



**Combined Shower, Urine Diversion
Dry Toilet and drip irrigation system
Design for
ECO-SANITATION MARKETING**

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SUMMARY

We propose a new and complete model for a rural sanitation system. The design is for a combined shower and dry latrine which contains a number of innovative features from the production process to the adaptation for sanitation marketing approach. Using an eco-sanitation design is a big step forward towards improved water management and food security, both of which are priorities in the developing world. This is possibly the first time that a latrine, replicable in an industrial process has combined all these elements at such a low cost, making possible its introduction on the market without subsidies.

Keys strategies of the design

- This latrine introduces a UDDT (Urine Diversion Dehydration Toilet) design.
- The design includes a shower as well as a toilet, so that there is increased motivation for maintenance.
- The evacuation of water and urine is connected to a drip irrigation system – the best practice for water management.
- Two compartments for sludge collection are included. Once one compartment is full (predicted to be after six months for a family of five), The pit covers taps have to be changed so the color code (red is composting, green is "in use") is respected and only one pit is used at a time.
- An alternate design for a pit latrine is also included (easy latrine), at the same price, for people not willing to use UDDT.
- The same molds and same shelter are used for both the pit latrine and the UDDT products proposed, making investment cheaper for the mason.

Other features of the design

- The use of UDDT and drip irrigation represents a big step forwards for food security and water management.
- There is no need to create another chain for sludge treatment.
- The irrigation of plants with urine reduces the need for chemical fertilizers.
- The enclosed shower cubicle provides privacy for people going to the toilet and washing themselves, making it a more pleasant experience, and having potentially a big impact particularly for women in places where it is common to wash while dressed at public water sources.
- The increase in food production and reduced costs of fertilizer is calculated to give a return on the investment costs of the latrine within approximately one year.
- There is virtually no maintenance, other than collecting the dry humus every six months, and cleaning the filter from time to time so the required behaviour change is fairly small compared to other UDDT systems.
- Having a toilet and bathroom together facilitate hygiene messages and practices in general.
- There are no risks of ground water contamination.
- There is no need to dig anything, and the toilet can be built in three minutes by the client.
- The latrine can be upgraded from a core to complete shelter.
- The price is low enough that the system can be part of a sanitation marketing project.

TECHNICAL PROPOSAL

Shower UDDT characteristics



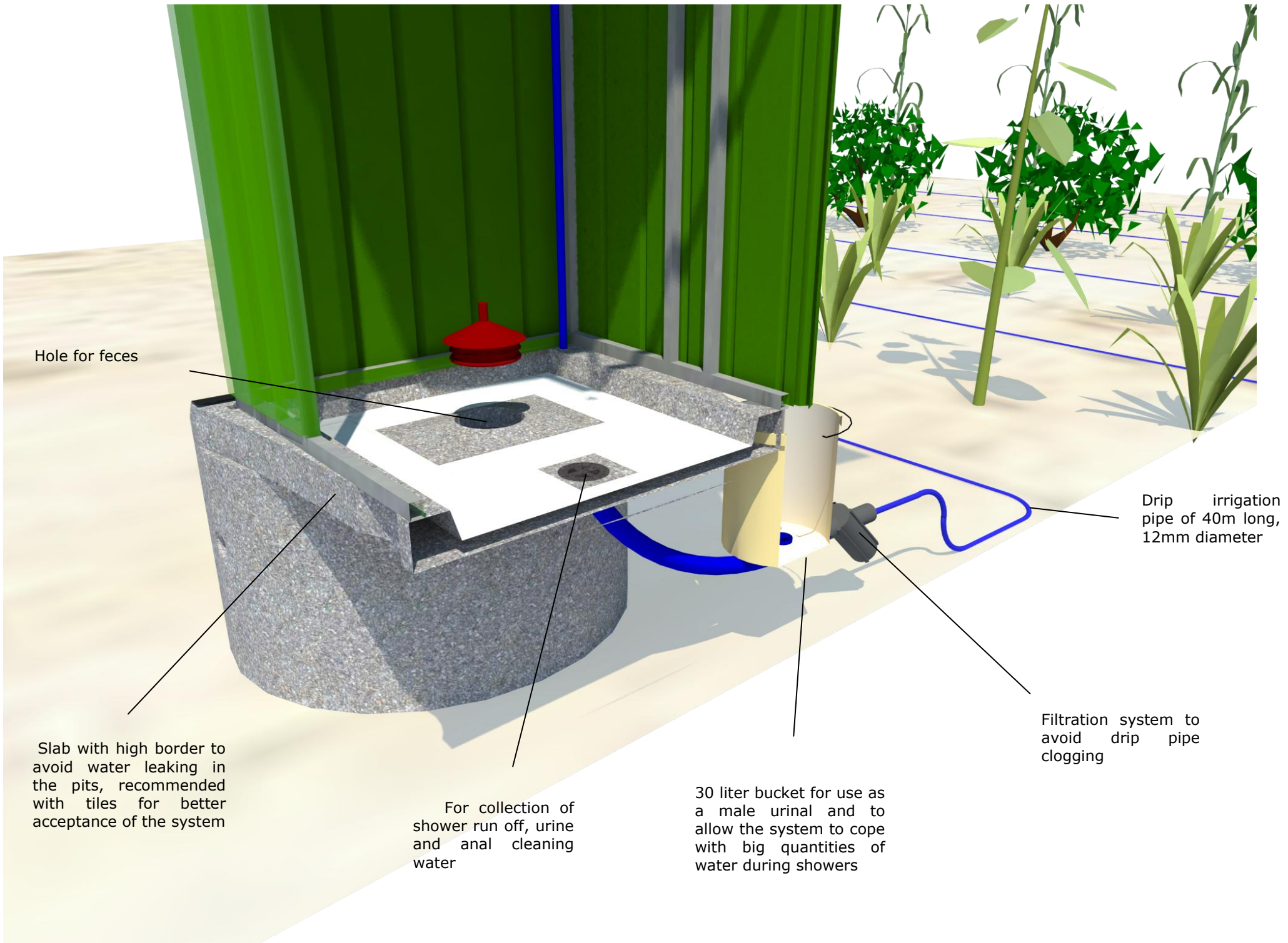
In this paper, we explain the concept of this shower/UDDT latrine system, which uses all the water that is used for body and anal washing, as well as urine and uses for drip irrigation. The actual shower system, like a hook for a bucket on top of shelter have to be developed according to people's preferences and habit.

