

Lesson Plan: Constructing a Latrine Pit Footing and Lining



90 minutes total

Lesson Description



This is an optional practical lesson. Participants practice basic skills in latrine pit lining and footing construction. A number of practical options are available. Select the options based on the designs that will be most appropriate to the local context and where the participants are working.

Learning Outcomes



At the end of this session participants will be able to:

1. Demonstrate how to construct a latrine pit footing.
2. Demonstrate how to line a latrine pit.

Scheduling this Lesson in the Agenda



The Lesson Plan: Excavating Pits and Lesson Plan: Lining Pits should be delivered before participants excavate and line pits. This will ensure that they understand the key design features and health and safety precautions.

Tools and Materials



- Construction tools and materials (see Practical Plans and construction manuals)
- First aid kit

Preparation



- Review topics in Latrine Construction Manual
- Review topics in Cambodian DRHC (Department of Rural Health Care) (2010). Household Latrine Construction Manual. A Guide to Constructing a Latrine as Described in the Informed Choice Manual on Rural Household Latrine Selection. Ministry of Rural Development, Cambodia. Available at: www.hesperian.info/wp-content/uploads/pdf/en_hmx/en_hmx_2010_latrineconstruct.pdf
- There are various methods to excavate and line a pit. Decide which pit latrines are most valuable to the participants. Decide the number and type of practical activities.
- Identify an appropriate location to dig the pits. Each pit will become a work station. Check with the host and local authorities where is safe to dig down (so as not to hit water mains, sewers or electrical supplies). Make sure that each station is safe distance from the next and that the route between stations is safe and unlikely to cause injury.

- Decide what to do with the pits after the workshop. They can be backfilled and covered for safety. If they are to remain for demonstration, then they should be signed and fenced so that somebody does not accidentally fall into the pits.
- Hire somebody to dig the pits ahead of the workshop or ask the participants to dig the pits as part of the practical session.
- Find out what skills, tools and materials exist locally
- Gather tools and materials
- Organize tools and materials into work stations. Name or number the stations for the participants.
- Put together a first aid kit
- Write local emergency phone numbers on flipchart paper

Introduction**5 minutes**

1. Ask the participants to show with their full bodies and voice how excited they are about excavating and lining pits.
2. Present the lesson description or learning outcomes.

Health and Safety**5 minutes**

1. Explain that it is important to work safely and avoid the potential for injury while excavating and lining a latrine pit. Review the health and safety precautions previously discussed in the Lesson Plan: Excavating Pits and Lesson Plan: Lining Pits.
 - *Tie a rope around the person's waist or harness so they can be pulled out if there is an accident*
 - *Always have a person at the surface who can help in case of an accident*
 - *Wear safety equipment such as a closed toe shoes, hard hat and gloves*
 - *Communicate regularly and loudly with the person working in the pit*
 - *If the soil or pit walls are loose, they should be sloped or temporarily supported until the pit lining can be constructed.*
2. Explain that the participants will also be lifting heavy objects, such as concrete rings. They must be extremely careful when lifting not to hurt themselves. Demonstrate how to properly lift by bending at the knees and not the back. They should wear closed toe shoes and gloves. A minimum of 4 people should lift the ring together and be very careful not to trap their fingers.



3. Explain the dangers of working with cement to make the mortar. Ask the participants “What can you do to protect yourself?”

What to wear:

- *Eye protection for mixing, pouring, and other work with dry cement*
- *A face mask to prevent inhaling cement dust*
- *Work gloves or rubber gloves*
- *Long sleeve shirt and full-length pants, pull sleeves down over gloves*

What to do:

- *Use a bucket, shovel or trowel to measure and mix cement.*
- *Work upwind from cement dust*
- *Remove rings and watches because cement dust can collect underneath and burn your skin*
- *Remove any clothing contaminated by cement*
- *When your skin comes into contact with cement, wash with cold running water as soon as possible. Flush out any open sores or cuts. Get medical attention if your skin still feels like it is burning.*
- *After working with cement, always wash your hands before eating, smoking, or using the toilet*
- *If your eyes are exposed to cement, rinse with cold clean water for at least 15 minutes. Get medical attention if necessary.*



4. Make sure everyone knows where the first aid kit is located. Make sure everyone knows who to call in an emergency. Write important phone numbers on flipchart paper and post it in a visible area.

