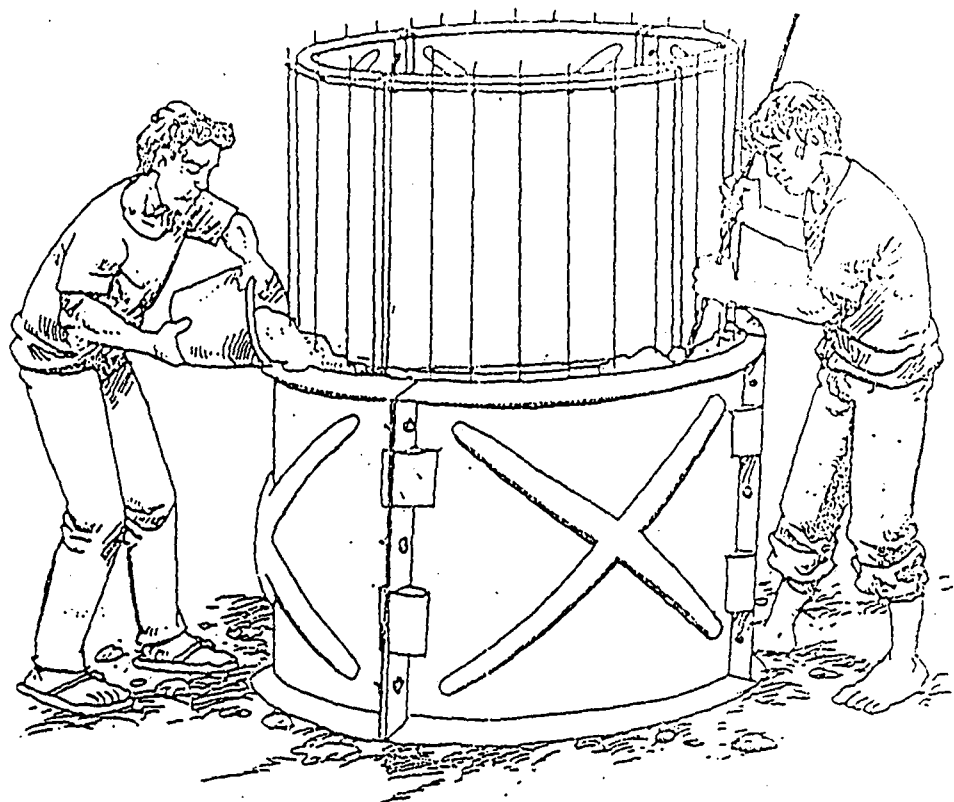


IST Draft.

MANUAL FOR
CONSTRUCTION OF RAIN COLLECTOR TANKS
USING FIBRE GLASS MOLDS



PREPARED BY
UNICEF, LUSAKA.

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Table of contents

| | Page |
|---|------|
| Constructions Type and Specifications.. .. . | 1 |
| Selection of site for the construction of RWCT | 2 |
| Tools and Materials needd to construct RWCT | 2 |
| Construction of rainw ater collelctor tank (RWCT) | 4 |
| Foundation | 4 |
| Construction of working floor and foundation | 5 |
| Prepare the reinforcement bars for the RWCT | 5 |
| Assembling the floor reinforcement | 7 |
| Assembling wall mold and casting RWCT walls | 7 |
| Casting cover for the RWCT | 8 |
| The last Works.. .. . | 9 |

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List of figures:

| | Page |
|--|------|
| 1.1: Diagram for the construction of RWCT.. .. . | 10 |
| 1.2: Type of Foundation.. .. . | 11 |
| H1: Draw a circle of diameter 1 meter with the rope and the wooden peg. .. . | 13 |
| H2: Make a hole of depth 10 - 12.5 CMS within the circle drawn. .. . | 13 |
| H3: Make the mixture. .. . | 14 |
| H4: Fill sand in the circular hole made. .. . | 14 |
| H5: Compact the sand filled to have a layer of 5 - 7.5 CMS. .. . | 15 |
| H6: Fill the hole with the concrete .. . | 15 |
| H7: a, Cover reinforcement .. . | 16 |
| H7: b, Floor reinforcement .. . | 17 |
| H8: Draw a circle of diameter with 1.86 CMS with a rope and wooden peg. .. . | 18 |
| H9: Drive the pegs (20 CMS apart) all along the circular pits. .. . | 18 |
| H10:a, Bend rods to form circular rings by bending along the pegs driven. .. . | 19 |
| H10:b, Join the ends of the rods with binding wire. Make 9 such rings. .. . | 19 |
| H11: Assemble the floor reinforcement .. . | 20 |
| H12: a, Assemble 2 sets of inner wall mold. .. . | 21 |
| H12: b, Bending of the reinforcement bars .. . | 21 |
| H13: Cast the concrete of RWCT floor and leave it to dry for one hour. .. . | 22 |
| H14: Apply solar/used oil to the inner wall mold .. . | 23 |
| H15: Assemble the inner wall mold on the floor surface constructed .. . | 24 |
| H16: Joint reinforcement rods for the wall .. . | 24 |
| H17: Apply solar/used oil to the outer wall mold.. .. . | 25 |
| H18: Assemble the first outer wall mold .. . | 25 |
| H19: Casting the RWCT wall .. . | 26 |
| H20: Assemble second outer wall mold on the top of the first wall mold .. . | 27 |
| H21: Casting the RWCT wall .. . | 28 |
| H22: Open the inner mold .. . | 29 |
| H23: Assemble the cover mold.. .. . | 30 |
| H24: Assemble cover reinforcement .. . | 31 |
| H25: Costing the cover of RWCT .. . | 32 |
| H26: Open the outer wall mold .. . | 33 |
| H27: Open the cover mold .. . | 34 |
| H28: Finishing the RWCT .. . | 35 |

**MANUAL FOR THE CONSTRUCTION OF
RAIN COLLECTOR TANKS(RCT)
USING FIBRE GLASS MOLDS**

1.1 CONSTRUCTIONS TYPE AND SPECIFICATIONS:

Diagram for the construction of Rain Collector Tank (RCT) is shown in Figure 1.1. RCT consist of the following four major parts:

- I. Roof cover for the RCT with man hole(square in shape) and the inlet hole (circular in shape).
- ii. The wall of the RCT which is cylindrical in shape of diameter 180 CMS and of effective height 160 CMS, complete with an outlet, over flow and drain for the cleaning.
- iii. Floor of the RCT.
- vi. The water collection pit is made of bricks, square in shape of dimensions 40 CMS X 40 CMS and of depth 40 to 50 CMS.

The dimensions of the RWCT are:

- | | | |
|-----|------------------------|---|
| 1. | Volume | 4 meter cubic= 4000 liters |
| 2. | Height at the axis | 180 CMS |
| 3. | Effective height | minimum 160 CMS |
| 4. | Effective diameter. | 180 CMS |
| 5. | Thickness of the floor | 7 CMS |
| 6. | Wall thickness | 6 CMS |
| 7. | Cover thickness | 5 CMS |
| 8. | Construction | Reinforced concrete with iron bars with a mixture of 1 cement: 2 sand: 3 stones. The reinforcement bars are mild steel 6 mm in diameter which is placed at every 20 CMS apart. |
| 9. | Foundation | RCT is constructed on a foundation, the specifications of which is dependent on the condition of the soil at the place of construction. Three types of foundations are shown in figure 1.2 a, b, and c. |
| 10. | Form work | Fibre glass molds for RWCT. |
| 11. | Use | To collect rain water for drinking water purpose during the summer season for one or two families or for health centers and school(for public places more than one will be needed). |

1.2 SELECTION OF SITE FOR THE CONSTRUCTION OF RCT:

Factors that need to be considered for the selection of site to construct RCT are:

- I. The roof of the house selected to make RCT should have a permanent roof either from zinc sheets / asbestos or clay tile roof to collect the rain from the roof with the help of a gutter.
- ii. Select a place where the ground (floor) is flat, soil is hard, compact and does not get flood. (RCT can also be constructed in areas that gets flooded or in loose sandy or marshy soils, by designing proper type of foundation which is not that simple and cheap).
- iii. If the RCT is for more than one household, the location can be selected in consultation with the user families and gutters from several houses can be connected to the tank if needed.

1.3 TOOL AND MATERIALS NEEDED FOR CONSTRUCTION OF RCT:

TABLE 1:TOOLS AND EQUIPMENT NEEDED:

| NO. | TOOL | QUANTI TY. |
|------------|-----------------------------|-----------------------|
| 1 | Hoe | 1 |
| 2 | Shovel | 2 |
| 3. | Cement Trowler/wooden float | 2 |
| 4 | Mason Trowel | 2 |
| 5 | Hacksaw with blades(6) | 1 |
| 6 | Hammer (3-4 kg) | 1 |
| 7 | Chisel | 1 |
| 8 | Wrench(spanner) | 2 |
| 9 | Measuring tape(3m) | 1 |

Construction of rain collector tanks

| | | |
|----|----------------------------|-------|
| 10 | Hammer (3-4 kg) | 1 |
| 11 | Plier/nipper | 2 |
| 12 | zinc scissor | 1 |
| 13 | 6mm rod bender. | 1 |
| 14 | Drum (200liters) | 1 |
| 15 | Buckets | 4 |
| 16 | Fibre glass mold | 1 set |
| 17 | Brush for applying oil(3") | 2 |
| 18 | small ladder | 1 |

1. Materials required for construction of 3 rain water collectors :

| No. | Description | Unit | Quantity for one | Quantity for 3 |
|-----|-------------------------------------|---------|------------------|----------------|
| 1. | Cement pockets 50kg | Pockets | 10 | 30 |
| 2. | Sand | m3 | 1 | 3 |
| 3 | Stones 2-3 cm dia. | m3 | 1 | 3 |
| 4 | Iron Bar 6 mm, 12 meters | lengths | 16 | 48 |
| 5 | Binding wire for reinforcement | kg | 1 | 3 |
| 6. | Faucet(tap) 1/2" | ea | 1 | 3 |
| 7 | Outlet pipe GI, 1/2", 30 cm | ea | 1 | 3 |
| 8 | Drain pipe GI, 2" dia,20cm with cap | ea | 1 | 3 |
| 8 | Overflow pipe GI, 2" dia, 20cm | ea | 1 | 3 |

| | | | | |
|----|--|----|----|-----|
| 9 | Iron/zinc sheet for gutter | ea | 1 | 3 |
| 10 | Bricks or Concrete Blocks | ea | 50 | 150 |
| 11 | Plastic water bucket for strainer on inlet | ea | 1 | 3 |
| 12 | Diesel | ea | 1 | 3 |

In addition to the above, for proper placement of rods for casting, rod spacers made of concrete are needed. Rod spacers are small square pieces of concrete 3 CMS X 3 CMS and of uniform thickness of 2.5 CMS with small binding wire which can be tied to rods before casting. With rod spacers, the rods are centrally placed across the thickness of the casted slab.

To make these, clear the ground 21 CMS x 21 CMS. Pour concrete of thickness 2.5 CMS, compact and level it. Cut it into 7 rows and 7 columns to form squares of 3 CMS. In each of the square so formed insert small binding wire pieces of length 10 CMS which helps in tying to the rods. Allow it to dry and harden.

6.4. CONSTRUCTION OF RAIN WATER COLLECTOR TANK(RCT):

- Clean the site and level the ground where the RCT will be constructed
- Collect all the tools and materials needed (table 2 and 3)
- encourage active participation of the beneficiaries from the beaming.

Follow the following sequential step by step construction method for the RCT:

1. FOUNDATION :

The type of foundation constructed depends on the type of the soil at the location. These types are given in figures 1.2 , a , b and c. These are:

- a. If the condition of the soil is good, which is hard and compact, especially rocky area, the foundation is simple and no special precautions are needed (fig 1.2a).
- b. If the area gets flooded, or there is stagnant water around, it is better to construct the tank on a raised foundation of 50-60 cm. The raised foundation is built by constructing a circular brick wall and filling with soil and compacting it (fig 1.2 b)

- c. If the soil condition is loose and not compact like in sandy or marshy areas, the foundation is constructed by driving round wooden poles or bamboos below the place the foundation is constructed (similar to driving piles). The foundation is also raised above the ground, often 50-60 CMS.(fig 1.2c)

Step by step construction of the simple type of foundation (fig 1.2a.) is described in this manual. The other two types (fig 1.2 b and C) are rarely needed and is not described in this manual.

I. Construction of working floor and foundation:

- a. Draw a circle of radius 1 meter, using the rope and a peg (fig H11)
- b. Scoop the soil inside the circle marked to depth of 15 CMS. (fig H12)
- c. Mix the concrete mixture - 1 cement : 3 sand: 5 Stones (fig H3)
- d. As the mixture is being mixed, fill the sand of thickness 10 CMS level it and compact it.(fig H4 and H5).
- e. Fill the mixture to get a thickness of 5cm above the compacted sand, level it and compact it. Leave it to dry and harden.

II. PREPARE THE REINFORCEMENT BARS FOR THE RCT:

The mild steel reinforcement bars needed are 6 mm in diameter. They are cut into smaller lengths and in quantities given in table 3. The reinforcement for floor and roof cover are respectively given in figure H7a and H7b.

Table 3.
Lengths of rods (6 mm) needed.

| No. | Length of rods (CMS) | Total Numbers |
|-----------|---------------------------------|---------------|
| I. | For Floor Reinforcement: | |
| 1 | 230 | 6 |
| 2 | 215 | 4 |
| 3 | 170 | 4 |
| 4 | 110 | 4 |
| | <i>Total:</i> | <i>18</i> |

| | | |
|-------------|--------------------------------|-----------|
| II | For Wall Reinforcement: | |
| 1 | 600 CMS | 9 |
| 2 | 180 CMS | 28 |
| | Total: | 37 |
| III. | For Roof reinforcement: | |
| 1 | 215 | 1 |
| 2 | 197 | 2 |
| 3 | 181 | 4 |
| 4 | 155 | 3 |
| 5 | 150 | 3 |
| 6 | 107 | 3 |
| 7 | 90 | 1 |
| 8 | 88 | 3 |
| 9 | 50 | 2 |
| 10 | 40 | 1 |
| 11 | 26 | 2 |
| | Total: | 25 |

Nine rings are needed for reinforcing the wall of the RCT. These are made from the 9 rods of 600CMS. To make them follow the steps:

- a. At place close to the site selected for the construction of RCT, make a circle of diameter 0.93 CMS (fig H8).
- b. Make pegs (from steel rods 6 mm/ wooden / bamboo) of 20 CMS long. Fix these pegs at every 20 CMS along the circle drawn in step a. (fig H9)
- c. Take the 9 mild steel rod of 600 CMS and bend one by one into circular rings using the pegs fixed as guide and tie the ends with binding wire (fig H10 a & b).

