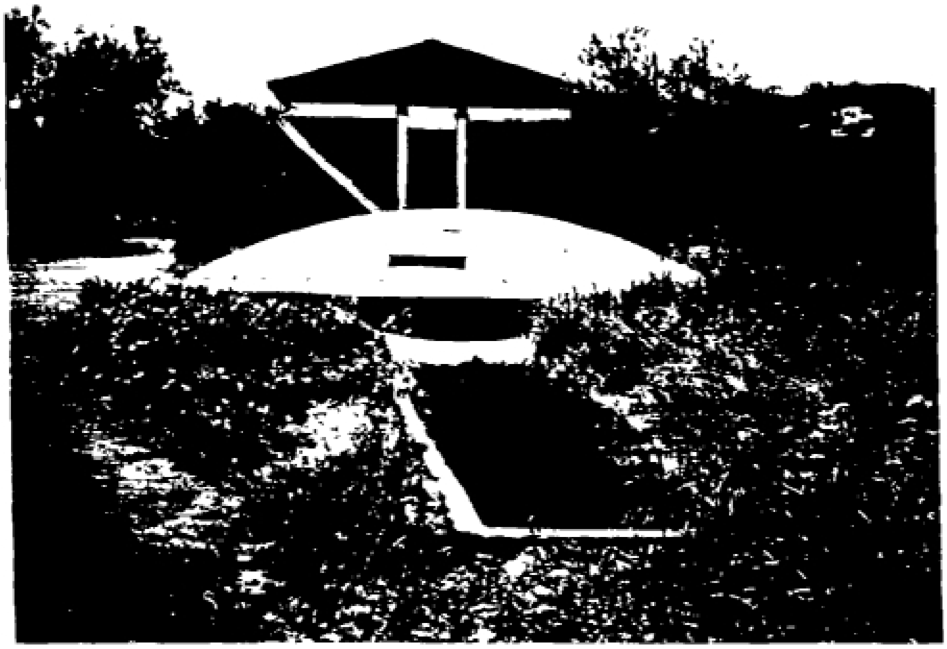
HOW TO BUILD
AN UNDERGROUND TANK WITH DOME

(Volume 80 cubic metres)



Using ferro-cement which is

* more durable than other types of water tanks
* costing US$ 20.00 per 1,000 litre volume, thus being the cheapest water tank available
* easy to build and maintain.

1,000 tanks have been built over the last 14 years.

ERIK NISSEN-PETERSEN

ASAL CONSULTANTS LTD.
P.O.Box 887, Kitui, Kenya

1992

Copies of these manuals can be purchased for the equivalent of US$ 10 per copy in hard currency by Bankers Cheque inclusive of registered surface mail from:
ASAL Consultants Ltd. P.O.Box 867, Kitui, Kenya.

This series of photo-manuals on "How to Build and Repair" consists of the following manuals:

"How to Build Cylindrical Water Tanks with Domes"
"How to Build An Underground Tank with Dome"
"How to Repair Various Types of Water Tanks"
"How to Build and Install Gutters with Splash-guard"
"How to Build A Double VIP-latrine"
"How to Build Smaller Water Tanks and Jars"

The series will be expanded to include:

"How to Build A Shallow Well"
"How to Plan and Manage a Water Tank Programme"
"How to Build Sub-surface Dams"
"How to Build A Sand-storage Dam"
"How to Build A Small Earth Dam"
"How to Build A Rock Catchment Dam"
"How to Build A Spring Protection"
"How to Build A Handpump and A Self-closing Watertap"

Another series of manuals on "Harvesting Rainwater in Semi-arid Africa" by Erik Nissen-Petersen, 1990, can also be purchased from ASAL Consultants Ltd. for the equivalent of US$ 10 in hard currency by Bankers Cheque. This series consists of the manuals:

"Water Tanks with Guttering and Handpump"
"Small Earth Dam with Animal Traction"
"Rock Catchment Dam with Self-closing Watertap"
"Shallow Wells with Bucketlift"
"Sub-surface and Sand-storage Dams"
"Spring Protections"

ASAL Consultants Ltd. is a private company which is specialized in water supply systems based on rain water harvesting.

ASAL Consultants Ltd. offers consultancy services on appraisal, review and evaluation of water programmes, as well as training of staff in siting, design, construction and maintenance of water projects.

Contents

ACKNOWLEDGEMENTS

The author of this manual is most grateful to Kim Nissen Petersen, Steve Robinson, Clare Gelsthorpe, Sue Clough and Richard Hanson for their proof-reading of this manuscript and for their very useful recommendations.

INTRODUCTION

These photo-manuals are illustrated with many photographs, accompanied by clear and short text, to describe step-by-step how to build various types of structures for harvesting rainwater.

This method of using a short series of consecutive photos with brief text to explain various construction methods for training artisans and supervisors has proved successful on several occasions.

The techniques explained in this manual are based on the author's experience of training more than 500 artisans and contractors in designing and building water projects in Africa since 1974.

It is hoped that this manual will assist water programmes as well as local contractors and clients, in building long-lasting water projects which will provide water for people and livestock.

BENEFITS OF

AN UNDERGROUND WATER TANK WITH DOME

(Volume 80 cubic metres)

The first of this hemi-spherical ground tank of ferro-cement was designed and built by the author in 1978. Since then some 400 of this type of tank have been built at schools and private homes in Kenya by various agencies.

About 60 of these tanks are used for storage of run-off water from roads and compounds. In order to reduce the cost these tanks were built without roofs. Due to health hazards and the risk of children and animals falling into these tanks, there is now an interest in roofing these tanks in a permanent way.

The rest of the 400 tanks are used for storage of run-off water from roofs. These tanks were roofed with galvanized iron sheets on timbers. It has now been found that the timbers are rotten although impregnated with wood-preservative. As a result of that, some roofs have caved in thereby leaving the tanks open to pollution. In order to solve this problem, the author was assigned to develop a dome of ferro-cement for the existing ground tanks as well as for new ground tanks in 1990.

This manual can therefore be used for building either new tanks or for building domes on existing tanks.

This underground water tank has a volume of 80,000 litres and can supply 440 litres daily during a dry period of 180 days.

A rainy season of 200 mm. rainfall which falls on a roof or rock catchment area of 400 square metres can fill the tank with water.

How to Estimate Demand and Supply of Water from Roofs:

In order to make water tanks for roof catchment of rain a perennial source of drinking water the following have to be estimated:

Water Demand:

If a school has, say 600 pupils and teachers, and each person requires 2 litres of drinking water daily, that gives a daily demand of 1,200 litres.

Required Storage:

If a region has, say 130 school-days in a 7 month period without rains, then the required storage volume will be 156,000 litres which will require 2 tanks, each with a volume of 80 cubic metres (80,000 litres).

Estimated Rainfall:

Find the rainfall data for one of the poorer rainy seasons and use that for a realistic rainfall figure, say 200 millimetres.

Required Roof Area for Rain Catchment:

The size of the roof area required for filling one tank is found by dividing the volume of the tank (80,000 litres) with the rainfall (200 millimetres) which gives 400 square metres. Add 10% for wastage = 440 square metres of roof are required for one tank of 80 cu.m.

Utilization of Overflowing Waste Water:

If the roof is smaller than required then the tank will not be filled, unless the rainfall is higher than estimated.

If the roof is bigger then the tank will just overflow into the tap station and from there to a waste pit with sugar canes. This waste pit could be extended into a small-scale irrigation of for example vegetables or tree seedlings in a school garden.

Cost Estimate of Building Ground Water Tanks:

The building of some 500 ground water tanks (60 cu.m., 78 cu.m. and 80 cu.m.) for DANIDA, USAID and UNICEF in Eastern Kenya since 1978 has given the following costs for one 80 cu.m. water tank with dome:

The Donors´ contribution

Site Surveyor, contracts and schedules with schools...	US$ 36
Training contractor, and manuals......................	" 10
Officer in charge of construction.....................	" 36
Supervisors, drivers, storekeepers, clerks, etc.......	" 70
Skilled labour, 3 contractors and 2 trainees..........	" 400
Purchased materials, (cement, reinforcement mesh, etc.)	" 800
Transport cost, (tractor, 4WD pick-up, motorcycle)....	" 67
Tools and equipment...................................	" 10
100 metres of gutters with splash-board cost..........	" 188
Donors´ contribution for 1 tank, 80 cu.m.	**US$ 1617**
Value of self-help work and local materials	**US$ 539**
Total cost and value of 1 water tank 80 cu.m.	**US$ 2156**

Cost comparison of 3 sizes of water tanks. USD.

Size of tank cu.m.	Donors cost	Self-help value	Gutters	Total cost	Cost per cu.m.
23	634	380	94	1108	48
46	1101	493	133	1727	38
80	1617	539	188	2344	29

Conclusions: The cost per cu.m. volume of a water tank decreases as the volume increases.

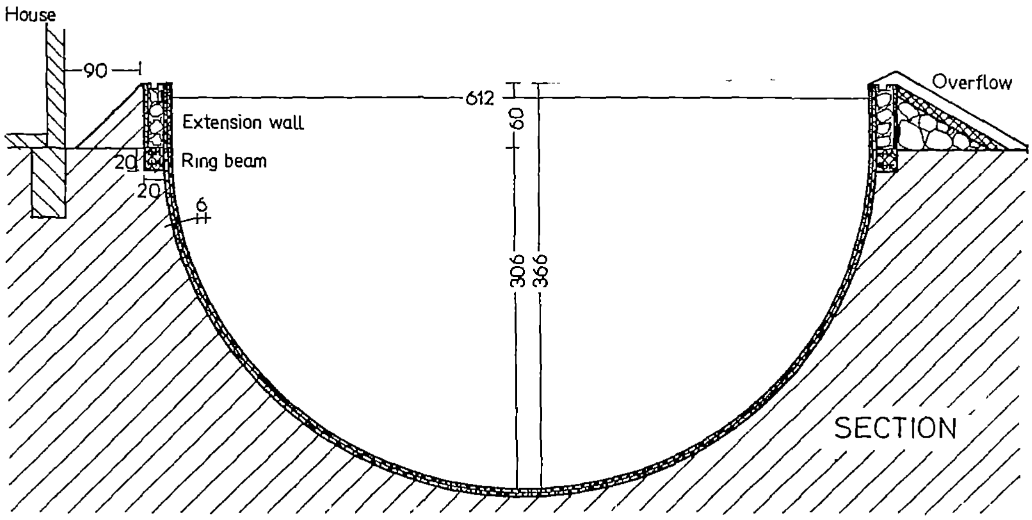
The bigger tanks require more craftmanship and supervision as well as good soil condition for carrying the weight of a full big tank,(up to 100 tonnes).

