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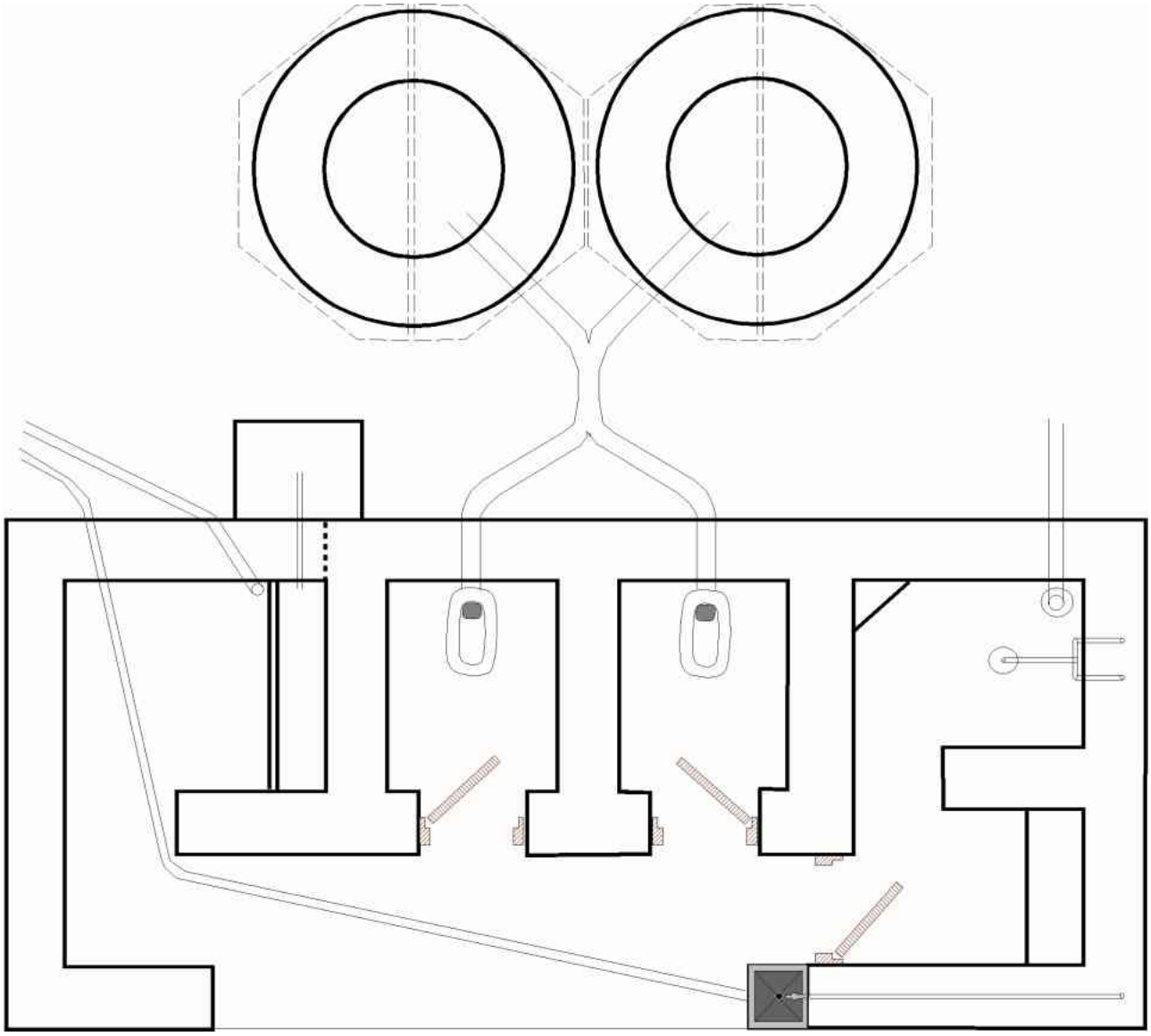
Himalayan Project Concept Paper

CONSTRUCTION of SANITARY COMPLEX



Foreword:

Himalayan Project supports the construction of public Toilets and Bathrooms in the remote Himalayan Regions especially connected to schools, because public knowledge about hygiene most efficiently starts among the coming generations.

But Himalayan Project demands a certain level of quality in the construction and functionality to prevent this complex to become nasty and useless within few years. As a hygienic complex it shall be easy to keep it hygienic by easy cleaning and washing, and preventing sharp and hidden corners to exist. But also to have the construction work done in a quality way, preventing cracks and fissures. The Sanitary Complex supported by Himalayan Project shall be a long lasting and permanent solution.

This description of construction is a guideline. It can be adjusted according to local needs and texture in the underlying soil or topographic conditions. It can any time be mirrored. But it may not be changed in its basic concept, and it may only be changed when the change will lead to an improvement in comparison with the complex described in this manual. If the institution wants to construct a simple and temporary complex, they shall not ask Himalayan Project to support it.

The complex shall be user friendly. The boys will have easy and fast access to the urinal, and will therefore only in less extend occupy the two toilets. In case there is a wish nominating the toilet rooms for specified users, the right one can be nominated for girls and female teachers, and the left one for boys and male teachers. But with a functional urinal, there should be no reason to do that. In the shower room there shall be facility to put clothes without having it splashed with water. As the complex is easy to clean, it has to be scrubbed and sluiced regularly.

The concept of Himalayan Project implies a semi-ecological approach to sanitation. There will be some handling of fertilizers. If the community can not deal with these fertilizers or if no one wants to touch it, the institution shall not ask Himalayan Project to support the construction of their toilet. This problem shall be discussed and solved before applying.

The Budget in this Concept Paper is estimated from informations given in "Construction Rates 2005 - Sallery" from "Ministry of Physical Planning and Construction, Department of Urban Development and Building Construction, Division Office Okhaldhunga" and knowledge about local tradition in Upper Solu. But each local area has their own tradition, their own easy or difficult access to building materials and different transportation rates. Therefore the budget is recommended price, which shall be adjusted by the construction committee before accepting the project.

Some Technical views:

Products from the Wet Pit Septic Tanks (wet because it is flushed with water):

- Gaseous Products (carbon dioxide, methane, vapors, odors and more) is lost and of no interest except for the smell. If leaves and other dry matters are thrown into the pit regularly, it will decrease the gas produced, changing it into solids instead. If pits are in the sun it will attract flies and produce more gas. Plant trees and bushes in that case.
- Water, Urine and Salts which are lost to the soil. Again leaves and dry matters will decrease the loss. Percolation of liquids into clay soil, through the pit wall, is 5-10 liter per m^2 of pit wall surface per day (a pit 1½ meter diameter and 1½ meter deep has a surface on 7 m^2 and percolates 35-70 liter of liquid daily), therefore the use of water

shall be reduced, and boys shall urinate in the Urinal. In pure sandy soil the percolation is 5-10 times more.

- Solids which accumulate and gradually becomes to rich soil. One grown-up person using the pit full time would accumulate 40-60 liters of solids per year. Children and part time users with collection of half of the urine will mean much less production per person per year. Probably 5-8 liters per person. With 100 students this will be 500-800 liters per year in a tank on 2.650 liter (2,65 m^3) (1½ x 1½ meter) which will leave only less space for adding leaves and dry matters. When the pit is left with absolutely no supply of water or waste for a period of (2-)3 years the solids will transform into compost/manure soil with no smell and no disease and it can be emptied with no harm. The compost/manure soil will be very useful as a good and strong fertilizer. It can increase crop yield with up to 70%. The weight of pit manure is 2.000 kg per 1 m^3.

Products from Urinal:

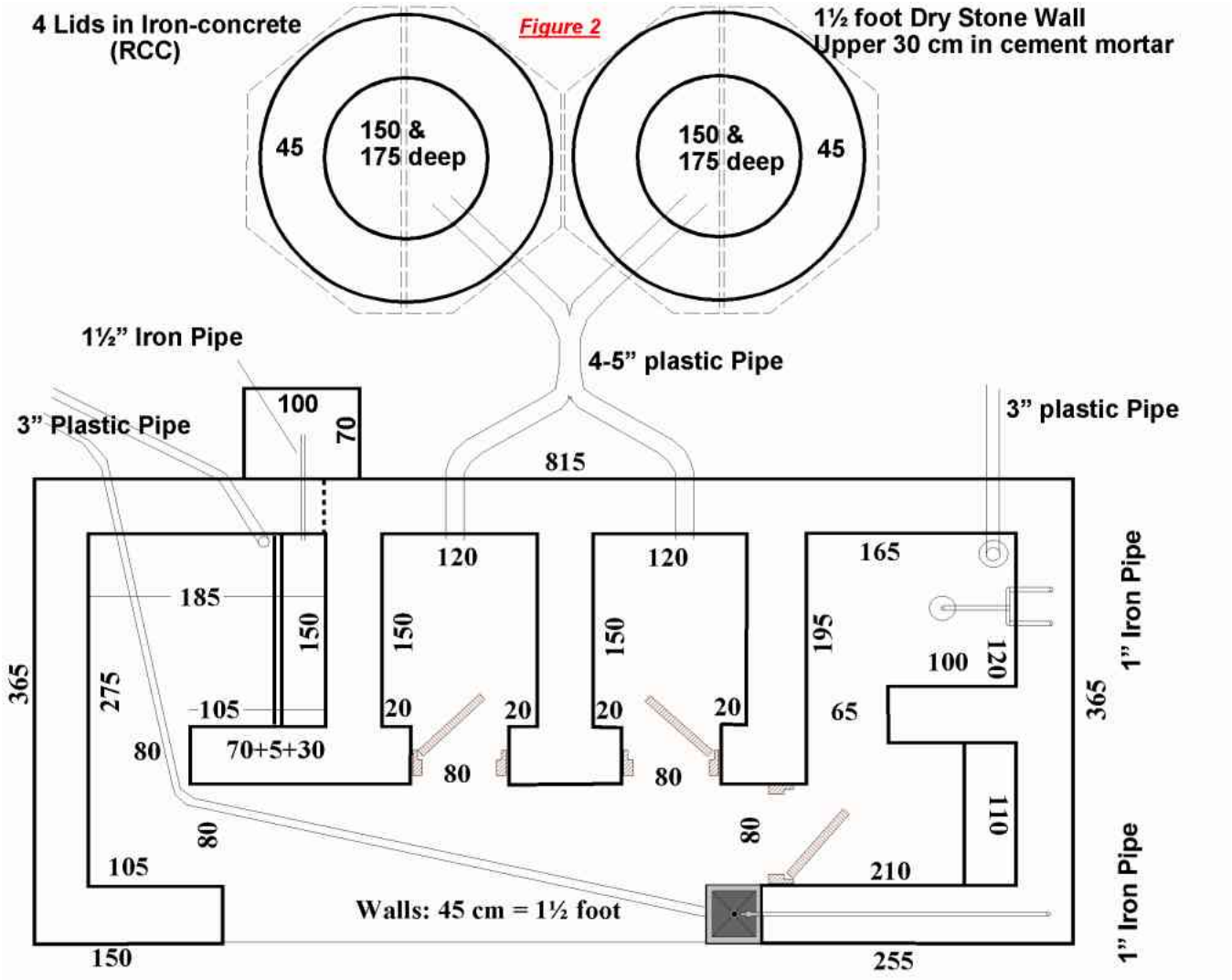
- Urine collected from the Urinal Grove shall be 100% urine. When the urinal is flushed with water for cleaning, the outlet tube shall be prolonged to let wastewater flush somewhere else into the soil. The collection tank shall have the size of 500-750 liter to secure, that it shall not be emptied every now and then. After a few days the urine will change into ammonia water, which has a strong stingy smell **ð** not of urine but from the fertilizer ammonia. Urine does not contain diseases, even when fresh. One grown up produces 1 liter of urine per day, or 20 kg of dry matter in a year, which corresponds 50 kg of barley. Especially for kitchen garden products it is a very efficient, fast and short working fertilizer, which can increase vegetable production with 25-35% when used at right time and right quantity. Before use it has to be mixed with water 1:5.
- Water from washing the floor will be of limited quantity and shall be lead into some wasteland or bushes not to soak the soil where people are walking.

Products from Shower:

- Water and Soap is of no value and shall just be lead away to some wasteland or bushes not to soak the soil where people are walking.

Maintenance:

- There should not be used more than 2-3 liter for anal cleaning and flushing, therefore the bucket inside the toilet room should not be bigger than 3 liter of content.
- Once a week the pan can be flushed with a whole bucket of water (10-15 liter)
- At the same time it will be very useful for the fertilization process to throw some handfuls of ashes into the pans.
- Once a week all rooms shall be swept well and truly on walls and floors and sluiced with water.



Construction overview:

1) The building: is build with mud mortar stone wall 1½ feet thick. All floors are done in cement concrete. The interior of the whole construction shall be plastered with a 12-15 mm rough cement plaster from floor to the top of the wall with all corners between walls and between wall and floor is plastered rounded and covered with a 3 mm neat cement punning. All for easy cleaning. Of course the floor shall have an even pitch (slope) on at least 3-5 cm per meter towards the outlets.
2) Water Tap: Very near the toilet or even included in the construction there shall be a water tap for: 1): filling the 2-3 liter water bucket in the toilets, 2): washing hands after visiting the toilet, 3): drinking water and 4): to provide water for cleaning the whole sanitation complex.
3) Floor drain: From the shower room the drain shall lead excess of water far away from the complex where the water and soap can drain into the soil without soaking soil where people are walking about. The drain from the urinal floor doesn't need to be that long as much less water will drain through it.
4) Entrance: consists of an entrance from where there are accesses to 4 rooms. The floor of the entrance is done in cement concrete. The roof of the building is covering the entrance as well. Here the users can wait for access out of rain.

