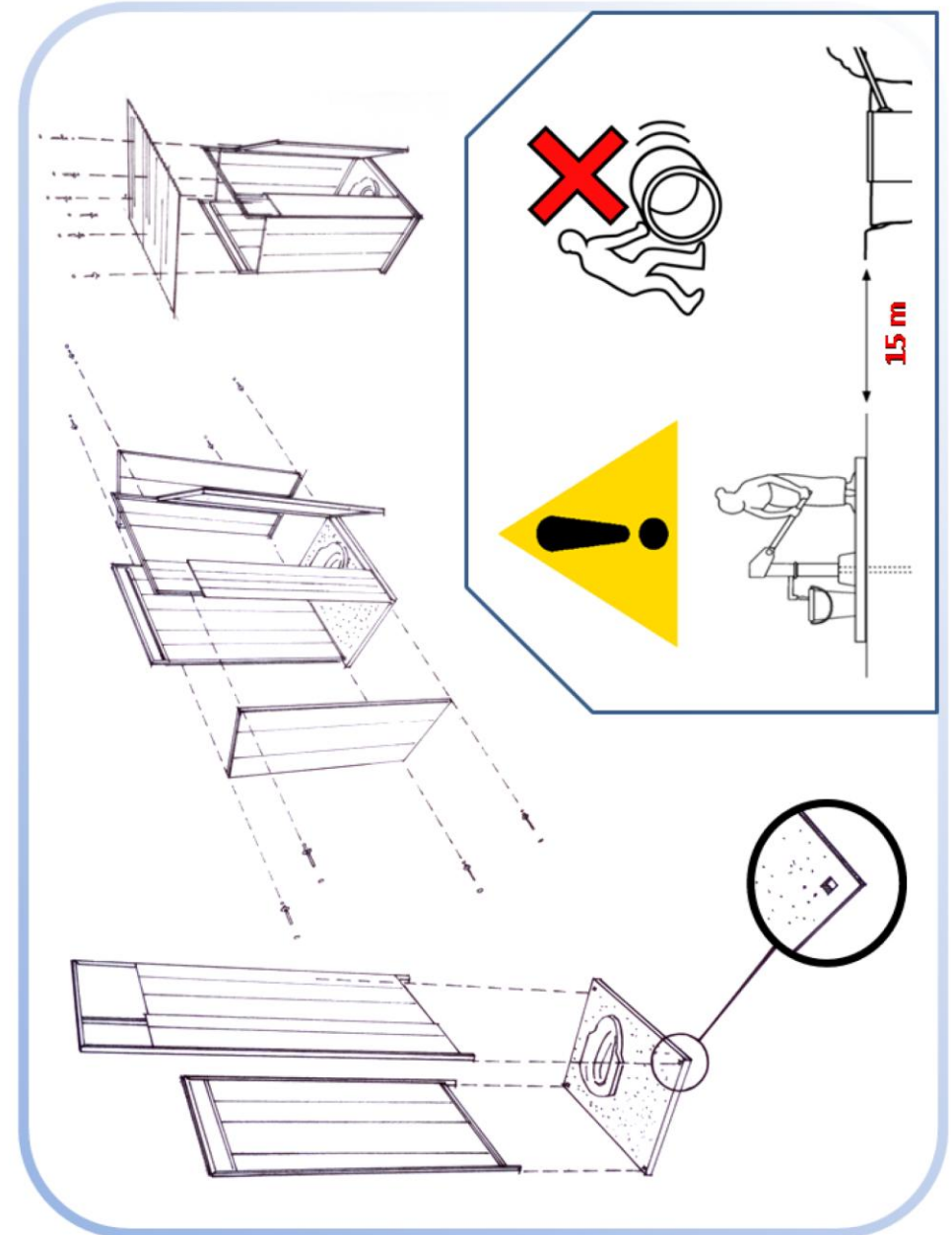


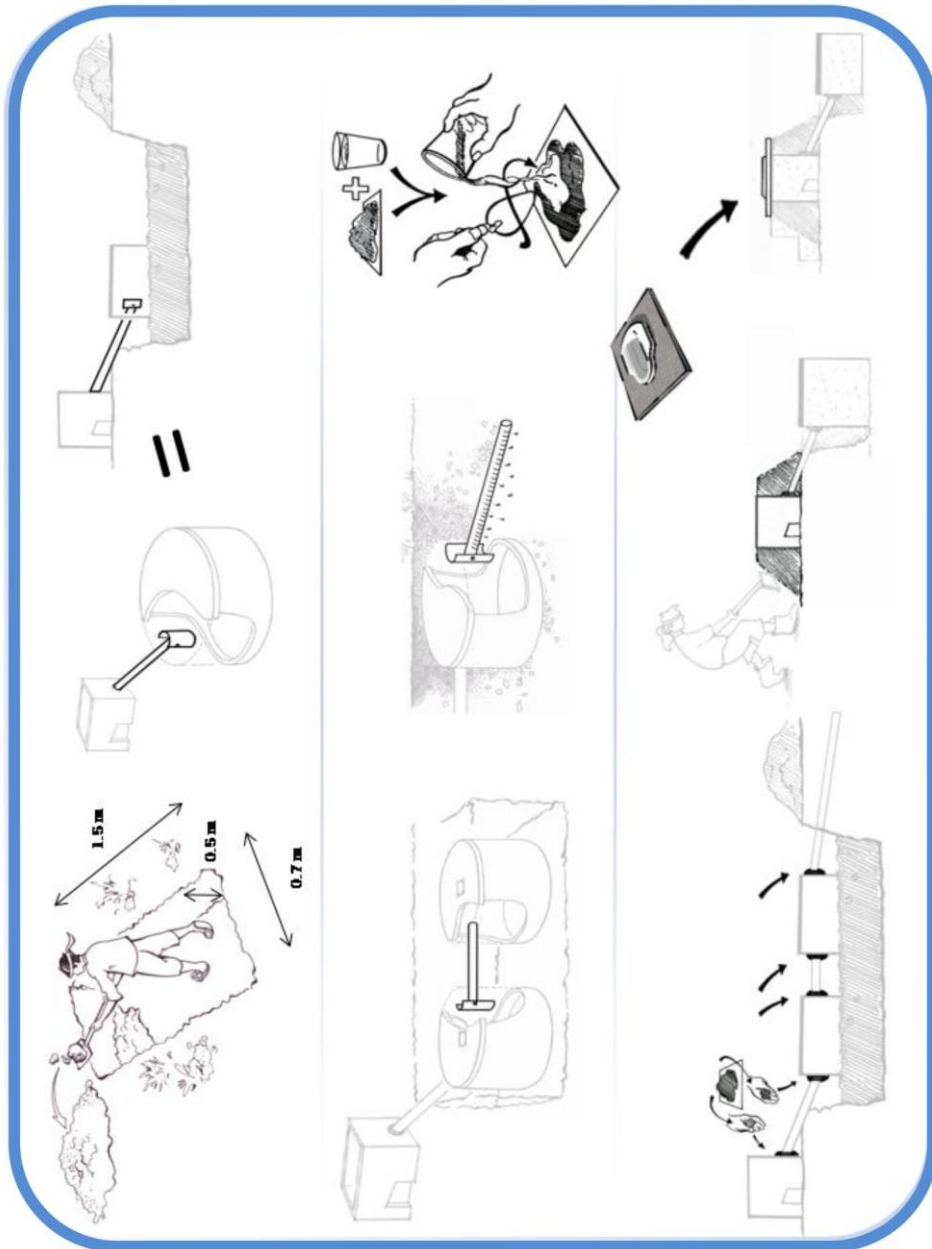
LATRINE

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SHELTER

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PAST BUSINESS

“My name is LEANG Kry. Since 1999, I have been running a small store selling particularly latrine elements and other construction materials. Previously, I thought the latrine business could only be a side-business and that I couldn’t make much profit for my family due to several reasons.

First, the profit I was making per latrine was 10-30 USD per latrine sold and installed (cement ring, pan, and cover). I was selling about 1 latrine per week so I could earn approximately 40-80 USD a month out of this business. Second, in my town people save and then spend 200-300 USD to get a latrine installed because they want it to be a brick-wall shelter and it takes a lot of time and budget. I had to go to the place and spend several days there to build the latrine, but I was selling only a few of them.

The old model of pour flush requires digging to 1.50m depth. In my region, Takeo, the bed rock is very shallow, which make it difficult for people to dig the bed rock in order to install the latrine. Many people told me that they can afford a latrine but they cannot find place for it. Digging is very hard here.

Finally, I never thought of doing marketing or advertising on the latrine. And I found people did not always really know about sanitation and hygiene practice. They thought there is no need for latrine because they can defecate wherever.”

NEW BUSINESS

“With new latrine design and marketing method I am not anymore relying on people to come, I’m going to them. Before I was selling few latrines with big profit, now I take little profit per latrine but I sell a lot of them, the benefit is now much higher for me and my family.

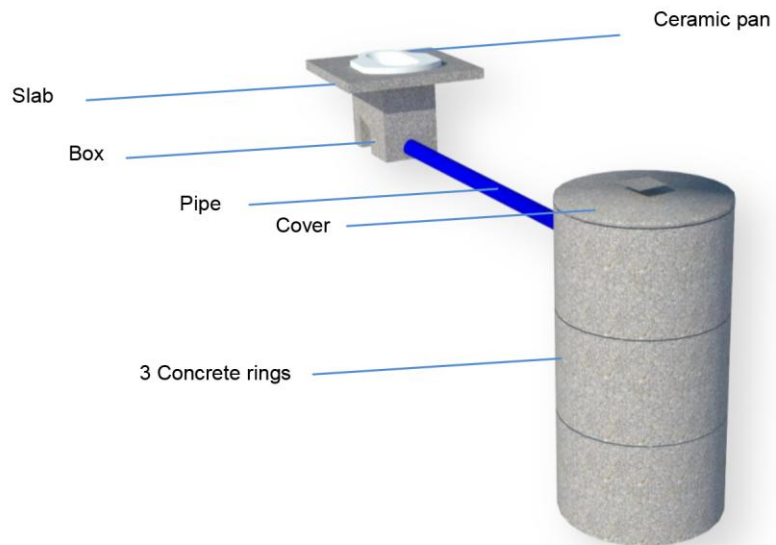
On the production matter, I see the improvement of production speed. With only one inside mold and two outside molds, I can production 10 cement rings/day, compared to 6 cement rings/day before. The box system allows the people to build latrine themselves, I’m spending my time for production rather than installation. The design and the price and the promotion made my business jump up to 30-60 latrines a month. Now, I can earn about 200-400 USD a month.

I realize that good design of latrine and good site management alone did not make latrine sold a lot. Without good marketing and promotion method, people do not know about our product.