III. ASSEMBLING THE FLOOR REINFORCEMENT AND CASTING:

- a. Place and arrange the 18 iron bars cut for the floor reinforcement (fig H11). The two central bars, perpendicular to each other, length 230 CMS (see fig H7a) is taken and the center point marked on both of them. From the center, mark points at every 20 CMS on the two central rods. Place the rods and use binding wire pieces and a plier to tie every intersection of the perpendicular rods.
- b. Assemble the inner mold(fig H 12 a). Place centrally the floor reinforcement on the assembled inner mold (fig H 12 b). Mark on each rod the a point that is 3 CMS from the outer edge of the inner wall mold. Bend the rods down wards (perpendicular) at the mark.
- c. Place the completed floor reinforcement on the concrete floor with the bend rods upwards.(fig H 13).
- d. Place the concrete rod spacers at several points to insure that the rods are raised for casting.
- e. Make concrete mixture (**1 Cement: 2 Sand : 3 Stones**) enough to cast the 7 cm thick floor. Fill concrete, compact and make it dry and even. (fig. H13)

IV. Assembling wall mold and casting RCT walls:

- a. As the floor casted is getting dry, apply used oil or solar on the smooth surfaces, of the inner wall mold, so that the concrete do not stick to the mold(fig H 14).
- c. Place the two inner wall molds assembled one above the other (fig H15)
- b. Join the 28 cut pieces of rods (length 180 CMS) for the RCT wall with the rods protruding from the floor along the circumference of the floor casted. Keep the rods vertical.(fig H16)
- c. Tie the rod spacers to each of the rod about 15-20 CMS below the edge of the inner mold. With the biding wire tie the rods one to another all along the circumference.(Fig H16)
- d. Apply used oil/ solar to the inner smooth surface of the four segments of the inner wall mold(fig H17).

- e. Assemble the four segments of the outer wall mold and center it so that the annular space between the inner and outer wall is uniform and is 6 CMS
- f. Take a rod or a straight wooden strip of 60 cm length and put an mark at every 20 centimeter interval. This will help to measure the concrete filled in the mold.
- g. Fill the concrete mixture in the annular space and simultaneously compact it. When concrete is filled up to a height of 20 cm (measured by the marked rod), lower a circular reinforcement ring prepared earlier. Repeat the above process and lower the 2nd, 3 rd and the 4th ring to fill up to the top of the mold (fig H19). check from time to time the height of concrete in the mold.
- h. Assemble the second outer mold on top of the first (fig H20). Repeat the process described in step (fig H 21)above. Leave the mold to allow the concrete to set and harden.
- I. Open the inner wall mold after at least 6 hours or the following day.(Fig H22). Use a mixture of (1 cement: 2 Sand) to make the walls even and smooth.

VI. CASTING COVER FOR THE RCT:

- a. Assemble the roof cover mold on the floor and apply the used oil/solar(fig H 23).
- b. Place the assembled mold on the wall of the RCT(fig H 24). Bend the vertical rods protruding inwards on the cover mold. Place the cut iron rods perpendicular to each other at positions close to bend rods (also see H 7a). Tie these rods with the binding wire at all intersections and joining the bend rods. Place the inlet hole mold at the center of the cover mold.
- c. Loosen the upper outer wall mold and raise the mold by 10 cm and tighten the nuts. This raised wall will help to fill the concrete on the cover.
- d. Cast the cover mold with a mixture of 1 Cement: 2 Sand : 3 stones(fig H 25). The cover should have a uniform thickness of 5 CMS. While filling, compact and level till the cover is of uniform thickness. Check at different point by poking a marked rod for 5 cm thickness. Leave the mold for the concrete to dry and harden for about 1 hour and remove the inlet hole mold.
- e. At this stage the outer mold can also be released and shifted to the next location to

start construction of the RCT(fig: h 26).

f. The cover mold is opened the following day when the concrete is hard and dry. To open the cover mold, lower the ladder from the man hole and open the mold from inside. Section by section of the mold is released and taken out from the man hole(fig H27).

g. Use a chisel or a big nail to make three holes in the wall, one for the drain, the second for outlet and third for overflow (fig H28)

- At the very bottom of the tank or the floor of the tank, make an hole to fix a GI drain pipe of 1 inch diameter. It is preferable to have this hole in the direction of the natural drain.

- At 10 CMS from the bottom of the floor make an hole to fix an ½ inch GI pipe for the outlet. The position of this should be at a convenient place planned for constructing a pit to collect water.

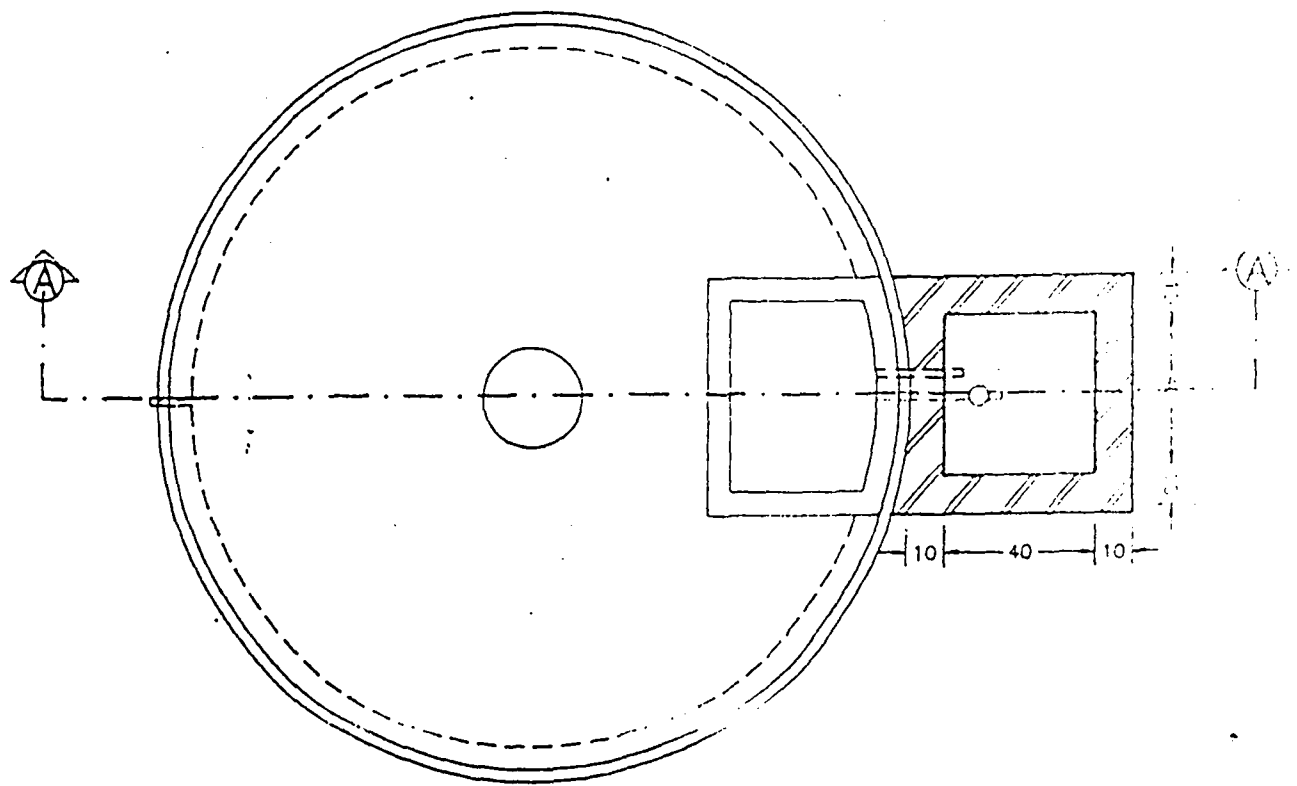
- At the top edge of the tank, make an hole to fix the overflow GI pipe of 1 inch diameter. The position of this should be in the same direction as the drain pipe towards the direction of natural drainage flow.

h. Use a mixture (1 cement : 2 sand) to make the outer surface of the walls of the RCT and the cover smooth and even (fig H28).

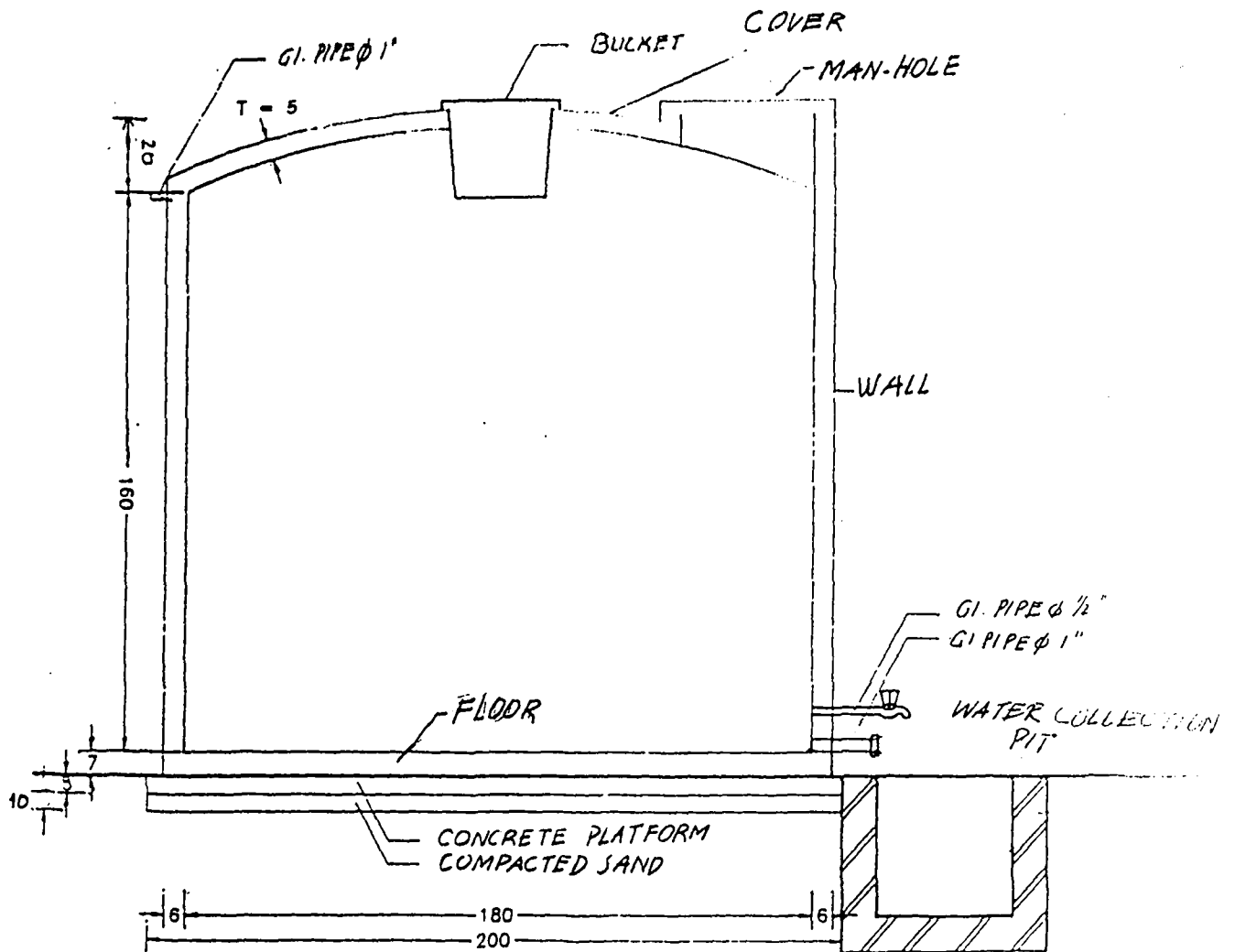
VII. The Last Works:

a. Fix the tap for the outlet and fix the cover for the drain pipe.

b. Below the tap dig a pit 50 CMS X 50 cm and a depth of 40 CMS. Make an brick wall for the pit. At the bottom fill with concrete, a layer of 10 cm thick to place the bucket or Jerry can. The dimensions of the pit can be adjusted to suit the commonly used utensil to collect water.