5) Urinal: To the left the boys can enter a urinal where an open groove leads the urine to an outlet. The upper part of the walls of the room is open to let the room ventilate with plenty of fresh air.

6) Toilet rooms: The two rooms have a lavatory bowl of Asian type. The door shall be well made and well fit for full security of privacy. The rooms should have an open ówindow-holeô for ventilation, in case it can be done in a way that secures privacy.

7) Shower room: is divided into a dressing room and a shower room in a way that secures that water from the shower head will not splash on the clothes. Besides of a bench in the dressing room, there shall be hooks for hanging up clothes. The shower shall be prepared for connection with a hot water aggregate. In a corner of the shower room there shall be a shelf as part of the wall for soap and other remedies.

8) Roof: The roof shall be of High Quality Corrugated Iron Sheets of a heavy and long lasting quality. The roof above the shower room shall be prepared for a hot water aggregate. As this is quite heavy, it shall be well constructed.

9) Outlet tubes: shall generally be of a far heavier quality with wider opening than expected. If tubes are too narrow they will easily be blocked by detritus, and it will be difficult and a nasty work to open it and clean it.

10) Post for Urine Container: as part of the foundation below the urinal a shelf shall be build, which can support the container for urine. The foundation for this post shall be so high, that a watering jug can be placed under the tap of the container. Of course there shall also be a regular access to the container. Actually a wooden closet should be build around the container, especially if south facing, to prevent sun and heat to ruin the fertilizer and the container.

11) Urine Container: shall be 500-750 liter and black to prevent sunlight to enter. At bottom of the container there shall be a tap of good quality. The iron outlet tube from the urinal drain shall reach the top of the container.

12) Two pits: shall be build. They shall be wide but not too deep, as it shall be possible to work inside the pits, when they successively shall be emptied after changing into compost. The walls of the pits shall be build as dry walls, but they has to be very well build with the rocks wider on the outer side than the inner side to prevent them falling in when emptying the pits. The reason building dry wall of course is letting liquids draining into the soil letting solids remain. The upper part of the pit wall shall be build in strong cement mortar to make a very solid and permanent upper frame for the lid, which has to be moved from time to time to throw ashes, leaves and grass into the pit for composting.

13) Toilet Outlet: shall be from smooth plastic. The two tubes from the two lavatory bowls shall join shortly after leaving the bowl. Shortly after, the joined tube shall again divide into two tubes leading into the two pits. At this last division it shall be possible to enter the tube to block one of the tubes and the corresponding pit.

CONSTRUCTION DETAILS:

The Building:

Foundation:

- The building is a compact and quite heavy construction, and often it is situated in the outskirts of the compound, where the ground can be loose or sloop. Therefore the Foundation shall be generally 3-4 feet deep.
- The outer walls shall at bottom be 2½ feet wide narrowing in to 1½ foot at surface. Though not at entrance, where 1 foot should be enough.
- The Inner walls shall be 1½ foot wide.
- At the outlet of Urinal, the foundation shall be deeper, as it at same time shall work as foundation for the urine collecting tank. This foundation shall be 2½-3 feet deep.
- The foundation shall be 2½ feet wide under urinal.
- In the corner of the shower room the foundation shall have a triangular extension
- In the dressing room the foundation shall build up for support of bench.
- The outlet tubes shall be incorporated in the foundation wall so it can connect to the outlet from the floor or toilet pans.
- All outlet tubes shall be more wide than necessary, as a narrow pipe will easier block than a wide one. And a wide pipe is easier to clean than a narrow one. It is recommended that the pipe from Toilet Pan to Septic Tank shall be at least 4 inch wide plastic tube, but rather 5 inch wide (internal measure). Floor drain from Shower Room, Urinal Room and Water Tap should be at least 3 inches wide plastic pipe (internal measure). Drain from Urinal shall be a straight iron pipe, only 1½ inch wide (internal). The steeper angle the pipes are having the less foreign elements will remain to constipate; at least 30^{o} but preferable op to 60^{o}.
- When foundation is constructed soil is thrown in between the walls, stamped firmly and leveled to make basis for the cement floor.

Analysis:

- The full length of the outer wall foundation is 17,7 meter = 58 feet plus foundation under entrance 4,1 meter = 13,5 feet
- The volume of outer walls foundation is 17,7 m (long) x 0,9 m (deep) x 0,6 m (average

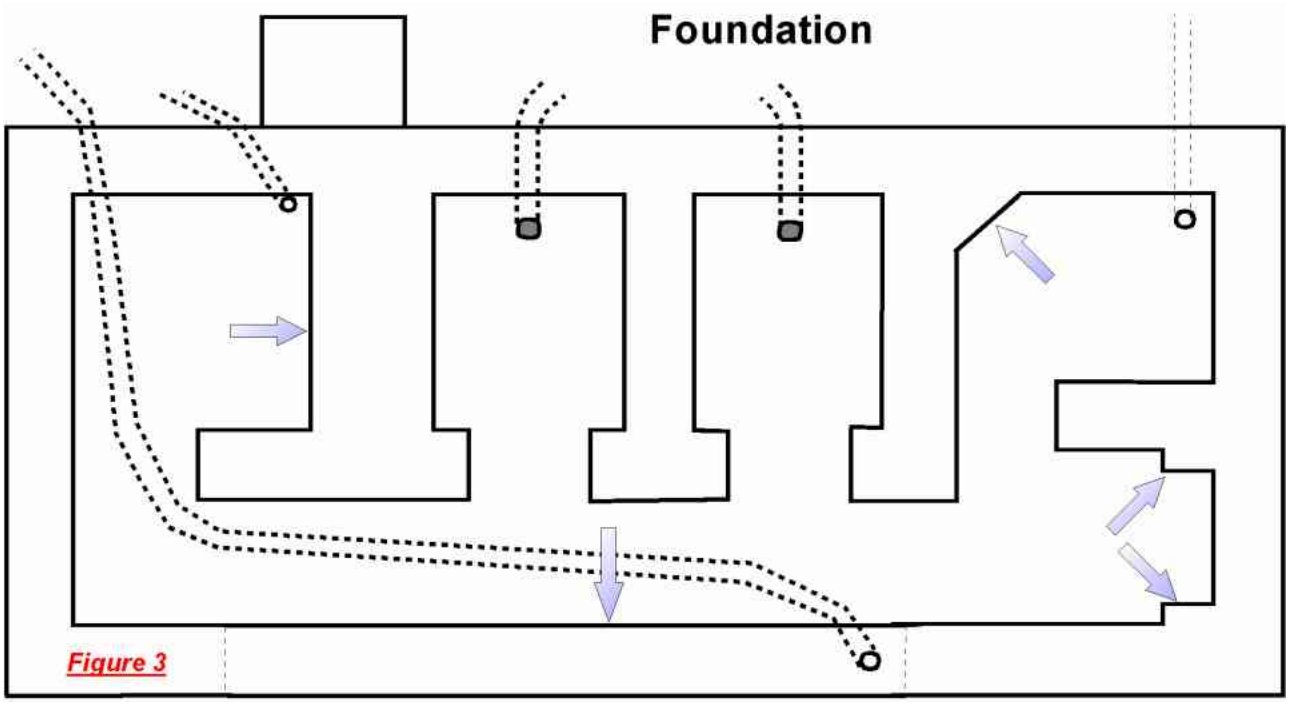


Figure 3

width) = 9,5 m^3 = 335 $feet^3$ plus 4,1 m (long) x 0,9 m (deep) x 0,3 m (wide) = 1,1 m^3 = 39 $feet^3$ **ð** in TOTAL = 10,6 m^3 = 375 $feet^3$

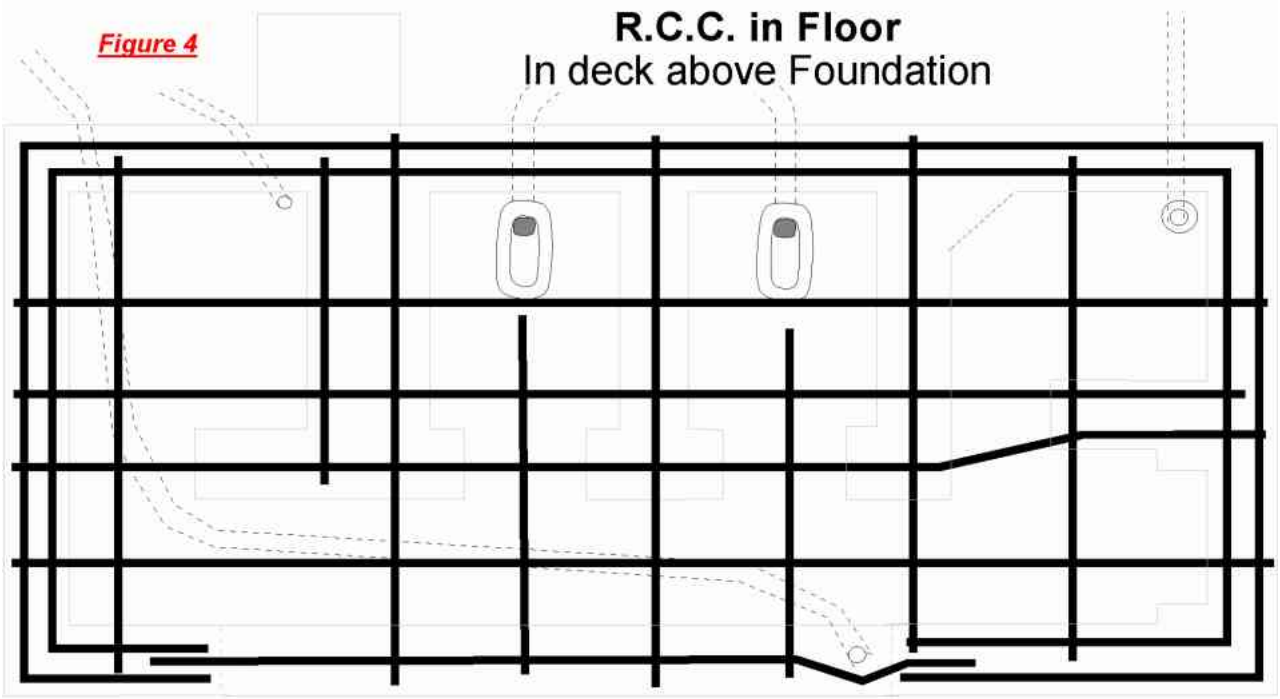
- Plus extra for Foundation under urine collection tank approximately: 0,75 m^3 = 25 $feet^3$
- The full length of inner wall foundation is 7,7 meter = 25 feet
- The volume of inner walls foundation is 7,7 m (long) x 0,9 m (deep) x 0,45 (wide) = 3,1 m^3 = 110 $feet^3$
- Plus extra foundation under urinal 1,5 meter = 5 feet plus a little extra for corner of shower room and for bench in dressing room, approximately: 0,4 m^3 = 12 $feet^3$
- The TOTAL volume of foundation: 15 m^3 = 525 $feet^3$
- In Foundation a pile of stones should be expected an utilization of 80%, which means, that a pile of stone 5x5x5 feet = 125 $feet^3$ = 3,5 m^3 can be utilized for 100 $feet^3$ = 2,8 m^3 of foundation.
- Therefore there will be a need of 5-6 piles of stone for Foundation.
- Approximately 20-25 m^3 = 700-850 $feet^3$ of soil shall be dug out to make way of foundation.
- The length of 4-5ó Pipe and 3ó Pipe shall be measured

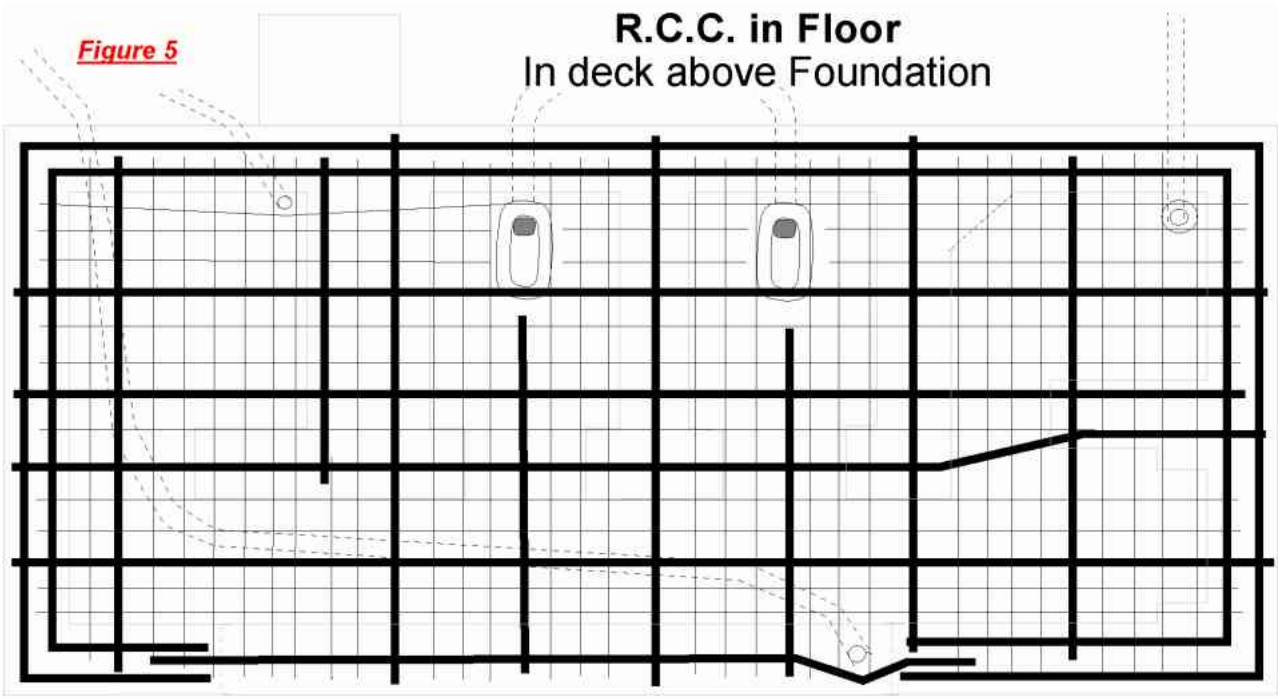
Calculations:

- Cutting of soil including lift 1,5 meter and disposal up to 10 meter takes 0,8 Man Day per 1 m^3 = 16-20 Man Days x 200 NRS/day for Unskilled Laborer = 3.000-4.000 NRS
- Stone usually cost 1.100 **ð** 1.400 NRS per Pile including breaking and easy transportation up to 1-2 km = 5.500-8.400 NRS
- Building the semi-dry wall of the foundation takes 1 Skilled and 2 Unskilled Man Day per m^3 of fundament x 300/200 NRS = 700 NRS per day x 15 m^3 = 10.500 NRS
- Putting back soil to fill up around foundation takes 1 Man Day per 2 m^3 of soil. 20-25 m^3 minus 15 m^3 divided 2 x 200 NRS per Man Day = 500-1.000 NRS
- 4-5ó Pipe and 3ó Pipe including transportation = 4.000 NRS

Floor:

- The whole surface area of the fundament and the intersections shall be covered by iron enforced concrete cement (R.C.C.)
- First of all Toilet Pans and outlet tubes shall be situated on the spot, where they shall





remain.

