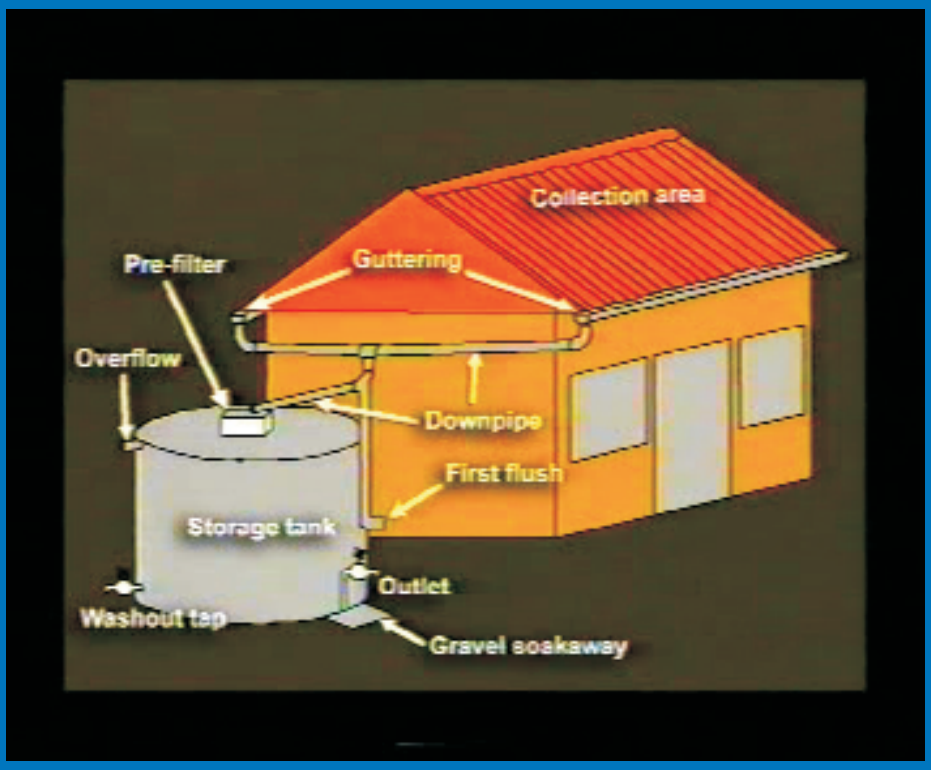

Domestic Rainwater Harvesting Tank

Training module

PRACTICAL ACTION

RAINWATER HARVESTING FROM ROOFTOPS USING FERRO CEMENT

INTRODUCTION

The recently instituted collaboration between Practical Action (formerly ITDG) and The Federation of Chambers of Construction Industry Sri Lanka (FCCISL) is prompted by the urgent need for skilled tradespersons in construction related activities. Presently there is an urgent need for providing permanent shelters for thousands of Internally Displaced Persons (IDPs) due to civil conflict and natural disasters. Apart from this immediate need, it is also imperative that occupants of houses that will be built must be provided with safe and adequate drinking water. All human settlement sites that have been chosen may not have sustainable natural sources of potable water for domestic use. For this reason, the construction of rainwater harvesting tanks has been considered important because areas with limited rainfall may not have the natural resource capacity to provide the water needs of communities throughout each year.

BACKGROUND

The Federation of Chambers of Construction Industries Sri Lanka FCCISL) is Sri Lanka's apex body of currently Fifty Five (55) private sector chambers and associations of commerce and industry including National Construction Association of Sri Lanka (NACSL), and is affiliated with Handwerksammer (HwK) Koblenz, Germany, a German chamber for skilled crafts representing more than eighteen thousand companies that has oversight of vocational training of more than ten thousand persons per annum. Presently a well equipped handwerk centre for vocational training has been operational in Kalutara and another vocational training centre has been initiated in Thrukkovil in the eastern province to serve the technology needs of the eastern province.