This product has been designed for a non-subsidy approach where we have minimised not only the costs of the final product but also the costs of production, transport, storage, and the costs of upgrading from simple core latrine to full complete shower with shelter. All elements have been designed in a Do It Yourself spirit so to similarly reduce the cost of installation.

From past experience, UDDT systems have frequently not been well maintained or have simply failed because of several reasons. Firstly, the users were imposed this technology without choice or alternative. Secondly, a lot of maintenance was necessary, involving urine collection before application, which was very time consuming and needing large behaviour changes, as well as advance knowledge in agriculture.

The shower UDDT goal is to achieve sanitation marketing by promoting a toilet aesthetic as much as possible. We believe that people would maintain the latrine and shower and make sure that the system is working well not because of the toilet, but because they like to take a shower.

Due to the fact that anal washing water would be evacuated in the same pipe as all the rest other water, vegetables that are normally eaten raw would have to be prohibited from the drip irrigation system for health reasons to avoid bacteria and viruses contamination.



Hole for feces

Drip irrigation pipe of 40m long, 12mm diameter

Filtration system to avoid drip pipe clogging

Slab with high border to avoid water leaking in the pits, recommended with tiles for better acceptance of the system

For collection of shower run off, urine and anal cleaning water

30 liter bucket for use as a male urinal and to allow the system to cope with big quantities of water during showers

Further characteristics:

- The system is cheaper than \$70 retail price for complete shower UDDT, including delivery costs (\$30 for the core part + drip irrigation system, \$35 for the complete shelter).
- Drip irrigation and adapted seeds would be provided for 100 m² of land.
- Shower water run off + anal water cleaning + urine go in the same pipe for drip irrigation.
- Above ground toilet.
- The product can be constructed by the client (DIY spirit).
- The system is made out of local, well known elements (such as the cement ring, square bars and corrugated iron).

We have designed it so that the sun is used to aerate the dry pits (by convection airflow) with a metal black cover on the pit so the faeces stays dry and non smelly, and the heat act as a sterilizer. The elements are easy to source in Cambodia where the product was designed, and it is believed that the same products would be as easy (if not easier) to find in India.

