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LATRINE CONSTRUCTION MANUAL

RWANDA RURAL SANITATION – ISUKU IWACU ACTIVITY

January 2018

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Introduction

The present Construction Manual has for aim to define the nature, the quality, the technical prescriptions, the standards to be observed and all setting in work of the execution of the Isuku Iwacu voucher system for two Prototypes of latrines used.

These two prototypes of latrines built are:

- Plastered Mud bricks latrine with SATO Pan fixed on wooden Floor
- Plastered Mud Bricks latrine with concrete slab

The present latrine construction manual includes in general: the general data (plans and drawings, technical details, etc.); of the technical prescriptions carrying on the quality and the preparation of the materials, the norms of construction and the fashion of execution of the different works according to the professional rules . The technical prescriptions, being by definition, specific to every category of works, are referred to the standards developed in the country.

These latrines will be built in the same construction materials. The difference is in the slab.

2. General works

2.1. Environmental health considerations

Before to start the construction works, it is essential to take into account the protection measures of the environment.

The contractor must respect the norms and prescriptions in relation to environment protection. On this note, he is supposed to remove all garbage and unused materials out of the site and deposited far away in conformity with environmental regimes.

Some of the Environmental Health considerations will include factors like the ones indicated in Table 1.

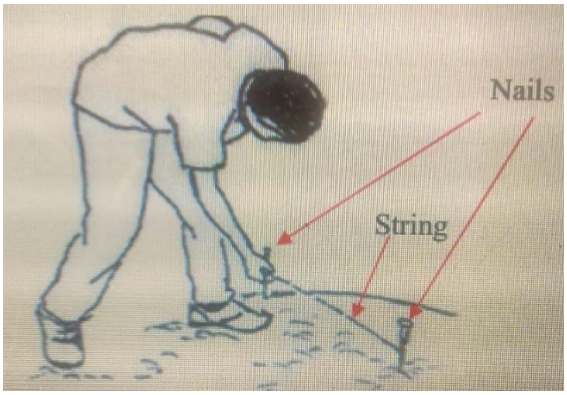
Table 1. The location of the latrine

N°	Specification	Reason
1	At least 30 meters from a ground water supply (e.g. well)	To minimize ground water contamination
2	10 – 15m away from the kitchen	To allow everyone (including the young, sick and aged) easy access to the latrine, even at night
3	Downhill from the ground water supply	So that waste from the latrine does not filter to contaminate the ground water supply
4	On slightly raised ground	So that rain water can drain away easily
5	On firm soil	To reduce the risk of the latrine collapsing
6	Away from dense vegetation	To allow easy flow of air over the vent pipe
7	Facing the windward direction	So that as much air as possible blows into the latrine
8	In direction of wind	So that smell from the latrine is blown away from home

2.2. Earthworks

2.2.1. Digging the Pit

In digging the latrine pit, the following steps are followed;

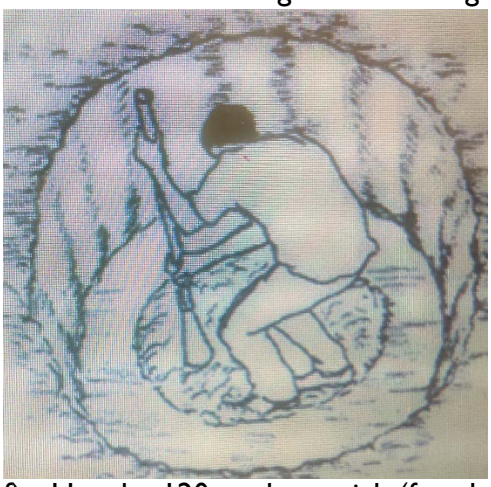
Activity	Materials/Tools
a) Mark outer a circle on the ground. The diameter of the cycle should be D=140cm. 	*String and 2 nails. The string and the 2 nails should be used as shown in the diagram below.*
b) Dig hole to firm layer (at least 1.25m, maximum 1.5m deep). 	*Big hoe, water and shovel.*
c) Scrape sides to ensure hole is circular, straight and vertical. Maintained pit diameter at D=120cm down to the depth of h=50 (for firm/hard soils) and h=100cm (for the loose soil). 	*Level or plumb line, small hoe and a 140 cm long stick.*

d) Mark inner circle at the bottom of the hole. The inner cycle should have a diameter of d= 80 cm for firm/hard soils. For loose/sandy soils, diameter of d'=120 cm should be maintained from the top of the pit down to the depth of 2.5 m.

String tool and 80 cm stick. Ensure inner hole is central.