Instructions

70 minutes



1. Tell the participants that every group will get to practice for 20 minutes at each work station. Explain that after 10 minutes you will say “Change task”. This means that people within the group change what they are doing so that everyone gets to try each part of the work station. You will ask the groups to rotate between the work stations after 20 minutes. One member of the group should remain at their work station for 5 minutes to instruct the next group on what they have done and how they found the task. They should also share any advice on techniques.
2. As a large group, describe the activities to be undertaken at each station. Identify the tools and materials that they will need. Tell participants where they will find the tools and materials. Encourage participants to work together and figure out a system for greatest efficiency. Take care to ensure everybody understands the process and objectives.
3. Divide the participants into the same number of groups as work stations. Assign each group to a work station.

4. Undertake the practical. While participants are constructing their pits be sure to check in with each group to answer questions and provide helpful hints.
5. After 10 minutes tell groups to change tasks. After 20 minutes ask the groups to change stations. Make sure one person remains at each station for 5 minutes to assist the next group in adapting to the new task.
6. After the groups have rotated through each station, ask them remain to at their starting station and complete the work that remains to be done. As each group finishes, they should be moved to help other groups that are still working, until all of the tasks have been completed.

Review**10 minutes**

1. As a large group, review the experiences of each work station.
 2. For each station, ask the participants “What worked well?”
 3. For each station, ask the participants “What have you learned?”
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Practical Plan: Poured Concrete Ring Footing



70 minutes total

Lesson Description



In this practical session, participants work in groups to pour a simple round concrete footing.

Learning Outcomes



At the end of this session participants will be able to:

1. Demonstrate how to pour a concrete ring footing.

Materials



- 2 pick axes (to dig the concrete ring)
- 2 garden trowels or small spades (to take soil out from the ring)
- 1 piece of string (10 metres)
- 1 measuring tape
- 1 bucket (15–20 litres for measuring the concrete, optional)
- 1 plastic sheet (70 cm x 8 m) (optional)
- Sand
- Gravel
- Cement
- Gloves

Preparation



- Review the Latrine Construction Manual on how to pour a concrete pit footing
- Organize the tools and materials at the work station

Constructing the Footing



1. Clearly mark the trench lines on the ground for a round pit. The inner circumference should be the dimensions of the calculated pit size. For this practical the inner circumference is 90 cm. The width of the trench will be the width of the blade of the pick axe (about 10 cm) which you are using to dig.
2. Excavate the trench to a minimum of 0.5 metres deep.
3. Build up the walls above the trench by 10 cm.

Option A: If the excavated soil is consolidated, then you can use this soil.

Option B: If the soil is too loose, then you can use the plastic sheeting. Cut the plastic sheeting so there are two sheets of 70 cm x 4 m. Place one sheet around the inside circumference and one sheet around the outside circumference. Make sure that the two sheets retain the trench width and do not touch each other.

4. Mix the concrete using the following ratio:
 - 1 part cement
 - 2 parts sand
 - 4 parts gravel
 5. Fill the trench between the soil or two sheets of plastic with concrete.
 6. Explain to the participants that the concrete should cure for at least 7 days. Afterwards, the rest of the pit can be excavated using the concrete footing as a guide.
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Practical Plan: Bamboo or Wood Ring Lining



70 minutes total

Lesson Description



In this practical session, participants work in groups to construct a pit lining from bamboo or wood sticks.

Learning Outcomes



At the end of this session participants will be able to:

1. Demonstrate how to line a pit using bamboo or sticks.

Tools and Materials



- 60 pieces of bamboo or straight wood sticks (2 metres long, diameter 4–7 cm)
- Short handle mallet
- Machete
- Strong string or tying wire (30 metres)
- Pincers to cut wire (optional if using wire)

Preparation



- Review topic in the Cambodian DRHC (Department of Rural Health Care) Household Latrine Construction Manual
- Organize the tools and materials at the work station

Optional: Digging the Pit

Note: The participants can make the pit lining aboveground without digging the pit. Decide on whether or not the practical will be done inside a pit or at the ground level.

