCTURES
- Consisting of 3 components: Superstructures, middle structures and substructures (the tank).
- The tank has 1 main chamber, 1 sediment chamber 1 absorbing pit. The two chambers are made of concrete rings. The pit is dug directly into the soil to save costs.
- The feces flushing channel: includes a siphone with water seal and a straight tube to channel the feces from the siphone to the tank.

5.1.2. ADVANTAGES
- Clean, convenient, can be built inside the house or combined with a bathroom
- Simple and convenient use
- One-time investment, durable use

5.2. CONSTRUCTION TECHNIQUES

5.2.1. CONSTRUCTION PLACE SELECTION
- High and dry place; Convenient for users (built inside the house, next to the bedroom)
- Accessible water source, or connected to the water supply

5.2.2. DESIGNS AND DIMENSION
- The tank has 3 parts: a main chamber made of 2 concrete rings, a sediment chamber made of 1 ring. Each ring is 50cm-high and has an outer diameter of 100cm and inner diameter of 90cm. In total, the septic tank latrine uses 3 concrete rings and 2 lids. The first chamber has a volume of 0.64m$^3$; the second’s volume is 0.32m$^3$.
- The water from the sediment chamber will enter the absorbing pit, which has a lid to provide safety. The pit can be replaced with a plastic tube of 90mm-diameter. The tube is drilled with holes and goes into the garden, which will act as a natural filter for the grey water.

Image 21: Drawing of the septic tank
5.2.3. TANK INSTALLATION TECHNIQUES

a. Prepare the pit:
- The first pit should be 0.9m deep and has a diameter of 1.5m; this is for the 2-ring main chamber.
- The second pit should be 0.55m deep, with a diameter of 1.5m. This is for the 1-ring sediment chamber.
- Depending on the area, the 2 pits can be dug next to or separately from each other. If so, make sure the plastic tubes can be connected easily.
- The third pit should be at least 0.5m deep and 0.4x0.5m wide, which means a minimum volume of 0.2m³. This pit’s location depends on the family. At the bottom of this pit, sprinkle a 20cm-layer of sand above of another layer of gravels for filtering.

Images 21 & 22: Digging the pits for rings placement

b. Concrete rings installation
- The installation techniques are as follows:
  **Step 1:** Make a concrete layer at the first pit’s bottom. The concrete is of grade 75, 6-8cm high, reinforced with latticed iron bars Φ6 of 20x30cm grid. Make sure that the pit’s bottom is leveled before and after making the layer.

Images 22 & 23: Making the tank’s bottom lid

**Step 2:** After making the bottom lid, continue to place the 1st ring onto the lid so that the 2 parts are sealed together. Make sure that the ring is leveled.
**Step 3:** Plaster the 1st ring’s top with mortar (1 cement: 4 sand) before placing the 2nd ring above of the 1st ring. After that, go inside the tank to plaster the intersections with cement (between the 1st ring and the bottom layer, between the 2 rings)

The 1st pit is now completed.

*Images 24 & 25: Placing the rings, plastering the intersections*

**Step 4:** Proceed with the 2nd pit. Before placing the ring, make another layer of reinforced concrete as with the 1st pit. Cautions:

- The pit’s deep must be calculated so that the top rings in 2 pits are of the same height. This will facilitate the connectors’ placement. The holes for connector on the rings’ wall are premade at 10-15cm lower than the ring’s top.
- Level the ring before and after placement.
- The 2 chambers can be dug near or separated from each other depending on the local conditions.

**Step 5:** After finishing both pits, proceed to place the tubes connecting the 2 chambers and the tube that goes from the sediment chamber to the absorbing pit. Use 90mm-tube to connect 2 chambers. The exit tube for the 1st chamber is an L-shaped connector that goes 40cm towards the 1st chamber’s bottom. The distance from the chamber’s bottom and the connector’s mouth is 50cm. The 2nd chamber has a similar L-shaped connector, but only goes 20cm towards the bottom and can be made with 60mm-tube for cost saving.

*Images 26 & 27: The two main chambers are connected with plastic tubes and connectors*
**Step 6:** Cover the 2 chambers with the premade lids. Use mortar (1 cement: 4 sand) as adhesion and cover the connection with cement coat.

*Images 28 & 29: Placing the lids*

### 5.2.4. PAN INSTALLATION

- The pan’s type can be squatting or sitting, depending on the family’s affordability.
- Estimate the pan’s height in comparison with the ground by connecting the siphone, the tube and the pan to the tank. Place bricks to support the pan.
- The pan should be tightly connected to the siphone with cement. Fill the hollow space under the pan with soil or sand.
- Siphone placement: Pour water into the siphone and adjust the height of the water seal to 1.5 – 2.0cm. Fix the siphone’s position with mortar and bricks.
- Feces connection tube: is a 90cm plastic tube, connecting the siphone to the Y-shaped connector. The lower end of the Y-shaped connector must be connected to a straight tube, which goes 15-20cm lower than the escape hole of the 2nd chamber, to make sure that this tube is always submerged during use. The other higher end of the Y-shaped connector is open and higher than the water level in the tank.
- The pan’s center should be 35cm away from either latrine’s wall. The pan will head to the latrine’s door to offer comfort.

