SMART Centres

Mzuzu drilling

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The SMART Centre Group

1 Copyright and disclaimer

The drawings in this manual are basic and will be updated in a next version. Mzuzu drilling has details which can be best learned with practical training. Therefore it is highly recommended to use this manual in combination with practical hands-on training that can be provided by a SMART Centre in Tanzania, Malawi, Mozambique, Zambia and in the future in other countries.

Please feel free to contact us via www.smartcentregroup.com

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3 Introduction

Techniques for drilling wells can be divided into Machine drilling and Manual drilling. Machine drilled wells are called boreholes and often 40 to 150 meters deep or more. Manual drilled wells often are called 'Tube wells'. Manual drilling is less complex than machine drilling but the drilling is slower, limited to softer ground layers and limited depths of 45 meters although options like EMAS and Baptist drilling go to 80 meters deep. In Africa mechanical drilling rigs are imported. Drill sets for manual drilling like Rota sludge, SHIPO drill and Mzuzu drill can be locally produced in any African country with local materials. They can be made (after proper training) in metal shops with basic tools like a welding machine and an angle grinder. Compared to hand digging of wells, the hand drilling of a well is less dangerous (no danger of collapsing) and can penetrate deeper into the aquifer (water bearing ground layer) so there is less risk of dry wells. Making a hygienic seal for a tube well is also easier and a tube well in general is cheaper especially compared to a hand dug wells of 10 m deep or more with a lining. In aquifers with a low permeability, hand dug wells maybe more effective because of the larger storage capacity. (Water can seep in at night and be taken out in the day)

The Mzuzu drilling combines Augers, a Stone punch and a Tube bailer. The Tube bailer uses a tube (polypipe) whereas conventional bailers use a rope. A Mzuzu drill set cost 150 to 400 US$ depending on the depth and number of drill bits. Compared to Rota sludge or SHIPO drilling, the Mzuzu drilling is easier since there is no need for a tripod, drilling mud, sink pit and gravel pack. The Mzuzu drill can drill to 25 m deep and penetrate 2 to 10 meters into an aquifer. It can drill in non-consolidated ground layers of sand, clay and gravel and crush stones but will not drill through hard stone layers.

This manual is part of a range of SMART manuals of which some in draft. The complete range includes:

Wells&Drilling

- Geology and site selection
- Well digging
- SHIPO drilling
- The making of a SHIPO drill set
- Mzuzu drilling
- The making of a Mzuzu drill set

Pumps:

- Rope pump model 1 Standard model
- Rope pump model 2 Economy model
- Rope pump model 3 With wood poles
- Rope pump model 4 With 1 pole
- EMAS pump
- Solar pumps
- Pump care taker training

Others

- Water storage tanks
- Groundwater recharge
- Irrigation
- Water treatment
- Workshop skills

Business skills

- Training of drilling companies.
- Business, financial and marketing planning

4 Parts of the Mzuzu drill set

A Mzuzu drill set . In this picture the set is for wells to 12 m deep.

Picture of some parts. From left to right:

- Combi bailer
- Two Spiral augers
- Two Handles to rotate the square drill pipe
- Core auger, 5 inch. For 4 inch casings.
- Core auger, 4 inch. For 3 inch casings. This auger has a slot. New models are closed
- Under; a security pin.