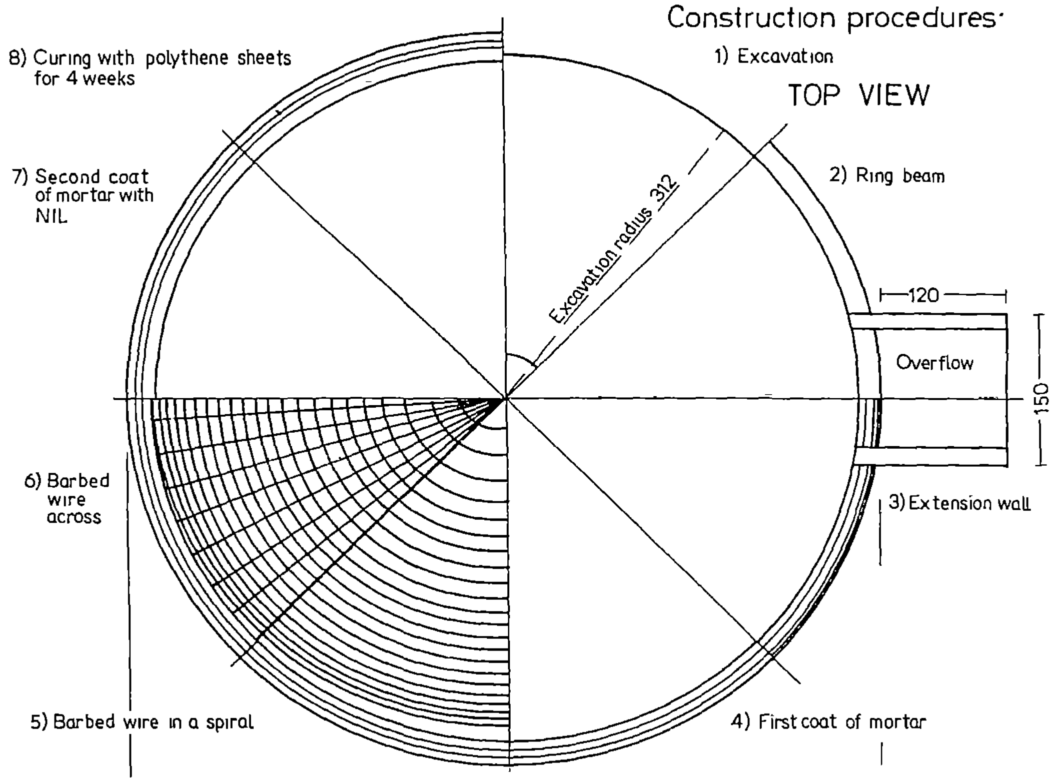
The risk for cracked or leaking tanks is reduced with a smaller tank.

Recommendation: A new water tank programme is therefore advised to start with smaller tanks, of e.g. 23 cu.m. volume

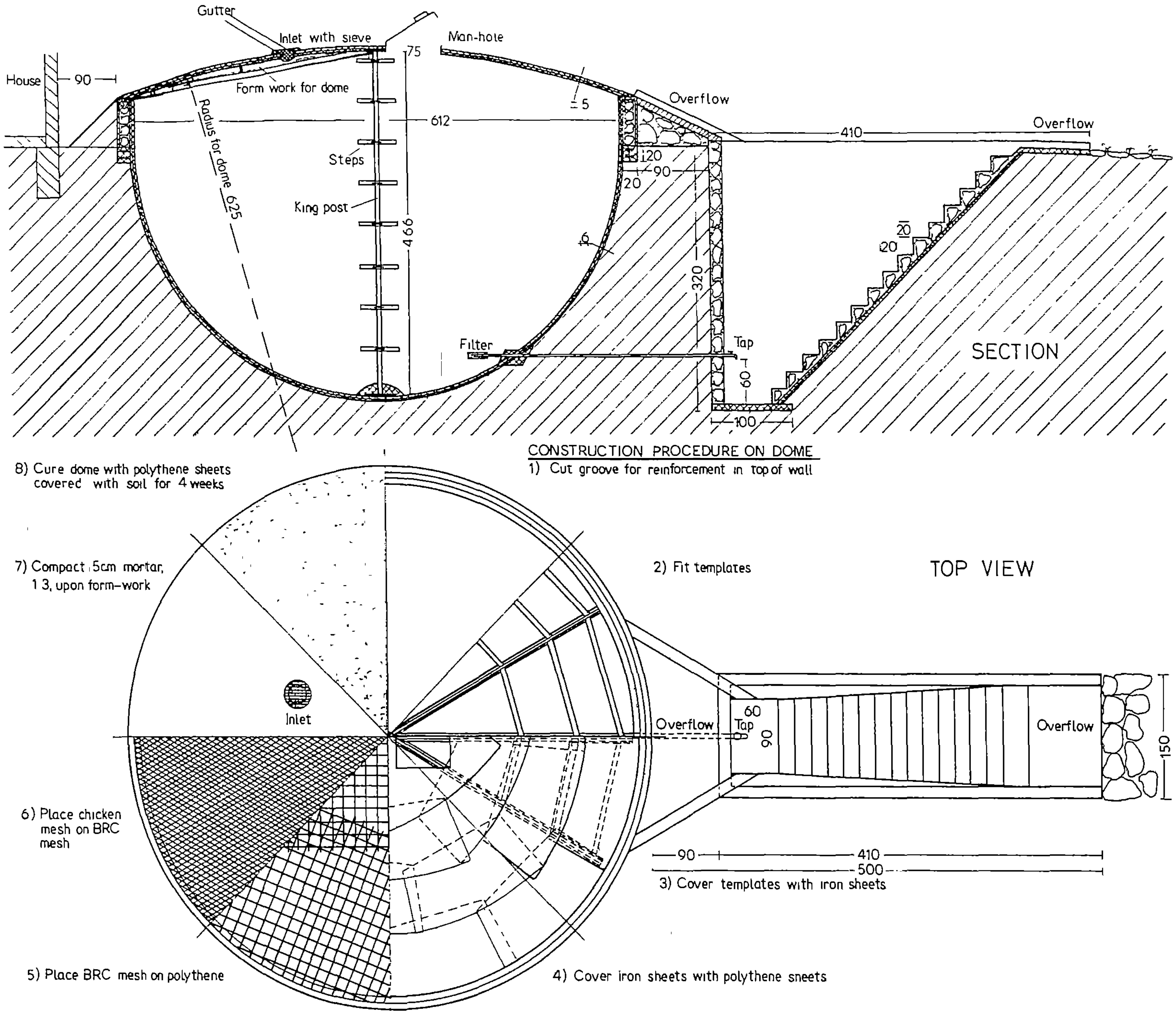
STANDARD DESIGN

OF AN EXTENDED GROUND TANK
(Volume 75 Cubic Metres)





STANDARD DESIGN OF A DOME ON AN EXTENDED GROUND TANK (Volume 80 Cubic Metres)

