

PROTECTED WELL FIELD MANUAL



**Synod of Livingstonia, Nkhoma Synod,
Synod of Zambia, Evangelical Lutheran
Church of Tanzania**

&

**Marion Medical Mission's
Protected Water Programme**

PROTECTED WELL FIELD MANUAL



This manual is intended for village well committees, installers and anyone else directly involved with the building or installation of wells in the field. It is intended as a general guide to the process of building a well, but it does not cover all possible details.

The drawings in this manual were done by Geoff Flack and Josh Jones under the supervision of Robert Work at Colorado State University.

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Revision Team:

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There are 8 parts to building a well. These are:

1. Community mobilization
2. Locate the well site
3. Build the top slab
4. Collect the materials
5. Dig the hole for the well
6. Lay the bricks
7. Build the apron and drain.
8. Install the pump

Pari vigaba vinkhonde na vitatu pakuzenga chisime. Vigaba vyake ni ivi:

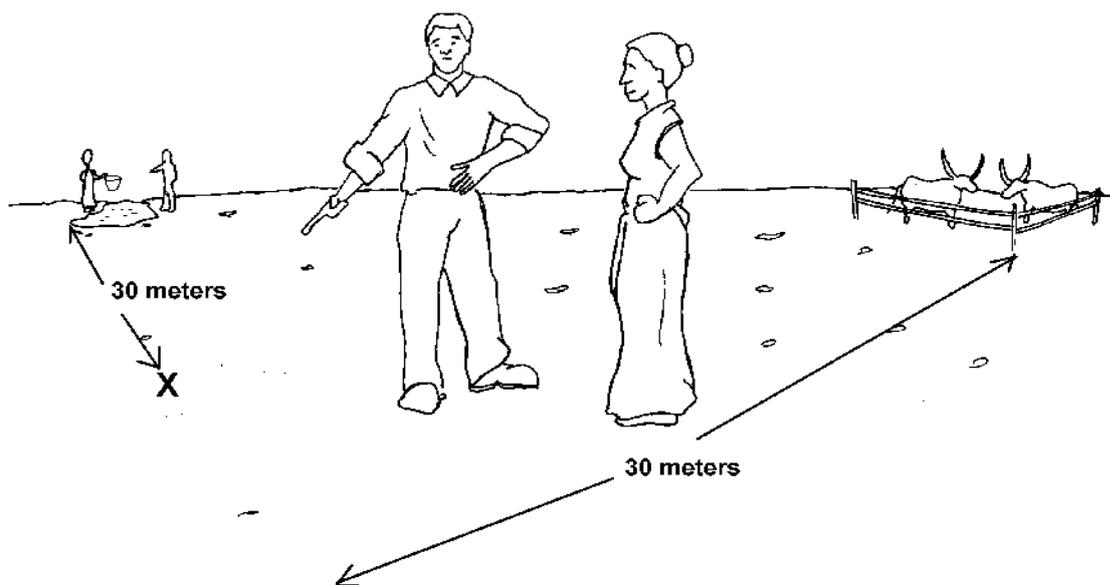
1. Khalani pasi na benecho ba chisime
2. Sangani malo agho mujimengepo chisime
3. Zengani chakujara pachanya pa chisime
4. Unjikiskani vyakuzengera
5. Jimani chisime pamalo apo mwasankha
6. Zengani kuyambira pasi pa chisime
7. Zengani khonde na mgero wa maji
8. Wikanipo pampu na kuzengerera

1. COMMUNITY MOBILISATION

KUKHALA PASI NA BENECHO BA CHISIME

2. LOCATE THE WELL SITE

KASANKHIRO KA MALO GHAKUJIMAPO CHISIME



Do not place a well too close to the traditional water source. It should be at least 30 meters from a stream or open water hole. A new well should also be located away from any other sources of contamination, such as toilets, animal corrals or waste disposal areas. They should be 30 meters or more away.

This ensures that contaminated water will not drain to the well. Obviously the site should be close to where people live.

The precise site should be chosen by the community in consultation with maintenance personnel or the installation supervisor.

More information must come from the village owners and more especially the elderly who have more information of their land.

Lekani kujima chisime chinu pafupi na apo banthu bakutekapo maji. Chisime ichi chikwenera kuba pa utali wa pa fupi mamita makhumi ghatatu panji kujuphira apo kufumira kuvinthu ivyo vingananga maji nga ndi vibaya vyang'ombe nesi nkhumba, nkhando ya kuthiramo viswaswa nesi vinkhandonkhando vyose nga ndi vyakuwumbirapo njerwa panji visage vya mukaya.

Fundo zapachanya izi zikupangiska kuti maji ghaleke kufumu kuvinthu viheni nga ndi vimbuzi panji vibaya na kujira mu maji ghinthu. Ntchakumanyikwirathu kuti malo ghinthu ghakwenera kuba pafupi na apo banthu bakukhala.

Malo agha ghakwenera kusankhika mwakuwirana na bakaswiri bavyamaji nga ndi wakunozga visime panji mulala wakunozga visime.

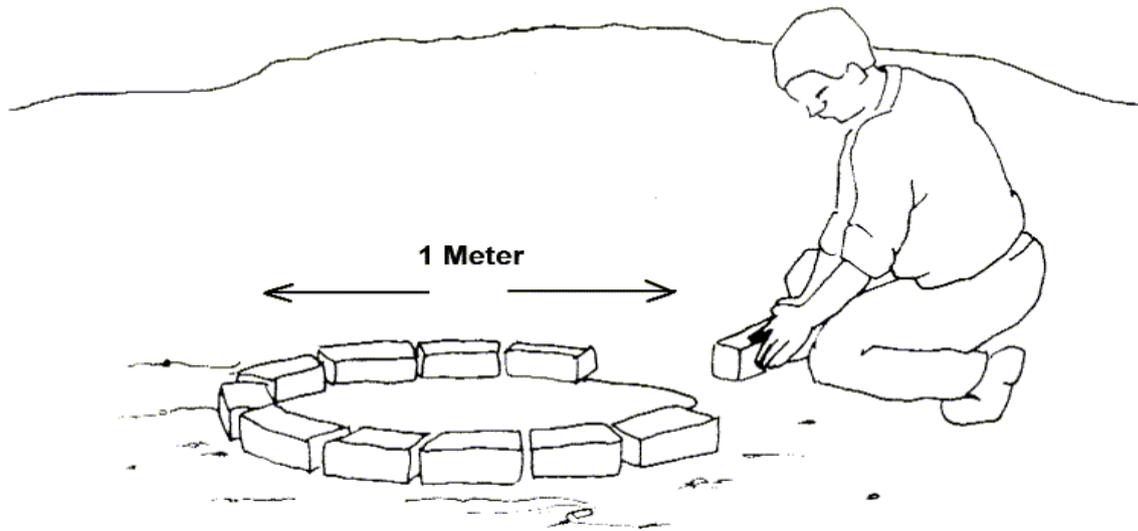
Ukaboni ghunandi wa malo agha, tikwenera kufumba kwa bene malo nga mbagogo binthu abo bali nambiri yonse ya malo agha.

Ghonani umo malo ghaliri, mtundu wa dongo, ndipo ghonani vinthu nga ndi makuni gha katope panji viduli. Apo pakusangika bakabirubiru, pakubanga chisime chiweme kuluska icho chajimika padongo la katondo

3. BUILD THE TOP SLAB

The Top Slab should be formed and poured as soon as the well site is determined, usually 1 to 2 months before the well digging begins. The Top Slab is one meter in diameter and about 7.5 cm thick (about 3 inches). A ring of bricks is used as a mould to form the top slab.

Ghumbani chakujara pachisime pa malo apo mujimenge chisime chinu, makamaka pambere mwezi ghumoza panji yibiri yindajumphe kufika apo mujimirenge chisime chinu. Chakujara pachisime ichi chibe mita yimoza (100cm) muusani ndipo 7.5cm (3 inches) muukhomi. Gwiraskani ntchito njerwa ngani chikombole chinu pakuumba chakujara pa chisime.