Learning from door-to-door marketing way, I find it helpful in many ways. I can sell not only latrine but also construction material. In addition, I can build my reputation and spread the information on latrine, thus sanitation and health.”

Pour flush latrine

Developed by IDE-Cambodia, the "easy latrine" is inspired from the originally developed in India by Sulabh International double pit latrine, the main interest of this technology is the price and the productivity we reached. The constructions methods are therefore at the center of the design, which we'll try to explain the best we can.

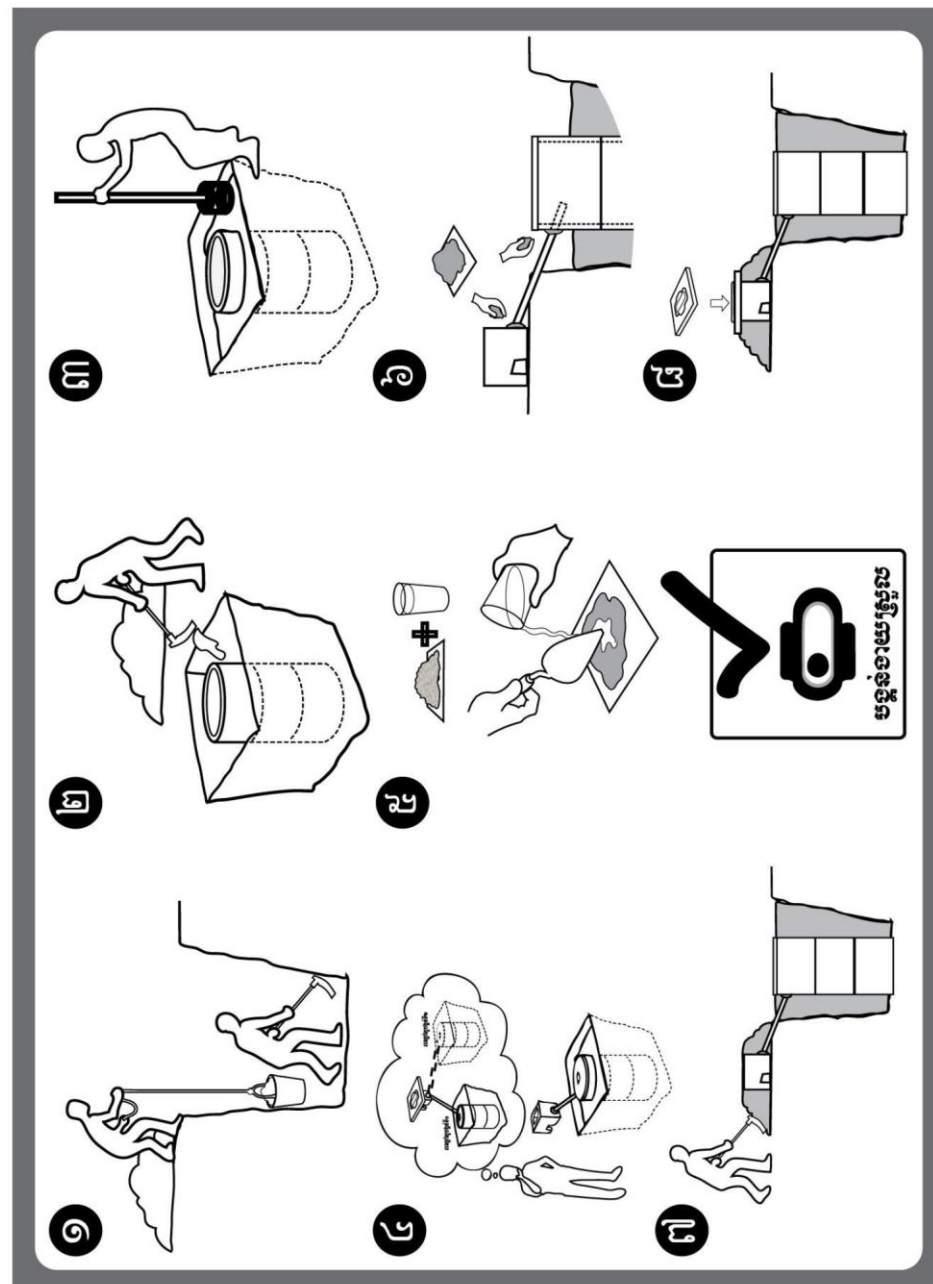


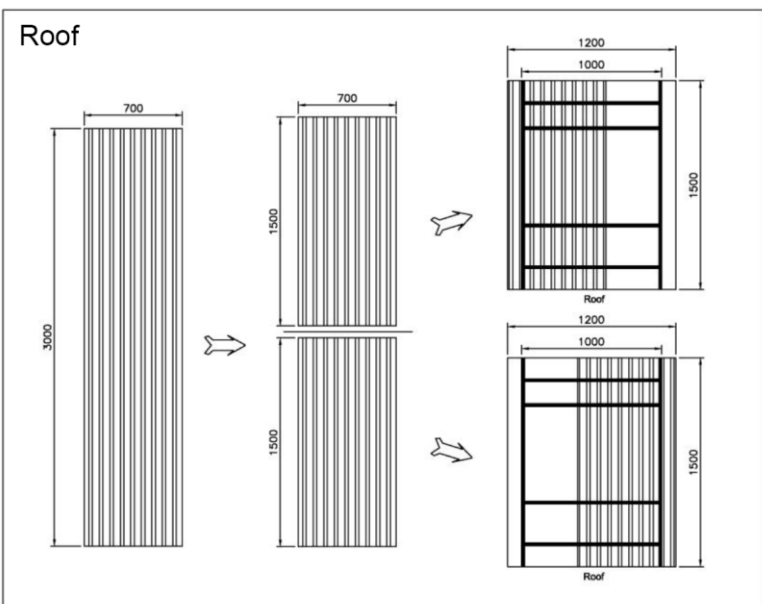
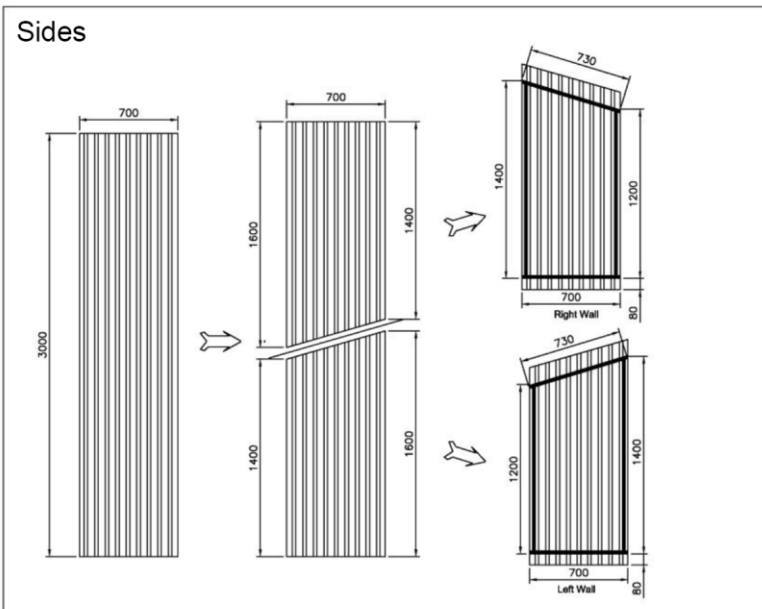
The elements will be described in the following chapters

- Quantity of concrete : 190 liters = 400 kg
- Effective capacity volume : 650 liters
- Labor time for construction of elements : 1 day worker
- Average material total price : 19 US\$ = 80,000 Riels



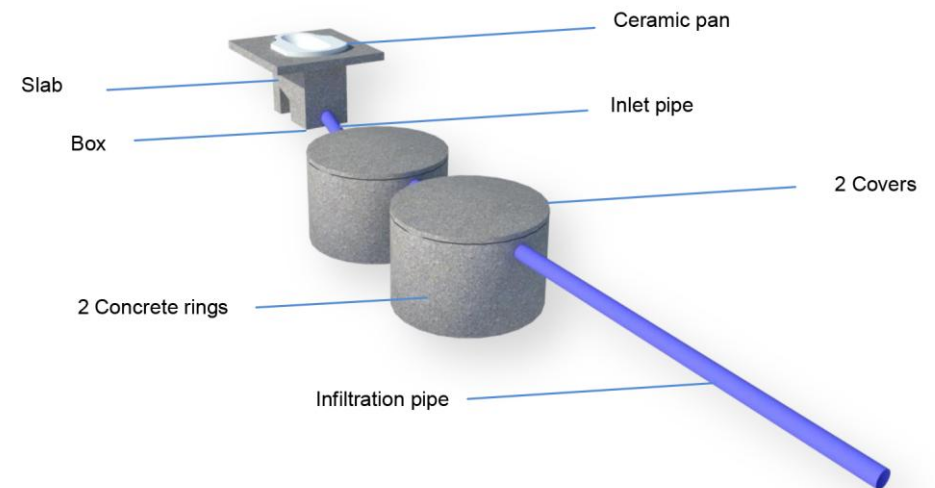
A second pit should be purchased by the user. When full, the first pit should be filled with soil. After 6 months the night soil becomes valuable compost. The second pit is usually sold for 10 \$. You can reuse the same pipe for both pits by changing the angle.





Pour flush micro septic tank

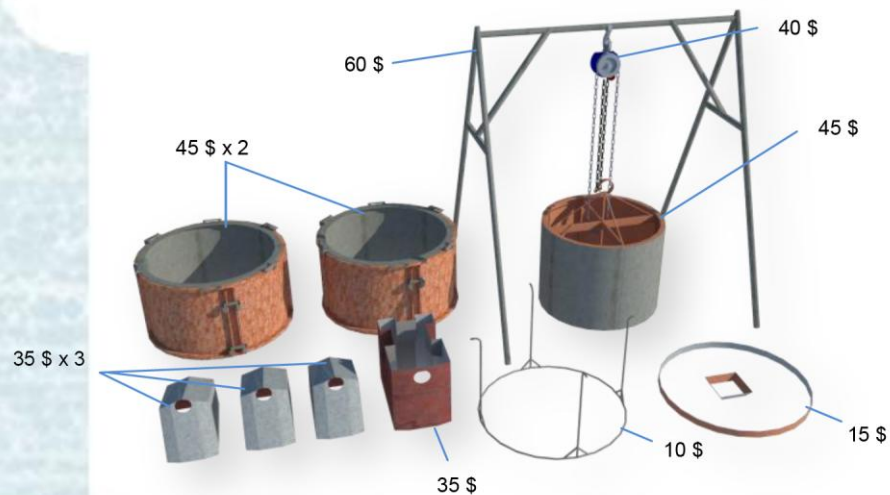
This concept has been developed by GRET in the areas where the bed rock is too shallow making impossible to dig more than 50 cm in depth. An optional third ring placed after the second pit and before the infiltration pipe will improve the treatment capacity of the latrine.