- Secondly a layer of Cement Concrete 1:2:4 (1 Cement : 2 Sand : 4 Gravel 20 mm), 4 cm thick, and with an even (horizontal) surface.
- Then Iron Rod is fixed. Basically a network of 8 mm Iron Rod as indicated on Figure 4. Then in between a network of 4 mm Iron Rod with a distance of 20 cm in between. The network is held together by Binding Wire.
- Lastly a layer of Cement Concrete 1:2:4 (1 Cement : 2 Sand : 4 Gravel 20 mm), 4-8 cm thick. Most thin at Toilet Pan and outlet tubes and most thick at entrances. It shall approximate the coming surface of the floor with drainage like in Figure 16. It shall reach a little lower than pans and outlets.

Analysis:

- The bottom layer of Cement Concrete 4 cm thick is 1,2 m^3 **ð** consisting of 385 kg Cement - plus 0,55 m^3 of Sand - plus 1,0 m^3 of Gravel 20 mm.
- The total length of Iron Rod 8 mm is 100 meter á 0,375 kg/m = 37,5 kg
- The total length of Iron Rod 4 mm is 185 meter á 0,1 kg/m = 18,5 kg
- Binding Wire for fixing Iron Rods to each other = 1 kg
- The upper layer of Cement Concrete in average 6 cm thick is 1,8 m^3 **ð** consisting of 575 kg Cement - plus 0,8 m^3 Sand - plus 1,6 m^3 Gravel 20 mm.
- Total Cement: 1.000 kg = 20 sacks
- Total Sand: 1,4 m^3
- Total Gravel 20 mm: 2,6 m^3

Calculations:

- Two Toilet Pans including transportation with wide outlet opening: 3.000 NRS
- Situating Pans and outlet tubes 2 Man Days skilled laborer: 600 NRS
- Cement price in Kathmandu is 10,5 NRS/kg **ð** plus transportation KTM-Jiri 1,5 NRS/kg **ð** plus transportation Jiri-Bhandar 2,5 NRS/kg **ð** in total in Bhandar 14,5 NRS/kg = 725 NRS/sack **ð** plus transportation with donkey Bhandar-Sagar-Bakanje 250-300 NRS/sack. In total in Sagar-Bakanje 1.000 NRS/sack. Similarly the price in Okhaldungha is 13,5 NRS/kg plus porter transportation 20-25 per kg for Salleri, which is 35 NRS/kg = 1.700 NRS/sack. In Thamakhani and Beni it will reach approximately 2.000 NRS/sack = 20.000-40.000 NRS

- The sand for floor can be of a quite course quality, which can be found in the vicinity at a rate of 3.000 NRS per m^3 (= 60 tin) including transportation up to 5 km = 4.200 NRS
- The gravel can be found with stonebreakers as waste materials and other places in vicinity at a rate of 1.700 NRS per m^3 (= 60 tin) including transportation = 4.500 NRS
- Iron Rod will cost around 85 NRS per kg in Bhandar and 175 NRS in Salleri plus around 5 NRS/kg for further transportation = 5.000-10.000 NRS
- Binding Wire for fixing Iron Rods = 100 NRS
- The work with Cement Concrete will take 0,8 Skilled and 7 Unskilled Man Days per m^3 which is 1.640 NRS/m^3 = 6.500 NRS
- The work with Iron Rod cutting and binding takes 1 Skilled and 1 Unskilled Man Day per 85 kg of Iron Rod = 500 NRS

The construction above ground:

Ventilation Frames & Door Frames (chaukhat):

- The door holes shall be 1,85 meter high and 0,80 meter wide
- The 3 doors shall have a relatively heavy and well fit frame
- There shall be no plank in bottom as it will rot in contact with the cement.
- The doorframe shall be lifted 5 cm above the floor as it otherwise will rot in contact with the cement
- The door frame therefore shall have iron anchors build into the wall.

Analysis:

- In total there are 13 meter of Door Frame
- First 13 meter plank 33 x 3,8 cm = 0,15 m^3 = 5,3 $feet^3$ of wood
- Then 13 meter panel 10 x 5 cm = 0,07 m^3 = 2,5 $feet^3$ of wood
- In total there are 5 meter of Ventilation Hole Frame
- First 5 meter plank 33 x 3,8 cm = 0,06 m^3 = 2,1 $feet^3$ of wood
- Then 5 meter panel 10 x 5 cm = 0,03 m^3 = 1,1 $feet^3$ of wood
- In Total: 0,31 m^3 = 11 $feet^3$ of wood

Calculations:

- Wood including salary is 150 NRS/$foot^3$ = 1.650 NRS
- Wall anchor can be taken from some rest of 8 mm Iron Rod

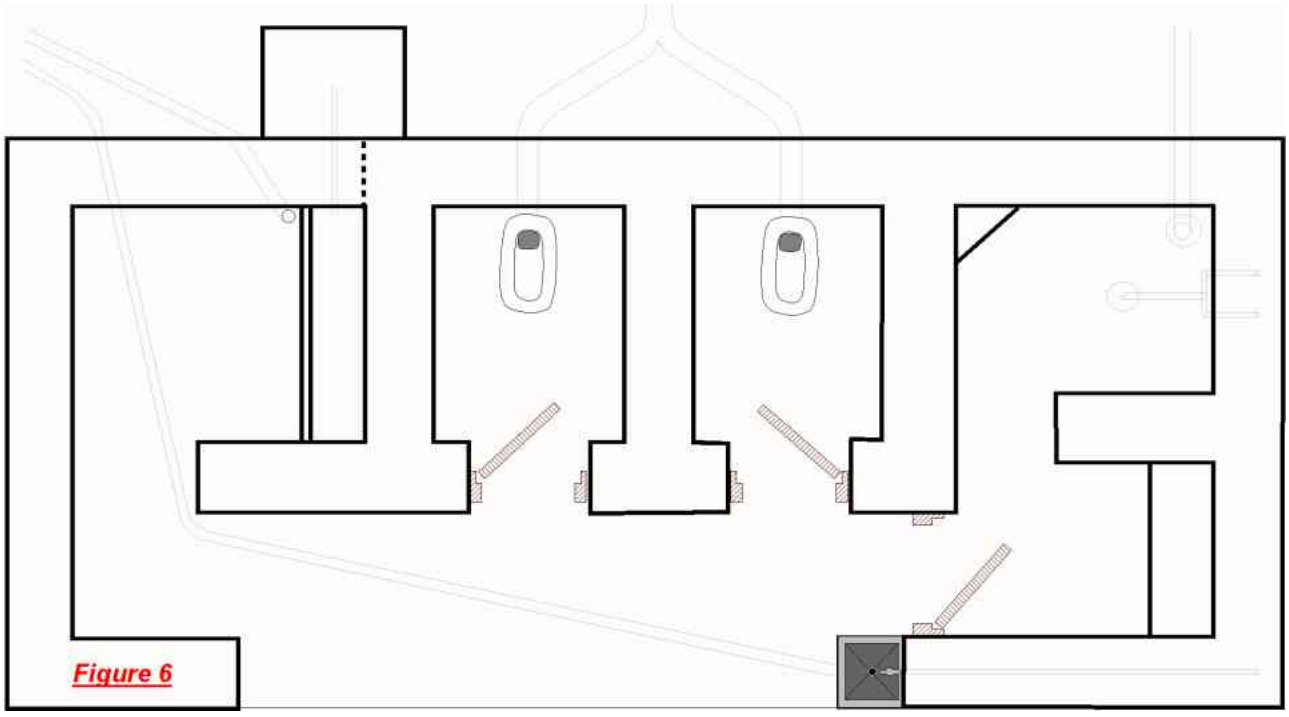


Figure 6

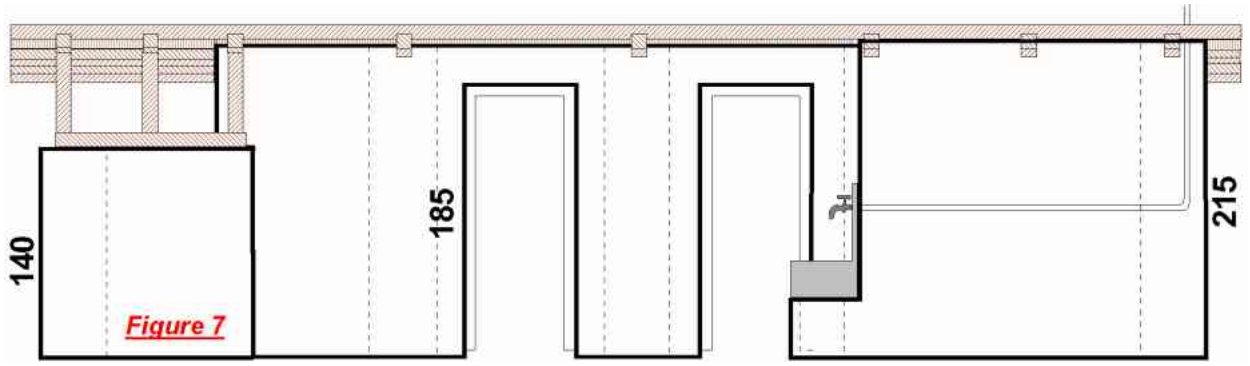


Figure 7

Walls:

- The walls above ground shall be 1½ foot wide. The stones shall be relatively well cut and shall fit relatively well, held together with a mud mortar, where a very little cement can be added.
- At the back side the outer wall shall reach 1,80 meter above floor and on front side it shall reach 2,15 meter above floor. All Inner walls shall follow the same standard. Only the outer wall around Urinal Room shall only reach 1,40 meter all the way around, to give sufficient of fresh air.
- At Urinal a ramp is build up so the lower end supports small boys, while upper end supports big boys. In this way the urinal will be very steep letting all urine running quickly out.
- At the lower end of Urinal an 1½ Iron Pipe shall be build into the wall leading through the wall with outlet over the opening of collection tank (see page 12).
- In the corner of Shower Room a triangle on 25 cm is build up to a height of one meter to create a shelf for soap and others. I shall be flat on top.
- In bottom Dressing Room on each side an excess is following up on each side. Both 10 cm wide and 30 cm deep and 50 cm high and flat on top. They are supposed to support the bench where users can undress and dress as well as being shelf for clothes.
- Pieces of 4 mm Iron Rod can stick out high in the wall in dressing room as hangers for clothes and towels.
- If there is a Water Tap very near the complex it is not necessary to construct the following tap. But if existing Water Tap is inconveniently far, it has to be done. The Wash Basin can be bought prefabricated or it can be made on the spot by cement:fine sand:coarse sand ð 3:2:2 by using thin iron rod for enforcement and wooden laths for shuttering. The cement shall cover the outlet in a way that the hole in outlet is smaller than in the tube, so that all constipating foreign elements will have a lesser dimension than the tube.
- Holes for doors shall be 1,85 meters high supported by a normal door frame.

