UNITED NATIONS
DEVELOPMENT
PROGRAMME
Prepared by
Department of
Development Support &
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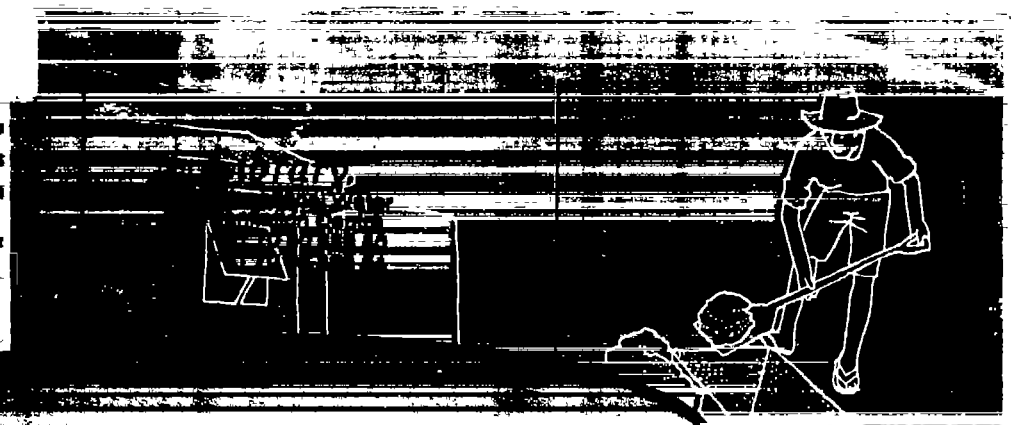

FERRO-CEMENT RAINWATER TANKS

English

and

Kiribati

RAS/92/304
KIR/87/006

UNITED NATIONS DEVELOPMENT PROGRAMME

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FERROCEMENT RAINWATER TANKS

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February 1994

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TE MONTAEKA

Te boki aei bon teuana mai buakon boki ake a katauraoaki ibukin buokaia taan mwakuri ake tabeia karekean te ran ao kain-nako-tari i bukia aomata ake a maeka i aon aba n te Betebeke.

Kairam nakon am makuri bon aikai:

- Katautaua te tabo are e na tau ibukin te tangke
- Katauraoa nnen te tangke
- Makena nnen te tangke
- Katea te booma ibukin te tangke
- Kabaouai ao korokoroi raoi biti ao warawara ibukin kamatoan te timanti
- Katauraoi ao kawenei baibu man te tangke nakon te taebu
- Wakina kaboan te timanti ae babaireaki raoi
- Wakina te buratita
- Wakina karaoan te taubuki
- Kakamaimai rabatan te tangke ibukin kamatoana, ao rabunna, n te maan aeitibong ni waerake, ao katiann mwakuri aika a uarereke

INTRODUCTION

This guide is one of a series of booklets designed to support practical training for those workers engaged in providing basic water supplies and sanitation for rural communities in the Pacific region.

The principal aims and objectives of this guide are to:

- Identify suitable sites for storage tanks
- Prepare the site for tank construction
- Mark out and set up the base
- Construct and erect tank formwork
- Bend and place reinforcement in position
- Prefabricate pipe connections
- Proportion and mix cement mortar
- Plaster tank walls
- Construct tank covers
- Cure tanks and complete ancillary works

(Words in *italics* are defined in the glossary at the back of this manual.)

ARONI KARAOAN TE TANKGE N RAN AE TE TIMANTI

1. Kanganga aika a reke nakon angin te botanaomata n te aono n Tebetebeke boniuarereken kawakinan te ran ae a maiuakinna, kioina bwa akean baina i bukin karaoana ma bon angia ke maitin te aomata ngkai, aika a maeka n taabo ni makuri (Tarawa ao Kauntira i Aonnaba) a boni kona n reke maiuia man te karau man taian kawawa n aia auti ae te kabwa taubukina ao a boni kawakinna n te tangke i bukin nimaia ao a maiti riki.

2. Te waaki ae kamanenaaki i bukin kanakoraoan kawakinan te ran ao aroia i bukin kawakinana.

a) Buburan taubukin - E na boni kona n te auti rawea te karau are e baka.

b) Kainikawawa - Tibatibakin te ma baibukarau man tetaubuki nakon tangke

c) Tangke - Taua te karau i nanon bakana i bukin kamanenana.

d) Baibu ao taian taps - I bukin kamanenana man taian tangke ao mani kabonganaaki raoi.

3. Te waaki aio e kona ni kabwarabwaraaki n aikai:

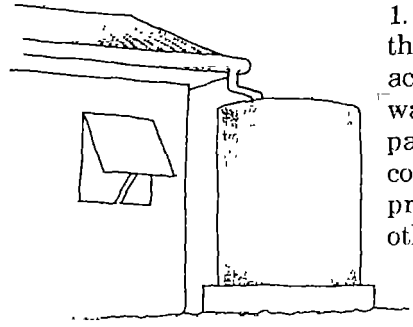
Te ran ae reke - Te ran ae nako = Rabatan te bwai are kawakina te ran (tangke).

a) Te ran ae e reke bon te karau ae e reke man taubukin te auti (te kaabwa).

b) Te ran ae e nako bon te karau are a kamanena taani bwaibwai.

c) Te tangke I bukin kawakinan te karau n te bwai teuana ae e na riai n reke bwa n aron ane e kabwarabwaraaki n (a) E boni bae n rereke n taai tabetai.

FERROCEMENT TANKS



1. A constant problem for many people throughout the Pacific Region is the lack of access to an adequate supply of safe drinking water. However, for many people and particularly those in rural areas, rainwater collected from roofs and stored in tanks can provide sufficient water for drinking and other uses.

2. This method is often referred to as a rain water *catchment* system and requires:

Roof Area	-Catches rain when it falls
Gutters and Down Pipes	-Pass rain from roof to tank
Tank	-Stores water when it rains so that it can be used when there is no rain
Delivery Pipe with Tap	-Allows stored water to be used carefully and safely

3. The system can be described as:

INPUT - OUTPUT = STORAGE

INPUT is the volume of useful rainwater from the roof.

OUTPUT is the volume of rainwater used by the consumers.

The STORAGE is needed because the input occurs at different times and rates from the output.

Aroni Karaoan te tankge n ran ae te timanti

4. Booki tabeua a karaoaki i bukin rabakau i aon karaoan ke kateitei i bukin kamanenaan te ran.
Aekaia:

a) Te Ran man te taubuki; taubuki tabeua; taian kata; ao taian baibu.

b) Tangke ae e kabwarabwaraaki i nanon te boki aei.

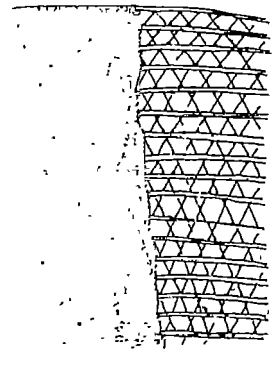
c) Mwakuri i aon taian baibu, te mwaake i bukin kawenean baibu, onean muin uruaki i aon taian taebu ao kainin nakon baibu.

Booki aikai a boni kona n reke man te Public Works Department ao te Regional Project.

5 Te boki aio e bon boboto i aon kabwarabwaraan te aekaki n tangke ae e na tabe ni wakinaki ngkai.

6. I nanon te waaki ao te tangke e boni kona ni karaoaki n aekakin karaoaia aikai.

- Te warawara ma te timanti
- Te timanti ma te biti/ae bitinaki
- Ae burikinaki ao buratitanaki
- Te kabwa ae kamronronaki
- Te aramanim
- Te biti ae tomatomak
- Te baibakirati
- E Buratitiki ke te rabwa



7. Te warawara ae timantiaki e bon nanonaki ikai bwa bon rabatan te biti ae uarereke n renganaki ma te timanti ni karika rabatan te tangke n te aro bwa e na boni kona n taua te rawawata ke rawatan te ran are i nanona.
Te warawara ae timantiaki bon rabatan te tangke ae tina tabe ni kamatebwaia aroni karaoana e a tia ni kaman wakinaki irouia tabeua aba i tinaniku i bukin kamanenana irouia i bukin kawakinan te ran ao riki n akean te karau bwa bon te tania.

I bukin teimaan rabatan te tangke a na bon riai n raraoi baina ao karaoakina raoi (ae e kabwarabwaraaki n te boki aei) te tangke e na boni kona n raoiroi i nanon 50 te ririki.

Ferrocement Tanks

4. A series of booklets have been prepared outlining the constructional techniques (and other aspects) of the parts of the system.
They are:

(1) Roof Catchments; Roof Coverings; Guttering and Down Pipes
(2) Ferrocement Tanks
(3) Plastic Pipework; Marking Out and Installing Pipework; Sanitary Plumbing; Repairing Taps and Valves

These booklets are available from the Public Works Department and the regional project in Suva, Fiji.

5. **This booklet deals with ferrocement tanks.**

6. In practice, tanks can be made from a variety of materials. The most common are:

- ferrocement
- reinforced concrete
- blockwork with cement plaster (rendering)
- corrugated galvanised steel
- zinc/aluminium alloy coated steel
- prefabricated metal sections
- fibre-glass (with metal rods)
- plastic or rubber lining
- prefabricated timber

7. Ferrocement refers to the use of fine wire reinforcement with a sand/cement mortar to form a thin layer which is resistant to loads, in this case, water pressure Ferrocement tanks have been in use in a number of countries for many years and subjected to varying climatic conditions.

Providing that good quality materials are used and care taken during construction (as outlined in this booklet) the life of the tank could exceed 50 years.

Aroni Karaoan te tankge n ran ae te timanti

8. E bon tanoata aroni bonganan ao karaoan tangke aikai bwa·

• e bebete aron wakinana ma bwain karaoana a kakaireke ao a boni kona ni karaoaki

• baina a boni kona n reke i abara n aron - te atama ao te tano.irouia aika akea aia atatai ngkana a kairaki.

• uarereken te kabuanibwai ni bwaina ngkai a boni kona n reke i abara i bukin karaiakia (ma e ngae n anne ao timanti i bukin baina a na bon kawakinaki ke titoanaki n te tabo ae mano man te mwaimwai).

• Raina ke rainibaoki n aekaia nako a boni kona ni manga kamanenaaki.

9. A na riai n tauraoi baina aikai ni kabane i bukin wakinana:

• Te rai i bukin rabatan te tangke, te baoki i bukin te katoto, te bentibwa.

• Te timanti, rengarenga, te ran, te rai ni kabobo.

• Te biti ni kabwaro, te warawara, te wire (uaea) i bukin te kabaebae, te warawara are kakamanenaki i bukiia mooa.

• Te tano, te atama, te raumea i bukin te tano.

• Te tiabora te burota te biti ao te kai ke te tireba.

• Te bwaketi, te kai ae eeti.

• Te ama, te kai ni katena, te boro kata, te tao, te unika.

• Te tape (ababaki), te neinei, te buram bob, te neinei i bukin te karai.

• Te buratitiki ae e roro.

(E na boni kona ni uarereke te kabo timanti ao maitia aika a na kabo timanti ngkana iai te mitini bukin te timanti).

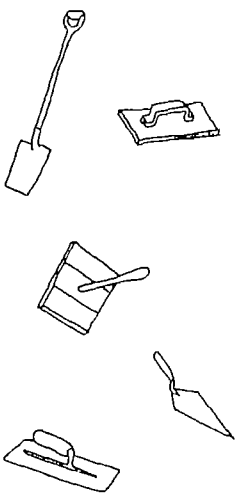
Ferrocement Tanks

8. Ferrocement tanks are becoming more popular because they:

- can be built using local materials - sand and aggregate
- require simple construction techniques involving basic hand tools and semi/unskilled labour
- are a cost effective method of construction.

In addition there can be:

- community involvement in the gathering of local materials and construction
- less chance of damage to non-local materials during transportation, however, cement must always be carefully stored and kept dry
- formwork if prefabricated, can be re-used.



9. The equipment and materials required to construct a ferrocement tank include:

- tank moulds, gauge box, pinch bar
- cement, additives, water, mixing board
- steel rods, mesh, tie wire, chicken wire
- sand, aggregate, sand sieve
- shovels, trowels, floats and *builder's hawk*
- plastic bucket, *slump cone*, straight edge
- claw hammer, pliers, bolt cutter, saw, chisels
- tape measure, spirit level, plumb bob, line level
- sacking or plastic sheets
- pipe and fittings

(If available, a concrete mixer will reduce the labour of mixing concrete and mortar).

Aroni Karaoan te tankge n ran ae te timanti

10. E boni maiti aron karaoan te tangke ae kabwarabwaraaki n te boki aei. Ma angiina a boni kona ni karaoaki n te rabwata teuana ae katotonga ke ni katea tamnein te tangke ae e na kona ni wakinaki i aona te buratita i nanona ao tinanikuna.

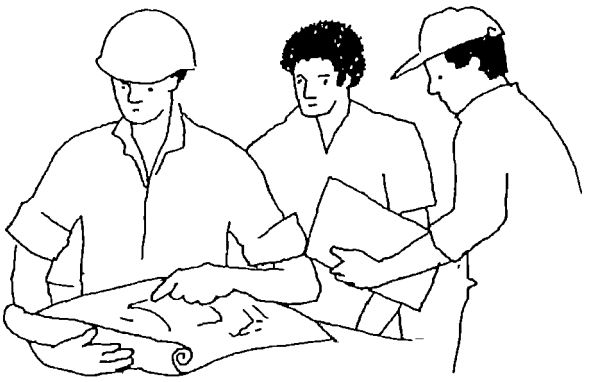
11. Buburan te tangke e bon nakon ana konaa temanna ma temanna ibukin baina ao bebeten karaoana.

Ti ngkana iai taian tamnei ibukin buburana ao e na boni konan iraki N akean taian tamnei ao e na boni kona ni kaira am iango te boki aei i bukin karaoana.

Ngkana iai am kanganga waekoa kaongoia aika a tabeakina te waaki aei ke temanna ae iai irouna ataakin te waki i bukin kairam n aron karaoan te tangke.