- Quantity of concrete : 175 liters = 380 kg
- Effective capacity volume : 450 liters
- Labor time for construction of elements : 1 day worker
- Average material total price : 21 US\$ = 88,000 Riels

Initial investment, Location and Human Resources

The following material and investment allow a production of 3 complete latrine/day.



TOTAL MOLD : 400 US\$

Investing an additional \$45 for a second outside mold increases production capacity from 10 rings/day to 15 rings/day.

To ensure product quality and optimal concrete strength the thinner rings of this technology require the concrete to cure (i.e.: not be moved) for 10 days before it can be transported.

INITIAL STOCK : 350 US\$

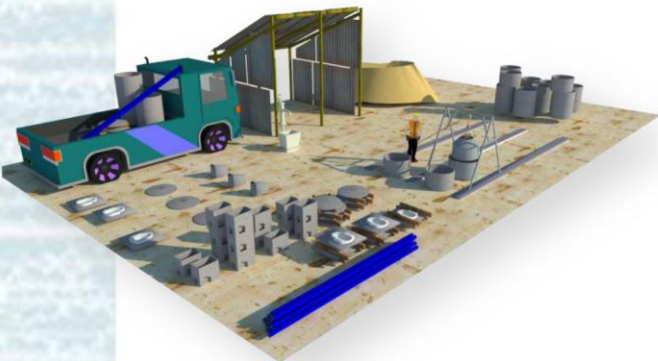
Land requirement: 100 m² Minimum

Water access: 350 liters/day

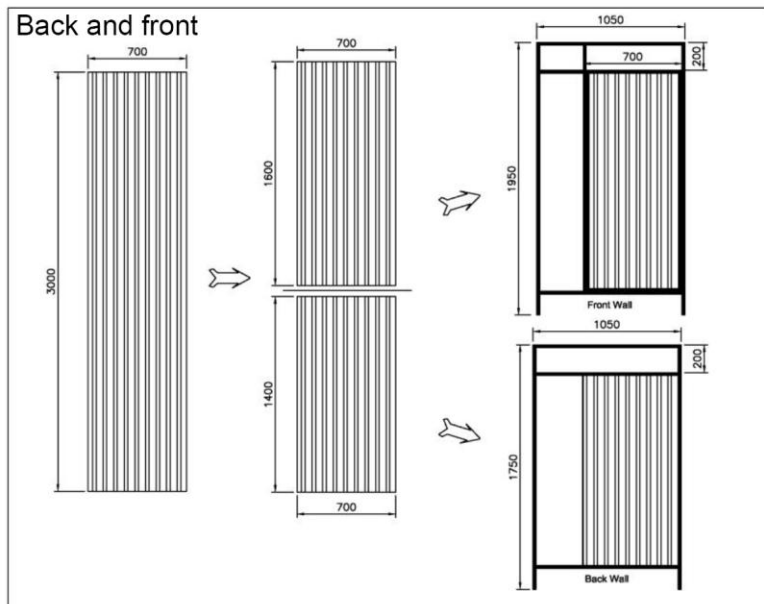
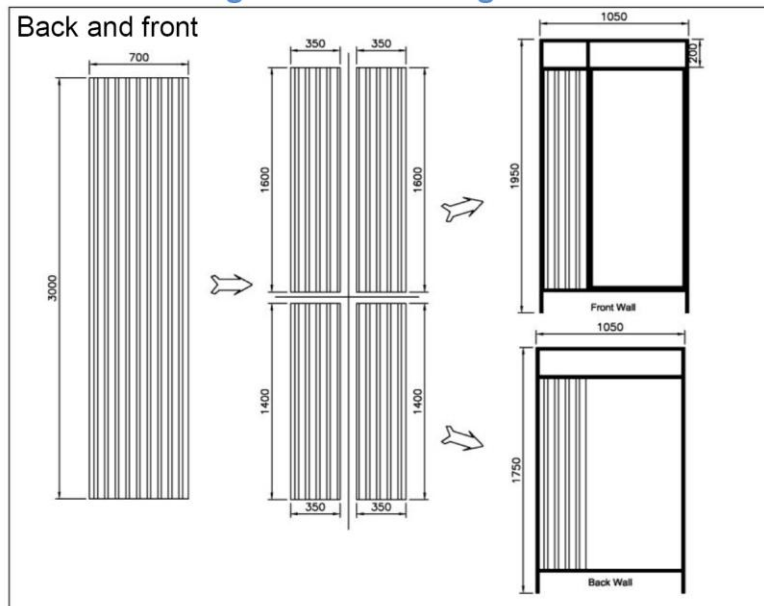
Cement stock: Covered area for cement required

Transport mean: Able to transport minimum 2 complete latrine on local roads (800kg and 3 m²)

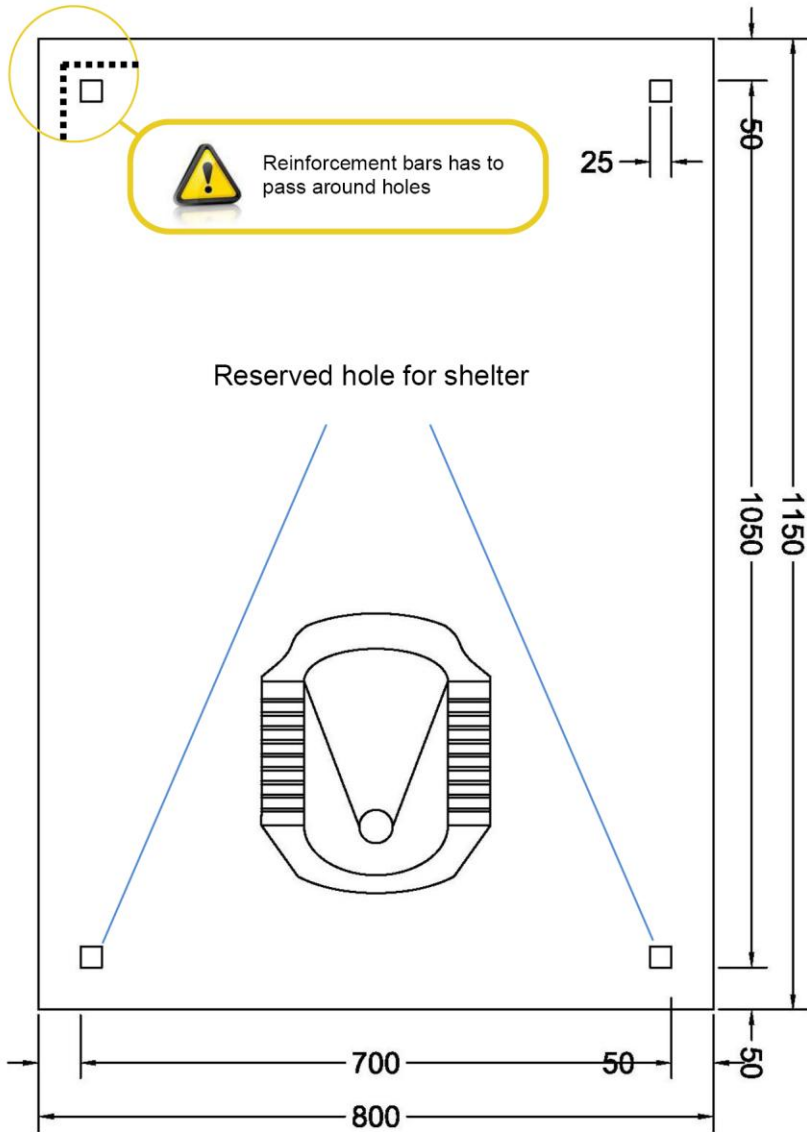
Working team: 3 Laborers



Corrugated iron cutting models

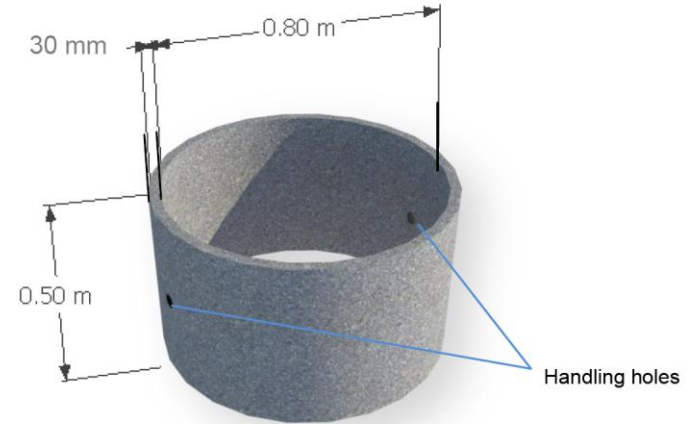


Slab with Holes Ready for Shelter Installation







Concrete ring

The concrete ring is an element pretty simple made from different methods and molds according to the country or region. Presented here is efficient, cost cutting method to make rings that that are strong enough to be transported several kilometers on bumpy roads without cracking or breaking.



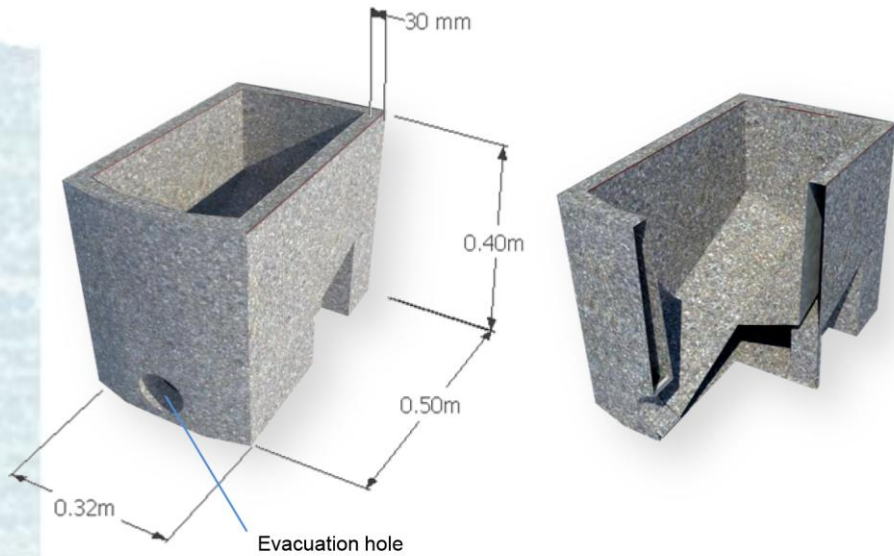
Two handling holes are needed to transport the rings, a bar through the handling holes will make it easy to move. The total weight is 80 kg, and inside volume is 250 liters.