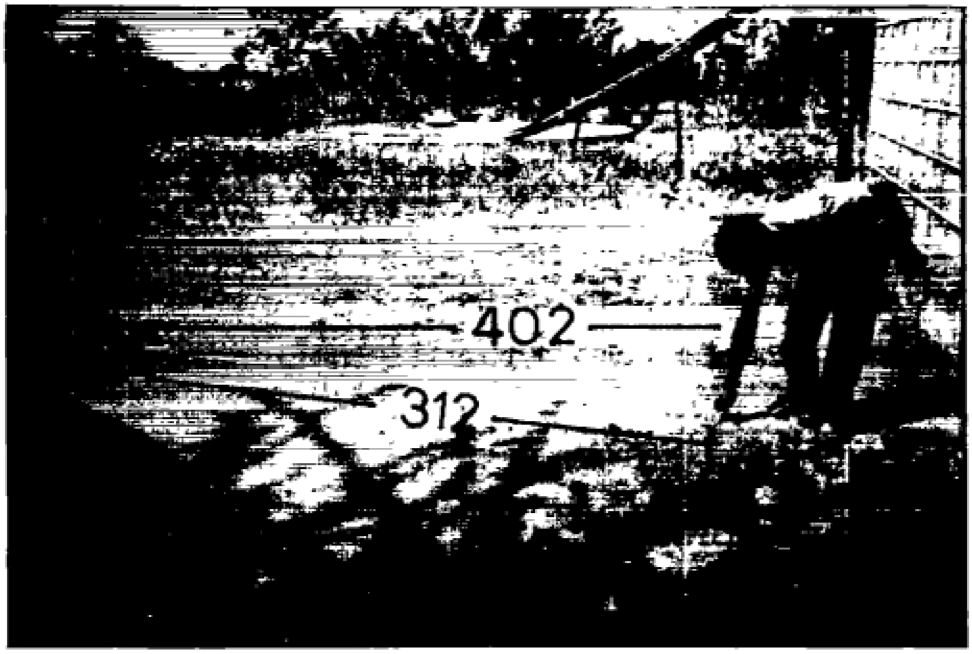


BILLS OF QUANTITIES
FOR 4 STAGES OF BUILDING A GROUND TANK WITH DOME

Item	Quantity for ground tank	Quantity for extension	Quantity for dome	Quantity for tap station	Total quantity
LABOUR. Provided by organization:					
A-Contractor..	6 days ...	3 days ...	4 days ...	3 days	= 16 days
B-Contractor..	6 days ...	3 days ...	4 days ...	3 days	= 16 days
B-Contractor..	6 days ...	3 days ...	4 days ...	3 days	= 16 days
Trainee.......	6 days ...	3 days ...	4 days ...	3 days	= 16 days
Trainee.......	6 days ...	3 days ...	4 days ...	3 days	= 16 days
Skilled Labour	30 days	15 days	20 days	15 days	= 80 days
Transfers to sites					5 days
Cost of Skilled Days					US$ 400
MATERIALS. Provided by organization:					
Cement........	35 bags	13 bags	15 bags	10 bags	= 73 bags
BRC mesh,65...			35 metres		= 35 metr.
Chicken mesh..	3 rolls		3 rolls		= 6 rolls
Barbed wire...	2 rolls	1 roll			= 3 rolls
Binding wire..			2 kg.		= 2 kg.
Nails, 2".....	10 kg.	3 kg.			= 13 kg.
Polythene.....	20 metres		10 metres		= 30 metr.
King-post, 2"GI			6 metres		= 6 metr.
Draw-off pipe.			6 metres		= 6 metr.
Lockable man-hole			1 unit		= 1 unit
Cost of Purchased Materials					US$ 800
LABOUR AND MATERIALS PROVIDED BY ORGANIZATION					**US$ 1200**
MATERIALS. Provided by self-help.(1 tonne = 8 wheelbarrows)					
Sand, coarse.	7 tonnes	3 tonnes	4 tonnes	3 tonnes	= 17 tonnes
Ballast......	1 tonne				= 1 tonne
Stones.......	3 tonnes	3 tonnes		6 tonnes	= 12 tonnes
Water........	3 tonnes	1 tonne	2 tonnes	3 tonnes	= 9 tonnes

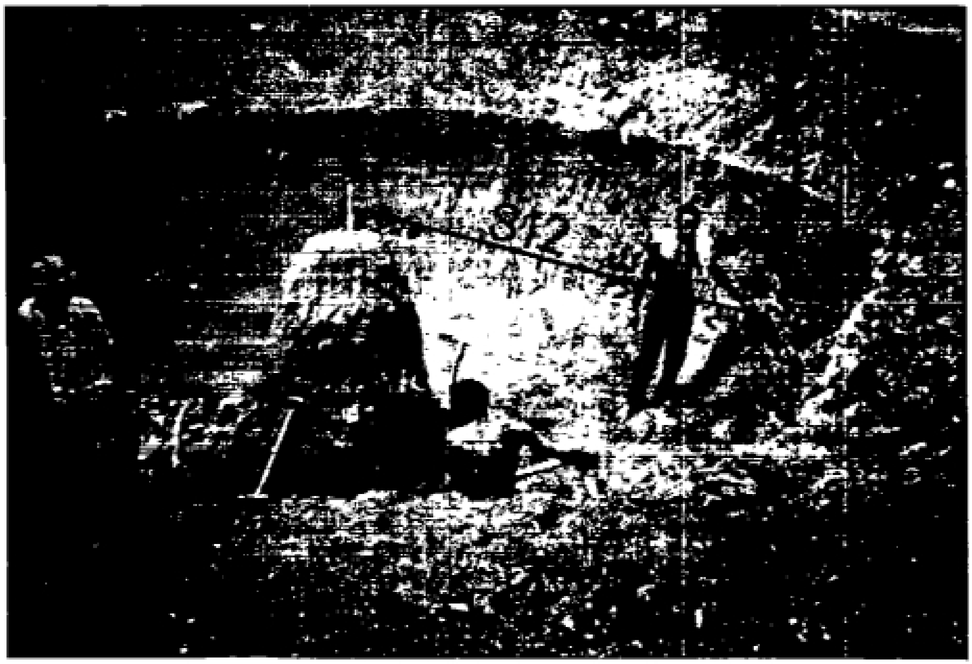
LABOUR.Provided by self-help:

Excavations............	9 days x	6 people	= 54 days
Transporting sand/water	18 days x	10 people	= 180 days
Making ballast.........	5 days x	5 people	= 25 days
Labour for construction.	28 days x	10 people	= 280 days
Value of Unskilled Labour Days			539 days = US$ 539
Grand Total Cost and Value			**US$ 1739**



1) *The site must be* free of ant hills and old pits. Trees must be at least 10 metres away from the tank or else be cut down.

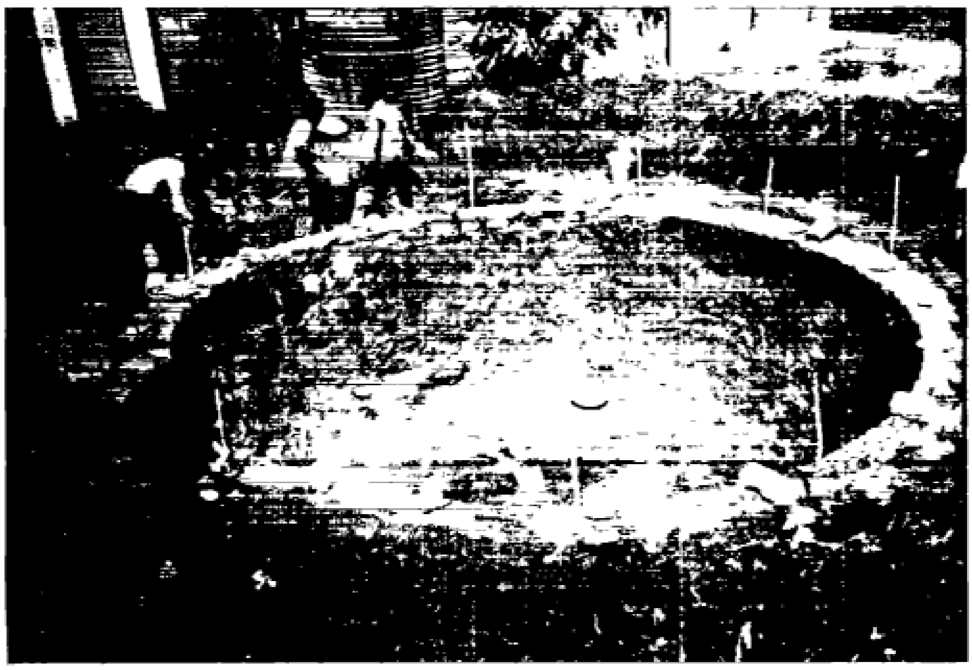
The centre of the tank is marked by a peg hammered into the soil 402 cm from the middle of the wall. Tie a string to the peg and mark a circle around the peg with a radius of 312 cm. This is the outline of the tank.



2) Excavation of the hemi-spherical shaped tank is measured by using a radius wire of 312 cm which is attached to the centre peg.

This wire is used to measure the distance from the peg to the wall of the pit as it is dug

The peg is left in its place on a pillar of soil until excavation of the wall is completed.



3) The horizontal level for the rim of the tank is marked on pegs placed 25 cm away from the excavation.

A shelf, 20 cm x 20 cm, is dug from the level marks on the pegs around he rim of the tank.

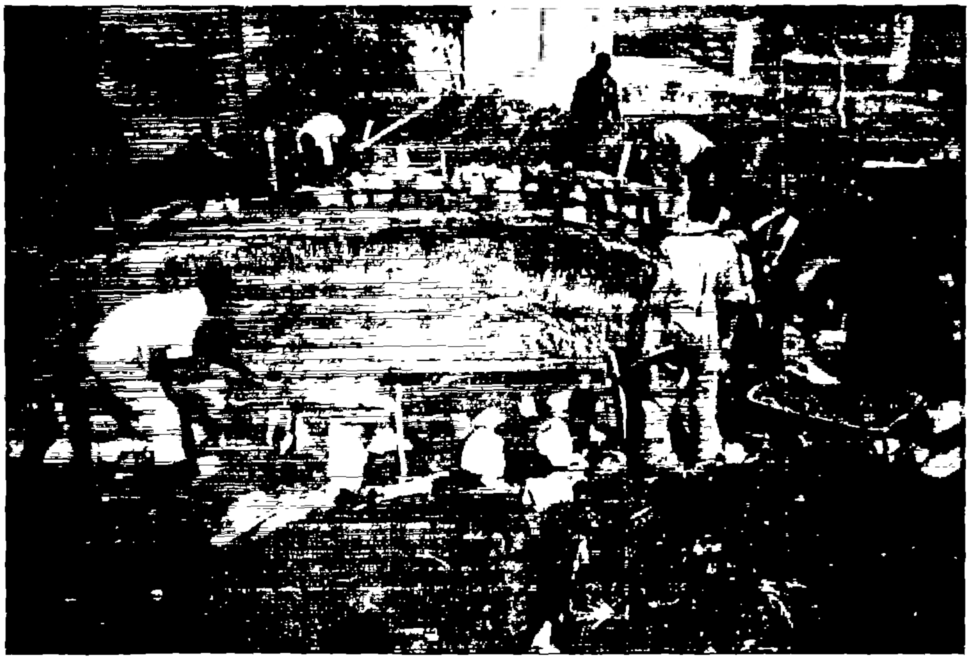
Depressions or holes in the excavation below the shelf are filled out with stones set in mortar 1:3 (see annex 1).

4) A *ring-beam of* reinforced concrete is built in the excavated shelf in the following way:

Pour a 5 cm. thick layer of concrete 1:3:4 in the shelf (see annex 3). Place 4 rounds of barbed wire, g.12, on the concrete. Then pour a 10 cm. layer of concrete upon the wires and compact it well.

Place another 4 rounds of barbed wire on the concrete. Cover the wires with 5 cm. of concrete and compact it well.

Cure the concrete beam with water under polythene sheets.