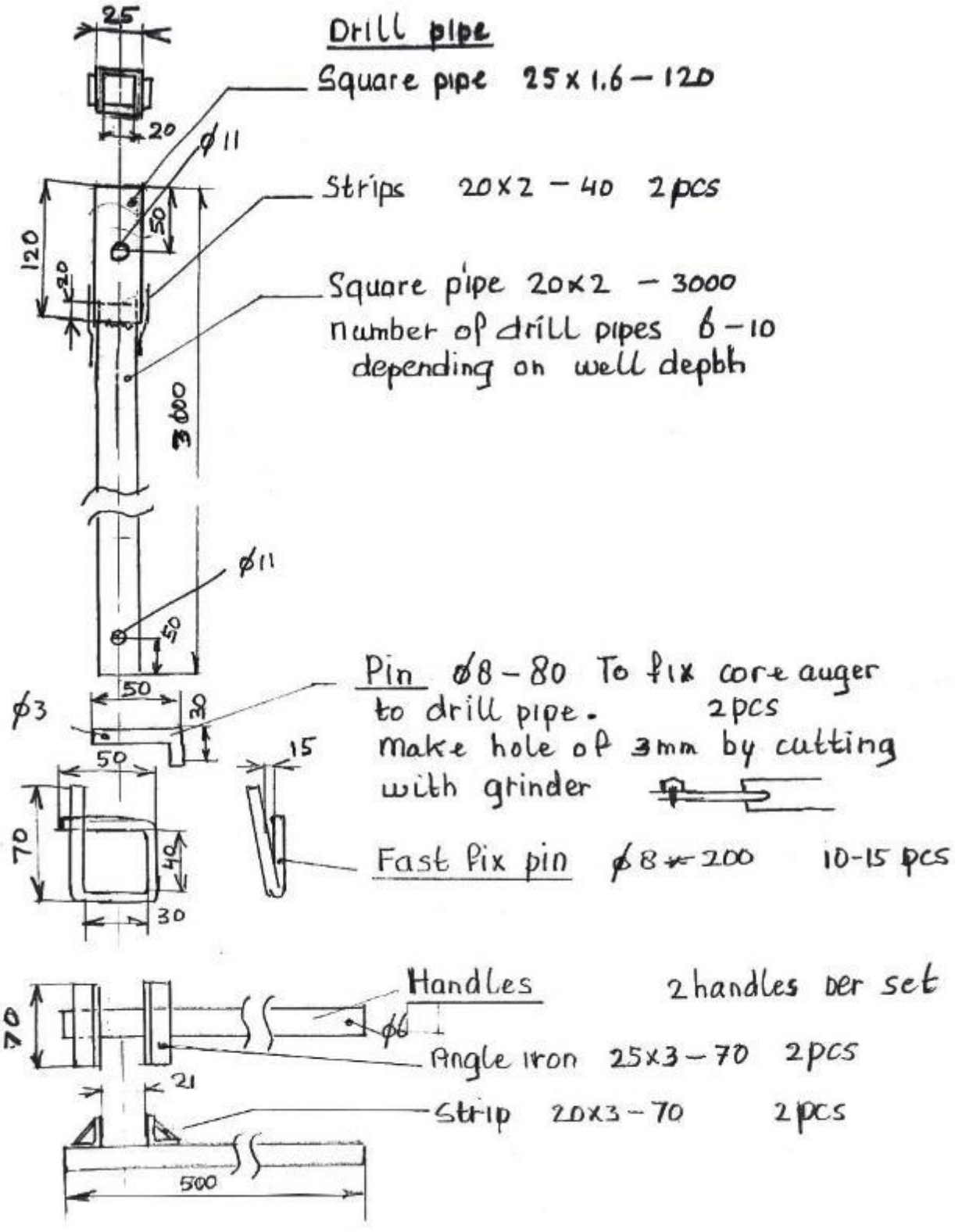
Item	No's	Observation
Core augers 5 Inch. (To make holes for 4 inch casings)	1	Optional Auger 4 inch, for casings of 3 Inch. Eventually spare augers
Spiral augers 5 Inch (To make holes for 4 inch casing)	1	
Spiral augers 4 Inch That fits inside Core auger 5 Inch (To make holes for 4 inch casing)	1	Used when entering in the aquifer
Stone punch 2 Inch with 2 round extention pipes	1	Event. Square pipes for extention
Stone punch 5 Inch (For 4 inch casings)		
Drill pipes Length 3 meters	6 to 10	(or 1,6mm)
Handles	2	
Fishing tool	1	
Tube bailer 1.5 Inch for a 3 Inch casing	1	
Tube bailer 3 Inch for a 4 Inch casing	1	
1" Poly pipe (connected to bailer)	15 m.	Or more Depending depth.
Hand tools (Hacksaw, round file, knife, lighter,..	1	1 each
Rubber strips	1 kg	
Fine clay to make drilling mud. Bags of 25 kg	1	Or Polymer. 5 kg
Spade and hoe	1	
Metal buckets	3	
Drill log form, pen and Marker pens (permanent)	2	
PVC pipe for casing 2" or 3" or 4" plus end cap		Number depend on depth
Pump to be installed , cement 1 bag		