Element	Kg/m ³	Weight kg	Volume l	Price (riels)	Price (\$)
Sand 	1600	62	39	1,500-1,700	0.35-0.4
Water 	120	4.5	3		
Cement 	400	12.5	4	5,000-7,000	1.2-1.65
Rice Husk Ashes 	20	0.61	2		
Reinforcement 	5	0.06		500-1,000	0.1-0.23
		80 kg	39 l	7,000-9,700	1.65-2.3

Adding 5% of cement weight in rice husk ashes increase the concrete strength significantly but decrease it if you put a higher ratio.

Box

The box is a key element in both latrine designs and requires lots of care especially when the molds are made. The diameter of the evacuation hole is 80 mm.

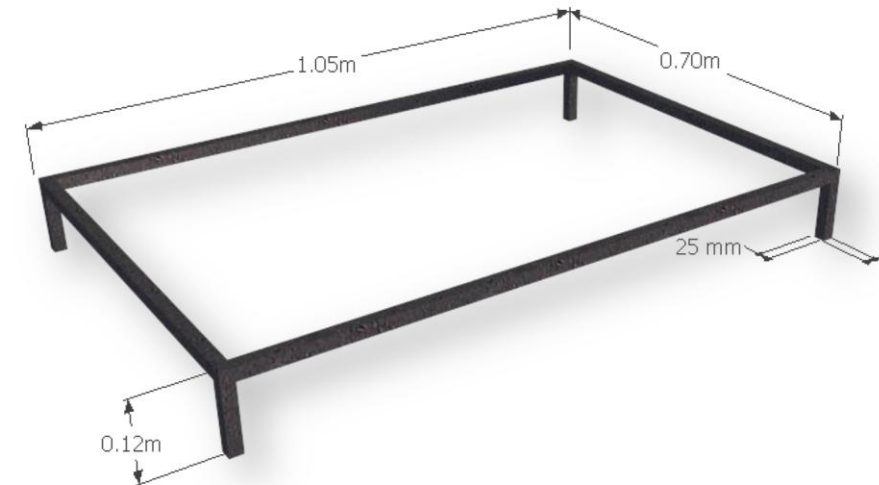


Element	Kg/m ³	Weight kg	Volume l	Price (riel)	Price (\$)
Sand 	1600	38	23	900-1100	0.2-0.25
Water 	120	2.7	2	20	
Cement 	400	10	3	4000-4200	0.9-1
Rice Husk Ashes 	20	0.3	2	20	
Reinforcement 	1	0.02		50	
		50 kg	25 l	7,000-9,700	1.1-1.25

Pattern for Slab holes

The pre-fabricated shelter should be installed using the Big Slab, as illustrated on page 19. The shelter supports are inserted into the holes in the slab. The Big Slab needs to be produced with 4 precisely located holes so the holes line up with the shelter supports.

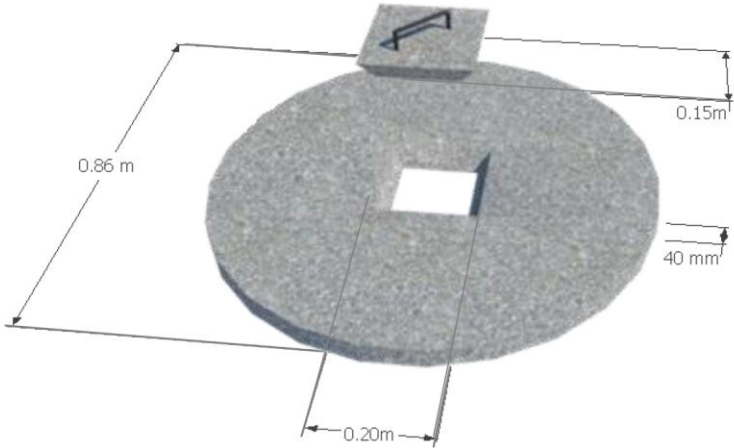
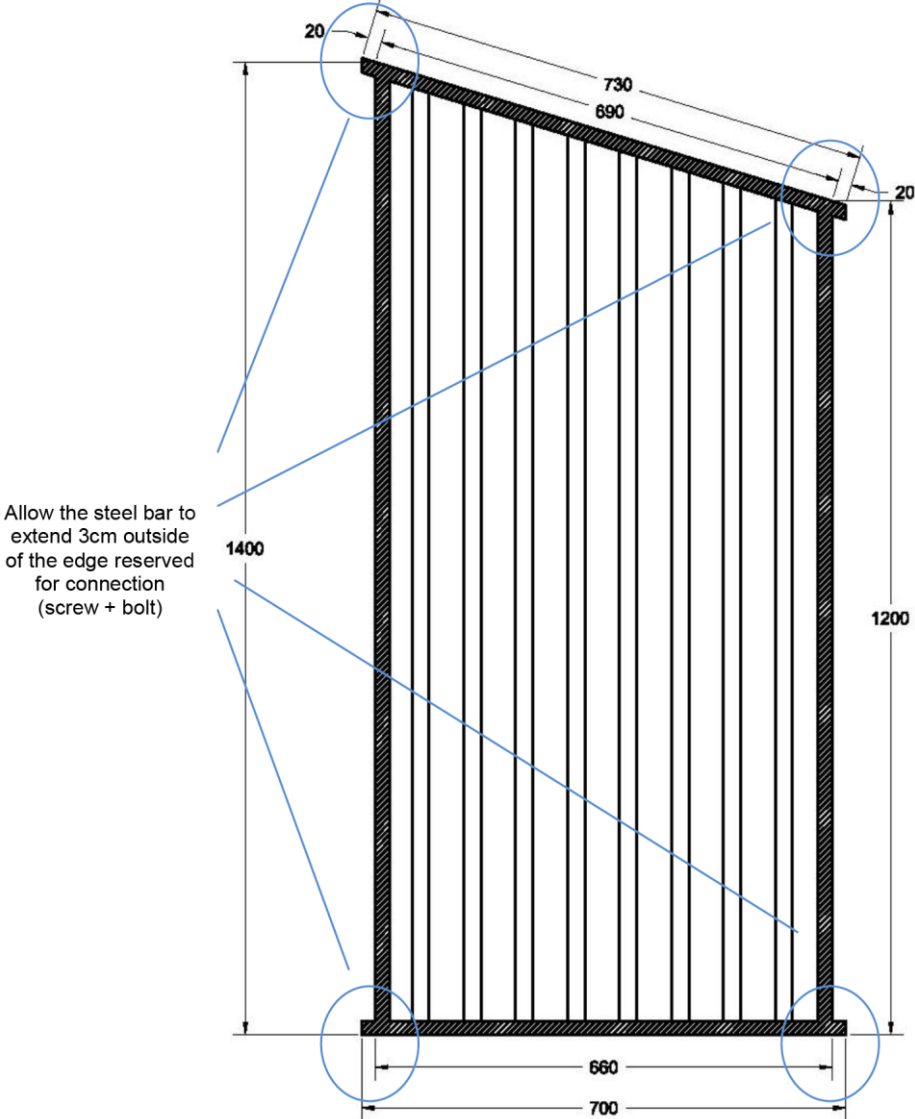
Use a hole metal pattern that is inserted into the wet cement of the Big Slab to create these holes, remove it when the concrete is strong enough. Create the hole pattern following the dimensions below.





Cover

The cover's hole has a "upside down pyramid" shape, but can be adapted to what is common in the area. It is important to remember that the sludge removal tool (pipe, pump, gulper, etc...) can enter in through the hole.

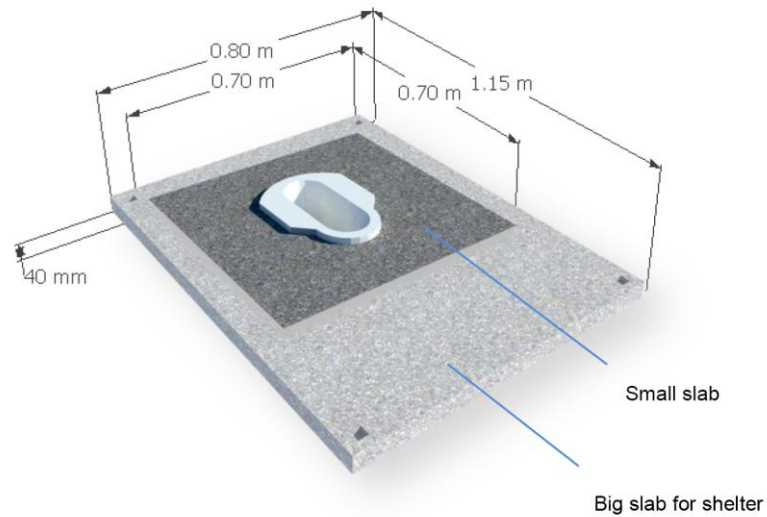
Pattern for right side walls



Element	Kg/m ³	Weight kg	Volume l	Price (riel)	Price (\$)
Sand 	1600	36	50	900-1100	0.2-0.25
Water 	120	2.6	2	20	
Cement 	400	9	3.2	4000-4200	0.9-1
Rice Husk Ashes 	20	0.3	0.7	20	
Reinforcement 	70	1.4		4000-5000	1-1.2
		58 kg	25 l	8,950-10,350	2.1-2.45