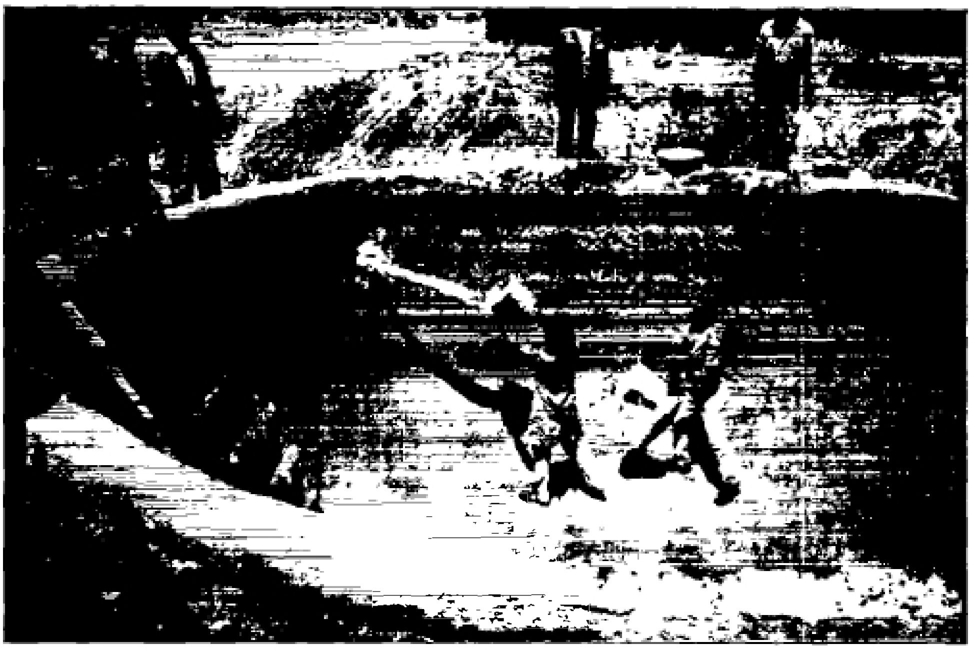


5) Build a 20 cm thick wall of stones, or blocks, with mortar 1:3 on top of the ring-beam. The wall should not be more than 60 cm high from the ring-beam.

Ensure that the top of the wall is at a horizontal level.

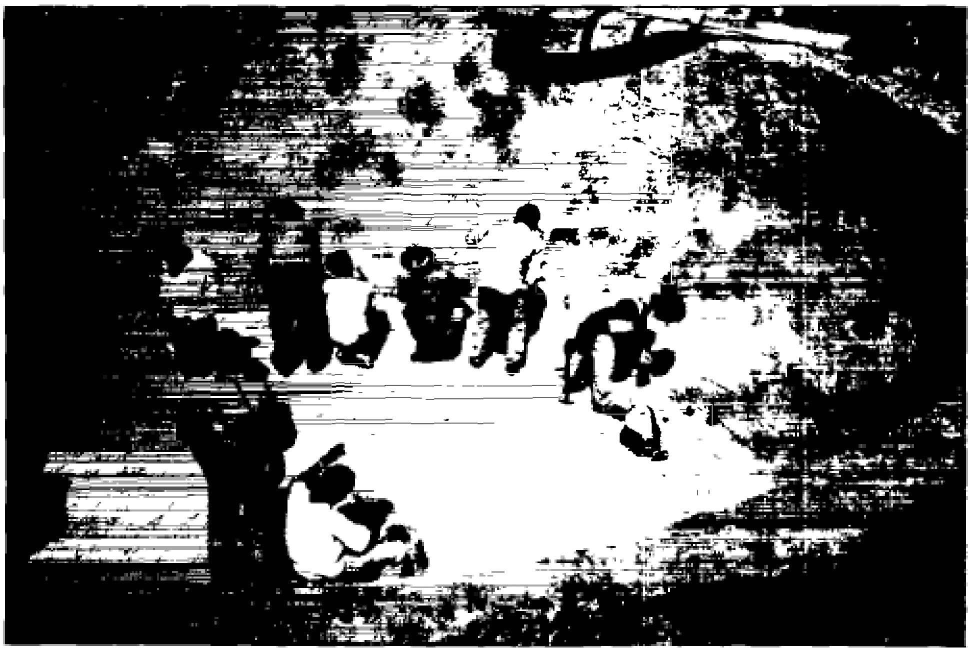
6) Wrap 12 rounds of barbed wire tightly around the outside of the wall for reinforcing it.

Cover the barbed wire completely with a coat of plaster, 1:3. Pile up the excavated soil against the outside of the wall so that it forms a slope away from the tank.



7) Plaster the interior of the tank with a 1 cm coat of mortar 1:3 (see annex 1).

On the following day, a second coat of mortar 1:3 is plastered onto the tank in a 2 cm thick coat. **This second coat must be completed in 1 day, and be wetted several times a day.**



8) Reinforcement of the tank consists of barbed wire and chicken mesh.

First nail barbed wire onto the tank in a spiral starting from the centre of the floor and ending at the top rim of the tank. The spacing of the barbed wire is 20 cm.

The best types of nails are either 2" nails, 1" ceiling nails or galvanized roofing nails.

9) When the spiral of barbed wire is completed, another set of barbed wire is nailed from the top of the rim down the wall and across the centre of the tank.

The spacing of this wire is 30 cm. at the top of the rim.

REINFORCEMENT OF WALL AND TAP STATION

10) The barbed wires must protrude 30 cm over the rim of the tank so that they can be tied onto the BRC mesh which will be placed on the dome.

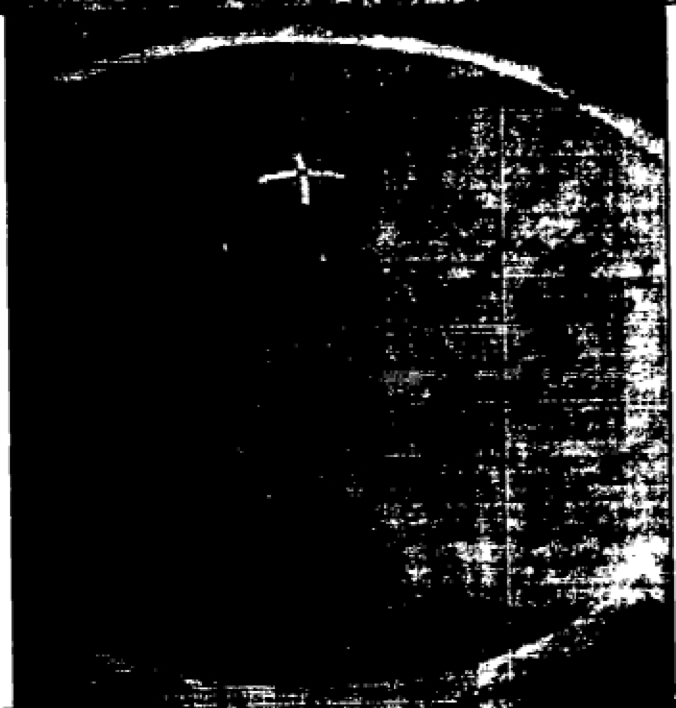
Four lengths of chicken mesh are laid from rim to rim right across the centre of the tank and spaced equally.

The remaining spaces are then covered with short lengths of chicken mesh with overlaps of at least 20 cm.

11) Inside the tank a hole is cut in the wall 40 cm above the floor of the tank for the draw-off pipe.A length of 3/4" G.I. pipe is then hammered through the hole into the excavation for a staircase with the watertap.
The pipe is then cemented into the tank wall.

12) The excavation starts 90 cm from the rim of the tank and it is 380 cm long. The width of the excavation is 150 cm at the top and 120 cm at the bottom. Its depth is 370 cm.

FINAL PLASTERING AND KING-POST



13) Apply a 3 cm. coat of mortar, 1:3, onto the inside of the tank. Ensure that the pipe is embedded properly in the plaster.

Within the same day, a coat of NIL (see Annex 2) has to be applied for water-proofing.

This plastering has to be completed within 1 day, and kept moist under polythene sheets for 3 weeks.

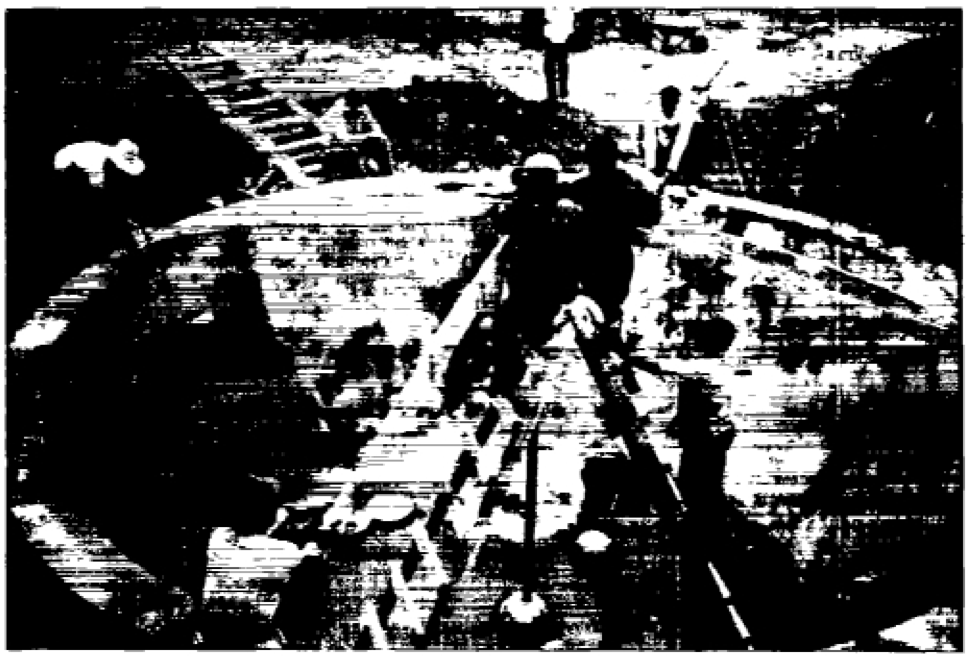
14) The king-post, of 2" G.I. pipe, is cut to a height of 100 cm above the wall (466 cm). Steps of angle irons are bolted onto the pipe

The pipe is erected in the centre of the tank which is found by dividing the rim into 4 sections and drawing lines in between the sections

Tie the top of the king-post to the rim with wires in order to keep it in vertical position.