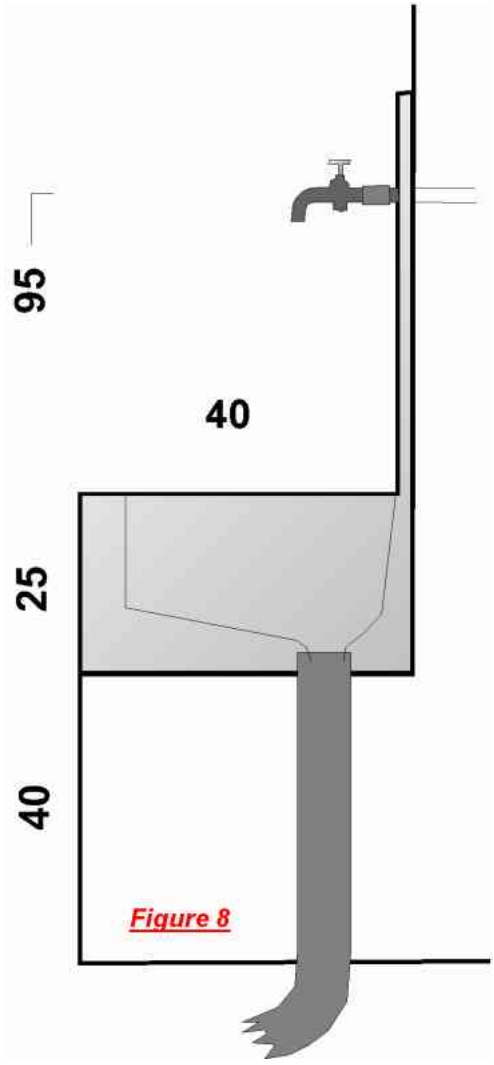
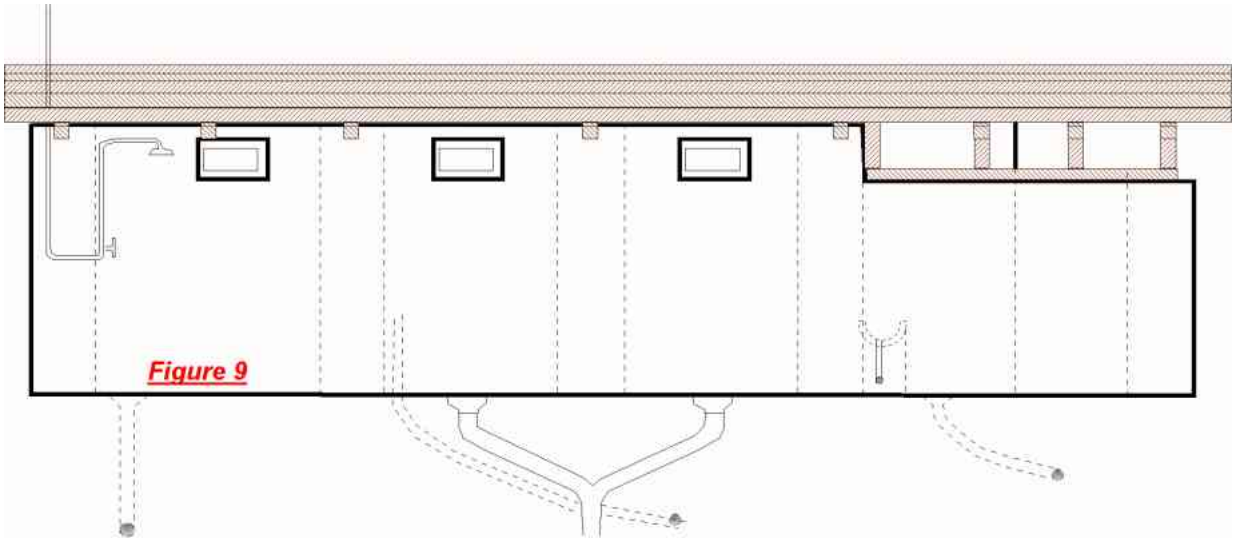


Figure 8



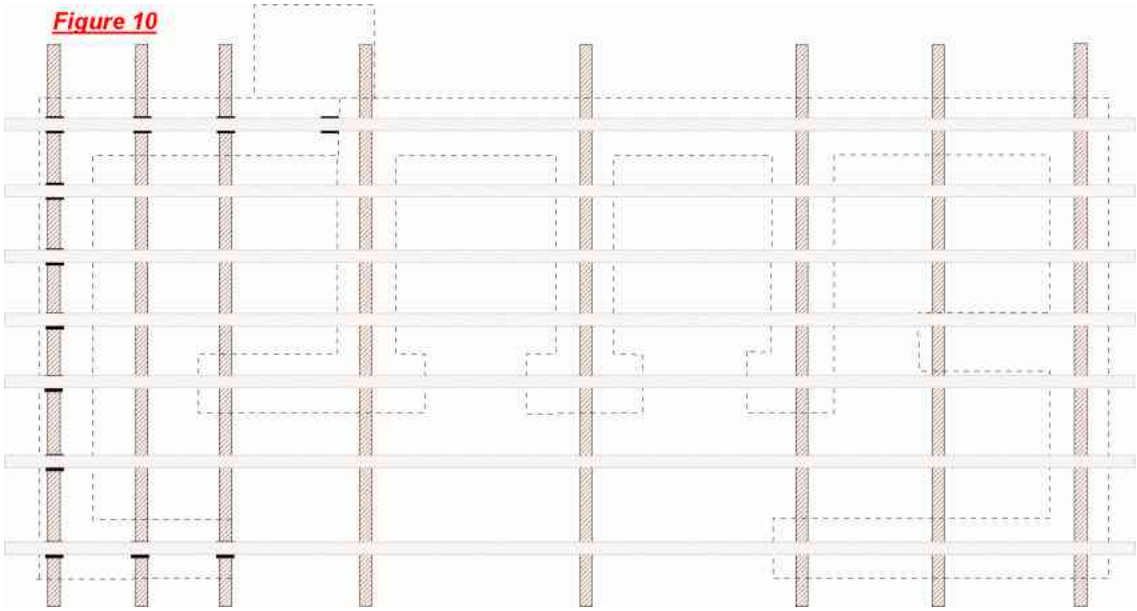
- In both toilet rooms and in shower room a ventilation hole shall be constructed in top, supported by a window frame. The size and position of the ventilation holes shall depend on how privacy can be secured in the rooms. For example 50 cm wide and 30 cm high could be fine for ventilation and for light to come in.
- The Hot Water Pipe and the Cold Water Pipe for shower and the Cold Water Pipe for Water Tap shall be built in, into the wall. Coming from the roof being incorporated inside the wall. To prevent breaks in the wall around the pipes, they should be supported by 4 mm Iron Rod and some extra cement in the mud mortar. (To protect against corrosion, the iron pipes can be lead through a plastic pipe of same internal opening as the iron pipeís external measure). The Shower Pipe shall by a bend leave the wall into the shower room in a height of 75 cm above the floor (see Figure 9). There shall be extra cement enforcements of the wall where the pipes leaves the wall. And Iron rods shall be built into the wall, so it later on can be adjusted to support the pipes, as shown in Figure 23.
- Iron Band shall be build in the wall two places at each End Wall and two places in the Mid Wall, for fixing the wooden heads of the roof.
- When the beams are put on top of the wall, the spaces in between the beams shall be filled in with wall materials, to prevent curious eyes to disturb privacy.

Analysis:

- The total volume of massive wall is 21,2 m^3
- As the stones shall be well cut and well fit it should be expected to be utilized with 65%, which means, that a pile of stone 5x5x5 feet = 125 $feet^3$ = 3,5 m^3 can be utilized for 82 $feet^3$ = 2,3 m^3 of wall.
- Therefore there will be a need of 9½ piles of stone for Walls.
- Mud for mortar takes 0,4 m^3 per 1 m^3 of wall **ð** in total 8,5 m^3
- There will be a need of 10 meter of 1ó Iron Water Pipe **ð** 9 pieces 90^o bends **ð** 1 piece T-bend **ð** 2 quality regulators for shower pipe **ð** 1 shower head - 1 quality water tap.

Calculations:

- Stone usually cost 1.100 **ð** 1.400 NRS per Pile including breaking and easy transportation up to 1-2 km = 10.500-13.500 NRS
- Mud for mortar is 200 NRS/m^3 = 1.700 NRS
- Work on mud mortar wall takes 1 Skilled and 2,3 Unskilled Man Days per m^3 of wall x 300/200 NRS = 760 NRS per day x 21,5 m^3 = 16.500 NRS
- And later to fill in gaps between beams and other finish = 1.000 NRS
- Iron Band in a roll to make 6 pieces á 1 meter to build into the wall plus some extra to fix beams to heads **ð** in total 15 meter = 1.000 NRS



- Iron Pipes and three bends for shower and water tap to be build in (see Page 18)
- Sink or home made washing basin = 1.000 NRS

Beams:

- All wooden beams, heads and pillars are same dimension: approximately 10 cm x 10 cm
- The 8 wooden heads is 4.50 meter long, giving eaves on front side on 25 cm and back side on 45 cm
- The 7 roof beams is 8,65 meter long, giving eaves both sides on 25 cm
- The 3 wooden heads on the wall around the urinal is adjusted to and resting on top of the wall. The head on the left wall is fixed to the build in Iron Bands.
- The 12 wooden pillars is tenoned down into the above wooden heads and up into the wooden heads after adjustment to height. Except one pillar, the inner one on back side, this goes directly up into the beam.
- Four of the wooden heads are build directly into the top of wall. The first from right side and the middle one is fixed to the build in Iron Bands. One is resting on top of the walls. Three is resting on top of the wooden pillars.
- The beams are folded into the heads and fixed with nails, and several places with iron band.
- After completing the beam work, the walls shall be build upto top of beam level.

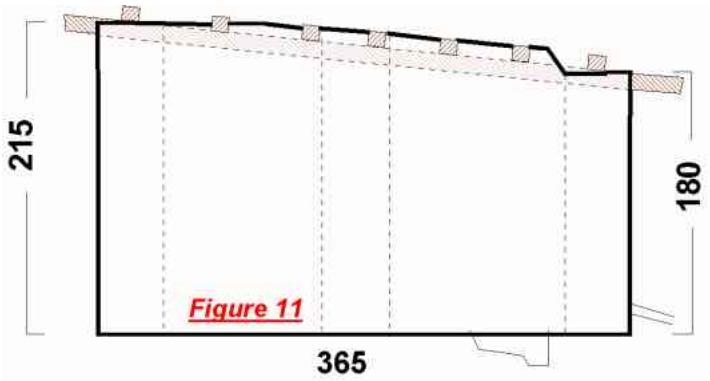


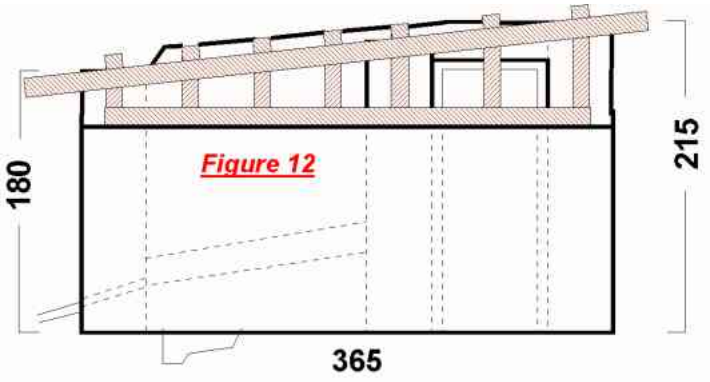
Figure 11

Analysis:

- There is a need of in total 110 meter of beams 10 cm x 10 cm, which is 1.1 m^3 = 39 $feet^3$
- The Iron Band is mentioned above.
- There shall be 6ó nails approximately 100 pieces and 3ó nails 0,5 kg

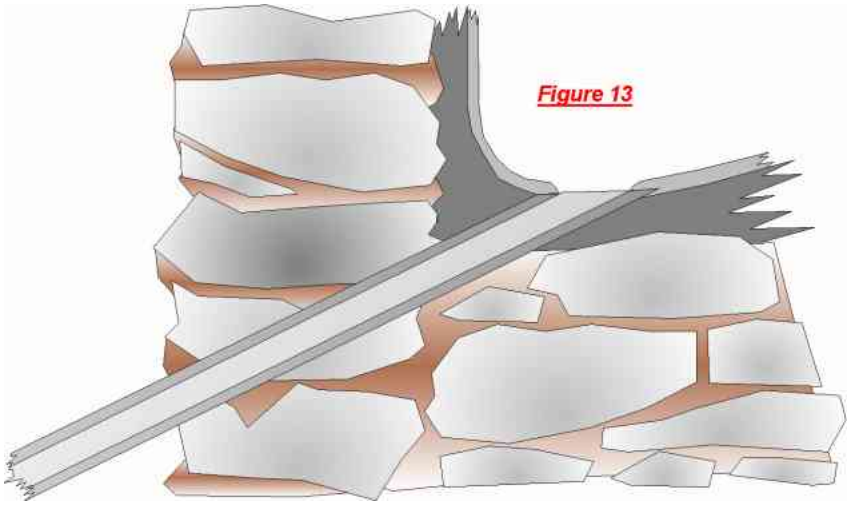
Calculation:

- The price of local wood will vary according to the distance to the cutting place but it will be around 40 NRS/$foot^3$ = 1.600 NRS
- 6 Skilled and 5 Unskilled Man Days per 1 m^3 of wood á 300/200 NRS = 3.000 NRS
- Nails 1.000 NRS



Urinal Build-up:

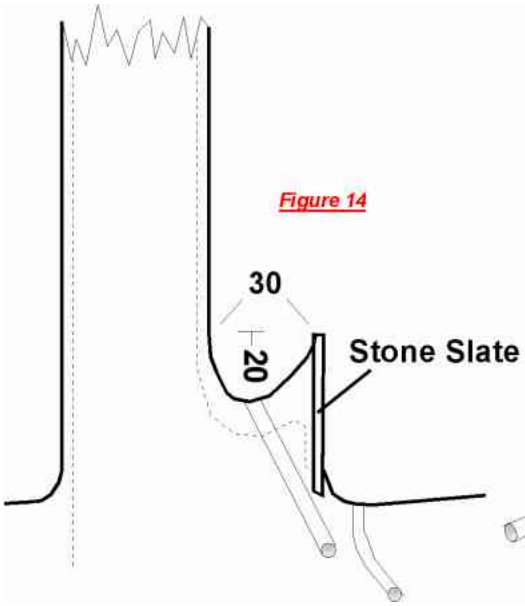
- The Base of the Urinal is already build up with the wall construction.
- The lowest part of the Base of the Urinal shall be 26 cm above the floor deck, and upper part shall be 25 cm higher
- The Base shall be 28 cm wide and have a some through form resembling the final grove in the Urinal
- Slate Stone Plates is cut to fit as front part of the Urinal. They are plastered on place with very fine sand-cement 1:1. The lower part of the slates can stand on the Floor Deck, as the floor plastering will cover the lower part. The upper part shall form a straight line, of which the lower part shall be 50 cm above floor Deck and upper part shall be 25 cm higher.

