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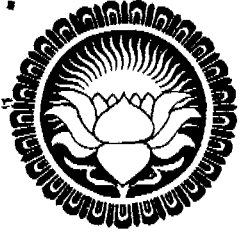
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**MANUAL FOR SUPERVISORS**

217 - 89MA - 6433



**LANKA JATHIKA SARVODAYA SHRAMADANA SANGAMAYA (Inc.)**  
(An approved charity)  
**Sarvodaya Rural Technical Services**

MANUAL FOR SUPERVISORS

PREFACE

This book is intended as a manual for the field staff of Sarvodaya Rural Technical Services, in particular for the supervisors.

Experience shows, that there is a demand for such a small reference book. This manual will only answer the questions most frequently arising on site and therefore it should be your companion in the field. To ensure the standards of common structures, make use of the respective available construction manuals and standard plans.

Sri Lanka, September 1989  
Heini Pfiffner  
Technical Advisor SRTS

Sinhala Translation by:  
Palitha Jayaweera  
Training Officer SRTS

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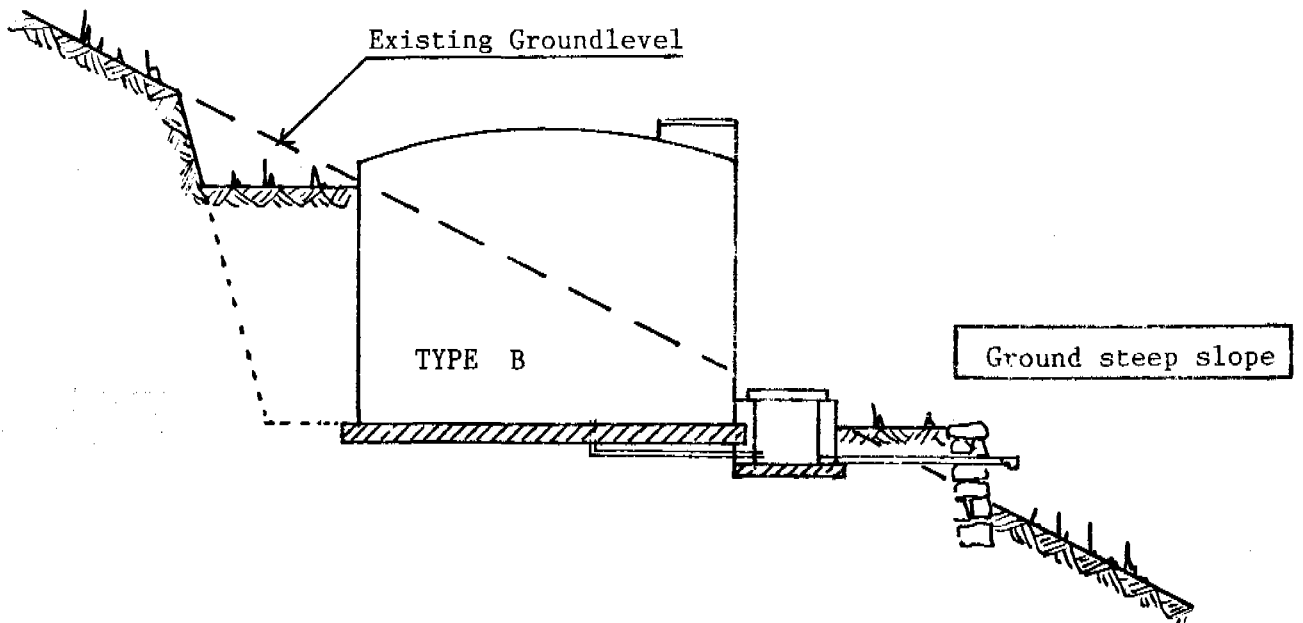
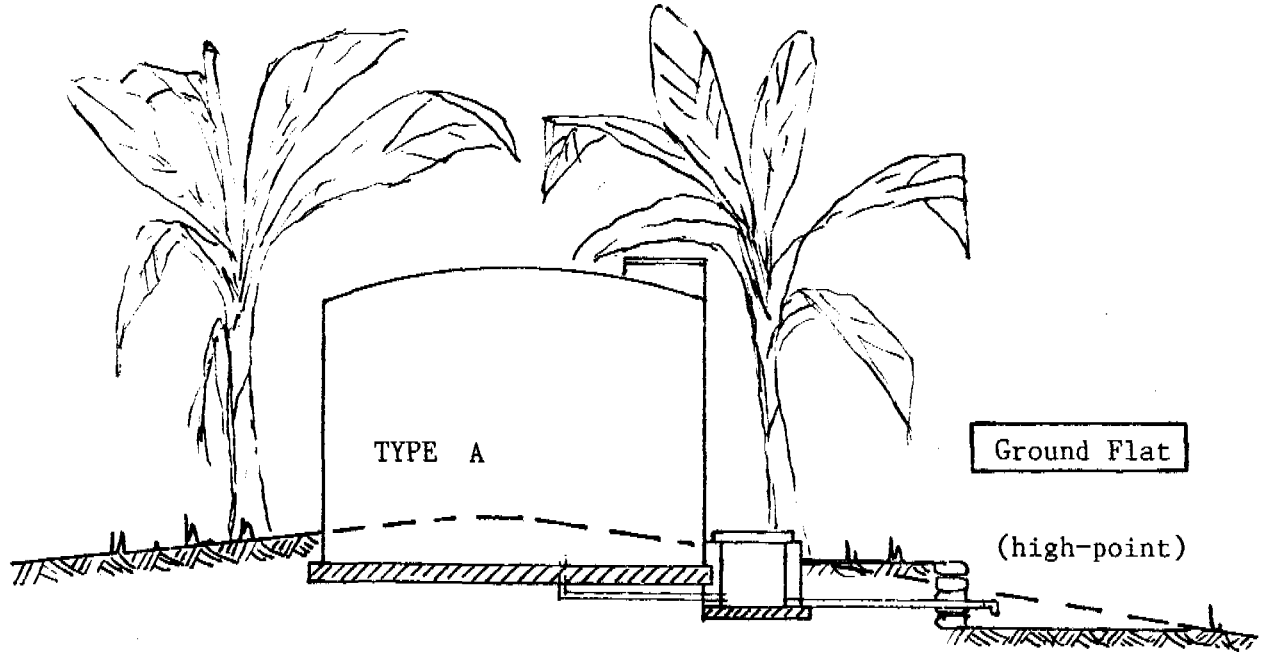
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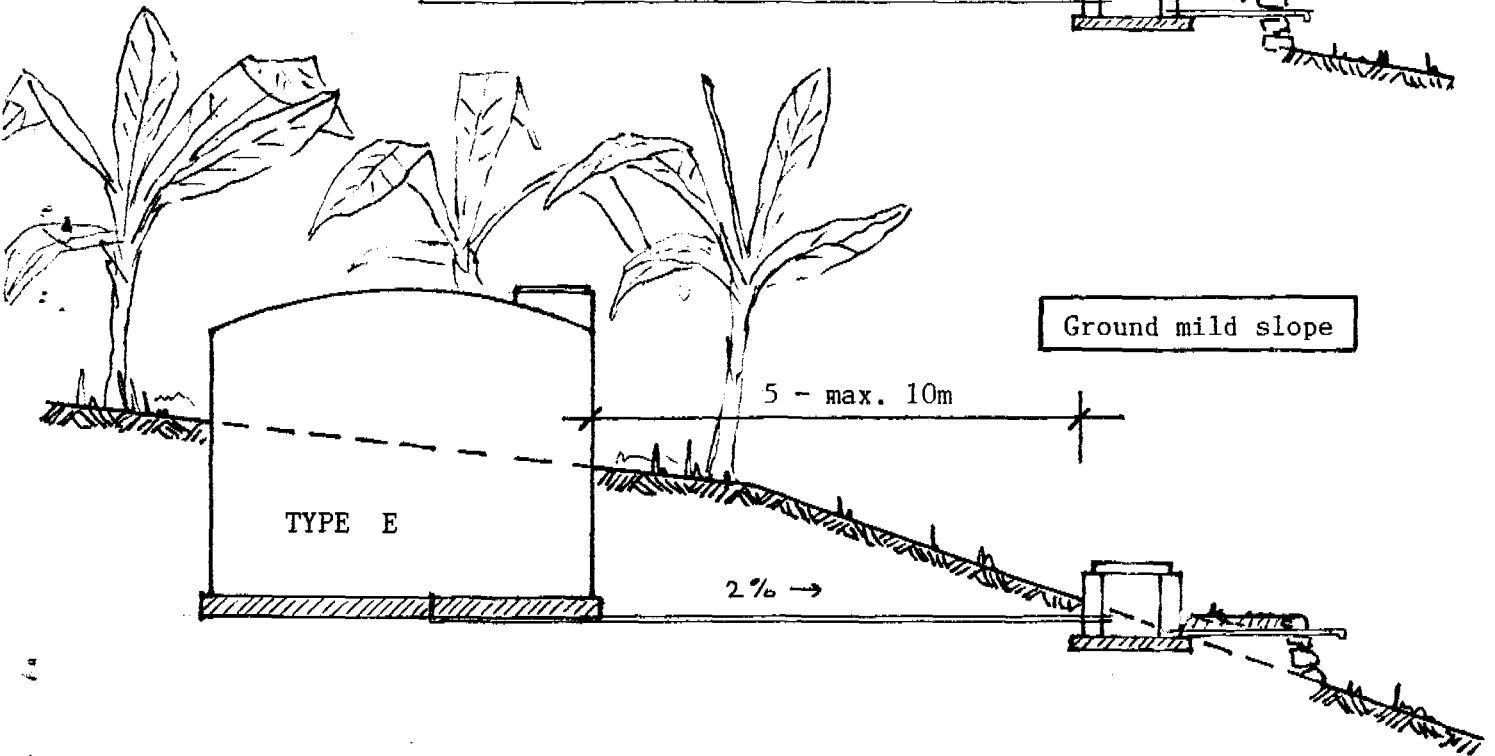
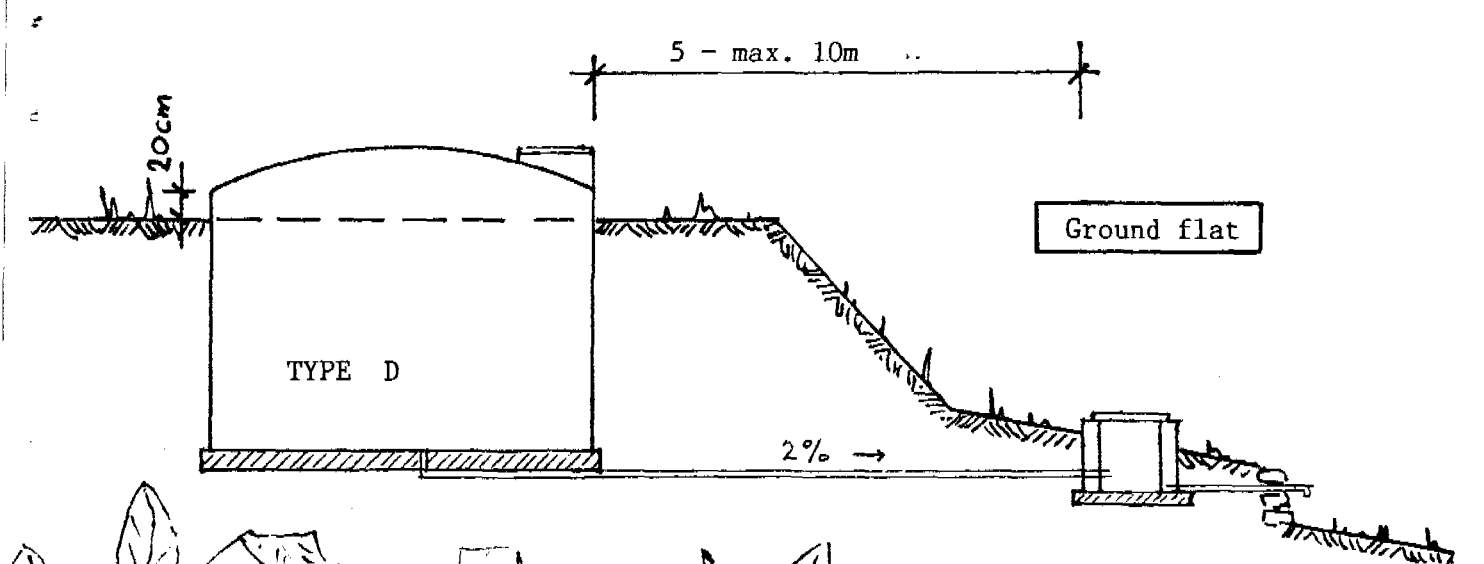
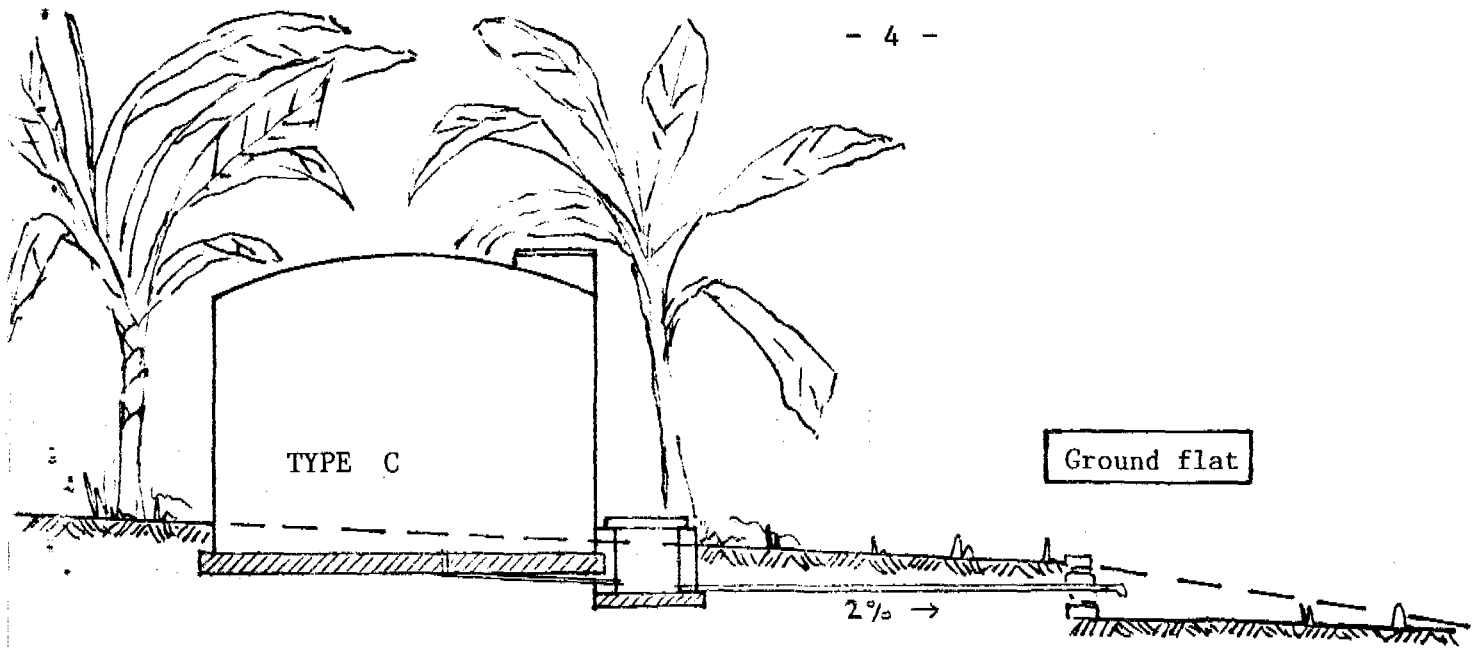
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VARIOUS ARRANGEMENTS OF STORAGE TANK AND VALVE CHAMBER