Te botaki ni kuakua tti, te botaki ni mwakuri ao iti, aika a tabe ma aei.

Ngkana akea am kanganga ao ko boni kona ni kamatebwaia tangke tabeua ao n ongora iroun te tia karaoia n te tabo ane ko kaan ma ngaia.



Ferrocement Tanks

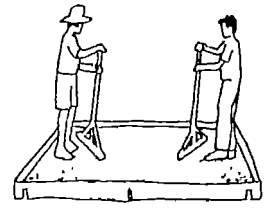
10. There are many ways of making ferrocement water tanks. Generally, they are built by forming a framework covered with a fine wire mesh which is plastered from both sides with a cement mortar.

11. The shape and size of a ferrocement tank varies considerably. It depends to a large extent on availability of materials and local conditions and practice.

Where there are local standards for design and construction these should be followed. Where there are no standards, this booklet provides guidance on the techniques of construction which should be followed. However, when possible, consult local health officials, builders or anyone who is in a position to offer sound, practical advice. If possible, examine tanks which have been built locally and consult the builders about the construction; what problems arose, if any, and suggestions for improvement.

12. I bukin karaoana ao aikai tabeua iango i main te waaki:

Buburan te tangke	-nakon buburan te taubuki ao maitin te ran i bukin maitiia aomata n te auti teuana (ke tabeman aika a na kona ni kabongana).
Kakaean te tabo i	-aki taun te tabo ribwariban bukin te tangke auti, ao ai tarakin te tano (kiribwabwa ke aomwaimwai).
Kateakina	-bwaina i bukin karaoana, kaboakin bwaina ngkana e tauraoi te mwane.



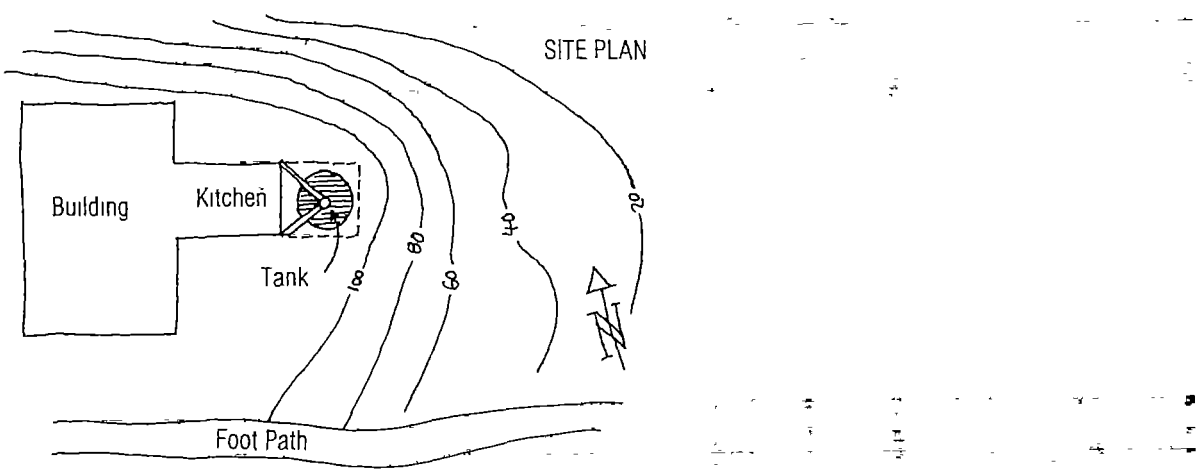
SIZE AND MATERIALS

12. Before construction begins, several important decisions must be made. They include:

Size of Tank - this is dependent on the available roof area, and the expected daily water consumption of the family (or other consumers)

Siting of Tank - this must be on level ground with a solid foundation and ready access to household users

Construction - this depends on what type of materials are available and must be of affordable cost



13. Te tangke ae e kabwarabwaraaki i nanon te boki aei, a boni mronron. I bukin ataakin kanoana ao ekona ni kaotaki n te warebwai aei:

Kanoana = .70 D^2H manπ (D^2÷4) x 0.9H

Kabwaraana: D = abwakin nanona/nanona ma nanona.

H = rietan tinanikuna/nano nako eta.

N araon aei:

Katautaua kanoan te tangke ae abwakin nanona 2.5 te miita ao abwakin tinanikuna ae 2 te miita.

(1 te miita = 3.28 te buuti)
(= .70 x 2.5^2 = 8.75 m^3)

N aron aei: 1 cubic miita = 1,000 litre (220 kaaran)
Kanoana = 8,750 riita (1,925 karau).

I bukin am kan atatai i aon maitin te karau ae kona ni kamanenaaki n teuana te bong:

Maitina/ Kabonganaki	Kawakinaki n te bongina
25 te riita n te bongina	350
50	175
100	87
200	43
300	29

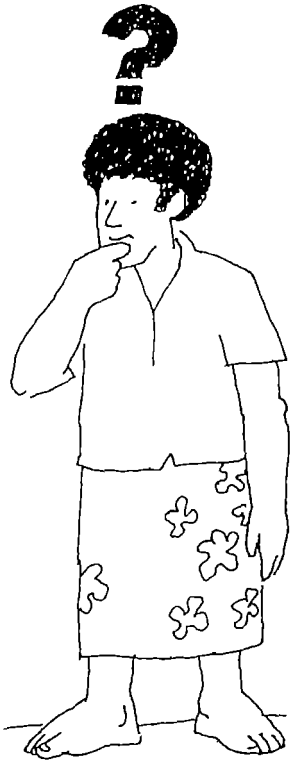
Ae e tau i bukin temanna 50 te riita n te bongina (200 te riita = 4 aomata).

Size and Materials

13. Ferrocement tanks described in this booklet are circular. Their storage capacity can be calculated from the approximation:

Capacity $= .70\ D^2H$ from $\pi D^2 \div 4 \times 0.9H$
where,
D = internal diameter of the tank
H = external height of the tank side wall

This makes some allowance for the position of the draw off from the tank and the overflow.



For example:

- Calculate the capacity of a tank of internal diameter 2.5 metres and a side wall height of 2 metres.
  (Note: 1 metre = 3.28 feet)

$C = .70 \times 2.5^2 \times 2 = 8.75$ cubic metres

As 1.00 cubic metres = 1,000 litres and as 1,000 litres = 220 Imperial (or U.K.) gallons, then :

Capacity = 8,750 litres (1,925 U.K. gallons).

Note: To convert litres to U.K. gallons , 1.00 u.k. gal. = 4.55 litres and to convert litres to U.S. gallons, 1.00 u.s. gal = 3.78 litres.
Allowing various daily *consumptions*, a tank of 8,750 litres would provide water for storage depending on consumption as follows:

Consumption	Storage Days
25 litres per day	350
50 "	175
100 "	87
200 "	43
300 "	29

A suitable personal allowance would be 50 litres per day (i.e. 200 litres for 4 people).

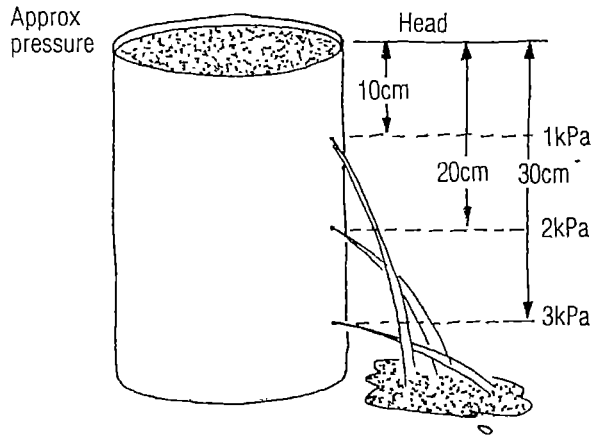
14. Teuana te riita ao rawatana bon teuana te kilogram. Ngkana 1,000 te ruta bon ti tebo ma 1,000 te kilogram, ke teuana te tan (tonne).

Okirikaaki nakon ara moan katautau are i maina ae, 8.75 cubic miita rawatana ngkanne bon 8.75 tan (tonnes).

I bukin rawatan te ran e bon nakon rietan te ran ke te nano ao e aki kangai, bwa i bukin tein rabatan te tangke bwa e mronron ke e tikuea. Te rawawata e boni katautauaki n aron aei (KPa).

Te nano ae teuana te miita (mai i eta) n te ran e katautauaki bwa 9.81 KPa rawatana n te nano anne.

N ataakina ikai i bukin te rawawata e katautauaki boni mai i nano nakon rawawatan ao nanona i bukin korakoran oon te tangke ao nakon naba te base.



15. N aron maitin kanoan te tangke i bukin rietan aon rarikina ao rababan nanona a na bon riai ngkanne ni kabonganaaki bwaai aika a raraoi nakon rabatan te tangke.

Ma e ngae n anne ao rietan te tangke ke te rietata e bon baireaki mai i aontano nakon te kata, i bukin butin te ran (karau).

I bukin tangke aika a tia ni wakinaki e na bon rangi ni bongana aron katamaroakiia i bukin rietaia ao i bukin rababaia i bukin kakaokoron kanoaia.

Size and Materials

14. One litre of water weighs one kilogram Therefore, 1,000 litres weighs 1,000 kilograms which is also 1 tonne.
Thus from our previous example, 8.75 cubic metres weighs 8.75 tonnes.
(Note: 1 kilogram = 2.20 lb.)

Water exerts a pressure which depends on its depth below the surface of the water and not on the shape or size of the tank. Pressure is measured in *kilopascals* (kPa). To convert to pounds per square inch: 6.9 kPa = 1.0 psi.

A 1 metre depth (or head) of water exerts a pressure of 9.81 KPa at that depth It can be seen that the pressure on the side wall increases with depth to a maximum at the bottom of the wall which also applies to the base.

The tank has to be designed to resist this pressure. In the case of the ferrocement tank, it is the reason why there is additional reinforcement at the bottom of the wall in comparison with the top and why a separate base is provided under the tank.

15. In theory, for a particular tank capacity, the best use of materials is made when the internal diameter and side wall height are the same. However, the height is often controlled by the distance between the ground and the rain water gutter.

When a number of tanks are being built, it is generally best to standardise on the diameter and adjust the height to provide different volumes.

16. Ngkana arona bwa e a tia ni karaoaki ke ni koreaki tamnein te tangke ae e na wakinaki ı bukin rietana ao rababana ao bwaina a na bon riai n tauraoi man te tamnei i bukin wakinana. I bukin nakoraoia a na waki i bukin te kabane mwane ı aon bwaina, ma katautau; i bukin te bao ao n raonaki naba ma te tia mwakuri e na bon nako naba i aan am kataumwane, ngkana e riai.

Table 1

QUANTITIES AND ESTIMATES

FERROCEMENT TANKS

Nominal Volume·	cu. m	12.0	8.4	9.0	5.4
US gallons	us gal	3170	2200	2380	1430
UK gallons	uk gal	2640	1850	1980	1190
Nominal Diameter Internal	m	2 50	2 50	2 50	2 50
" Height External	m	2 60	1 90	2 00	1 30
" Wall Thickness	m	0 05	0 05	0 05	0 05
Main base thickness	m	0.10	0 10	0 10	0 10
" " length of side	m.	2 90	2 90	2 90	2 90
Mortar (1 2) for tank	cu m	1 57	1 27	1 33	1 03
Concrete (1·2 4) for base	cu m	0 84	0 84	0 84	0 84
Sand (moist)	cu m	2 64	2 24	2 32	1.93
Aggregate	cu m	0 78	0 78	0 78	0 78
Cement	tonne	1 45	1 25	1 30	1.05
Waterproofer (febproof)	litres	14 3	11 6	12 1	9 4
Length of 4 mm wire	m	327	245	262	196
" 1 6 mm tie wire	m	18	13	14	10
Area of chicken wire	sq m	52 5	44 8	49 1	36 8
Area of FG2 mesh	sq m	8 7	8 7	8 7	8 7
20 mm pipe	m	1	1	1	1
20 mm tap adaptor	No	1	1	1	1
20 mm tap	No	1	1	1	1
20 mm elbow (90° bend)	No.	3	3	3	3
Labour-craftsman	man days	4	3	3	3
" -unskilled	" "	11	10	10	8
* Tractor and trailer	hours	6	5	5	4
* Concrete mixer	"	7	6	6	5
* Vibrator	"	1	1	1	1

Size and Materials

16. Once the size of the tank has been established, a materials list should be prepared. A good list details the quantities of materials that are needed to build the tank and may also include information on labour and plant requirements.