Place 2 flat irons under the king-post on the floor of the tank. Cover the irons with mortar 1:3.

15) If a dome is to be build onto an old tank which has a shorter king-post for a roof of iron sheets, then the king-post must be extended to a point 100 cm higher than the top of the wall.



16) *The curve of the* dome is part of a circle passing through the top of the tank wall and the top of the king-post. (See Annex 5).

Draw a centre-line with the exact shape of the tank on a clean patch of soil.

The exact curve for the dome will be found by moving a point up and down along the centre line.

Timbers for the 12 templates are marked with the found curve and cut into shape, and thereafter nailed together.

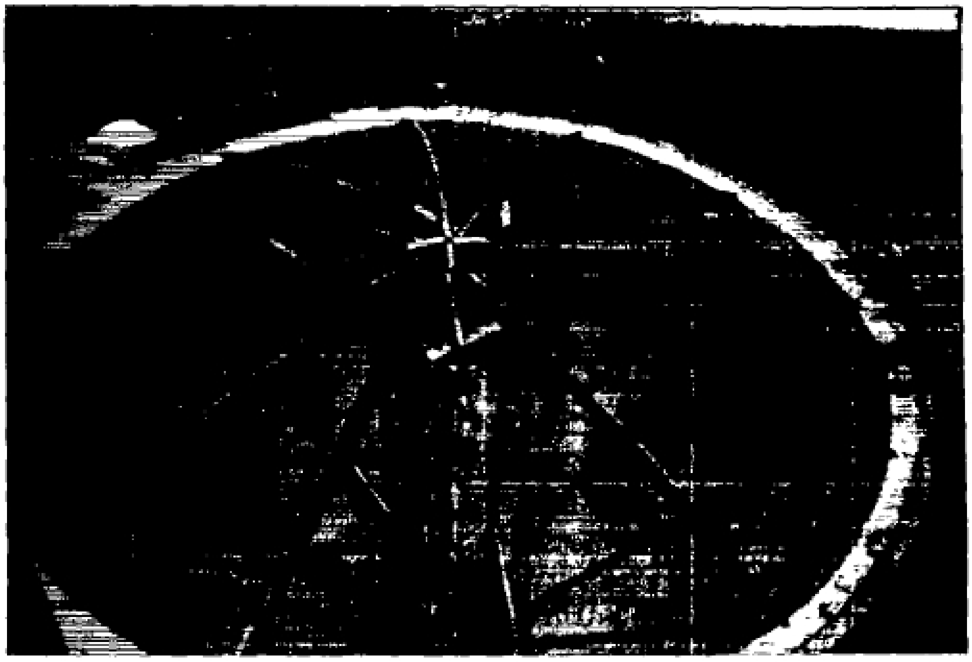
17) The upper ends of the templates will rest on timbers placed upon the steps and tied to the king-post.

The lower ends of the templates, which will rest on top of the rim, are reinforced with an iron rod tied onto the underside of the templates.

18) The first 4 templates are placed upon the timbers which are tied onto the steps at the king-post.

The templates are tied together with wires.

The lower ends of the 4 templates are positioned at exact equal distance at the wall. Find that distance by measuring the circumference of the rim.

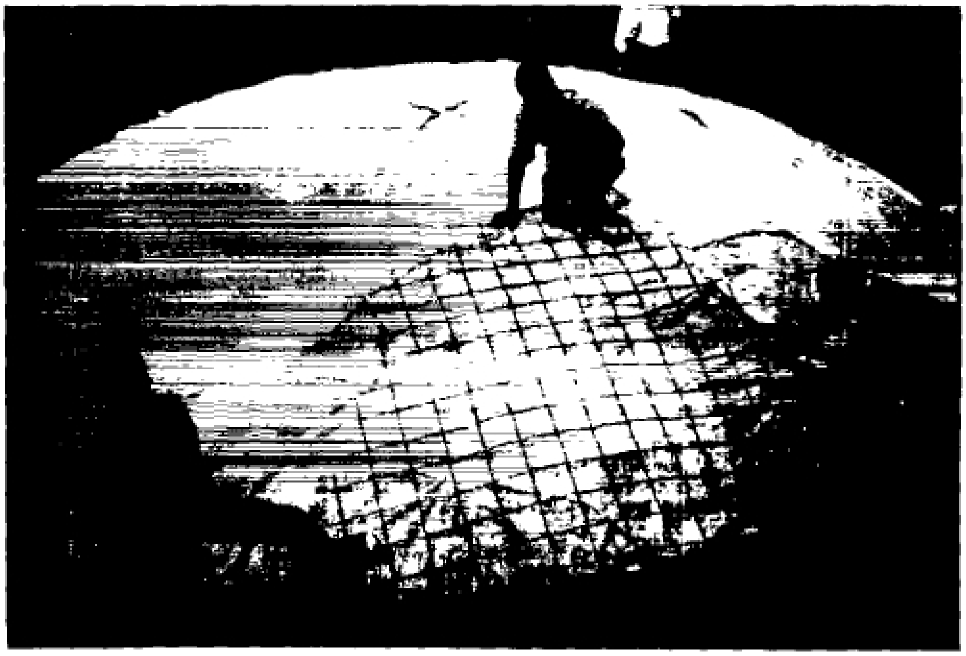


19) *The remaining 8* templates are fixed between the first 4 templates.

The distance between the lower ends of the templates should be equal in order to support the layer of flattened oil drums. When the templates are on their marks, timbers are cut and nailed between the templates in order to keep the form-work firm.

20) Oil drums, flattened to form sheets and cut into shape, (see Annex 5), are laid upon the templates. The lowest round of sheets rests on the rim of the tank and against the protruding barbed wire

The other rounds of sheets are tied to the sheets on the opposite side of the dome with wires. A space 75 cm x 75 cm,space for the man-hole is made at the top of the dome next to the king-post which protrudes 2 cm.



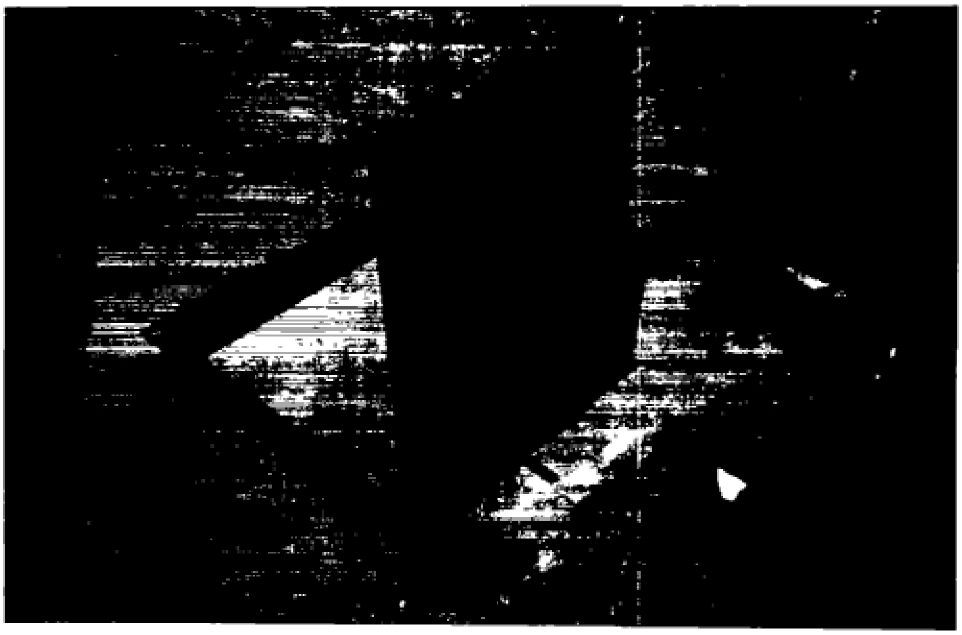
21) Some 40 to 50 sisal poles are propped up against the sheets from underneath to support them and maintain the curve of the dome.

The dome is then covered with polythene sheets. BRC mesh is cut into 9 pieces, (see Annex 5), and laid upon the polythene sheets. All overlaps of the BRC mesh must be at least 20 cm.

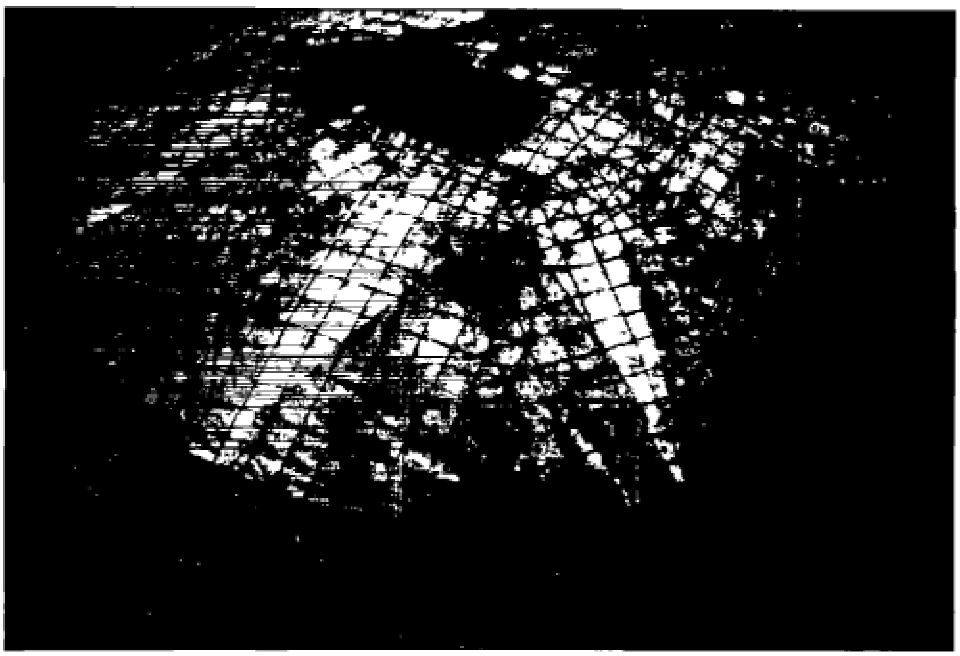
22) Tie the pieces of BRC mesh together with binding wire for every 15 cm.