PLAN



SEC. A-A

1.1: Diagram for the construction of RWCT

TYPE OF FOUNDATION

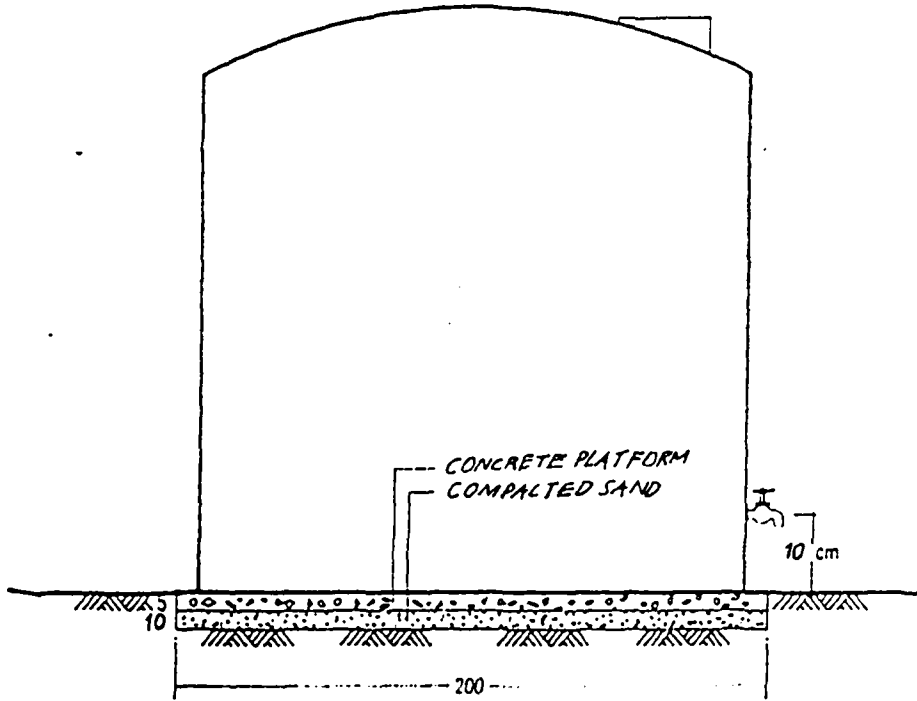


FIG 1.2 a

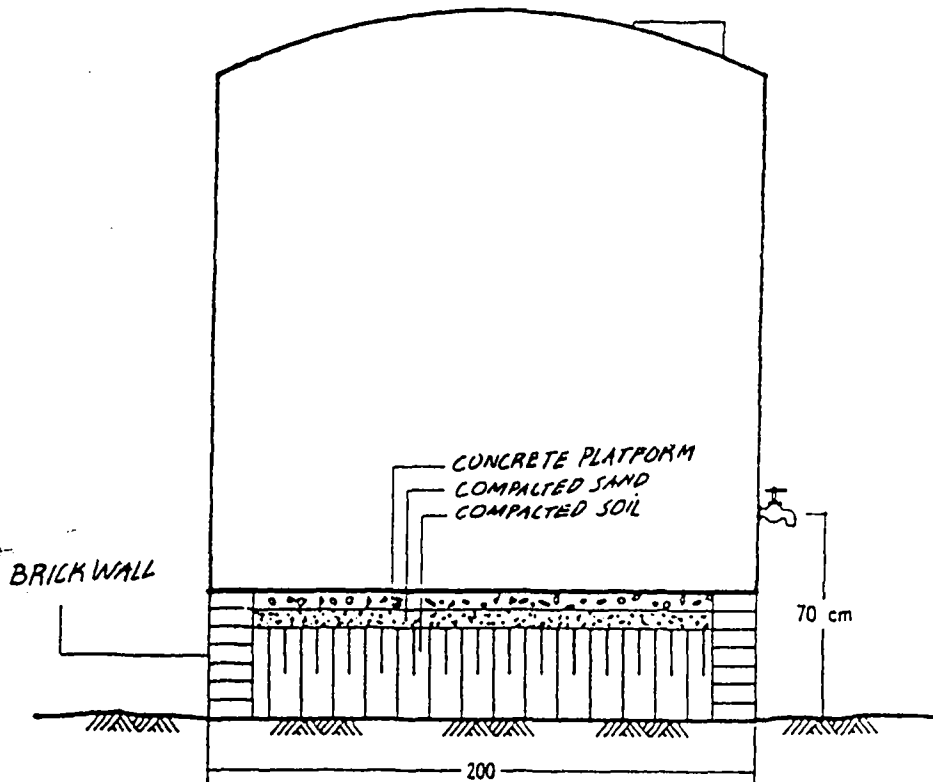


FIG 1.2 b

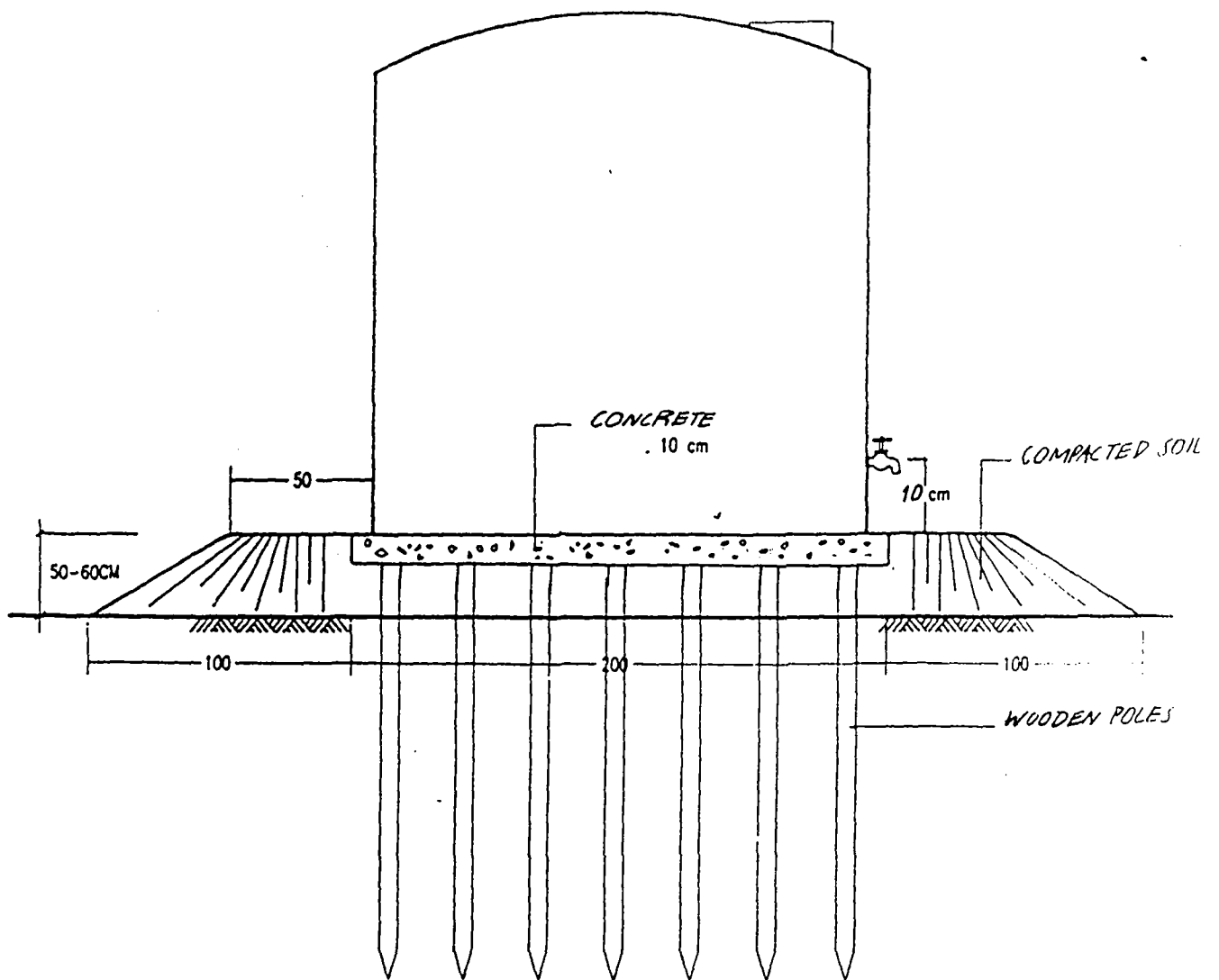
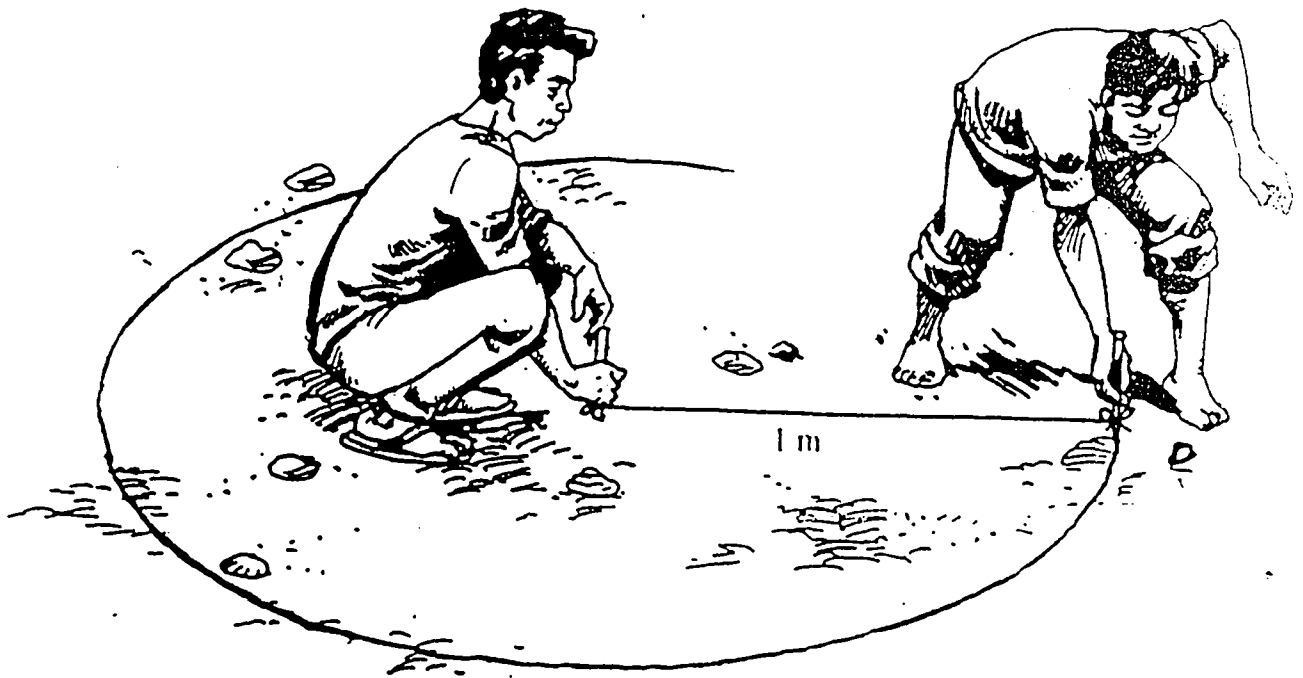
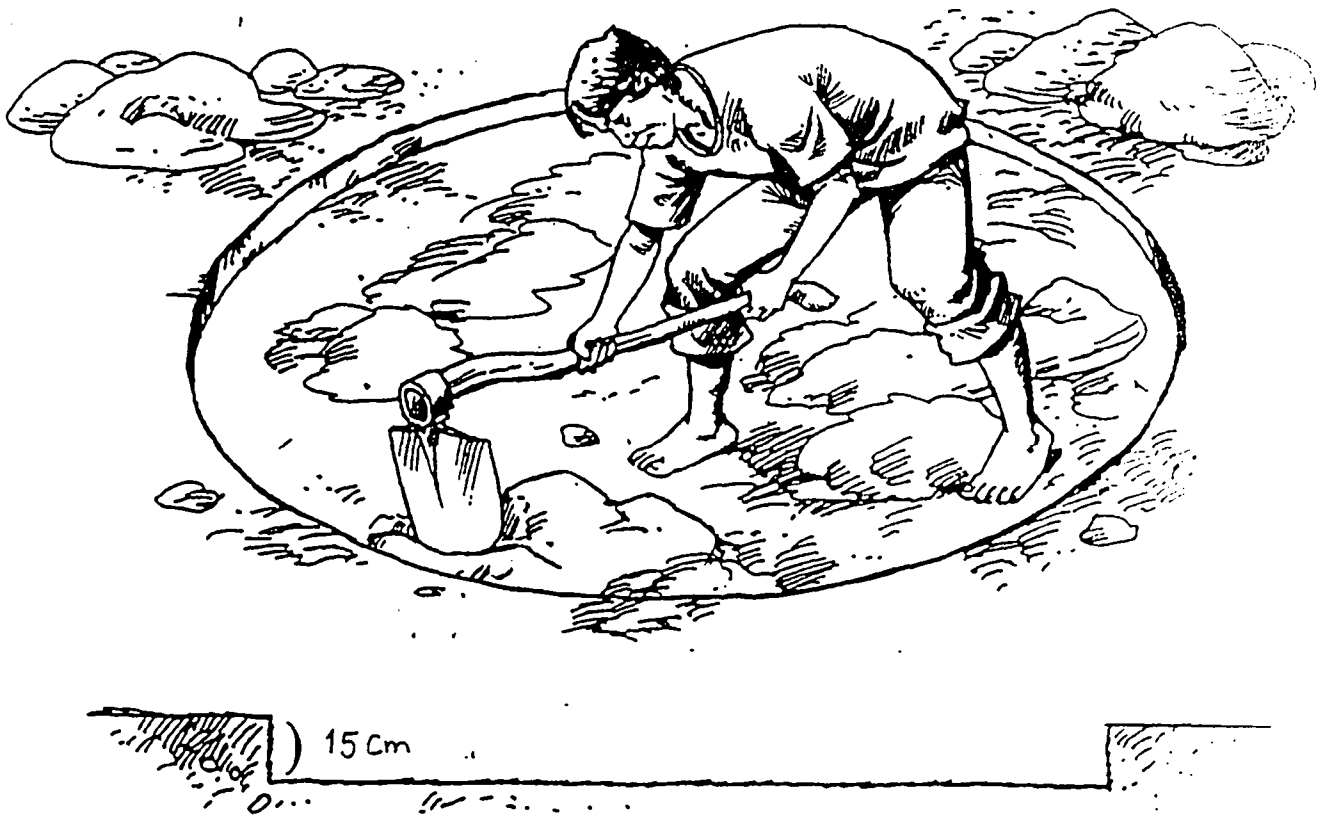


FIG. 1.2.C



H1: Draw a circle of diameter 1 meter with the rope and the wooden peg.



H2: Make a hole of depth 15 CMS within the circle drawn.



H3: Make the mixture.



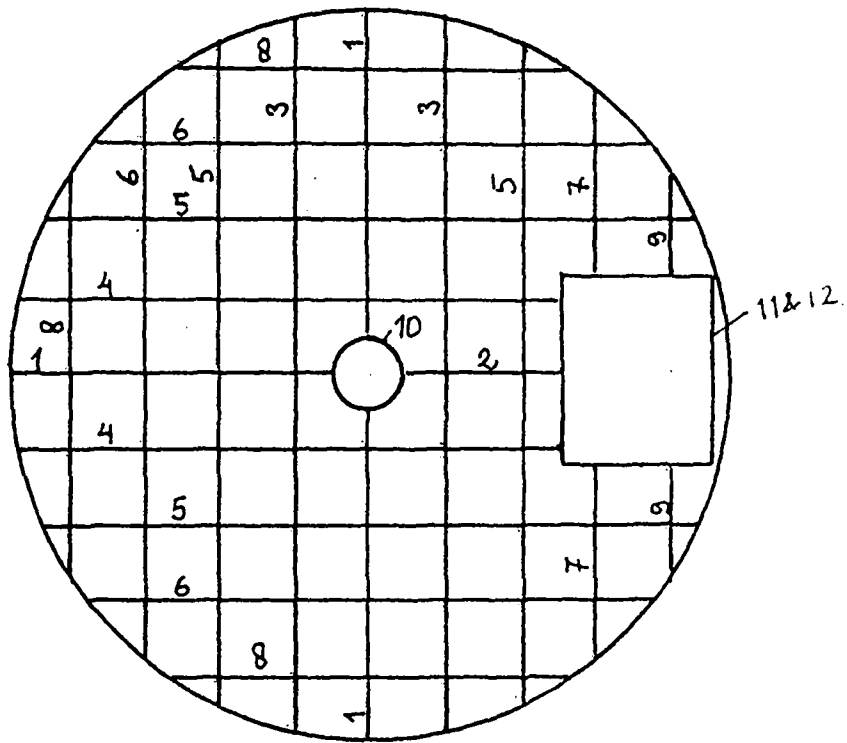
H4: Fill sand in the circular hole made.



H5: Compact the sand filled to have a layer of 10 CMS.