General Data:

- Calculations were based on five people using the latrine: $P = 5$ people
- Time between rotation of the slab, and emptying of the pit: $N = 6$ months
- Solid waste volume per year per capita (80% is water): $S_f = 60$ litres when fresh,
 $S_o = 10$ liters when old
- Volume of 1 ring (if 80% of the volume is used): $V_r = 200$ litres
- Theoretical quantities after six months use : $P \times N \times S_f/12 = 140$ litres
- Quantity of humus after 6 months (from S_f to S_o divide the volume by 5) = 30 litres
- Quantities produced by a family of 5 = 11.5 kg of nitrogen, 1.5 kg of phosphorus,
6.5 kg of potassium

Prices of elements (In Cambodia)



Total material costs = 51\$
Labor cost = 7\$
Benefits = 7\$
Total retail cost = 65\$

CONSTRUCTION OF THE SHOWER UDDT / PIT LATRINE

Rings and slab

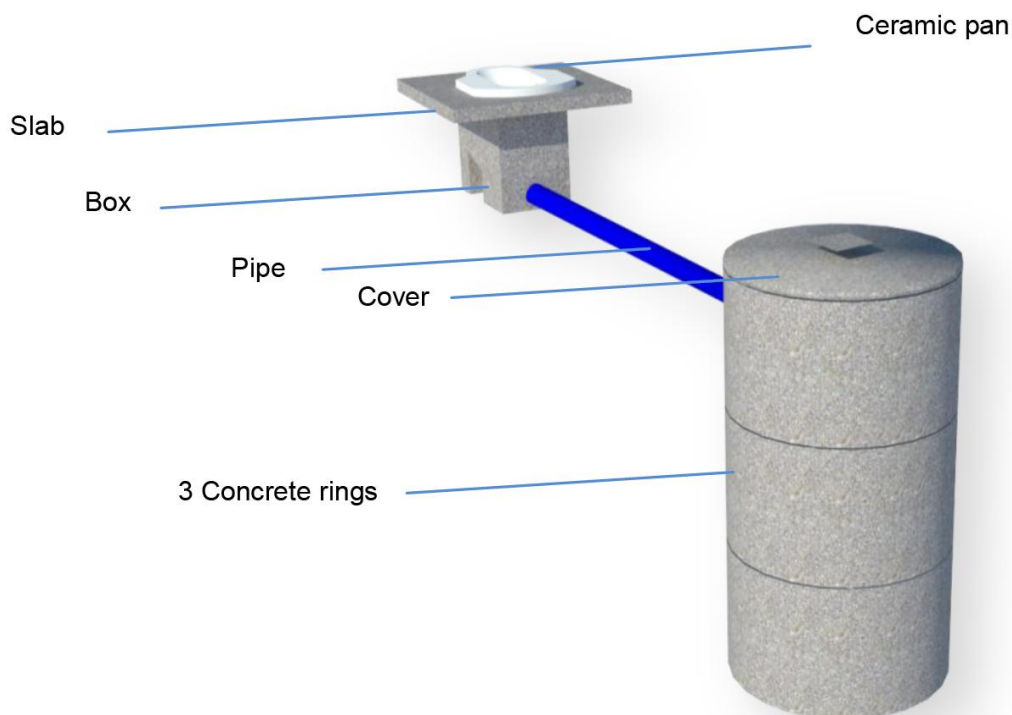
This design has been developed as an addition to a sanitation marketing program that is currently implemented in Cambodia with "easy latrine", a simple pour flush pit latrine.

The following therefore includes information on both of the designs, as we believe that UDDT should never be imposed on people. By proposing that the pit latrine and Shower UDDT are sold for the same price, people can decide for themselves, a decision which may also be affected by the maintenance of the UDDT drip irrigation system, which is slightly more time consuming than pit latrine.

On the construction side, the mason will use the same ring mold for both options, which make his investment far cheaper.

As the UDDT Shower is a complementary product to the Easy Latrine, it leverages the Easy Latrine manufacturing equipment and methods.