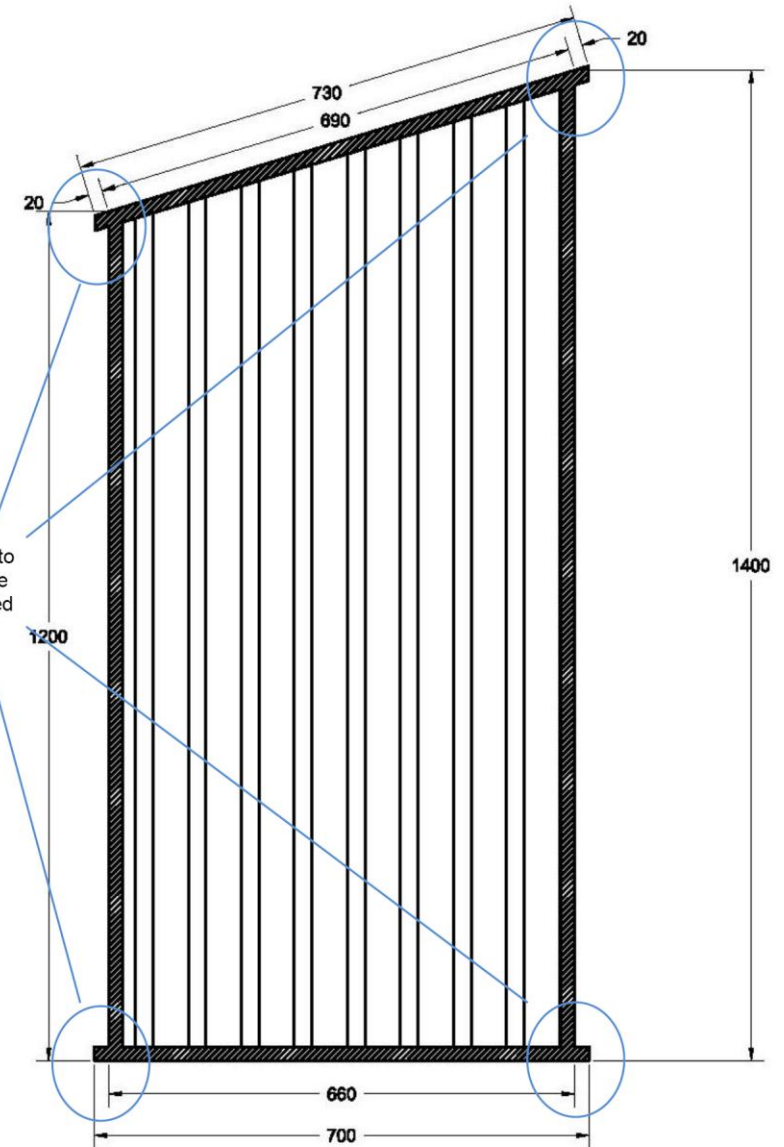
Slab and ceramic pan


Different slabs are used for different uses, a bigger model with holes has been designed in order to join the shelter with it. The left rows of the quantity chart refer to the small slab, the right rows refer to the big one. For the big slab construction methods, please go to page 29.



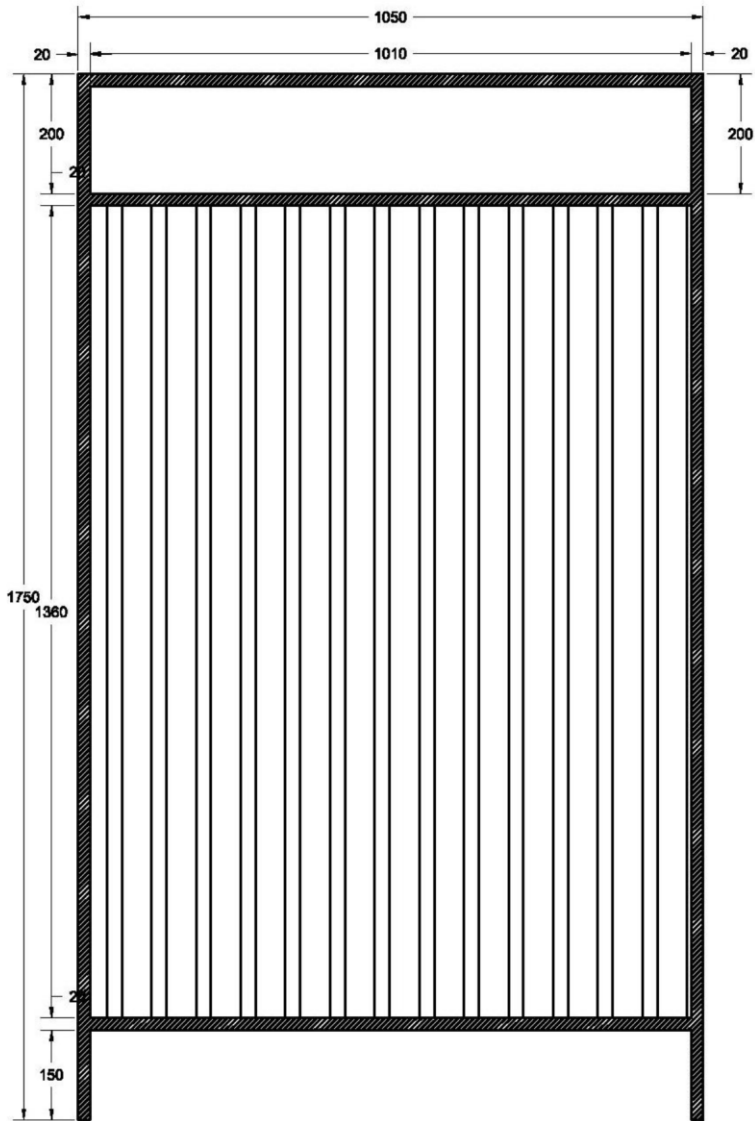
Pattern for left side wall

Allow the steel bar to extend 3cm outside of the edge reserved for connection (screw + bolt)



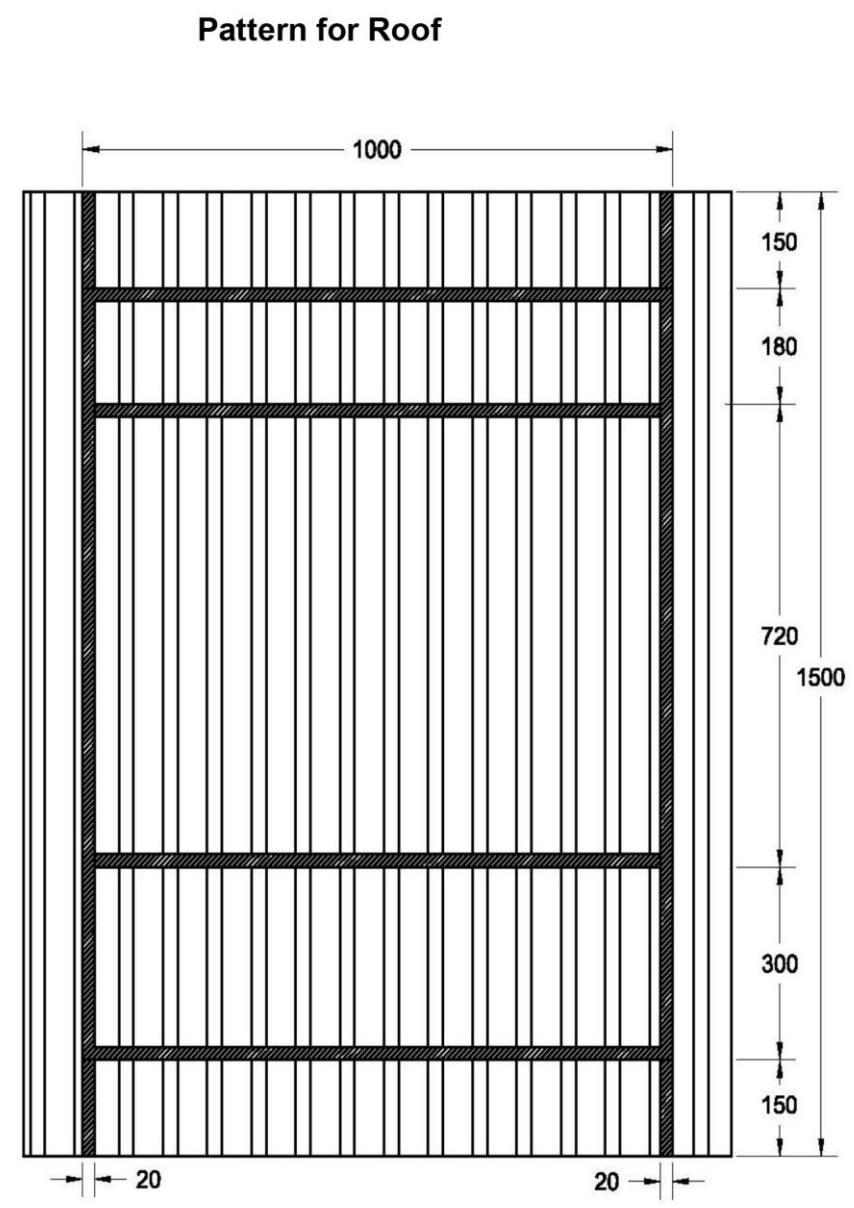
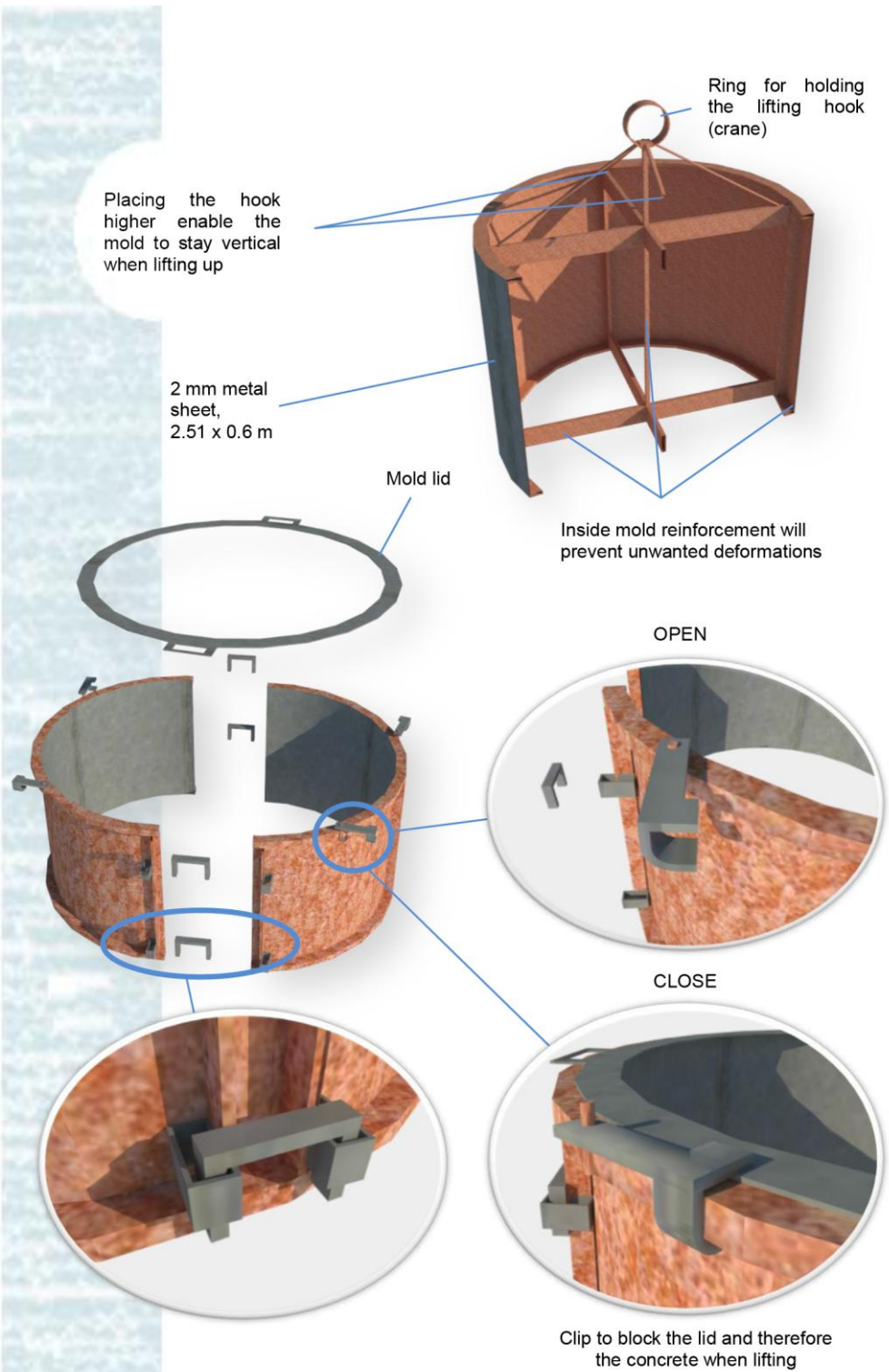
Element	Kg/m ³	Weight kg		Volume l		Price (riel)		Price (\$)	
Sand 	1600	32	64	50	100	1000	2000	0.2-0.25	0.4-0.5
Water 	120	2.6	5	2	4	20	40		
Cement 	400	8	16	3	6	3900	7800	0.9-1	1.8-2
Rice Husk Ashes 	20	0.3	0.6	0.7	1.4	20	40		
Reinforcement 	70	1.4	3			4500	9000	1-1.2	2-2.4
		47 kg	95 kg	19 l	38 l	9,000	18,200	2.1-2.45	4.2-4.9