Table 1
QUANTITIES AND ESTIMATES
FERROCEMENT TANKS

Nominal Volume:	cu. m	12.0	8.4	9.0	5.4
US gallons	us gal	3170	2200	2380	1430
UK gallons	uk gal	2640	1850	1980	1190
Nominal Diameter Internal	m	2.50	2 50	2 50	2 50
" Height External	m	2 60	1 90	2 00	1 30
" Wall Thickness	m	0.05	0 05	0 05	0 05
Main base thickness	m.	0 10	0 10	0.10	0 10
" " length of side	m.	2 90	2.90	2 90	2.90
Mortar (1.2) for tank	cu m	1.57	1.27	1.33	1.03
Concrete (1.2.4) for base	cu m	0.84	0.84	0 84	0.84
Sand (moist)	cu m.	2 64	2 24	2 32	1 93
Aggregate	cu m	0.78	0 78	0 78	0.78
Cement	tonne	1 45	1 25	1.30	1 05
Waterproofer (febproof)	litres	14 3	11 6	12 1	9.4
Length of 4 mm wire	m	327	245	262	196
" 1 6 mm tie wire	m	18	13	14	10
Area of chicken wire	sq.m.	52.5	44 8	49 1	36 8
Area of F62 mesh	sq.m	8 7	8.7	8 7	8 7
20 mm pipe	m	1	1	1	1
20 mm tap adaptor	No.	1	1	1	1
20 mm tap	No	1	1	1	1
20 mm elbow (90° bend)	No	3	3	3	3
Labour-craftsman	man days	4	3	3	3
" -unskilled	" "	11	10	10	8
* Tractor and trailer	hours	6	5	5	4
* Concrete mixer	"	7	6	6	5
* Vibrator	"	1	1	1	1

Table 1 gives relevant details for tanks associated with individual housing. It is important that all materials are available on site prior to starting and that the necessary labour, small tools, equipment and plant have been arranged The last three items marked with an asterisk (*) are optional - they would normally be used on large projects where many tanks are to be built in each location. An engine-driven concrete mixer has the advantage of providing a thorough and consistent mixing and can help to keep the water to cement ratio low enough for high strength concrete (when mixed by hand there is sometimes a temptation to add too much water in order to ease the effort of mixing a good stiff batch of concrete). Vibrators can be used to help distribute the concrete in the base; however, careful tamping and rodding can achieve the same effect of getting a dense concrete by eliminating any voids (gaps or holes) and getting all corners fully filled

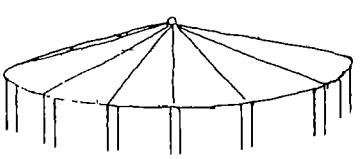
17. A kona n aki kabonganaaki aekaki n rengarenga i bukin renganam timanti ao aroni manenaia ae e na kabwarabwaraaki n aron aei:

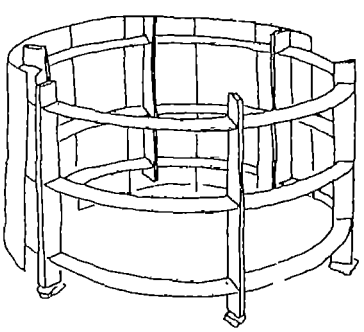
Febproof equivalent - i bukin tukan roronakon te ran n te timanti ao e bon rangi ni manena naba ngkana e aki nakoraoi raoiroin ke korakoran te tano (te tanobwai).

Ngkana arona bwa a na kamanenaaki aekakin rengarenga aikai ao e na bon riai aron kabwarabwaraana i aonaba. A na raiai n aki kamanenaaki ngkana akea aron kabonganaana i aona, irouia taan karaoia.

18. I bukin wakinan tangke aika a titebo aroia ke ti te aekakina teia are nanona bwa a na aki kakaokoro, ao e riai ngkanne ni karaoaki te rai ni kabwaro (formwork) ae e na manga kona ni kamaenakoaki ao ni manga kateaki naba n ti te arona ma are e karaoaki.

I bukin wakinan aon tangke, bwaina i bukin wakinana n aron taian kaintautau ao bwaina tabeua i bukin rabwatana aika a na kamanenaaki ao ni manga kona naba ni kamaenakoaki a na riai n tauraoi.





Size and Materials

17. Whilst tanks can be built without using additives with cement, there are advantages in using water proofing additives.

One which has been used with good results in Tuvalu and Kiribati **febproof.** This water-proofing compound serves to reduce the permeability of the finished mortar and to increase the workability of the mortar so that it is easier to mix and apply even with a low water to cement ratio. It is an emulsion, or organic ester, combined with a lignin-based water-reducing agent and it does not contain chlorides or nitrates, or trap air bubbles.

Where an additive is used, the manufacturer's instructions should be followed. Additives should not be used in combination without first consulting the relevant manufacturers.

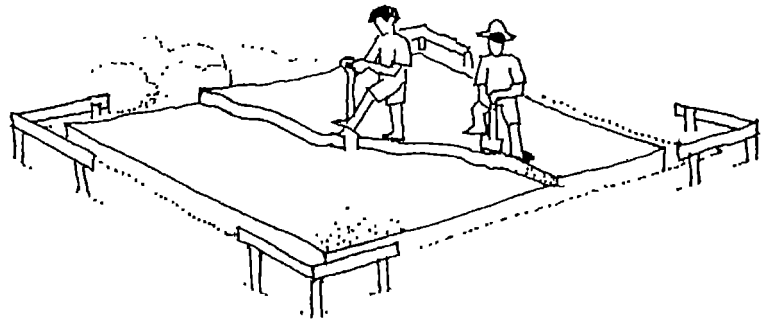
18. When producing a number of identical tanks, prefabricated permanent formwork should be made and used. It should be easily put together and taken apart.

NNENA: KARAOAN NNEN TE TANGKE

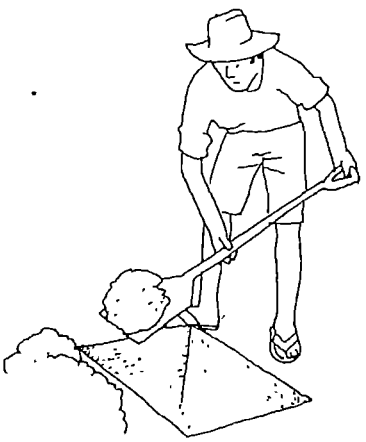
19. I bukin tein ke aekakin rabwatan te tangke ae e a tia ni katautauaki ma nnena n tei, e na riai moa ni karaoaki te tutuo i aon raoiroin te tano i bukin te rawawata, bwa n tabo tabeua iai ae tanotano, ao iai naba ae e aomwaimwai ao ni maraurau. I bukin aei ngkanne ao kena te marua ae uarereke ao taraia bwa e na bon anganiko aekakina, ao katautaua i bukin rawawatan te tangke ni ikotaki ma rawatan te ran bwa e na kona n taua te rawawata ke e aki.

20. I bukin aki raoiroin te tano, ao manga kakaea te tabo teuana ae e na tau. Aio bon te mwakuri teuana ke te waaki ae e raoiroi i bukin tei manin am tangke.

21. Ngkana arona bwa e a tauraoi nnena ao kaitiaka taiana maange ao aroka aika a tutuki i bukin wakaia ao tabeua mange (e oti n makoro 30). I bukin te waaki ni makuri e riai te mwawa i bukin karaoana.



THE SITE & MAKING THE BASE



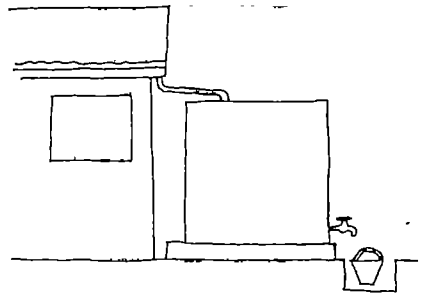
19. Having decided on the type and size of tank to be built and its proposed location in relation to the building, check that the sub-soil can support the weight of a full tank. By digging a small trial hole it can be seen if the ground is soft or swampy. If the ground is unstable, a lot of work will have to be done to build and ensure a strong foundation and base for the tank.

20. If the results are poor, find an alternative site if possible. The preparation of a solid foundation and base is one of the most important aspects of tank construction.

21. Having decided on the site, clear away all vegetation and other rubbish (see paragraph 30). Space is needed for the tank together with adequate room in which to work.

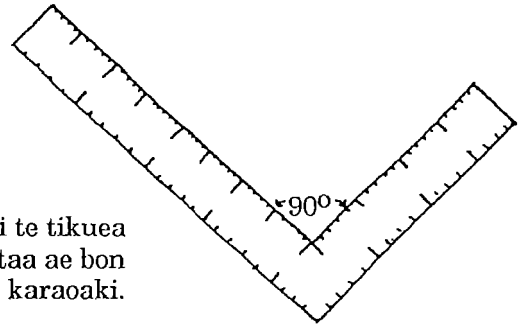
Nnena: Karaoan nnen te tangke

22. Rietan te tangke e na katautauaki ma rietatan te kawawa (gutter) ao i bukin naba te baibu ni kawawa i bukin bararana nakon te tangke Te kaokoro e na bon ririki man rietan te kabwaro are e toka iai te tangke. E na riai naba ni katautauaki rietana i bukin mwawan te bwaketi i aan te taebu (tap)



23. I bukin mwakenan te kabwaro ao uniki 3 te beke ni katoa koona ao katikuea. Ao man taian beke aikai ao e kona n anganiko ngkanne rabwatan ke buburan te kabwaro. Man am beke ao kaneineia are ngaia ai bon am mwaake naba i bukin rietata.

24. Raubwabwa aika a na neranaki man te beke a bon aranaki bwa taian kai ni mwaake are e kaota rietan te kabwaro nakon te neinei ae e a tia ni mwakenaki.

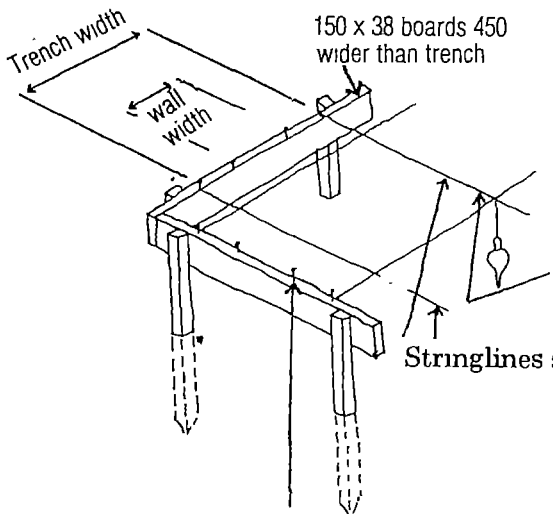


25. I bukin ataakin ae e a tikuea ao iai te tikuea teuana ae aranaki bwa aia tikuea kabentaa ae bon 90° ae rabwatana bon te kai ae e karaoaki.

The Site & Making the Base

22. The distance between the gutter and the ground should be measured and compared with the height of the tank plus an allowance for the down pipe system. The difference is the maximum height of the tank base above the ground. It is better to elevate the tank so that buckets can be placed under the outlet tap, to draw off all the stored water in the tank.

23. To set out the base, roughly measure the size on the ground. At each corner outside of this mark, drive in 3 stout pegs at right angles (90°) to each other. To these pegs, boards are nailed. The top of the board corresponds to the finished height of the tank base.



24. These boards are known as *profiles*. On top of each board the exact position of the tank base is marked.

Plumb bob showing position of trench

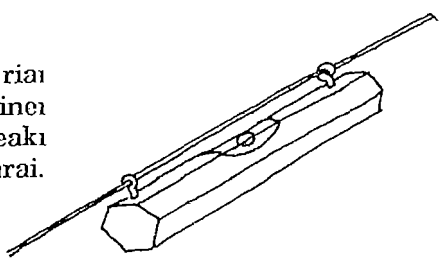
Stringlines showing trench width

Profile boards supported with pegs

25. To check that the profile boards are exactly at 90° to each other at the corners, a builder's square is used.

26. I aon am kai ni mwaake ao uniki 1 neera n tian am mwaake ao katika am karai nakon am neera. Tuoa bwa e tikuea ke e aki. Tuoa te koona nakon te koona, ao e na bon anganiko bwa e bobuaka ke e boraoi te mwaake.

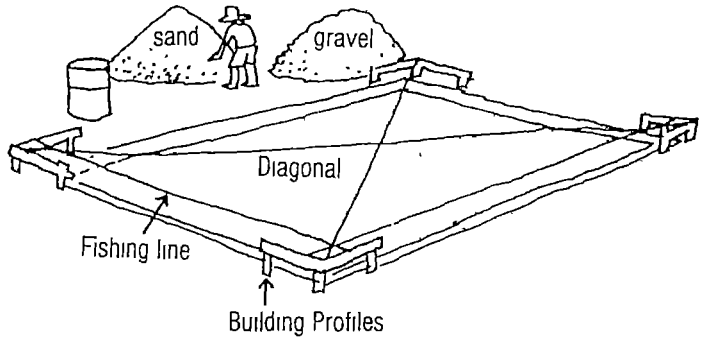
27. Ko na riai n tuoa am kai ni mwaake bwa a na riai ni bane n neinei, ao tuoa n te neinei ke te neinei teuana ae e uarereke ae e boni kona ni katineaki nakon te karai.



28. Te waaki teuana i bukin tuoan te neinei bon te ran. Ane e nanonaki ikai bwa bon te ran i nanon te baibu ke te ooti te buratitiki ae ko na konaa n nora rietan iai te ran ao e boni kaota te neinei, e boni karaoaki aei i bukin akean te neinei i nanon am tai ni waaki.

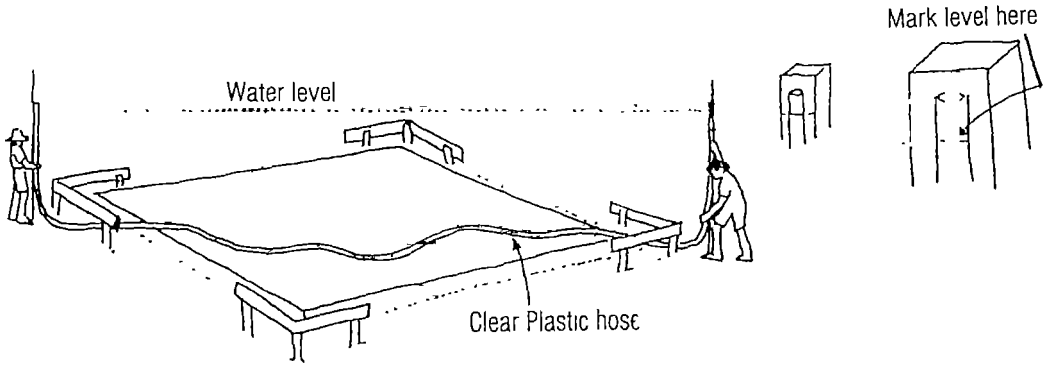
The Site & Making the Base

26. On top of the profile, partly drive in a nail, to which a string line is attached. Run the line around all 4 profiles. To check that the base is square, measure the diagonals. The measurement from corner to corner should be the same.