Practical action South Asia has over 20 years of experience throughout Asia, Africa and Latin America in the development of different types of cost effective and disaster mitigating, environmentally sensitive housing technologies including research and development on building materials. Practical Action's integrated housing services (IHS) project work includes dissemination of knowledge and sharing of expertise gathered over the years in Sri Lanka especially in post-tsunami reconstruction, as well as internationally through its partners & regional offices, to facilitate the process of disaster sensitive, cost effective, and holistic housing in order to provide solutions to the basic needs of communities through integrated housing construction programs.

Each of the above organizations has chosen to collaborate with the common aim of building the capacity of construction related tradespersons in quality construction methods and appropriate technologies relevant to building sustainable human settlements. FCCISL provides the facilities for the proposed training and Practical Action provides the technical information and training in this program. The reason for initiating a Training of Trainers (TOT) program is because many more technical officers in the local district have to be trained. Therefore, trainers must be adequately informed and equipped to build the capacity of trainees to effectively train other potential trainers.

TRAINING CONCEPT

The training concept adopted for the training program is based on a time-tested teaching/training methodology that first tells, then shows and finally lets the trainees actually do what has been taught.

1. **Tell them:** first tell the trainees **what** they should know and do and **why**
2. **Show them:** then show them **how** through the use of visuals and clear descriptions
3. **Let them do it:** finally involve the trainees in the actual construction of the prototype model toilet

The focus of the training will be on the actual step-by-step construction of a typical eco-san toilet in which trainees get hands-on experience in constructing a toilet from the top of a ready built foundation to the roof as well as an adjacent plant bed. **The overarching requirement of quality must be emphasized throughout the training program.**

ADVICE TO TRAINERS

Trainers are required to become thoroughly familiar with the training document and be sure to adopt the above described training concept in implementing the training program. All instruction must be clear, audible and readily understood by all trainees. Invite trainees to inform the trainer on occasions when things said are unclear. Be helpful and courteous when communicating with trainees. Be positive and enthusiastic when discussing the importance and usefulness of rainwater harvesting. Keep in mind that many trainees will have many questions to ask because of being unfamiliar with rainwater collection systems. They have to be assisted in developing a positive view of its relevance and usefulness in specific locations where annual rainfall does not meet the annual water needs of people. It is vital to **emphasize the importance of ensuring quality** in all aspects of construction of Ferro cement rainwater tanks. This can best be done when instructing at lecture sessions as well as in actual construction of the prototype model that trainees will share in building. **Trainers must endeavour to make lecture sessions interactive** by asking questions and inviting questions and opinions from trainees. Also stress the need for punctuality and active participation, not passive listening and observing only, throughout the program. Each trainer must be conscious of sticking within the time allocated for each session and plan each session accordingly. The training will cover five full days as indicated in the schedule given below.

It is essential that all needed equipment and tools need for each day's activities as well as handout documents are on hand at the start of each day. For lecture sessions, ensure that flip charts and marker pens etc. are on hand. It is advisable for trainers to make a checklist of what is required, thereby ensuring that training sessions move smoothly. It is important to ensure that all participants fill in the attendance register daily, and fill out and forward the evaluation form each will be given at the end of the program.

On the first day of the program invite all participants to introduce themselves and indicate which institution they represent. The trainer who introduces the program must give a brief overview of what will be covered during the five day period of the training. At the beginning of each day the trainer opening the day's sessions must outline the program for the day.

It is best for two trainers to share in conducting training sessions in order to introduce variety and sustain the interest of the participants. Ideally a single trainer will instruct for 30 minutes the most and will be followed by the next. Both trainers will take turns in sharing instruction. However, in practice each trainer may have to conduct training instruction for 45 to 60 minutes.

At the end of the five day TOT program a report (joint report in the event of two trainers sharing in instruction) must be prepared and forwarded to FCCISL. The report will be brief and cover the following:

- Number of participants each day along with daily attendance sheets
- Brief description of trainee participation level
- Noteworthy problems and how these were or can be overcome
- Comment suggestions on the logistics in relation to arrangements for accommodation, meals etc.
- Summary of evaluation responses along with evaluation forms submitted by participants
- Any noteworthy features or suggestions for improvement of the TOT program

Trainers are encouraged to carry out their assignment with **a sense of commitment and dedication**. These positive qualities along with **genuine enthusiasm** are likely to rub-off to trainees who are potential trainers and eventually contribute to the success of the total program.