5 How to make a Mzuzu drilling set

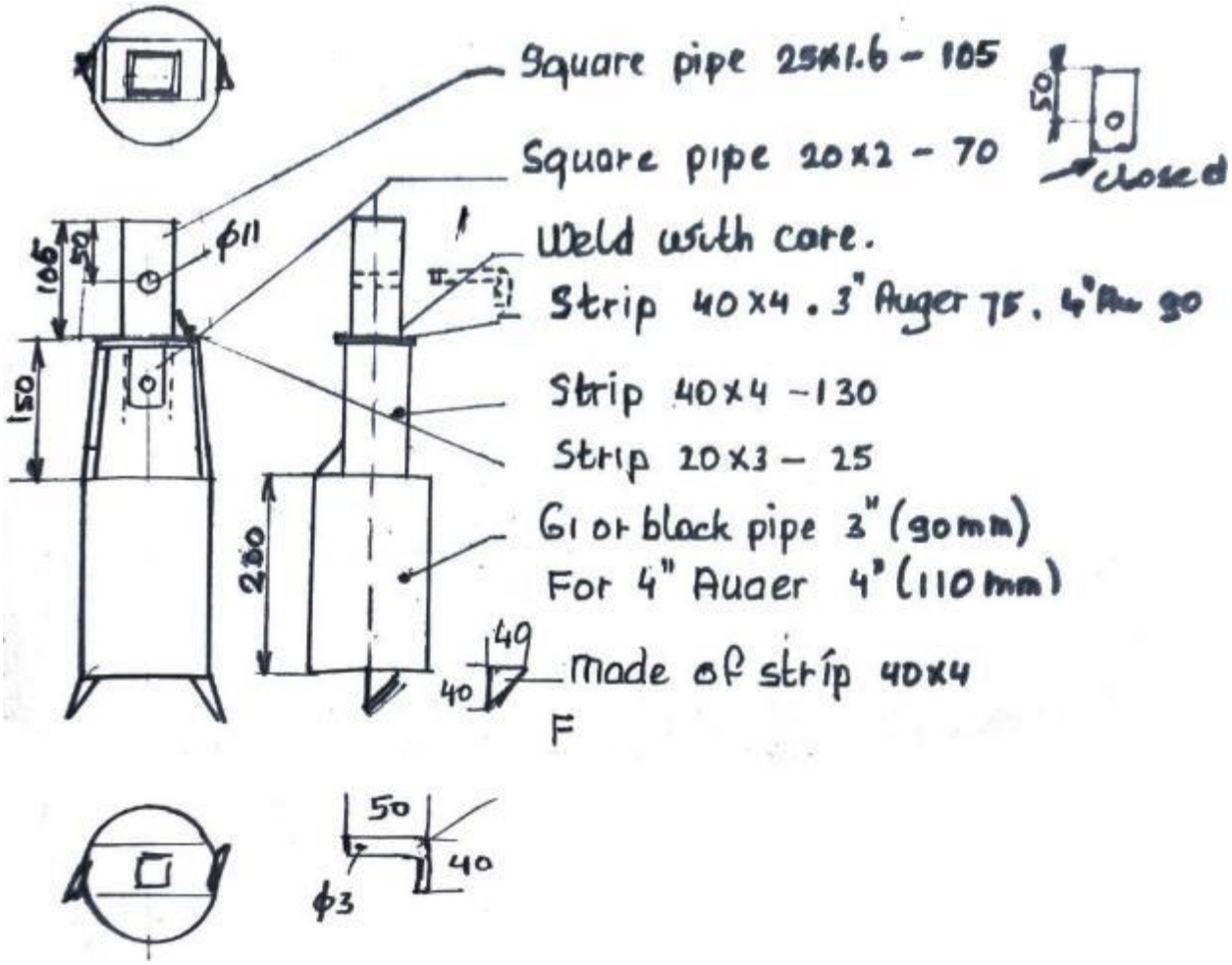
5.1 Material list

Materials	Unit	Number	Observations
Square Black pipe. 25 mm. x 2mm	6 metres	3 to 5	Depending on desired well depth
Square Black pipe 32 mm. x 2 mm (event.1.6 mm)	6 metres	1	To connect drill pipes and augers. Pipe of 25x2 should fit inside
Round Black pipe 50 mm x 2 mm. Event 1.6mm	6 metres	1	For Stone punch
Round black pipe 32 mm Thickness 1.2 mm	6 metre	2	For Stone punch and handle
Gi pipe ½". Thickn.1.8 mm	metres	1	For augers
Gi or black pipe 1.5'' Thickn. ca 2.5 mm	metres	0.5	For bailer
Gi or black pipe 2'' Thickn. ca 2.5 mm	metres	1	For augers, Stone punch, bailers
Gi or black pipe 3'' Thickn. ca 2.5 mm	metres	0.2	For core auger and bailer
Gi or black pipe 4'' Thickn. ca 2.5 mm	metres	0.2	For core auger and Stone punch
Strip 40x4 mm	metres	3	For core augers
Strip 25 x 3	metres	3	For drill pipes etc.
Angle iron 25x2.5	Metres	2 m	For handles
Poly pipe, 1" (32mm)	metres	15 m	Or more. Depends depth. For bailer
Sockets 1"		3 pcs	Or more . For bailers
Nipples 1"		3 pcs	Or more. For bailers
Round bar 8 mm	metres	2	For bailer valves and security pins