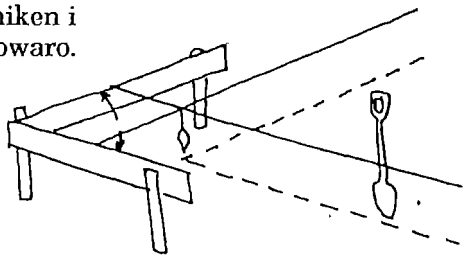


27. Using a line-level attached to the string line will indicate whether the profiles are set to the same height.

28. Another method that can be used to establish the height of each profile is the water level. As water finds its own level, by filling a suitable length of clear plastic hose pipe with water, it can be easily seen at what height the other profiles must be fixed to be level with the first one.

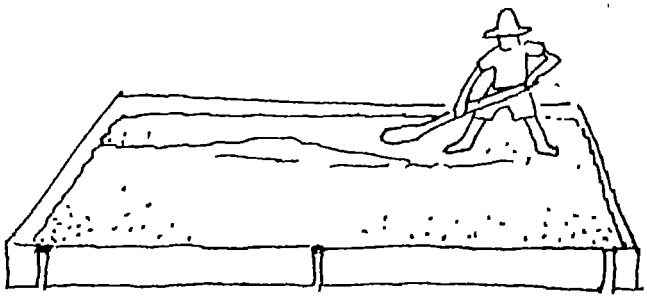


29. I muin tian am waaki ao e kona ni waaki te keniken, ao katınca te buram baobu ni katokoa i aontano ke te neinei te biti ao e na bon anganiko te mwaake ae e koaua ı bukin buburan am keniken i bukin te kabwaro.



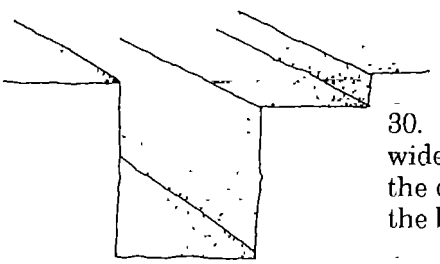
30. Buburan ke rababan am keniken bon 300 mm (1 te buuti) ae e na booraoi ni kenna ae e na kabwaroaki 150 mm (6 te inti) rikaki i bukın te rawawata.

31. E karaoaki aeı bwa aontano i boni ıai ae e maraurau ao ni kona ni karıka te raeuaki nakon taian kabwaro ma ngaıa ae kanoa nanon ae e a tia ni kenaki n te atıbu ae e na bon ribonobono i bukin te rawawata.



The Site & Making the Base

29. To transfer the building line from the profile to the ground, suspend a plumb bob or use a spirit level. This shows exactly where the foundations for the base will have to be excavated.



30. Excavate the foundation trench 300 mm wide and 300 mm deep. Remove any topsoil to the depth of 150 mm over the whole area of the base.

31. Where the ground may not be firm enough to support the weight of a full tank, extra ground will have to be excavated and replaced with hard fill such as broken stones, coral or gravel.

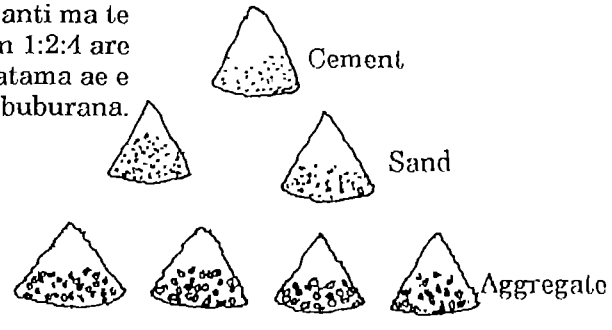
32. N te tabo are e katautauaki man mronron oon te tangke, bairea nnen te ran ibukin are e na nako mai iai. Katautaua te raroa ae 300 mm man te baibu ae 20 mm ao ni kabaoua man anne. Ngkana iai ae e katauaki ibukin te ran n nako ao e na boni karaoaki naba n teuana te tai. Tara naba te kibu 67 i nano.

33. I bukin nikiran am rietata nakon am kabwaro kanoaia n te tano ao kaibea ni kamwaimwaia ni katautaua matenin am kabwaro ao katauraoia nakon te kabwaro.

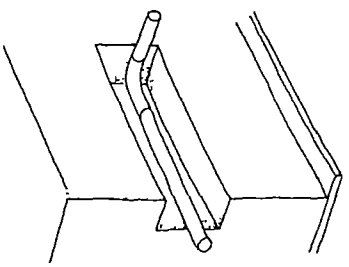
34. Katautaua matenin am kabwaro nakon aon am karai ke te raubaba 100mm (4 te inti) ao kawenea te meti uaea (warawara) ao katautaua bwa e na mena raoi i nukan am kabwaro nanona bwa 50mm (2 te inti) mai i eta.

35. I main ae kona waaki ao tuoa raoi bwa a na tauraoi bwaina ni kabane ao maitin te tia mwakuri ae e na tau n te aro bwa e na aki tokitoki te waaki.

36. A bon tatannako taian kabo n te timanti ma te kabo ae e na kamanenaaki i aon aei bon 1:2:4 are nanona bwa 1 te timanti 2 te tano ao 4 te atama ae e tau buburana.



The Site & Making the Base



32 From a suitable point within the planned circular wall of the tank, prepare a shallow trench to the outside of the base to a point where outlet will discharge. Lay a length (about 300 mm) of 20 mm pipe with bend and upstand within the trench. (If a drain is provided this should be placed at the same time). See also clause 67.

33. Allowing for the foundation strip, backfill the remaining area of base with suitable clean *hardcore* to a depth of 120 mm from the top. Compact this with a tamper. Spread sand over the base, rake it smooth and compact it using the hand tamper.

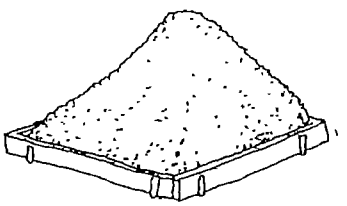
34. With the level of sand 100 mm below the top edge of the base, place steel wire reinforcing mesh (or bars) to cover the top of the base. Raise the mesh using small stones to a height of 50 mm above the sand.

35. Before mixing and placing concrete in the base and its foundation, check that you have available the quantities of materials, small tools and labour that you require.

36. A suitable mix for the concrete is 1:2:4 which means 1 part cement, 2 part of sand and 4 parts of aggregate (gravel). Previous experience with ferrocement tanks in the South Pacific where a leaner mix was used (e.g. one part cement to three parts sand) has shown a tendency for the tanks to leak and require frequent repair. For similar reasons a water proofing additive is also recommended (see para 17 above regarding this).

37. I bukin aei ao e bon kona ni karaoaki te baoki ni kabo ae buburana 300 x 300 x 300 ke 1' x 1' x 1' ae e karaoaki taningana i bukin tabekana irouia uoman, ke 250 x 250 x 250 ke 10" x 10" x 10" i bukin temanna te aomata.

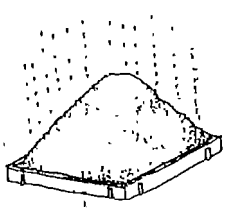
38. E na tauraoi am rai ni kabobo ao kabwaroa am mwaiti ae e na tauman taian baoki ake a karaoaki ao kaboboa i main ae ko na renganna ma te ran. Kabongana te kabo are kabwarabwaraaki mai i maina 1:2·4



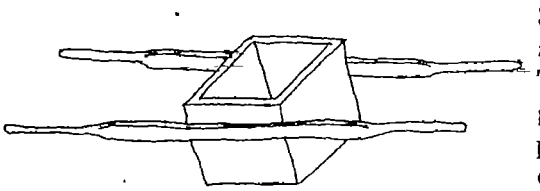
39. Kaboboa ma te tiabora ni karokoa ae ko taku bwa e a tau boona ma e na aki ran te kabo. E na kuarerekea te makuri te timanti ni kabo ke te mitiin ni kabo.

40. A riai ni kanoaki taian keniken i nanon maimain te kabwaro ao ni waetata naba ni karokoaki nakon te rieta are e katauaki iai.

41. I bukin korakoran ao teimatoan te timanti e riai te tano ma te atama n tebotebokaki ke ni kanakoaki taian taoro mai iai ke ni katukaki i aan te karau i nanon te maan ae 2 te namakaina i main ae e na kamanenaaaki. Kamaenakoa i aontano nakon te maten ae 100 mm (4 te inti) i bukin waekoan nakon te taoro



The Site & Making the Base



37. To produce a consistent and uniform mix all materials should be measured by volume. This can best be done by using a wooden gauge box measuring 300 x 300 x 300 mm and provided with handles for ease of lifting and carrying by 2 people

38. Fill and empty the gauge box onto the mixing board, with 1 box of cement, 2 boxes of sand and 4 boxes of aggregate.

39. Using a shovel, the dry mix should be turned and mixed thoroughly before adding water. Add only enough water to form a thick pasty mix. A concrete mixer reduces the manual labour involved.

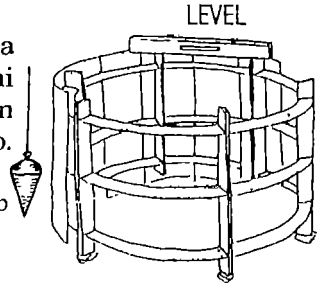
40. The concrete should be poured into the base and its foundation trench as soon as it is mixed. The wet concrete should be *tamped* down and smoothed off to the required height as measured down from the profiles.

41. It should be noted that sand and aggregate used for construction purposes must be clean and free of salt or other impurities. If beach sand or aggregate is used, spread it out to a depth of 100 mm and wash it thoroughly. Alternatively let rainwater *leach* out the salts for a period of at least 2 months before using.

KARAOAN TANGKE: NGKANA IAI TE BOOMA

42. Taian rai ni kabwaro ake a tia ni katauaki i bukin rabwatan te tangke a na riai ni kateaki ni nneia. Rai ni kabwaro i bukin aei a na bon raiai ni kateaki mai nukan te kabwaro. N taai nako ao tuoa man tokin maken am kabwaro nako nuka.

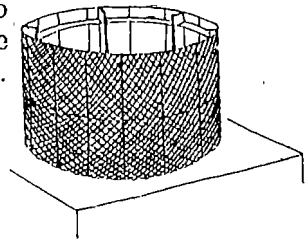
43. Ngkana arona bwa ko nang karokoa ke ni katia am neinei i bukin tein am tangke ao ko kona ni kabonganai atibu ni karorokoa am neinei i bukin tein am tangke, ke taian rai ni kabwaro.



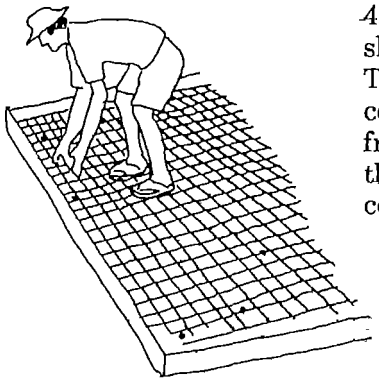
Plumb line and bob

44. I bukin te rai ni kabwaro ao a bon tatannako aroia. Tabeua taian rai a na riai ni kabiraki n te oera i bukin bebeten kamaenakoaia i bukin manga karaiakiua, i bukin kamanenaia i bukin tangke tabeua.

45. A tatannako buburan taian tangke, ao te warawara e niniraki ni katobibia te bubura anne tao uoua rinanin te warawara ni kaea rietan te tangke are e katautauaki iai.



MAKING THE TANKS: STANDARD FORMS



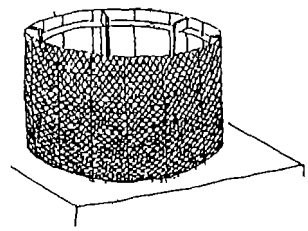
42. If standard forms are available, these should be assembled and moved into position. The formwork is then placed directly over the centre of the base. Check this by measuring from the outside edge of the square base to the formwork. It should be the same at the centres of each side.

43. With the formwork assembled and in position, check the *plumbness* and level. Use small stones to adjust the bottom of the formwork to make it perfectly straight.

44. Depending on the formwork material, the outside surface should be lightly oiled (i.e. timber and sheet metal). This helps to separate the formwork from the concrete (or mortar) once it has set. If formwork is oiled, all traces of oil should be removed from the face to be plastered.

45. Depending on tank size, a single or double layer of galvanised (chicken wire) woven wire mesh is wrapped around the formwork and tied in place with tie wires. Over the wire mesh a number of galvanised steel hoop wires are placed . Alternatively, a single length of wire is wrapped in a spiral.

46. I bukin matoan ke tauan raoi te warawara ao boni matoan naba te tangke e riai ni manga aonaki aon te warawara anne n te uaea ae buburana tao 3 mm ae te karawanaiti (Galv.).



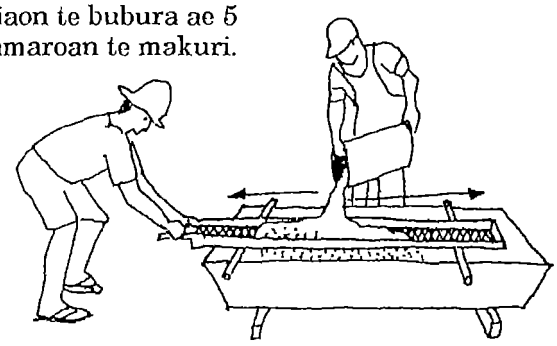
E aonaki aon aei mai i nano ma e na bon okoro marangana ni kabwarabwarana n aron aei:

- Mai i nano te maranga 15mm nakon te rietata ae 500 mm
- Mai i aon anne te maranga 30 mm ni karokoa te rietata ae 900 mm
- Nakon tokin te rietata te maranga bon 40 mm

47. N tian nirakin te uaea ae e a tibwa tia ni kabwarabwaraaaki ao uringa bwa a na bon riai ni boraoi marangaia ao man raoiroi naba taraaia, ao man kabaebaeaki ma te warawara n te maranga ae e katautauaki 500 mm. Te uaea e na bon riai ni katikaki raoi ibukin tauan ao matoan te warawara ibukin te mwanunu.