Pattern for Back wall

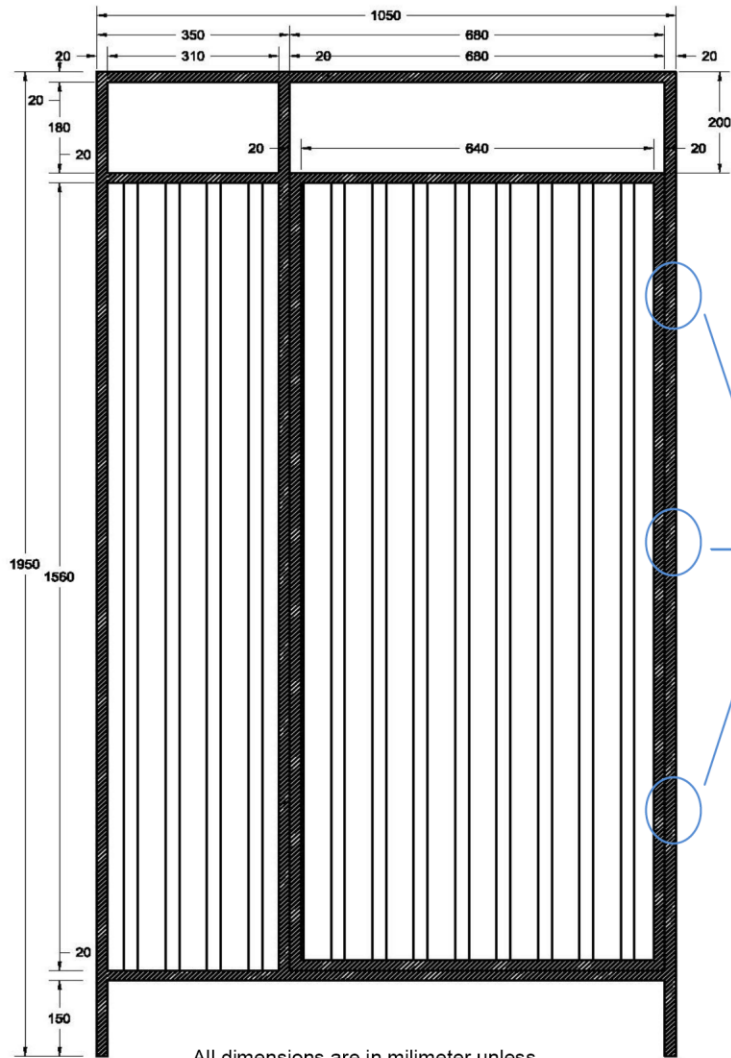


Ring Molds





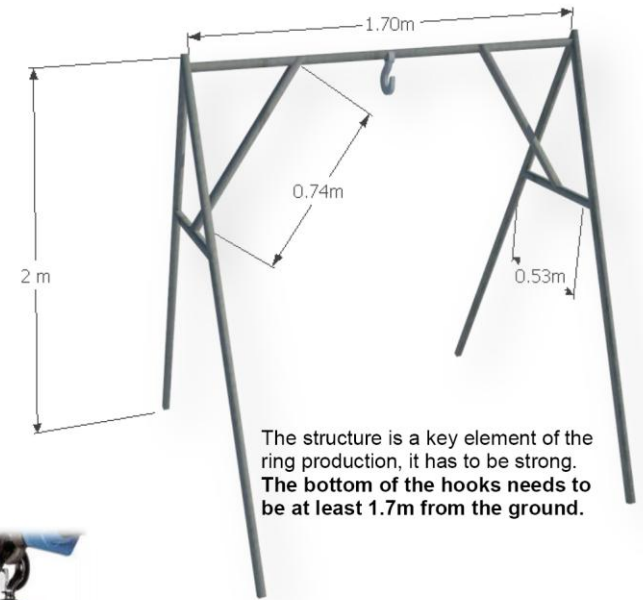
Pattern for Front Wall



Install door hinge

All dimensions are in millimeter unless otherwise stated

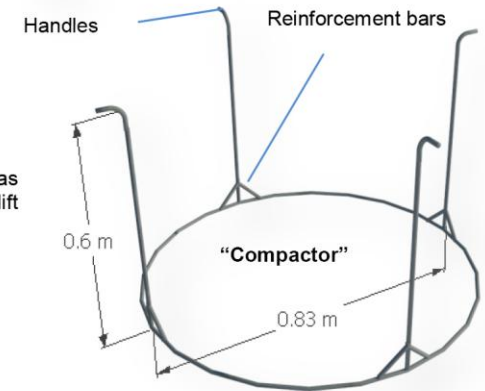
Structure & accessories



The structure is a key element of the ring production, it has to be strong. The bottom of the hooks needs to be at least 1.7m from the ground.



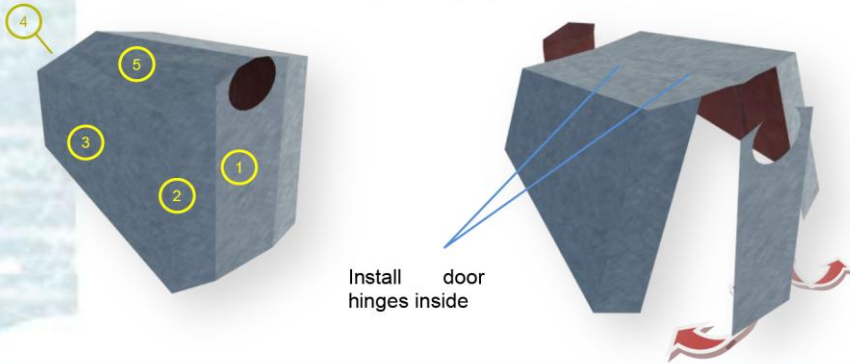
The crane has to be able to lift 2 tons.



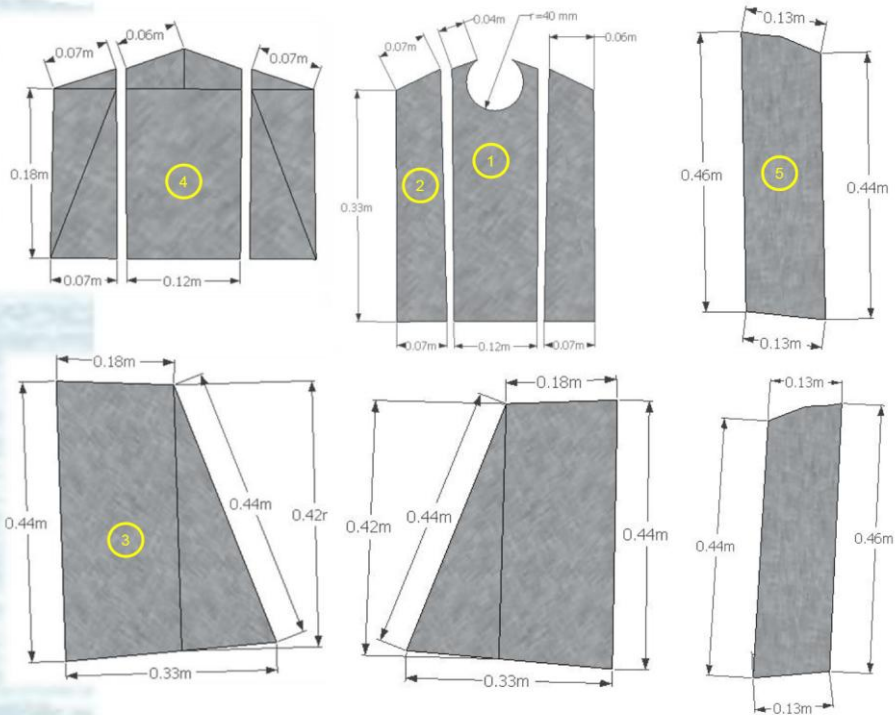
The concrete is very dry and needs to be compacted as the mold is being filled. The "compactor" tool needs handles to protect the laborer's hands and reinforcement bars are needed to make the tool more durable.

Techniques and methods are explained further on.

Box mold



The inside box mold has got a pyramid shape, which means a smooth angle makes the mold removal easy, this point is very important if you don't want to break the box when you're removing it and breakage during removal minimal.



Initial Investment



200 \$



30 \$



10 \$



30 \$



25 \$ x 5



10 \$

TOTAL : 405 US\$



The production steps are the following:

STEP 1 Use the shelter pattern to measure the length for the shelter frame by placing the steel pieces into the pattern and cut to the length of the pattern (1).