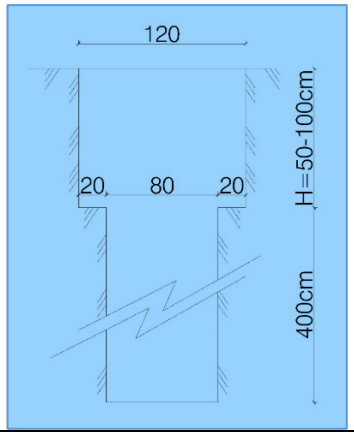
e) Dig inner circle, 80 cm diameter down to H= 2.5-3.0 m. Make sure the edge is not damaged.

Digging stick, small hoe, bucket, rope.



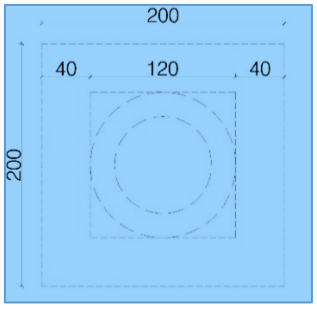
f) Use the 120 cm long stick (for checking the top inner diameter of a pit dug on firm/hard soils down to the depth of 20 cm. The 80 cm long stick should be used for checking the inner pit diameter on firm/hard soils after the top inner diameter of 120 cm.

Level and the 2 sticks (80 cm and 120 cm long). Small stick (80 cm long)



2.2.2. Excavation of foundation

The excavations of foundations should have a width of 50cm and a height of 50 to 80cm according to the nature of the ground. The side should be straight and vertical.



2.3. Masonry

2.3.1. Ring

The Rings are needed to prevent the sides/walls of the latrine from collapsing. They are inserted in the pit one at a time until they reach the top of the pit as discussed in later sections. A ring is made with 100cm diameter, 20cm thick and 50-100cm depth. The total size of the ring would then be 120cm. The ring is built in burned bricks with cement mortar (***250kg/m^3: 1 bag of cement for 5 barrows of 50 litters or 4 barrows of 60 litters***)

Before purchasing the bricks, the Contractor shall perform manual tests to verify the quality and strength of the products.

Dry bricks tests

Test 1

- *Select 2 average quality bricks (for dimensions, finishing and color specs) from the supply*
- *Clap the bricks surfaces one to the other with the same power as a hand clap for 3 times.*
- *If one or both bricks crack or break, the bricks shall be rejected*

Test 2

- *Select 3 average quality bricks (for dimensions, finishing and color specs) from the supply*
- *Rest one brick horizontally across two others overlapping only 1 cm and stand / jump on the brick*
- *If the brick cracks the bricks shall be rejected*

Wet bricks tests

- *Select 5 average quality bricks (dimensions, finishing and color specs) from the supply*
- *Submerge the bricks into cold water and leave them into the water for at least 24 hours*
- *If the bricks are not compacted they will start to release air (air bubbles).*
- *After 24 hours check the quality of the bricks. If some of them are cracked or broken or pulverized, the supply shall be rejected. If the bricks are still compact and show integrity, remove the bricks from the water and proceed to the dry test.*

The results of the tests shall be communicated to the Employer's representative. The Employer's representative shall decide to reject the supply or approve or request samples for more tests.

2.3.2. Masonry of foundation

a. Blinding under foundations

The blinding concrete is cast under the foundation masonry. It is cast on firm soil. It has a thickness of 5 cm. The cement and sand ration is 200Kg/m^3 (200Kg, 400 litters of sand and 800 litters of gravel = ***1 bag of cement for 2 barrows (50litters) of sand and 4 barrows (50litters) of gravel or 1$^{1/5}$ barrows (60litters) of sand and 3$^{1/3}$ barrows (60litters) of gravel***.

b. Stone Masonry

The stone masonry foundations (at walls and pit latrine) shall be made of local stones, extracted from the best quarries. Stones found on site can be used upon approval of the Employer's representative. The stones shall besquared shaped to fit the excavation and the width of the wall as specified in the drawings. The stones dimension should vary to compose a compact and tightened wall. The stones layout shall alternate stones that cover the entire wall width and smaller stones.