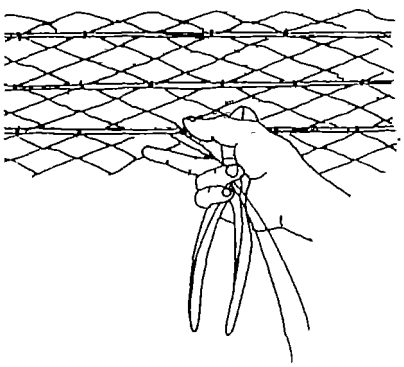
48. I nanon tian raoi am waaki i aon aei ao uringa ni kaitiaka raoi rarikin te tabo are e na waaki iai am tangke i bukin te buratita ao i bukin te makuri n te timanti.

49. Te tano i bukin karaoakin te tangke aei e na bon riai n raumeaki, e na bon aki riaon te bubura ae 5 mm i bukin tamaroan te makuri.



Making the Tanks: Standard Forms

46. Starting from the bottom of the tank form, the steel hoops should be spaced 15 mm apart for the first 500 mm. From this point the spacing can be increased to 30 mm between hoops, until within 900 mm of the top of the tank. From here to the top the spacing increases to 40 mm. (The distances between adjacent hoops applies to the single wire spiral).



47. The hoops should be *parallel* to each other and tied to the woven mesh with tie wire at about 500 mm in the horizontal spacing The hoops should be tight and the joins in the wire must be staggered. The hoops can be *kinked* to tighten them firmly in place

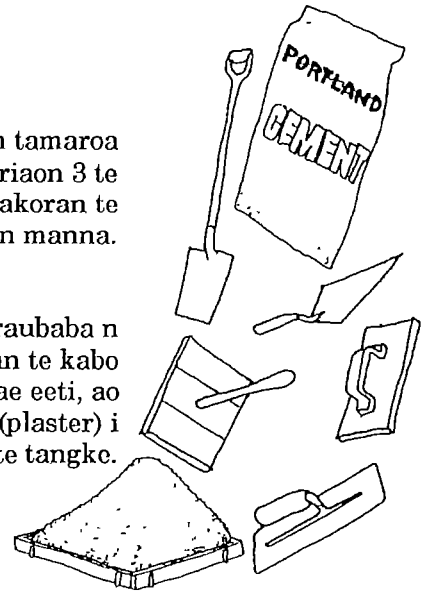
48. With all the reinforcement in place the whole area should be thoroughly cleaned in preparation for trowelling mortar onto the tank form.

49. Sufficient clean sand should be sieved through a screen with an opening of not greater than 5 mm. This removes larger stones and other waste material.

Karaoan tangke: Ngkana iai te booma

50. A na tauraoi ni kabane bwaai i bukin am waaki n aron aikai: te turam 44 gal, ao te baketi naba i bukin te kabo, ngkana e nang waaki kabirakin rabwatan te tangke.

51. Te timanti ae e na kabonganaki e na bon tamaroa n aea te kiri buabua mai iai ao e na bon ai riaon 3 te namakaina manna i bukin raoirom ao korakoran te tangke i bukin manna.

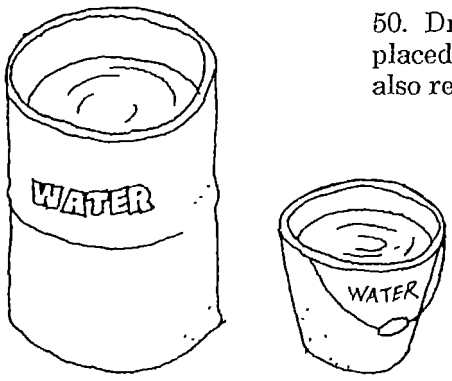


52. I bukin te kabo ao e riai n tauraoi te raubaba n aron aei te plywood ke te aramanim i bukin te kabo timanti ao taian tireba, tiabora, te kai ae eeti, ao bwaai tabeua i bukin te waaki ni buratita (plaster) i aon te tangke.

53. I bukin te waaki ao a tatannako taian kabo i bukin te timanti ma i bukin te tangke riki i aon te buratita te kabo e na bon riai n 1:2 ao e na riai naba n tauraoi bwaina n aron te bwaketi i bukin te baa ke te baoki teuana ae e karaoaki ma a na titebo aroia i bukin kanoaia.

54. Kaboakin te timanti e na bon riai moa ni kaboboaki i nanon manna. Te tano ao te timanti n renganaki n te kabo ae 1:2 ae e taekinaki mai i maina ao i muina e na riai n roko te ran. Uringa bwa iai te rengarenga ae e na riai nakon te timanti mai iai katautauaia ae e makoro i aona. N aki otam ao kakaea buokam i bukin renganana. Te timanti e na riai n aki maimai ke e na riai n aki titi.

Making the Tanks: Standard Forms



50. Drums of fresh, clean water should be placed near the mixing area. A clean bucket is also required for use when mixing the mortar.

51. Bags of *Portland cement,* which should be free of lumps and not more than 3 months old, should be stacked near the mixing area and covered with a waterproof sheet.

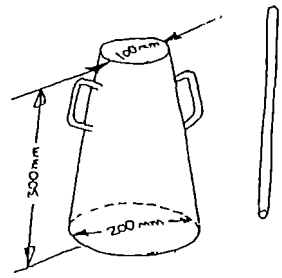
52. A large flat platform is required for mixing the mortar. Shovels, trowels, floats, a builder's hawk and timber straight-edges should be provided to mix, place and plaster the mortar onto the tank form.

53. To produce mortar of a consistent quality, a gauge box should be used. If a 1:2 mix is specified, then 1 levelled box of cement and 2 levelled boxes of sand are heaped onto the mixing board.

54. The heap of sand and cement should be dry mixed first. A hole is then made in the centre of the heap, and small amounts of water added to the mix. Continue turning the heap with shovels, adding water until the desired consistency is reached. The mortar should be firm and fatty. Too much water produces a runny mix and cannot be trowelled onto the form without falling off. If used, the waterproofing agent should be added during mixing or as instructed by the manufacturer.

Karaoan tangke: Ngkana iai te booma

55. Tuoan te kabo i aon te timanti e kona ni kabonganaaki te tin ae e uarereke matana mai i eta ao e bubura rikaaki ae e mronron. Kanoaia n te timanti ao kaibeibea ma te makoro ni biti tao 10 te tai ao manga kanoaia ni karokoa ae e on nako matana, ao n tiana ao buta te tin ao ngkana e na anaaki rietana i bukin te mwaimwai.

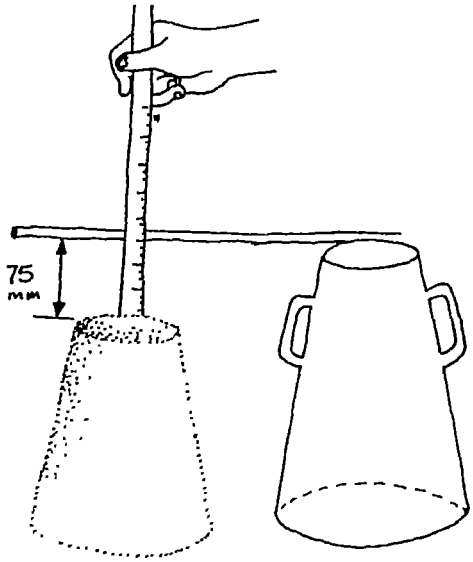


56. Te tua i aon aei e na riai te kabo i muin anaakin rietana. Katea te tin are e baanaki iai te timanti ao katautaua ngkanne ke a na abwakina mai i aon te tin arei, ma e na riai nikee i ana 75mm - 85mm. Ngkana e rietata ao nanona ngkanne bwae e na tangira te ran teutana, ma ngkana e kee i aan te mwaake ao nanona bwa e mwaimwai te kabo. Ngkana arona bwa iai rengarenga aika a kabonganaaki ao e kona n aki tauaki baana.

57. Ngkana arona bwae e a tauraoi i bukin te waaki muin tuoakina ao buratitana te tangke n aron are ko ataia ke ongora mairouia taan karaoia. I bukin tauakin te mwaimwai ao karekea te baeki ae te kunikai ao kamwaimwaia ao kavenea i aon te timanti are a kabonganaaki i bukin raoiroina.

Making the Tanks: Standard Forms

55. To control the consistency of the mix, a *slump cone* should be used. A metal cone is placed on a flat board, and half filled with mortar. The mortar is rodded 10 times with a piece of steel rod. The cone is then filled and rodded again, before levelling off the cone. The cone is then lifted clear from the mortar and the slump is measured.

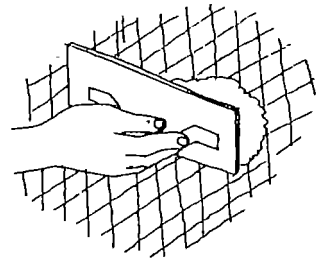


56. The measured slump should be between 75 to 85 mm. If less, add more water to the mix. If more, use less water. With practice it should not be necessary to test every mix particularly if consistent volumes of materials are used.

57. Once the correct slump has been obtained, commence plastering the mortar around the tank form. Use all the mortar within 1/2 hour of mixing, otherwise it will become unworkable. Place a wet sack over the pile of mixed mortar to prevent it from drying out too quickly.

58. Kabongana te burota te biti ke te burota te kai i bukin te buratita I bukin bebeten am mwakuri i bukin bwakabwakan te timanti karaoa te raubaba ae iai bwain tauana mai i aana ao ririmuin am buratita i bukin mwawana. I bukin te moan waaki ao uringa bwa e na aki raka i aon 15 mm maten te buratita ni katobibia.

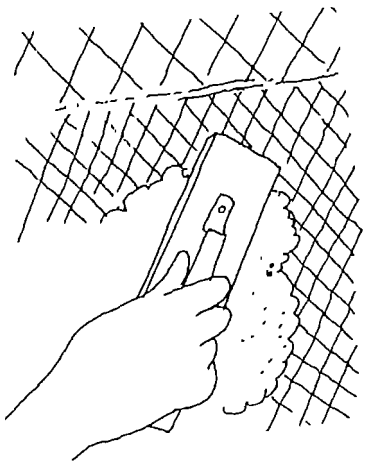
59. Buratina te moan buratita are e katokaaki ngkana e a kaan mwau i bukin manga nimn te kauoua n toka, n te uaca buratı ke te burum. Kaboa te kauoua ni kabo ao taraia bwa e na aki raka matenna naba ı aon 15 mm:



60. Tuoa matenin te buratita ma te kai teuana are a katauaki i bukin tuoakin te eeti ao te tabukibuki. Ngakana iai aki nakoraoin te buratita ao e na bon oti n te kai arei.

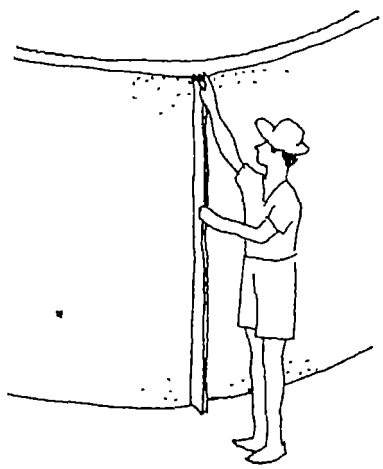
Ngkana e a tia am kabubuti ao wakina te katamaroa ma te tireba te biti i bukin maranranna.

Making the Tanks: Standard Forms



58. The mortar is applied by hand to the walls of the tank using a plasterer's steel float and builder's hawk A layer of mortar not exceeding 15 mm is trowelled onto the formwork from the base of the tank upwards just covering the reinforcing wires. Continue on and around the tank, plastering on the first layer of mortar.

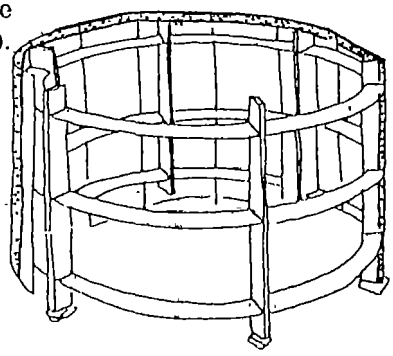
59. When the first layer of mortar has hardened sufficiently, scratch and roughen the surface. This provides a key for the second layer of mortar. Mix a new batch of mortar and plaster on a second layer. The thickness of this layer should be 15 mm.



60. Using a straight edge, check the thickness of mortar between the bottom and top of the tank. Strike off any high spots. After the mortar has hardened slightly use the steel float to smooth the surface.

Karaoan tangke: Ngkana iai te booma

61. I muin 24 te aoa ao kamaenakoa taian raubaba i bukin te tangke mai ı nanona ma taraia bwa e na aki reke te uruaki i aon rabwatan te tangke. Ao manga kaitiaka muin te timanti ı aon te raubaba ma baina nako i bukin manga kabonganaakina nakon te tangke teuana (ni ırekereke ma No. 44).



62. I bukin buratitanakin nanona e na riai te moan toka 10mm matenna ma e na riai n tau mwanna i bukin manga tokan te kaaua ao te kanimaua ae matenna 10mm nakon 15mm. Ma e na rial ni maranran n te aro bwa e na kai reke rinakon te ran ao e na kabuakaka ke ni karana te tangke.

63. Rabuna rabwatan te tangke n te baeki ke te buratitiki are a e roro i bukin tauan mwauna bnwa e na waekoa ni mau. E kona naba ni kabonganaaki baan n te banana, te banni ao tabeua riki aika a na kona ni katana rabwatan te tangke inanon te maan ae 2 te wiki. Aio i bukin ae e na tei maan te tangke.

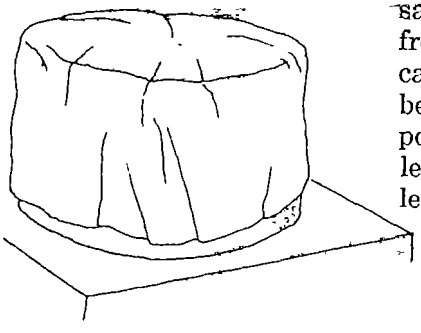
64. Manga kaboa te timantı i bukin te toma i nano ao karaoıa nakon tinanikuna ao nanona naba ma taua atenna tao nakon 100-125 mm rauniia rabatan te tangke.