(For ferrocement or stonemasonry tanks)

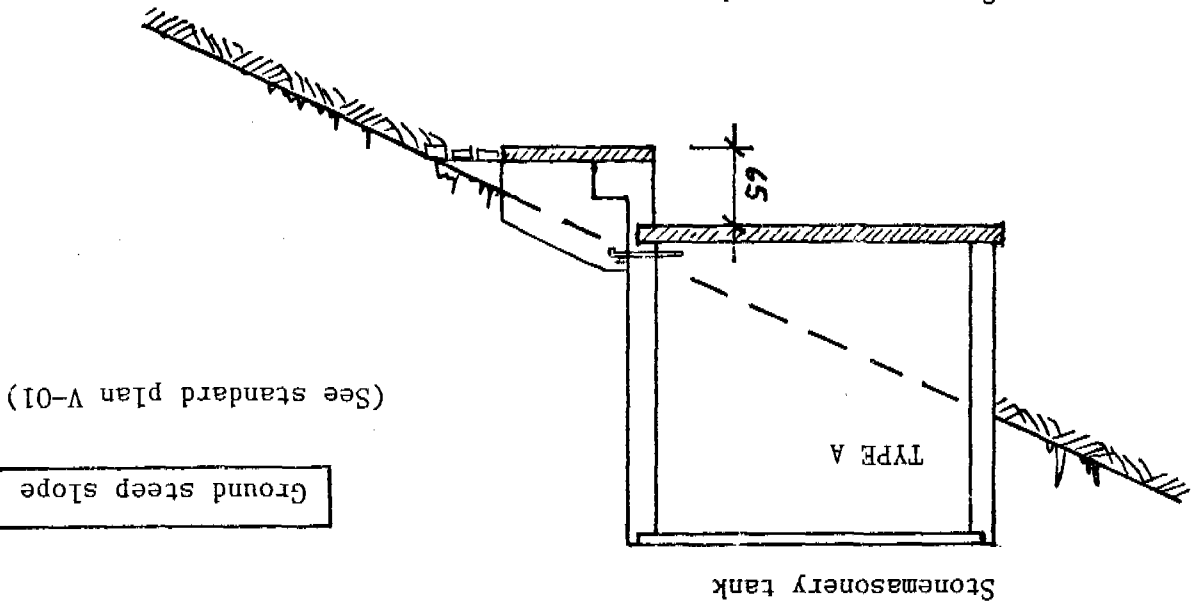
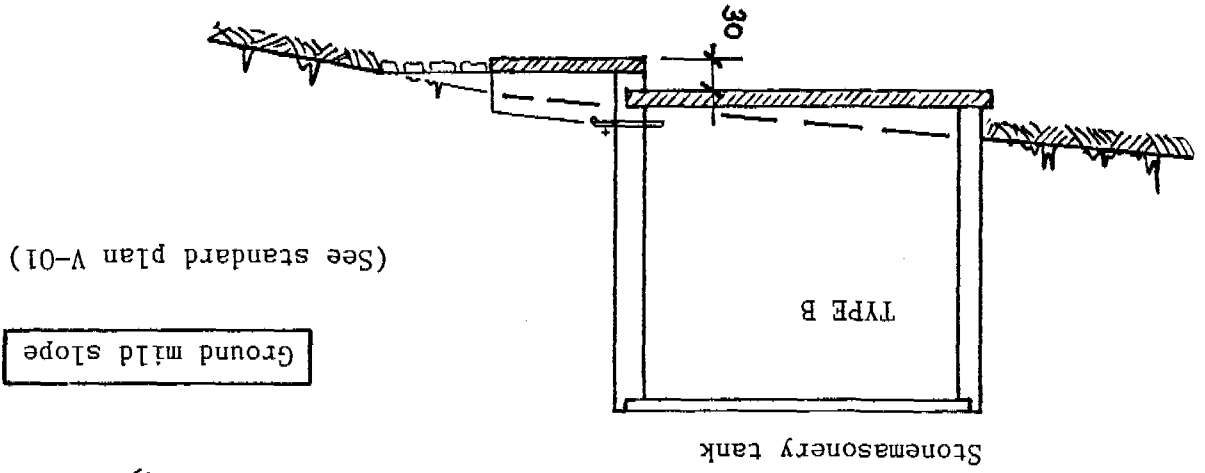
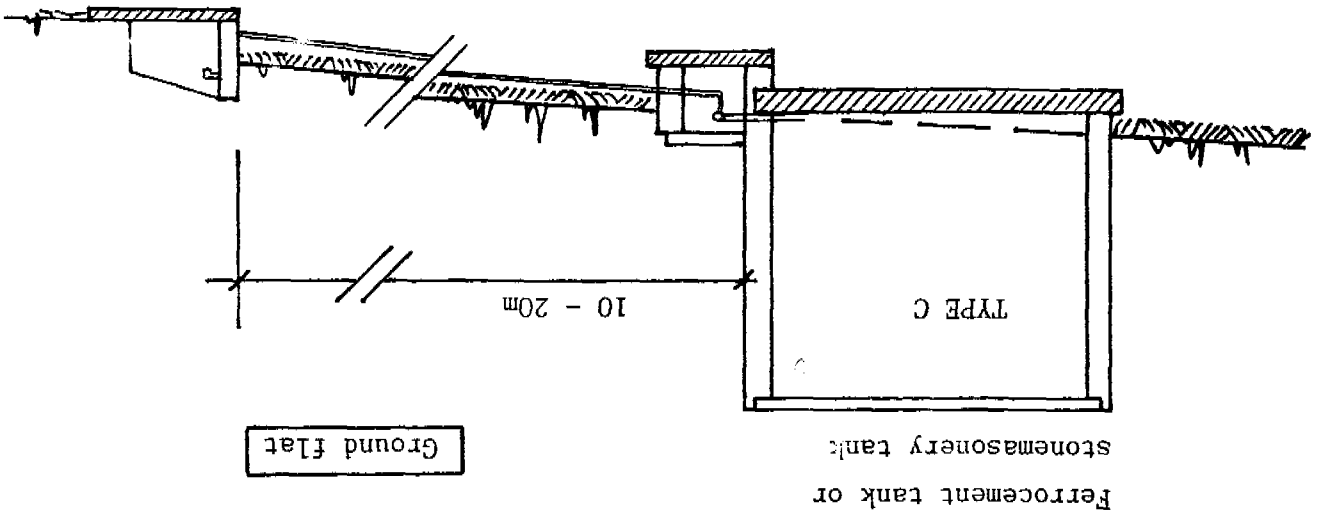
If more than 2/3 of the ferrocement tank is exposed to direct sunlight plant trees (banana) around the structure to provide sufficient shadow.





VARIOUS ARRANGEMENTS OF STORAGE TANK WITH ATTACHED TAP

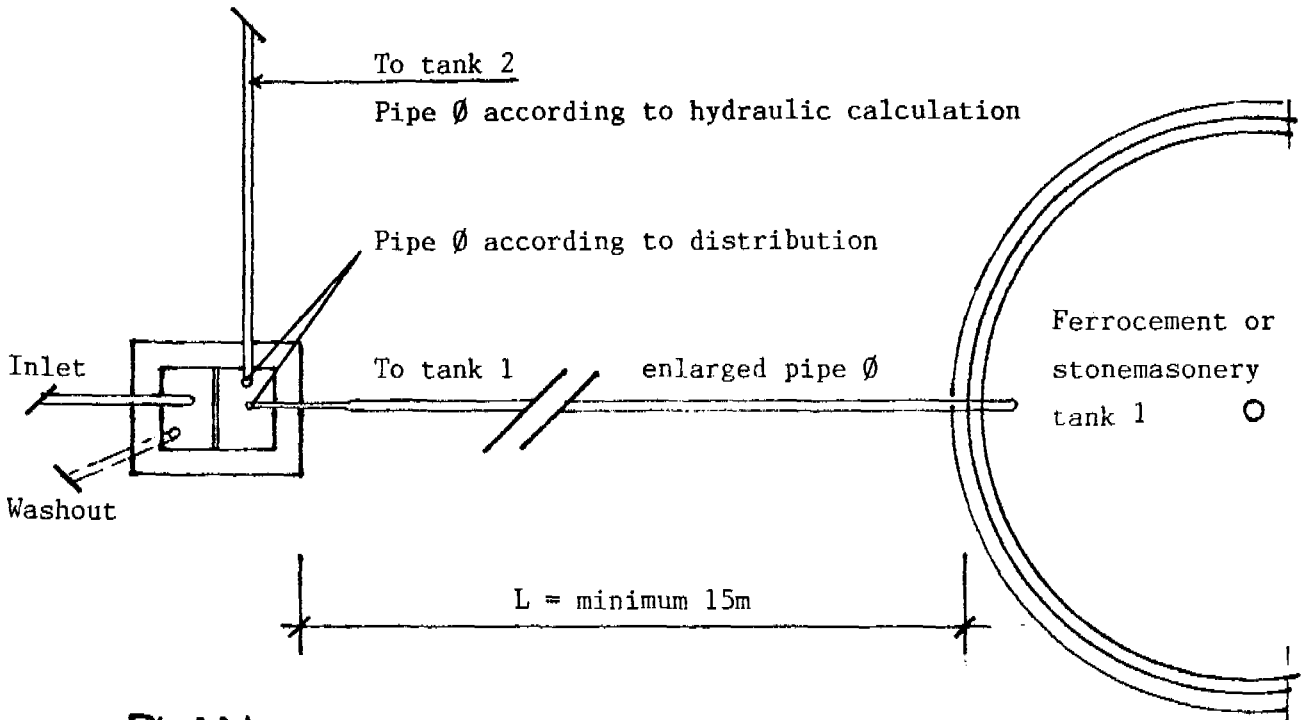
Attached tap on flat ground is not recommended.



(See standard plan V-01)

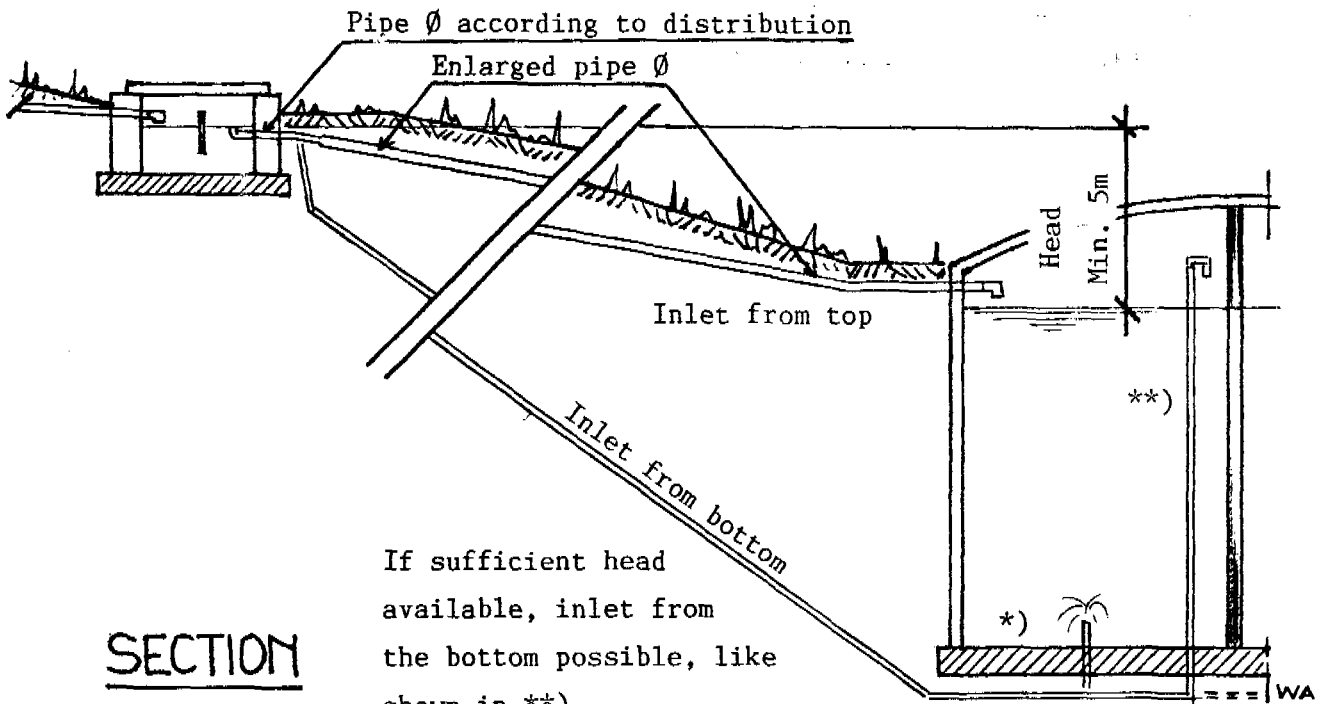
(See standard plan V-01)

DISTRIBUTION CHAMBER SEPARATE FROM STORAGE TANK



PLAN

If not sufficient head available,  
 $H \leq 5m$ , make inlet from the top or  
from the bottom like shown in \*)



SECTION

If sufficient head  
available, inlet from  
the bottom possible, like  
shown in \*\*)