NOTE: *The stone walls axis is usually the same axis of the building bricks walls above. However on the exterior walls the stone foundations have been shifted to fit under the wall and buttresses width.*

The mortar ration shall be:

- *Cement - 300 kg/m^3*
- *Gravel - 1200 lt*
- *Water - 150 lt*

(1 bag of cement for 4 barrows of 50 litters or $3^{1/3}$ barrows of 60 litters)
The water to cement ratio shall never be higher than 0,6.
The mortar must be protected from wind, rain and sun and must be put to use within 45 minutes of mixing. The mortar that has set should not be used.

c. Screed Levelling

The screed levelling on top foundation is made by a mortar of cement: 200 Kg/m3: 200Kg: 1050 Litters of sand = ***1 bag of cement and $5^{1/3}$ barrows (50litters) of sand or $42^{/3}$ barrows (60litters) of sand.***

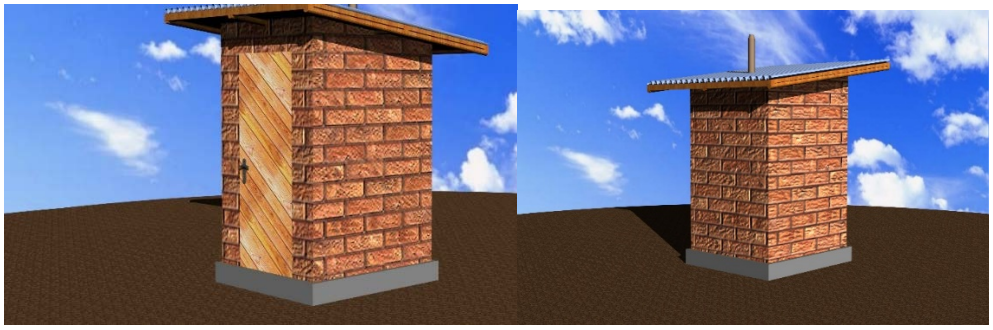
d. Dump proofing

Protection against the upward moisture of all the external and interior walls.

The work includes:

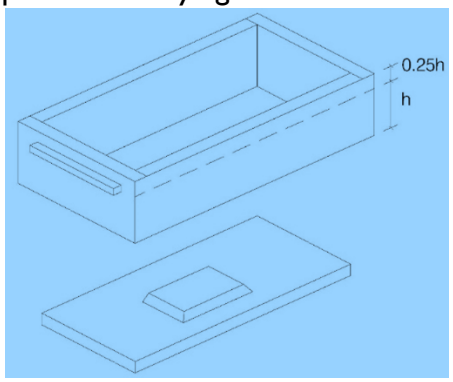
- *The supply and installation of a smooth asphaltic felt on the base of a well-made screed (with the top of the levelled cover)*
- *The covering of l0 cm minimum to the connections between bands*
- *The sealing layer is placed at the base of the wall, immediately above the floor.*

e. Elevation with Mud bricks



A mud brick measures 40x19x12cm.
To have a brick of good quality, the following conditions must be respected.

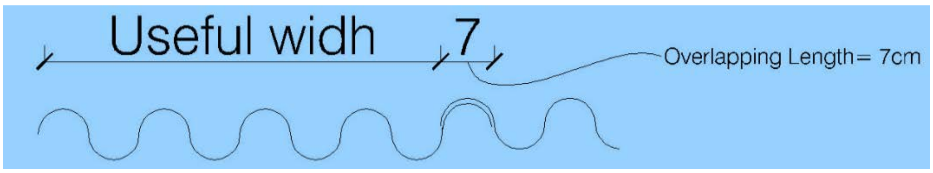
1) A better selection and mix of the soil
2) The use of several molds, so that you can wait a little before unmolding
3) The use of a hinged mold, to unmold more easily
4) The use of bottom for the molds, on which the blocks can dry until they are resistant
5) The preparation of a flat and clean drying area, this will avoid using the mold bottom recommended above: use a pavement already completed or well leveled and cleaned ground;
6) Drainage around the drying area
7) The manufacture of blocks with a partial hollow, by adding a wooden block on the bottoms, it improves the drying inside the block and the attachment to the joints



8) The use of a raised mold that will not be completely filled and then compaction with a wooden lady
9) Add chopped straw to the soil, to regulate the drying and reinforce the blocks
10) Add termite mound soil that contains a useful binder
11) Gradual drying, in the shade, for example under the roof. Temporary construction of roof of house on poles, under which blocks are made and dried
12) The choice of the right season; it is: the beginning of the dry season, because in the dry season blocks can dry quickly and crack

2.4. Roof

1) The Purlins and rafter are in round timber (Eucalyptus).
2) The wooden purlins are laid in the masonry, are fixed by steel strip, embedded in the masonry
3) Do not put purlins directly on mud bricks wall. The load concentrated there will cas cracks. It is best to spread this weight across a rafter.
4) The iron sheer colligated are 32BG, and the lateral overlapping length is at least one wave.