WHY HARVEST RAINWATER?

Many communities in areas with low annual rainfall experience difficulty in obtaining a sustained supply of water for drinking and cooking and washing. Rainwater harvesting from roofs of houses using Ferro cement collection tanks has been used successfully in many parts of the world including Sri Lanka. Annual rainfall in the wet and dry and intermediate zones of Sri Lanka is adequate to initiate rain water harvesting in all three zones. The lower sides of the roof of the house must be fitted with adequately sized rainwater gutters to collect and direct the run-off rainwater. UPVC gutters are preferred to Galvanized Iron gutters that corrode easily. A simple, controllable diversion system is employed to channel run-off rainwater from the roof into an above-ground tank made of Ferro cement. Using simple filters, dust and other particles in the run-off water have to be filtered before the water enters the storage tank. The choice of Ferro cement for tank construction is guided by considering cost optimization, replicability and performance characteristics as well as acceptance by beneficiary communities. If cheaper options that ensure adequate strength and durability are available elsewhere, these can be adopted after consultation with beneficiaries.

The benefits from harvesting rainwater from rooftops are many:

- Eliminates or reduces time spent by women to fetch water from distant sources
- Rainwater harvesting systems are integrated with the house, which makes water readily accessible
- Encourages water conservation and self-dependence
- Rainwater is naturally soft unlike most well water
- Rainwater is relatively contamination free, thereby reducing the risk of water borne diseases.
- Properly stored water can be used for drinking and cooking and washing
- Ground water sources are increasingly depleted or getting polluted. Bore wells are silting up, or running out of water due to over-harvesting, thereby making ground water unreliable or unsafe.
- The use of Ferro cement for tank construction is cost-effective and proven in Sri Lanka
- Skill for Ferro cement technology can readily be passed on to masons who can use their acquired skill profitably in replicating rainwater harvesting tanks.

Some disadvantages of collected rainwater are:

- The initial cost of construction of the tank and associated mechanisms.
- Rainwater is mineral-free and has a flat taste and is not popular for drinking.

- The quantity of available stored water is limited by the size of the rainfall Catchment area and storage capacity.
- The user/s must learn to ration use of water during dry seasons
- Inadequate maintenance can lead to contamination of the stored water

WHY FERRO CEMENT?

Ferro cement technology is extremely simple to implement and semi skilled workers can learn it with ease. It can be used to construct a tank for storage of safe drinking water. It has a high degree of impermeability and resistance to cracking and has a long life. Ferro cement requires only a few easily available basic materials: cement, sand, Galvanized Iron (GI) wire mesh and Mild steel (MS) bars in small amounts and is cost-effective. Ferro cement is thinner and lighter than poured concrete and has greater tensile strength and flexibility than ordinary concrete because it has wire reinforcement distributed throughout the structure. It is relatively more economical than steel or concrete. Its maintenance is minimal and less costly and easy to repair in case of local damage. The Ferro cement rainwater harvesting tank detailed in this document consists of a skeletal cage that is overlaid externally and internally with a cement rendering

CONDITIONS FOR ADOPTION

- Rainwater harvesting from roof tops is most suited to areas of water scarcity. This may be due to low annual rainfall or potable water sources being too distant from users and sometimes difficult or expensive to carry or transport.
- Adequate seasonal rainfall must be available in the area. For example during the monsoon period/s.
- The roof must be adequately sloped RCC flat roof (20), clay tile (min. 300), and corrugated sheet roofing (min. 100). Thatch roof is unsuitable because of problems of dirt and other contamination.
- A catchment area (roof) of 160 to 215 sq. ft. (15 to 20 sq. mtrs) or above is sufficient.
- Roof gutters must be adequately sloped to facilitate flow of run off water from roof to down pipes that lead to rainwater collection tank. Gutters must be at a higher level than the mouth of the tank.
- Simple water diversion mechanism must be used to direct unclean water away from the collection tank as and when needed.