Make sure the ground is level (a spirit level is the best guide on this). Most builders pour sand for easy leveling and making the ground suitable for concrete. One has to be very sure that the center, where a socket ring is placed, is hard enough. You can place a brick at the center and make the whole area level. This will not allow a socket ring to sink upon ramming. Some slabs have been seen with the reinforcement bars seen underneath the slab making it very unsafe to people. Put sand or paper on the inside of the socket to prevent cement from getting on the threads while the top slab is being built. The top of the socket should be even with the top of the concrete or slightly above.

NB: Most of the top slabs have slanted socket rings therefore never remove a spirit level completely after the first measure of the socket ring. At all this, the Spirit level is your KING.

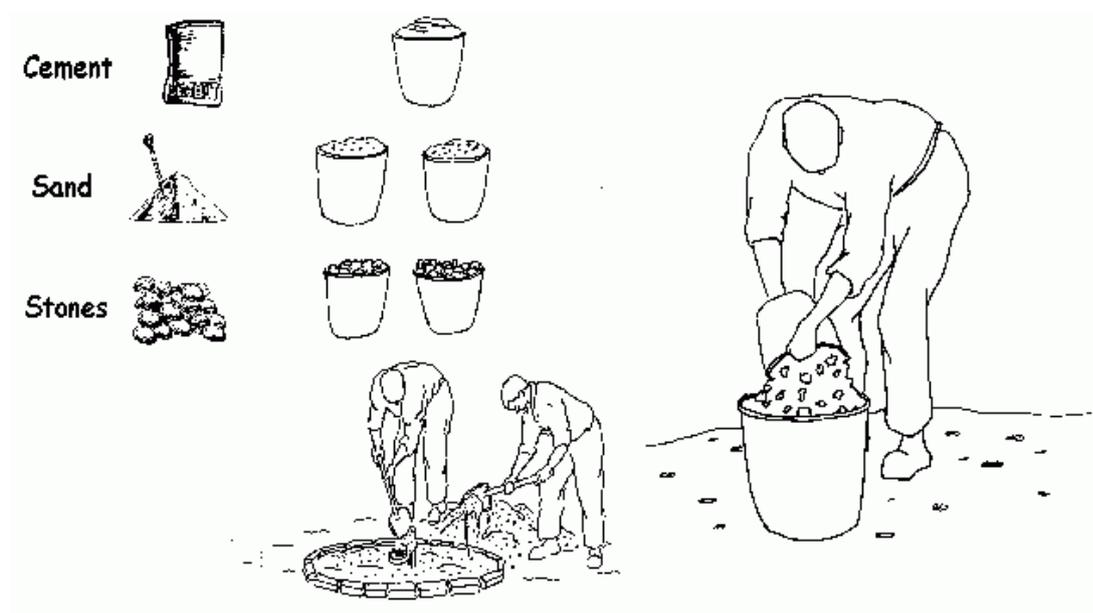
KUZENGA CHAKUJARA PACHANYA PACHISIME

1. Onesekani kuti malo agho muumbirengapo ghakuyana ghose. Gwiriskani ntchito levulo yinu pakusalazga.
2. Para tagwiriska ntchito mchenga kuti malo ghithu ghaba ghakuyana lubiro, tikwenera kuoneseka kuti pakati apo tibikenge soketi Ring'i ghinthu phakukhola mwakufikapo yinganjiranga pasi chara. Mungajimirapo njerwa mwakuyaniska na levulo yinu.
3. Wikani mchenga panji chipepala mukati mwa soketi ring'i kuti konkili yingajalanga chala mazinga paku sindira

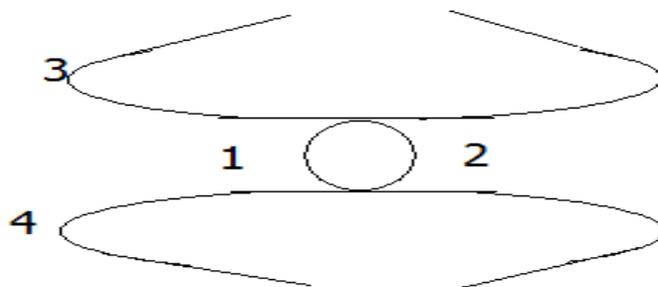
4. Para mawaya ghakubonekera kuwaro kwasilabu yinu yikukholanga yayi.
5. Oneseskani kuti pala mukusindira konkili yinu RING'I yibe ndithu levulo.

The concrete for the slab is made with a mixture consisting of 1 part Portland cement, 2 parts river sand and 2 parts of small stones.

Pakuzenga chakujara pachanya ichi tikusazga ndowo yimoza yasimenti, ndowo zibiri za mchenga na ndowo zibiri za malibwe ghachokoghachoko.



PLACING CONCRETE



Spider (Utatavu)

KAWIKIRO KA KONKILI

Yambirani pakati pa mawaya ghinu mbwenu mumphepete

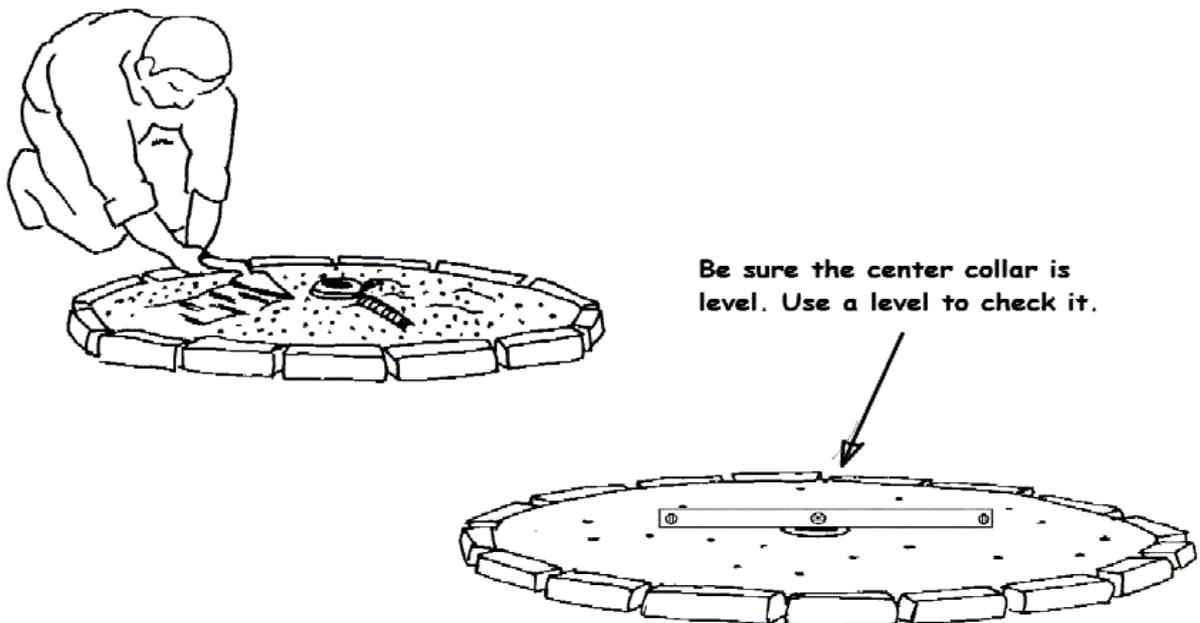
The socket with attached bars, called a spider, is placed in the center of the form before pouring the slab. Use a level to be sure the socket is level and at the same height as the ring of bricks. Place concrete in between the legs of the spider first and then later on where they fold very close to the socket ring but not touching it. Use the trowel to pull concrete to the socket. Make sure the ring is still level. The slab is poured to the height of the single layer of bricks.

While the concrete is drying, it should be kept from drying too quickly by covering it with sand or grass or straw and keeping the covering wet, for the first week.

Chisulo chapakati icho chikuchemeka kuti (spider) nga utatavu, chikubikika pakwamba pambere mundathire simenti. Gwiriskani ntchito levulo kuti muone kuti kasi chayana na pachanya ugho.

Chakujara pachanya ichi chikwenera kuba masentimita ghankhonde na ghabiri (7cm) panji mainchezi ghatatu kuyana waka na soketi Ring'i.

Thirirani maji chapachanya ichi kwakuyana na mazuba ghakhonde na ghabiri. Mungachibenekera na uchani panji mchenga para chakhwima na kuuzumbwiska.



Onesekani kuti Ring'i ya pakati yichali levulo.

Before the concrete dries, write **Glory to God** in both English and in the local language, as well as the **Date** on the slab.