Round bar 6 mm	Metres	2	For bailer valves
GI wire 2 mm	Kg	1	Optional. To secure the pins
Rubber strips	Kg	1	To fix step. Or use vice grips
Tungsten drill tips	Pcs	4	Or bike crank axles
Bike axles front wheel	Pcs	3	For bailers
Tools for the field			
Safety helmet	Pcs	2	Depending # people
Hacksaw, half round file	Pcs	1	
Pipe wrenches, 12 Inch	Pcs	2	Or similar
Buckets 20 ltrs (Metal)	Pcs	3	
Clay.	Bags 25kg	1-3	depends diam. casing and soil type. Or Polymer, 1-5 kg
Tools for production			Vice, Angle grinder, Welder and rods, Hand drill with drills 5, 6, 10 mm. Hacksaw, Round file

Making of drill pipes, pins and handles



5.2 Making Core augers



Core Auger 4 inch. The teeth can be made by cutting and welding an extra piece reinforced with a hard materials like a file. Here the tip is a 6 mm concrete drill bit with tungsten tip

Core auger 5 inch combined with spiral auger inch. This can be used when the soil is to wet to stay inside the Core auger .

Core auger 5 inch combined with spiral auger

Length of 4 inch pipe is 20 cm. Length of strip is 15 cm

Drilling with a core auger. 1 person on the Foot step to increase the weight.