65. E na karaoaki aei naba nakon te floor are mai i nanona i bukin bonon raoi matan te timanti i bukin te raran.

Making the Tanks: Standard Forms

61. After 24 hours the mould can be carefully stripped and removed from inside the tank. Care must be taken not to damage the wall in any way. Clean the mould for the next tank (in accordance with paragraph 44).

62. A 10 mm layer of mortar is then plastered around the inside of the tank and allowed to harden sufficiently before plastering on the fourth and final layer of 10 to 15 mm. This layer should be trowelled to a smooth finish.



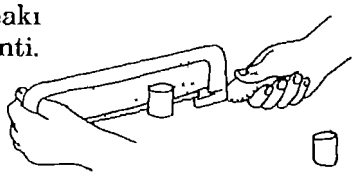
63. The tank should be covered with wet sacking or polythene sheeting to prevent it from drying out too quickly which would cause cracking in the walls. The walls should be kept damp by moistening under the polythene or by keeping the sacks damp for at least two weeks. Materials such as banana leaves can also be used.

64. A batch of mortar can be mixed and placed as a fillet at the junction of the base and outside of the wall.

65. Another batch is produced and placed inside the tank to form the floor 50 mm thick. Care should be taken to compact the mortar and form a watertight joint between the wall and floor of the tank.

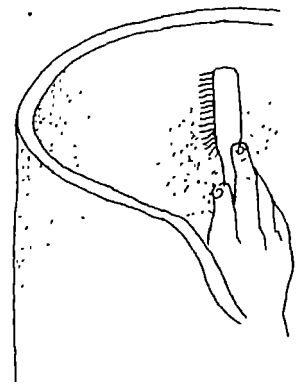
66. Kabooa te timanti ma te ran i bukin beniakin nanona ao tinanikuna ao matenna 2 - 4 mm.

67. Te baibu are e tiki nakon te taebu e na rial n rinenako mai i aon te timanti 50 te mm ao ngkana iai te baibu i bukin kaitiakan nanona e na riai ni koreaki ni kaboraoaki ma aon te timanti.



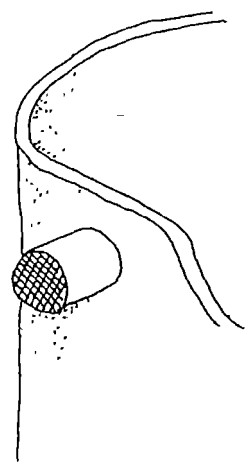
68. Mai i eta ao katautaua buburan te baibu ae 50 mm ao mwaakenna ao koreia mai i eta n te koro titioro (cold chesel) i bukin ataakina bwae e aon ao buokan naba onraken te tangke. Raraoana mai ieta 50 mm are e na bon neinei raoi iaan taubukin te tangke. Kanimwa te warawara i bukin te maninnara. Tabon te baibu ibukin taonakon te ran man te tangke e na bon riai ni warawara are mai itinaniku.

Making the Tanks: Standard Forms



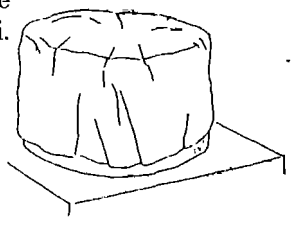
66. To effectively seal the tank, a 2-4 mm coat of *cement slurry* (cement and water), should be brushed or wiped over the internal and external surface of the tank.

67. The delivery pipe should extend 50 mm above the floor surface. If provided, the drain pipe (or washout) should be cut off flush with the floor.



68. Cut a piece of 50 mm PVC pipe, long enough to be used as a tank overflow. Decide on the position for the overflow and cut a hole down from the top of the tank, through the tank wall. Provide the overflow level about 50 mm below the top of the wall. Carefully break out the cement and cut through the reinforcing. Fit the pipe, and cement it in place. The end of the overflow outside the tank should be screened with insect mesh.

69. I buakon mwakurian rabatan te tangke aei ao te bwai teuana ae moan te kakawaki ke ae e na riai n ataaki bwa bon aron matoana. Ngkana e roko ni mwauna te tangke ao ke timanti ao e na bon iai te raeuaki nako iai, ma e kakawaki ao e riai n ataaki bwa e na riai ni mwamwaimwai ao man naba inanon te maan ae 2 te wiki.



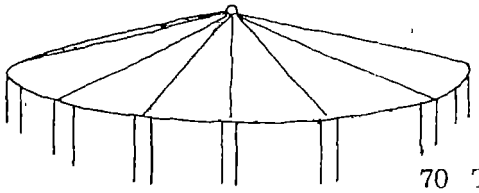
70. I nanon tian rabwatan te tangke ao wakina te taubuki ni bwaina aika a tia n tauraoi, ao maten te taubuki 50 te mm. Ma e na bon riai naba ni wene te warawara ao te uaea are e karaoaki nakon rabwatan te tangke.

71. Aron karaoan te taubuki ke teina e na bon riai n rietata mai i nukana ao e a bwatete naba nako rarikina. E aki bati n tamaroa are e borababaua. E riai aei i bukin bwateten taian mange ao e totokoa naba tiin te ran mai i aon taubukin te tangke.

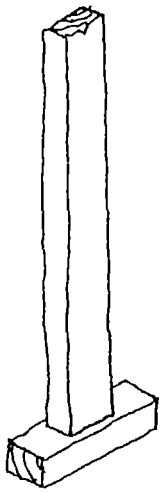
72. Iai taian kai aika a karaoaki i bukin te taubuki, ao lai naba taian kai i bukin totokoana mai i aana i bukin kamatoana. Te ueeti te kai i bukin te 2.karokoroko nakon te rieta.

Making the Tanks: Standard Forms

69. An important part of ferrocement tank construction is in the curing of the tank. As cement dries out it shrinks and cracking occurs. It is essential that the wall and subsequently the roof be kept damp and shaded for at least two weeks.



70 To complete the tank, the roof formwork is prepared and assembled, on which reinforcing mesh and wire are laid and plastered with 50 mm of mortar.

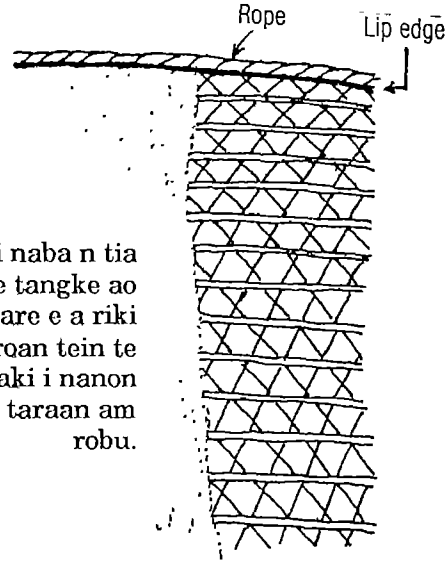


71. The shape of the roof should be domed, as this type of structure is stronger than a flat roof. It also sheds rainwater and dirt from the top of the tank.

72. The roof formwork is supported by using timber props placed inside the tank. Sliding wedges under the props are used to adjust height differences.

73. Te bwangabwanga e na riai naba ni karaoaki mai i aon taubukin te tangke i bukin kaitiakana ao manga karaoana, ma e na tau buburana i bukin temanna te aomata.

74. Uringa bwa e na riai n nim te warawara nakon te bwangabwanga aei i bukin tukan taian mange tabeua ao te bwangabwanga aei are e butimaea naba te ran man taubukin te auti.

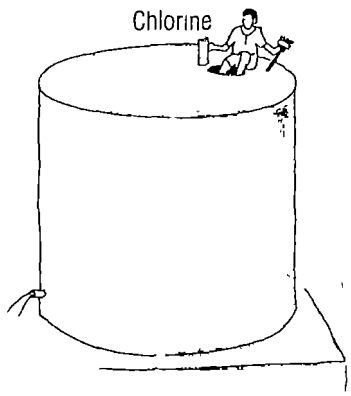


75. I muin tian raoi te taubuki ao e na riai naba n tia buratitanakina. I tinanikun rabwatan te tangke ao ninira te roobu ae buburana 20 te mm are e a riki naba bwa ai te rain naba ao katamaroan tein te taubuki. E na kabwarabwaraaki i nanon mwakuriana. Ma uringa bwae e na neinei taraan am robu.

76. Te tangke i muina ao e na bon riai n aki kanoaki i muin tabeua te bong ao e a tibwa kona ni kanoaki. Te katautau i aon aei bwa 1 te namakaina i muin tiana ao e a tibwa roko ni matoana ao e a kona ni kanoaki. Tabeua tangke a kai uruaki ke n raran bukina bwa e tuai n roko ni matoana ao e a bon kanoaki nabani kaonaki. Ma te kantaninga i aon aei bwa i muin 7 te bong ao ko boni kona ni kakanoaia 300mm n te rietata ni katoa bong i bukin naba maitorona ao kamatoana. Uringa ni kakamanoa te tangke man taai i bukin matoana, ao kakamwaimwaia.

Making the Tanks: Standard Forms

73. A *manhole* is cast into the top of the tank. The manhole should be large enough to allow a person to gain access into the tank, for inspection, cleaning and carrying out repairs.



74. The manhole should be screened to prevent insects or dirt from gaining access to the tank. The opening is also used as the discharge point for the rainwater.

75. After the tank top has been plastered, the internal joint between the top of the tank and the roof should be completed. Externally a lip edge can be made by tying a length of 20 mm rope around the top edge of the tank. The rope is then tightened and levelled and mortar plastered around the rope. On setting, the rope is removed so leaving a straight edged joint.

76. The tank should be progressively filled over a number of days to allow the stresses within the tank walls to be distributed over the whole structure. **It takes approximately one month for the ferrocement to reach its full strength.** Many tanks fail because they have been filled with too much water too soon. Remember, keep the outside walls covered and damp, while adding no more than 300 mm per day to the water level of the tank. Filling should start 7 days after the removal of the roof formwork.

KARAOAN TANGKE: NGKANA AKEA TE BOOMA

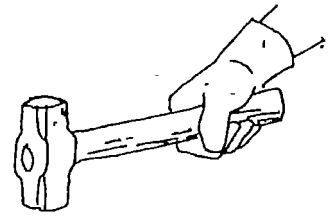
77. Te waaki teuana aio are e bon aki kabonganaaki iai taian raubaba. Te tangke e kona n tei rabwatana man taian biti ni kabwaro ao n niniraki n te warawara ao e buratitanaki ni kauaitera nanona ao tinaniku.

78. Rabwatan te tangke n te waaki aei e bon kateaki man taian biti ni kabwaro ae buburana 10 te mm ni katotonga rabwatan te o te uaea. Te anga teuana, te meti uaea e kamronronaki ao e tomaki. Te meti uaea mai i aona ngkanne e bon ninıraki n te warawara ni kamatoaki raoi.

79. I bukin aei ao te base ke te tımanti are e nā tekateka iai te tangke e na riai n tauraoi n aron are e a tia ni kabwarabwaraaki. E bon nakon rabwatan te tangke ma buburana. Unika te kai ke te bitı i nukan raoi te buroa ao kamronrona te bubura are e baireaki n te makoro n rai ke te karai, n aron ae e na kona n ataaki bwa nukan te tangke D/2 ae e kabwarabwaraaki man te biti are e unikaki i nukan te tangke.

80. Man te mronron are e a tıa ni mwakenaki ao uniki tabeua taian biti ae kabaouaki nako nanon te kabwaro ae buburana 12mm bwa ai tauan naba rabwatan te tangke. Man taian biti aikai ao kabaebaea te biti ae kona katautaua i bukin am rıetata, ao aio are e na kona n taua rabwatan te tangke ma te kabwaro.

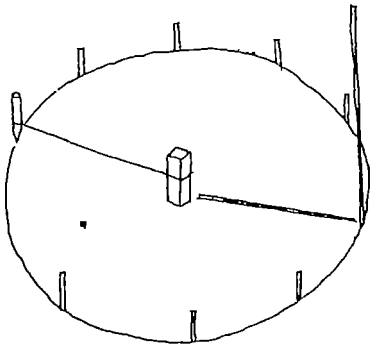
81. I nanon te waaki i bukin kakaeakin am biti i bukin te tangke uringa bwa a na riai n raraoı taian biti n aron aeı: e na riai n eti, e na riai n akea te rara i aona, kaıtıakia n te uaea burati ma e na tamaroa riki kabonganaan te biti ae te karawanaiti (galvanized rod).



MAKING THE TANK: FREE FORMS

77. This method of ferrocement tank construction does not require the use of moulds. The tanks are built by forming a framework, covered with a fabric of fine wire mesh, which is plastered from both sides with mortar.

78. The framework is constructed from 10 mm reinforced rods in the form of a cage, around which hoops of reinforcing rod are tied. Another method is to use welded mesh. The sheets are curved and tied together to form a cylinder and fine chicken mesh wire wrapped and fastened to it.



79. For free form tank construction, a solid foundation and base should be built as previously described. Depending on the diameter of the tank to be built, a stake is driven into the exact centre of the tank base. A peg is attached to a piece of rope, the length of which is equal to the radius of the tank D/2, is scribed around the stake and marks out a circle.

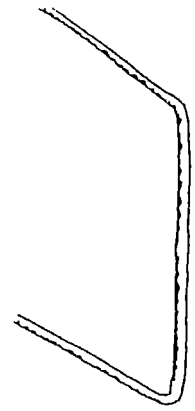
80. Around this circle, a number of 12 mm bent reinforcing *starter bars* are driven into the base. The vertical reinforcing rods are then wired onto the starter bars. This securely fixes the tank to the base

81. In selecting and using reinforcing bars and rods for tank construction, make sure that they are straight and free of rust or scale. Chip and wire brush off any rust and straighten the rods before cutting and bending, or alternatively use galvanised bars.