### 5.2.5. SUPERSTRUCTURES

- Depending on the household’s economic conditions, the latrine can be built in combination with the bathroom, or have big superstructures. The minimum dimension for the superstructures is as follows: 100cm long, 90cm wide, 200cm high for the front wall and 180cm high for the rear wall. The basement’s height depends on the soil, normally is 15-20cm.
- The superstructures are made of bricks, lime, sand, cement. The outer walls are plastered with a waterproof cement coat. The inner wall can be enamelled with tiles or plastered with a waterproof cement coat.
- The latrine’s floor should be sloped into the pan. Plaster a polished 2cm-high cement coat.
- The ventilation window is 1.4m high.
5.3. USE AND MAINTENANCE
- Fill all the tanks with water before using
- There is enough water for flushing. The water container should be clean and have lid to avoid mosquito larvae.
- Regularly clean the latrine’s floor.
- Only toss self-decomposing toilet paper into the pan. Other types of toilet paper should be tossed into a trashbin with lid and regularly burnt.
- Don’t toss hard things into the pan, they may clog it. When the pan is clogged, use a flexible stick or a small hook to pull the obstacle out. Don’t use a hard stick, which can break the siphone.
- Don’t pour detergent into the tank
- Take out the sludge regularly, every 2-3 years.

5.4. ESTIMATED CONSTRUCTION MATERIALS
(For a 1.2m³ septic tank latrine with pre-built concrete rings and cement floor)

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<th>Material</th>
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<td>Concrete rings</td>
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</tr>
<tr>
<td>2</td>
<td>Concrete lid (if the pit’s bottom is built later)</td>
<td>Unit</td>
<td>2</td>
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<tr>
<td>3</td>
<td>Gravels 1,2</td>
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</tr>
<tr>
<td>4</td>
<td>Sand</td>
<td>m³</td>
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<td>5</td>
<td>Cement</td>
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<td>9</td>
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<tr>
<td>13</td>
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The superstructures can be built solidly or with temporal materials such as bamboos, wood, palm leaves, etc.
6. SEPTIC TANK LATRINE WITH BRICKS

6.1. STRUCTURES, OPERATING MECHANISMS, ADVANTAGES AND DISADVANTAGES

6.1.1. STRUCTURES
- Consisting of 3 components: Superstructures, middle structures and substructures (the tank).
- The tank has 1 main chamber, 1 sediment chamber 1 absorbing pit.
- The feces flushing channel: includes a siphone with water seal and a straight tube to channel the feces from the siphone to the tank.

6.1.2. ADVANTAGES
- Clean, convenient, can be built inside the house or combined with a bathroom
- Simple and convenient use
- One-time investment, durable use

Image 31: Drawing of the septic tank latrine with brick tank

6.2. CONSTRUCTION TECHNIQUES

6.2.1. CONSTRUCTION PLACE SELECTION
- High and dry place; Convenient for users (built inside the house, next to the bedroom)
- Accessible water source, or connected to the water supply

6.2.2. SEPTIC TANK CONSTRUCTION
- Dimension: 1.5 -2m long, 1m wide, 1.2 – 1.4m high
- The tank is plastered with mortar
- The tank’s bottom must be reinforced and well leveled.
- The interior walls must be plastered with mortar coat and polished to be waterproof
- The tank’s lid must be made of reinforced concrete of 6-7cm high.
6.2.3. PAN, SIPHONE AND FECES TRANSPORTING TUBE INSTALLATION
- The pan’s type can be squatting or sitting, depending on the family’s affordability.
- Estimate the pan’s height in comparison with the ground by connecting the siphone, the tube and the pan to the tank. Place bricks to support the pan.
- The pan should be tightly connected to the siphone with cement. Fill the hollow space under the pan with soil or sand.
- Siphone placement: Pour water into the siphone and adjust the height of the water seal to 1.5 – 2.0cm. Fix the siphone’s position with mortar and bricks.
- Feces connection tube: is a 90cm plastic tube, connecting the siphone to the Y-shaped connector. The lower end of the Y-shaped connector must be connected to a straight tube, which goes 15-20cm lower than the escape hole of the 2nd chamber, to make sure that this tube is always submerged during use. The other higher end of the Y-shaped connector is open and higher than the water level in the tank.
- The pan’s center should be 35cm away from either latrine’s wall. The pan will head to the latrine’s door to offer comfort