Pambere konkili yindawomire lembanipo mazgu ghakuti “Uchindami kwa Chiuta” panji ‘Glory to God’ mchingerezi, na zuwa ilo mwaumbira.

4. COLLECT THE MATERIALS

UNJIKANI VYAKUKHUMBIKWA VYOSE PAKUZENGA PA MALO AGHO GHASANKHIKA

The villagers are responsible for making the bricks and collecting sand and stones for the concrete and mortar. These should be gathered and piled near the well site before the digging begins. Make sure only clean sand and stones are collected; no dirt should be included with the sand and stone as it weakens the concrete. The sand and stones for making the top slab need to be collected when the top slab is to be built, usually in August or September.

Ndi ntchito ya banthu wene wachikaya kuumba njerwa nakuunjika mchenga na malibwe yakuzengela chisime. Vyose ivi bakwenera kuunjika pafupi na apo pajimikenge chisime chomene chomene mu mwezi wa August panji September.

Tchakwenerera kubonesesya kuti mchenga na malibwe ghaba ghabemi. Pala muli viswaswa panji madongo konkili yikukholanga chala.



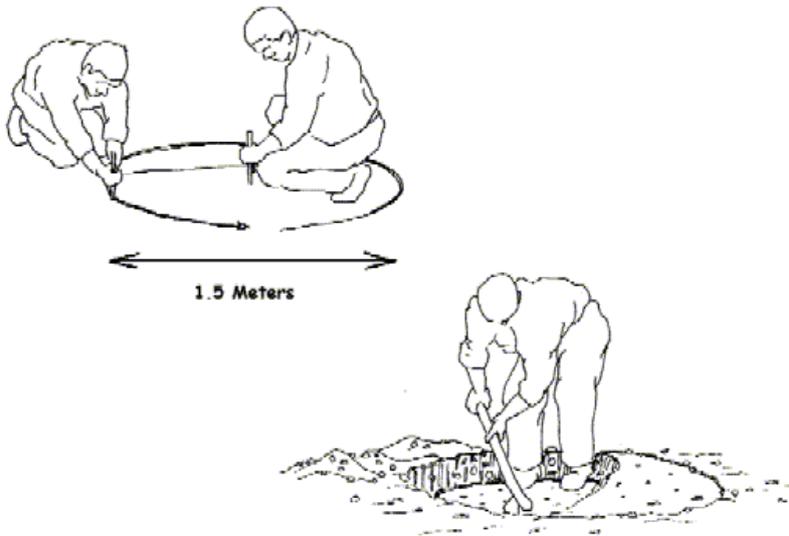
Collect the sand, stone, clay and bricks before the well is dug.

- **4000 bricks**
Njerwa zichokozichoko ziwe 4000
- **50 pails river sand**
Mchenga ndowo 50
- **50 pails small stones - gravel**
Malibwe ghachokoghachoko ndowo 50

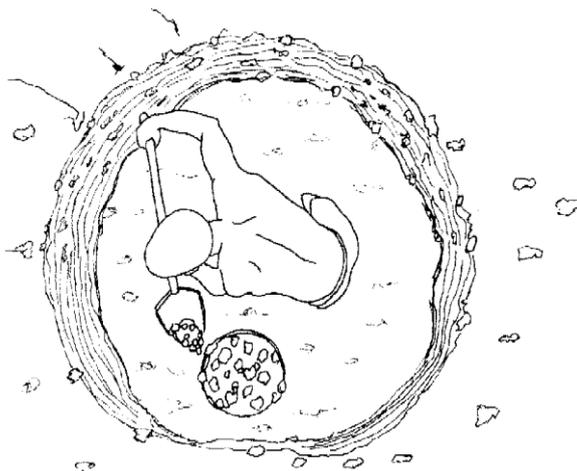
- **1 cart large stones**
Malibwe ghakulughakulu ngolo yimoza
- **5 carts clay from anthill**
Dongo la pa chiduli ngolo zinkhondi

5. DIG THE HOLE FOR THE WELL

Jimani khululu linu muusani 150cm panji 1 mita na hafu



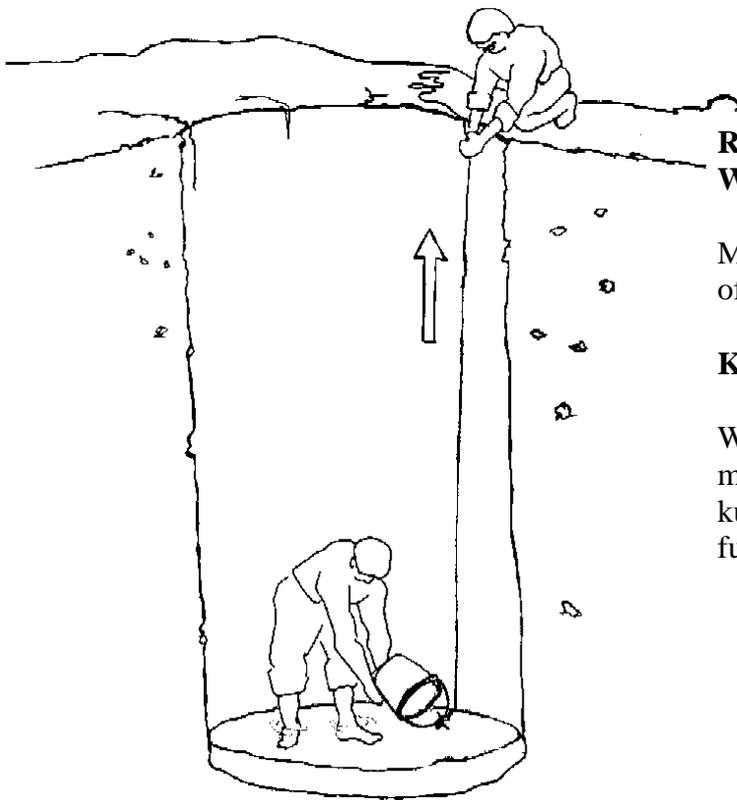
The hole is 1.5 meters across.



Dig until you are unable to empty the water from the well even if you use two pails or treadle pump.

Jimani mpaka maji ghatondekenge kukapika nanga mungagwiriska ntchito ndowo zibiri panji tredo pampu.

CHAKUZIRWA: kuti maji ghabe ma mita yabiri muchisime chithu pala tajima.



Removing Water from the Well

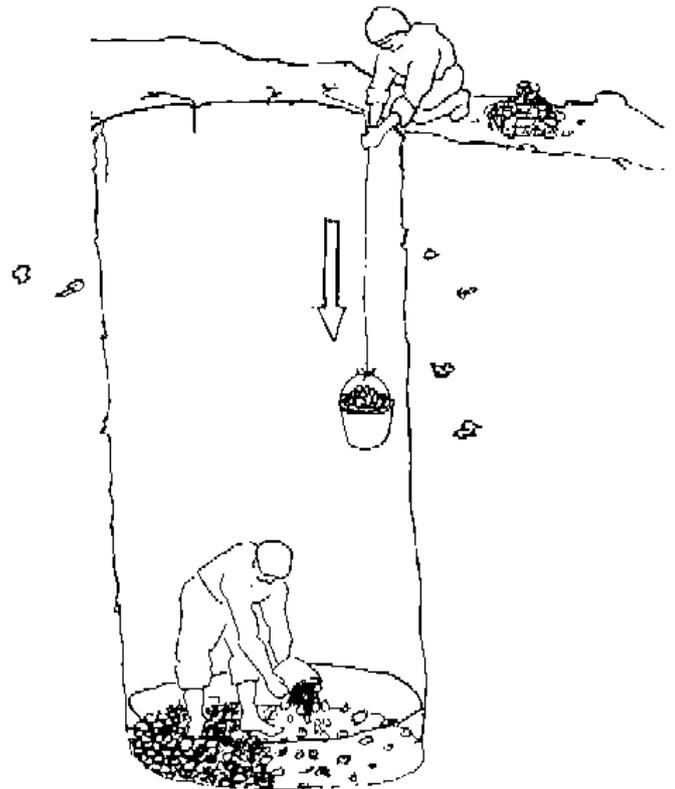
Make sure you have 2 meters of water before emptying

Kufunyamo maji mu chisime

Woneskeskani kuti muchisime muli maji 2 mitas panji kujumpha pambere munda funyemo

Placing Stones in the Well

Kubikamo malibwe mukati mu chisime



Place 10 centimeters of small stones in the bottom of the well.