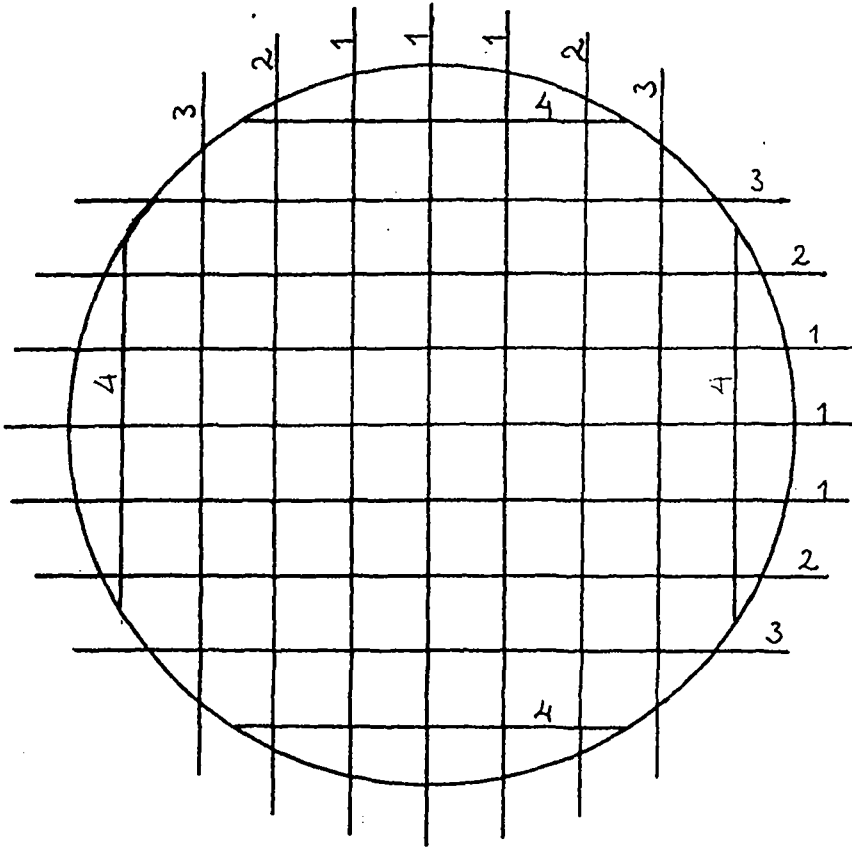


H6: Fill the hole with the concrete



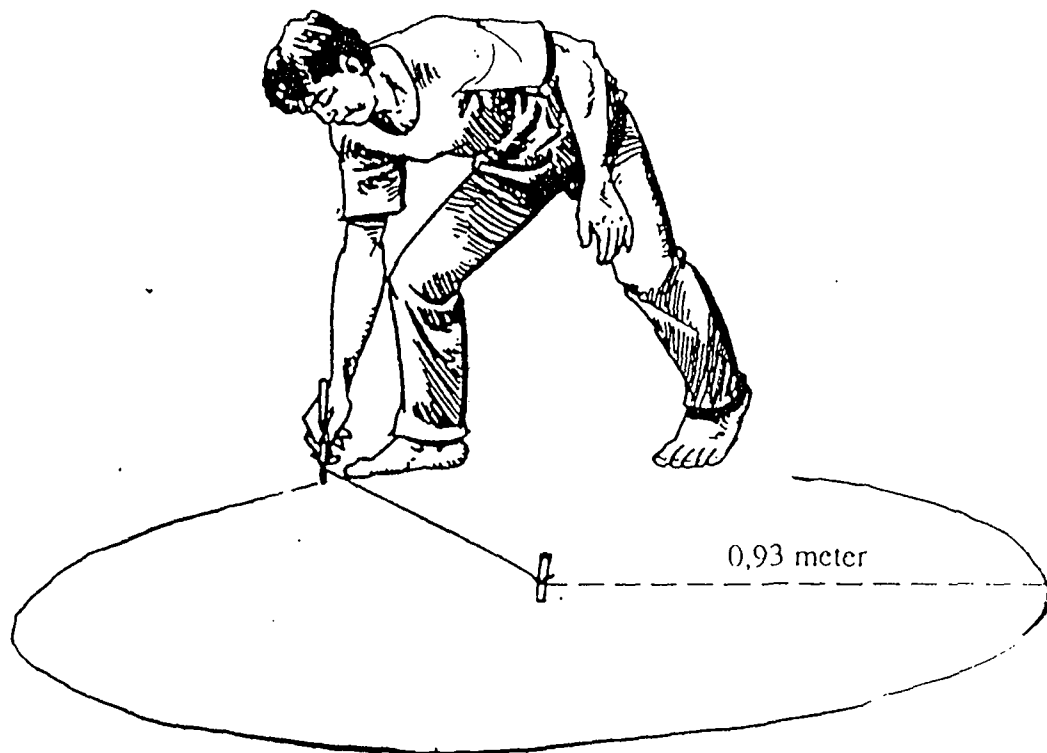
| No | Length | Quantity |
|----|--------|----------|
| 1 | 88 Cm | 3 bars |
| 2 | 40 Cm | 1 bar |
| 3 | 197 Cm | 2 bars |
| 4 | 150 Cm | 2 bars |
| 5 | 181 Cm | 4 bars |
| 6 | 155 Cm | 3 bars |
| 7 | 50 Cm | 2 bars |
| 8 | 107 Cm | 3 bars |
| 9 | 26 Cm | 2 bars |
| 10 | 90 Cm | 1 bar |
| 11 | 215 Cm | 1 bar |
| 12 | 150 Cm | 1 bar |

H7a: Cover reinforcement

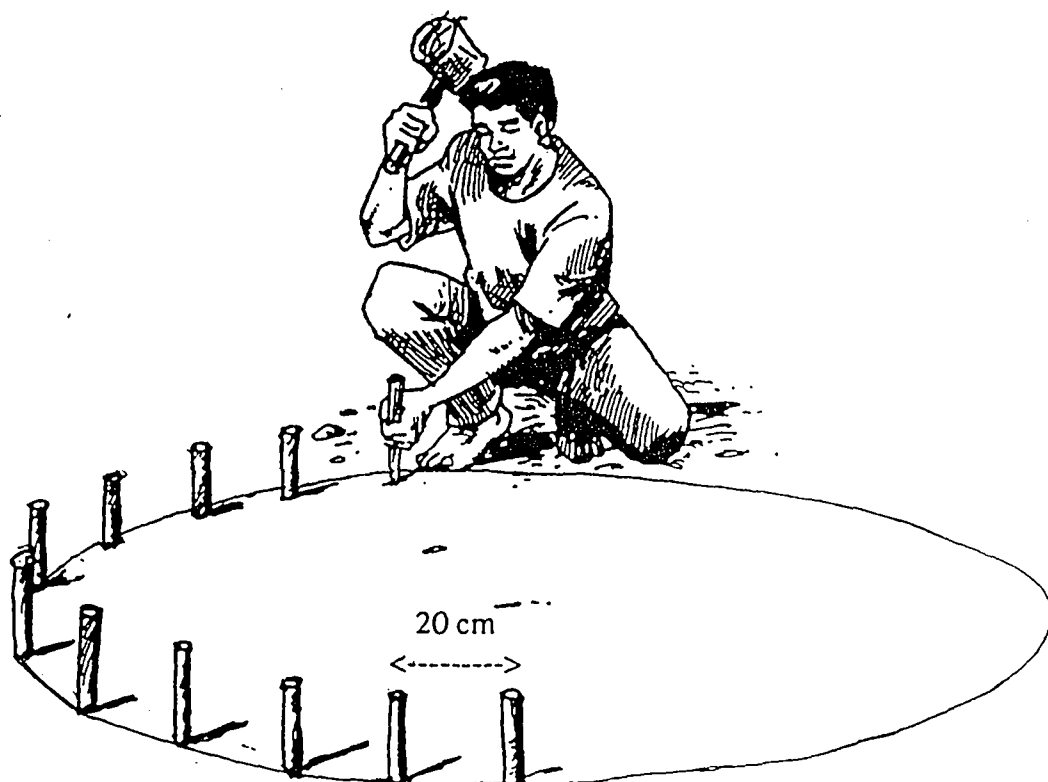


| No | Length | Quantity |
|----|--------|----------|
| 1 | 230 Cm | 6 bars |
| 2 | 215 Cm | 4 bars |
| 3 | 190 Cm | 4 bars |
| 4 | 110 Cm | 4 bars |

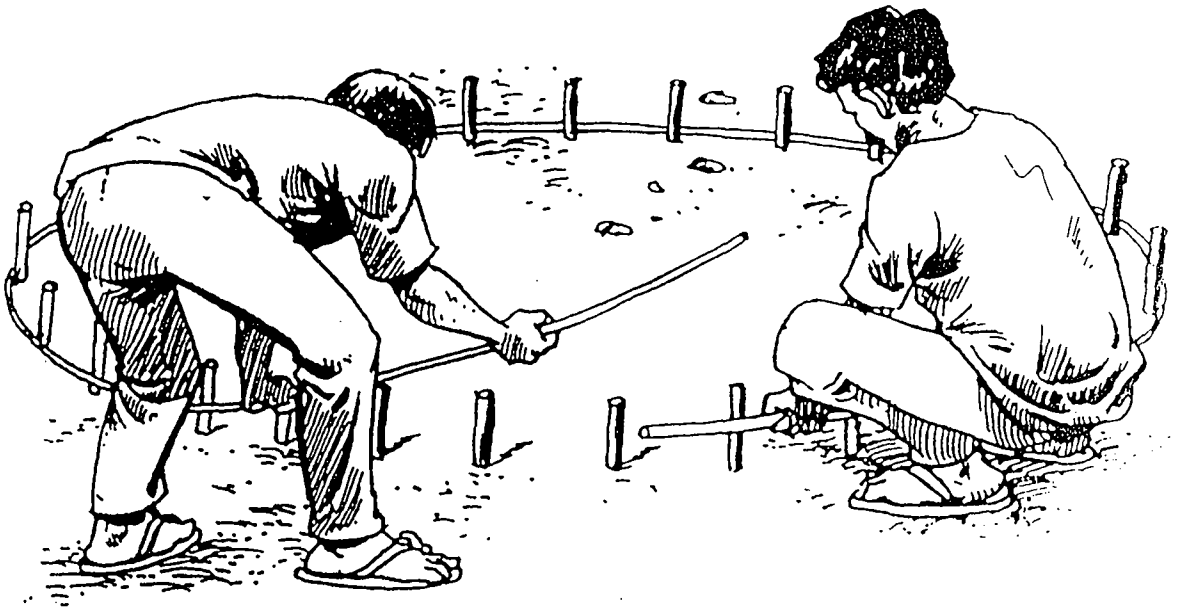
H7b. Floor reinforcement



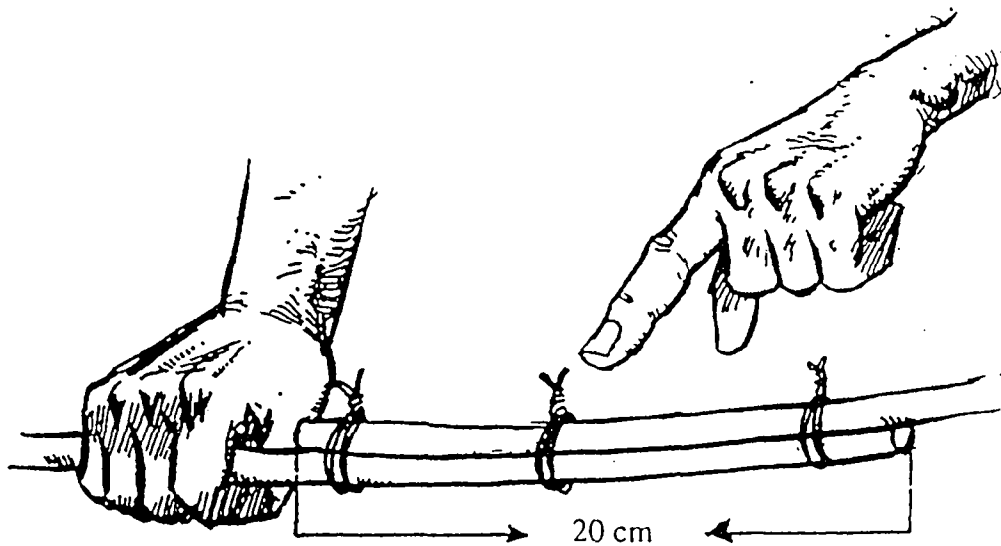
H8 Draw a circle of diameter with 1.86 CMS with a rope and wooden peg.



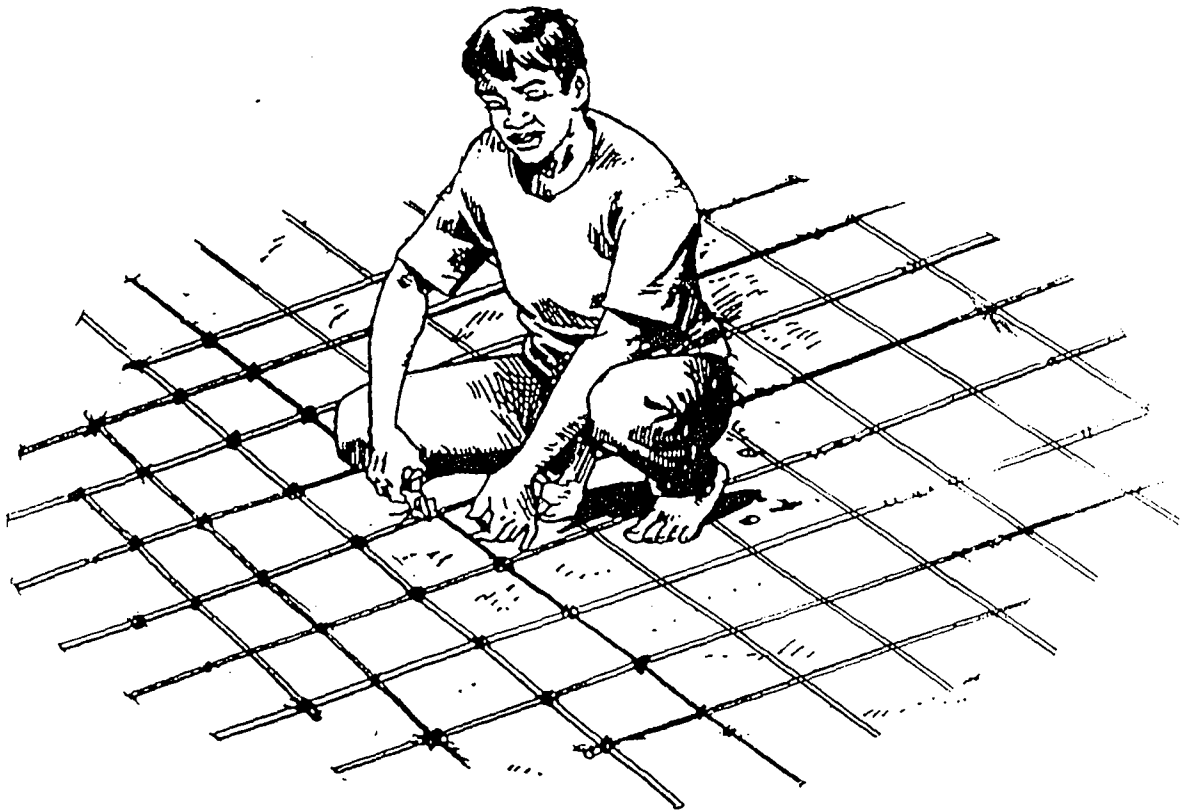
H9 Drive the pegs (20 CMS apart) all along the circular pits.