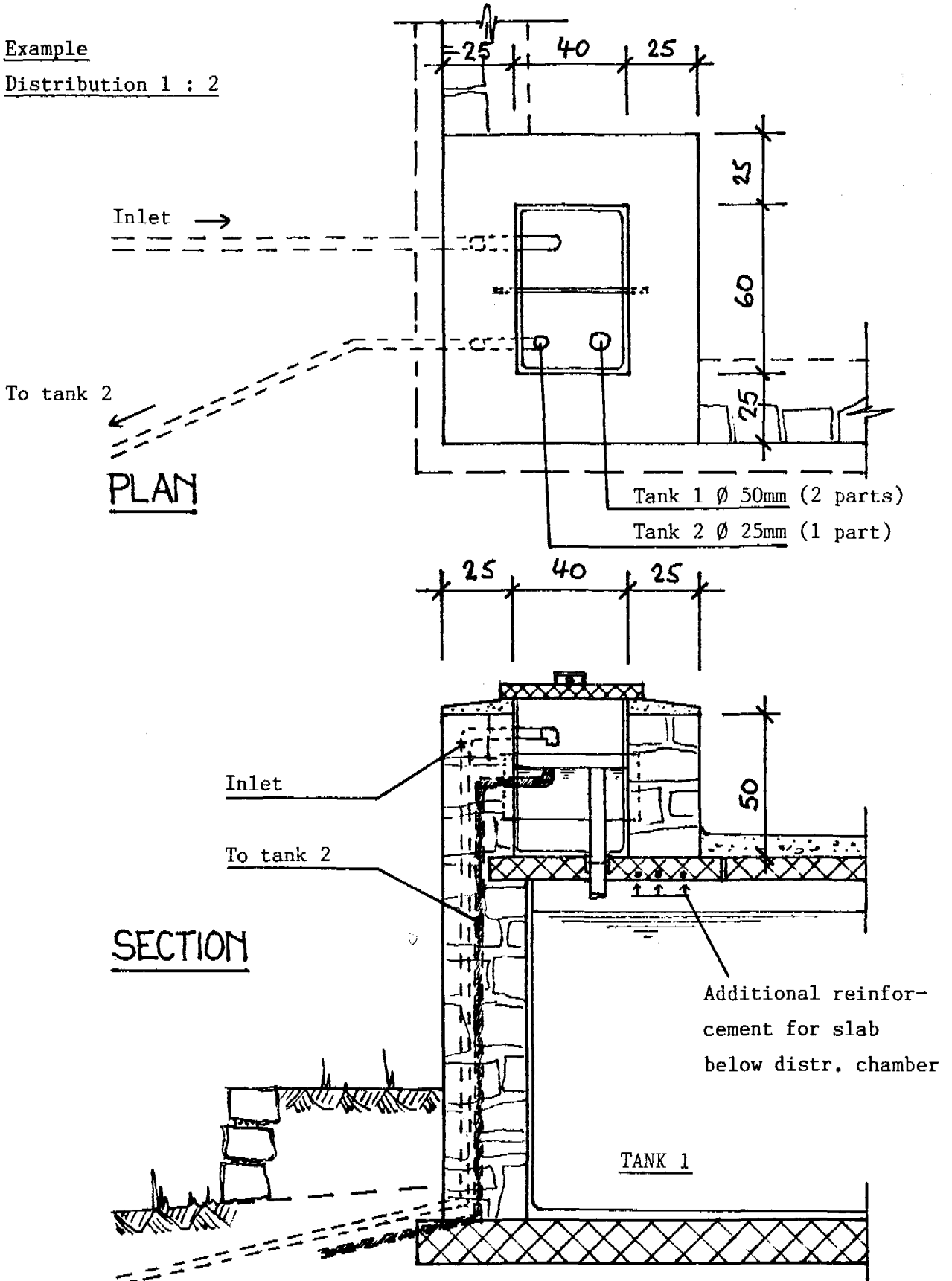
DISTRIBUTION CHAMBER COMBINED WITH STORAGE TANK

Built on top of stonemasonry tanks only.

For distribution see standard plan C - 04

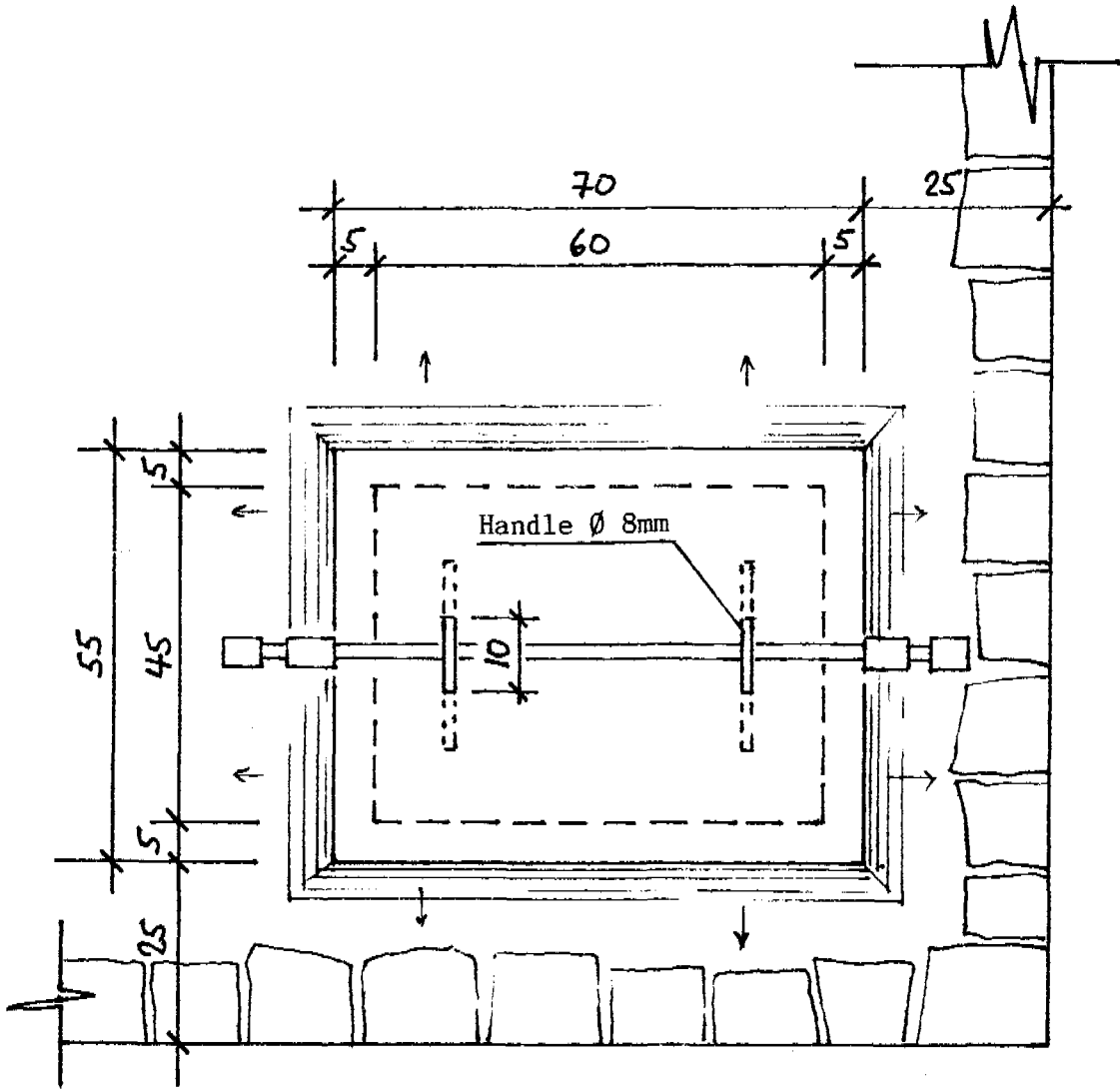
Example

Distribution 1 : 2

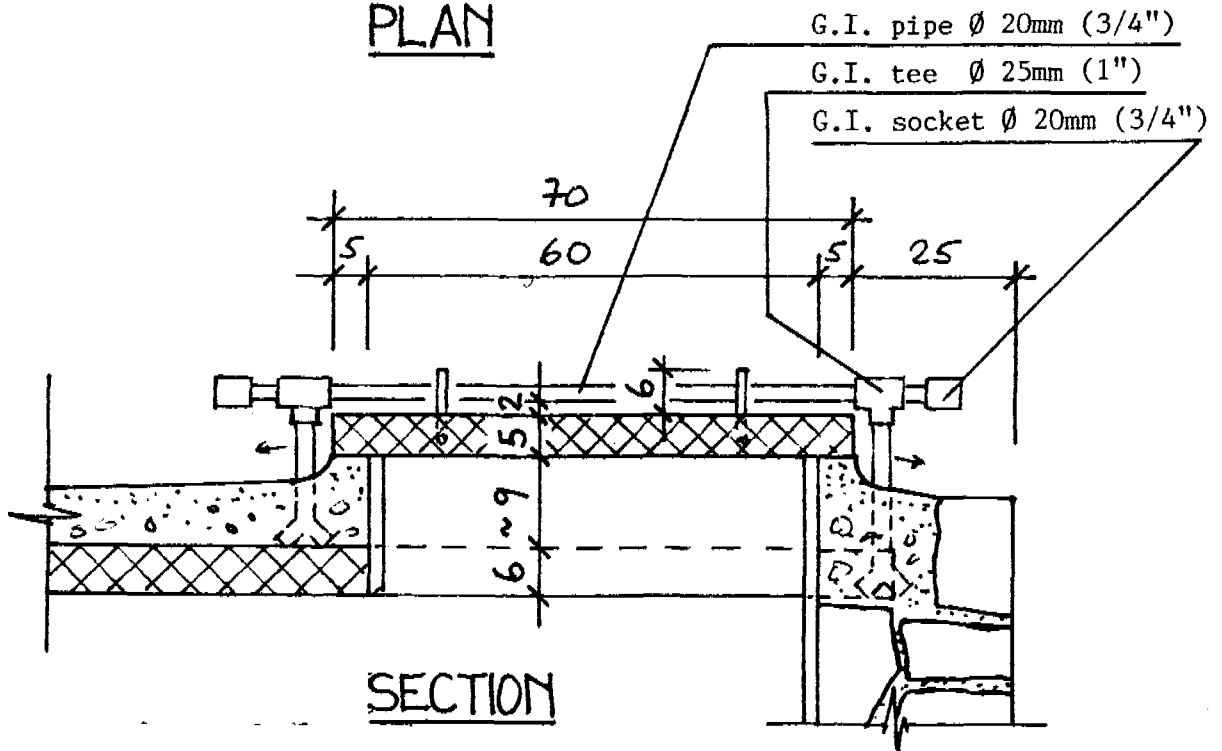




MANHOLE COVER OVER STONEMASONRY TANK



PLAN

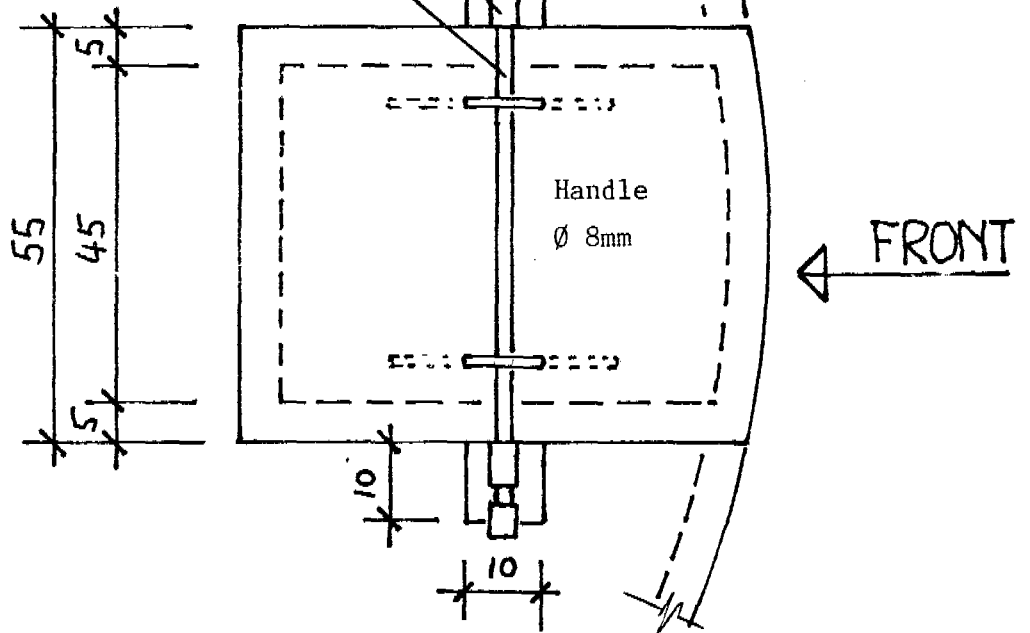


SECTION

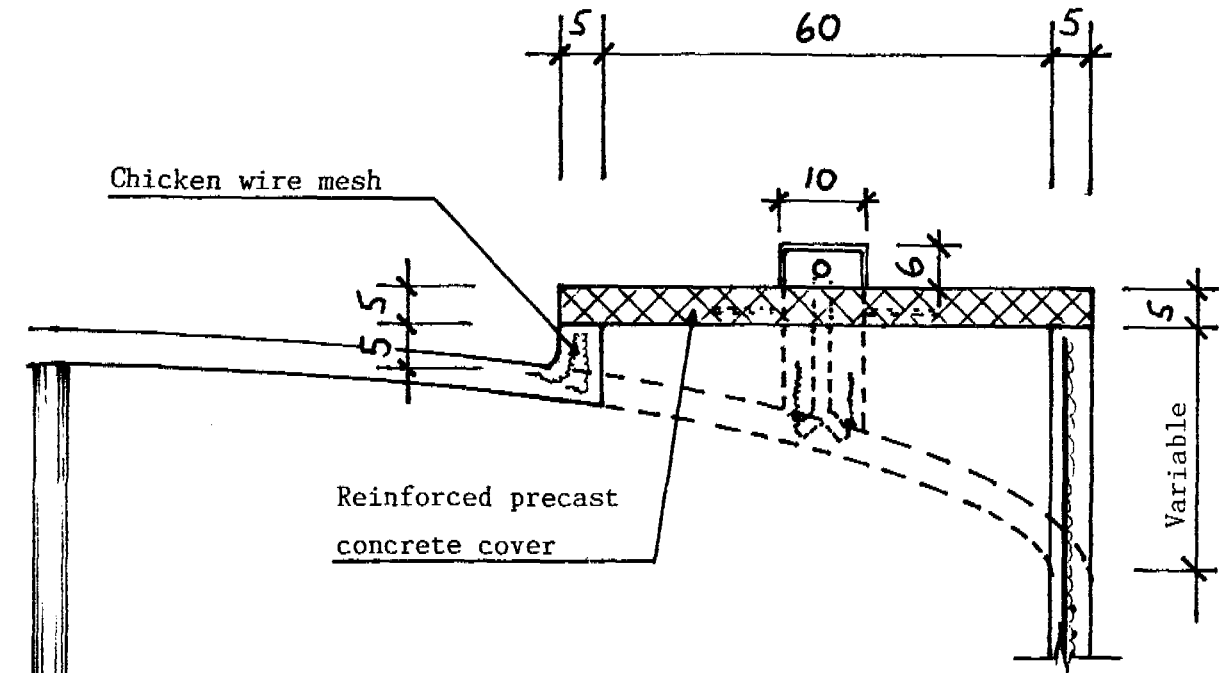
MANHOLE COVER OVER FERROCEMENT TANK

- G.I. socket  $\varnothing$  20mm (3/4")
- G.I. tee  $\varnothing$  25mm (1")
- G.I. pipe  $\varnothing$  20mm (3/4")