OPERATIONAL PRECAUTIONS

In order to have potable drinking water, the following precautions must be taken:

- Smooth roof surface without excess debris (leaves etc.) is desirable for easy flow of water
- The roof should not be under trees or to close to overhanging branches of trees to prevent dirty leaves and bird droppings from falling on it.
- Gutters must be kept free of dirty leaves etc. to promote free flow of run-off water
- The tank must be properly sealed to keep out mosquitoes, lizards and other insects and vermin.
- Ensure that sunlight does not enter the tank
- Before the onset of the monsoon or rainy period or after two rains, the roof and gutters should be properly cleaned and water diverted away from the storage tank when cleaning. Also the rainwater must be briefly diverted at the time the rain begins to fall at the start of the rainy period. This will ensure that only clean water is collected.
- Filters must be cleaned periodically to remove impurities and dirt etc.
- The Ferro cement tank must be cleaned periodically, at least before each rainy season

- All joints and bends in pipes should be regularly checked for leakage and repaired as necessary.

THE BASIC ELEMENTS OF A RAINWATER HARVESTING SYSTEM

- Collection area (usually roof of building)
- Conveyance system (gutters and down pipes)
- Filtration / treatment (gravel, sand, charcoal, metal or plastic mesh installed in gutters or entry to tank)
- Storage (tank or cistern)
- Usage / recharge (maintenance)

QUALITY OF WATER

Whether collected and stored rainwater is suitable for a particular purpose depends on the criteria or standards of acceptable quality for that use. The physical as well as the chemical quality of water is important to decide its suitability for drinking. Usually the parameters for water analysis include: ph, conductivity, total dissolved solid, total hardness, calcium, magnesium, sodium etc. The standards would usually indicate acceptable/ desirable standards as well as permissible standards. For these reasons it is important to carry out an analysis of the water before deciding how it may be used.

It is important to ensure that the storage tank has a tight cover with dark storage conditions to prevent growth of algae and breeding of mosquito larvae. Periodic cleaning of the tank is vital to maintain water quality.

TREATMENT OF STORED WATER

Care must be exercised in treating water for drinking. Chlorine or alum has been used in treating water to improve its quality. Advice from qualified health authorities must be sought before using these purifying agents. In most places the collected rainwater is used without treatment by boiling the water for drinking purposes. Even if the water is filtered by some means, it is vital that water must be boiled for drinking.

MAINTENANCE

Maintenance of rainwater harvesting systems is of great importance. Major concerns are prevention of contamination of the tank during construction and while it is being replenished during rainfall. For this reason proper materials must be used to construct the tank and finish its surfaces. It is important to prevent entry of insects, bird and animal droppings into the collection tank. Note that the first flush after rainfall should be diverted away from the tank. Usually water captured in the first ten minutes after rain begins to fall is unsuitable for drinking. The storage tank must be checked and cleaned periodically. Cleaning procedures consist of thorough scrubbing of the inner walls and floor. Use of a chlorine solution (chlorine and water) is recommended for cleaning, followed by a thorough rinsing. Gutters and down pipes must be inspected and cleaned periodically. Households must establish a maintenance routine that will be carried out by family members. For more details of maintenance, see subheading; Operational Precautions.

If the Ferro-concrete sides of the tank gets damaged. The tank can be emptied and fresh cement mixed with a suitable waterproofing/bonding agent can be applied and allowed to dry and cure.