H 10a Bend rods to form circular rings by bending along the pegs driven.

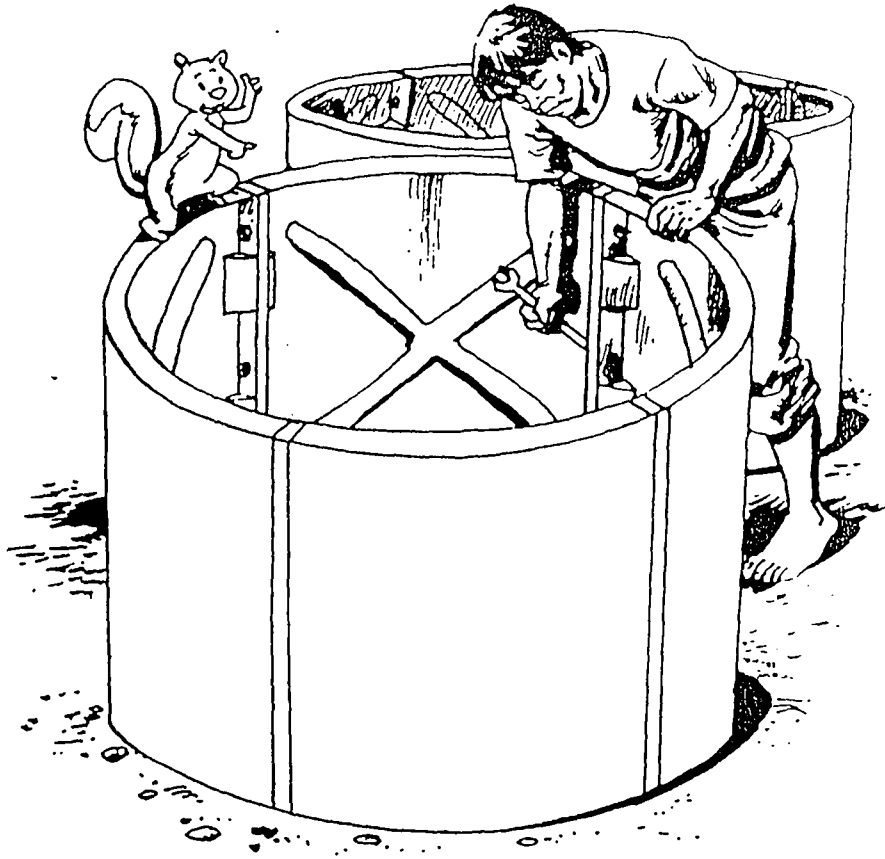


H10b Join the ends of the rods with binding wire. Make 9 such rings.

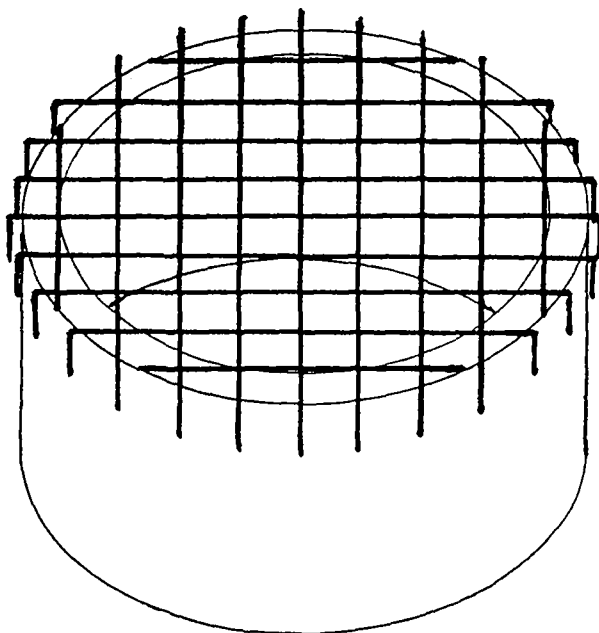


H11

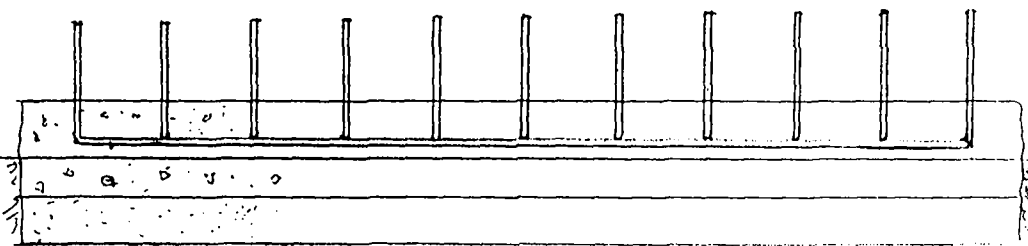
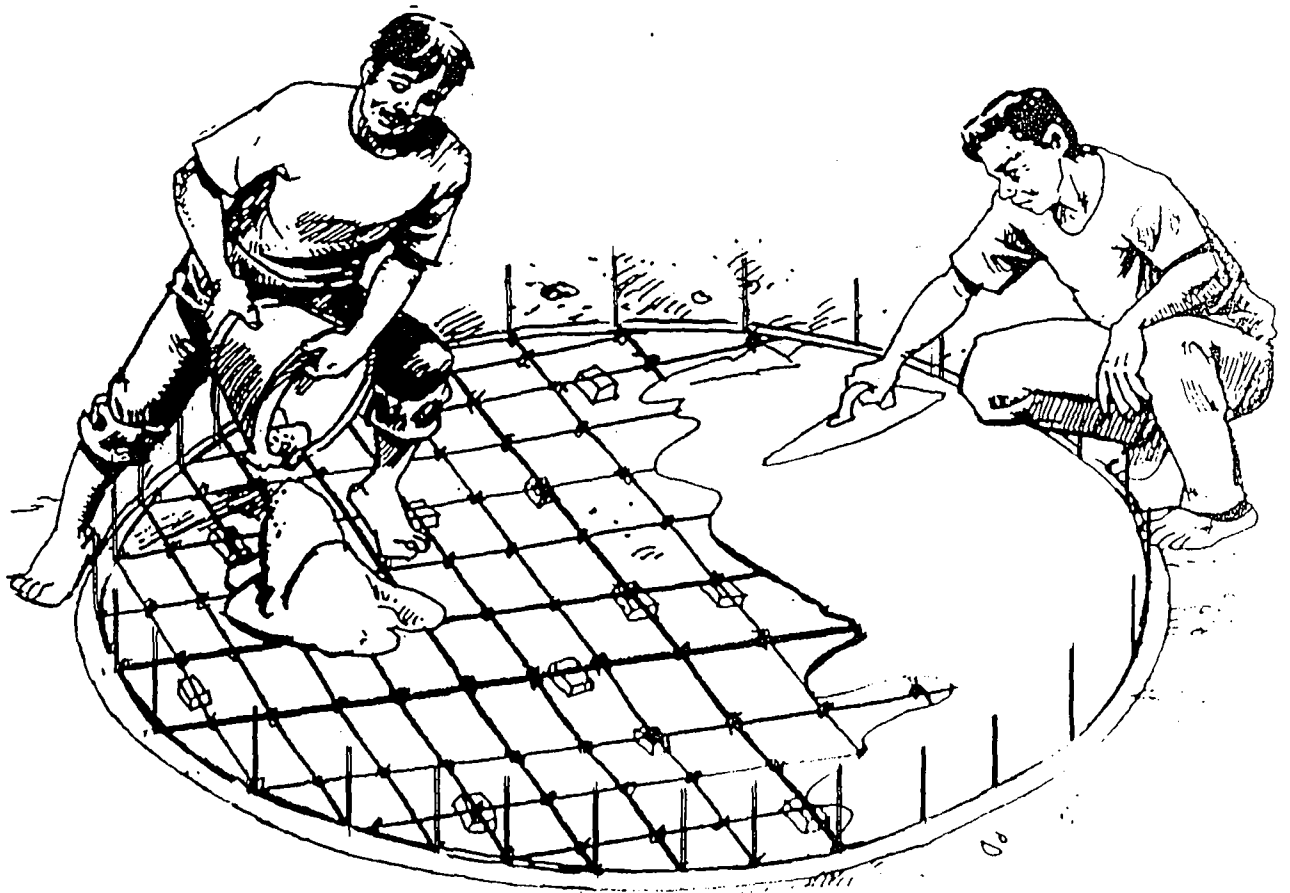
H11: Assemble the floor reinforcement



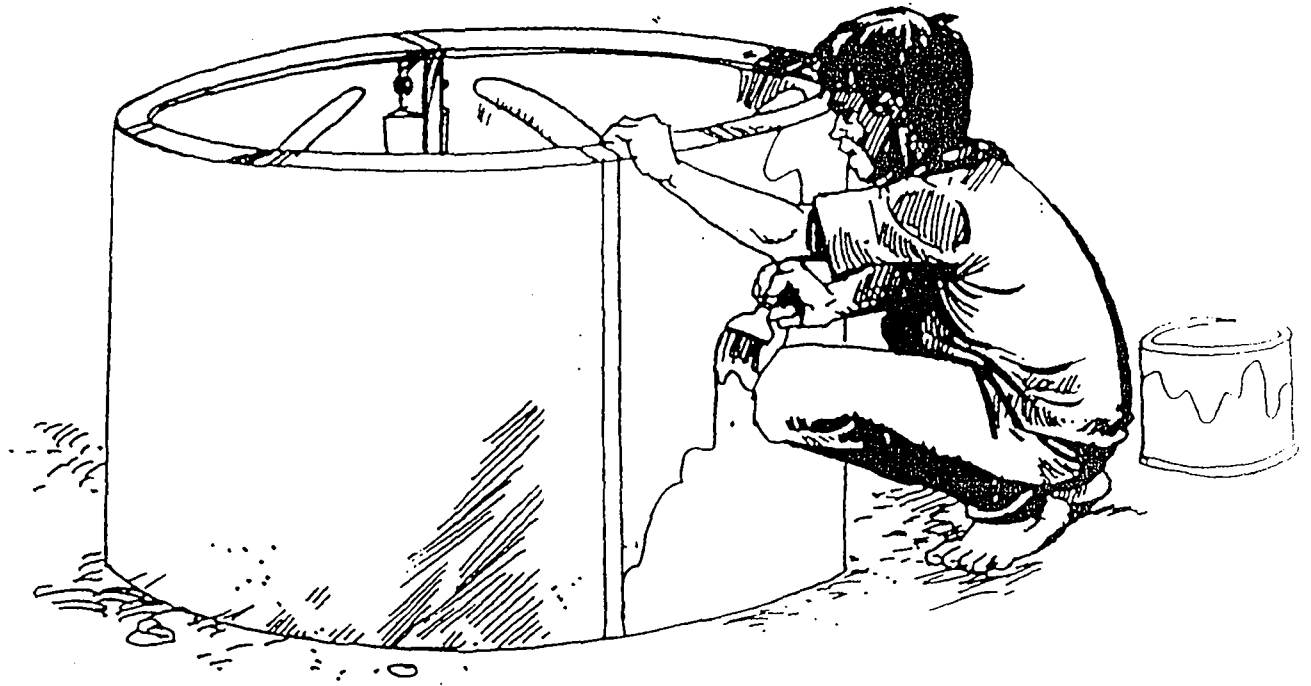
H12a Assemble 2 sets of inner wall mold.



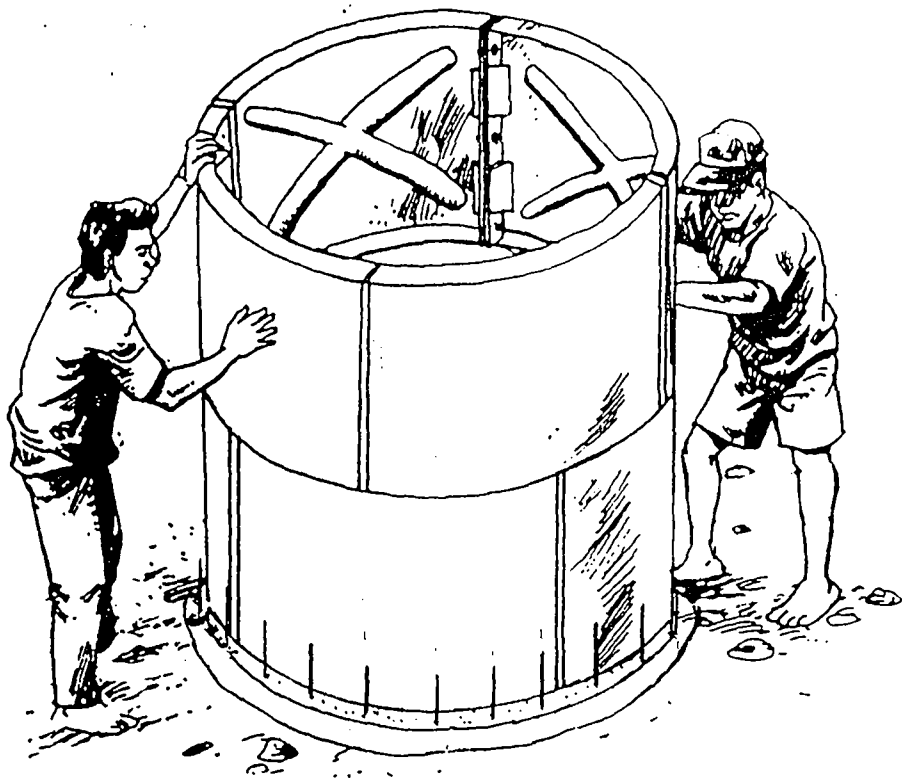
H12b: Bending of the reinforcement bars



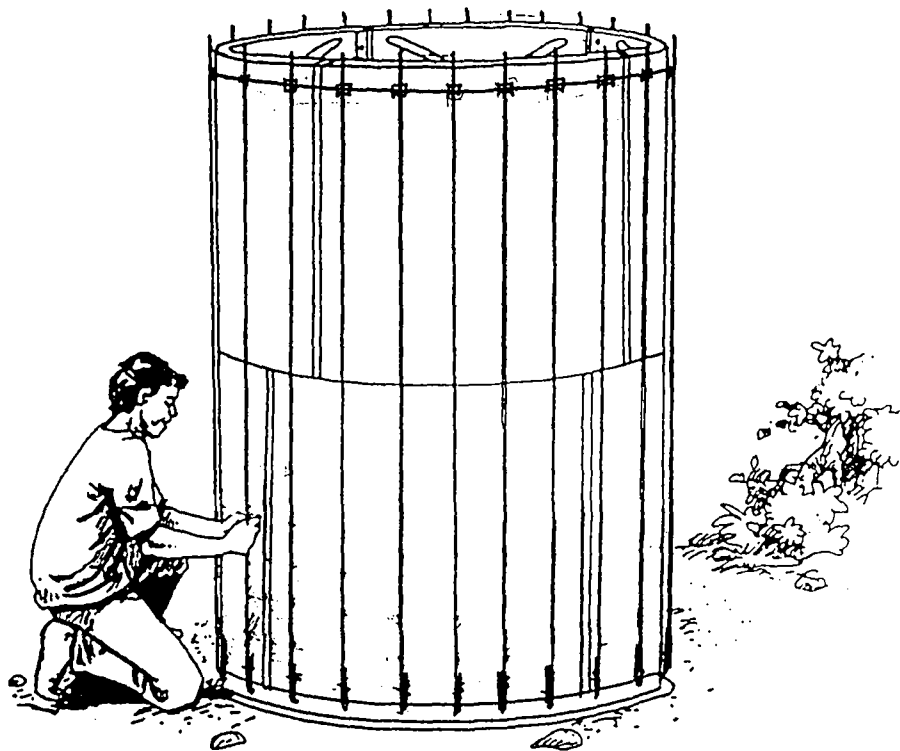
H13: Cast the concrete of RWCT floor and leave it to dry for one hour.