82. E kona ni karaoaki tamnein te mronron i aon te benti, ma e na riai te bubura ke buti aika a uarereke ni unikaki i aon te benti 3 maitina i bukin buokam ni kamronron, ao e na boni kona n anganiko te baoua ke te mronron ae tamaroa. E kona ni korekoreaki biiti aikai n te borokata ma e na bon raoiroi riki ke e na tau naba te taoi i bukin te biti.

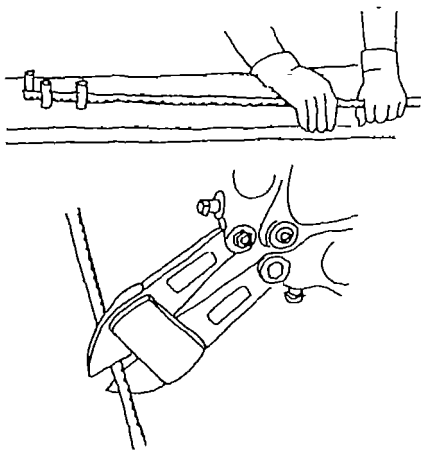
83. I bukin uarereken taonaban am biti n anaakin raoi abwakina. Kataua raoi am abwaki, a na riai naba ni manena taian mwakorokoro.

84. I bukin bwaouan biiti ake a teirake ao a na riai ni bwaoua ake mai i nano ao a na kaitibo i nuka ao mai i eta e na boni bwaoua naba ma e na kaea tein te taubuki i bukin te barara ma a na toma naba i nuka.



85. I nanon katean am uaea ao iai te uaea ae kamronronaki i bukin tuan taian biti akana a teirake. E kona ni bibitaki buburana ma e na aki uarereke nakon 5 te mm. Kabaebaea te biti ane e mronron ao kabaea ma te biti are e teirake n te uaea ae e irariki i bukin matoana.

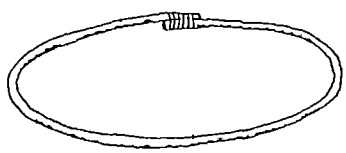
Making the Tank: Free Forms



82. A simple jig can be made by fitting 3 short pieces of 25 mm rod into a thick board. Accurate bends and offsets can be reproduced on the bending table. Cutting of rods is best done by using compound action bolt cutters. Alternatively a hacksaw can be used.

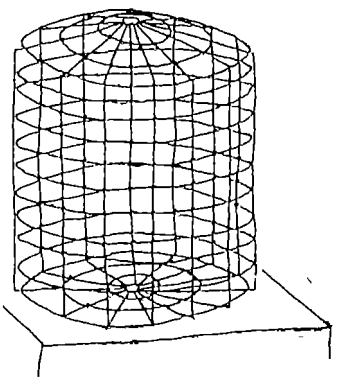
83. To minimise wastage of reinforcement, carefully measure all lengths and utilise any off-cuts in the fabrication of the form.

84. Bend the vertical rods to shape with the bottom pieces long enough to meet at the centre of the tank. The bends at the top of the tank should correspond to the angle of the tank top.



85 Circular hoops of different diameters or sizes should be formed and placed on the bottom and top of the tank The reinforcing rods and hoops are then tied together using soft tie wire.

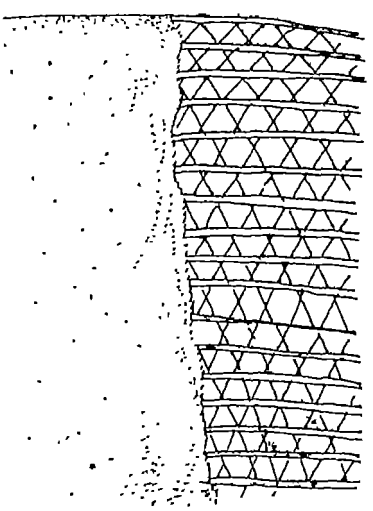
86. Tabeua taian biti akana a mronron a bon tauaki ke ni kabaeaki ma akana a teirake, ma uringa bwa a na aki raka marangarangaia nakon 300 mm. Kabongana te kai ni katena i bukin te uaea bura tauan taian biti.



87. Ni karaoakin aei ao uringa bwa a na riai ni bane n neinei am biti ao i mwina a nang rauniaki n te warawara. E bebete riki ngkana ko katia raoi aron am rabwata i main nirakina n te warawara.

88. Ninira 2 ke 3 te warawara ae e na katokatoka n aron ane e oti mai i eta ao kabaea te warawara n te uaea ae e na kona n taua te warawara.

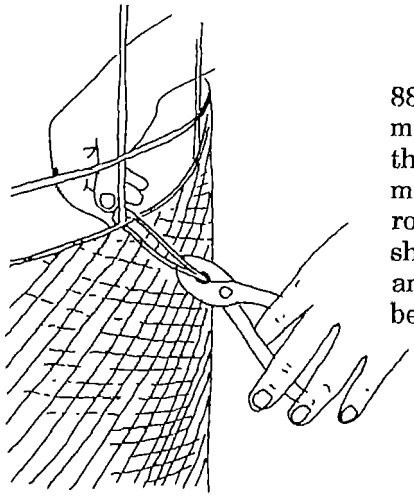
89. Katauraoa te kabo i bukin te buratita. Te moan kabo e na waaki kabirakina n te tai ae ti teuana. Temanna e waaki mai i tinaniku ao temanna e waaki mai i nanona.



Making the Tank: Free Forms

86. A number of hoops are formed and tied around the outside of the vertical form. These should be spaced no more than 300 mm apart (in the vertical). At each intersection securely wire the rods together using a pair of pliers and soft tie wire.

87. At this stage carefully check each joint and use a spirit level to check that the form is plumb and square. It is easier to make minor adjustments to the tank form before the wire mesh is fixed in position.



88. Wrap 2 to 3 layers of fine chicken wire mesh around the steel cage and secure it to the steel bars with soft tie wire. The wire mesh is extended up and over to cover the roof form. Carefully cut out the manhole shape and tank overflow. The manhole frame and overflow pipe are positioned and secured before plastering the tank.

89. Prepare and mix the mortar as previously described. The first layer should be plastered onto the wire mesh from both sides at the same time. One operator works from inside the tank while the other plasters on the mortar from the outside.

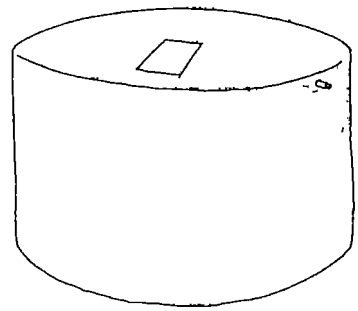
Karaoan tangke: Ngkana akea te booma

90. E na bon ni manni te booma i bukin aei ma e na riai te karaurau ke n taraaki raoi bwa e na aki uruaki te buratita i main ae e na mwau raoi. Te moan toka e na riai ni mwakerekere teutana i bukin nimn raoi te kauoua n toka ma e na aki riaon teuana te aoa ibukin mauna ngkana e nang toka te kauatoka.

91. Wakina te buratita ni kauatabo mai i nanona ao tinanikuna n te tai ae ti teuana. Kabongana te burota te biti i bukin tararaoina ke ni kamaranna. I mwin 24 te aoa n tian te buratita i aon oon te tangke ao e na riai ni waaki katiakin raoi te buroa (floor). A na riai ni mano raoi taian biti ni kabaro, ao maten te timanti e na waakinaki ni karokoa te maten ae e katauaki, ma e na riai n tamaroa ke ni maranran.

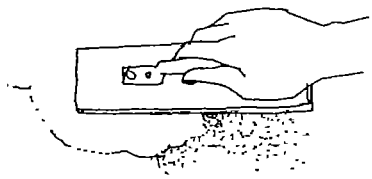
92. N tian raoi te tangke ao rabuna aona n te baeki ae e mwaimwai i nanon **7 te bong** ma uringa ni kakamwaimwaia n taai nako i bukin raoiroina ao matoana.

93. Ngkana e a bobonga raoi aron te tangke ao te taubuki ke aon te tangke e na riai ni beniaki n te mainaina n tuka korakoran taai nakon rabwatan te tangke ao e na bon bucka naba tamaroan ke mwaitoron te ran i nanon te tangke. Kabongana te been ae e na tau i bukin aei.



Making the Tank: Free Forms

90. Initially the wired cage or form feels rather flimsy. Care must be taken not to dislodge the mortar during the first hour before it has set. The first layer should be left in a rough state to provide a key for the next layer.



91. Plaster on a second layer to both the inside and outside of the tank. Using a steel float, trowel this to a smooth finish. After 24 hours the floor of the tank can be finished off. Mortar is passed through the manhole, spread over reinforcement to the required thickness and trowelled to a smooth finish.

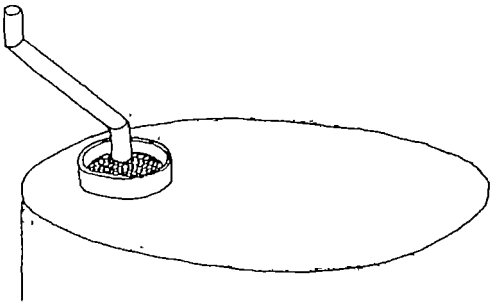
92. When complete, cover the tank with wet sacking and allow it to cure for **at least 7 days** before gradually filling it with water and keep the outside of the tank covered with wet sacking during the gradual filling process.

93. With the tank completed, the outside surface can be painted white as this will reflect the heat away from the tank, cooling the stored water. Use a vinyl base paint or whitewash.

KAWAKINAN TE RAN BWA E NA ITIAKI

94. I bukin kawakinan te karau ao e riai ni kamanoaki ao tararuakai raoi. Taian kawawa a na riai ni kakaitiakaki riki nakon taabo aika a mangaongao n te kai i bukin te mange.

95. Te baibu are man te kawawa e boni karokoa te ran nakon te tangke ma e na riai ni mano te bangabanga are i aon te tangke n te warawara ae e na kona n taua te mange, ma te mange ane i aona e na boni kakaitiakaki naba.



96. I bukin rababan taubukin auti n taabo aike e karako iai te karau, ao bon iai te kanganga ae aki toki n reke ni kaineti ma te bareka. Ngkana e tiba bwaka te karau ao e bon korakora te bareka n ira te ran nakon te tangke are e na bon karika buakakan te ran .

97. Ngkana e aki kakaitiakaki te kai-ni-kawawa n taai nako ao e bon kona ni kaitiaki nakon kanoan te tangke. Ni karaoan aei ao e riai moa ni karekeaki ana Kaota te Tia Mwakuri n te Mweraoi bwa tera te bae e riai ni kaitiakaki iai te tangke anne.

98. Te karau are e reke man te rau bon iai boia are bon boin te baa-ni-kai ae bwata ao are e na bon karekea te ran ae bareka man memea ranna. Ngkana ko tangiria bwa e na itiaki te ran anne ao karaua raumeaia n te raumea te-ing ke te mamata E ngae n anne ao e bon korakora kabonganan te aro aei n aron te katei.

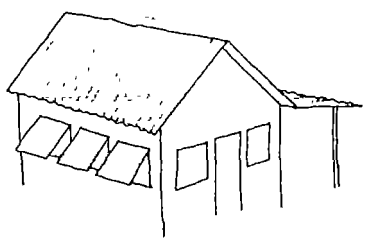
KEEPING WATER CLEAN

94. Every effort should be made to safeguard and protect the stored rainfall. Gutters should be cleaned regularly, especially where shaded by trees.

95. The rainwater downpipe should discharge into the tank over a screen installed in the manhole. Rubbish collected on the screen should be cleared away regularly. As an alternate a large mesh screen may be placed at the top of the downpipe where it leaves the gutter and a fine mesh screen can be placed where the water leaves the downpipe and enters the tank.

96. For large roofs in areas of infrequent rainfall, the accumulated dirt and rubbish on the roof presents a problem. With the first rains, the dirty water enters the tank and could contaminate the supply.

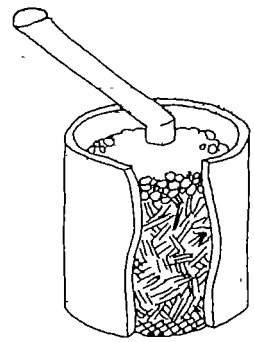
97. If the gutters and tank screen are not cleaned regularly it may become necessary to clean out the tank. In such an instance, advice should be sought from the health authorities as to the type and quantity of chemical to be used in the cleaning process (chlorine is widely available and commonly used).



98. Rainwater collected from thatched roofs may sometimes smell of decomposed leaves and have a yellowish or tea colour. To clean the water, it can be filtered through crushed charcoal, coconut fibre or sand. For these reasons local attitudes and tradition play an important part in the use, or otherwise, of such run off.

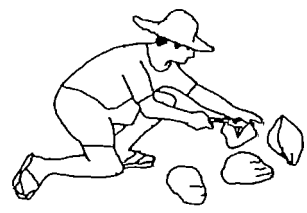
99. A boni kona ni kanenaaki taian kaibwabwa ae e bwenauaki mai i nukana ke taian kai rababa ae korea tamnein V i bukin tauakin te karau n taian taubuki. Taian kawawa n aekaia nako a kona ni kanimwaki n taian uaea nakon taian taubuki ma e na barara teutana i bukin wanakon te ran man te kawawa nakon te tangke.

100. I bukin tararuakin raoi ke kamanenaan te karau man taian taubuki e kona ni kamanenaaki te turam ke te batiketi ae e kanoaki n te ing ni kaibeaki nakon te rieta ae 500 mm.