Bikanimo malibwe ghachokoghachoko pasi pa chisime ghakukwana masentimita khumi

6. LAY THE BRICKS

ZENGANI CHISIME

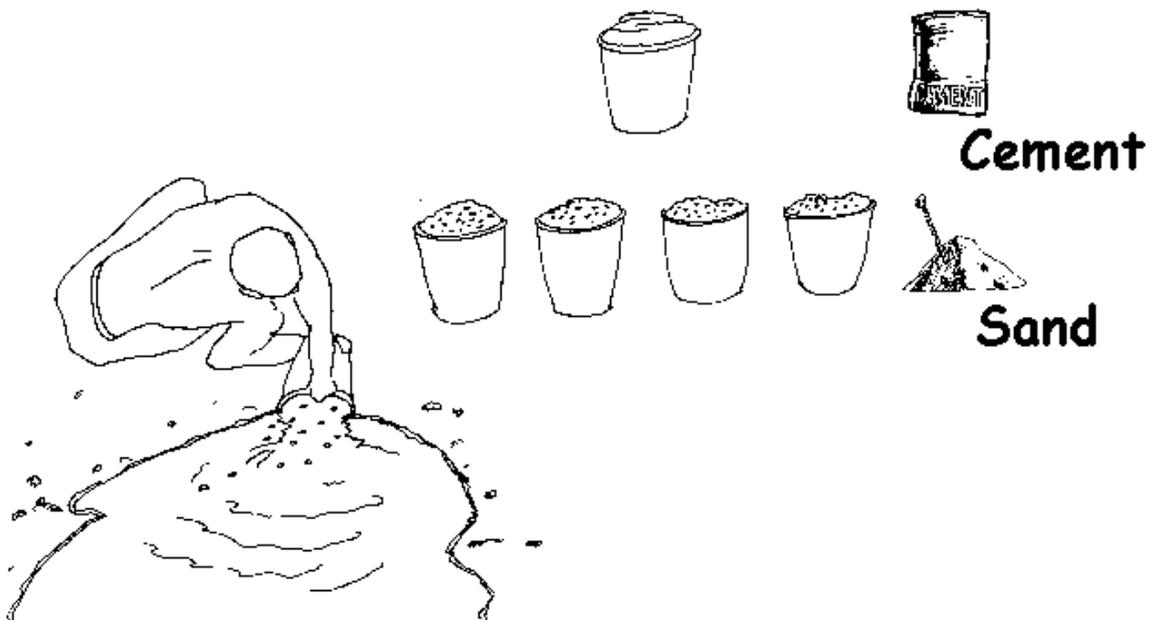
The mortar is made with a mixture consisting of 1 part Portland cement, and 4 parts sand.

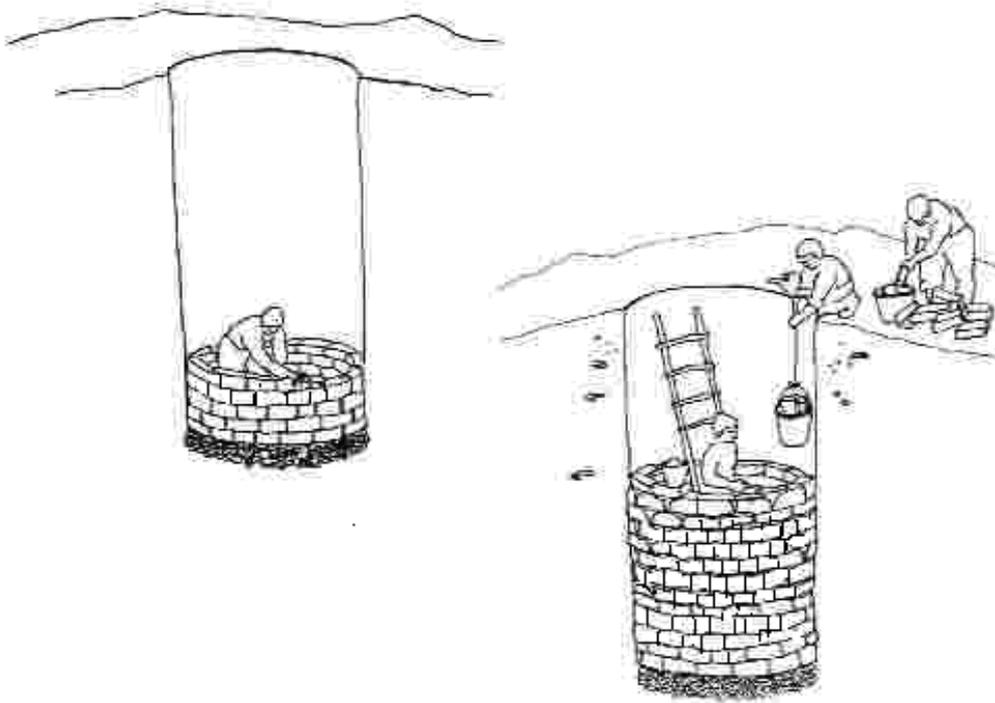
As the top slab is only one meter diameter, at a certain level depending on the depth of the well you need to be reducing the diameter of the well in order to accommodate the top slab which is only one meter diameter.(This is called cobbling).

Pakuti chakujara pachanya pa chisime ntchisani mita yimoza, mwaichi ntchakwenera kuchepeskangako usani wa chisime chithu kulingana na utali wa chisime icho chikuzengeka. Mwakuti pakuzakafika pachanya usani wa chisime uyane waka na chakujara pachanya.

MIXING THE MORTAR

KASAZGIRO KA THOPE LITHU





**First 5 layers are laid without mortar
Mortar is used on the rest of the well.**

Makozi ghankhonde ghakwamba tikuzenga kwambula thope panji simenti (mota) kudikanya waka.

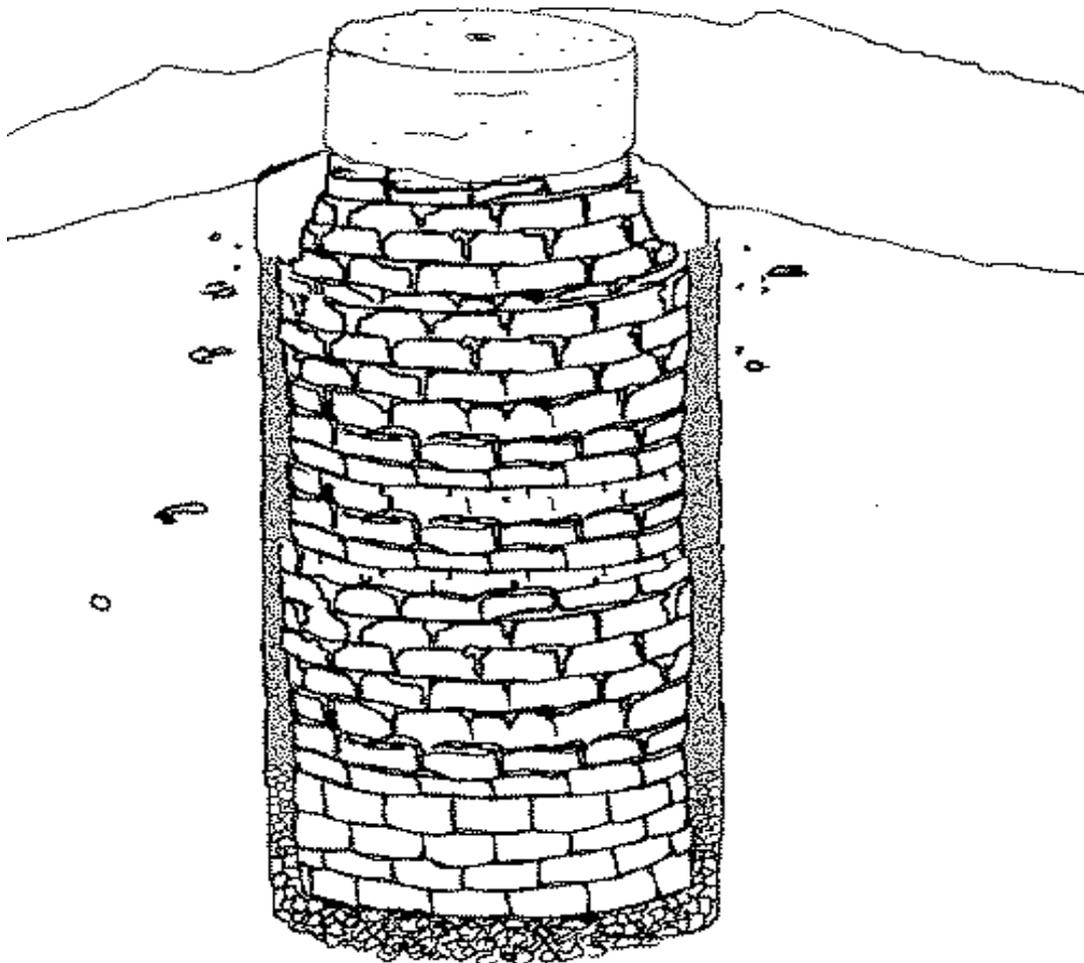
IMPORTANT: From the 6th layer and up, mortar is used