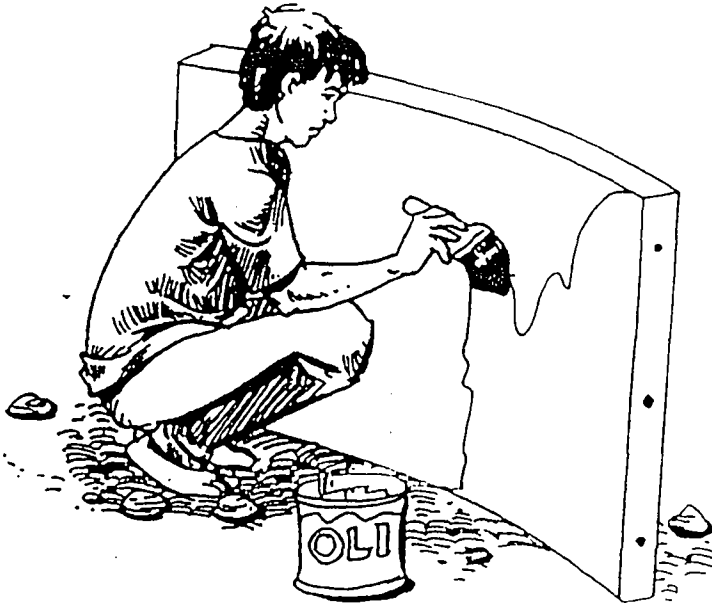
H14: Apply solar/used oil to the inner wall mold



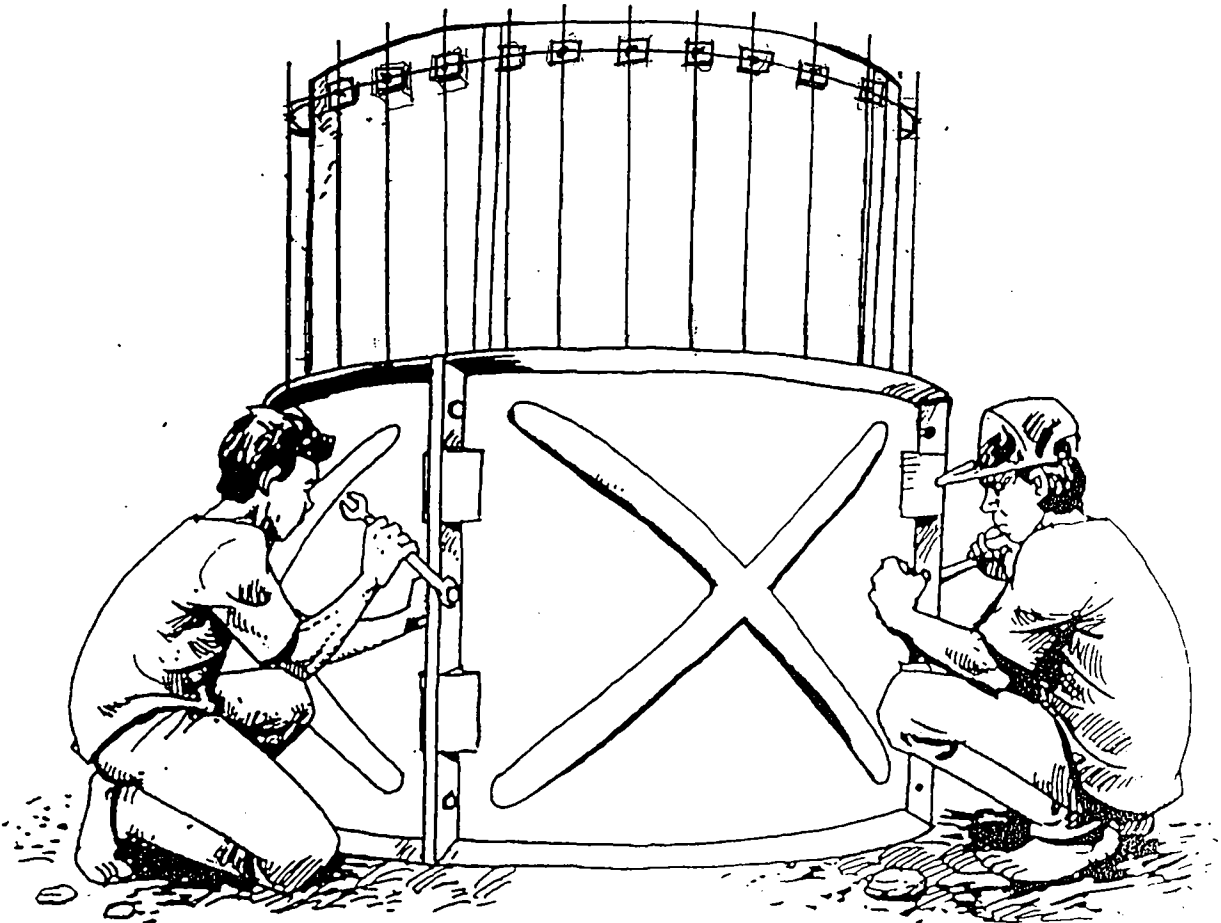
H15: Assemble the inner wall mold on the floor surface constructed.



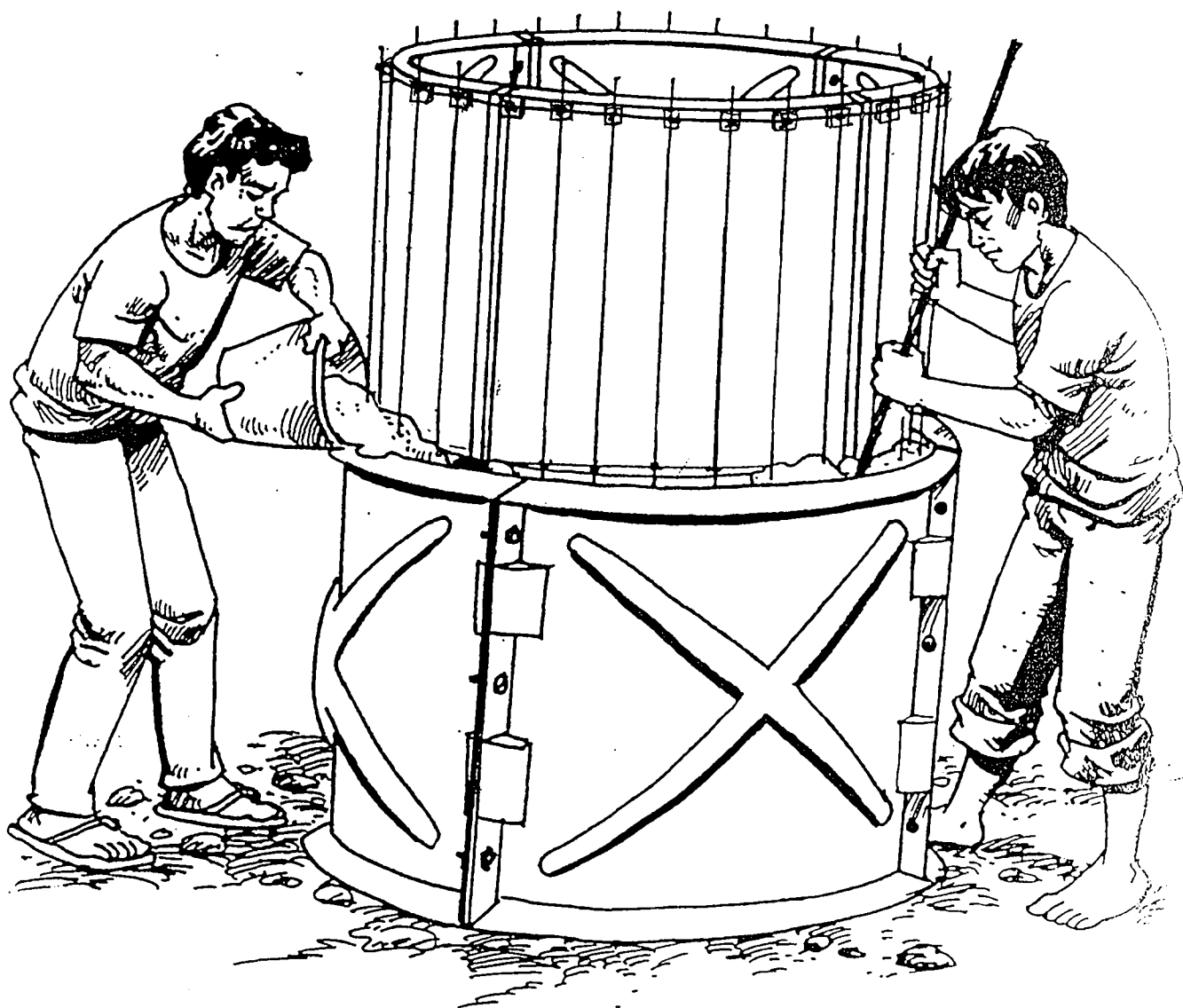
H16: Joint reinforcement rods for the wall



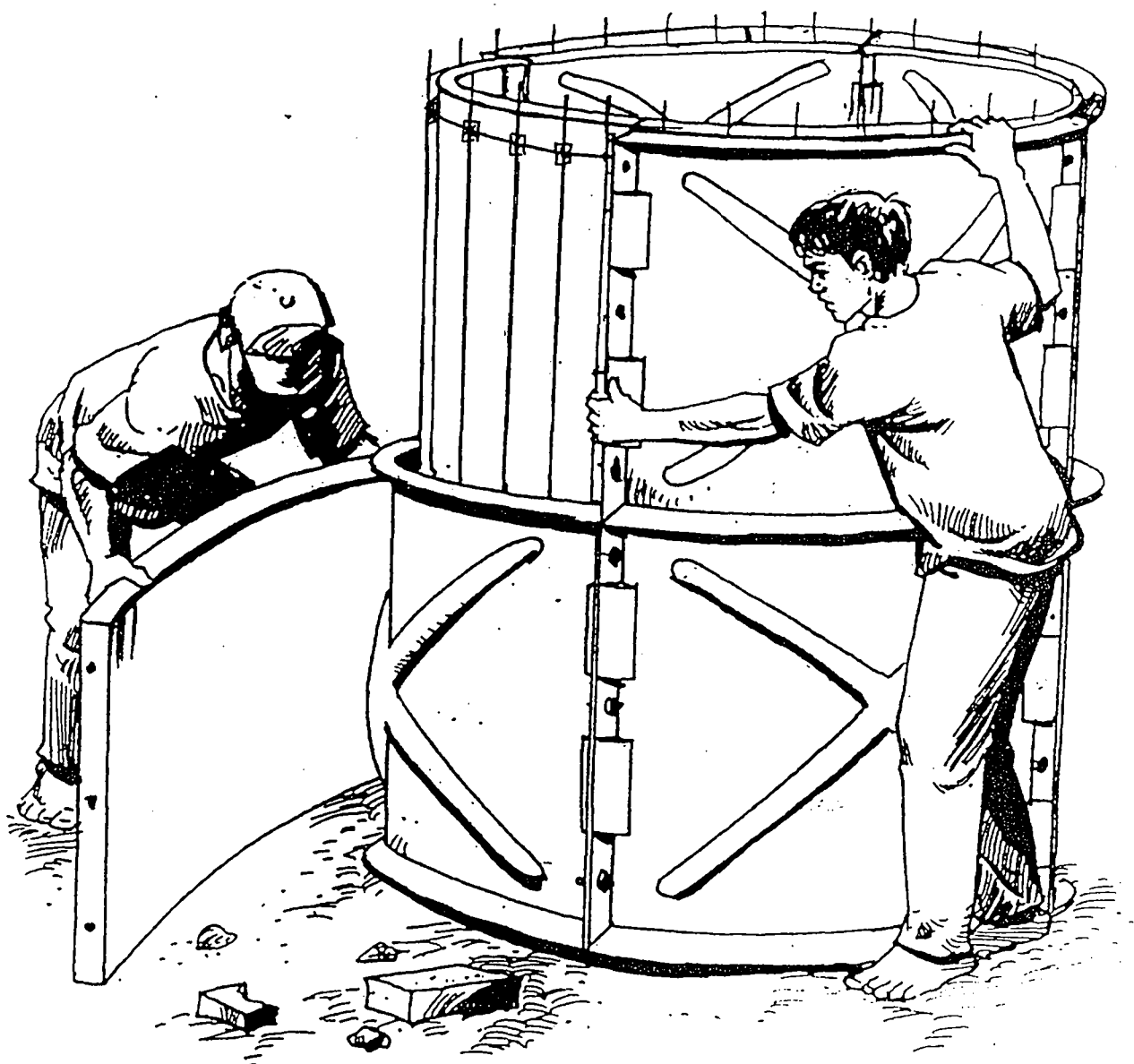
H17: Apply solar/used oil to the outer wall mold