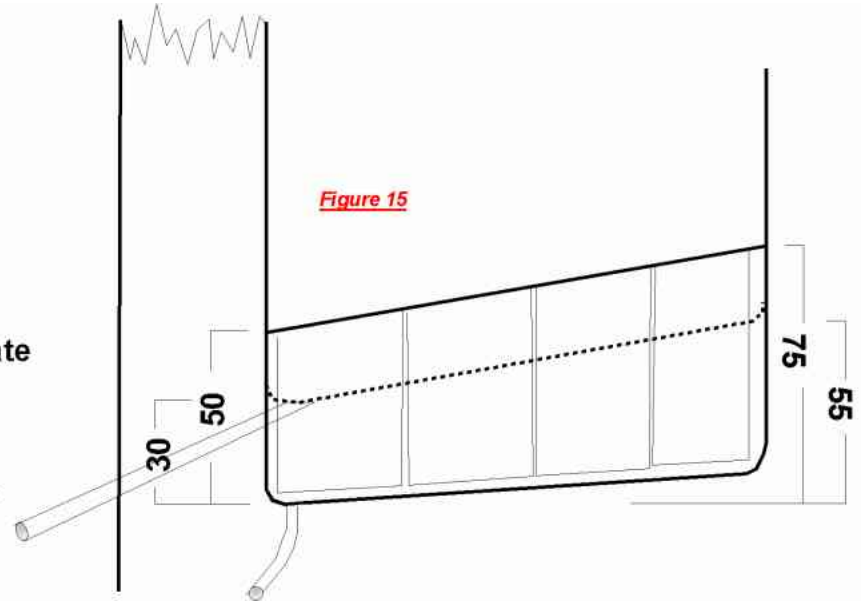


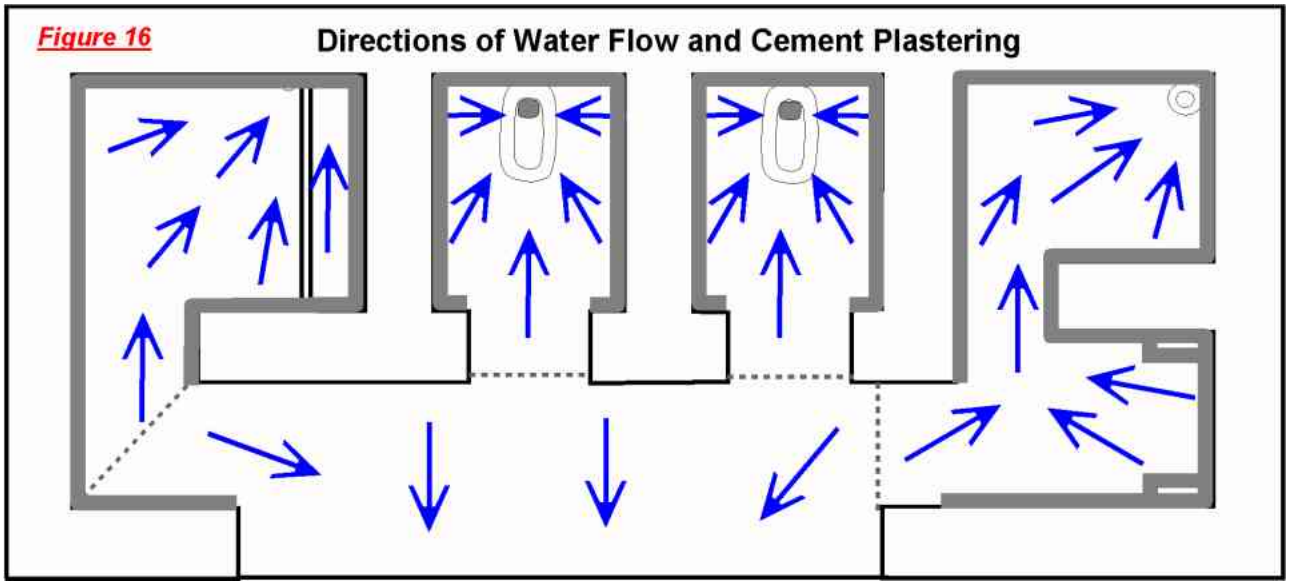
- The Iron Pipe leading out the urine shall be cut in a very oblique angle for easy fitting with cement plaster. The inner opening shall be completely level and reach 32 cm above the floor deck. The outer opening shall be above the opening of the urine collection tank.
- The plaster covering the base of the urinal will be 5 + 1 cm.

Calculation:

- Cement will be included in the Cement Plaster Work.
- Stone Slates including cutting, adjusting and fixing = 1.000 NRS
- Iron Pipe 1½ó 1½ meter long (can be adjusted later on) 200 NRS





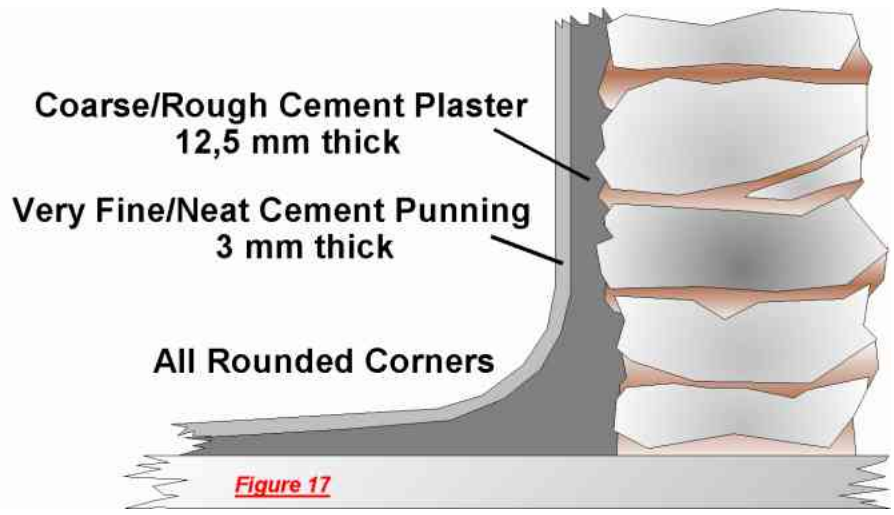


Interior Cement Plastering:

- To make cleaning and hygienic precautions easy, all rooms shall be plastered with a 12,5 millimeter layer of course/rough sand cement 1:4.
- The rooms shall be plastered from top to bottom and over the floor.
- All angles and corners shall be plastered in a way, that they are heavily rounded, so no dirt and humidity can gather there.
- The forming of the urinal groove shall happen at the same time as the wall is plastered and with the same mix.
- On top of this rough plaster layer there shall be a very fine/neat layer of plaster (punning) only 3 millimeter thick mixed with an extremely fine sand and cement 1:1,5.
- This layer shall cover all the rough plaster in an even layer and it shall be glazed to make a glossy surface which is relatively water repellant.
- The neat layer shall be added before the rough layer is completely dry; to make sure it will adhere completely. Otherwise it will later crack off in flakes. Therefore it might be advisable to take one room at a time to complete it with both layers before moving for the next.

Analysis:

- Urinal walls: 13,85 m^2 - plus floor: 2,95 m^2 = 16,80 m^2
- 2 x Toilet walls: 8,60 m^2 **ð** plus floor: 2,15 m^2 = 10,75 m^2 x 2 = 21,50 m^2
- Shower Room walls: 11,80 m^2 **ð** plus floor: 2,25 m^2 = 14,05 m^2
- Dressing room walls: 7,90 m^2 **ð** plus floor: 2,30 m^2 = 10,20 m^2
- Entrance floor: 5,80 m^2
- TOTAL: 68,50 m^2
- For rough plaster the need of materials is 1 sack cement per 9 m^2 and 1 m^3 of sand per 65 m^2.
- For neat punning the need of materials is 1 sack of cement per 12 m^2 and 0,35 m^3 of very fine sand.



- Labour for rough plaster is 1,2 Skilled and 1,6 Unskilled Man Day per 10 m^2 and for neat punning it is 1 Skilled and 1 Unskilled Man Day per 10 m^2.

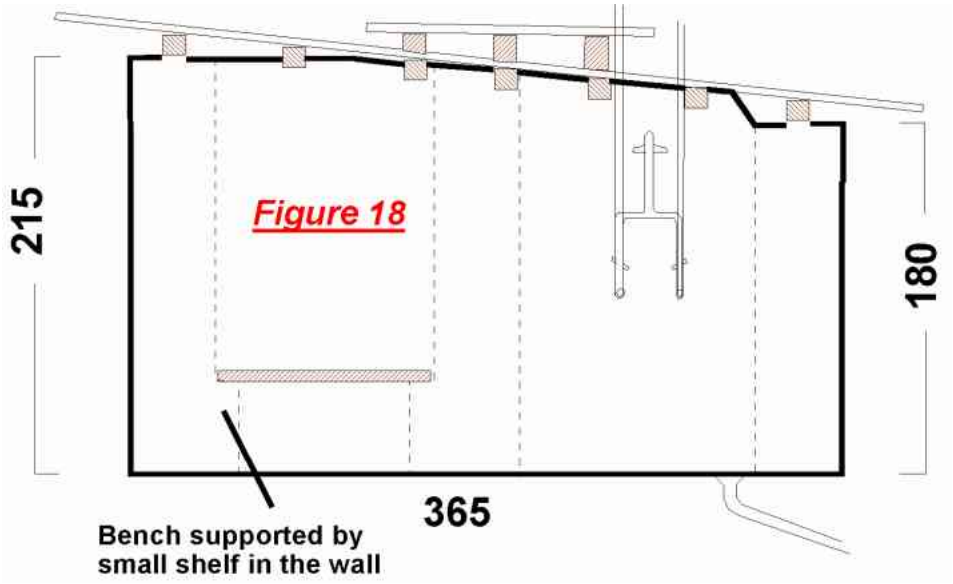


Figure 18

Calculation:

- Cement in total: 8 sacks plus 6 sacks plus 1 sack for Urinal = 15 sacks, costing 1.000-2.000 NRS/sack depending on the place = 15.000-30.000 NRS
- 1 m^3 of sand including transportation = 3.000 NRS
- 0,35 m^3 of very fine sand including transportation = 1.500 NRS
- Labor cost of 15 Skilled and 18 Unskilled Man Days = 8.100 NRS

C.G.I. Sheet Roofing Works:

- There shall be used 26 BWG Colored C.G.I. Sheet for roof ð color of own wish.
- Each sheet is 3 x 6 feet = 0,915 x 1,83 meter but this is only valid for the last and upper row of sheets as the size of the rest is reduced by the overlay. For the rest the efficient size is width 32 inch = 0,813 meter and length up to 68 inch = 1,725 meter.
- The roof consists of in total 33 sheets.
- 2 sheets can be replaced with 2 Skylight Plates for toilet room, if it is a wish.