CHAKUZIRWA: kufumira para mwazenga njerwa makozi ghankhonde na yimoza mpaka kuchanya mkwenera kuzengera simenti iyo mwasazganga apa

**COBBLING - DECREASE THE DIAMETER OF THE WELL
FROM 1.5m TO THE 1.0m DIAMETER OF THE TOP SLAB**

Remember to start building with a diameter of 1 meter inside the well at the bottom (i.e. you will have a diameter of 1.5m outside the well at the bottom).

When you are about 3' to the ground you need to start cobbling (that is decreasing the inside well diameter so that it can have a diameter of 1 m outside in order for top slab to fit without problems). Note: you can start cobbling at any other height other than 3ft depending on the depth of your well. Only make sure that it is not in the water zone.



KUCHEPESKA USANI WACHISIME

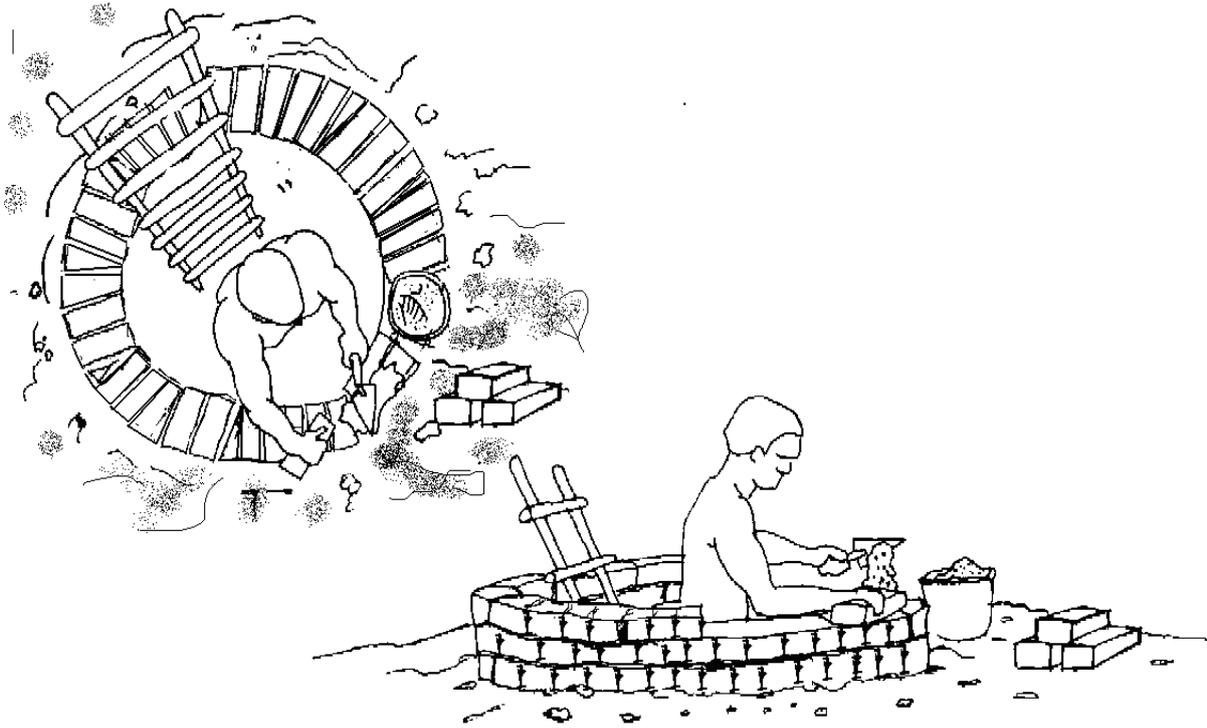
- Kumbukani kuchepeska usani wa chisime chinu kufuma pa 1m usani wa mukati pasi mpaka 1m usani wakuwalo pachanya pachisime (usani wa chisime chinu kuwalo ube 1.5m pasi ndipo kuwalo pachanya ube 1m)
- Mungamba kuchepeska pa 'mafeet' yatatu kukwela kuchanya mwakuti chibe 1 meter na kuwalo, kuti chakujara pa chisime chithu chiyane makora.
- **MANYANI ICHI:** Mungamba kuchepeska pa mtunda unyake uliwise kupatula pa 3 feet, kwakuyana na umo chanjilira chisime chinu, kweni muoneskeske kuti ni malo agho maji ya kufumira yayi.

BACKFILLING WITH CLAY FROM THE ANTHILL/STRONG CLAY

KUWUNDA CHISIME CHITHU NA DONGO LA PA CHIDULI

One ox-cart full of anthill clay will be enough for the backfilling of the well. This anthill clay must be partially wetted i.e. it should be loosely held together. Begin backfilling with clay when the well construction is above the water bearing sands. Compact the soil continuously as backfilling is performed.

- Gwiriskani tchito ngolo yimodza yadongo la pa chiduli kuwunda mphepete mwa chisime chinu.
- Dongo lapachiduli libe lamunyanya
- Muyambe kuwunda mphepete mwa chisime chinu usange mwajumpha unandi wa maji panji mmalo umo maji yakufumira.
- Mukwenerera kusindiranga dongo pala mukuwunda



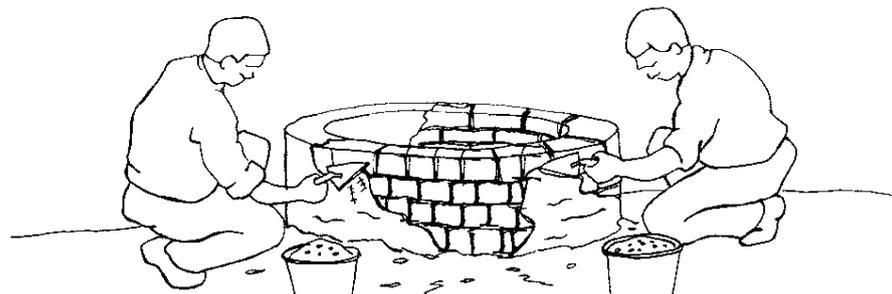
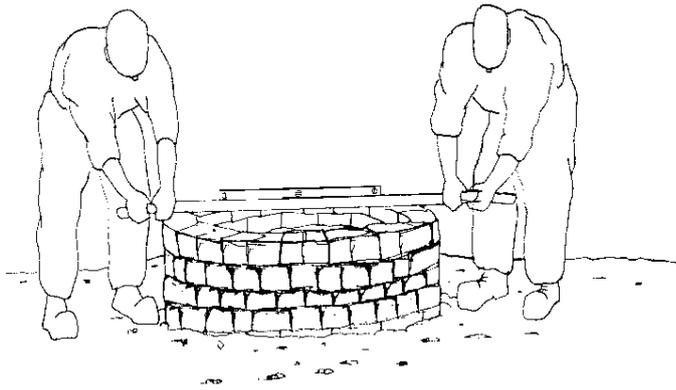
A double thickness brick pattern is best (headers only)