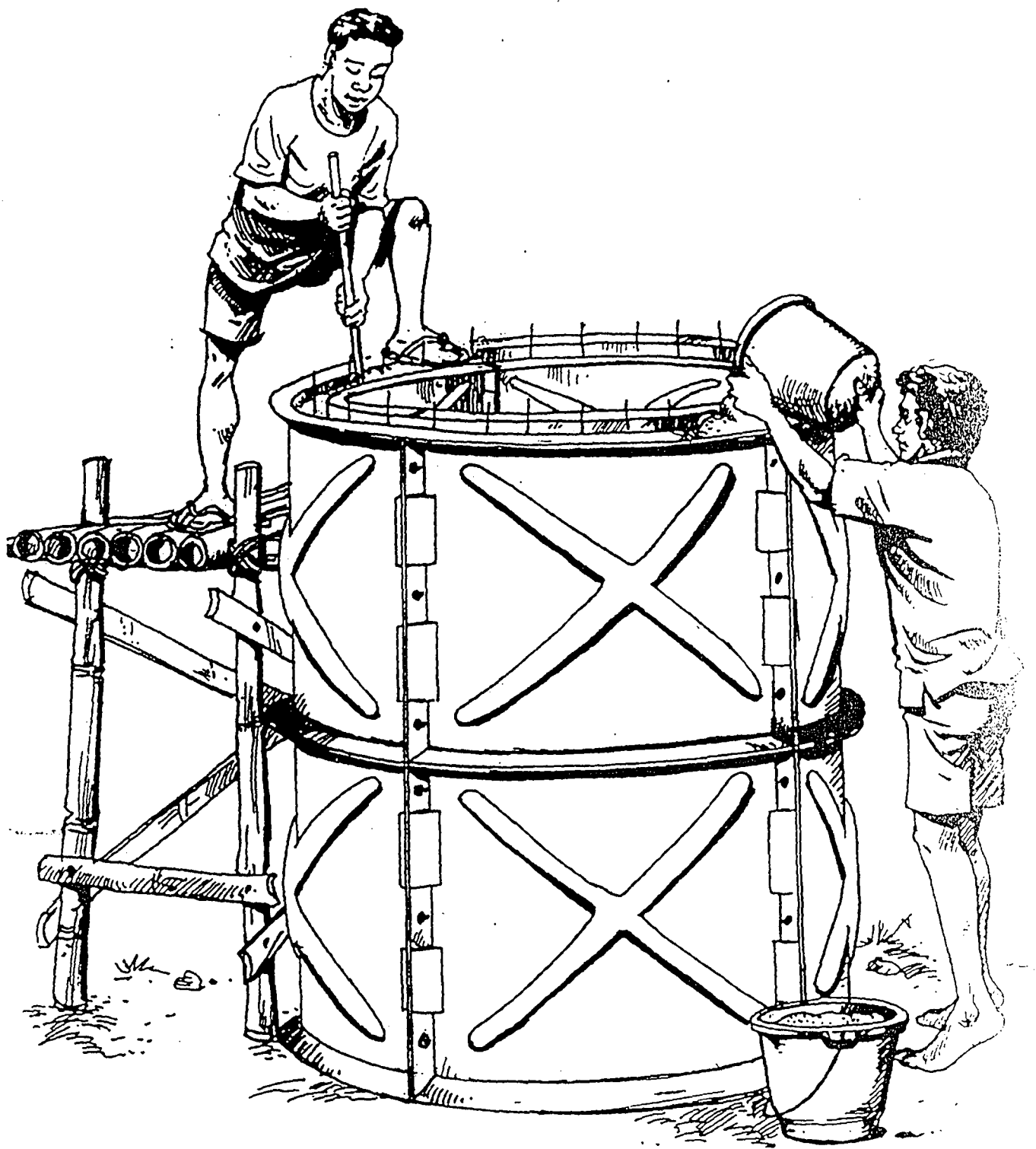
H18: Assemble the first outer wall mold



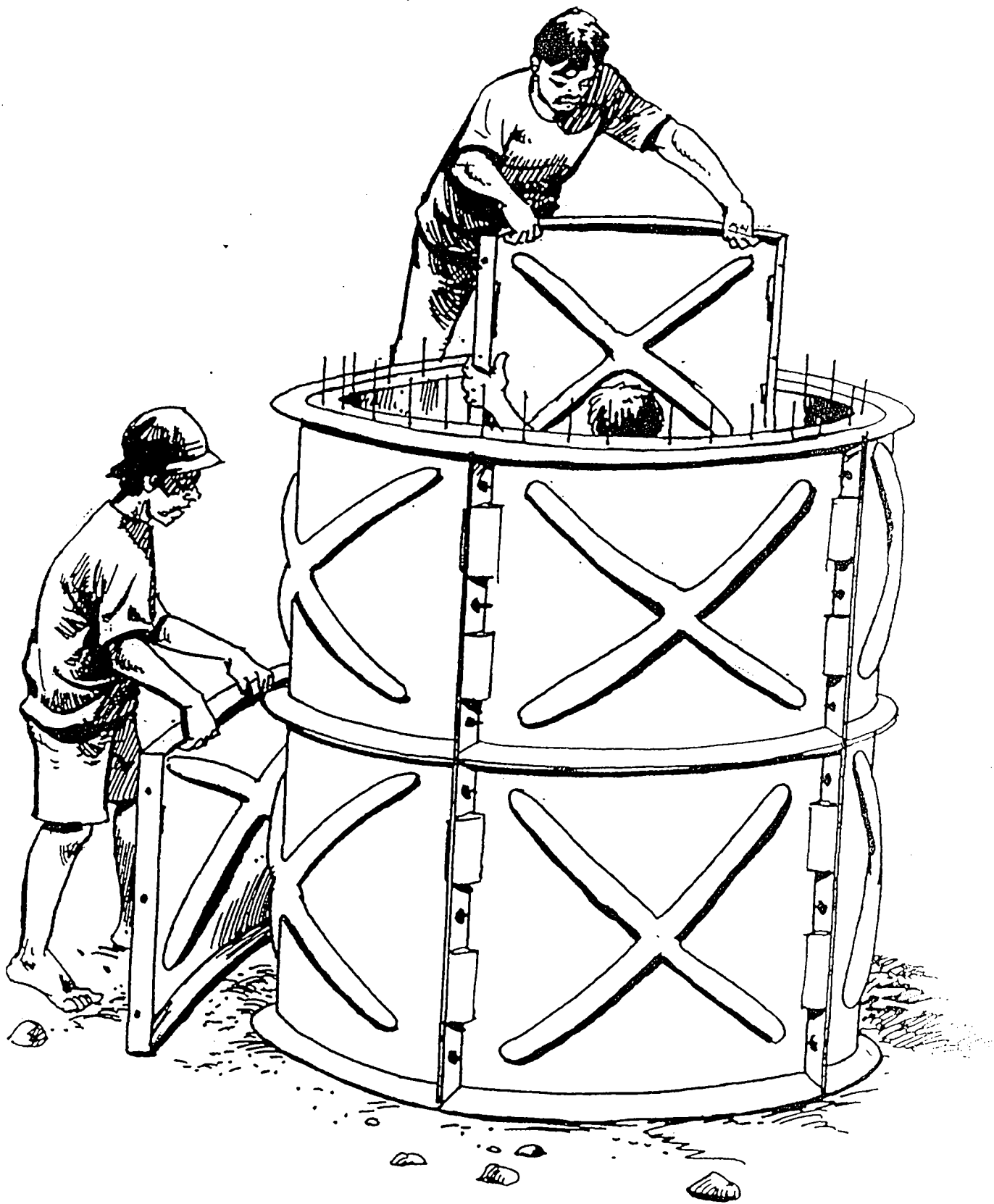
H19: Casting the RWCT wall



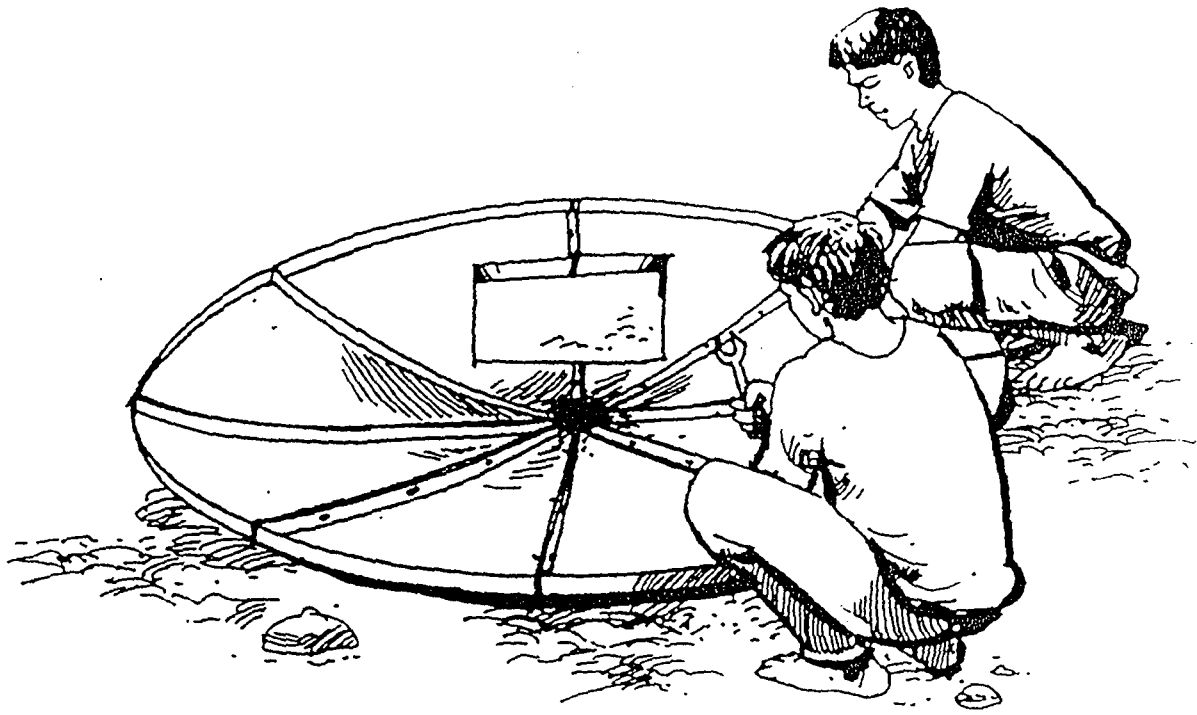
H20: Assemble second outer wall mold on the top of the first wall mold