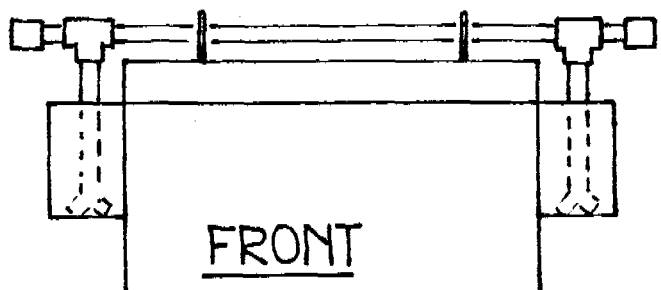
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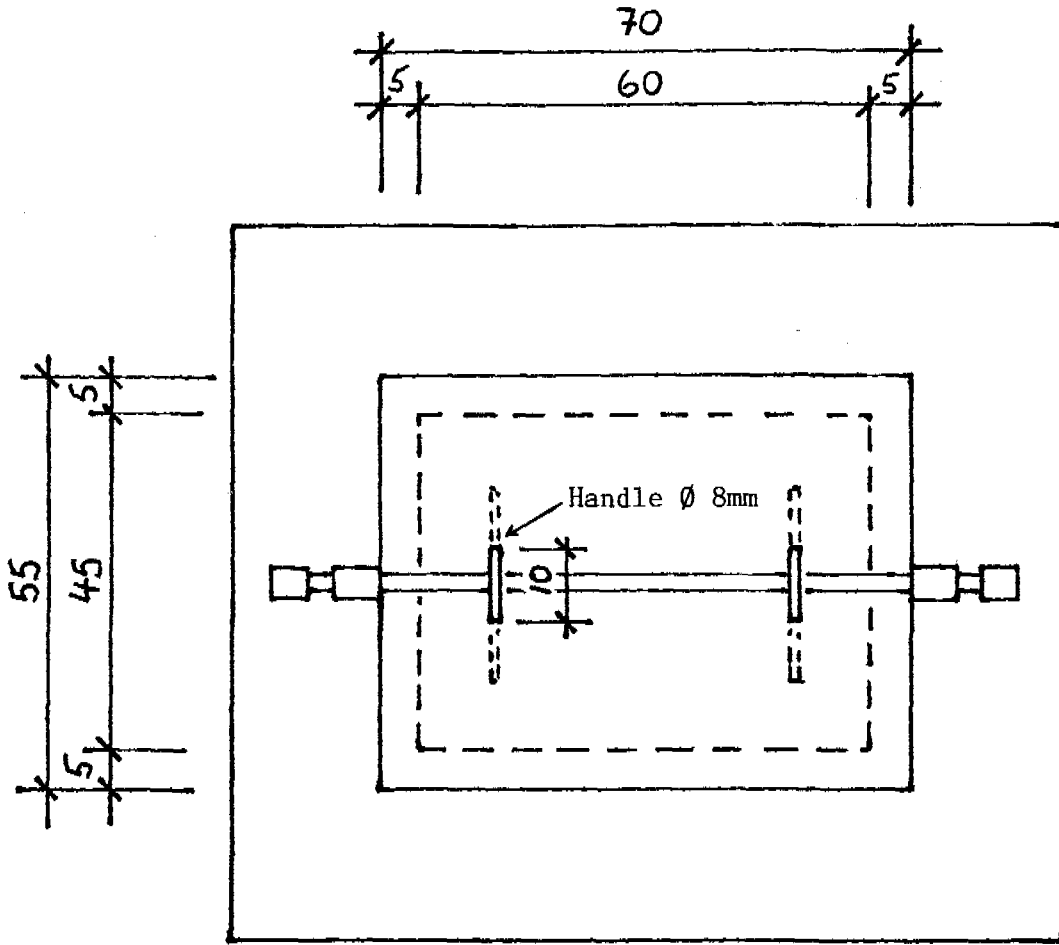
Chicken wire mesh



SECTION

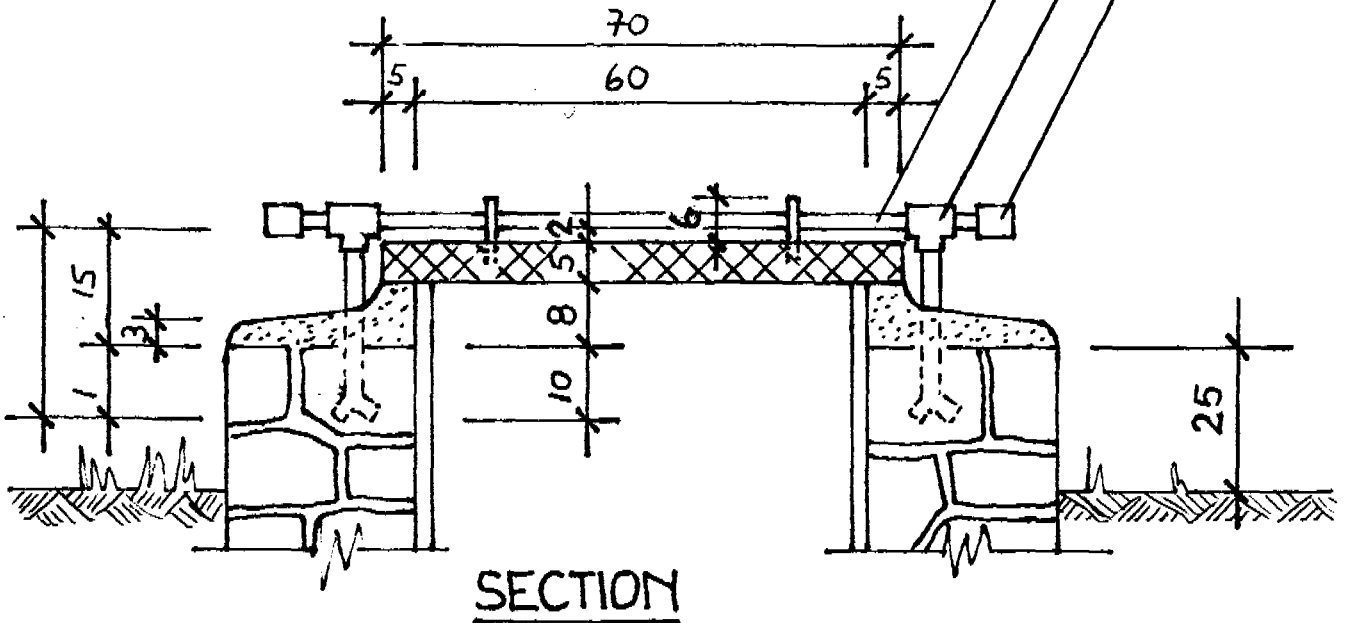


MANHOLE COVER OVER CHAMBER

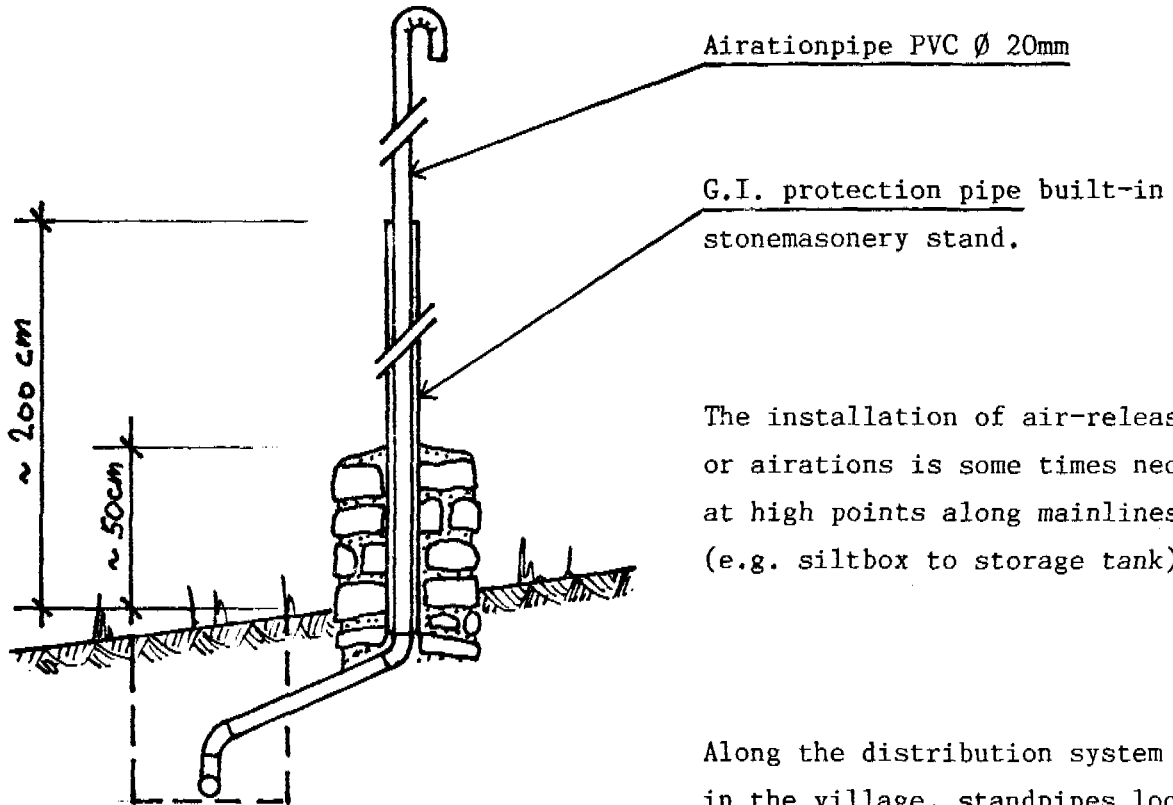


PLAN

- G.I. socket Ø 20mm (3/4")
- G.I. tee Ø 25mm (1")
- G.I. pipe Ø 20mm (3/4")



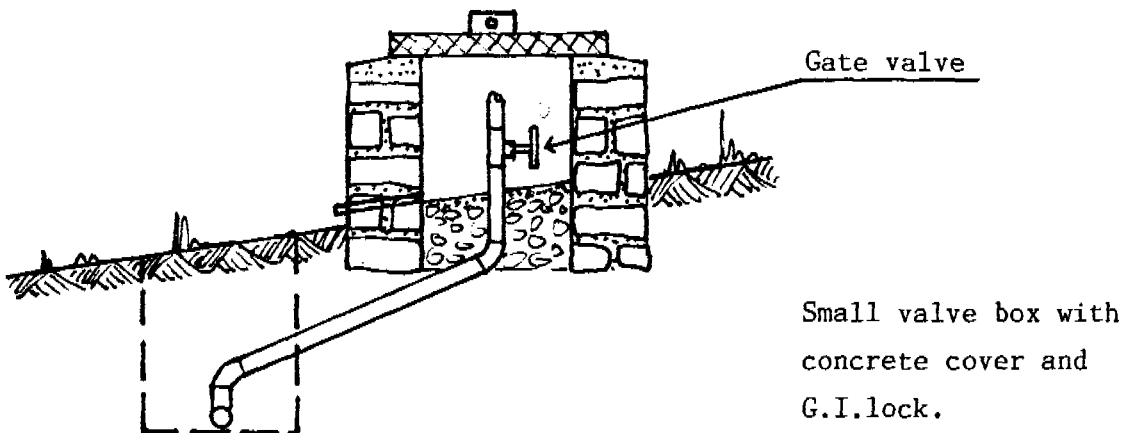
AIR - RELEASE AND AIRATION



The installation of air-releases or airations is some times necessary at high points along mainlines. (e.g. siltbox to storage tank).

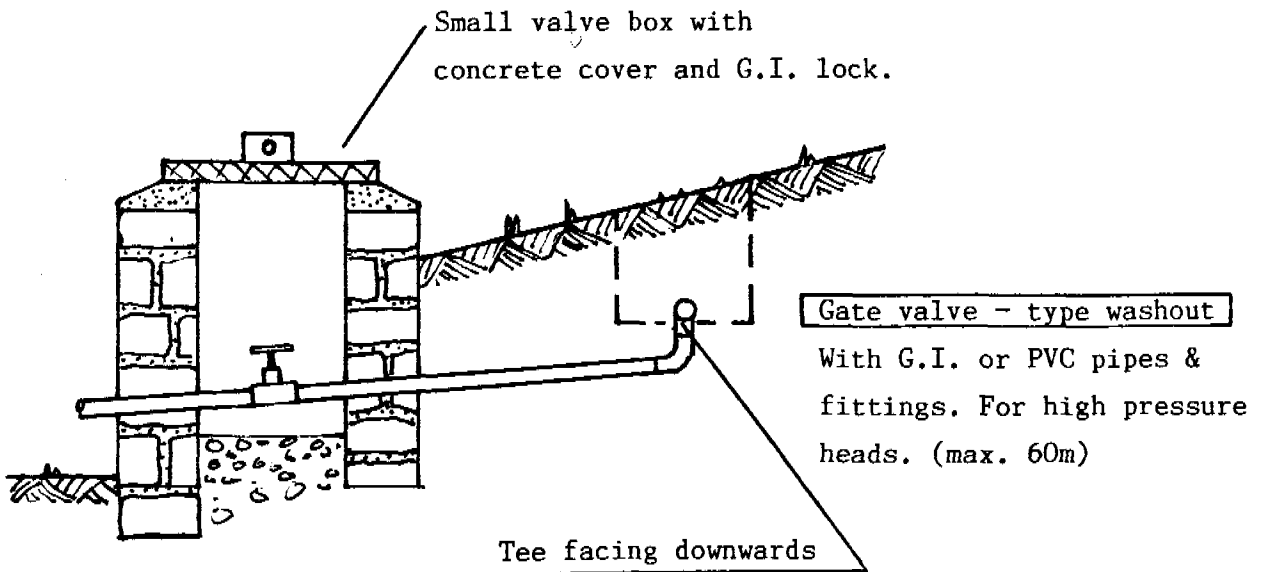
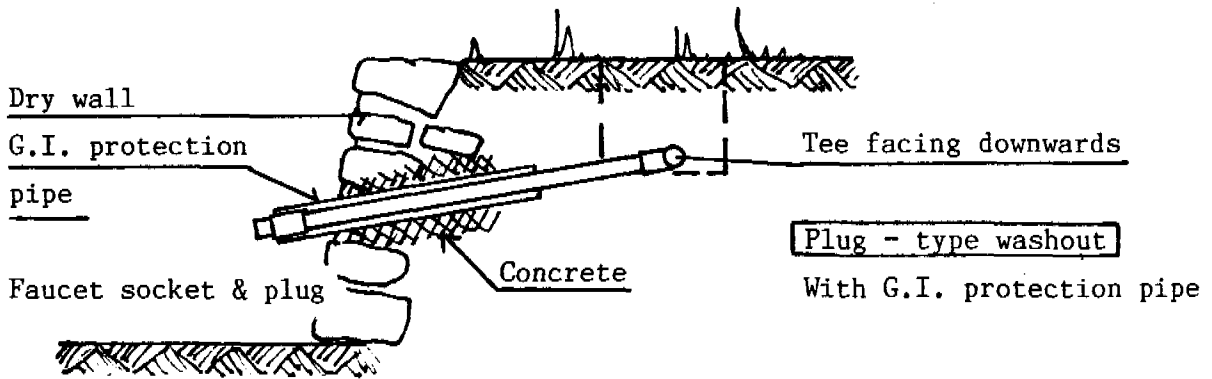
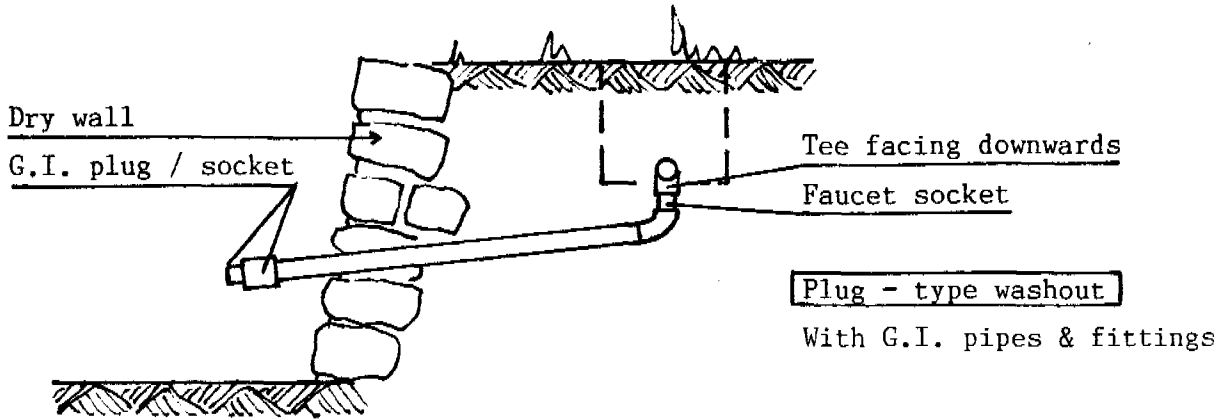
Along the distribution system in the village, standpipes located at high points work as air-release.