6.2.4. SUPERSTRUCTURES
- Depending on the household’s economic conditions, the latrine can be built in combination with the bathroom, or have big superstructures. The minimum dimension for the superstructures is as follows: 100cm long, 90cm wide, 200cm high for the front wall and 180cm high for the rear wall. The basement’s height depends on the soil, normally is 15-20cm.
- The superstructures are made of bricks, lime, sand, cement. The outer walls are plastered with a waterproof cement coat. The inner wall can be enameled with tiles or plastered with a waterproof cement coat.
- The latrine’s floor should be sloped into the pan. Plaster a polished 2cm-high cement coat.
- The ventilation window is 1.4m high.
6.3. USE AND MAINTENANCE
- Fill all the tanks with water before using
- There is enough water for flushing. The water container should be clean and have lid to avoid mosquito larvae.
- Regularly clean the latrine’s floor.
- Only toss self-decomposing toilet paper into the pan. Other types of toilet paper should be tossed into a trashbin with lid and regularly burnt.
- Don’t toss hard things into the pan, they may clog it. When the pan is clogged, use a flexible stick or a small hook to pull the obstacle out. Don’t use a hard stick, which can break the siphone.
- Don’t pour detergent into the tank
- Take out the sludge regularly, every 2-3 years.

6.4. ESTIMATED CONSTRUCTION MATERIALS
(For septic tank latrine with a 1.5m³ tank built of red bricks and cement floor)

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The superstructures can be built solidly or with temporal materials such as bamboos, wood, palm leaves, etc.
7.  **CONCRETE RING PRODUCTION**

7.1. **USE OF THE CONCRETE RINGS**

- The concrete rings can be used to build septic tank and soakage pit latrines.
- In comparison with latrine built of red bricks, the concrete ring latrine has better durability and solidity; also helps reduce the risks of technical errors during the waterproof coating process. More importantly, the concrete ring latrine’s price is about 1 million dongs cheaper than the red brick version.
- A septic tank latrine often has 2 chambers and needs 3 rings in total. The main chamber is made of 2 rings placing one above of another, and the sediment chamber uses 1 ring.
- The soakage pit has 2 concrete rings, one placed above of the other. Both rings have holes to facilitate water absorbing into the soil.

![Concrete rings for septic tank latrine](image1) ![Concrete rings for soakage pit latrine](image2)

*Images 34 & 35: Different types of concrete ring*

7.2. **REQUIRED TOOLS**

For producing concrete rings, it’s necessary to have:
- Concrete ring technical drawings
- Concrete molds
- Construction materials: Iron bars, Cement, Gravels, Sand, Plastic tube
- Masonry tools

7.2.1. **CONCRETE RINGS’ TECHNICAL DESIGN**

a.  **Technical design for a set of concrete ring for septic tank latrine (3 rings + 2 lids)**

- 3 rings and 2 lids are produced with concrete of grade 75 (Cement: Sand: Gravels = 1:2:3).
- Each ring is reinforced with 2 circles made of 6-mm iron bars.
- The 2 lids have 5-6cm height, 100cm diameter and reinforced with 6mm-iron wires forming 30x40cm.
b. **Technical drawing for a set of concrete ring for soakage pit latrine (2 rings + 1 lid)**

- 2 rings and 1 lid are produced with concrete of grade 75 (Cement: Sand: Gravels = 1:2:3).
- Each ring is reinforced with 2 circles made of 6-mm iron bars. The lid is 5-6cm wide and has a diameter of 100cm. Each lid is reinforced with an iron net placing at 30x40 density.
7.2.2. RING MOLDS

- Molds are needed to produce concrete rings for wet latrines. The molds used are similar to the ones used to produce sewage rings. Each set of mold consists of 2 circles, one bigger than the other. The difference between the circles’ radius is the width of the product ring. Each circle is assembled by 3 - 4 curving metal sheets.
- Molds can be made of different materials, but the most common ones are made of iron or tin. The prices and durability varies depending on the material used. The most common molds are from 1 – 5.5 million dong each.

<table>
<thead>
<tr>
<th>Type of mold</th>
<th>Description</th>
<th>Price (per set)</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tin mold</td>
<td>The mold is made of tin, curving into circular form. The mold is reinforced with 2 belts made of iron bar (rectangular form of 10 – 14mm width). The mold production is quite simple; many workshops can make it if they are provided with a blueprint. The time for mold production is about 12 days</td>
<td>About 1.000.000 VND</td>
<td>1 - 2 years</td>
</tr>
<tr>
<td>Iron mold</td>
<td>The mold has an iron structures, and covered with iron slates or thick tin. This mold is more durable but heavier, thus hindering transportation. The time for mold production is about 12 days</td>
<td>About 3.500.000 VND</td>
<td>More than 5 years</td>
</tr>
</tbody>
</table>