Bend the ends of the barbed wire from the reinforcement of the tank over the BRC mesh and tie them together with the BRC mesh.

Chicken mesh, with overlaps of 20 cm, is then tied onto the BRC mesh with binding wire.

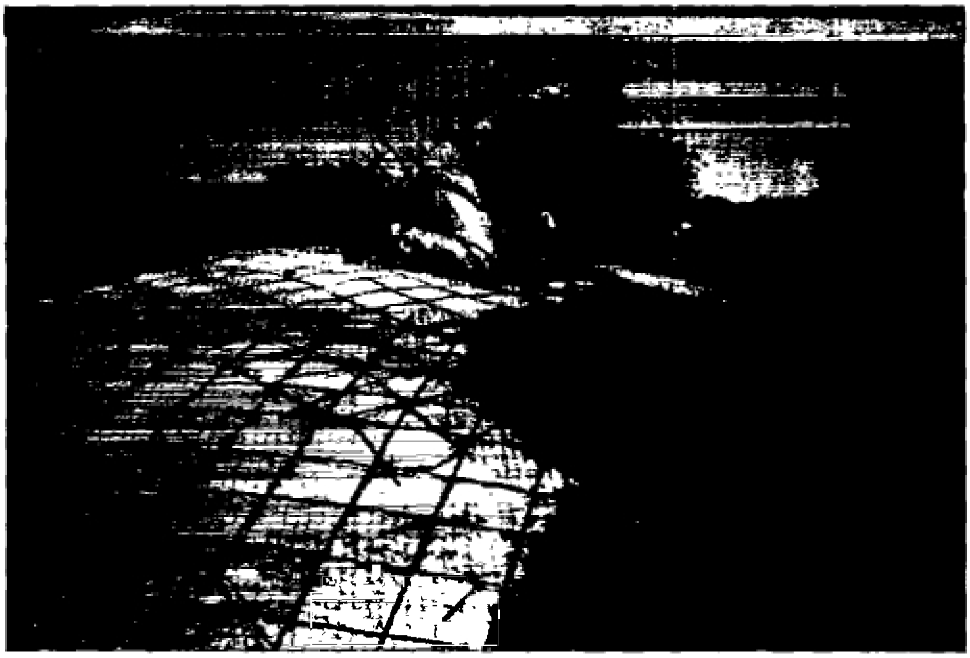


23) A man-hole with a lockable lid and measuring 75 cm x 75 cm is made of galvanized steel.



24) Two flat irons are placed on top of the king-post where they will be cemented into the dome for support of it.

The man-hole is placed in its position and tied to the BRC mesh with binding wire.



25) *Place mortar 1:3* on the dome in a 5 cm. layer. Lift the reinforcement into the middle of the mortar and compact the mortar well around the BRC and chicken mesh.

Smooth the surface of the dome to a good even finish.

The dome must be kept moist with water and covered with polythene sheets for at least 3 weeks.

Do not remove the form-work until the dome has been cured for at least 10 days.

26) While the dome is curing, the water tap station is build and the gutters are made and fitted to the roof.

The floor of the tap station is excavated to 70 cm below the water tap. The floor for the staircase is made straight at 45 degrees.

Pour a 5 cm. layer of concrete 1:3:4 on the floor for the staircase and a 10 cm layer for the tap station.

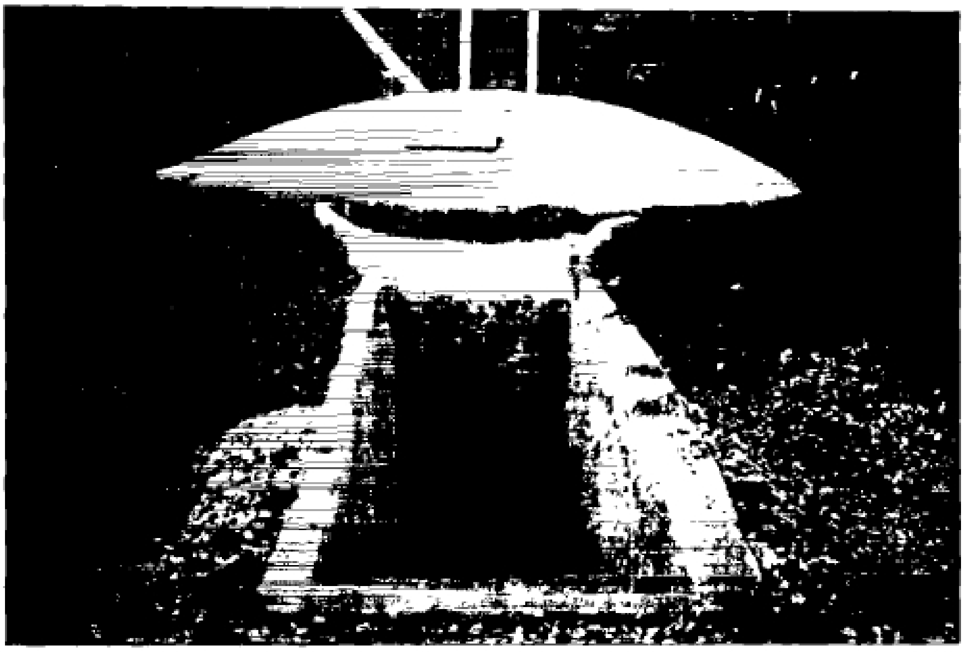
Form-work for the steps consists of 8" x 1" timbers which are fitted across the foundation of the staircase with a horizontal interval of 20 cm. That will make the steps 20 cm high and 20 cm wide.

Fill this form-work with stones packed in mortar.

27) Then build the walls of the stair-case of stones set in mortar 1:3. Use a template at the gable of the wall for drawing building lines to the top of the stair-case.

Leave the stairs with a rough surface to provide a better grip when the stair-case is wet.

The staircase should be built water-tight, so it can hold water if the water tap breaks or someone forgets to close it.



28) Remove the form-work for the dome 10 days after it was concreted.

Be careful not to be hurt by the sheets when they drop down.

Seal the interior joint between the wall and the dome with compacted mortar of 1:3.

ANNEX 1

Mixing mortar 1:3

It is very important to mix mortar correctly for ferro-cement structures, and to cure the ferro-cement work with water and polythene sheets for at least 3 weeks.

For the purpose of proper curing, 20 metres of polythene sheets are given to every school and the headmaster instructed in the procedures of the daily curing.

The correct mixture for mortar for ferro-cement is 1 portion of cement to 3 portions of sand, called 1:3.

The sand for this mortar has to be clean and coarse river sand. Any lump of soil or clay, or a piece of straw, will create a leakage in the water tank.

Mixed mortar has to be kept in shade and used within 1 hour.

1) Mortar is mixed in portions consisting of:

1 bag of cement,(50 kg).

2 wheelbarrows of coarse and clean river sand levelled off to the rim of the wheelbarrows.

2 3/4 buckets of fairly clean water, (40 Litres).

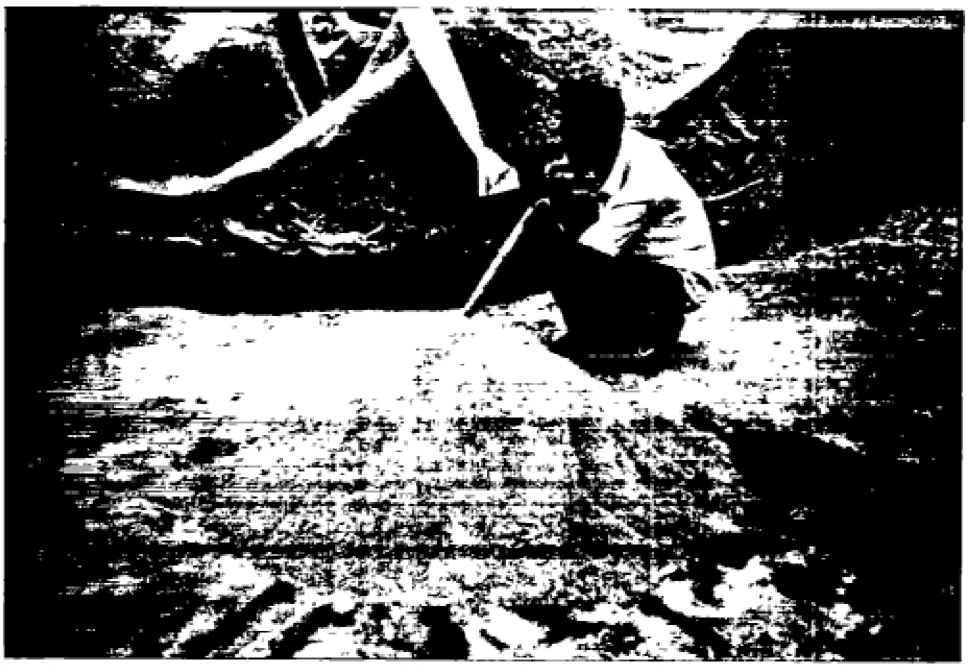
2) Mixing should take place on a clean slab and not on the ground as shown here.

The procedure for mixing is:

a) Off-load the sand in the two wheelbarrows into a heap on the mixing slab.

b) Open the bag of cement and pour it over the heap of sand.

c) Turn the sand and cement into another heap next to the first heap.