This structure works as an air-release only and some times it is subsequently needed for maintenance purposes. When water after maintenance work is allowed to refill the pipeline, trapped air at high points can be released by opening the gate valve.



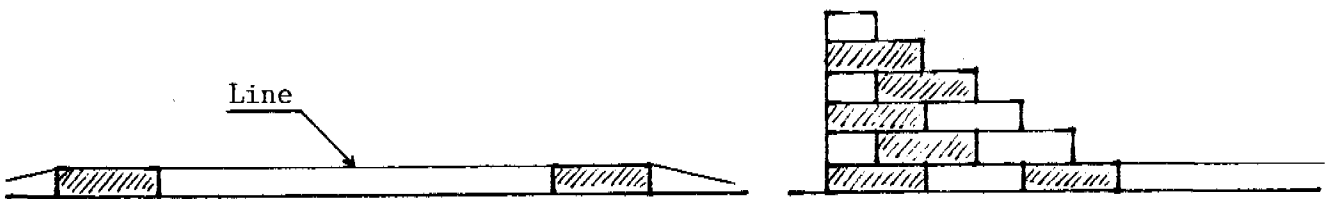
WASHOUTS

The washout pipe should be of the same pipe size as the pipeline at that point. Plug - type washouts will require that the pipeline will be completely drained before the plug can be replaced, which is not so with the gate valve - type washouts.



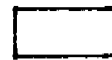
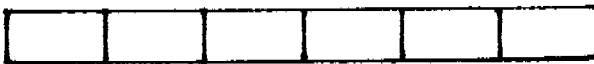
BRICKMASONRY WORK

- Make an exact settingout of the structure and mark the external corners.
- Lay the first two courses dry, (without mortar) in order to get the correct bond.
- Build the cornerstones first and hang the line for the first course.
- Build up the corners 4-5 courses high, then build the bricks inbetween.
- Bricks should be sprinkled with water before they are build in.
- Before the mortar has set, do the pointing.
- Plastic mortar is used for building, ratio 1:4
- Horizontal joints are 12mm / Vertical joints are 10mm.



STRETCHER BOND

First course



FULL BRICK

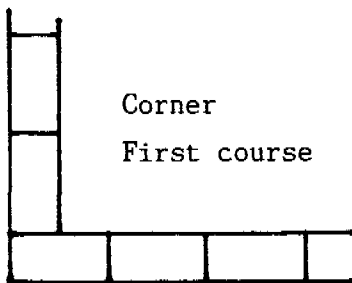
Second course



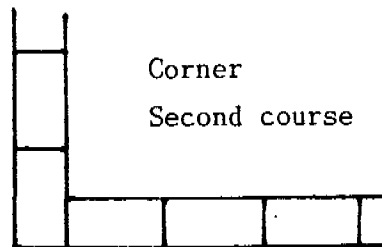
3/4 BRICK



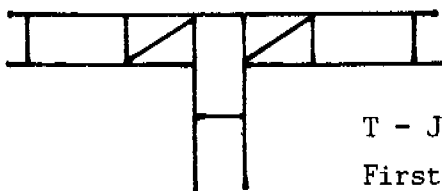
1/2 BRICK



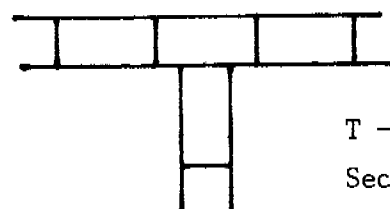
Corner  
First course



Corner  
Second course

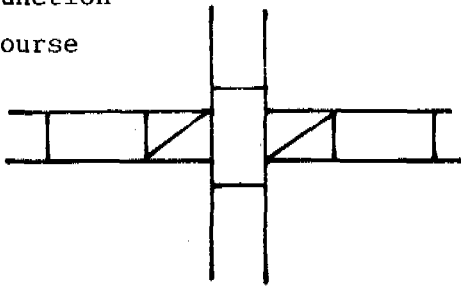


T - Junction  
First course

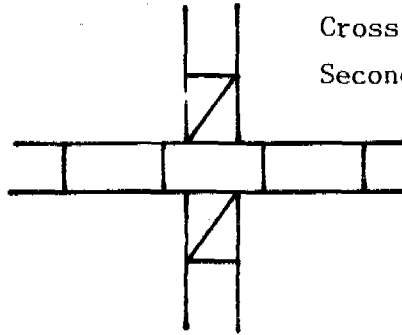


T - Junction  
Second course

Cross Junction  
First course



Cross Junction  
Second course



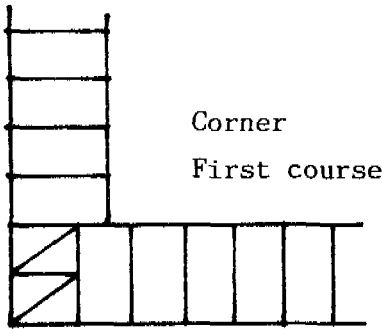
HEADER BOND (Binder bond)



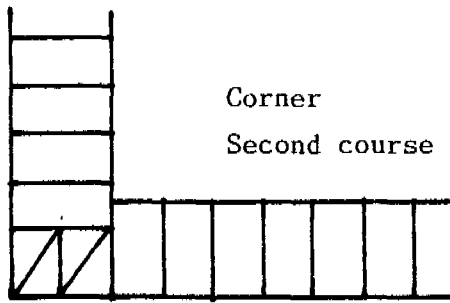
First course



Second course

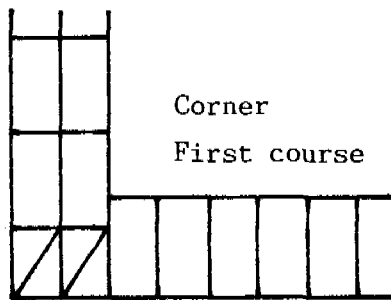


Corner  
First course

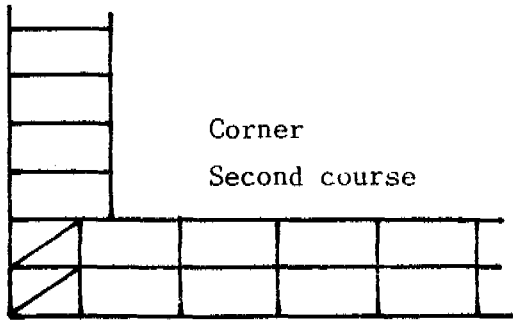


Corner  
Second course

ENGLISH BOND (By using 3/4 bricks)

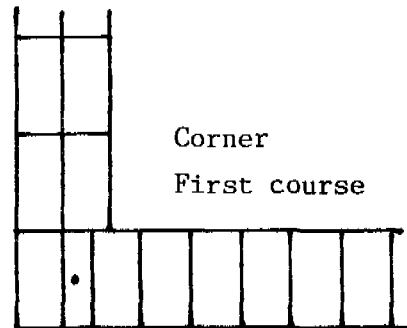


Corner  
First course

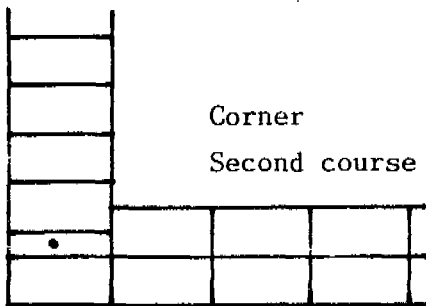


Corner  
Second course

ENGLISH BOND (By using queencloser)\*



Corner  
First course

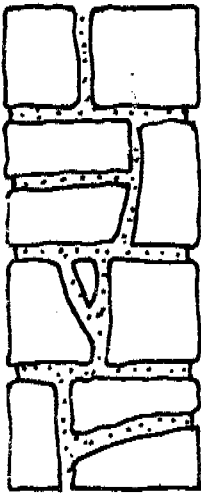


Corner  
Second course

STONE MASONRY WORK

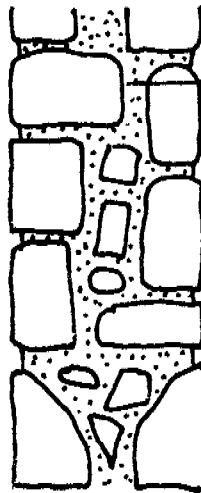
- Make an exact settingout of the structure and mark the internal and external corners.
- Built up the corners to the height of about one meter, then build inbetween using two lines on each side to raise the wall uniformly.
- Always two masons should build on a wall, one inside and one outside the wall.
- Stiff-plastic mortar is used for building, ratio 1:4

GOOD MASONRY

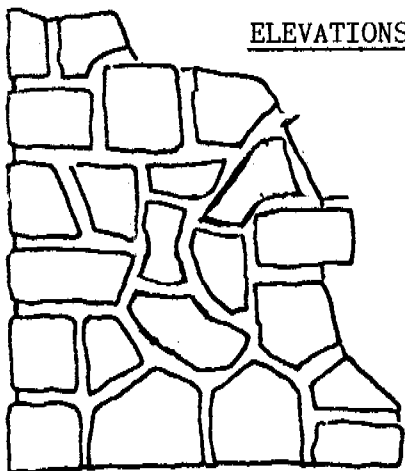


SECTIONS

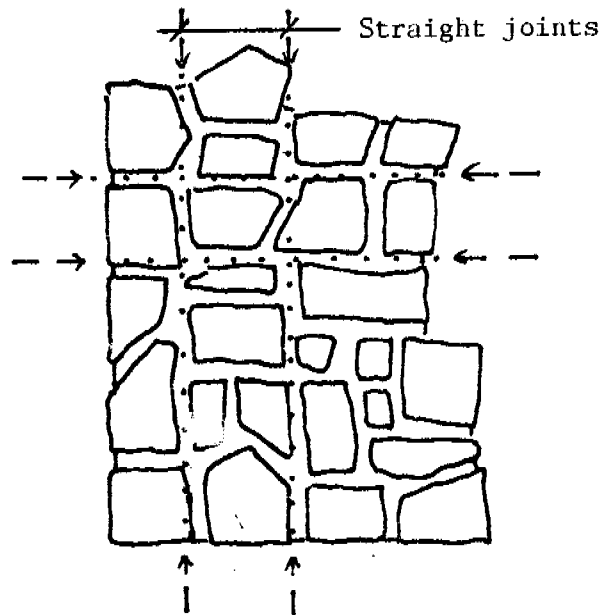
BAD MASONRY



To much mortar used and no bonding.



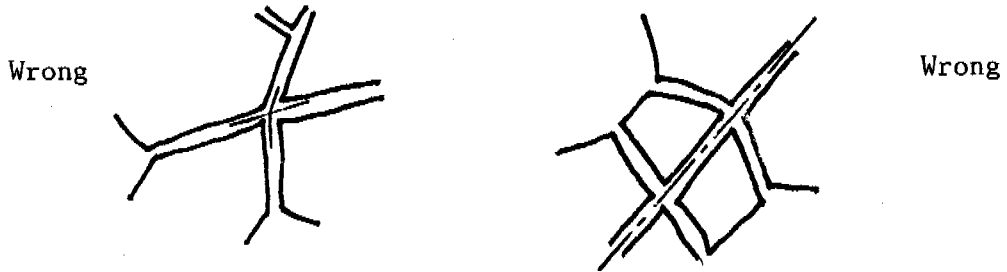
ELEVATIONS



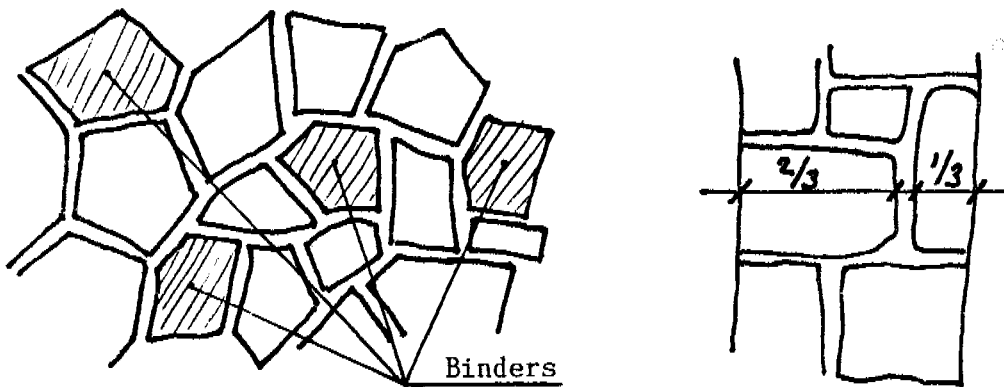
- Joints should be minimum 1.5cm, maximum 2.5cm thick.
- Straight joints should be not longer than 3 stones.



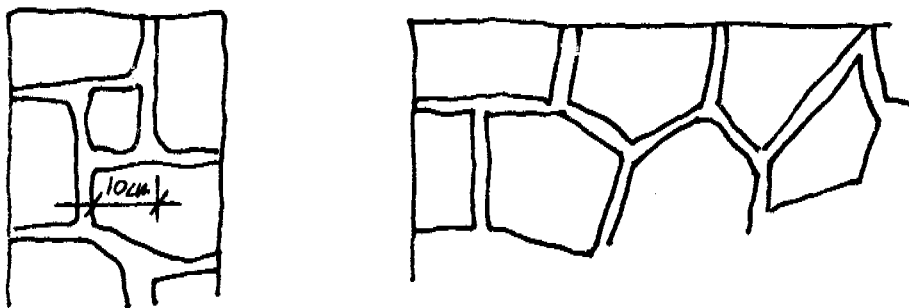
- Four joints should never come together at the face of the wall. Straight joints longer than two stones should be avoided.



- Every third stone should be a binder. Length of the binder min.  $\frac{2}{3}$  of the thickness of the wall.