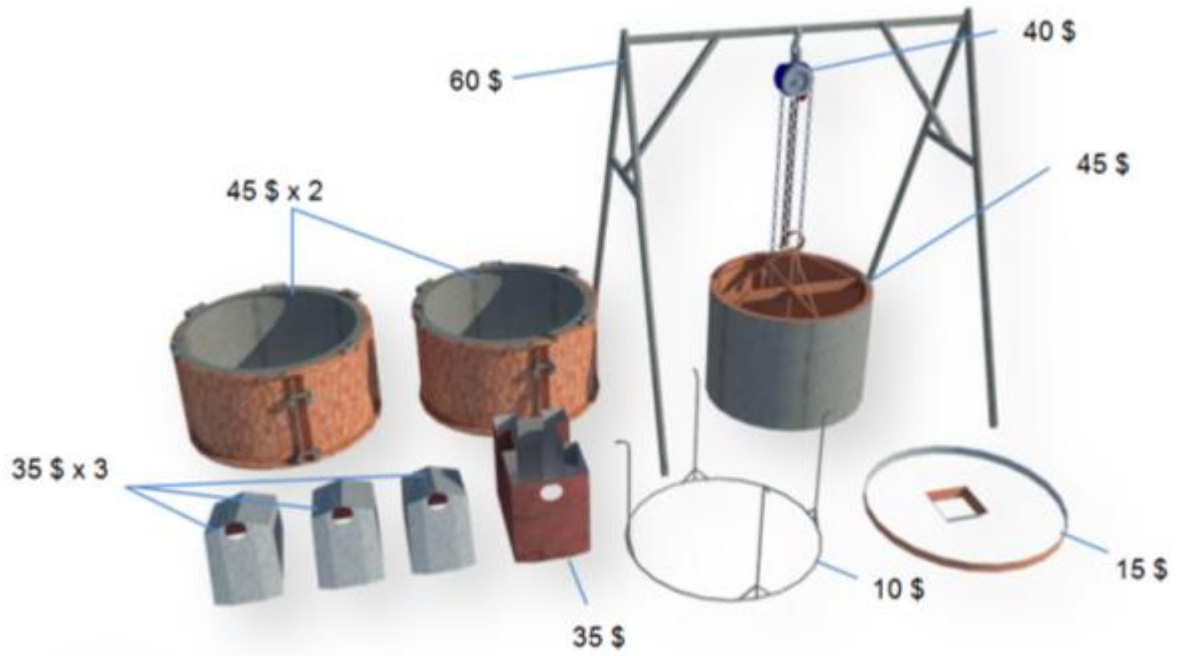
The manufacturing equipment and methods are central to the cost savings (i.e. lower price) and increased production capacity of the sanitation business.



The elements will be described in the following chapters

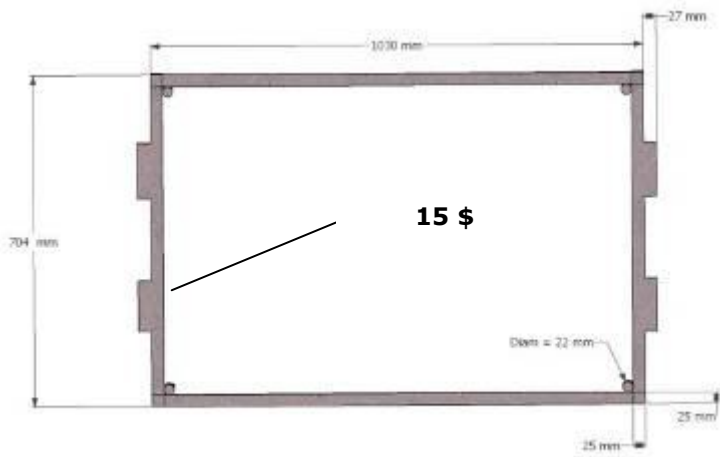
- Quantity of concrete : 190 liters = 400 kg
- Effective capacity volume : 650 liters
- Labor time for construction of elements : 1 day worker
- Average material total price : 19 US\$ = 80,000 Riels

Core latrine molds used for easy latrine and shower UDDT

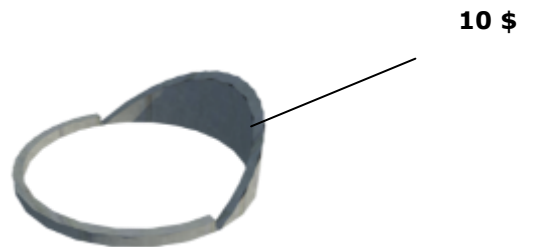


Extra molds necessary for Shower UDDT

Molds for holes in the slab



Extra mold for cut rings



Molds for Slab



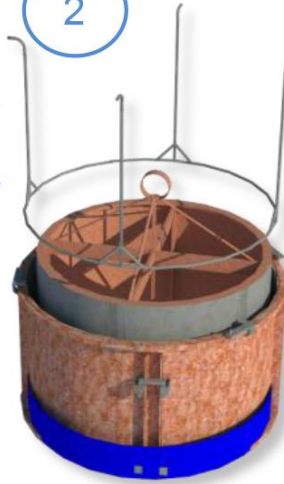
1

Construction Process



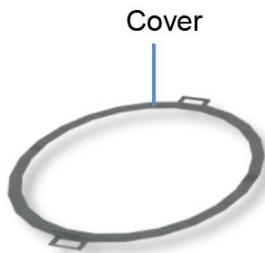
STEP 1 (1) Put oil, diesel or any other grease on the molds to prevent sticking to the metal molds.