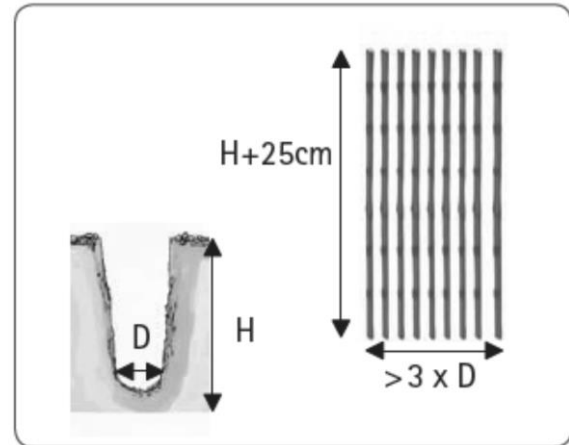


1. Ask the participants to dig the pit or hire someone to dig the pit prior to workshop.
 - Circular pit dimensions: diameter 90 cm, depth 175 cm
 - The walls of the pit should not be dug vertical, but V shaped. For every 1 m of depth the walls should be splayed by 10 cm. For example, a pit that is 2 m deep and with a diameter of 90 cm, should have a base diameter of 90 cm but the diameter at ground level should be 110 cm.
 - The bamboo or sticks should penetrate the base of the pit by 15 cm and should extend at a minimum 10 cm above ground. Therefore you should add 25 cm to the depth of the pit for your pole length. If you are in a flood prone area this should be raised further aboveground and the pit depth or stick length adjusted accordingly.

Constructing the Lining

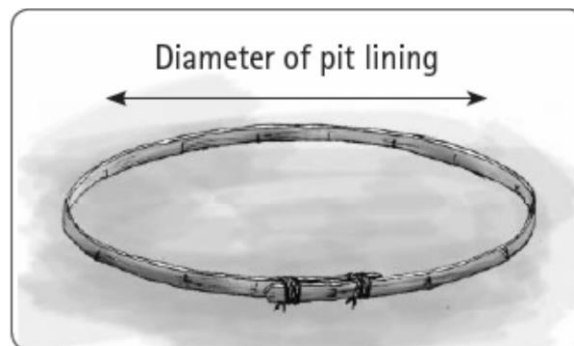


1. Check how many lengths of bamboo or sticks are needed by multiplying the diameter of the pit by 3. This will give you the approximate length of the lining as if it was rolled out in one length. For example, if the pit diameter was 1 m the length of the bamboos or sticks laid side-by-side needs to be at least 3 m. The number of bamboos or sticks required can be then calculated by dividing the length above by the diameter of the bamboos or the poles. For our 90 cm pit this should cover 2.7 m.

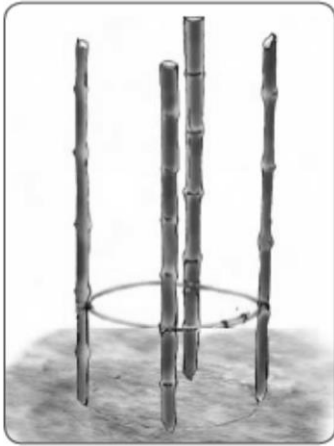


2. Make up three or more bamboo rings (about 3–5 mm thick and 15–25 mm wide) by bending and binding the ends together. These should be the same diameter of the pit, plus an overlap of around 50 cm.

The length of the bamboo ring = pit diameter x 3 + 50 cm.



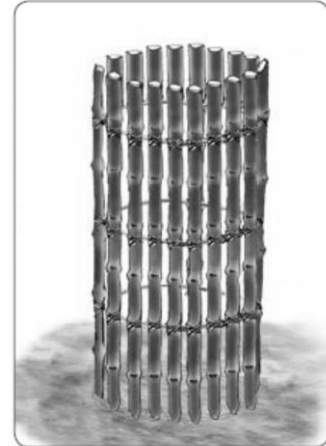
3. Use the machete to sharpen one end of the bamboos or sticks. This makes it easier so that they can be pushed into the soil at the bottom of the pit.
4. Place one of the bamboo rings on the ground. Put 4 bamboos or sticks on the outside of the bamboo ring at regular intervals. Lightly push or tap the bamboos or the sticks into the ground. Lift the ring up a short height and start to bind the bamboos or poles to the bamboo ring. Use rattan or bamboo string to bind each of the bamboo pieces to the ring.
5. Add the other remaining rings at even spaces and bind them in the same way.
6. Add the bamboo or stick, firmly binding them to the bamboo rings until the whole lining is complete.



Step 4



Step 5



Step 6

7. If you have dug a pit, then you can continue with the next construction steps. If not, then you will need to explain how to do the following steps.
 8. Place the lining into the pit.
 9. Use the mallet to knock the bamboo or sticks 15 cm into the ground. They should also stick out 10 cm above the ground.
 10. Backfill the space between the lining and the pit walls with the soil that was previously dug out to make the pit. Heap up the soil to create a platform 10 cm above the ground level.
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Practical Plan: Brick or Adobe Block Lining

**70 minutes total**

Lesson Description



In this practical session, participants become familiar with working with brick or adobe block pit linings. They learn how brick laying can be adapted to allow infiltration.