The fast fix pin to connect 2 drill pipes

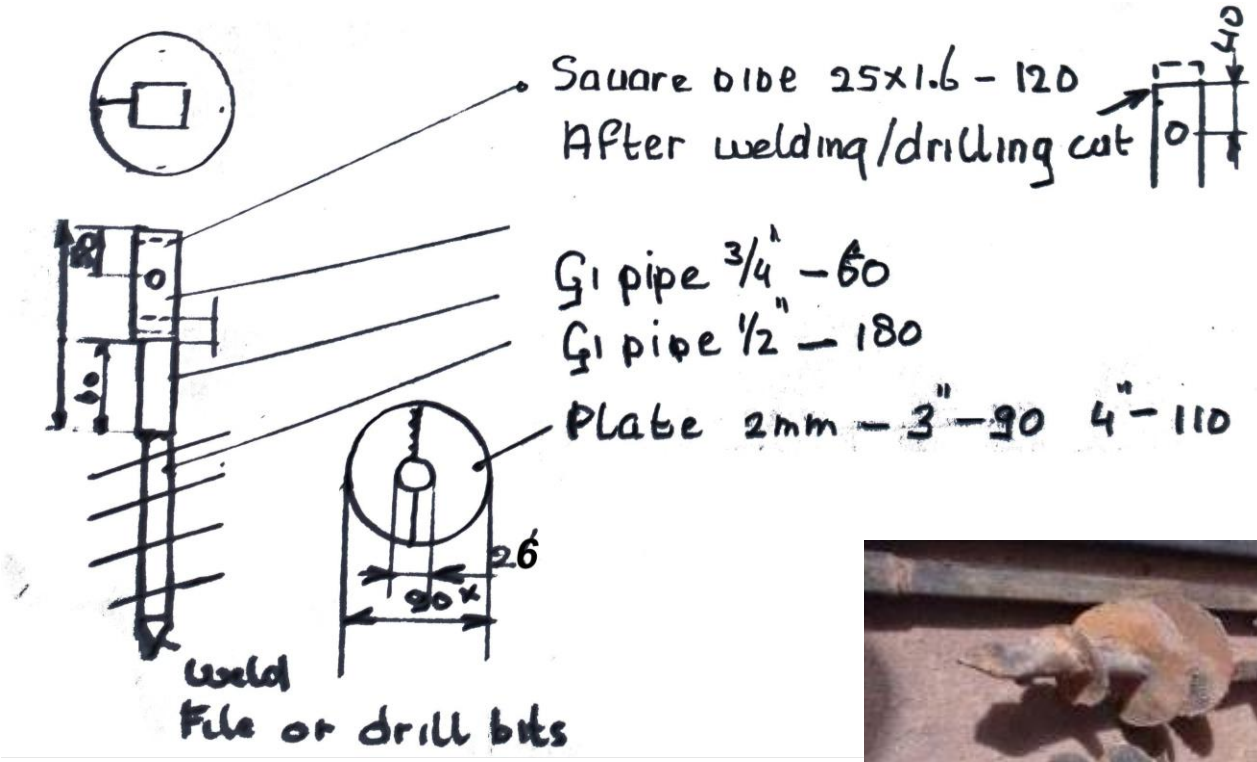
A tool to connect a bailer to the 1 inch Poly pipe/ tube

Cleaning pins. The core auger can be cleaned by pushing the core auger on the small cleaning pin

The second step is cleaning with second pin, a pin with a plate of 8 cm round that fits inside the core auger of 5 inch

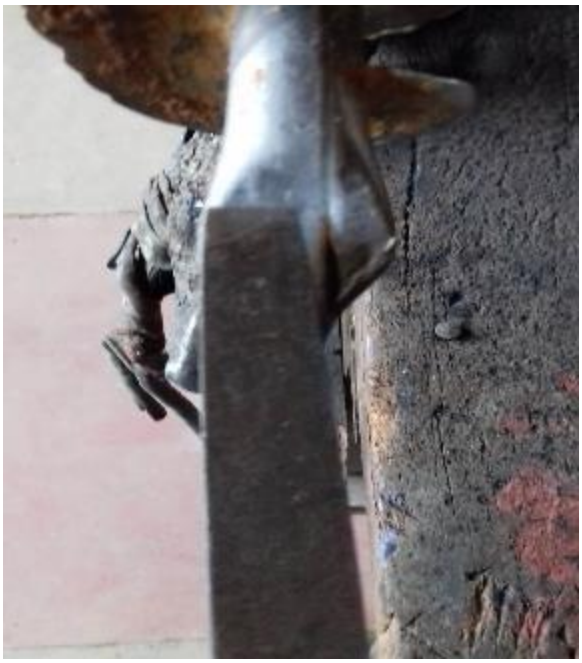
Cleaning pins with diameters of 1 and 3.5 inch

5.3 Making Spiral augers



The Mzuzu drill has augers with different diameters. The plates of a Spiral auger can be made of a 2 inch GI pipe made flat. The hole in the plate should be 7 mm more than the diameter of the Centre pipe so for a ½"pipe (20 mm) the hole should be ca 27 mm. The outer diameter of the plates can be anything from 50 to 250 mm

Bend the plates in a vice until opening is 40 mm or more. Weld the plates on a ½”GI pipe



Make the point flat. Weld a piece of an old flat file on the point. Sharpen with and angle grinder, make a cutting edge.