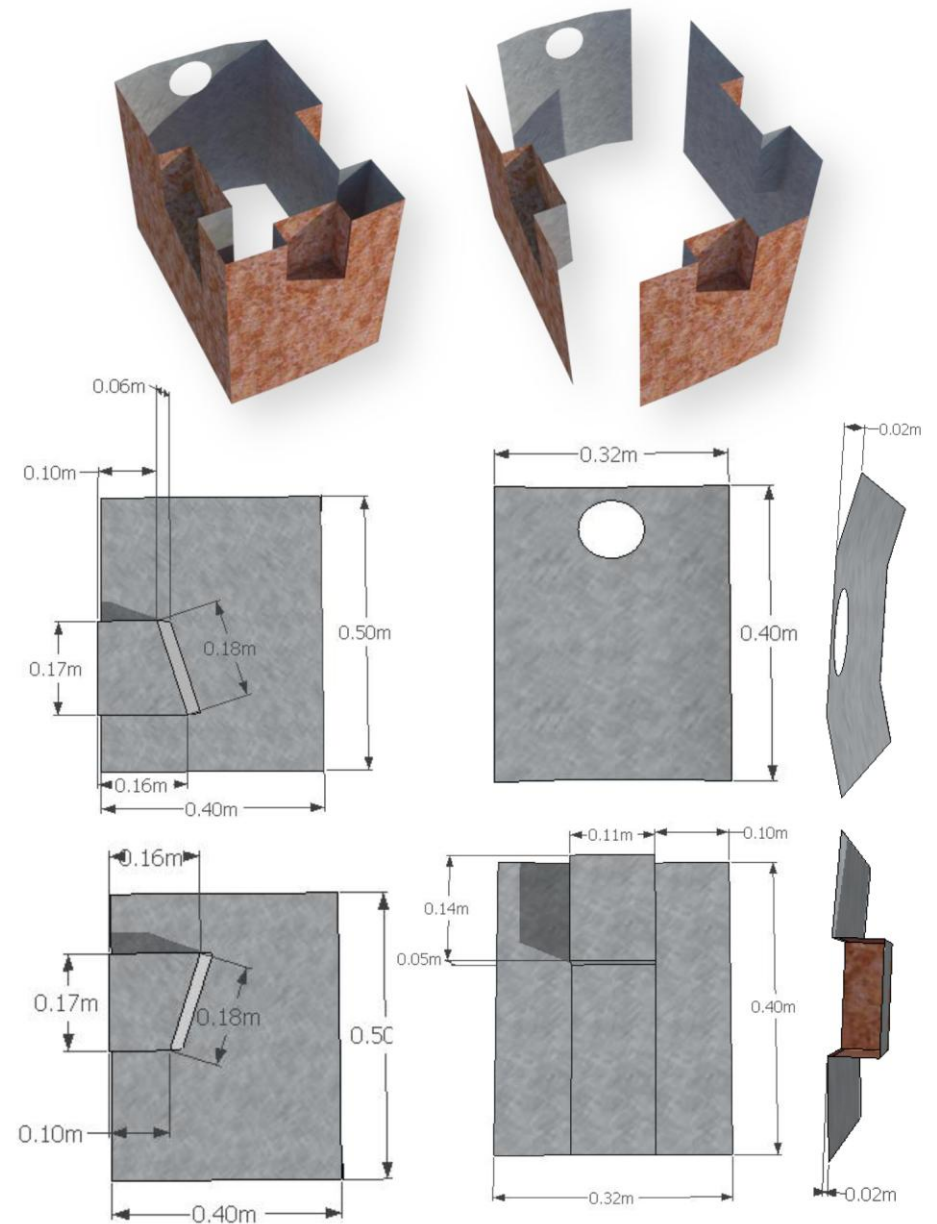
STEP 2 For the horizontal frame pieces, on the ends of the steel cut off only 3 sides of the steel and leave at least 25 mm of excess length on one side. This extra steel at the end will be used to attach pieces together (2).


STEP 3 When all of the pieces have been cut, drill a hole through both bars to connect. Make sure the hole is the same diameter as the head rivets (3).

STEP 4 Secure rivets in the drilled holes to attach together all of the pieces (4).

Then you'll have to cut corrugated iron following the instruction on following chapter Corrugated iron cutting model p30.

STEP 5 Attach the corrugated iron to the each of the four walls of the shelter frame by drilling holes through the corrugated iron and the shelter frame and attaching them together using rivets. Attaching the corrugated iron to the frame makes the finished shelter stable and strong (5).

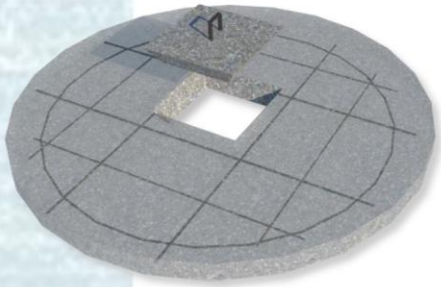


 The choice of making the shelter 0.7 x 1.05 m on the ground has been made because in Cambodia the standard width for corrugated iron is 0.7 m. Corrugated iron is the most expensive part of the shelter, you will understand looking p 30 corrugated iron cutting pattern. In other country, other dimensions can be taken keeping the spirit of the design.

Concrete Reinforcement

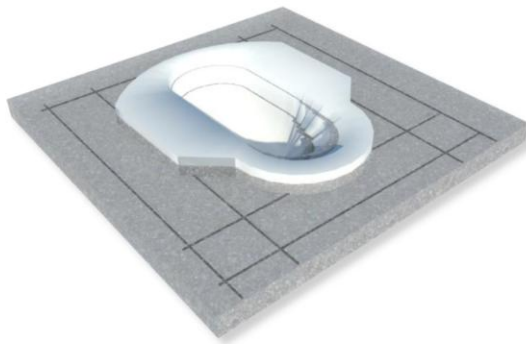
Basic rules of reinforcement bars

- The steel bars have to be attached to one another with wire – The reinforcement steel bars should always be placed in the middle of the concrete, because of the thinness of the concrete components this is of extreme importance – High adherence steel bars should be used, but smooth bars can be used – The steel bars need to be inside the concrete and not at all visible on the outside - DO NOT use bamboo reinforcement for these elements this will produce a low quality product that risks braking and harming users.

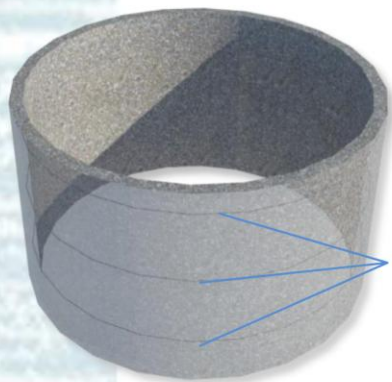


The cover metal reinforcement are usually **4 mm** diameter but should be bigger if we expect cars or heavy loads on this cover through the time. **Almost 7 m long are required for the cover.** It is extremely important to place the steel bars in the middle of the concrete.

The center hold cover doesn't need reinforcement but a handle bar for lifting.



The steel reinforcement for the slab needs to be at least **4mm diameter. 4.2 m long are required.** Placement of the steel reinforcement is more important than the diameter of the steel. The steel bars need to be placed underneath the ceramic pan at the edges to support it - placing the steel bars too far towards the middle of the ceramic pan will make it difficult to form a seal between the ceramic pan and catchment box when the latrine is assembled.

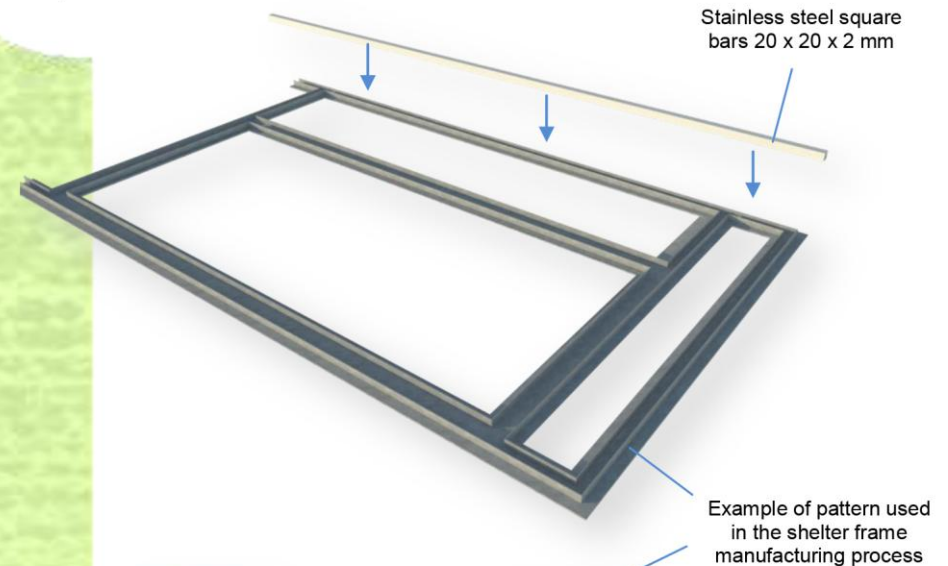


Reinforcement bars

Reinforcement for the rings is very thin stainless steel wire, 2mm diameter. Three rings of the wire needs to be placed equal distance apart while avoiding covering the handling holes in the middle.

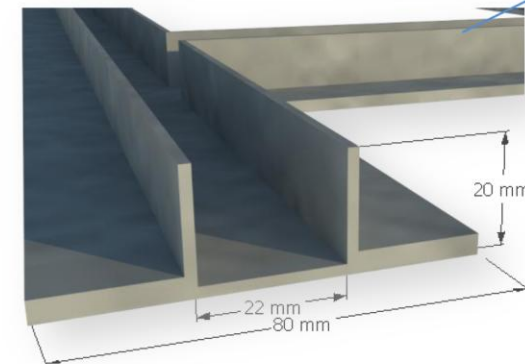
Production methods

To build every component, a concept of "pattern" has been developed. It is basically assembled bar which will guide the shelter frame 2 x 2 cm square bars in order to manufacture the structure easy, quick, consistent and standardized. The pages 23 to 31 are dedicated to the dimension of these patterns.