Learning Outcomes



At the end of this session participants will be able to:

1. Demonstrate how to line a pit using bricks or adobe blocks.
2. Explain how brick laying can be adapted to allow infiltration.

Tools and Materials



- Shovel
- Trowel
- Level
- Sand
- Gravel
- Cement
- Water
- Plastic or cloths (optional to use for mortar curing)
- 400 bricks or adobe blocks (use the cheapest possible local bricks, preferably handmade adobe blocks)

Note: Adobe blocks are rectangular blocks of clay baked by the sun or in a kiln; commonly used as a building or paving material.

Preparation



- Review topic in the Latrine Construction Manual
 - Review topic in the Cambodian DRHC (Department of Rural Health Care) Household Latrine Construction Manual
 - Organize the tools and materials at the work station
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Optional: Digging the Pit

Note: The participants can make the pit lining aboveground without digging the pit. Decide on whether or not the practical will be done inside a pit or at the ground level.



1. Ask the participants to dig the pit or hire someone to dig the pit prior to workshop.
 - Circular pit diameter = 90 cm
 - Depth depends on if it is just for demonstration or a real latrine:
 - i. If it is a real pit to be used, then determine the pit depth according to the Technical Brief: Sizing a Latrine Pit
 - ii. If the pit is just for demonstration, then dig it about 1 m deep
 - The width of the diameter of the pit should be increased by two times the width of the brick. For example, for bricks with a width of 10 cm, the diameter at the base of the dug pit should be: $90 \text{ cm} + 2 \times 10 \text{ cm} = 110 \text{ cm}$.
 - The walls of the pit should not be dug vertical, but V shaped. For every 1 m of depth the walls should be splayed by 10 cm. For example, a pit that is 2 m deep and with a diameter of 110 cm, should have a base diameter of 110 cm but the diameter at ground level should be 130 cm.

Constructing the Lining



1. Explain that you are going to demonstrate the basics of pit lining and three types of ways of laying bricks:
 - i. Fully sealed (for no infiltration)
 - ii. Verticals without mortar (for infiltration)
 - iii. Verticals with large spaces (for infiltration)
2. Explain that it is important to start with a flat bottom onto which the bricks can be laid.
3. Explain that if you have unconsolidated soil you should pour a concrete foundation (footing channel) on which the bricks will sit. The foundation will give the bricks and structure stability. It should be 15 cm deep and 20 cm wide. This ring will be the base on which the bricks can be laid.
4. In the bottom of the pit, demonstrate how to arrange a layer of gravel (5 cm deep). Add a thin layer of sand to the top of the gravel and wash it into the gravel with a small amount of water.
5. Demonstrate how to mix the mortar using the ratio 1 part cement to 4 parts sand (1:4).

6. Demonstrate how to place a ring of mortar around the bottom of the pit and set the first layer of bricks on top of it. Discuss how there is no need to put mortar in the vertical joints between the bricks. This provides a porous lining so that liquid can infiltrate into the soil. If the soil is very stable and has a high clay content, then it may need larger holes to allow water to pass through. This type of lining cannot be used in loose unstable soils as the soil may fall through the holes into the pit. The pit wall also have less structural strength as there is less contact points for mortar.
 7. Add the next layer of bricks on top of the first using a mortar layer. Again, do not put mortar between the vertical joints. Also make sure that the vertical joints are in the center of the brick underneath. Continue until 3 brick layers have been done.
 8. Add the fourth layer of bricks using a mortar layer. Again, do not put cement between the vertical joints. But this time make the vertical spacing 1/3 of the brick length. Show how the vertical joints for each layer will be a third across the bricks. Continue adding layers until you have reached the top 50 cm of the pit.
 9. Explain the final 60 cm will need to be completely impermeable for the footing (50 cm for the pit footing plus 10 cm aboveground). Explain we are now going to practice this.
 10. Add the next layer of bricks using a mortar layer. Make sure that the participants put cement between the vertical joints. Also make sure that the vertical joints are in the center of the brick underneath. Continue adding layers until 3 layers have been done.
 11. If there is enough time, ask the participants to also apply render (a layer of mortar) to the top three layers of brick wall. Demonstrate how to make the top 50 cm of the pit wall impermeable. Explain that you can also use render on chicken wire if you are building a pit lined with bamboo or sticks to make the top 60 cm impermeable. And similarly would need to allow it to cure for 3 days.
 12. Explain that during the curing process the mortar must be kept damp. This will ensure that the strength of the mortar is maximized. Allow mortar to dry completely over 3 days. While curing, cover it with plastic or moist cloths. Add water as needed to keep it damp.
 13. Backfill the space between the lining and the surrounding ground with soil. Pack the backfill with a shovel or piece of timber. Optional: Clay (if locally available) or mortar can also be used to backfill the top 0.5 metres between the pit lining and ground. This will create a water resistant seal between the lining and the ground, preventing surface water draining down around the lining. Using mortar would increase the construction costs.
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Practical Plan: Concrete Ring Holding Tank or Pit Lining 70 minutes total