TIME SCHEDULE FOR RAINWATER HARVESTING TANK WORKSHOP

Total days: 4 days and 1 ½ days: Total 5 ½ days

Four sessions daily totaling 6 hours of workshop activity not including tea and lunch breaks

Day 1	Time	Activity.
	09.00 – 11.00 a.m.	Session 1 (2hrs) Registration, introduction, coverage of information on pages 3&4 of training module.
	11.00 – 11.30 a.m.	Tea
	11.30 – 01.00 p.m	Session 2 (1 ½ hrs) Set out base and build base
	01.00 – 02.00 p.m.	Lunch
	02.00 – 03.30 p.m.	Session 3 (1 ½ hrs) Complete cementing of base
	03.30 – 03.45 p.m.	Tea
	03.45 – 04.45 p.m.	Session 4 (1 hr)) Place bolts in concrete base and allow to cure.
	09.00 – 11.00 a.m.	Session 1 (2 hrs) Fabricate removable framing components
	11.00 – 11.30 a.m.	Tea
	11.30 – 01.00 p.m	Session 2 (1 ½ hrs) Fabricate removable framing components
	01.00 – 02.00 p.m.	Lunch
	02.00 – 03.30 p.m.	Session 3 (1 ½ hrs) Fabricate removable framing components
	03.30 – 03.45 p.m.	Tea
	03.45 – 04.45 p.m.	Session 4 (1 hr) Fabricate removable framing components
	09.00 – 11.00 a.m.	Session 1 (2 hrs) Place framing components and tie circular ring.
	11.00 – 11.30 a.m.	Tea
	11.30 – 01.00 p.m	Session 2 (1 ½ hrs) Install wooden props inside tank framework. Attach metal hoops around tank
	01.00 – 02.00 p.m.	Lunch
	02.00 – 03.30 p.m.	Session 3 (1 ½ hrs) Cut 7' lengths of chicken wire and place over tank frame surface.
	03.30 – 03.45 p.m.	Tea
	03.45 – 04.45 p.m.	Session 4 (1 hr) Attach chicken mesh on base to sides of tank. fabricate cylindrical mesh to hold filter bucket
	09.00 – 11.00 a.m.	Session 1 (2 hrs) Render first coat of cement on mesh
	11.00 – 11.30 a.m.	Tea
	11.30 – 01.00 p.m	Session 2 (1 ½ hrs) Render second coat of cement on mesh
	01.00 – 02.00 p.m.	Lunch
	02.00 – 03.30 p.m.	Session 3 (1 ½ hrs) Fabricate lid for tank
	03.30 – 03.45 p.m.	Tea
	03.45 – 04.45 p.m.	Session 4 (1 hr) Provide holes in filter bucket and place washed pebbles and charcoal inside bucket
	MINIMUM TWO-DAY BREAK (Cure Ferro cement)	
	09.00 – 11.00 a.m.	Session 1 (2 hrs) Install scaffolding. Remove ten (10) frames
	11.00 – 11.30 a.m.	Tea
	11.30 – 01.00 p.m	Session 2 (1 ½ hrs) Render coats of cement on walls of tank
	01.00 – 02.00 p.m.	Lunch
	02.00 – 03.30 p.m.	Session 3 (1 ½ hrs) Render cement on base of tank
	03.30 – 03.45 p.m.	Tea
	03.45 – 04.45 p.m.	Session 4 (1 hr) Apply waterproof slurry inside tank
	09.00 – 11.00 a.m.	Session 1 (2 hrs) Place lid on tank, fit filter bucket, remove scaffolding, clean up
	11.00-11.30 a.m.	Tea
	11.30 – 01.00 p.m	Session 2 (1 ½ hrs) Final discussion
	01.00 – 02.00 p.m.	Lunch

Note: each trainer can divide the time allocated for each session between them. In a 2 hour session each will conduct 1 hour of the session, and in a 1 ½ hour session each will conduct ¾ hour of that session.

Model tank capacity

The capacity of the model tank that will be fabricated at the training workshop is 5,000 liters. The size of the tank and the specifications for reinforcements are suited to Ferro cement tanks of the above capacity. Larger tanks will require different specifications. Do not attempt to fabricate larger tanks with the materials and specifications for the model tank applied in this training workshop.

Refer the photographs and drawings shown in sequence along with the details given below.