Zengani njerwa mwakulaziska ku chimati cha chisime

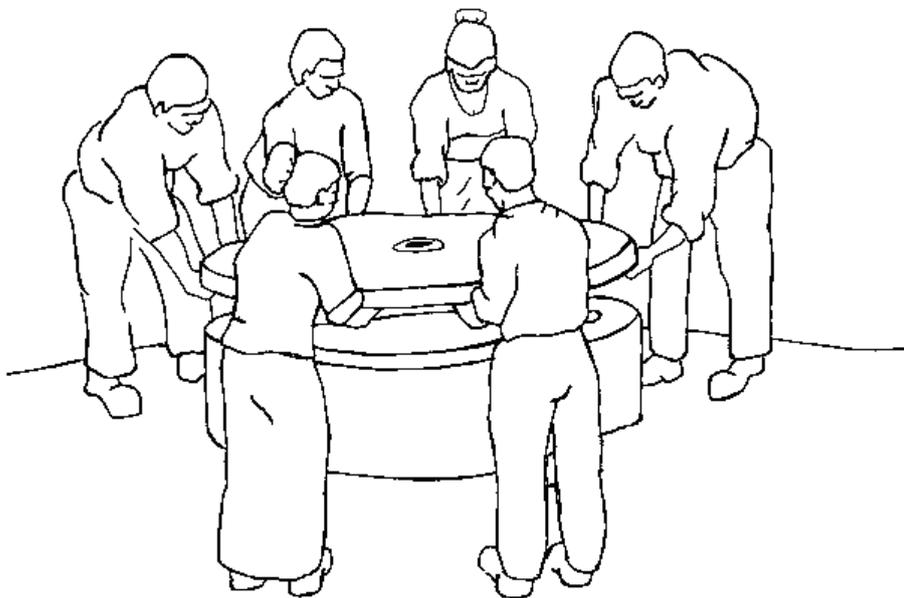
4 courses of bricks are built above the ground level.

Be sure the top is level.

Makozi ghanayi ghazengeke kufumira pachanya pachisime. Onesekani kuti pachanya pachisime chinu mphakuyana (levulo).

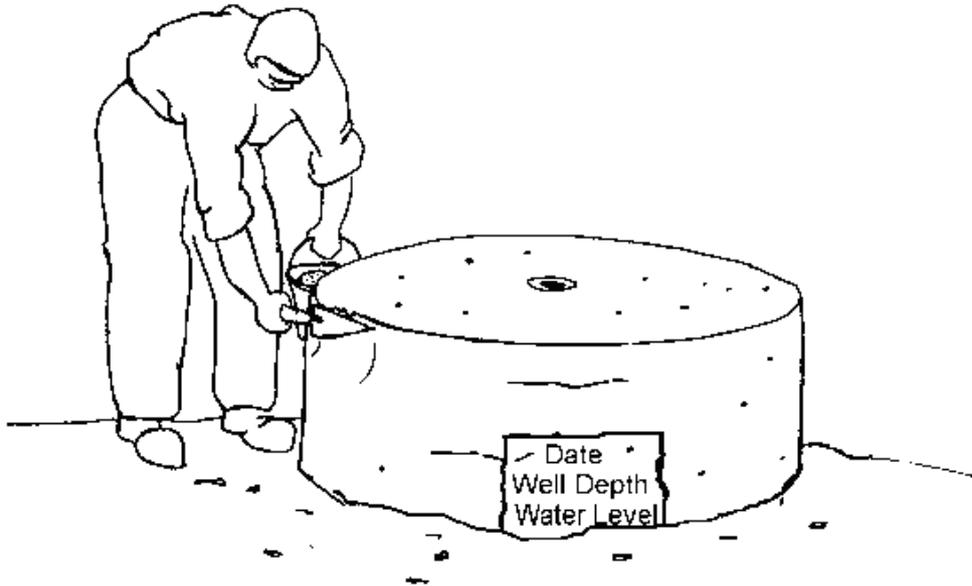


Put top slab on with mortar.
Bikanipo chakujalira chapachanya na simenti.



Plaster the outside of the well. Write date, well depth and water depth in the headwall plaster.

CHAKUZIRWA: Kuchita plastara kuwaro kwa chisime naku lembapo dzuwa ilo chisime chazengekera, utali na unandi wa maji.

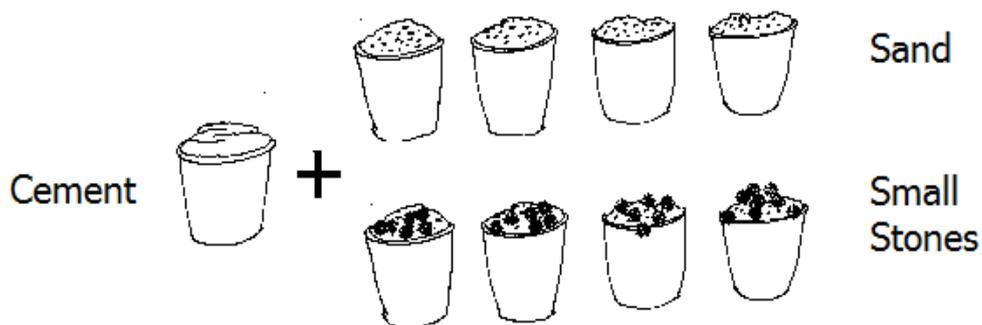


7. Build the Apron and Drain

ZENGANI KHONDE LA CHISIME NA MGERO WA MAJI

MIXTURE FOR APRON AND DRAIN:

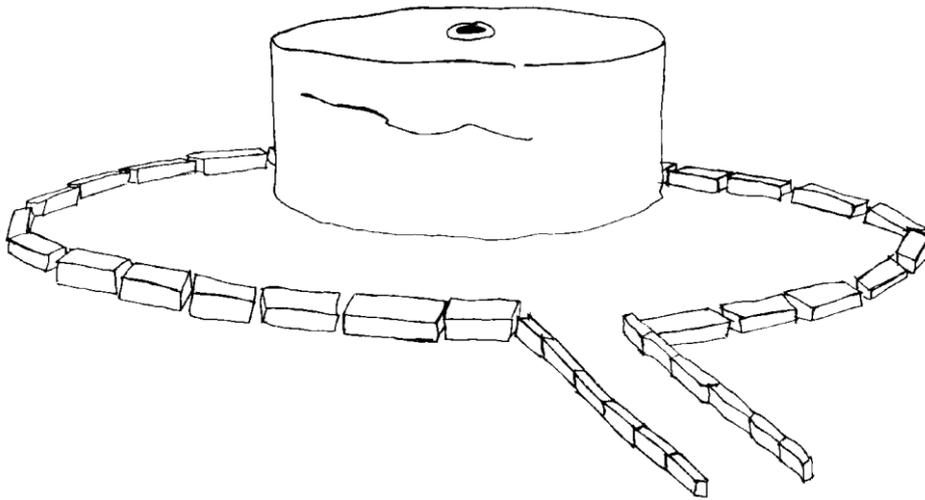
- 1 Part Cement
- 4 Parts Sand
- 4 Parts Quarry Stone



When forming and troweling the apron and drain, be sure they are shaped so water flows away from the well. The apron extends 1 meter beyond edge of well. The drain must not be less than 3 meters long.

Ghoneskani kuti uko mukukhumba kuti maji ghalutenge nkhwakukhira. Khonde lithu likwenera kuba 100cm (mita yimoza) kufuma pa chiliba chapakati cha chisime.

Mgero withu ghungabanga wa kufupikila pa ma mita ghatatu chara.



Form the apron and drain and pour concrete. **RESERVE A FULL DAY FOR THE CONSTRUCTION OF THE APRON. DO NOT** use bricks in the surface.

Any unused bags or partial bags of cement must be returned. If convenient, they can be picked up at the time of the dedication, Otherwise, take note of this and inform the FO for the area of the need.

Zengani khonde na mgero wa chisime pakugwiriska ntchito konkili pera. Njerwa izo zazingizgika pachisime chithu zibe waka chikombole chakuumbira khonde lithu na mgero. Ghuskaniko njerwa zones mumphepete nakusesketa makola napolonto ndipo paumaliro shayinani chisime chinu.

Pala cement yinyake pachisime chithu indagwire tchito panji yakhalako tikwenera kuwezge.

SANDY SOILS

In most of the times, sandy soils do not make good well pits. It collapses. To avoid this, we use concrete rings that hold the soil from collapsing.