Lesson Description



In this practical session, participants become familiar with working with precast concrete rings to construct a holding tank. They learn how to adapt the concrete rings to allow infiltration in a pit latrine. Participants also learn the caissoning technique for excavating a pit in unstable soil.

Learning Outcomes



At the end of this session participants will be able to:

1. Demonstrate how to line a latrine pit using concrete rings.
2. Demonstrate how to use the caissoning technique to excavate a latrine pit.
3. Demonstrate how to build a holding tank using concrete rings.

Tools and Materials



- Level or clear plastic hosepipe filled with water
- 2 shovels
- Rubber mallet
- Trowel
- Large pile of sand (minimum 1 m³)
- Cement
- Sand
- Gloves
- Clear plastic tubing (5 m in length)
- 3 concrete rings (number depends on size, preferably the rings should be 30 cm in height for the pit lining, can also use perforated rings for the pit lining if they are locally available)
- 12 strong bricks or stones that are flat and of equal height (minimum height 5 cm)

Preparation



- Review topic in the Latrine Construction Manual
- Review topic in the Cambodian DRHC (Department of Rural Health Care) Household Latrine Construction Manual
- Organize the tools and materials at the work station
- Place one concrete ring on top of the sand pile

Constructing a Holding Tank



1. Explain that the participants will be practicing two ways of using concrete rings to construct:
 - i. A holding tank which should be impermeable
 - ii. A lined pit that is permeable
2. Explain that they are first to construct an impermeable holding tank. Explain that this would typically have a poured concrete floor, or a precast concrete base.
3. Place one concrete ring on the ground. Ask the participants to check that it is level. This can be done using a level or either with a clear plastic tube filled with water. Hold the tube so that the water is level with the top of one side of the ring. Then hold the other end of the tube at the opposite side of the ring. The water in the tube should be level with the top of the ring on both sides. Adjust the ring until it is sitting level.
4. Demonstrate how to mix the mortar using the ratio 1 part cement to 4 parts sand (1:4).
5. Mortar the top edge of the first concrete ring.
6. Placing the second ring on top. Mortar again around the inside joint line. Check again that the rings are level.
7. Repeat placing rings until the desired height. You can just place one or two rings for demonstration purposes.
8. Explain that during the curing process the mortar must be kept damp. This will ensure that the strength of the mortar is maximized. Allow mortar to dry completely over 3 days. While curing, cover it with plastic or moist cloths. Add water as needed to keep it damp.
9. Remind the participants that this method is used to construct a holding tank or as part of a septic tank. The base would also have to be sealed so that water cannot infiltrate.

Constructing a Pit Lining



1. Place and level a new concrete ring on the ground. Or remove the top rings from the demonstration holding tank before the mortar has dried.
2. Mortar the separating stones around the top edge of the concrete ring. The stones must be evenly placed around the edge so that the next ring will balance safely on top.
3. Place the second ring on top of the stones. Mortar the stones to the top ring. Make sure there is space between the separating stones that is not mortared to allow water to infiltrate.
4. Explain that concrete rings which are not very high will have more gaps and so are preferable as they will allow more infiltration. In some areas there are rings purposefully made for this which are about 30 cm in height.

5. Remove the concrete rings form each other. Take off all the mortar and the separating stones to allow the next group to perform the activity. The group must then move to the caissoning demonstration.

Caissoning Demonstration



1. Explain that in some conditions soil is unstable and so it is difficult to dig without the pit wall collapsing in. To prevent this we can use a technique called caissoning.
 2. Place a concrete ring onto the sand pile.
 3. Ask some participants to dig out the material from the inside of the ring and dump it outside the ring. At the same time, others put pressure on the outside of the ring by pushing it down with their hands or using a mallet.
 4. When the ring is emptied of sand and level with the sand pile they have completed the task.
 5. Explain that typically they would continue the process by adding rings on top and continuing to dig inside and pushing the rings down.
 6. Ask the participants “What can you use instead of the concrete rings?”
 - *Perforated steel or plastic drum which has had the bottom removed*
 7. Remove the ring and place the sand back in a pile again for the next group.
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