Eventually make teeth on edge of the plates
Weld a spot and grind a teeth.
Note the cutting edge of the point

Use a 8 or 10 mm tungsten drill bit to weld in the tip of the auger. Cut in 3 pieces and grind the edge of the tips on the sides also with an angle

Cleaning tool to clean the Spiral auger

made of strip 25 mm

The extention drill pipes. Made of square black pipe of 25 mm. The number of pipes depend on depth. Start with 6 pipes of 3 meter length

The connections. made of square pipe 32 mm with 1.6 mm wall thickness

Handles. These are made of square pipe and angle iron of 25 mmx 2.5 mm. or the same square pipe. See last page

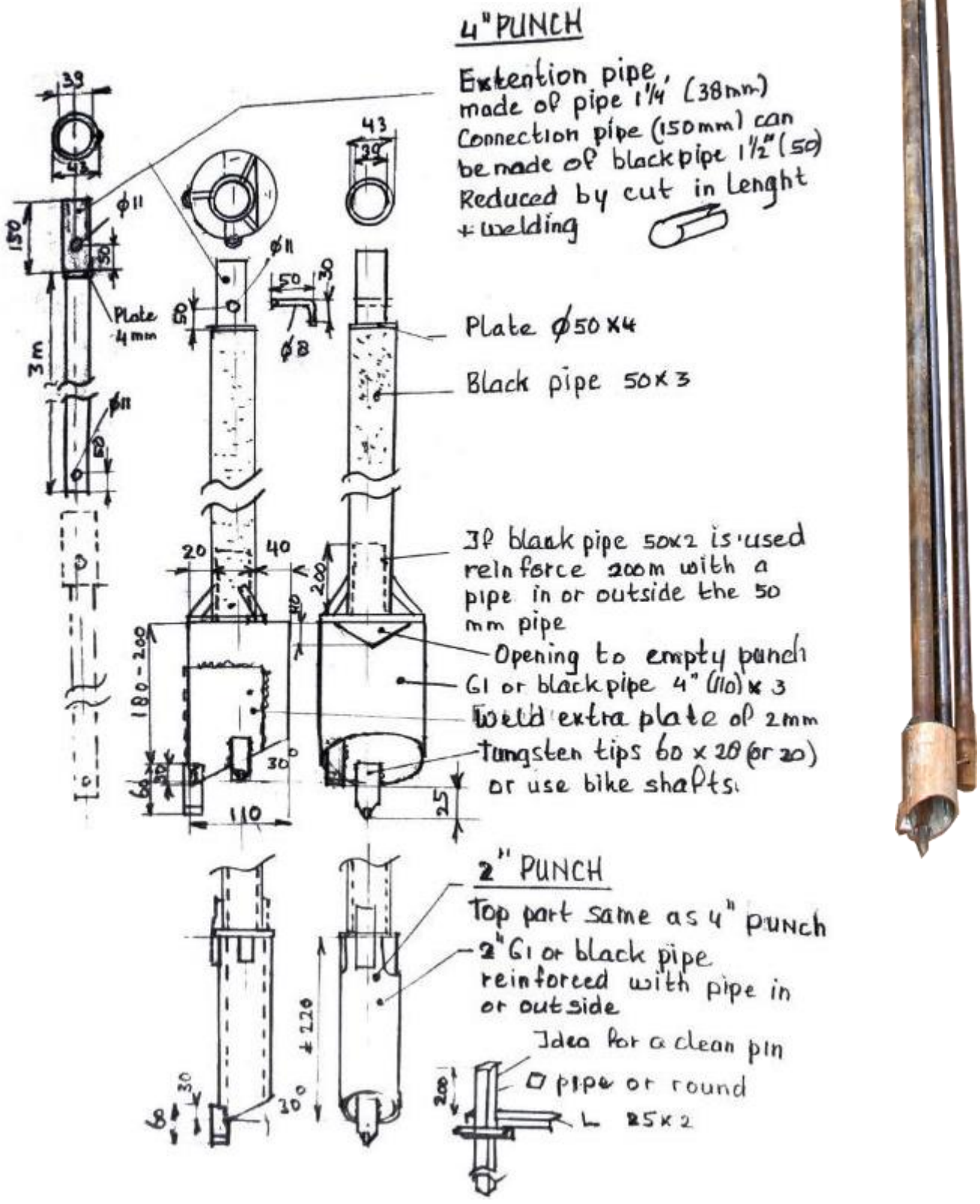
Foot step. In case rubber strips are used instead of a Vice grip, weld strip to avoid cutting of the rubber strip