3) Turn over the heaps 4 times without water.

The colour of the heaps must be uniform; without any portions being either too sandy or too grey with cement.

4) Scoop the heap of the dry mixture into a volcano-shaped cove.

Add the 2 3/4 buckets of water into that cove slowly, so that the mixture has time to soak up as much water as possible.

5) When water starts to overflow the rim of the heap, close the overflow with dry mixture from the floor.

6) *Continue adding* dry mixture to the top of the rim, until all the water poured into the heap is absorbed.

7) Then, quickly overturn the wet mixture into another heap while mixing it with shovels.

Turn the wet mixture over a second time.

8) After the second turning, the mortar is ready to be used.

The mortar must be used within 1 hour or it will lose its strength and be useless for building a water tank.

Keep the heap of mixed mortar under shade and overturn it now and then to keep it from setting.

Do not add water to the mixed mortar because that will spoil its strength.

ANNEX 2

Mixing NIL for Water-proofing.

Water-proofing cement is not used for building these tanks because:

- Water-proofing cement is expensive and difficult to purchase in rural areas, and
- Water-proofing cement gives the artisans a false feeling of being able to cover up a poor mixture of mortar.

Instead of using Water-proofing cement, the traditional method of using cement-slurry, called NIL, is advocated.

1) The process of making NIL is quite simple:

a) Fill a bucket halfway with water.

b) Pour in dry cement in small amounts until a consistency equal to that of uji (millet porridge) is achieved.

Do not mix more NIL that can be used in 1/2 hour.

2) Apply this NIL mixture with a tin can and a square steel trowel to walls and floors that have been plastered that very same day.

ANNEX 3

Mixing concrete 1:3:4 for foundations of water tanks.

Concrete for a foundation for a water tank is mixed in 2 portions:

- half of the required volume of concrete which is poured into the foundation before the reinforcement is placed in the foundation, and

- the other half of the required volume of concrete which is poured when the reinforcement has been placed. By doing so, the reinforcement will be placed right in the middle of the foundation.

Building the foundation for a 46 cubic metre water tank:

1) Off-load 12 wheelbarrows, loaded to the level of their rim, with coarse and clean sand onto the mixing slab.

2) Pour 6 bags of cement over the heap of sand.

3) Mix and turn-over the sand and cement 4 times, or more, until it is uniform in colour.

4) Off-load 16 wheelbarrows of ballast over the heap and level it evenly.

5) Turn over the sand/cement with the ballast whilst water is added.

6) When the mixture is uniform, it is ready to be poured into the excavation for the foundation.

The water required for this volume of mixture is 450 litres which is equal to 30 buckets of water.

The work on a foundation for a water tank has to be completed in 1 day.

ANNEX 4

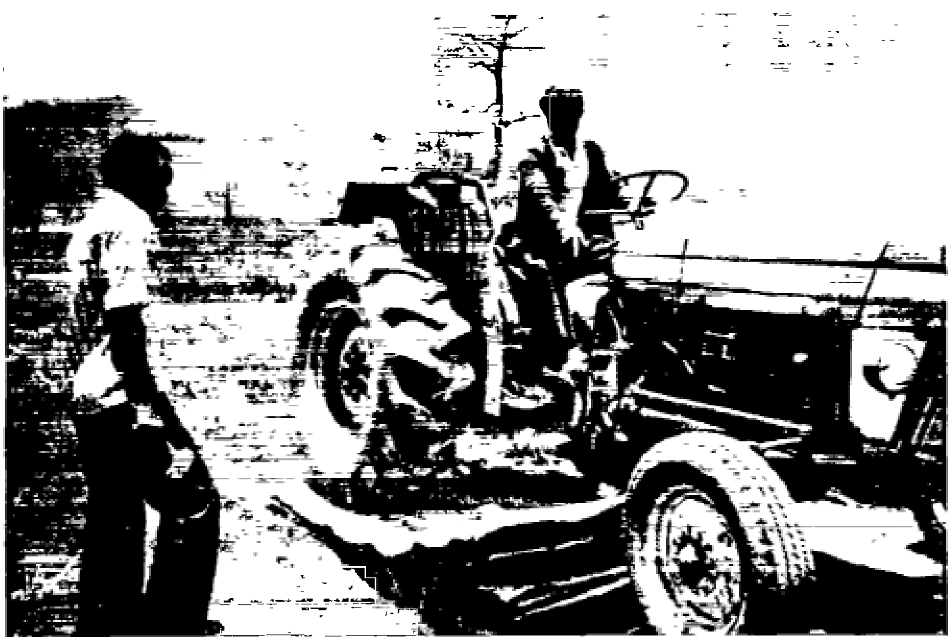
Form-work for the Dome

A set of form-work for the dome can be used for building more than 50 water tanks before it is worn out.

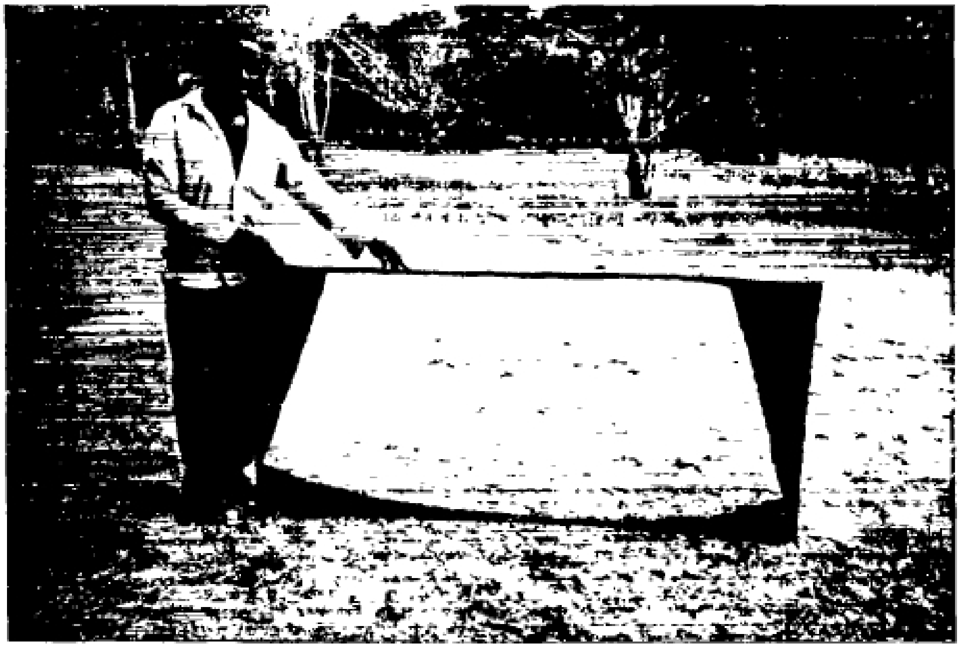
The cost of a dome made of ferro-cement and a set of form-work for building it, is cheaper, stronger and longer-lasting than any other forms of roofing a water tank.

A dome over a water tank eliminates evaporation losses almost entirely, and it keeps the tank's water clean and free of insects, etc.

1) Cut open 29 old oildrums and flatten them out to sheets with hammers.



2) If available, the rear wheels of a tractor or a lorry can flatten the sheets nicely.



3) Mark one side of a sheet with the inside curve of the rim of the water tank. Mark the ends of that sheet with the centre-lines of the tank.

Cut the sheet along the lines with a hammer and chisel.

4) After having confirmed that this sheet has the correct shape, it is used for marking the other 28 sheets which are to be cut into the same shape.

The king-post is made from 2 pieces of 4" x 2" timbers, each 240 cm long, which are nailed together.

A karai (steel basin) is nailed as a platform onto the top end of the king-post. The 12 templates will rest on that platform.

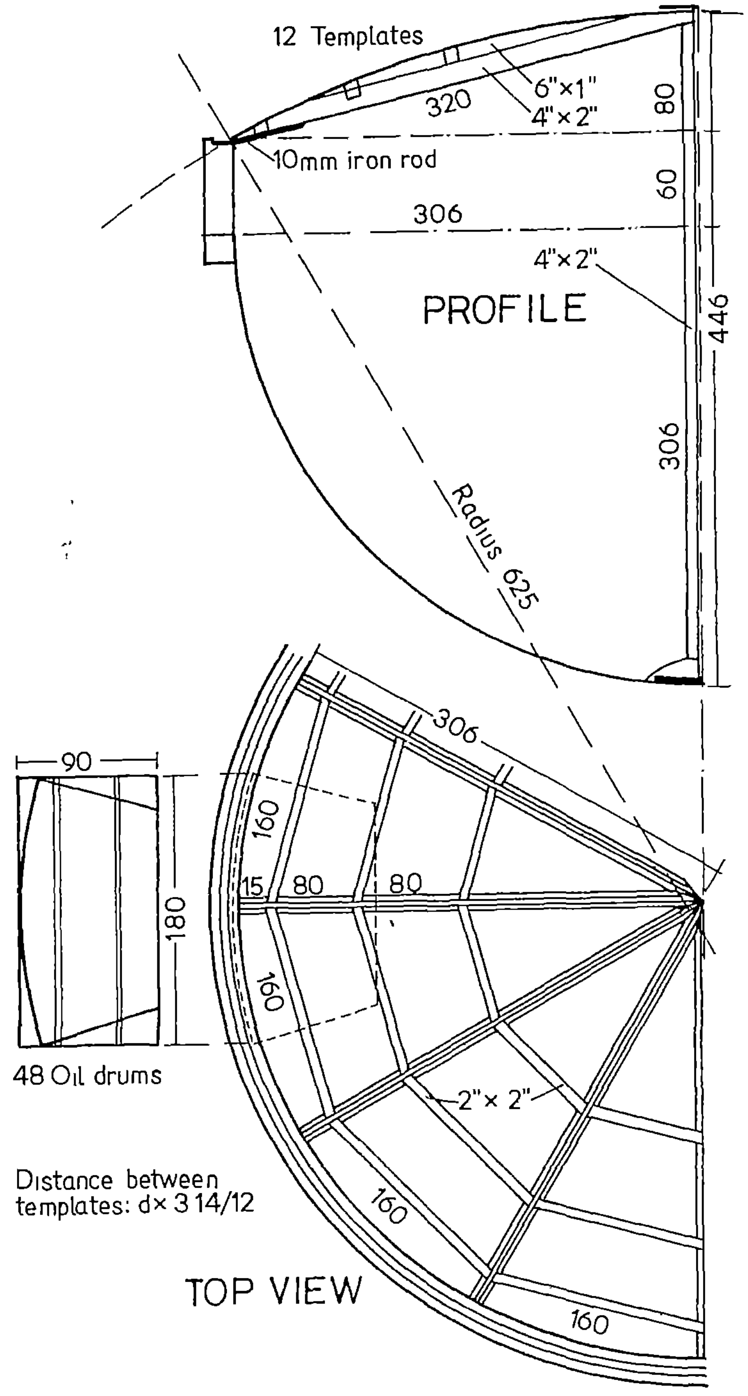
5) The 12 templates are made from 12 pieces of 8" x 1" timbers, each being 270 cm. long.