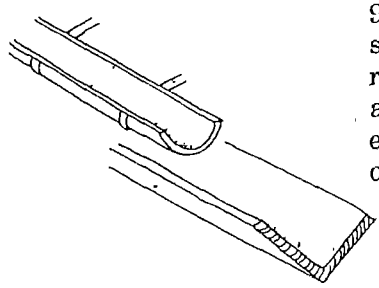


I bukin te tangke te timanti ae e tackinaki n te boki aei e boni kona ni karaoaki te raumea ae te batiketi ae e a tia ni kabwarabwaraaki i aon te tangke ma e na riai n raoiroi karaona i aon te tangke I an te batiketi ao e riai ni mena i aana te warawara te biti i bukin totokoan bakana nakon te tangke.

101. Ni kaineti ma katauraoan te raumea, ao kamaraa te ewanin i nanon te ran i nanon 2-3 bong. Kamaenakoa te ewanin anne ao manga kamaraa riki i nanon tenibong (3) riki ni karokoa e babane te bareka man te buruburu n ewanin anne ao man bitaki matana. Te buruburu are e itiaki ahne e a kona ngkanne ni baireaki raoi i matan te kai-ni-kawawa nakon te turam. E riai ngkanne n oneaki man karenakoaki ni katoa tenua nako aua te namakaina.



Keeping Water Clean



99. Gutters made from split bamboo or V shaped boards can be used to collect the rainwater from thatched roofs. The gutters are secured by straps or wires to the rafter ends, providing sufficient fall towards the outlet to drain the gutters.

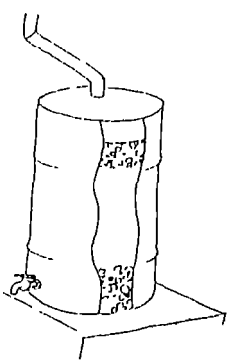
100. The rainwater downpipe discharges into a filter drum that is filled to a height of 500 mm with compacted coconut fibre. For ferrocement tanks the filter basket can be built into the top of the tank to the dimensions shown. At the bottom of the drum a wire mesh screen prevents the fibre from falling into the tank.

101. To prepare the filter material, soak coconut husks in water for 2-3 days. Shred the fibre from the husks and soak it for a further 3 days until all the dirt and colour has been washed out of the fibres. The cleaned fibres are packed into the filter drum. Generally the fibre in the drum has to be discarded and replaced every 3-4 months.

It is important to regularly check the condition of the filter and the quality of the water. If the fibre deteriorates or the water becomes discoloured, clean out the filter and repack it with new clean coconut fibres.

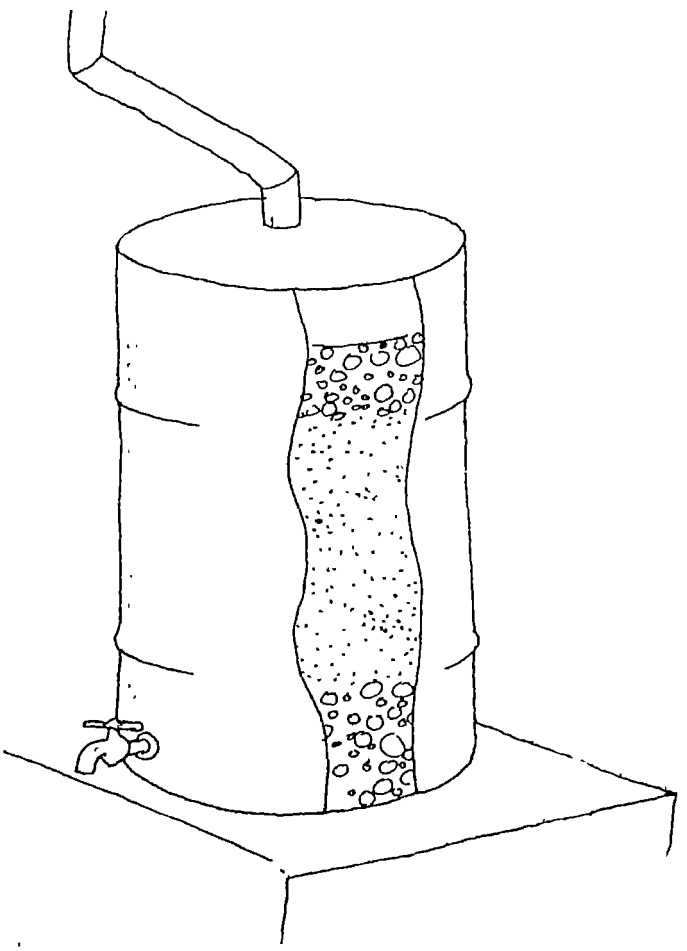
102. N aron te katautau e boni kona ni kamanenaaki te tangke te biti ae e a maan ao te turam, ae e bane itiakina i bukin te raumea.

N te turam i nanona mai i nano ao a bon rinan aron taian atama, te mannang ke te makorokoro n atibu aika a roro i mwin buena n te ai ao atama aika a bon tau buburaia. Mai i nano i nanon te turam te atama ae te kabanea ni uarereke e kanoaki nakon te rieta ae 50mm, i mwina te ing ke makorokoro n atibu ke te kai ae e a tia ni bue aika a roro ni kanoaki nakon 150mm i aon te atama are uarereke, ao te kabanea bon te atama ae e tau buburana ae e kamaenakoaki i aon aikai. Te ran are a bareka e bon karaurau n rinnako ao man raumeaki raoi i nanon te ing ni ikotaki ma mange tabeua. Ngkana arona bwa e bono te raumea te ing ao e riai ni manga oncaki.



Keeping Water Clean

102. As an alternative, a metal tank, or an old, clean oil drum, could also be used as a filter. The bottom of the drum should be filled to a depth of 50 mm with pea-sized gravel, fibre or charcoal and is packed into a depth of 450 mm above the gravel, and a 50 mm layer of coarse gravel is spread over the top. The dirty water will percolate down through the filter, with larger particles being trapped in the fibres. When the filter becomes clogged it has to be cleaned out and repacked with new materials.

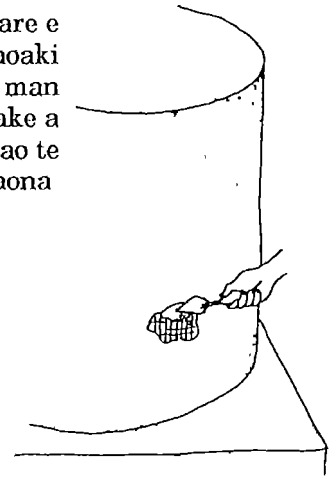


ONEAKIN AO KARAOAN URUAKIN TE TANGKE

103. Ngkana e ruaki te tangke ao e riai n noraki bwa tenaan uruaki a bon kona ni bono-raraniaki, raran aika a uarereke a kona ni bonotaki n te timanti ae renganaki ma te ran ao ni kabiraki bwangabwanga akanne n te makoro ni baeki.

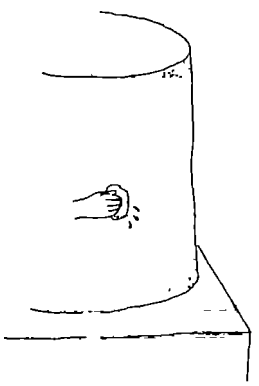
104. I bukin raeuaki n te tangke aika a karina ao te bwai ae riai ni karaoaki bon korean te tabo are e raeuaki mai i nanon te tangke n te koro-titioro ke te bwai ni kaaka ao i muina kanoai tabo akanne n te timanti, n te kabo ae e kamanenaaki i bukin te buratita (1:2).

105. Ngkana iai te uruaki nakon mataniwin te tangke are e karika te mrara ao te moan bwai ae e riai ni karaoaki bon kaitiakan taabo ake e bwaranako ao man kanakoi mrara akanne ni katobibia. Kaeti biiti ake a baoua ao kabonganaa te kabo ae 1:2 timanti ao te tano ni kaboboa ao imuina kabira aona



106. I bukin tangke ake a bon aki reke oneakia ao e riai ni matata bwa e na kabonganaki te tangke anne bwa ai te booma naba ao e a waaki te mwakuri i aona. Te kantaninga i aon aei bwa e na riai ni manga kaitiakaki raoi rabwatan te tangke anne n aron te nimroona ao mani kamakerekereaki i bukin manga tokan te timanti i aona i bukin te buratita. E boni kona ni kamanenaaki te uaea buratı i bukin aei.

REPAIRS AND MAINTENANCE



103. If a tank leaks it should be repaired, but it should be noted that some leaks are self-sealing

Very small porous holes can be sealed by mixing cement and water and rubbing the mixture into the holes with a piece of sacking.

104. For minor cracks caused by impact, first cut out along the line of the crack inside the tank with a cold chisel or scraper and fill the crack with cement mortar of the same mix as the original. (*Epoxy resin* can also be used).

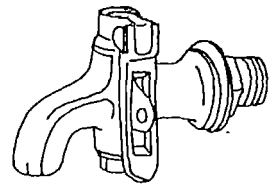
105. If the ferrocement has surface damage causing the cement to shatter, first clean around the damaged area and remove any loose material. Straighten any bent reinforcement and, using a 1:2 cement sand, mix plaster over the spot. Large holes may also be fitted with a patch of mesh prior to plastering (this patch should be wired into existing reinforcement at the edges of the hole).

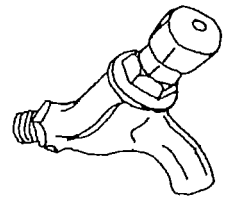
106. For tanks that are beyond repair, consideration should be given to using the old tank as existing formwork for a new one. Clean the external face properly to remove algae etc., and roughen the surface, then wrap wire mesh around the old tank and plaster mortar over it, thereby forming a new tank.

Oneakin ao karaoan uruakin te tangke

107. A riai ni kawakinaki raoi baibun te tangke. Kamanoi/Rabunui aoia n te timanti ke kabaea raoi tenaan baibu akanne ma te boua. Aei are e na bon totokoi bwaketi ake a kakatineaki i aon te baibu ngkana e kanoaki are e na bon karekea te uruaki ke ni kamaotoi baibu.

108. N totokoa bakataean te ran ao man kawakina raoi te tangke, ao e riai te taebo n iai rokana ke n lai binina.





109. E riai raoi n tutuoaki kanoan te tangke tao uatai n te wiiki.

Repairs and Maintenance

107. Pipework from the tank should be well protected. Encase the pipes in concrete or secure the pipe to a post. This prevents buckets being hung over the pipe for filling which could cause the pipe to fracture.

108. To prevent wastage of water and to safeguard the supply, the tank should be fitted, where possible, with either a lockable tap or a spring loaded one.

109. Water depth is usually monitored at intervals by inspection.

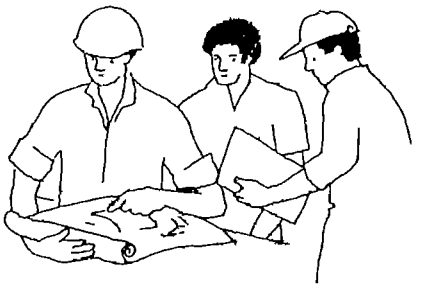
Oneakin ao karaoan uruakin te tangke

110. I bukin te waaki i aon aei ao a riai ni bane n tauraoi bwaai aikai i bukin aron bebeten te waaki i aon rabwatan te tangke.

- katautauan ao iangoan buburan te tangke
- maitin bwaina i bukin karaoana
- kakaean raoi nnena
- katauraoan ao mwakenan nnen kabwaroi bukin te tangke
- karaoan te kabwaro i bukin te tangke ao kavenean taian baibu i bukin te taebu (tap)
- katean te rai ni kabwaro ao bitina i bukin matoana
- karokoan raoi bwaina ao kamatoan kekabaebaean te meti uaea ni nnena
- buratitanakin te timanti nakon rabwatan te tangke
- katian rabwatan te rai ni kabwaro ao buratitanakin aona
- katiaan raoi te mwakuri i aon tebaibu
- tuoa raoi rabwatan te tangke i bukin beniakina
- kaitiakan ao katararaoan rarikina

111. Ae boni ngae n ataaki iaon makuri tabeua, ataakina ke rabakau i aoia, a bon rereke n te taneiai. Karaoakin te tangke ae e na tamaroa ao e na bon riai ni wakinaki raoi ni kawaina mai imoana ni karokoa ae e waaki te buratita. Rabakau aikai a bon aki kanganga wakinaia.

Ngkana iai te raraoma, uringa n taai nako ni kakaea buokam.



Repairs and Maintenance

110. With careful planning and having all the necessary materials and tools readily available a systematic approach should be made to:

- calculating and determining the size of the tank
- estimating the quantities of material required
- determining the exact location of the tank
- preparing the foundations and marking out tank position
- building the tank base and installing pipework
- erecting the formwork, or fabricating the steel framework
- placing and securing the wire mesh
- plastering on the mortar
- curing the tank
- completing the formwork and plastering the top
- completing the pipework
- carefully checking the tank and painting it
- cleaning up the surrounding area

As with most jobs, proficiency comes with practice. To build a good ferrocement tank requires a methodical approach in setting out, fabrication, and application of mortar. These skills are not difficult to master.

If in doubt, always seek advice or assistance.

GLOSSARY

Note: Those words in *italics* are included in this glossary.

absorb	-	suck up or drawn into
batch	-	a volume/measure of mortar or concrete
builder's hawk	-	small flat board with handle in the middle
catchment	-	area in which rainwater collects
cement slurry	-	a runny paste of cement and water only
consumption	-	amount of water used
epoxy resin	-	two part mix, that has great strength on hardening
gas generation	-	bubbling of gas in cement mortar
fabricate	-	make, build or construct
hardcore	-	rocks, stones, concrete or similar
kilopascal	-	unit of measurement for pressure
kinked	-	bent or adjusted
leach	-	wash out
manhole	-	frame or opening into tank
parallel	-	equal spacing
plumbness	-	verticality
porous	-	allows water to seep through
Portland cement	-	used for general construction purposes
profile	-	outline of the height and shape of the base
slumpcone	-	truncated cylinder
starter bars	-	angled or bent steel rods
strike off	-	knock or level off
tamped	-	packed or forced down