MAKING CONCRETE RINGS

KUWUMBA MA RING'I YA KONKILI

A ratio of 1:6 is the best mixture of concrete. Make sure you use river sand of very good quality. Place 6mm wire about 3-4" of the concrete and another wire about 3-4" above the bottom one. Leave the rings to cure for seven days.

PLEASE NOTE: water the rings three times a day.

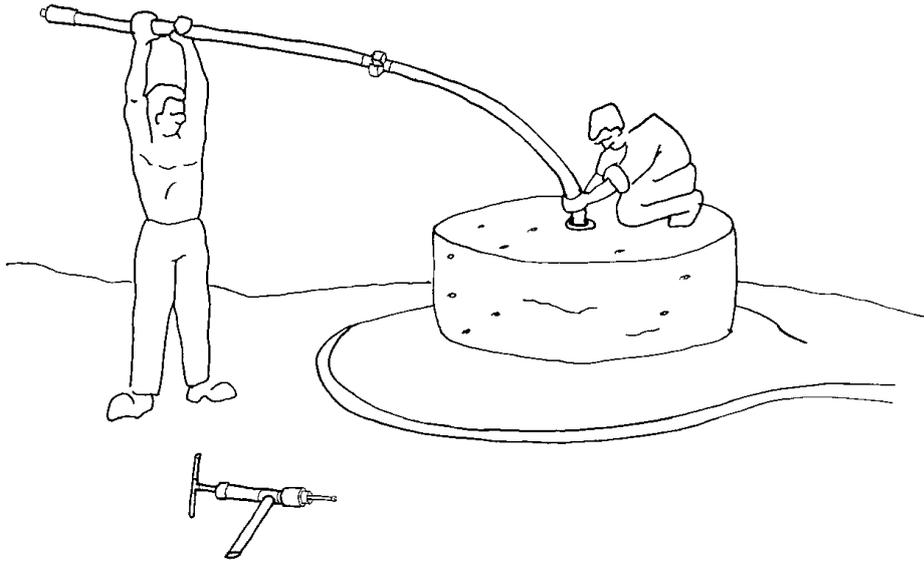
Kusazga kwa konkili kukwenera kuba ndowo yimodza ya cement na ndowo zikhonde na imodza za mchenga. Onesekani kuti mchenga nguwemi kweneso ngwa mdambo.

Wikani waya wa mamilimita ya khonde na imodza (6mm) pafupi fupi ma inchezi ya nayi ya konkili na waya unyakhe pafupi fupi ma inchezi four pachanya.

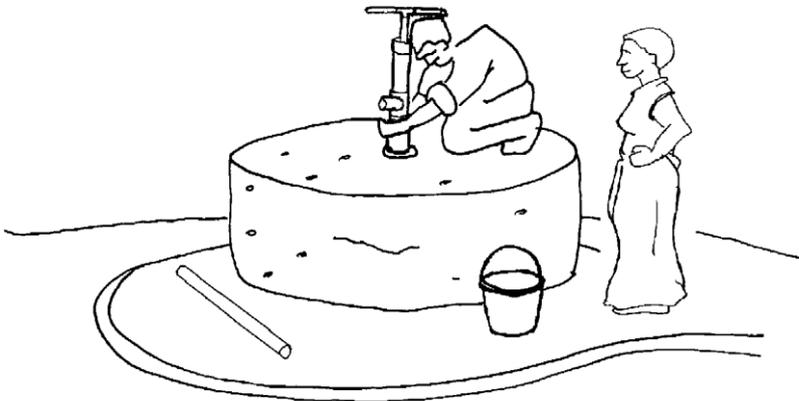
Lekani ma ring'i kuti ghabomire kwa sabata yimodza.

CHAKUZIRWA: Kuthiranga maji pa ma ring'i yinthu katatu pa dzuwa

8. INSTALL THE PUMP



The pump will be installed by the well team, assisted by the local maintenance person.



Celebrate The Installation

Tikondwere na kusekerera chifukwa timwenge maji ghaweme.



Collecting the yearly maintenance fee

Tolani ndalama za pa chaka za chisime

The community can pay in cash or in kind.

Benecho chisime bangapeleka ndalama panji vyakukolora



COMMON MISTAKES

SITING:

1. Do not site the well in flood zone or upland areas; make sure that the site is 30 meters from: homes, kraals, pit latrines, rubbish pits, holes and anything that cause contamination.

COLLECTION OF MATERIALS:

1. Shortage of materials during construction which leads to premature work being done.

TOP SLAB CONSTRUCTION:

1. Constructing very wide top slabs that are a big risk to user's lives and do not look nice.

DIGGING THE WELL:

1. Dig the well hole that is 1.5 meters in diameter and not less than this or more than that.

BUILDING THE WELL:

1. Soon after dry bond the use of stretcher bonding instead of headers. If you lay your bricks the other way you end up having 4-inch thick wall instead of having a 9-inch thick wall
2. Some builders use any ordinary soil for back-filling the well or broken bricks instead of soil from an anthill. This results in a big crack around the head wall as it is not properly rammed.
3. Building of a well without concrete mortar - automatically the well will collapse.
4. Building only foundation like a house steal all the cement - found one will be arrested.

APRON AND DRAIN:

1. Some builders pour small stones round the apron and drain and then later on plaster with some cement mortar in fear of making concrete. This is

not allowed and after some time the top mortar will peel off leaving your stones below.

2. Failure to make a slope on the ground before pouring in concrete leading to a poorly sloped apron.
3. No lip around the apron and drain. Use of bricks in the well circumference of an apron and drain which does not last. Some builders think using concrete to form a lip is difficult to construct but if you use bricks as a mould it is as easy as ABC. Remember to remove the bricks used as a mould before the cement has set.

WELL SURROUNDINGS:

1. Leaving the surrounding untidy after construction.

PUMP INSTALLATIONS:

1. A well without water will never be installed.

KASANKHIRO KA MALO GHAKUJIMAPO CHISIME

1. Munga sankhanga malo ya chisime mu malo agha yayi: umo mukwenda maji ya vula, m'malo gha muchanya (malo gha komira), malo agha ghabe mamita 30 kufuma ku nyumba zawathu, vibaya, vimbuzi, nkhando, vibuwu ivyo vikusunga maji, nachose icho chingatiska kuti maji ghamuchisime ghanangike.

KUZENGA CHAKUJARA PACHANYA PA CHISIME

1. Kuumba vyakujala pachanya vikulu chomene vikulu chomene ivyo vikupeleka mantha kwa abo bakugwiriska ntchito chisime.

UNJIKANI VYAKUKHUMBIKIRA VYOSE PAKUZENGA PA MALO AGHO GHASANKHIKA:

1. Kuyamba kuzenga chisime kwambula vyakuzengera vyakukwana kukuchedweska tchito nakutiso chisime chikuwa makora yayi.

JIMANI KHULULU

1. Jimani khululu la chisime ilo liwe muusani 1.5m, lingachepanga panji kukula kuluska apa yayi.

ZENGANI CHISIME

1. Banji pala bamala kuzenga kwambula simenti bakuzenga njerwa mutali (stretcher) icho ntchakuzomerezgeka chara.

2. Banji bakugwiriska ntchito dongo liri lose pakuundira mumphepete mwa chisime pakuzenga para pajumphanyengo chikusweka mumphepete mwa chapakati.
3. Kuzenga chisime kwakugwiriska ntchito njerwa pera kuyambira pasi mpaka pachanya kwambula simenti.
4. Kuzenga chisime pachanya pera (faundeshoni).