Location of rainwater harvesting tank

The tank must be located close to the house it serves and positioned to receive rainwater from the gutters of the house. The gutters of the house must be higher than the level of the tank where water enters it. Usually the gutters must be at least 9 feet above ground in order to supply a 5,000 litre tank identical to the model tank demonstrated at this workshop.

Construction of base for tank

- First level the area where the tank is to be located and mark on the ground a circle with a radius of 2' 9". Then mark off a square 3' 0" x 3' 0" around the marked circle.

1- Mark off 2'-9" circle

2- Mark off 3'-0" square

- Excavate a shallow trench 12" wide and 9" to 12"deep along the four edges of the square. Fill the excavated trench with stone and mortar to form a perimeter foundation.
- Fill the area within the stone foundation with sand and compact the sand.

3- Excavate shallow trench

4- Cement the stone foundation

5- Cement the brick layer

- Place a single 9 "wide layer of kiln dried clay bricks with cement mortar centrally on the surface of the 12" stone foundation to from a square.

- Cut two lengths of 4" off a 1½ "diameter PVC water pipe and attach each to a 1½ " diameter PVC elbow joints and fix a length of pipe to the other side of each elbow bend. The 4" length of pipes must be turned upwards and placed close to the centre within the square with the longer lengths placed over the layer of bricks on one side of the bricked square and firmly supported beneath. One pipe is a draw-off pipe that has a tap at its end. The other pipe is the wash-out pipe that has to be placed on a side different to the draw-off pipe. It is possible to use one pipe to serve as outlet and flush out. If so, the 4" upturned pipe must be removable (not fixed with gum).
- Within the area of the border of bricks lay 1:2:4 concrete mix to a depth of 2 ½ ". Ensure that the PVC pipes are firmly embedded.
- Mark off a circle 2'- 4" radius (4'- 8" diameter) centrally on the prepared base.


6- Place draw-off pipes


7- Place concrete


8- Mark off 2'- 4" circle

- Cut four (04) 4'x 2' lengths of chicken mesh and place two (02) lengths adjacent to each the base and place the other two lengths adjacent to each other in the opposite direction of the chicken mesh beneath. Bind the panels of mesh together with binding wire. Place the double layered mesh on the prepared base. Cut holes in the mesh to allow the upturned PVC pipes to penetrate.


9- Place 2 layers chickens mesh


10- Cut mesh around pipes


11- Place PVC strip at pipes

- Cement a single row of kiln dried clay bricks around the outer side of the marked circle.
- Cut a piece of PVC sheet to place around the protruding PVC pipes and use a heated rod to create two holes in the PVC to fit around the upturned pipes and press the PVC sheet firmly down on the chicken mesh.
- Mark off a circle 4' 0" diameter centrally within the 4' – 8" diameter circle on the base and place ten (10) nos. ¼" dia. 2 ½ " steel bolts (head down) through the chicken mesh within the perimeter of the 2' diameter circle. Make sure that the steel bolts are placed equidistant from each other and pour 1½" layer of concrete 1:2:4 mix on the layers of chicken mesh. Make sure that the threaded ends of the embedded bolts are not covered with concrete.
- Smoothe the surface of the concrete.
- Allow the concrete to cure for one (01) day.
- Remove the row of brick after the concrete is cured

12- Place bricks around 4'-0" circle

13- Place bolts within circle

14- Lay concrete within brick circle

15- smoothen concrete surface

16- Remove row of bricks

Fabrication and erection of the skeletal framework

- Fabricate ten (10) curved metal frames out of 1 ½ " wide x ¼ " thick mild steel flat as per drawings. The inside of the curve must be strengthened with ¼" x ¼ " mild steel rib. The leg of each frame must be provided with a hole of appropriate diameter in order to fix the frames to the fixed bolts in the base. The top of each frame must be provided with a suitably sized metal bracket as shown in the drawings.
- Fabricate a metal ring of 3'-0" diameter to be fixed at the mouth of the tank to hold the vertical frames together.
- Screw down nuts holding the frames at each upturned bolt and tighten them after ensuring that distances between frames are equal.
- Use coir rope to tie the fabricated metal ring to brackets at the top of the vertical metal frames
- Use wooden poles or strong sticks as props in order to stabilize the metal framework as shown in illustrations
- Cut several 12" lengths of binding wire for tying circular metal hoops (6 mm) to the vertical framework. Tie the 6mm metal hoops around the metal frames using binding wire. The metal hoops must be placed horizontally parallel to each other at approximately 6" centres. The ends of each hoop must overlap and be tied with binding wire.