Platform for Hot Water Aggregate:

- Upon the roof a platform shall be build for Solar Heated Hot Water Aggregate, which will be supplied to the construction, when several Sanitary Complexis has been build, so they all can be completed at the same time.
- This platform has the size of 3 pieces of 26 BWG Colored C.G.I. Sheet for roof, which is 2,55 x 1,83 meter.
- The platform shall have only a very little pith. Much less than the roof. The height of the 3 supporting beams shall vary according to that.
- As the weight of the aggregate is considerable, the roof as well as the platform shall be supported by extra enforcements:
  - § Under the upturning waves of the sheets a wooden Strip shall be adjusted to the wave. Not only under the platform, but also outside for enforcing the roof under workers at the aggregate (see Figure 20).
  - § The supporting beams shall stand on the top of the waves,

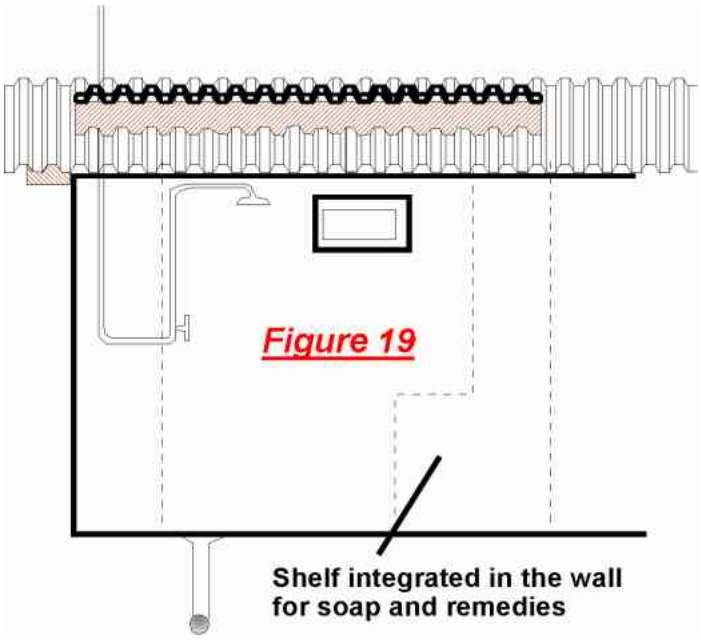
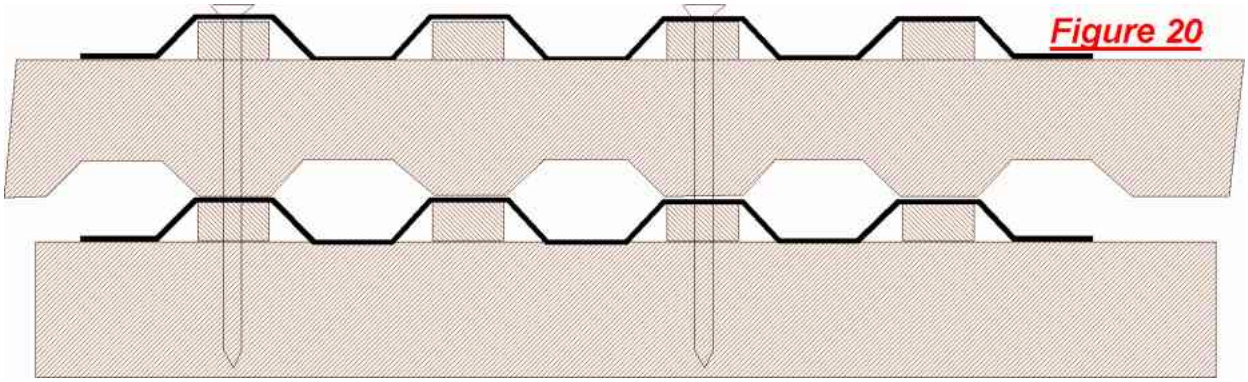


Figure 19



but have a notch above each downwards wave, to secure that leaves and dirt will not be trapped at the beams (see Figure 20).

§ Also the platformís upturning waves shall be supported by the Strip (see Figure 20).

§ The nails fixing the platform of course shall go through the top of the waves.

· The supportive wooden Strips actually could be a round stick of bamboo in the right size.

Analysis:

o The roof is 39 m²

o Strips for supporting the roof waves: 27 pieces á 3,5 meter plus lists for supporting the platform: 14 pieces á 3,50 meter (= 27 pieces á 1,75 meter) = 145 meter

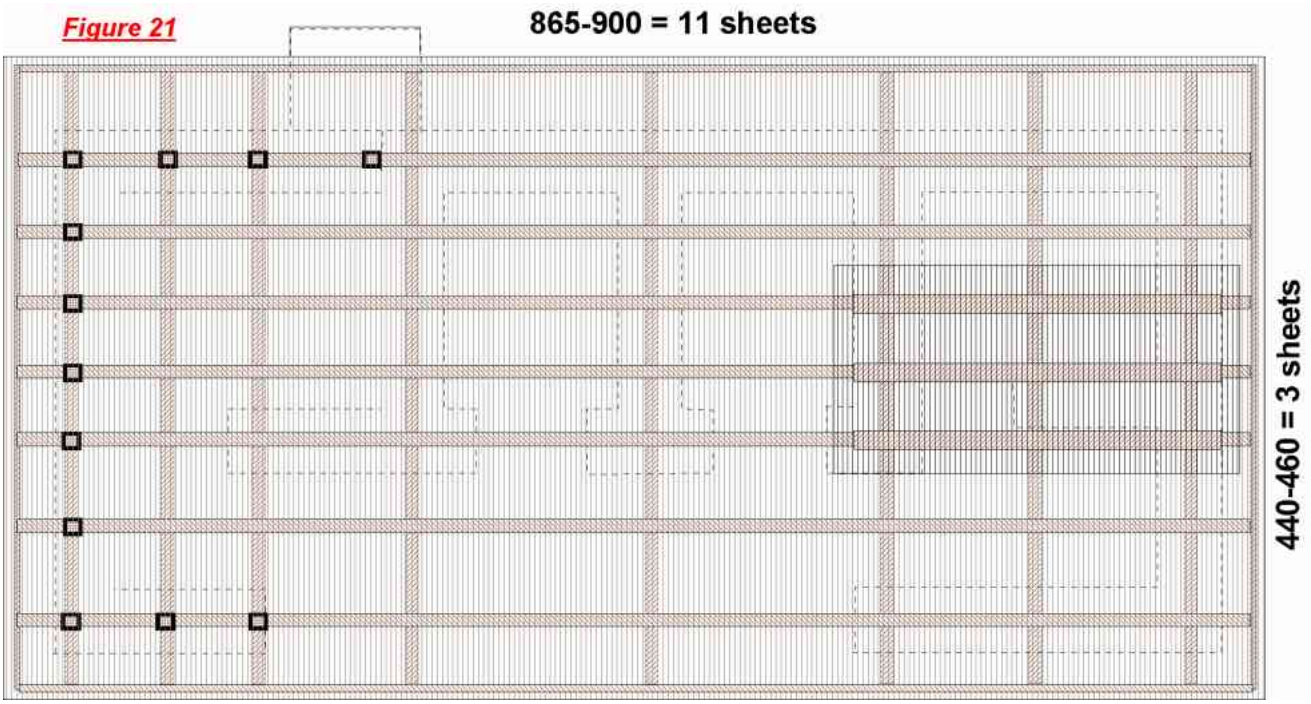
o The 3 beams supporting the Platform is 2,45 meter long and 10 cm wide and the first is 10 cm high **ð** the second 16 cm high **ð** the last 22 cm high and planed into angle, so it can stand vertical on the roof.

o Labor need is 1,1 Skilled and 1,2 Unskilled Man Days per 10 m² of roof plus 2 Skilled and 1 Unskilled Man Days for the platform

Calculations:

o 36 pieces of 26 BWG Colored C.G.I. Sheet is 3 Bundle. In Sagar-Bakanje the price is 9.000 NRS/bundle including transportation. In Thamakhani it is probably will be 10.500 NRS/bundle = 27.000-31.500 NRS

o Nut Bolts and Hooks = 2.000 NRS



- Wooden Strips and Beams including Labor = 1.500 NRS
- Labor = 3.000 NRS
- In case of Skylight: withdraw 850 NRS and add 1.500 NRS per plate (1.300 NRS)

Completing the Building:

- 3 doors shall be fitted into the frames, so they will always work in a proper way.
- Wooden Boards attached to the ends of heads and beams.
- Wooden plank as a bench in the Dressing Room, which shall rest upon the two excesses mentioned on Page 10.

Analysis:

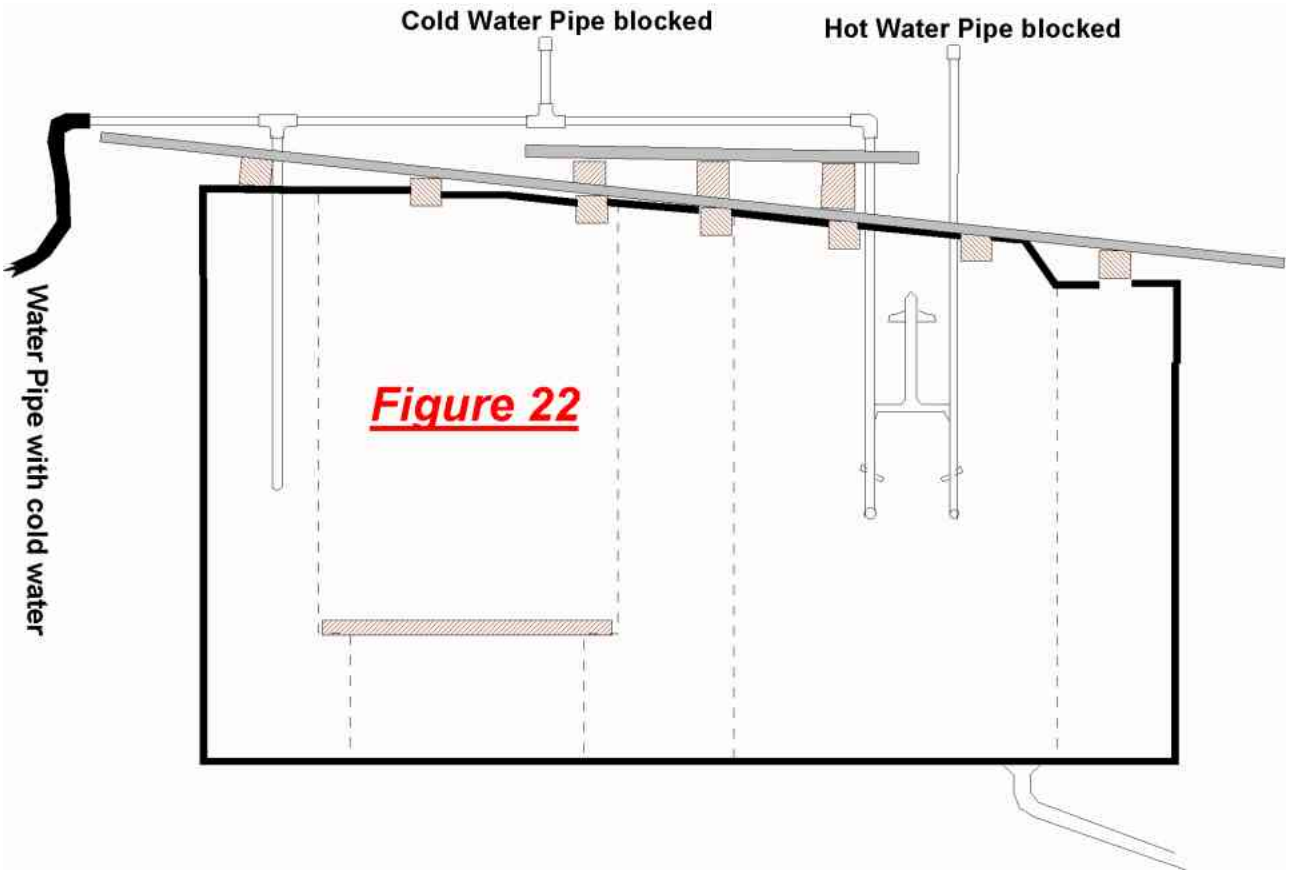
- All 3 doors are 0,70 x 1.70 meter = 2,13 x 5,60 feet = 11,9 feet^2
- The Wooden Boards is planks 12,0 cm (wide) x 2,8 cm (thick) **ð** 2 are 4,50 m (long) = 9,00 m **ð** plus 2 are 8,60 m (long) = 17,20 m **ð** Total 26,20 m **ð** (4,75ó x 1,1ó x 86 feet) = 34 feet^2
- Wooden Plank 1,1 meter long x 40 cm wide x 4 cm thick

Calculation:

- All 3 doors including wood and labor 2.500 NRS
- Wooden Boards including wood and labor 1.500 NRS
- Wooden Plank 250 NRS

Shower and Water Tap supply:

- The water pipes and supportive Iron Rods should now be built into the wall as mentioned on Page 10 and 11.
- The pipe which is meant for hot water for shower shall tower up above the roof, and it shall be blocked by a Blind Socket, waiting for Hot Shower Aggregate to be built.
- The water pipe for cold water from shower shall reach up above the platform. By a bend it shall go straight over the roof.



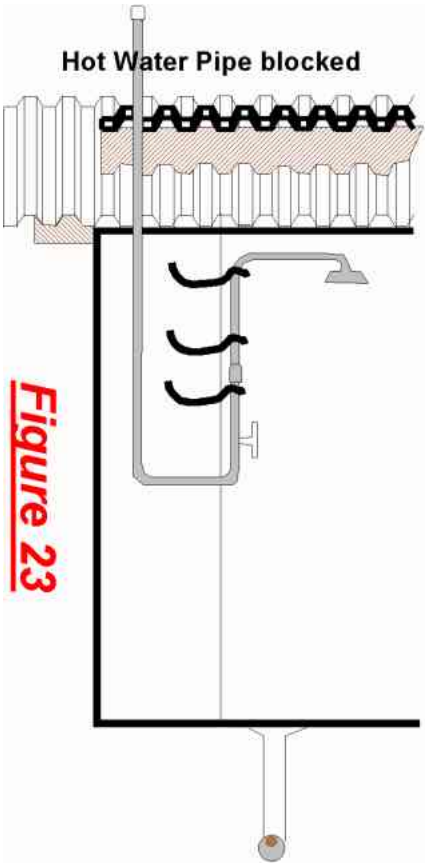


Figure 23

- At upper end of platform it shall be divided by a T-pipe, leading one part horizontally straight on, and one part straight up. On the latter part a small piece of pipe with a Blind Socket shall be drilled in.
- The main pipe continues straight over the roof until it meats the Water Tap-Pipe, to which it connects with another T-pipe.
- From the T a piece of pipe is drilled in, which shall connect to the water supply plastic pipe.
- The water supply should be carried on through a not too small pipe, to secure a proper flow in the pipes. Otherwise the temperature in the shower will vary too much when the water tap is opened, or some air moves through the pipe.
- It shall be possible in a very easy way to disconnect the water pipe and empty all the iron pipes. This shall specifically be done when a risk of freezing will occur, as thin iron pipes and taps quite easily freeze blow.
- Inside the shower room the two pipes coming out the wall is each of them connected to an upturning bend.
- After a 4ó piece of pipe, a Regulator (of very good quality) is connected to each pipe.
- After another 4ó piece of pipe the two pipes are connected to another bend turning inwards.
- After another 4ó piece of pipe, the two pipes are connected to a T-pipe.
- After a double thread pipe made on the spot, adjusted to a little less than roof, a bend and another 45 cm piece of pipe and a bend, and finally the Shower Head. This shall not be adjustable, but just a big, strong and simple head turning straight down in a distance of 50 cm from the wall.
- The Water Tap above the washing water basin shall also be of a very good and long lasting quality.