2.5. Door

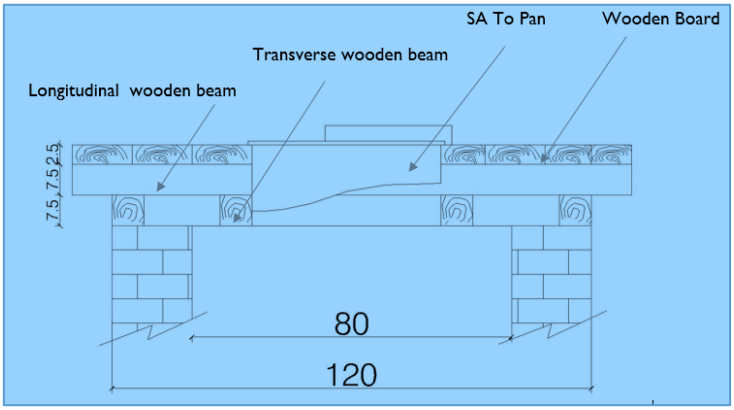
The door is made in wood (Grevelia), with two hinges, a padlock holder, padlock, and a coat of varnish. Dim: 80x200cm

3. Mud bricks latrine with SATO pan fixed on wooden floor

3.1. Wooden floor and SATO Pan

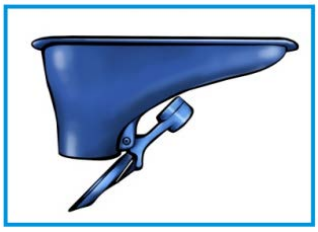
3.1.1. Wooden Floor

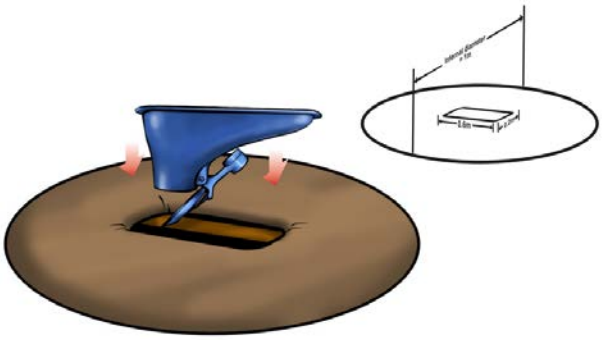
The structure of floor is made in transverse wooden beam 75mm x 50cm and longitudinal wooden beam 75mm x 50mm. The floor is made in wooden board (50mmx25mm). They are assembled by 8mm nails.



3.1.2. SATO Pan

The SATO Pan is made in plastic, and it is fixed on the wooden floor.





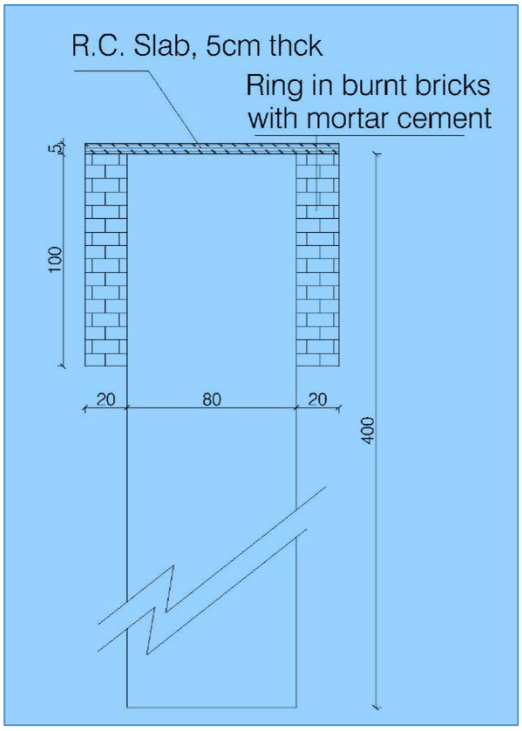
3.1.3. Bill of Quantities of construction works of muds latrines with SATO pan fixed on a wooden floor