17- Fix the metal frames

18- Tighten nuts at frames

19- place ring at top of frames

20- Tie ring to top of frames

21- Fix metal hoops to frames

22- Place props inside framework

Fixing of mesh over skeletal frame

- Lay 7' x 4' lengths of chicken mesh on the entire outer surface of the skeletal framework and tie the mesh to the metal hoops only, using binding wire.
- Wrap a second layer of chicken mesh around the outer surface of the first layer of mesh and tie the mesh to the metal hoops with binding wire. Make sure that joints of the bottom and top layers of mesh are covered or overlapped.
- Firmly pull the double layer of chicken mesh, at the base, upwards and around the already fixed mesh on the sides of the tank structure. Secure the base layer of chicken mesh to the metal hoops with binding wire

23- Place chicken mesh on frames

24- Fix chicken mesh to frames

25- Fix base layers of mesh

- Prepare a cylindrical shaped roll of chicken mesh that is sized so as to accommodate a plastic bucket (typically 1 2 litre bucked used for paint). Provide for a 10" extension of the mesh cylinder. Make about 4 or 5 cuts to a depth of 10" in the extended part of the cylinder as shown in the drawing. Place the mesh cylinder on the top surface of the tank structure in a location closest to the incoming rainwater pipe from the gutters of the building. Tie the splayed ends of the **cylinder to the mesh envelope and metal hoops.**

26- Fabricate mesh cylinder

27- place mesh cylinder on tank

Laying and curing the Ferro cement outer layer

- Sieve a quantity of sand finely.
- Prepare a cement mix 1: 3 to a workable stiff paste and place ¾" thick cement rendering on the outer surface of the chicken mesh. Place a second layer ¾" thick over the first layer of cement. It is important to place both layers of cement on one day.
- Place the prepared cement mix on the raised lip at the top of the tank. The finished lip must be 3" high and 1 ½ " thick. Also place cement on the chicken mesh cylinder.
- Smoothen the outer surface of the cement before the rendering dries
- Leave the cemented structure to cure for two (2) days. Keep the tank moist and under shade. Gunny bags (Jute hessian) can be used on the top surface and these can be kept wet during the curing period. Spray water on the outside of the tank regularly during the curing period.

28- Place first layer of cement

29- Place second layer of cement

30- Place cement at base

31- Smoothen outer surface

32- Smoothen lip of tank

33- Allow tank to cure

Laying the Ferro cement inside the tank and curing the tank

- Set up sturdy scaffolding around and over the tank so it can be accessed through the opening at the top. A workman can then climb into the tank and unscrew the bolts of the ten mild steel frames and remove the frames along with the metal ring that linked them together at the top.
- Prepare a cement mix 1: 3 to a stiff paste and place ¾" thick layer on the inside of the tank.. The base should be given a layer of cement to a thickness of 1" up to a height of 12"
- Prepare a slurry mixture with a suitable waterproof agent (Pudlo) and smoothen the inside of the tank surface
- Allow the inside of the tank to cure for 14 days and ensure that the surface is kept wet thought the curing period.
- Six (6) days after the curing period fill the tank slowly, 12" at a time.

34- Erect scaffolding - enter tank

35- Remove nuts at frames

36- Remove frames

37- Take frames outside tank

38- Prepare waterproof slurry

39- Smoothen inside with slurry

Fabricating the cover of the tank

- Form a ring with a mild steel flat to 3'- 0" diameter.
- Place a ¾ " layer of cement 1:3 mix on a flat surface covered with a sheet of polythene. Place two 6mm bars perpendicular to each other on the surface of the cement layer. Place a layer of chicken mesh within the ring and attach a pre-formed metal handle to one of the cross bars. Place a second layer of cement 1: 3 mix within the metal ring and allow the tank cover to cure.
- After curing, place the tank cover firmly over the mouth of the tank.