Calculation:

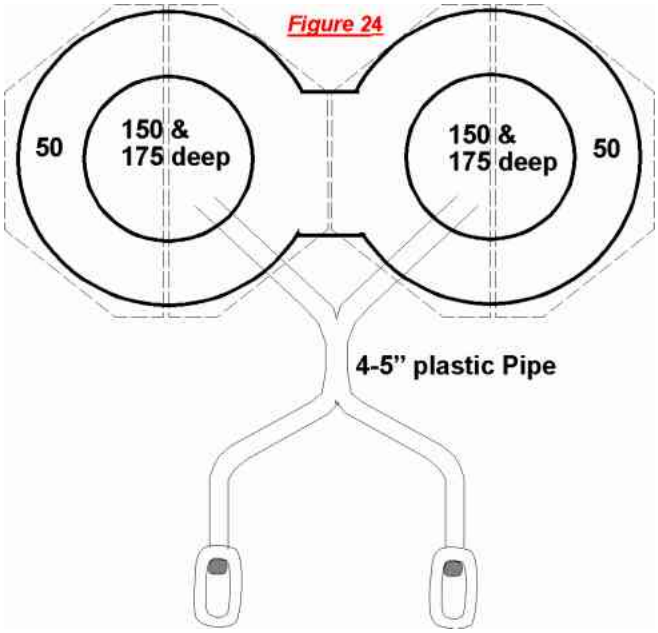
- Besides the three build in bends there needs 7 bends (10 in total)
- 3 T-pipes
- 2 Blind Sockets
- 7 pieces of 4ó double thread pipes
- 2 regulators of a very good quality
- A heavy and good quality but simple shower head
- 1 very good quality water tap
- 12 meter of 1ó Iron Water Pipe
- In total by estimation including labor 4.500 NRS

Septic Tanks:

- There shall be two Septic Tanks. Even the second one shall not be used before 2-3 years; it shall be build already now.
- The tanks shall be built down the slope lower than the toilet in such a way, that the waste pipe connecting toilet pan and Septic Tank shall have an angle on at least 30 degree drop, but much better on 60 degree. The higher drop the less waste will remain and the less flushing water is needed.

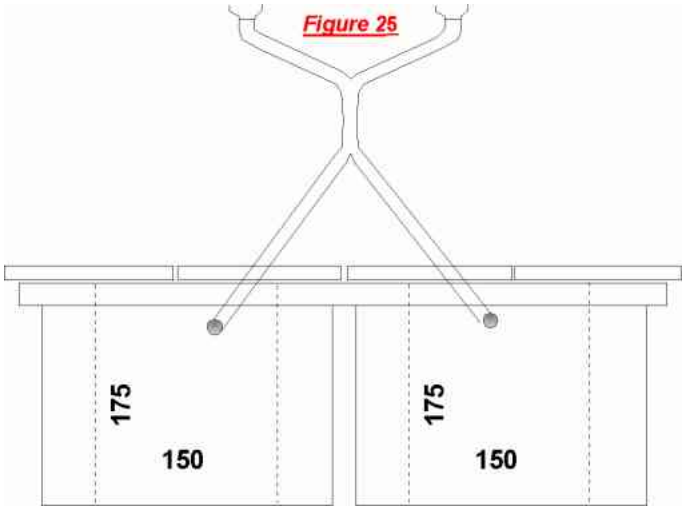
- Fill a layer of 15 cm of soil on the place where the tanks shall be build and make it completely horizontal and level.
- Mark the centre of the tanks, and then mark two circles around each centre. The first circle with 75-85 cm of radius and the second one 50 cm more (125-135 cm). There shall be a distance between the two outer circles on 20 cm ð it means 2,70-2,90 meter between the two centers.
- Dig a grove between the two circles 20 cm deep (and 50 cm wide). The sides shall be nicely vertical and the lower edge shall be sharp and even. Connect the two groves where the two groves are close (see Figure 24).

Figure 24



- Put 5 cm of cement-concrete 1:2:4 (1 Cement : 2 Sand : 4 Gravel 20 mm) in the groves. Then one ring of 8 mm Iron Rod, and some straight iron rods connecting the Iron Rings where the two rings will be poured together. Then 8 cm of cement-concrete. Another 8 mm Iron Rod and straight iron rods. And filling the grove up to the upper edge with cement-concrete. Finally when the cement is still wet, do the upper finish with cement-sand 1:2 making the casting completely horizontal, level and even.
- When the cement circle is completely dry, the holes for the septic tanks can be dug. Of course being careful not undermining the rings too much, but on the other hand enough to be able building the dry wall of the tank.
- The walls shall be built up very careful, that the tanks can be long lasting and stand up to the pit being emptied after composting is completed. The stones shall be placed carefully that they lay very firm on their place, but at the same time leaving sufficient hole between them, that fluids can disappear. They should be placed with the wide end turning outwards and the thinner end inwards, that they shall not fall into the tank. The wall shall be 1-1½ foot wide, depending on how well it is build. The more carefully the stones ate put in place, the thinner the wall can be constructed. When the wall reaches the cement rings, the stones can be fixed to the ring by cement, to be sure that the wall supports the ring all the way.
- Before the wall is completed, the waste pipe shall be put in place. The pipe can be formed by heating it, or prefabricated bends and connections can be bought. But basically the two pipes shall connect to fill into the same tank for 2-3 years. To be able to shift the tank every 2-3 years, the pipe shall again divide into two. The pipe shall enter the tank halfway down the cement ring, and shall have outlet more than 20 cm into the tank.
- It is a problem how to make it possible to come into the division to place a block, which can effectively prevent the waste to run into the composting tank. One way to do it is, to put a turn able

Figure 25



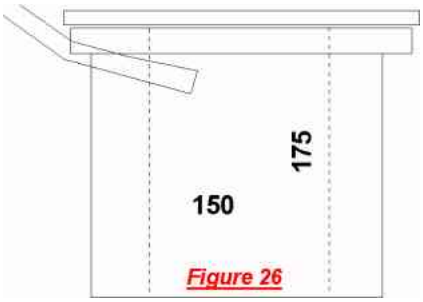


Figure 26

bend instead of a division. And fixing a smaller piece of tube into both of the tanks. The pipe connecting the bend and the tank-pipe shall be divided in two which can slide into each other to shorten it. In this way the one pipe can just be changed into the other tank every 2-3 years. One problem with this will be, that the connections possibly will join firmly together during the time. Another solution will be making a òwindowó just over the division which can be on- and off-screwed, so that a hand put in, can adjust the block. Problem with this solution can be the òwindowó being leaky, and the block not being efficient, so liquid waste will go into the composting tank, delaying the process considerably.

· 4 slabs for lids of the tanks shall be produced from cement-concrete. They shall be strong but not too heavy. If produced with two layers of strong iron net (chicken net) it can be as thin as 3-5 cm. Otherwise with 2-3 mm iron rods in a network with 10 cm in between it should rather have a thickness of 5-8 cm. They shall be produced on level ground with wooden boards as shuttering. In the centre there shall be a hole 15-20 cm in diameter for ventilation and for adding leaves, ashes and dust for the composting. (Later on a wooden plug shall be produced to keep the hole closed to prevent unintended things to fall into the pit.) Elaborate 3 handles for each slab by bending 8 mm Iron Rod. They shall be formed with a òhookó in the two ends which is inside the cement, which can take hold on a iron enforcement rod. The cement-concrete shall be 1:2:2 (1 Cement : 2 Sand : 2 Gravel 5 mm).

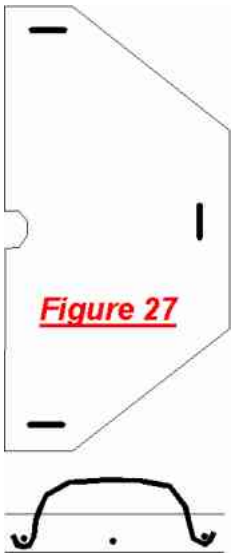


Figure 27

Analysis:

- The cement put into the groves for the upper lining will have a volume of 1,1 m^3 = 39 $feet^3$, consisting of 350 kg cement, 0,5 m^3 (= 31 tin) of sand and 0,9 m^3 (= 56 tin) of gravel grain size 20 mm.
- Preparing and digging the grove will take one Skilled Man Day and filling in the cement will take one Skilled and 7 Unskilled Man Days.
- Each of the 4 iron rings poured into the concrete will be 6,5 meter long, plus 6 pieces, each 0,9 meter, to connect the rings two by two. Total 31 meter weighing 0,375 kg/m = 11½ kg.
- Each tank to be dug is 10 m^3, means 20 m^3 for both. Cutting of soil including lift 1,5 meter and disposal up to 10 meter takes 0,8 Man Day per 1 m^3 = 16 Man Days.
- The dry wall in each tank will have a volume on 4 m^3 = 140 $feet^3$, when internal radius is 0,8 m and thickness of the dry wall is 1¼ foot. With a utility rate of 70%, one pile of stone will give 85 $feet^3$ of wall - then 3,3 piles are needed.
- Building the dry wall of the tanks takes 1 Skilled and 2 Unskilled Man days per m^3, which gives 4 Skilled and 8 Unskilled Man Days.
- The length of plastic waste pipe 4-5ó has to be calculated on spot, but probably 10 meter will do under normal circumstances.

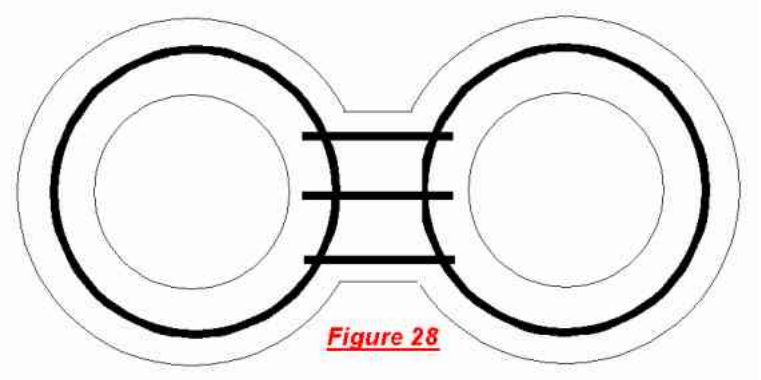


Figure 28

- When each slab is 2,20 meter long, 1,10 meter wide, 7 cm thick and a hole on 20 x 10 cm and corners cut - it will be 2 m^2 in surface and have a volume of 0,14 m^3 and 4 slabs will be 0,56 m^3 = 20 $feet^3$, consisting of 190 kg cement, 0,4 m^3 of sand and 0,4 m^3 of gravel with grain size 5 mm.
- There will be a need of 16 m^2 iron net (chicken net)
- There will be needed 30 cm of 8 mm iron rod for each handle. I total 12 handles, means 3,6 meter.
- Producing the slabs will take 1 Skilled and 4 Unskilled Man Days

Calculations:

- Cement for grooves and for slabs plus a little extra is 550 kg, which is 11 sacks for 1.000-2.000 NRS/sack = 11.000-22.000 NRS
- Sand for grove and slabs: 0,9 m^3 (= 55 tin) can be found in the vicinity at a rate of 3.000 NRS per m^3 (= 60 tin) including transportation up to 5 km = 2.750 NRS
- Gravel 20 mm for grove: 0,9 m^3 (=55 tin) at a rate of 1.700 NRS per m^3 (= 60 tin) including transportation = 1.500 NRS
- Gravel 5 mm for slabs: 0,4 m^3 (= 25 tin) at a rate of 2.500 NRS per m^3 (= 60 tin) including transportation = 1.000 NRS
- 8 mm iron rod for grove and handles of slab: 11½ kg = 1.150-2.300 NRS
- Iron net (estimate) = 1.500-3.000 NRS
- 3,3 piles of stone at a rate of 1.100-1.400 NRS/pile = 3.600-4.600 NRS
- Digging grove and filling with cement at 300/200 NRS per Man Day = 2.000 NRS
- Digging tanks is 16 Man days at 200 NRS/day = 3.200 NRS
- Building the dry wall of the tanks at 300/200 NRS per Man Day = 2.800 NRS
- Making slabs at 300/200 NRS per Man Day = 1.100 NRS