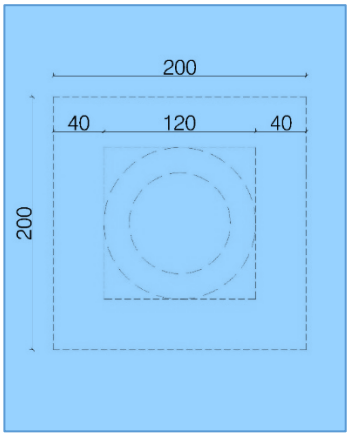
N°	Description	Unity	Quantity
I.	**Labors**		
1.1	Excavation of pits	meter	4
1.2	Excavation of foundation	M/day	0.5
1.3	Mason	M/day	4
1.4	Assistant mason	M/day	4
	S/Total		
II.	**Construction Materials**		
2.1	Sand	Truck	0.068
2.2	Gravel	Truck	0.012
2.3	Muds bricks	Piece	203.84
2.4	Roofing	L	5.6
2.5	Stones	Truck	0.3584
2.6	Cement	Bag	2.38
2.7	Timber 14x5cm² (Eucalyptus) (planks=4m)	Piece	0.30
2.8	Beam in Timber 7,5 x5 (Eucalyptus)	Piece	1.2
2.9	Board 5x14cm (Eucalyptus)	Piece	3.5
2.10	Wooden rafter	Piece	1.1
2.11	Wooden Purlns	Piece	1.1
2.12	Iron Sheet corrigated 32BG L=300cm, l=90cm	Piece	3
2.13	Nails 8cm	Kg	0.5
2.14	Nails 10cm	Kg	1
2.15	Wooden door (*Porte planchette*) 200x80cm	Piece	1
2.16	Lock holder	Piece	1
2.17	Padlock	Piece	1
2.18	Water	Jerycan	8
2.19	Sa To pan in plastic	Piece	1
Legend			
	Community contribution		
	Project contribution		

4. Mud bricks latrine with reinforced concrete

4.1. Pits and Ring

The pit and ring are the same as descripted in chapter 1.2.1. Only the measuring are different.

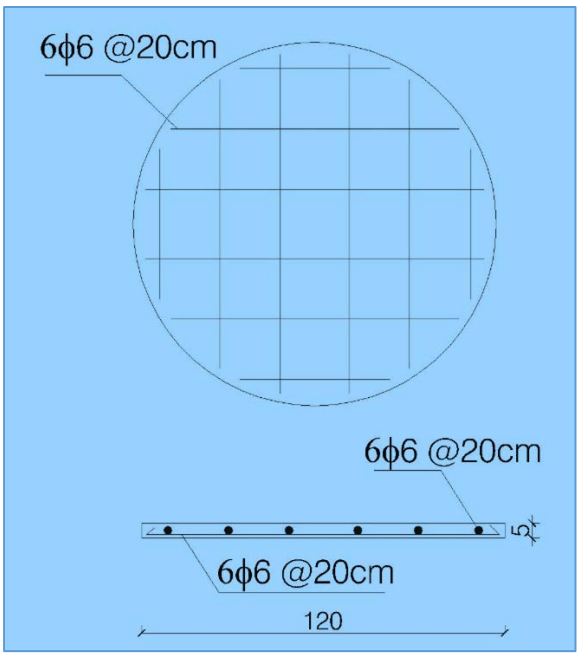




Excavation of foundation

4.2. Reinforced Concrete Slab

The slab is made in reinforced concrete 5cm thick, with iron bar 6□6 spaced by 20cm. The ration of cement, gravel and sand is: 350Kg/m: 400l of sand, 400 l of gravel



4.3. Bill of Quantities of construction works of muds latrines with SATO pan fixed on a wooden floor

N°	Description	Unity	Quantity
I.	**Labours**		
1.1	Excavation of pits	Meter	4
1.2	Excavation of foundation	M/day	0.5
1.3	Mason	M/day	5
1.4	Assistant mason	M/day	5
	S/Total		
II.	**Construction Materails**		
2.1	Sand	Truck	0.10
2.2	Gravel	Truck	0.03
2.3	Roofing	L	6
2.4	Burned bricks	Piece	76
2.5	Muds bricks	Piece	204
2.6	Cement	Bags	4
2.7	Stones	Truck	0.5
2.8	Timber 14x5cm² (Eucalyptus)	Piece	0.3
2.9	Iron bar ϕ6	Piece	2
2.1	Bending Wire	Kg	0.5
2.11	Wooden rafter	Piece	1.105
2.12	Wooden Purlins	Piece	1.1
2.13	Iron Sheet corrugated 32BG L=300cm, l=90cm	Piece	3
2.14	Nails 6cm	Kg	0.5
2.15	Vent pipe PVC 90mm	Piece	0.5
2.16	Wooden door (Porte planchette) 200x80cm	Piece	1
2.17	Lock holder	Piece	1
2.18	Padlock	Piece	1
2.19	Fly Screen in PVC with plastic net	Piece	1
2.2	Polythene sheet	L	2
2.21	Wooden Baord (planks)	Piece	1
2.22	Water	Jerrycan	10

Legend

Community contribution

Project contribution