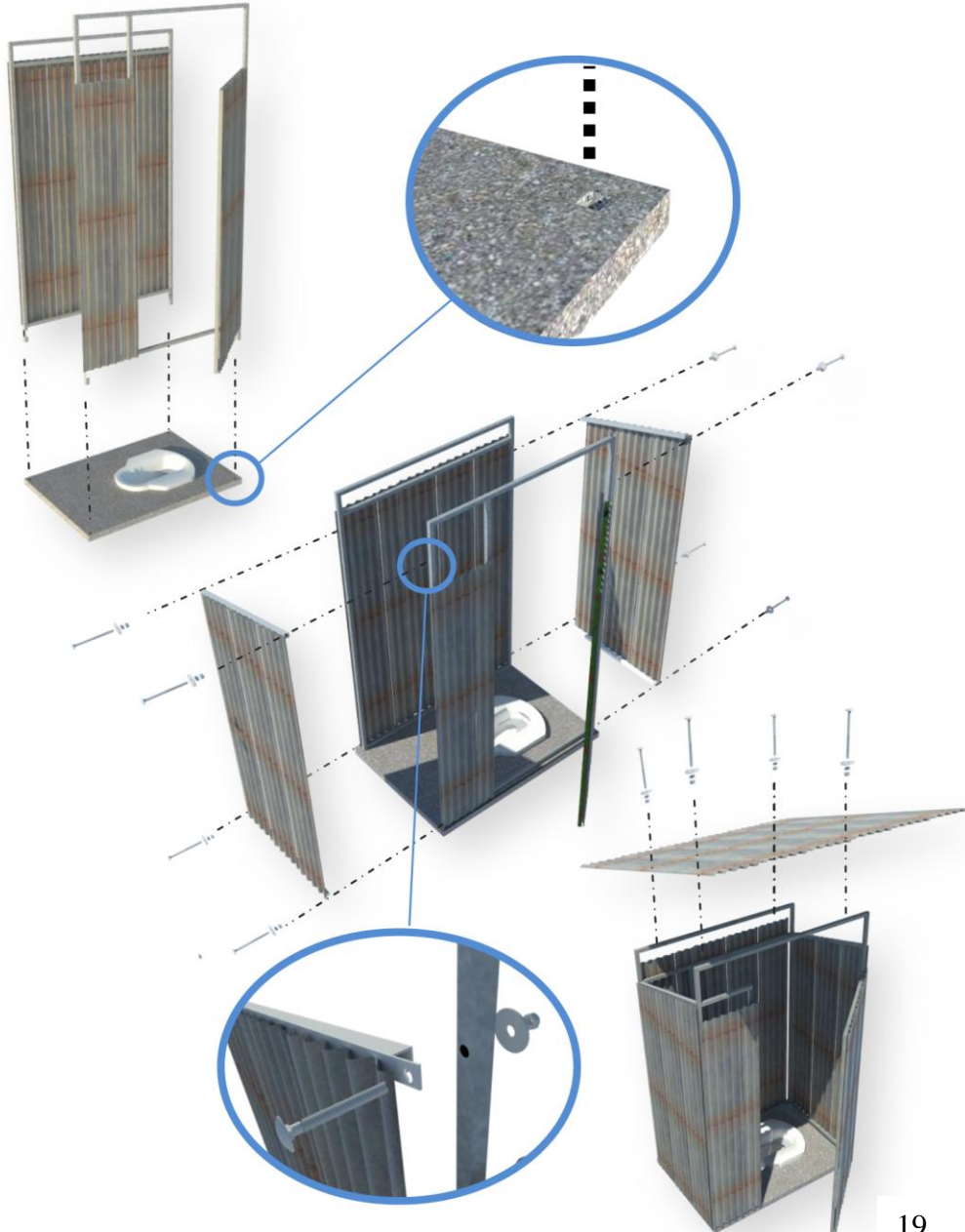
Stainless steel square bars 20 x 20 x 2 mm

Example of pattern used in the shelter frame manufacturing process

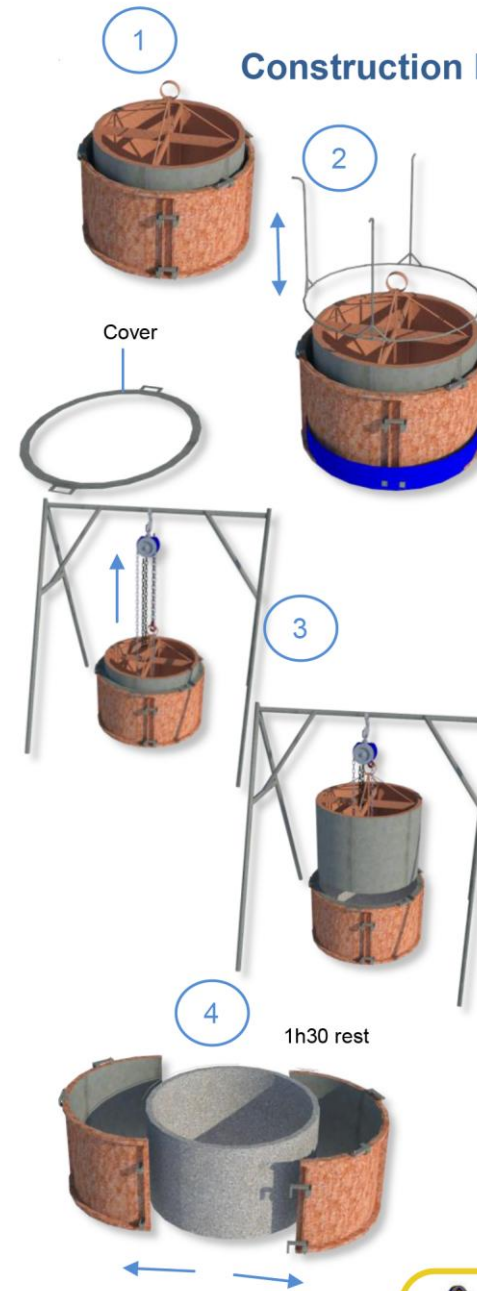


To prevent the pattern away from rusting, it is important to buy stainless bars, paint them and keep them covered when not in use.

The shelter is made out of 5 flat elements that are manufactured separately then joined on the top of the slab. Making it easy and quick to manufacture, to store, transport, and easy for a villager to install themselves.



Construction Process



STEP 1 (1) Put oil, diesel or any other grease on the molds to prevent sticking to the metal molds.

The concrete has to be very dry so it will keep its shape when the inside mold is removed. After a few tests the right concrete consistency will be found.

STEP 2 Gently and equally pour the concrete inside the molds. After a third of the mold (marked in blue on the picture) is filled, start using the "compactor" (2) which will compact the concrete and remove any air bubbles stuck inside the concrete.

Compact the concrete for 1-2 minutes then place the first 2mm reinforcement wire inside the mold taking care to place the reinforcement wire 15cm apart. When the mold is full, place the mold lid on top and close the clips.

Once the mold is full of concrete and well compacted, put the cover and close the clips all around the outside mold. Once it's done, place the crane (3).

STEP 3 Place the crane over the closed mold. To lift the mold, one laborer has to stand on the top of the outside mold to make it easier to remove the inside mold. Lifting must be done smoothly and without stopping to avoid poor quality rings. Step 3 is completed when the inside mold is removed.

STEP 4 The outside mold and the concrete need to be left untouched for 1hr30min - 2 hours, depending on the quality of the sand (4). After this time is completed, open and remove the outside mold. The outside mold can now be reused to make another ring.

This method of production is very attractive because money is saved by needing only one inside mold and greater production volume is achieved with the accelerated curing process (1hr30min compared to 3 hours with traditional practices) This production technique is easy and fast to learn and takes only a few practice tries to perfect the technique.



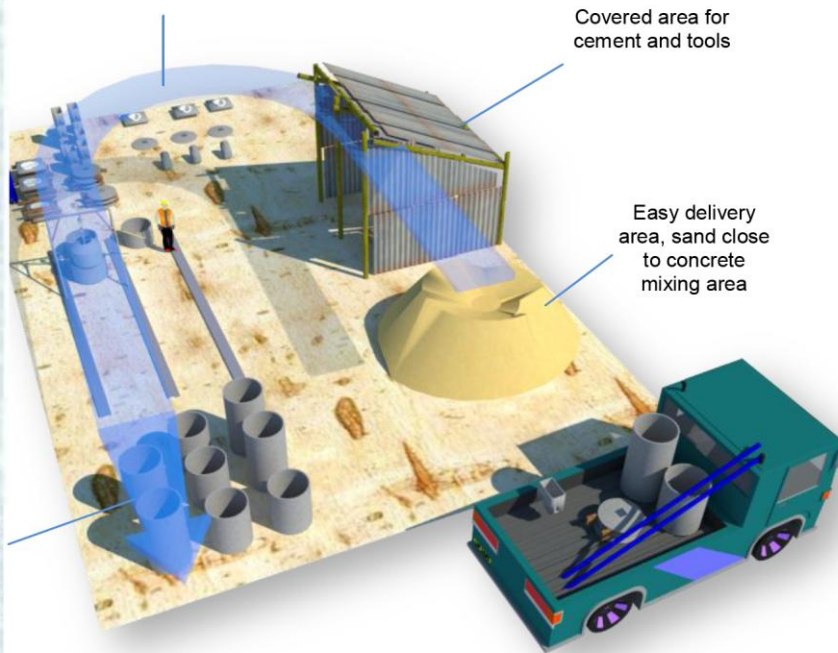
The rings have to cure for **10 days** before transportation, in order to let the concrete reach half its final strength.

Construction site

The layout of the construction site is important to reduce the distance from one task to another and to make stock easy to access by the delivery truck for transportation. **The minimum construction site size for production capacity of 3 latrines/days is approximately 100m².**

The construction site needs to have access to sufficient water needed for production. Each latrine requires approximately 100 liters of water plus water for drinking and cleaning the tools and ceramic pans. **Access to at least 350 liters of water/day is needed for production capacity of 3 latrines/day.**

The construction process needs to be close to each other, going in order, starting with inputs (sand, cement, water) to the finished product.



Every plant has its specificity and dimensions, that's why we cannot give here a plan of the "perfect" Plant. You will have to focus your attention on every little motion the masons are doing, thinking step by step how could you place every action as in a industrial chain where every action is designed to be the less tiring, with less transportation of heavy elements and offering the best safety for workers.

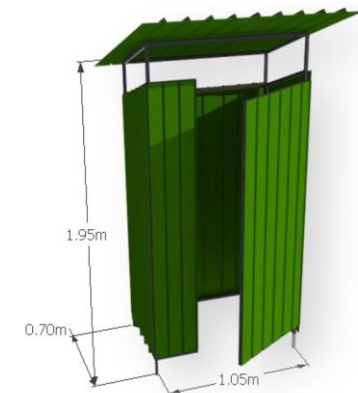
Shelter

As Cambodia is located in the monsoon region, it is necessary to make the shelter resistant to strong winds. Moreover, the shelter needs to be transportable and easy to assemble. To manufacture it, we need:

- 3.5 sheets of Corrugated iron plate of 3 x 0.7 m
- 5 Stainless square steel bar of 20 x 20 x 1 mm
- Half box of rivets
- 14 pieces of bolts of 5cm long



Latrine shelter frame



Completed Shelter

Elements	Quantity	Total (Riel)	Total (\$)
Corrugated Iron Sheet 3x0.7m	3.5 sheet	51450	12.25
Rivet	0.5 box	10000	2.38
Stainless Cube Steel Bar	5 bar	41500	9.88
Bolt of 5cm long	14 pcs	14000	3.33
Total		116950	27.84