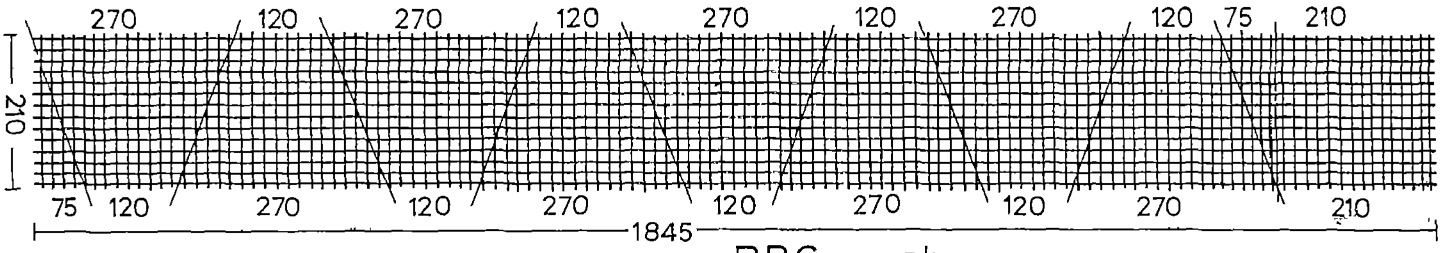
The curved upper side of the templates is marked with a pencil in a string with a radius of 600 cm.

A 5 mm. hole is drilled into each end of the templates. A leg, 190 cm. long, is made from 2"x 2" timber which is then bolted onto the template.

ANNEX 4

FORM-WORK AND BRC MESH FOR DOME





BRC mesh

ANNEX 6

STANDARD TOOLS AND EQUIPMENT FOR CONTRACTORS

Item	A-Contractor	B-Contractor	B-Contractor
Tools			
Tape measure, 30 metres	1		
Tape measure, 2 metres	1	1	1
Mason trowel	1	1	1
Mason hammer	1	1	1
Mason chisel	1	1	1
Mason square	1	1	1
Steel trowel, square	1	1	1
Wooden float, curved	1	1	1
Straight edge, 6 ft	1	1	1
Spirit level, 3 ft	1	1	1
Builders line, nylon	1	1	1
Sisal brush	1	1	1
Lockable wooden tools box	1	1	1
Equipment			
Sieve for sand, 3 ft x 5 ft.	1		
Oil drums for storing water.	4		
Large empty sugar sacks	35		
Templates for form-work	12		
Kingpost for form-work	1		
Flattened oil drums	29		
Sisal poles, 7 ft. to 9 ft.	25		
Double ladder, 8 ft	1		
Wheelbarrows	2		
Buckets	2		
Shovels	4		
Karais	6		
Pick-axes	2		
Jembes	2		
Pangas	2		
Tents	1	1	1
Stationeries			
Photo-manual	1	1	1
Note books	1	1	1
Muster roll	1		
Duplicate book	1		

ANNEX 9

MAINTENANCE OF TANKS AND GUTTERS

As part of the agreement between this programme and each school, it is the Headmaster or Headmistress's responsibility to ensure that maintenance of the tanks and gutters is carried out after these instructions:

Gutters:
The roof and the gutters supply water to the tank(s) and must be clean in order supply water suitable for drinking, therefore:

1) Prune any trees over-hanging roofs and gutters so that they do not drop their leaves on the roofs and in the gutters.

2) The first rainshower in a season carries dust, dirt and leaves which pollutes the tank. Divert this dirty away from the tank by lifting the down-pipe out of its seat in the tank before the onset of a rainy season, and lift it back in its seat when the rainwater is clean.

Tanks:
A water tank can crack if a tree grows near a tank or if water is allowed to settle on the surface near a water tank, therefore:

3) Cut any tree down which grows within 8 metres from a tank.

4) Backfill the apron of soil around the tank before any rainy season, so that water will drain away from the tank.

5) Clean the trench draining water away from the tap station before any rainy season and ensure that water can run freely to the waste-pit in which sugar canes should be planted.

6) If the watertap does not function well, then have it repaired in good time before a rainy season.

7) If the tank leaks, then report it in writing to the programme immediately, so that the contractor can repair or seal it before he gets his final payment for building the tank.

8) Always keep the man-hole closed and locked so that animals and children cannot enter the tank.

9) If the tank runs dry for water, then use this opportunity to clean the interior of the tank with a brush.

WATER SUPPLY SYSTEMS

based on

RAIN WATER HARVESTING

RELIABLE WATER SUPPLY

Rain Water Harvesting can provide reliable water supply systems in all climatic regions, except in deserts with an annual rainfall below 100 millimetres
The techniques of rain water harvesting have proved viable in most climatic regions of the world over several thousands of years. The oldest known rain water harvesting systems functioned for two thousand years in the Negev Desert of Israel

FEASIBLE SOLUTION

In many regions of the world rain water harvesting is the only feasible solution to provide water supplies due to the problems of

- saline ground water,
- polluted rivers or lakes,
- high cost of drilling bore-holes and pumping groundwater up to the surface, and of pumping water from surface reservoirs through pipelines, and
- lack of qualified manpower for maintenance and management of mechanical water supplies, and foreign exchange to purchase spare-parts

SOUND ENVIRONMENTAL ASPECTS

Rain water harvesting is environmentaly sound because it collects and stores rainfalls where they precipitate, thereby reducing soil erosion caused by rain storms. Rainwater harvesting goes hand in hand with Soil and Water Conservation.

RECHARGE OF GROUND WATER

Some types of structures for rain water harvesting also act as recharge of ground water, which benefits recharge of shallow wells and bore holes

SUSTAINABLE DEVELOPMENT

Rain water harvesting is ideal for sustainable development because it consists of low-technology inputs which require only local skills and locally available materials for construction and maintenance.

COST EFFICIENCY

Compared to more advanced types of water supplies, rain water harvesting systems are the most cost-efficient to construct and maintain.

INFORMATION ON ASAL CONSULTANTS LTD.

Legal status

ASAL Consultants Ltd was incorporated as a Limited Company in Kenya in April 1990.

Objectives

The main purpose of ASAL Consultants Ltd. is to utilize the experience of seasoned advisers to assist development organisations and governmental departments in assisting the rural people of Africa in obtaining a higher standard of living.

Associations

ASAL Consultants Ltd. is associated with regional and international consultants with many years of experience in rural development.

Main activities

Most of our expertise is, however, concentrated on self-help activities on water programmes based on Rain Water Harvesting, and Soil and Water Conservation.

Clients

Since ASAL Consultants Ltd. commenced operations in 1990, it has carried out assignments on

- Appraisals,
- Reviews and Evaluations,
- Training,
- Production of Manuals,
- Site Surveys and Designs,
- Management

FOR:

- Danida in Kenya and Tanzania,
- SIDA in Kenya and Tanzania,
- Danchurchaid and LWF in Zimbabwe and Zambia,
- IRCSA in Kenya and Taiwan,
- Danish Red Cross/Kruger Consult A/S in Sudan,
- BTC in Botswana,
- MOA, KIDP and UNICEF in Kitui, Kenya

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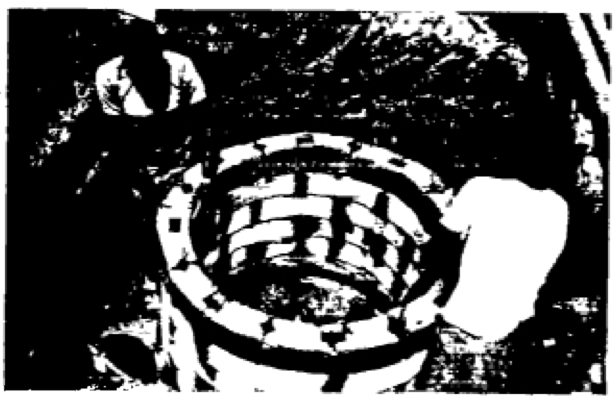
TYPES OF STRUCTURES FOR RAIN WATER HARVESTING

Water for households and livestock:

- Water Tanks and Jars.
- Earth Dams and Pans.
- Ground-water Dams (sub-surface dams and sand-storage dams)
- Rock Catchment Dams
- Shallow Wells and shallow hand-drilled boreholes.
- Spring Protections with gravity-fed pipelines.

A water tank (46 cu m.)

A ground water dam (1,000 cu.m)



A shallow well

A rock catchment dam (5,000 cu.m.)

Water for farming and forestry:

- Micro-catchments
- Macro-catchments.
- Flood diversion (spate)
- Soil conservation

A small earth dam (800 cu m)

Should your organization be interested in learning more about the benefits of using the services of ASAL Consultants Ltd., please do not hesitate to contact us.

We can give you a free quotation for a consultancy if you provide us with information on your objectives or on water-related problems.