2



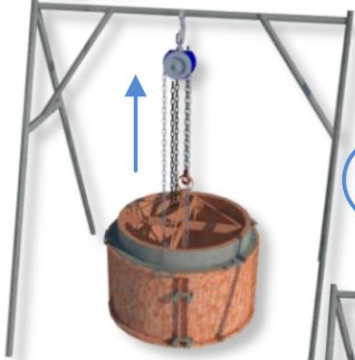
The concrete has to be very dry so it will keep its shape when the inside mold is removed. After a few tests the right concrete consistency will be found.

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.

3

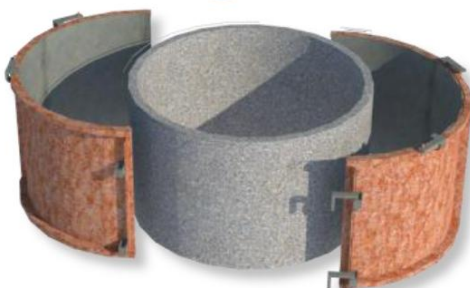


Once the mold is full of concrete and well compacted, put the cover and close the clips all around the outside mold. Once it's done, place the crane (3).

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.

4

1h30 rest



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.

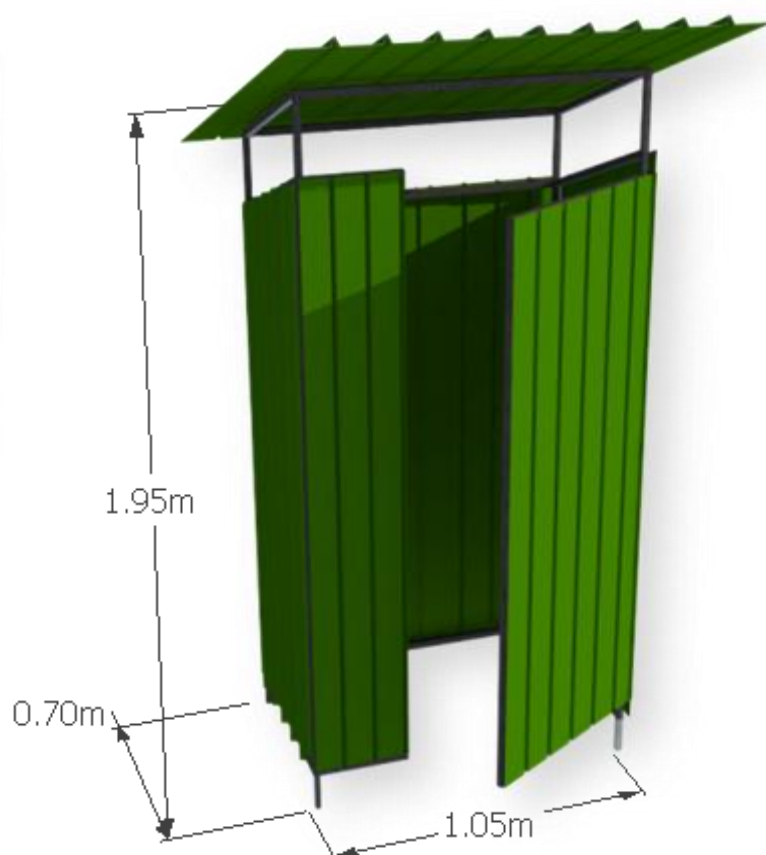


The rings have to cure for **10 days** before transportation, in order to let the concrete reach half its final strength.


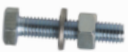
Shelter Construction



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

Investment

	_____	200 \$
	_____	30 \$
	_____	10 \$
	_____	30 \$
	_____	25 \$ x 5

As you can see, if electricity is available already the producer will be able to save 200\$.

The total for complete mold set would therefore be:

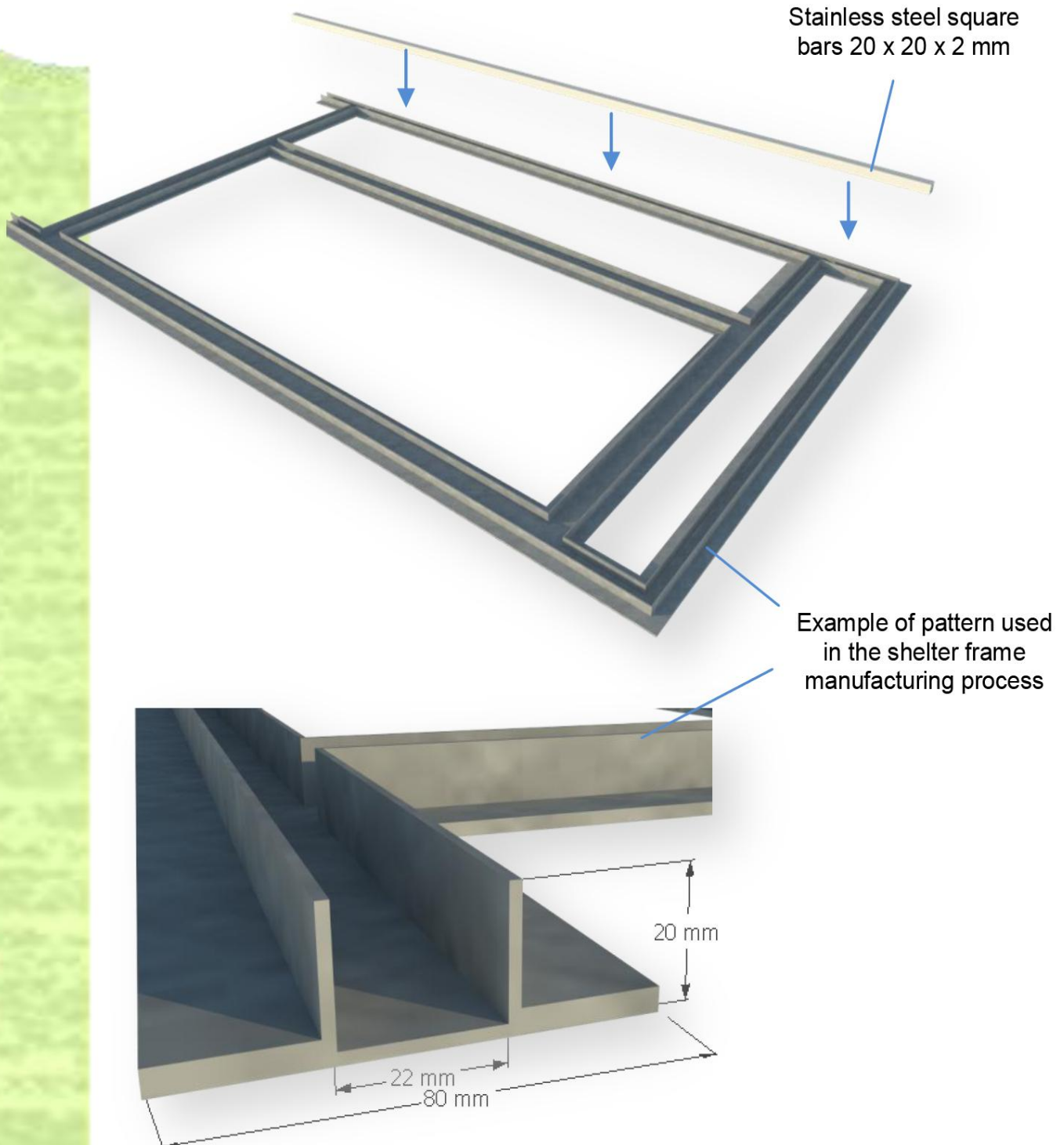
- With electricity available : 750 \$
- Without electricity : 950 \$

Further detailed information are summarized p17 over the price of the molds.

As you can see on the next page, the shelter is made out of five 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 the villager to install themselves. This shelter is adaptable for both latrines, the structure only can be sold for 10\$ and the people would put palm leaves or other covering material that they usually make roof with.

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.

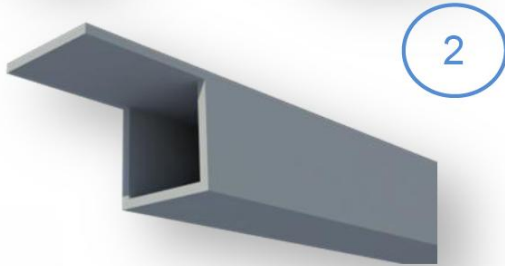


To prevent the pattern away from rusting, it is important to buy stainless bars, paint them and keep them covered when not in use.



The 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).