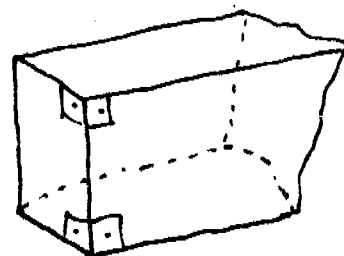


- The top of the wall should be built with shaped stones which are properly bonded into the rest of the wall.



- The overlap of the stones should be a minimum of 10cm in all directions.

- Sample of shaped corner-stone



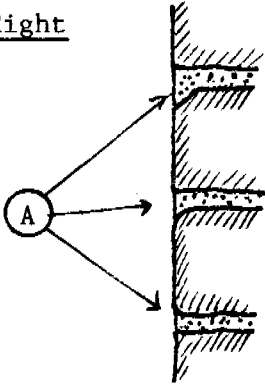
## Pointing

For uncoursed rubble stone masonry we use flush or keyed pointing.

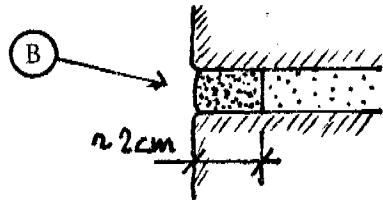
### Flush pointing (A)

It is normally used, where the wall will be backfilled. It can be done after building, but before the mortar has set. Fill mortar between the stones (joints), not on the surface of the stones.

Right



Wrong



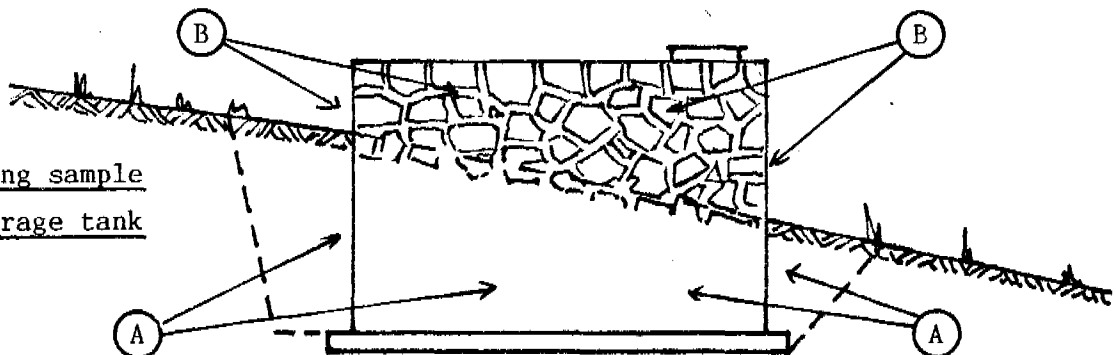
### Keyed pointing (B)

This pointing is workintensive and expensive. Therefore it should be applied on exposed wallsurfaces only.

Scratch 2 cm mortar out of the joints, as soon as the building mortar has set.

Key-pointing is normally done after the walls are built. Later on make sure that the joints are cleaned and well watered before applying pointing-mortar. The joints are filled with the pointing trowel and smoothed.

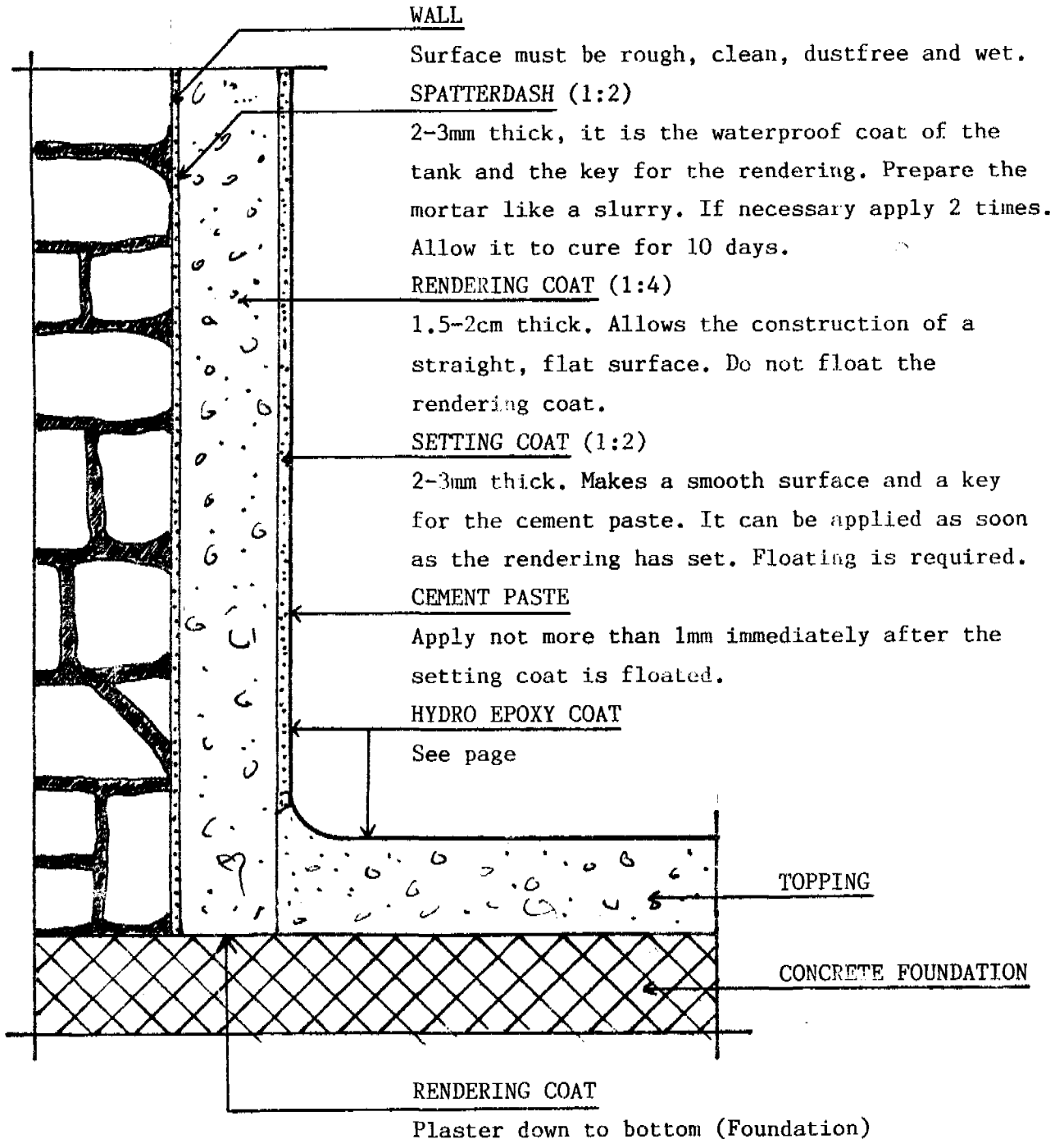
Pointing sample  
of storage tank



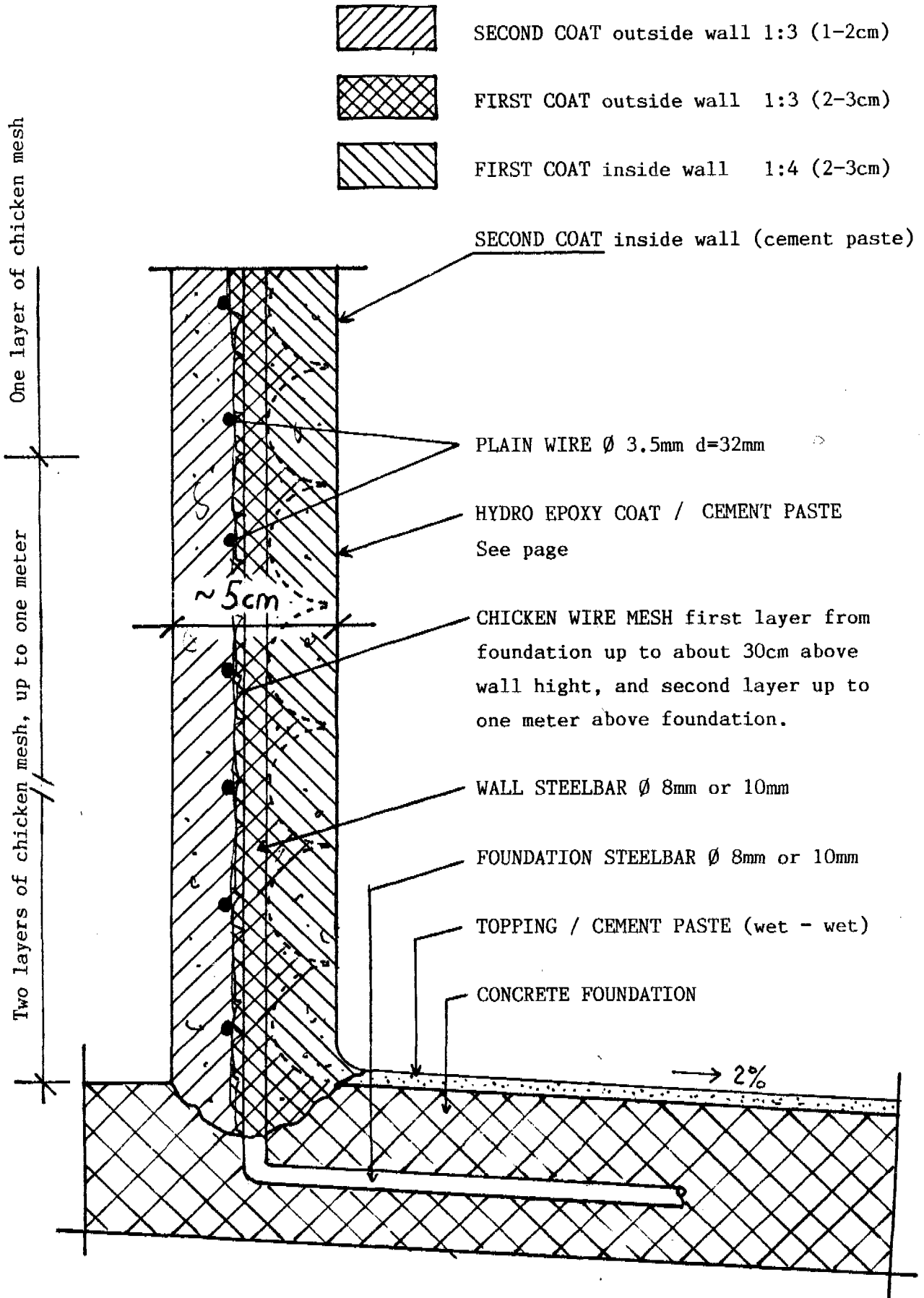
WATERPROOF PLASTERING / RUBBLE STONEMASONRY TANK

Water containing structures are plastered in order to make them completely waterproof and to get a smooth surface on which hydro epoxy coat can be applied easily.

The different coats and their functions:



WATERPROOF PLASTERING / FERROCEMENT TANK



## THE CONSTRUCTION OF FERROCEMENT TANKS

### PREFACE

This proposed schedule is meant as a guide to construct ferrocement tanks within the most shortest possible time, as well to plan the required village participation needed on each day. This time schedule will not differ much for the construction of 8 m<sup>3</sup>, 10 m<sup>3</sup> or 15 m<sup>3</sup> tanks, provided that good supervision and sufficient village participation is available.

### SITE PREPARATION

For a smooth execution following preparations have to be done in advance:

- All the required building material according material list mentioned on standard plan for the construction of ferrocement tanks is available.
- All the equipment like P.E. pipe Ø 32mm for the wall-formwork, eventually hardboard for the dome-formwork (roof), planks for strutting and bracing etc. are available.
- All the installations like washout, overflow, inlet and supply-pipes are ready.
- All the reinforcement bars according to the reinforcement-table are ready. (Number and shape of each position)
- Further it is advisable to do the hard core (sloping to the center), and the setting of the PVC support pipe Ø 50mm (filled with concrete) beforehand as well.

For the construction refere to standard plan,

"FERROCEMENT TANK" plan NO. T - 05 and T - 06

CONSTRUCTION SCHEDULE FOR THE CONSTRUCTION OF FERROCEMENT TANKS

1st day:..... Installations: washout, overflow, inlet, supply.  
Reinforcement: foundation steel bars.  
Foundation: concrete 1:2.5:4 topping wet/wet

2nd day:..... Reinforcement: wall steel bar.  
Wall-formwork: P.E. pipe  $\emptyset$  32mm  
Cover fresh topping to avoid damages.

3rd day:..... Wall-formwork: P.E. pipe  $\emptyset$  32mm  
Reinforcement: chicken wire, plain wire  $\emptyset$  3.5mm

4th day:..... Plastering: First coat 1:3 outside wall (2-3cm)  
surface rough.  
Second coat 1:3 outside wall (1-2cm)  
surface floated.  
Apply second coat after first coat  
has set.

5th day: Hardening time for plastering outside wall.

6th day: Cover the wall with suitable material and cure

7th day:..... at least three times daily.

8th day:..... Plastering: remove P.E. pipe.  
First coat 1:4 inside wall (2-3cm)  
surface floated.  
Second coat: cement paste (1-2mm), apply  
up to 5-10cm above proposed water level.

9th day:..... Reinforcement: roof steel bar.  
Manhole wood formwork (45 x 60cm)  
Plain wire  $\emptyset$  3.5mm / chicken mesh  
Roof-formwork: Hardboard

10th day:..... Plastering: First coat 1:3 outside roof (3-4cm)  
surface floated.

After 7-14 days remove roof-formwork and apply second coat 1:3 (2-3cm)  
inside (dome-roof).

## HYDRO EPOXY COAT

Hydro Epoxy is a water based system. It is consisting of part A which is the Epoxy Resin, and part B which is the Polyamide Curing Agent.

Hydro Epoxy will adhere to damp or dry surfaces. It is used as a water-proof coating inside of water-containing tanks and chambers.

Hydro Epoxy should be applied on to clean surfaces only. (Cement paste) Porous surfaces (Setting coat) should be made damp to assist application and prevent bubbles.

In well ventilated areas, the coating will be hard dry in 24 hours, but completely cured in 7 days.