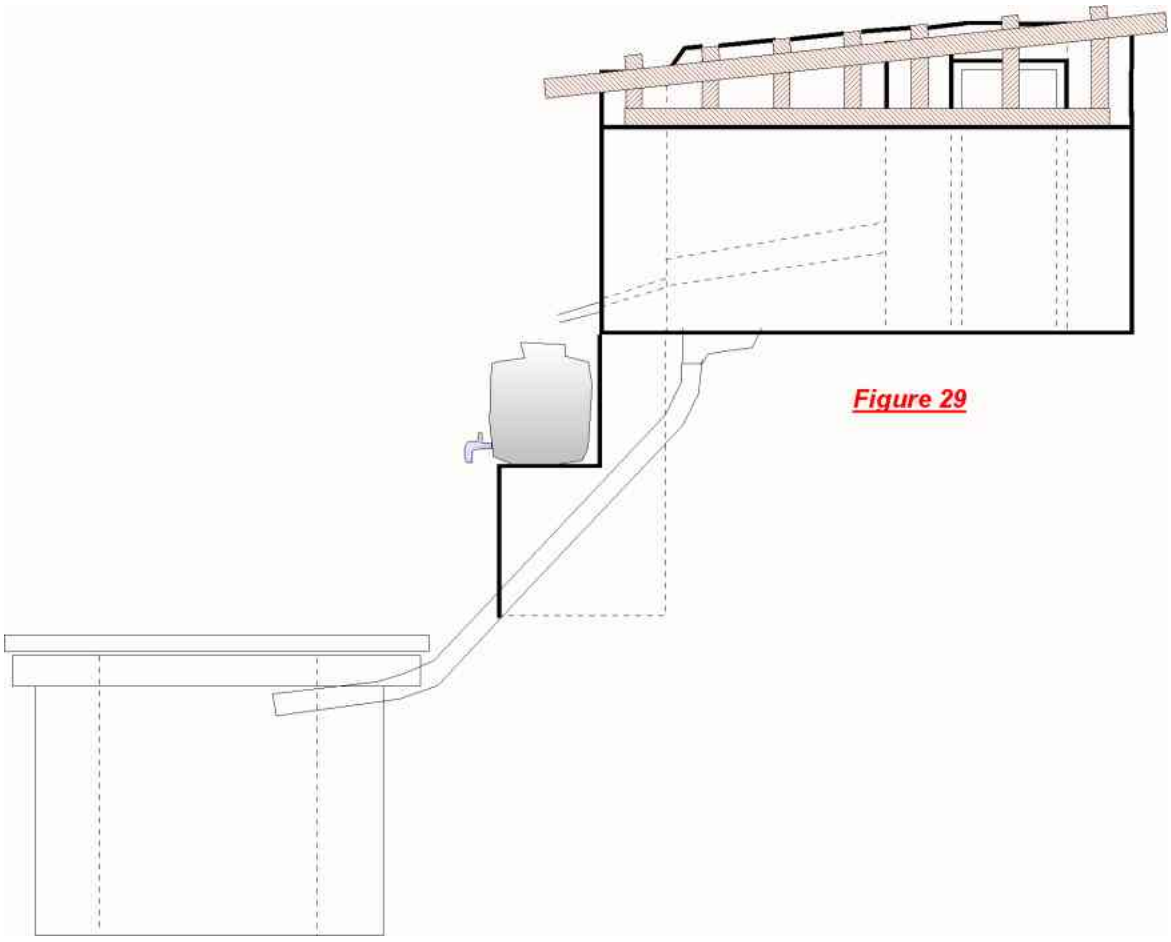


Figure 29

Urine Tank:

- The tank should be a 500-750 liter black tank with tap. I should be purchased before its post is build to be sure that post and urinal outlet pipe is situated on right place and size.
- If the post and tank shall stay in the sun, there should be build a wooden box around the tank to prevent it to heat up and give growth of algae.

Calculations:

- Black Plastic Tank including tap and transportation 2.000 NRS
- Wooden Box including labour = 1.000 NRS

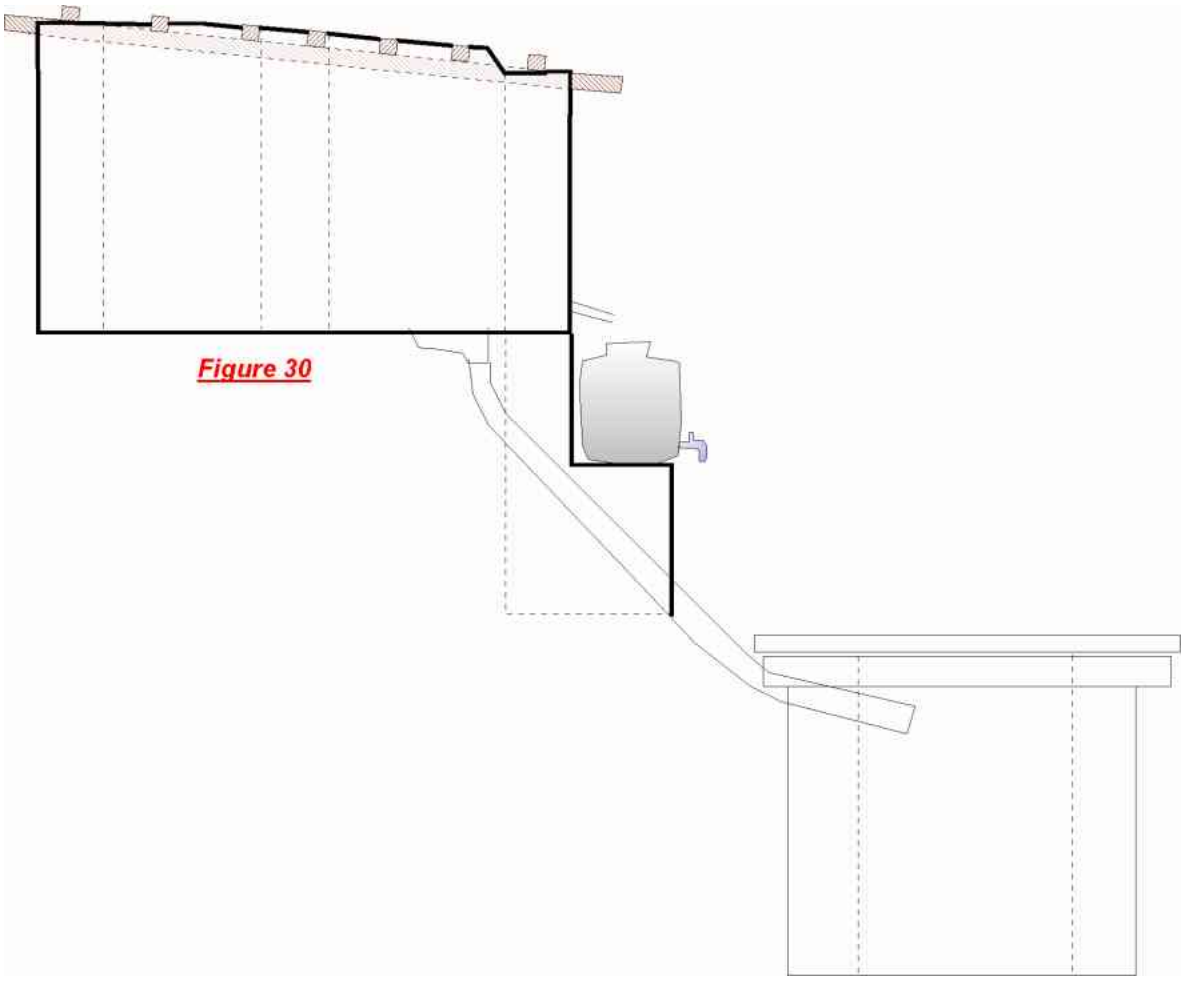


Figure 30

TOTAL BUDGET:

	Materials Cost	Labour Cost
Foundation	9.500-12.400 NRS	14.000-15.500 NRS
Floor	36.800-61.800 NRS	7.600 NRS
Ventilation and Door Frames	1.650 NRS	
Walls	14.200-17.200 NRS	17.500 NRS
Beams	2.600 NRS	3.000 NRS
Urinal	1.200 NRS	
Cement Plastering	19.500-34.500 NRS	8.100 NRS
C.G.I. Sheet Roofing Works	30.500- 35.000 NRS	3.000 NRS
Completing the building	4.250 NRS	
Water supply	4.500 NRS	
Septic Tanks	22.500-37.150 NRS	9.100 NRS
Urine Tank	3.000 NRS	
TOTAL:	150.200-215.250 NRS	62.300-63.800 NRS

GRAND TOTAL: 212.500 ð 279.050 NRS

Currency Rate 70 NRS/US$ 3.036 - 3.986 US$

Currency Rate 12 NRS/DKR 17.708 - 23.254 DKR

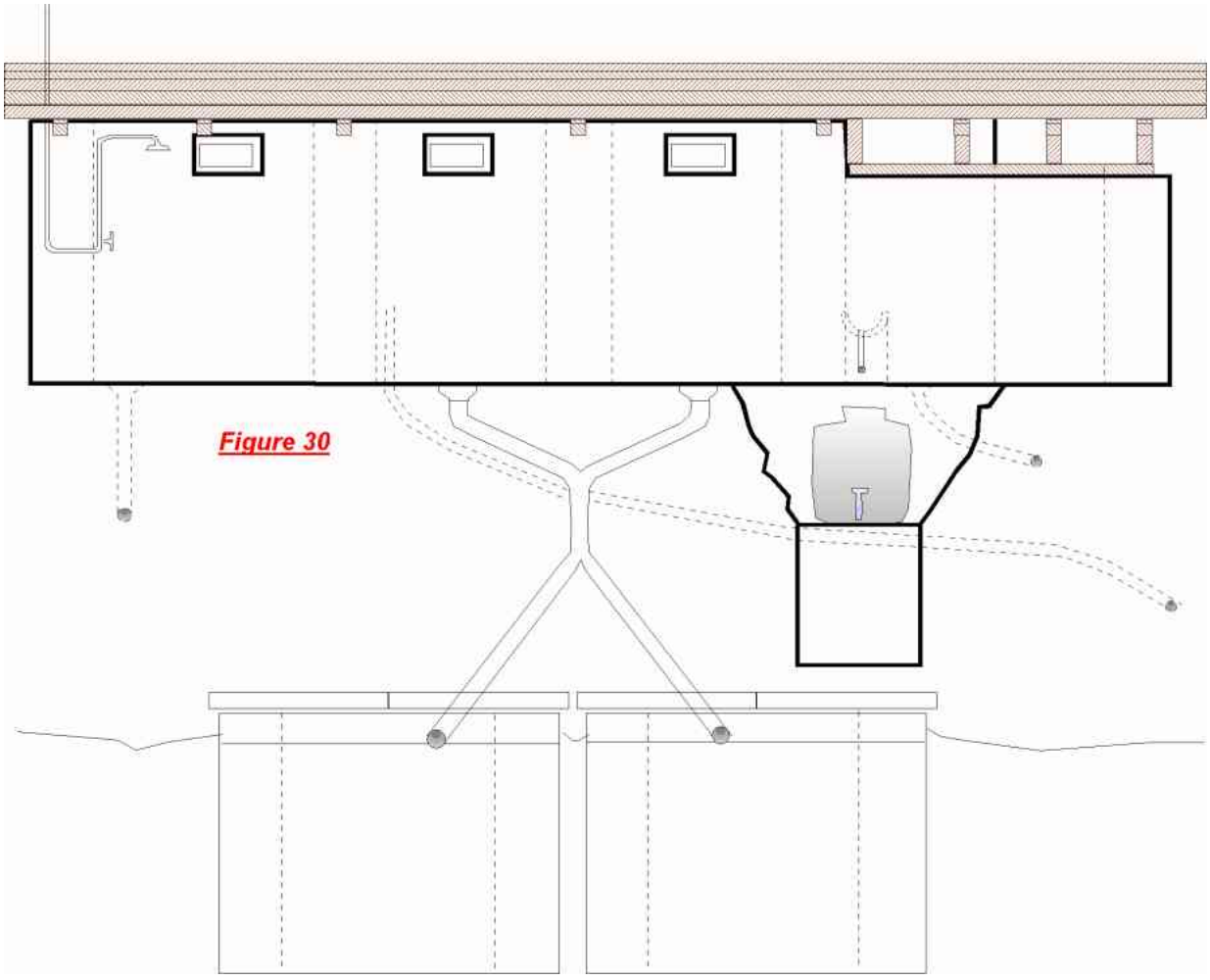


Figure 30

Materials in Use:

Stone	18-19 piles
Mud for mortar	8,5 m^3
Cement	46 sacks (2.260 kg)
Very fine Sand	0,35 m^3 (22 tin)
Sand	3,25 m^3 (203 tin)
Gravel 5 mm grain size	0,4 m^3 (33 tin)
Gravel 20 mm grain size	3,5 m^3 (219 tin)
Stone slates	1 m^2
Iron Rod 8 mm	135 meter (51 kg)
Iron Rod 4 mm	185 meter (18,5 kg)
Iron Net (Chicken Net)	16 m^2
Binding Wire	1 kg
Iron Band	6 meter
Toilet Pans	2 pieces
Washing Sink	1 piece
Urine Tank 500-750 liter	1 piece
4-5ó Plastic Pipe for toilet waste	measure
3ó Plastic Pipe	measure
1½ó Iron Pipe	1,5 meter
1ó Iron Pipe	12 meter
90º Bends	10 pieces
T-pipes	3 pieces
Blind Sockets	2 pieces
1ó iron pipes with thread in both ends ð 4ó long	7 pieces
Regulators for Shower	2 pieces
Shower Head	1 piece
Water Tap	1 piece
26 BWG Colored C.G.I. Sheet	3 Bundles (36 pieces)
Nut Bolts and Hooks or Nails for sheets	
Nails 6ó	100 pieces
Nails 3ó	0,5 kg
Wood:	
33 x 3,8 cm plank	18 meter (7,4 $feet^3$)
10 x 5 cm plank	18 meter (3,6 $feet^3$)
10 x 10 cm beam	110 meter (39 $feet^3$)
10 x 10 cm beam	2,45 meter
10 x 16 cm beam	2,45 meter
10 x 22 cm beam	2,45 meter
Strips supporting roof sheet	145 meter
12 x 2,8 cm boards	26,20 meter
40 x 4 cm plank	1,1 meter
Boards for doors and box etc	