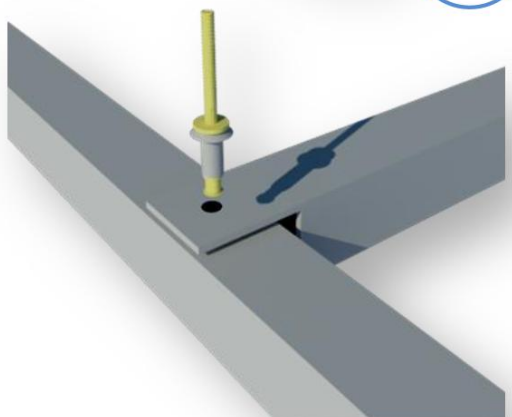
STEP 2 For the horizontal frame pieces, on the ends of the steel cut off only 3 sides of the steel and leave at least 25 mm of excess length on one side. This extra steel at the end will be used to attach pieces together (2).



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).

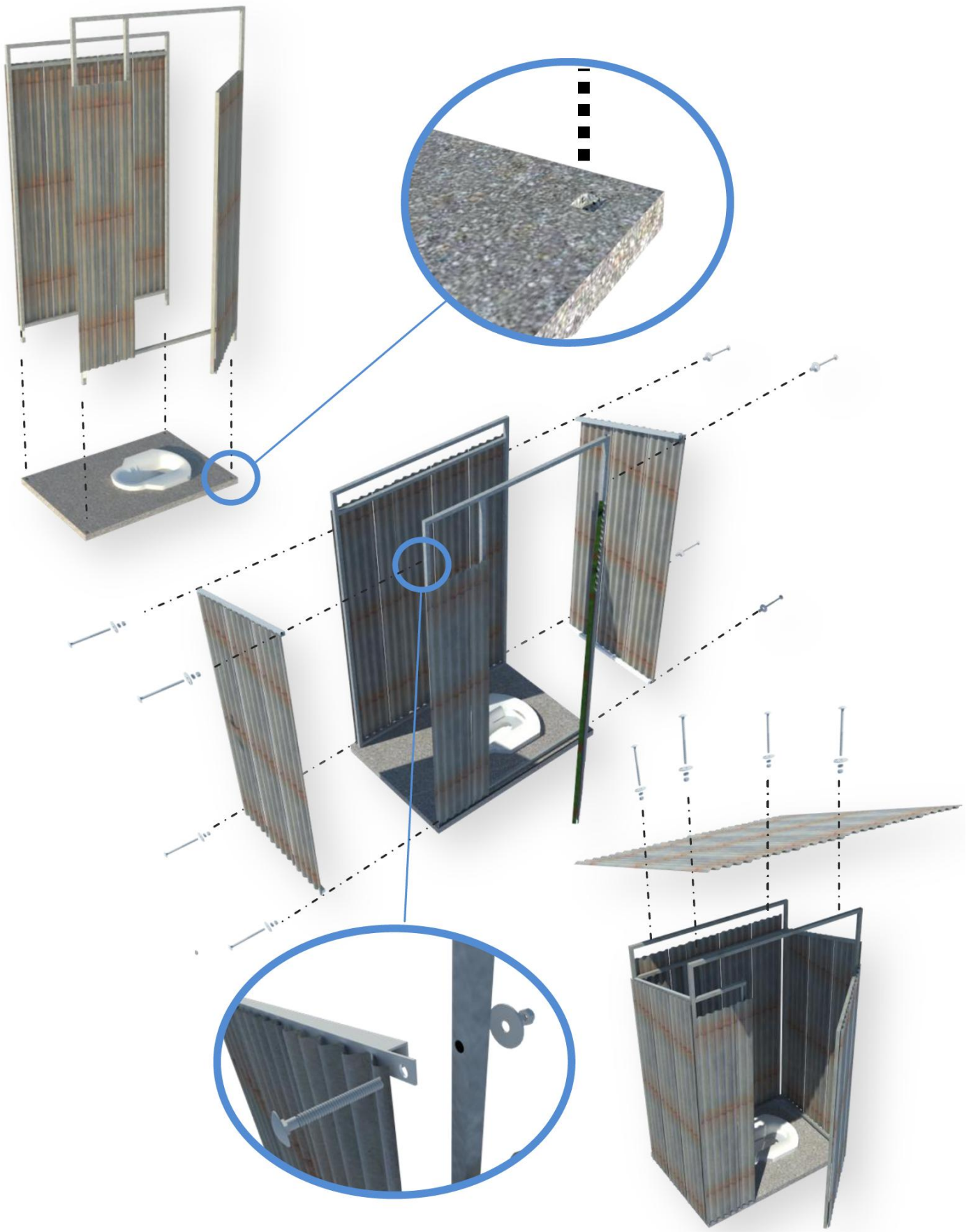
Then you'll have to cut corrugated iron following the instruction on following chapter Corrugated iron cutting model p30.