.

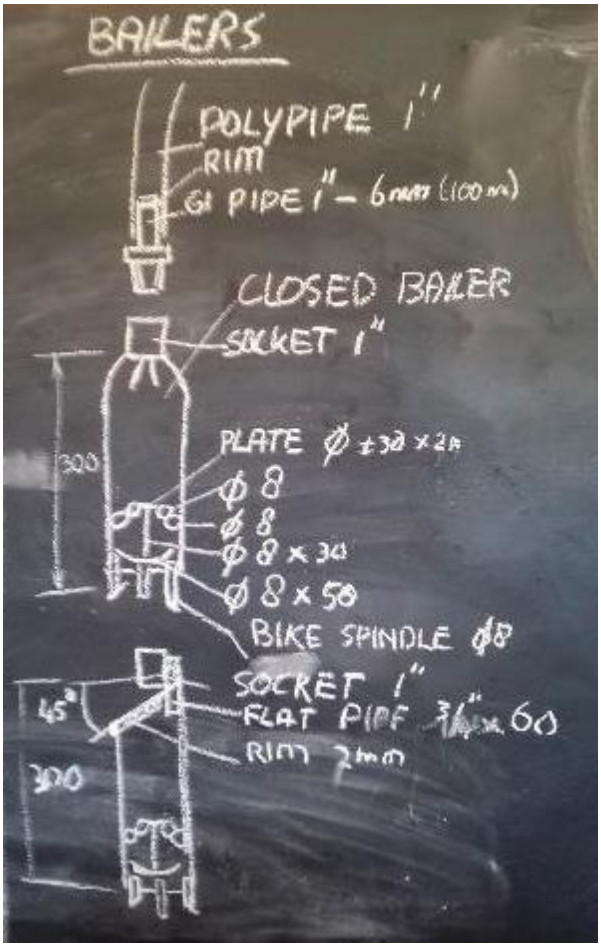
Mark each extension pipe to make sure that the holes fit.

Make sure the first pin (auger to drill pipe) use a wire for security. Make sure the length of the pin is just the size of the drill pipe. Here it is too long which will increase the danger of getting stuck

5.4 Making a Stone punch



5.5 Making a Tube bailer



Basic drawings of a Tube Combi bailer and a Tube Gravel bailer . The top of the Combi bailer has a piece of 12 cm of 1 Inch GI pipe.

The outside ring of the valve is made of round bar 10 mm. Rings made with a strong pipe 32 mm

Note the bar with a round shape on the valve. This to maximise the flow.

To fix the valve inside the 2 inch pipe, make 2 cuts and weld pieces of welding rod.

Than weld at the bottom.

Make an opening at the top of the bailer
Weld 2 pins at the lower end. (Pins can be for example the axle of a bike front wheel)
Make sure bailer fits in the used casing with min 10 mm clearance.

Combi bailer 3 inch. Production of a 3 inch bailer. Valve seat made of round bar 10 mm and 6 mm

Combi bailer 3 inch. Valve made of Round bar 10 mm. Outside diameter .. mm. And a plate of 3 mm

Combi bailer 2 inch. This bailer can be used in closed and open position. In this case it is in an open position.

Open the bailer in case of deeper wells and soils with course sand or gravel
In closed position the bailer will work till depth of 5 to 8 meters.

To make it a closed bailer push down the PVC pipe.

Use rubber strip to make sure it is closed completely