ZENGANI KHONDE LA CHISIME NA MGERO WA MAJI:

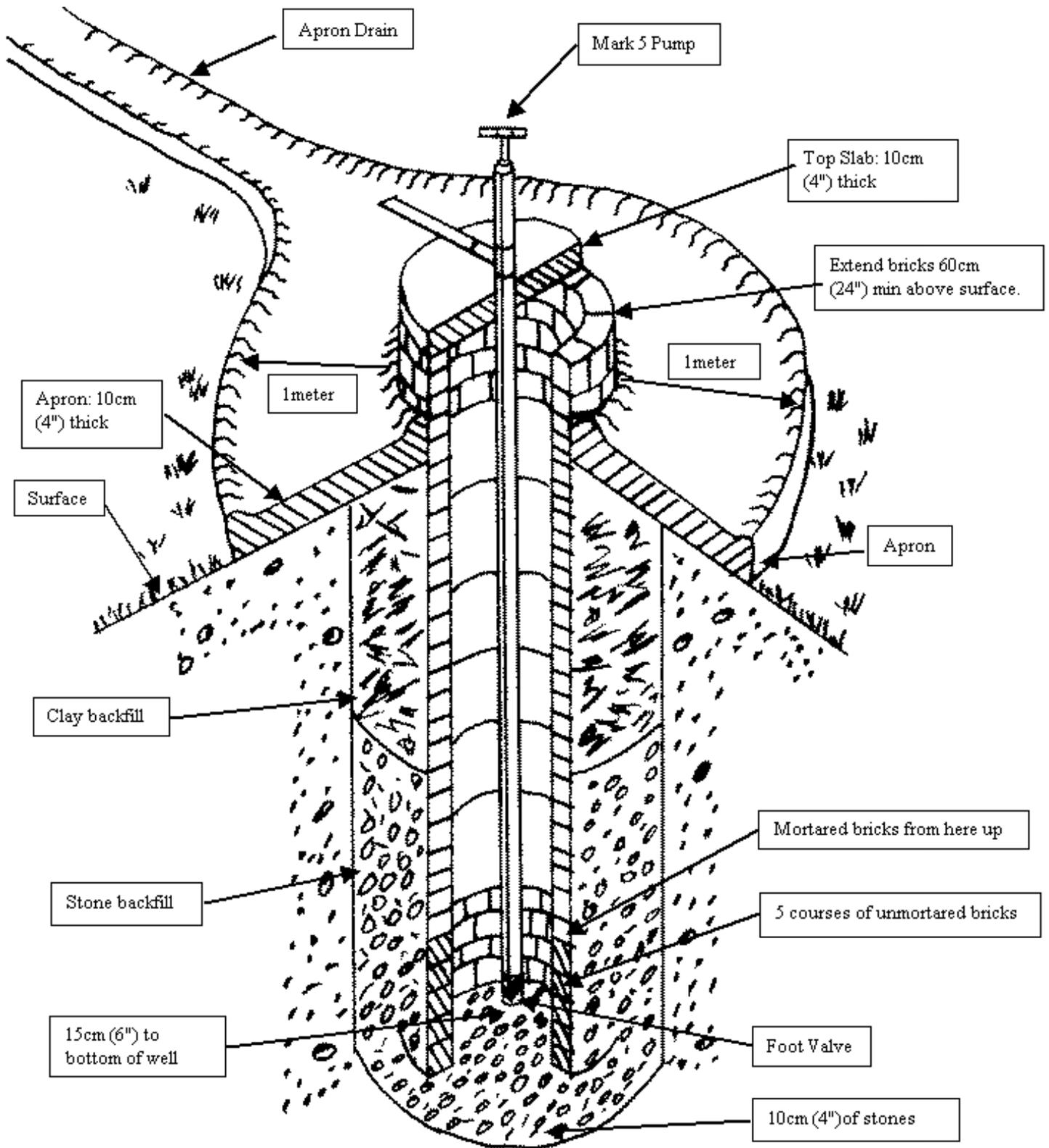
1. Bakuzenga banyakhe bakuthira malibwe ghachokoghachoko na kusalazga paumaliro na kuyika plastara pachanya.
2. Bakuyamba waka kuzenga khonde na mgero wake kwambula kusalazgirathu pasi kuti kunyakhe kube kwakukhira kale, ichi chikupangiska kuti maji ghatondeke kuluta uko nkhwakukhumbikwira.
3. Kuumbirira njerwa muphepete mwa khonde na mgero na maghanoghano kuti ntchinono kuumba konkili.
4. Kuzenga khonde na mgero kwambula kuyika kakujanda maji mumphepete.
5. keleka waka njerwa izo zagwiriskika ntchito nga ndi vikombole pakupanga khonde na mgero

BALAZA LA CHISIME:

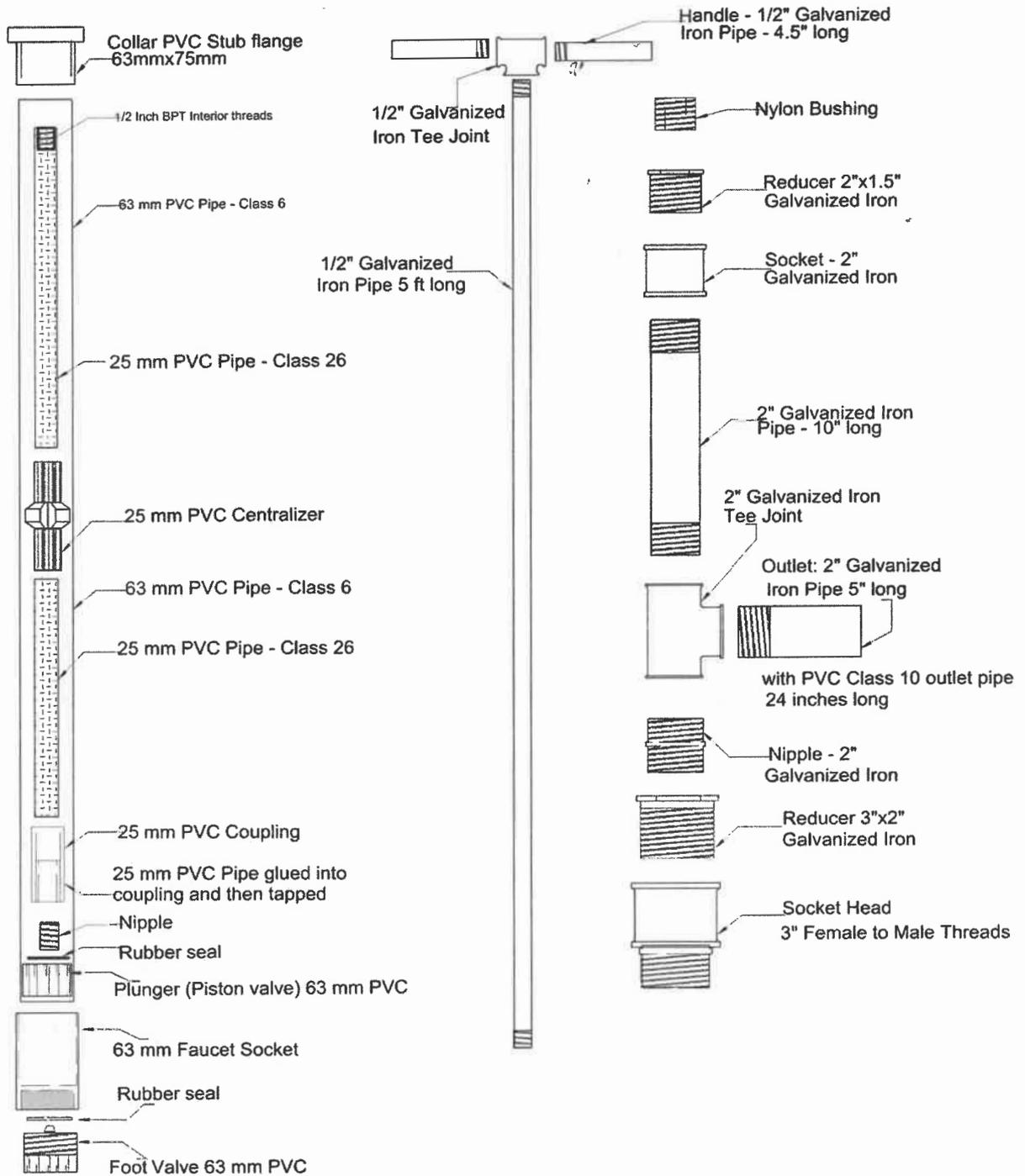
1. Kuleka malo nyankhafu chala para chisime chazengeka

PAMPU YIBIKIKE:

1. Chisime chambula maji kubika pampu chara



MARK 5 WELL PUMP



Drawn by: Jim Nussbaumer, 2 June 1997
 Dwg. Updated by: Jim Nussbaumer, 22 Dec. 2011
 Engineered by: Mr. H.M. Soko
 Design Updated by: Jerry Roush, 20 Dec. 2011
 Embangweni Hospital, Embangweni Malawi