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.



CHEMICAL / POLLUTION OF THE SOIL:

The main issues remain the quantity and the quality of effluent, which is mainly problematic because of the soap.

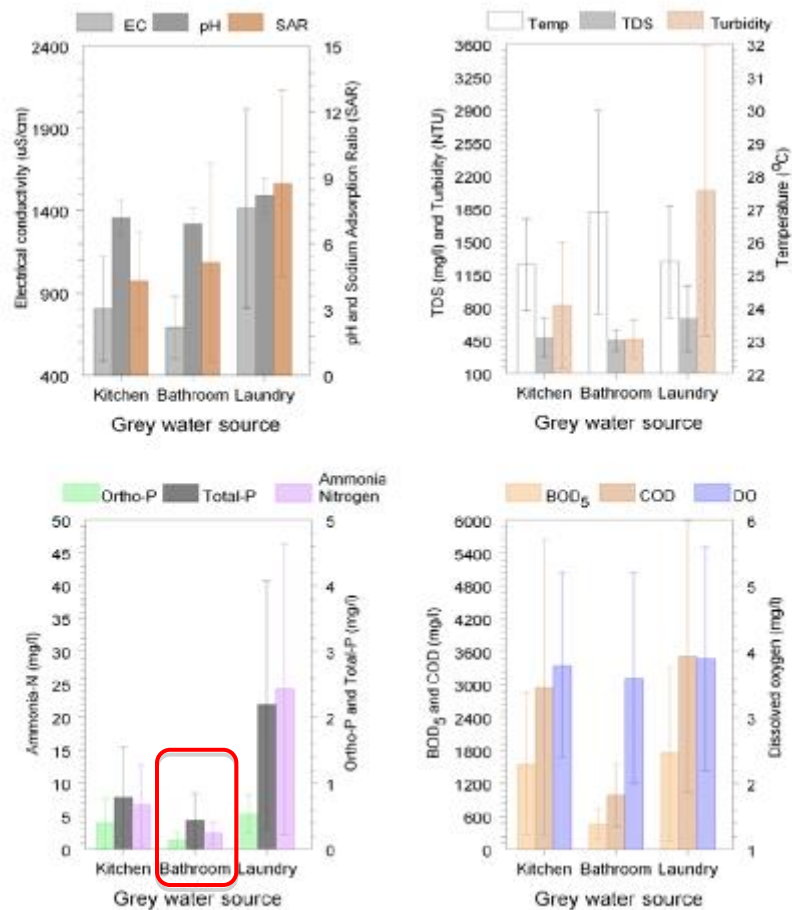


Figure 3 Characteristics of greywater from different sources in Kitgum Town Council (bars represent mean values ± standard deviation; n ≥ 35)

We can see on these charts from "Ecosan club, grey water treatment and reuse", that the bathroom grey water is one of the cleanest effluent of a household. If we are able to clearly explain that only body soap (ph close to neutral generally, no boron and less sodium than clothes washing powder) can be used in the bathroom, then we could try a pilot without risk to public health.

HEALTH RISKS

Most urine managers consider urine as safe or presenting only a very small risk of contamination. However transmission of pathogens in the downstream cultures is still possible via the anal cleaning. **Therefore, it has to be clear that every plant grown with this system has to be a vegetable that you cook or a fruit/vegetable that is high from the ground. No vegetable eaten raw can be grown by this system.**

BUSINESS ANALYSIS

The following sums are necessary for the latrine producer (nearly 6 months salary) and **considering that he will have to build a consequent stock**, we also need to train him properly so he understands at each stage what he is earning.

MASON INVESTMENT:

The following figures have to be updated to the Indian context, the following prices are the one met in Cambodia.

	Element	Price/unit	Unit	Total
Core latrine				
Ring	Inside mold	45	1	45
	Outside mold	45	2	90
	Crane	40	1	40
	Structure	60	1	60
	Mold adapter UDDT	10	6	60
Box	Inside mold	35	3	105
	Outside mold	35	1	35
Top	Mold	15	1	15
Shower UDDT Slab	Mold	30	1	30
Shelter				
Steel patern				140
Material	Rivet clunch/drill/cutting machine			70
Group	Optional			200
Stock to let the concrete cure 10 days before transport				
Stock				600
			TOTAL :	\$1,490

Depending on the creation of demand and the speed of business expansion, and considering that the mason would make \$7 profit per latrine sold, he would need to sell 200 latrines to get his return on investment. The system detailed above allows him to produce three latrines per day, so he would need at least two and a half months to reach this point.