### How to use

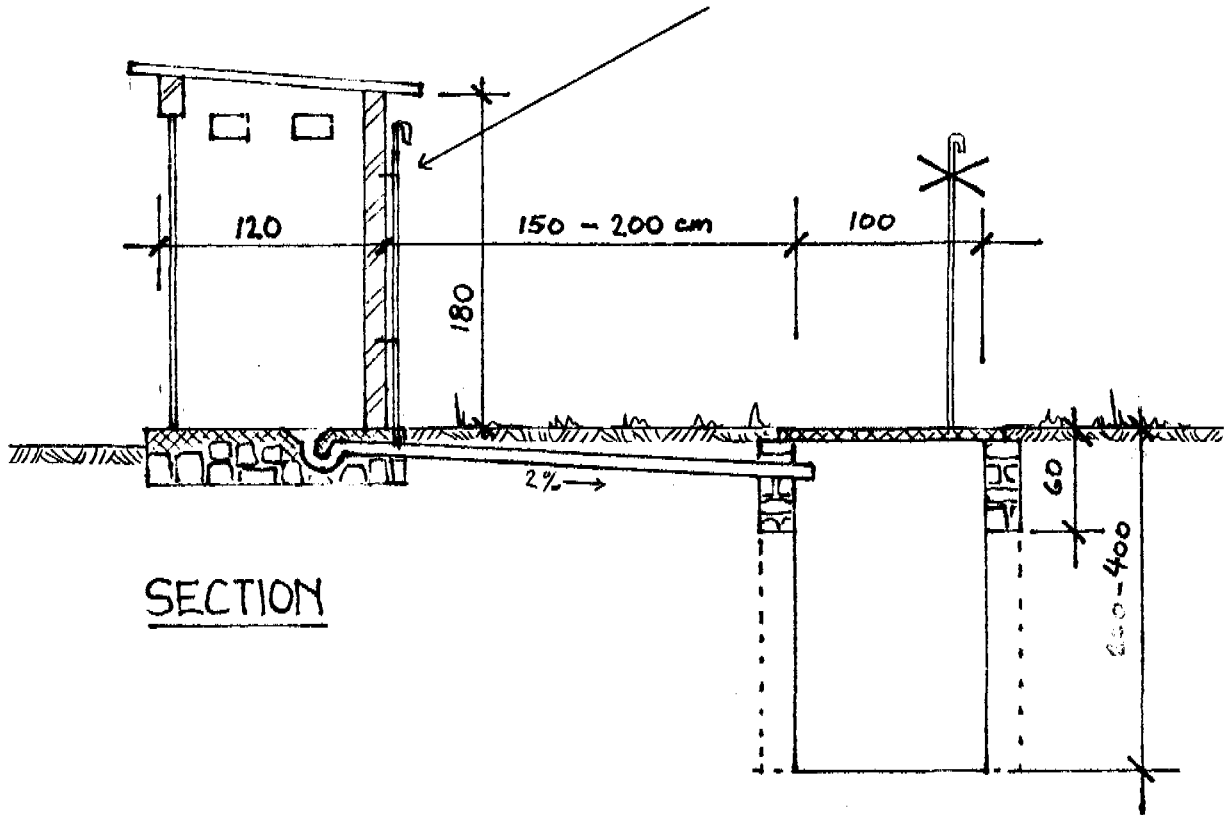
- Always add part A to part B and mix well.
- Add clean water to make up to 1 litre of paint.
- Mix well again.
- Do not devote more than 10 minutes for this operation.
- Immediately after mixing commence painting.
- For small quantities use separate tin and use half of part A and B (equal parts), add water to make up to 1/2 litre of paint.
- The volume of one plastic tin is 500 ml = 1/2 litre.
  
- Do not add water to part A or B separately. Water should be added only after mixing part A and B together.
- Do not keep prepared paint over night as it will harden.
- Do not get in contact with exposed areas like hands, arms etc.
- In case of accident, immediately wash affected area with soap and water.

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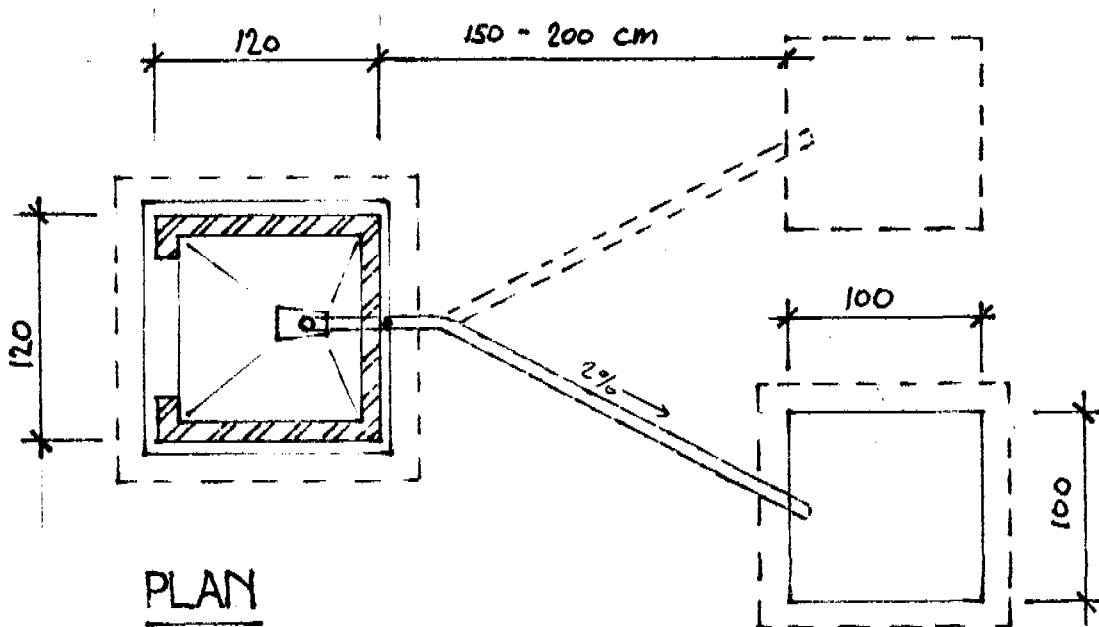
Whenever possible apply Epoxy coat before placing the roof-cover. (Precast slabs or ferrocement tank). The Epoxy coat will dry quicker if well ventilated.

WATER SEALED LATRINE / SOAK AWAY PIT

Ventilation pipe is fixed with hooks to latrine wall



Keep at least a distance of min. 150cm between latrine and soak away pit.

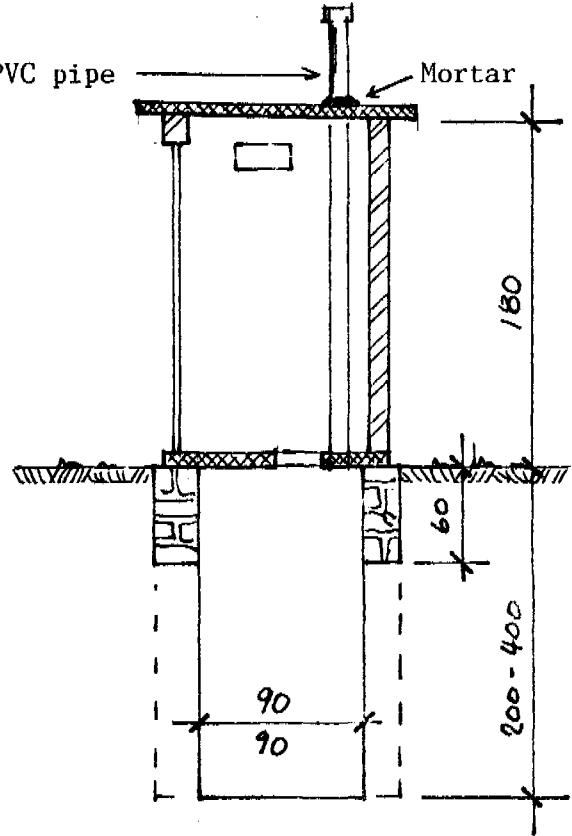
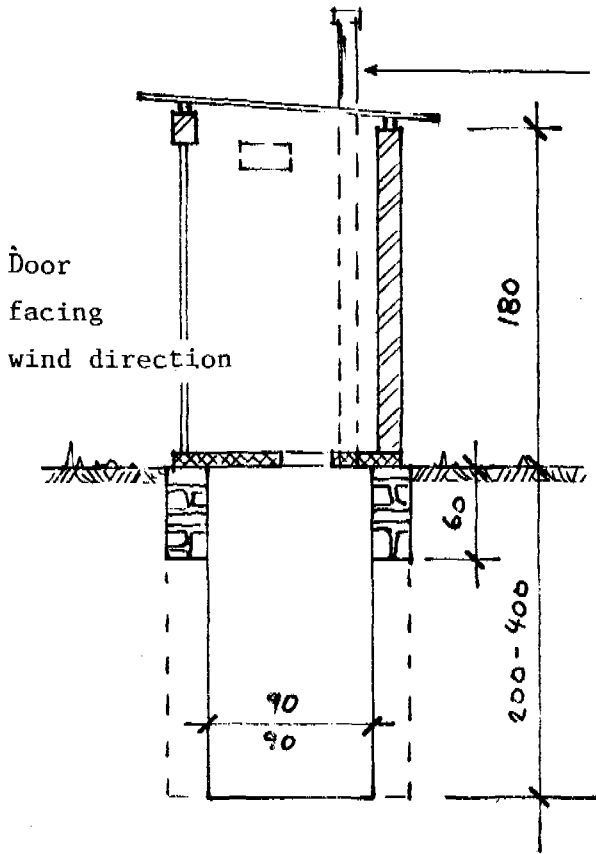




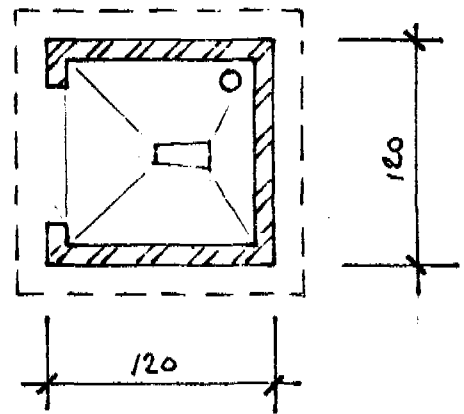
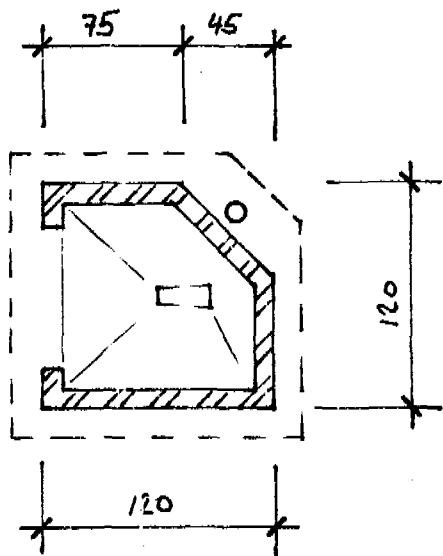
VENTILATED IMPROVED PIT LATRINE (V.I.P)

Roof cover with G.I. sheets

Roof cover with concrete slab most recommended

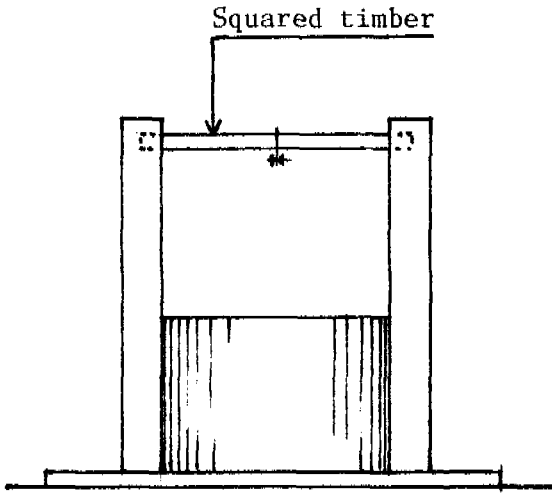


SECTION

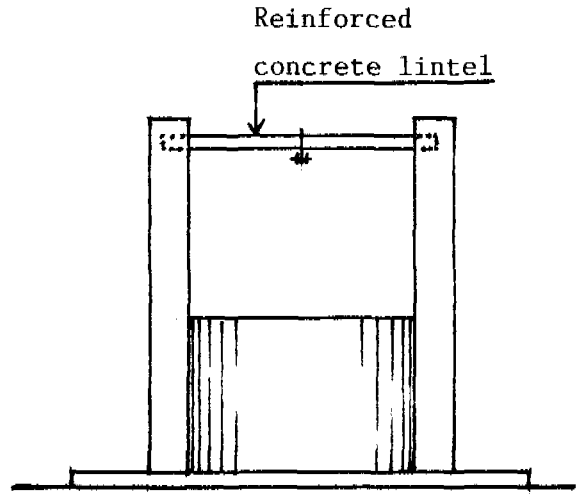


PLAN

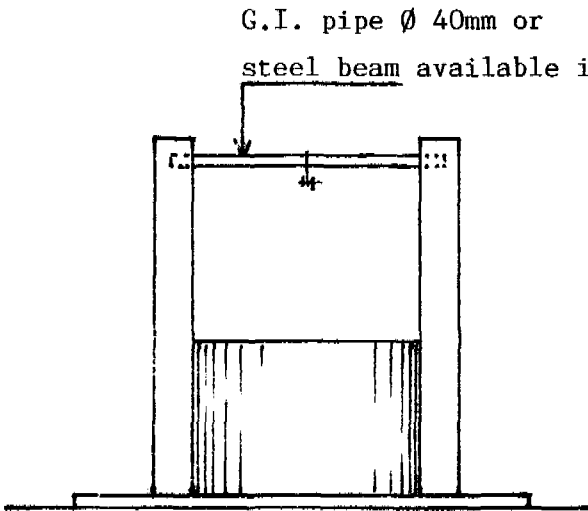
PULLEY CONSTRUCTION OVER DRINKING WELL HEAD



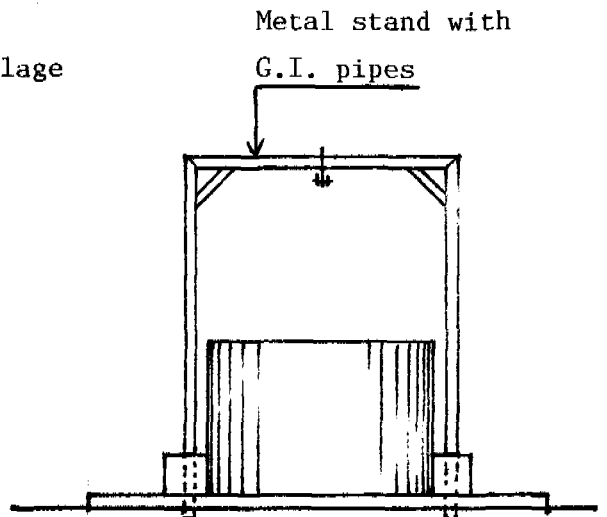
Not suitable



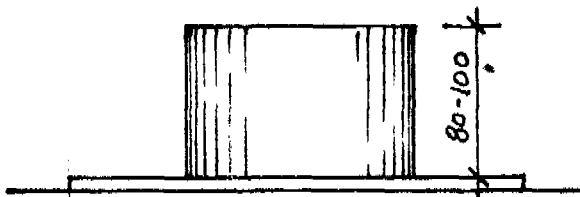
Most recommended



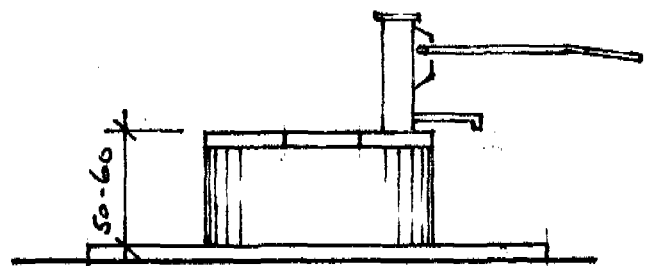
Suitable



Not recommended  
(expensive)