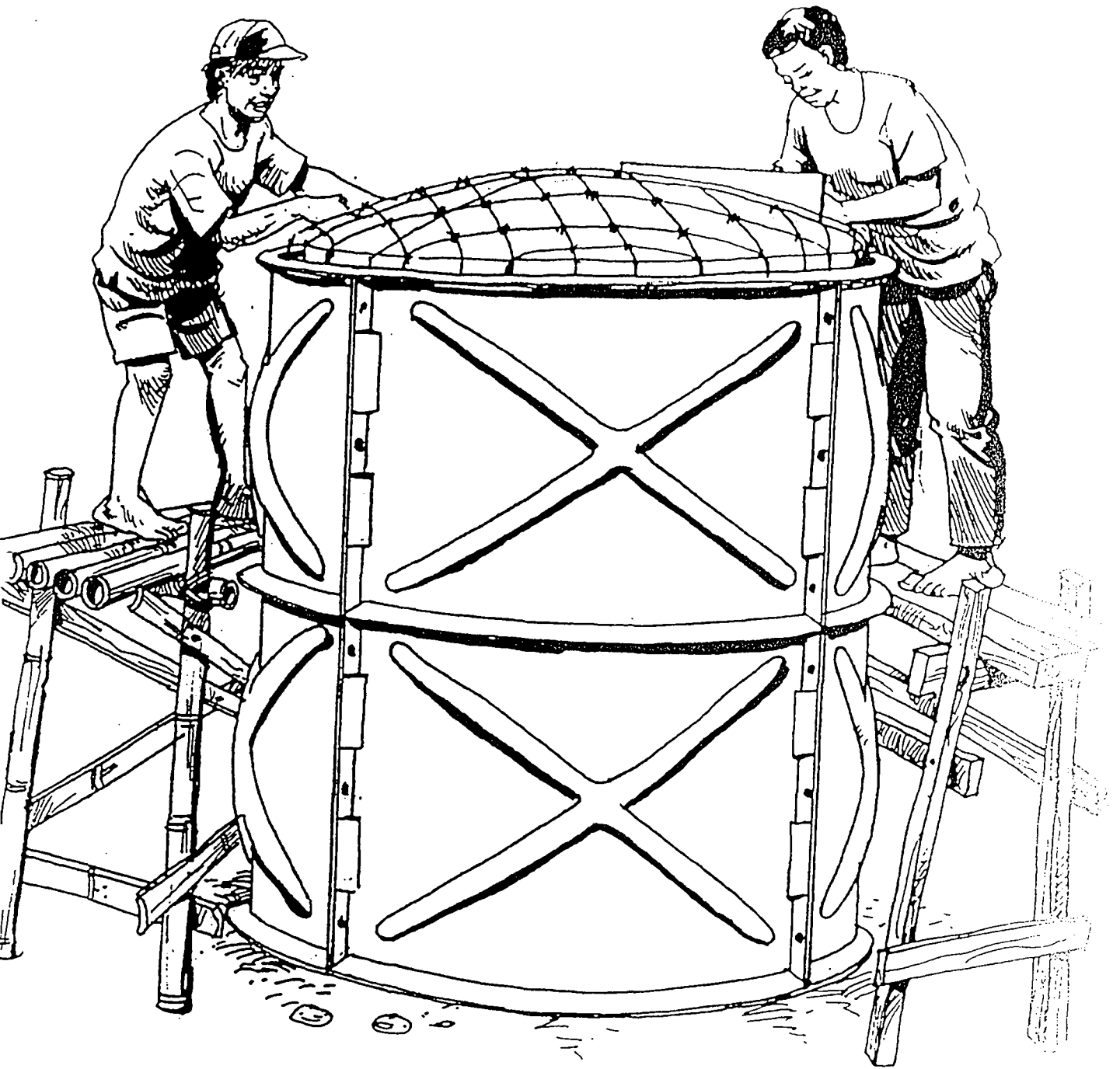
H21: Casting the RWCT wall



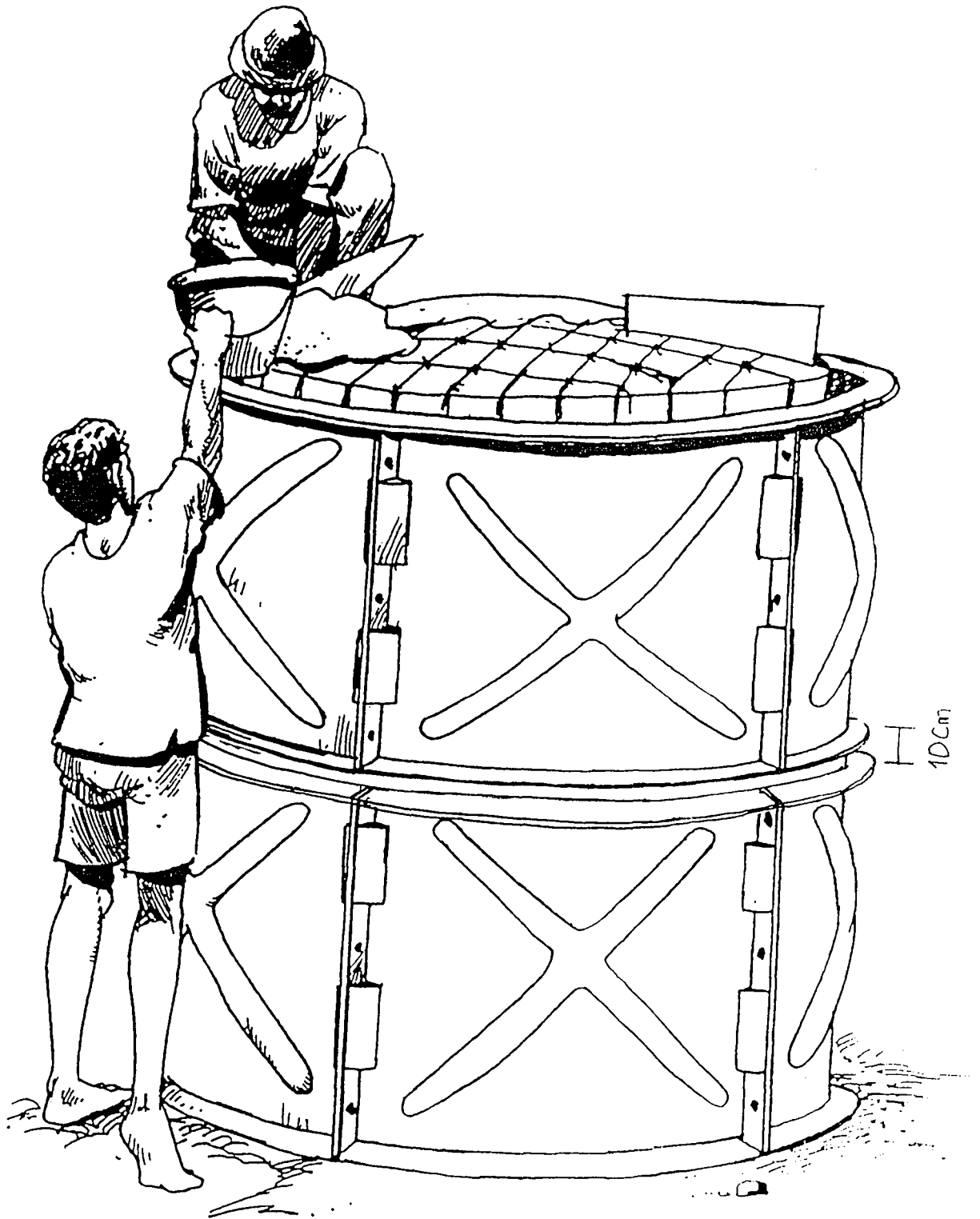
H22: Open the inner mold



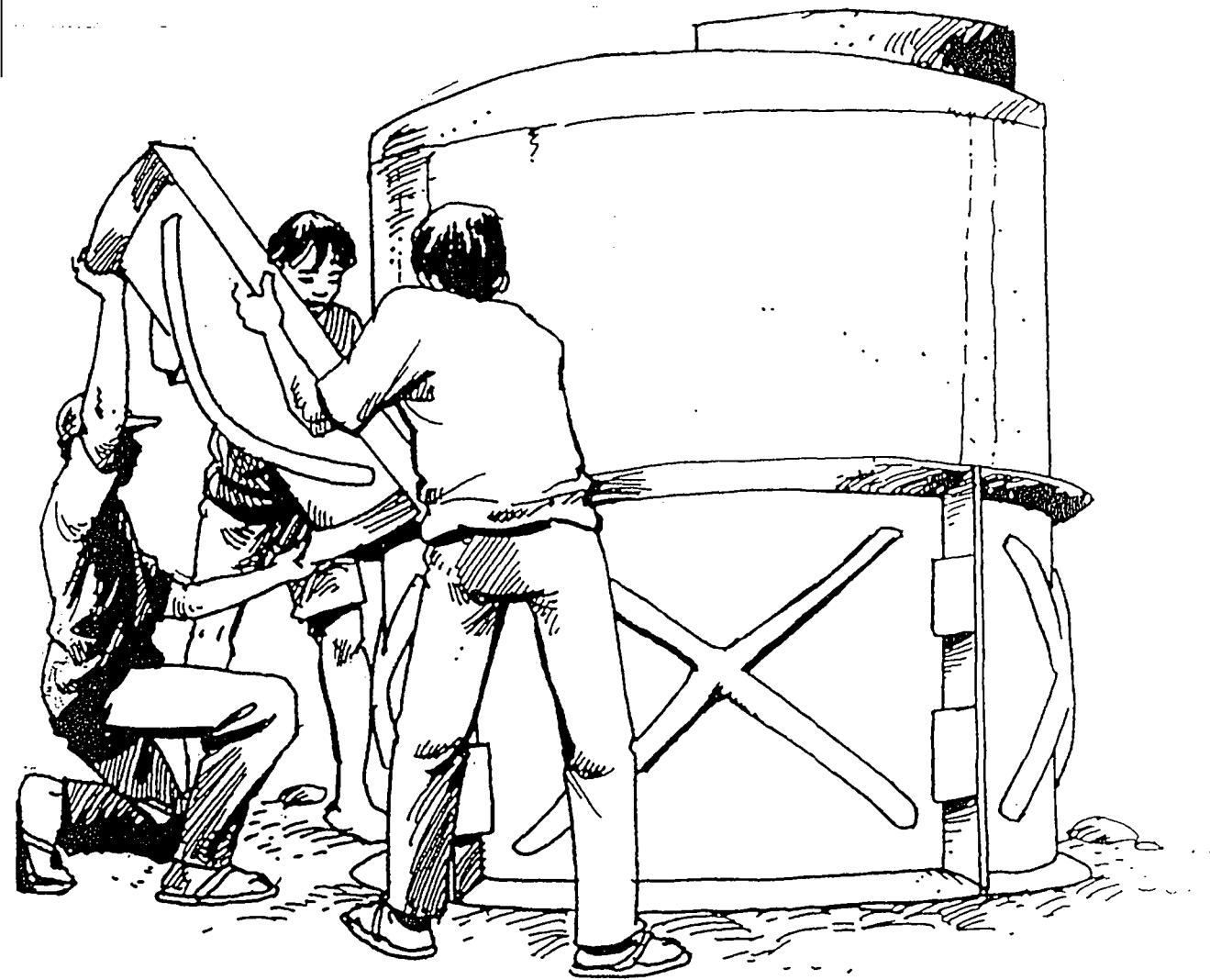
H23: Assemble the cover mold



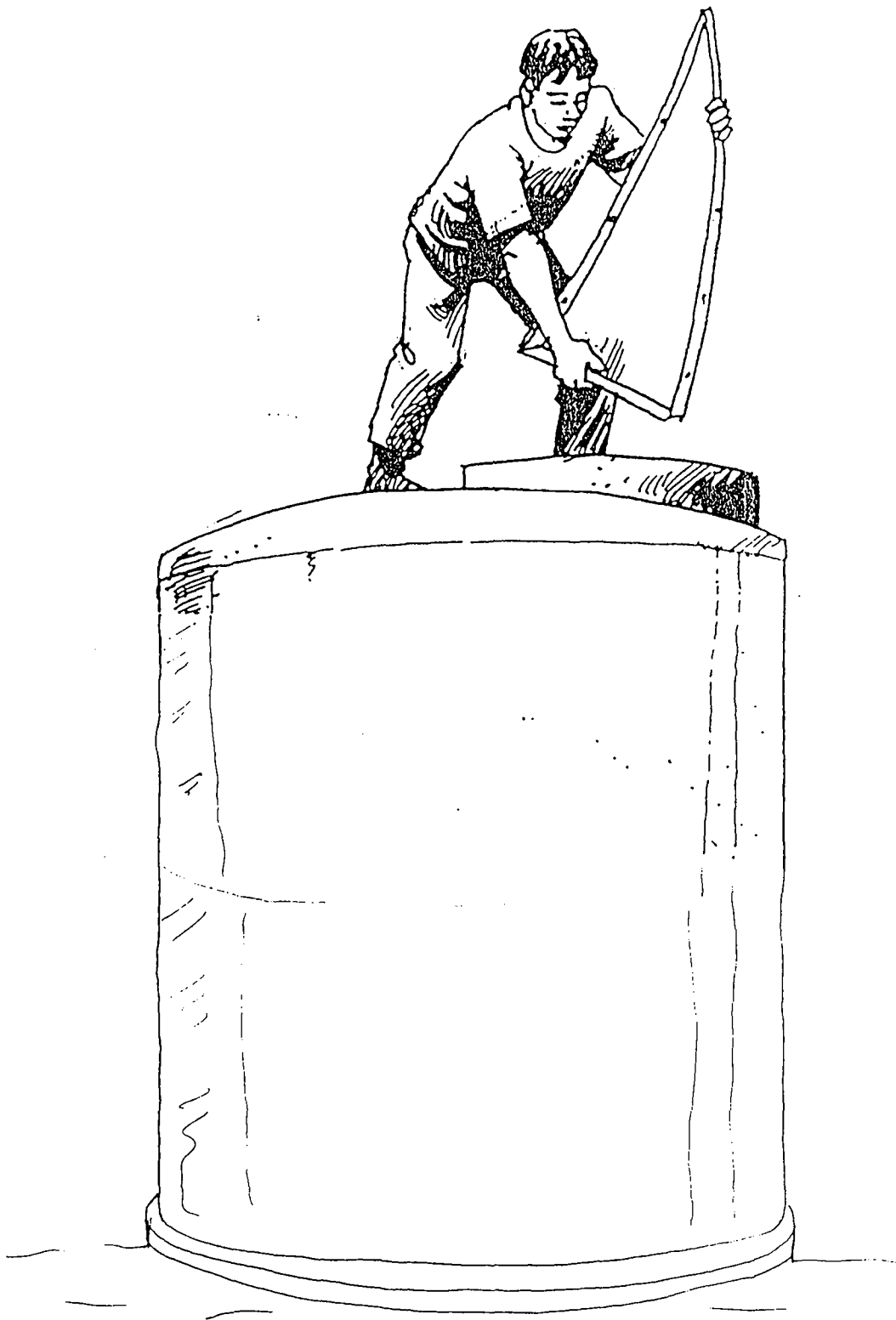
H24: Assemble cover reinforcement



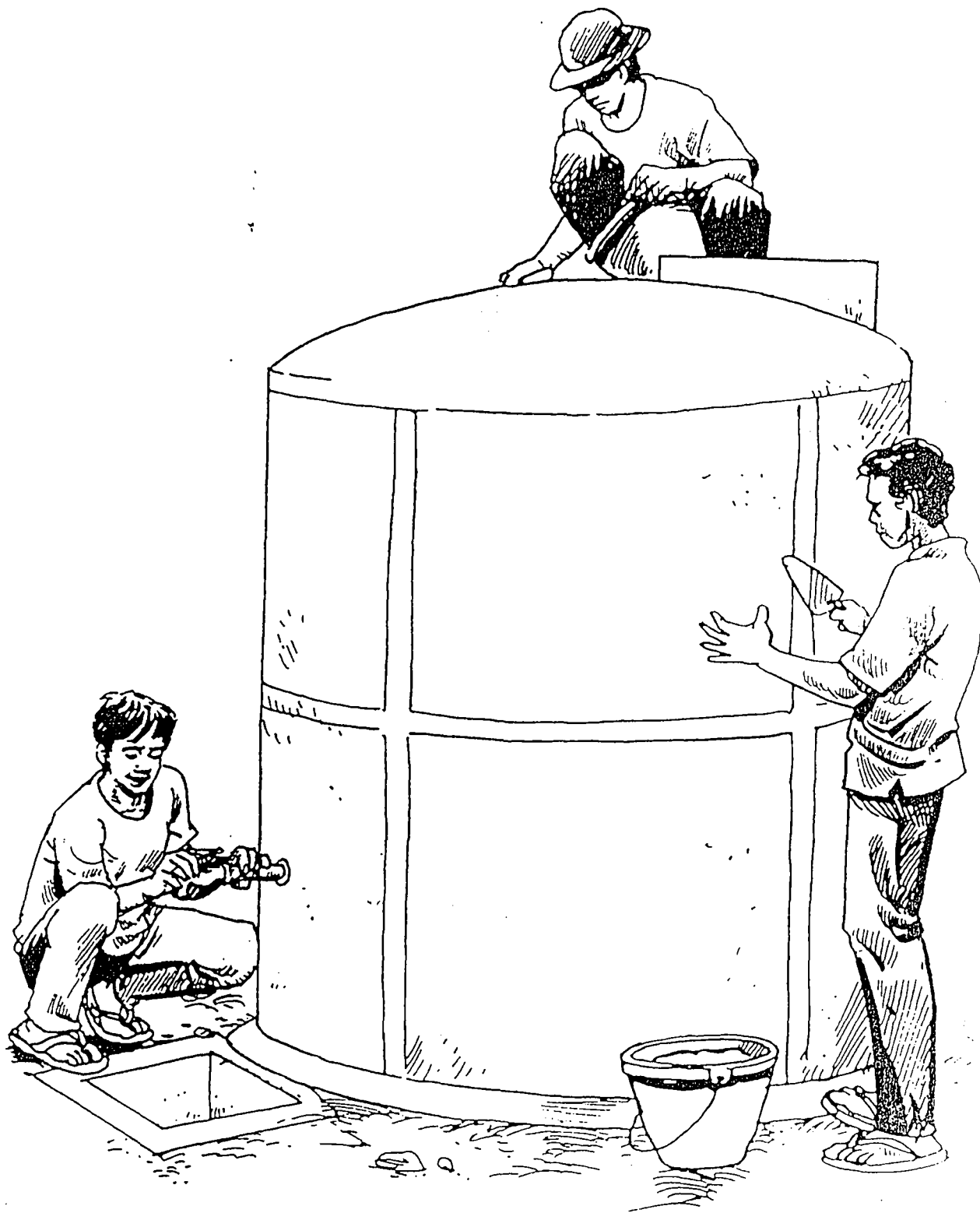
H25: Costing the cover of RWCT



H26: Open the outer wall mold



H27: Open the cover mold



H28: Finishing the RWCT