7.2.3. OTHER NECESSARY TOOLS
- Mounting tools: wrench
- Manual cement mixing tools: shovel, pail, hoe
- Iron bending tools: Iron scissors
- Transporting tools: Conveyor belt
- Other optional supporting tools: Concrete vibrating machine, iron bender, cement mixer

7.2.4. MATERIALS: CEMENT, SAND, GRAVELS, IRON BAR Ф6
- Septic tanks latrine needs 3 rings and 2 lids. Soakage needs 2 rings and 1 lid.
- The concrete ring is made of mixed concrete, which consists of cement, sands, gravels (0.5 – 1.2cm), iron bar Φ6. Each ring will use 2 iron circles as reinforcements. Each circle is placed at 20cm from either side of the ring.
- The required amount of construction materials for each type of latrine, and average prices are as follows:

<table>
<thead>
<tr>
<th>#</th>
<th>Material</th>
<th>Unit</th>
<th>Materials for producing 1 set of rings for septic tank latrine</th>
<th>Materials for producing 1 set of rings for soakage pit latrine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Qty.</td>
<td>Price</td>
</tr>
<tr>
<td>1</td>
<td>Iron bar Φ6</td>
<td>Kg</td>
<td>6</td>
<td>16,200</td>
</tr>
<tr>
<td>2</td>
<td>Cement</td>
<td>Kg</td>
<td>130</td>
<td>1,215</td>
</tr>
<tr>
<td>3</td>
<td>Gravels</td>
<td>m3</td>
<td>0.3</td>
<td>234,000</td>
</tr>
<tr>
<td>4</td>
<td>Sand</td>
<td>m3</td>
<td>0.2</td>
<td>216,000</td>
</tr>
<tr>
<td>5</td>
<td>Plastic tube Φ60</td>
<td>M</td>
<td>0.15</td>
<td>216,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>368,550</td>
</tr>
</tbody>
</table>

*(Reference price, taken in August 2014)*

### 7.3. CONCRETE RING DIMENSIONS

The dimensions for a ring of 3.2m³ are:
- Height: 50cm
- Outer diameter: 100cm
- Inner diameter: 90cm
- Ring width: 5cm

### 7.4. CONCRETE RING PRODUCTION PROCESS

#### Step 1: Mold mounting and adhesive-proofing

- Assemble the metal sheets with nuts and bolts, or with hinges.
- After that, apply a layer of grease on the inside face of the mold, to reduce the concrete’s adhesion and thus facilitating the demounting
Step 2: Iron bending

- Firstly, straighten the iron bar. Then cut out 2 sections of the same length, depending on the ring’s dimension (with this example, the length should be 92 – 93cm).
- Bend the bars into circles and fix the opens with iron wires.

Step 3: Cement mixing

- Mix the prepared materials (cement, sand, gravels) with the portion of Cement: Sand: Gravels = 1:2:3, to create a concrete of Grade 75. The concrete shouldn’t be too wet; otherwise the ring will take longer to dry out and to be demounted.

Step 4: Mold filling

A. For septic tank ring:
- A set of concrete rings for septic tank latrine will have 3 rings, 2 of them have 2 symmetrical holes to place the connectors and 1 ring without holes.
- Use shovel to fill the mold with mixed concrete by layers. After reaching the height of 20cm, use the vibrating machine to level the concrete and put the first iron circle into the mold.
- Continue to fill the mold. Level the concrete after every 20-cm layer.
- When the concrete is 30 cm from the ring’s top, place the 2nd circle.
  - To make the rings with holes:
    - Continue to fill the mold until the concrete is 20cm from the top. Now the workers have to create 2 symmetrical holes of 10-cm diameter, by placing 2 sections of 10-cm plastic tube.
    - Continue to fill the molds until the concrete reaches the top.
  - To make the ring without holes
- Continue to fill the molds until the concrete reaches the top.
B. For soakage pit ring:
- A set of concrete rings for soakage pit latrine will have 2 rings.
  o The first ring has only 1 row of holes. Each hole’s diameter is 5cm. The distance between holes is 10cm. And the row is 40cm from the ring’s bottom.
  o The second ring as 2 rows. The distance between holes is 10cm. The distance between rows is 15cm. And the first row is 20cm from the ring’s top.
- The production process is similar to the septic tank ring’s process. The trick to make the hole is to cut a 5-cm-wide plastic tube into various sections and place them into the mold as filling the concrete.

Step 5: Mold demounting and ring maintaining

- After filling, the mold will need at least 4 hours before demounting.
- The ring maintenance starts 12 hours after the production. During the first 3 days, for every 24 hours, the ring needs to be watered to increase the concrete’s durability.
- The ring shouldn’t be transported for at least 12 days after the production.