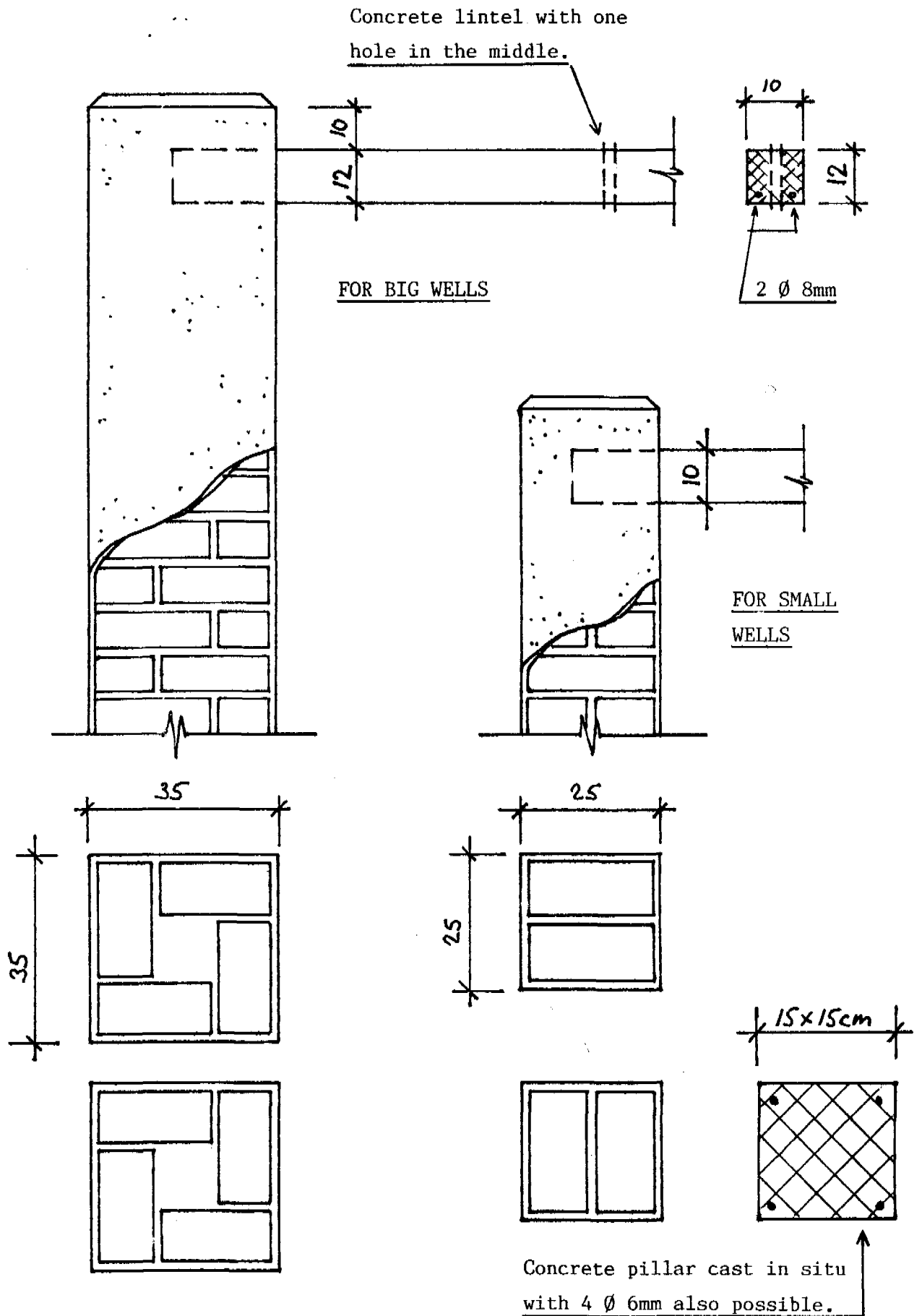


Without any protection not recommended for drinking wells.



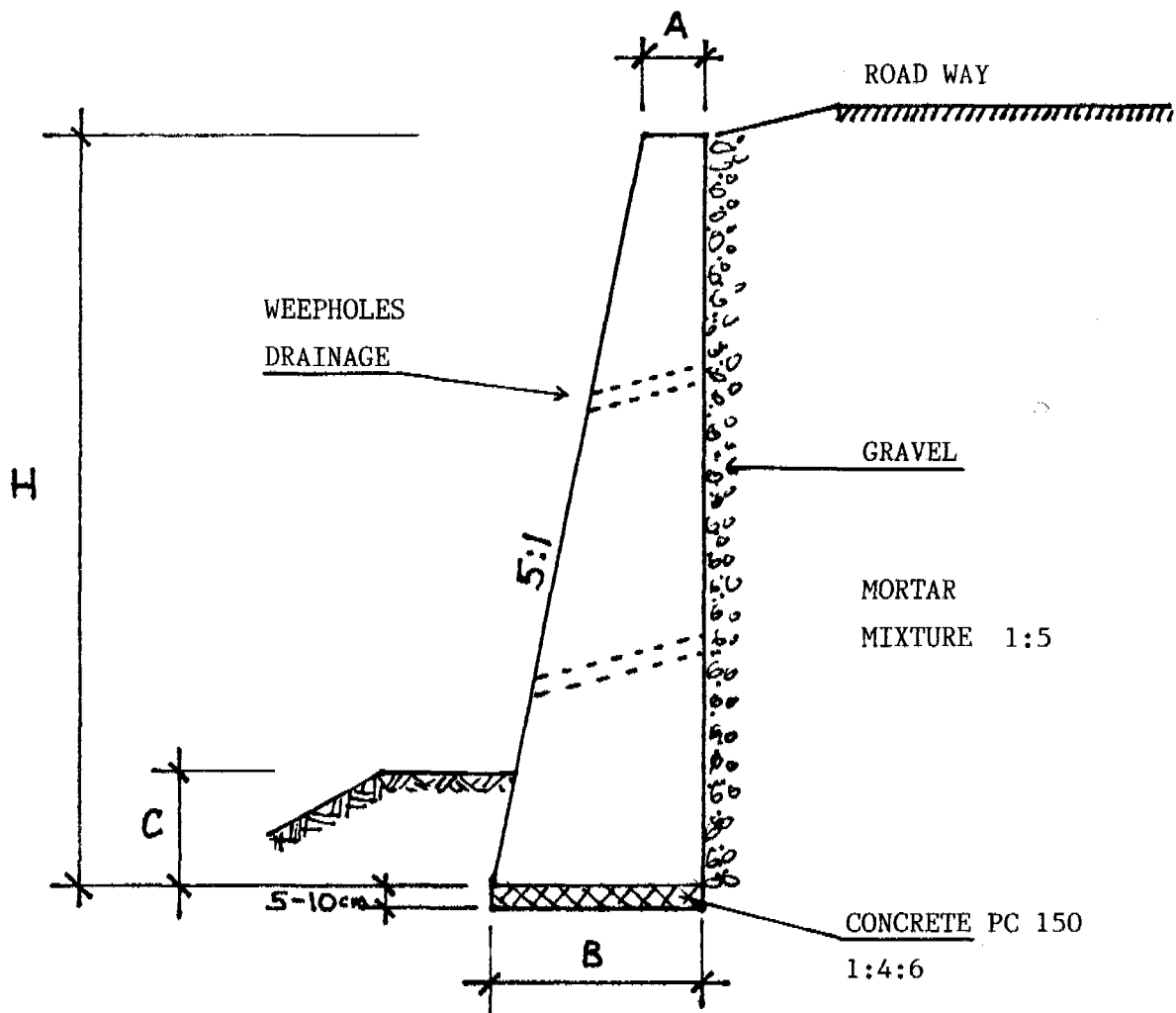
Well cover with opening 45x60cm, with or without handpump SL5  
(For details see handpump manual)

BRICK PILLAR PULLEY STAND (Traditional type)



RETAINING / WING - WALL IN RUBBLE STONEMASONRY

For rural access roads



$H =$	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
$A =$	30	30	30	30	40	40	40	40	40
$B =$	50	60	70	80	1.00	1.10	1.20	1.30	1.40
$C =$	30	30	35	35	35	40	40	40	40

Cement Bags	1	1.5	2.2	3	4.6	5.8	7	8.3	9.8
Sand m <sup>3</sup>	0.15	0.25	0.35	0.5	0.75	0.95	1.15	1.35	1.55
Stones m <sup>3</sup>	0.50	0.90	1.30	1.80	2.75	3.40	4.10	4.90	5.85

CONCRETE AND MORTAR MIXTURES

Concrete Mixtures

- PC 100 ( 1 : 6 : 10 )      Lean concrete, used for levelling uneven rock surface etc.
- PC 200 ( 1 : 3 : 4 )      For unreinforced structures only
- PC 250 ( 1 : 2.5 : 3.5 )      For ordinary reinforced concrete, like foundation, cover of tanks etc.
- PC 300 ( 1 : 2 : 3 )      For concrete with higher demand on strength, like all prefabricated slabs etc.

Topping

- Cement : Sand ( 1 : 3 )      For all toppings of structures, like tanks, standpipes etc.

After casting and screeding the concrete apply immediately a thin layer of topping and float properly. This method is the only one to obtain a smooth surface on concrete.

Where additionally cement paste is required, apply the cement paste immediately after screeding and floating the topping.

Curing

Curing means to protect the cement works from premature drying, caused by temperature and wind. Curing can be done by the community. Instruct properly and check frequently. Curing has a big influence on the quality of the works.

Curing must be done for 10 days,

- sprinkle water continuously
- cover cementwork with bags or sand and keep them wet
- fill tanks with water (after appr. two days)

Mortar Mixtures

Used for:	Ratio	Bigest Grain	Consistency
Building mortar for bricks	1 : 4	4mm	plastic
Building mortar for blocks	1 : 4	4mm	plastic / stiff
Building mortar for stones	1 : 4	4mm	plastic / stiff
Topping	1 : 3	4mm	stiff
<u>Plastering:</u>			
Spaterdash	1 : 2	4mm	slurry
Rendering coat	1 : 4	4mm	plastic
Setting coat	1 : 2	1-2mm	slurry
Pointing	1 : 2	1-2mm	plastic

QUANTITY SURVEY FOR MASONRY AND CONCRETE WORK

Rubble stonemasonry wall: (incl.pointing; per m3 wall)

Cement : 100 l (2.5 bags)  
Sand : 360 l  
Stones : 1.5 m3 (approx. 200 - 500 stones, depending on size)

Brickmasonry wall 9": (header bond; per m2 wall)

Bricks : 120 pcs  
Sand : 100 l  
Cement : 40 l (1 bag)

Brickmasonry wall 4.5": (strecher bond; per m2 wall)

Bricks : 60 pcs  
Sand : 50 l  
Cement : 20 l (0.5 bag)

Plastering waterproof: (4 - coat; per m2 wall)

Cement : 16 l  
Sand : 40 l

Topping: (3cm thick; per m2 floor)

Cement : 10 l  
Sand : 30 l

Concrete: (finished; cast and consolidated; per m3)

Mixtures :	<b>PC 300</b>	<b>PC 250</b>	<b>PC 200</b>	<b>PC 150</b>	<b>PC 100</b>
Ratio :	(1 : 2 : 3)	(1 : 2.5 : 3.5)	(1 : 3 : 4)	(1 : 4 : 6)	(1 : 6 : 10)
Cement :	240 l	205 l	180 l	130 l	90 l
Sand :	480 l	514 l	540 l	523 l	500 l
Metal :	720 l	721 l	720 l	787 l	850 l
Total :	1440 l	1440 l	1440 l	1440 l	1440 l

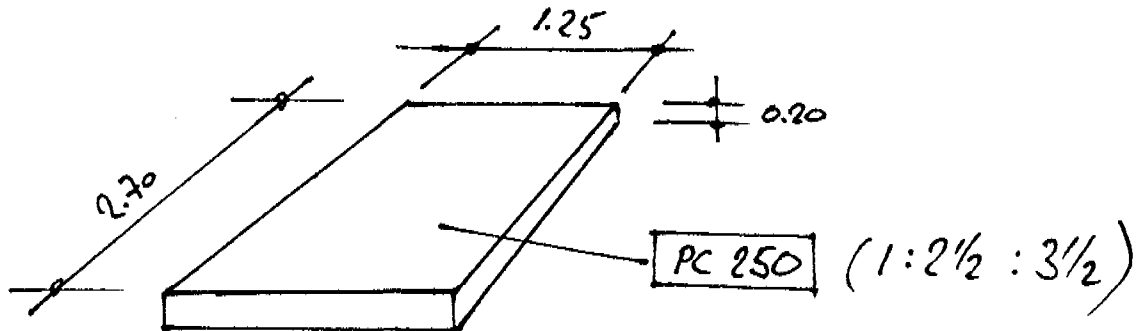
To make one m3 concrete, cast and consolidated, we need approximately 1200 l aggregates (sand and metal).

Concrete PC 300 means: 1 part cement  
2 parts sand  
3 parts metal

One bag of cement contains 40 l of cement or 50 kg.

Quantity Survey: (Example)

You have to cast the foundation of a siltbox. The measurements of the foundation are: 2.70m x 1.25m x 0.20m ; mixture PC 250. How many bags of cement, m3 sand and metal are needed?



1st Reach: Volume of foundation.

$$2.70\text{m} \times 1.25\text{m} \times 0.20\text{m} = \underline{0.675 \text{ m}^3} \text{ or } 675 \text{ l (finished concrete)}$$

2nd Reach: Cement needed.

$$0.675 \times 205 \text{ l/m}^3 = 138.37 \text{ l} : 40 \text{ l/bag} = \underline{3.5 \text{ bags}} \text{ of cement}$$

3rd Reach: Sand needed.

$$0.675 \times 514 \text{ l/m}^3 = \underline{346.9 \text{ l}} \text{ of sand}$$

4th Reach: Metal needed.

$$0.675 \times 721 \text{ l/m}^3 = \underline{486.6 \text{ l}} \text{ of metal}$$

S.R.T.S. Kandy	CONSTRUCTION SCHEDULE FOR: G.W.S. MAKAMPE (EXAMPLE)													
Structure / Section	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Spring catchment (4)	██████████			7 weeks										
Siltbox V=500L		██████████		5 weeks										
Trench digging S.B-Tank	██████████			7 weeks										
Ferrocement Tank V=8m <sup>3</sup>			██████████		4 weeks									
Trench digging Dist. Taps			██████	██████	██████	██████			10 weeks					
Constr. of Stand pipes (15)			██	██	██	██	██	██	██	9 weeks				
Various finishing work								██	2 weeks					

Planned construction period = 7 months  
 Skilled labour )\* on daily payed basis  
 1 Supervisor (SRTS) = 28 weeks x 6 workingdays/week = 168 mandays  
 2 Masons (local) \*) = 28 -||- x -||- x 2 = 336 mandays  
 Total = 504 mandays  
 Unskilled labour (Community contribution)  
 8 Villagers/day = 28 weeks x 6 workingdays/week x 8 = 1344 md