40- Place cement in MS ring

41- Place mesh & handle

42- Lay cement on mesh

43- Allow cover to cure

Fabricating and fixing the filter

- Take a standard empty plastic bucket (typically 2 litres bucket for paint) and pierce holes on the sides and bottom with a heated rod as shown in the illustrations.
- Place a layer of washed pebbles at the bottom of the bucket
- Place a layer of charcoal on the layer of washed pebbles. Leave some space at the top of the bucket.
- Secure a net around the mouth of the bucket and place it inside the Ferro cement cylinder at the top of the tank.

44- Heat metal rod

45- Pierce holes in bucket

46- Place pebbles & charcoal

47- Cover bucket with net

48- place bucket on tank

49- Fix draw-off pipe tap

Fitting the supply pipe and overflow pipes

- Tie a net around the mouth of the overflow pipe to prevent insects from entering the tank
- Place a 3 ½ " (9 cm) PVC pipe that runs from the water filter to the rainwater gutter system of the building.
- Fabricate and fix 3 ½ " (9 cm) PVC pipes to connect with the gutters of the building as illustrated. The flush pipe must be fitted with a stopper that can be removed and re-fixed. This permits the initial run-off water from the roof to be diverted away from the tank. After the first flush of run-off water, the stopper is replaced at the end of the down pipe.

50- Tie net on overflow pipe

51- Install rain water pipes

52- Install run-off pipe

53- Fix stopper to runoff pipe

Use 3 ½ " (9 cm) PVC for gutters and down pipes

ITEMS NEEDED FOR GUTTERS AND DOWN PIPES

ITEM	DESCRIPTION	UNIT
01	Running head 3 ½ " (9 cm) PVC	01
02	Tee bend 3 ½ " (9 cm) PVC	01
03	Elbow bend 3 ½ " (9 cm) PVC	02
04	Valve socket 3 ½ " (9 cm) PVC	01
05	Threaded end cap 3 ½ " (9 cm) PVC	01
06	Down pipe 3 ½ " (9 cm) PVC (length as needed)	01
07	Down pipe clips for 3 ½ " (9 cm) PVC down pipes	08

MATERIALS REQUIRED

The table below describes the material required for constructing a rainwater harvesting tank of 5,000 Litre capacity.

MATERIALS FOR RAINWATER HARVESTING TANK (5,000 litres)

Item	Description	Quantity
01	Cement	12 bags
02	Chicken mesh (2'-0" wide)	50 mtr
03	Binding Wire (20 gauge)	01 kg
04	Binding wire(18 gauge)	01 kg
05	PUDLO cement	01 kg
06	Nut/bolt set (1/4"dia. x 2 ½")	10 Nos.
07	0.5" Tap	01
08	0.5 Set socket	01
09	0.5" PVC pipe	02 mtr
10	1.5" PVC pipe cap	01
11	1.5" PVC pipe	02 mtr
12	1.5" elbow joint	02
13	0.5: elbow joint	01
14	0.5" pipe valve socket	01
15	PVC gum (100 grms)	01
16	Side cup	01
17	Gutter brackets	04
18	Plastic bucket (standard paint bucket 2 litres)	01
19	Running head PVC	01
20	Metal aggregate	0.5 cube
21	Stones for foundation	0.25 cube
22	Fired clay Bricks (standard)	75 Nos
23	Tor steel (6mm)	25 kg
24	Metal ring	01 No.
25	PVC gum (100 grms)	01 No.
26	Side cup	01 No.
27	Gutter brackets	04 Nos.
28	Mild steel flat – 10'-0" length x 1 ½" x ¼ " (for frames)	10 No.
29	Mild steel square bar – 9' 0" length ¼" x ¼" (for frame ribs)	10 No.
30	Insect net – 24" x 24"	01 No.
31	Pair of pliers	03 No.