

232.2  
81IN

232.2

81IN

KD 3417

USC-WATER RESOURCES CENTER

a n d

THE ASIA FOUNDATION

LIBRARY  
International Resources Unit  
for Community Water Supply

CEBU-MACTAN LEVEL ONE

WATER RESOURCES PROJECT

INSTALLATION MANUAL FOR CYLINDER PUMP

232-2181IN  
KD 3417

C O N T E N T S

INSTALLATION MANUAL	PAGE
1. WELL CASING . . . . .	1-5
1.1.a Importance of Well Casing . . . . .	1
1.1.b The Grout . . . . .	1
1.2 Materials to be Used and Size . . . . .	2
1.3 Advantages of Using PVC Pipe for Casing. . . . .	3
1.4 Preparation of PVC Pipe Casing . . . . .	3
1.5 Disadvantages of PVC Casing . . . . .	4
1.6 Installation of PVC Pipe Casing . . . . .	5
2. CONCRETE COLUMN AND BEARING PLATE SLAB . . . . .	7-11
2.1 Forms . . . . .	7
2.2 Reinforcing Bars . . . . .	9
2.3 Foundation Bolts . . . . .	10
2.4 Concreting and Preparations . . . . .	11
3. PUMP CYLINDER . . . . .	13
4. SPOUT ASSEMBLY . . . . .	14
4.1 Functions and Descriptions of the Different Parts . . . . .	14
4.2 Installation . . . . .	14
5. RISER PIPES AND PUSH RODS . . . . .	15
5.1 Recommended Pipe and Rod Sizes . . . . .	15
5.2 Preparation . . . . .	15
5.3 Installation . . . . .	15
6. BEAM SET AND PIVOT . . . . .	18-19
6.1 Length of Beam . . . . .	18
6.2 Materials Used . . . . .	18
6.3 Preparation . . . . .	18
6.4 Installation . . . . .	19
7. PROCEDURES IN CONNECTING THE PUSH ROD TO THE YOKE . . . . .	21
WORKING DRAWINGS . . . . .	24-41

Open wells are practically always contaminated, that is experience. So in order to provide safe drinking water a closed well with pump is necessary. It is mainly with this in mind that the following manual has been compiled. Still, around any handpump there remain openings through which dirt can reach the water. A good construction reduces these possibilities enormously. When these instructions are followed a sound and lasting pump will be the result. Still one corner needs special attention: the concrete under the bearing plate should be finished so that splashed water runs away from the well opening. Because it can be done so easily, there is no excuse not to do it.

The coverslab is provided with a special notch. In this way it is possible to have access to the well in an emergency, while there is a minimal chance that water will run into the well. Show your craftsmanship by a good finishing of this notch.

## 1. WELL CASING

### 1.1.a Importance of Casing

Drilled or dug wells in unconsolidated materials as sand or clay will cave in when no casing is used. But in limestone or other similar situations the casing can be omitted, because the hole will remain open. However, surface water which is never safe for drinking, easily can enter the hole. For that reason the first 6 m from the surface of the drilled well must always be provided with a casing. In addition, the space between this casing and the wall of the hole must be carefully filled with material which prevents the surface water to seep through. It is normally done by means of a mixture of sand and cement (ratio 1:2) which is called "grout". For drilled wells see Fig. 1.1.a for the construction and as for the case of open dug wells, refer to drawing # 15.

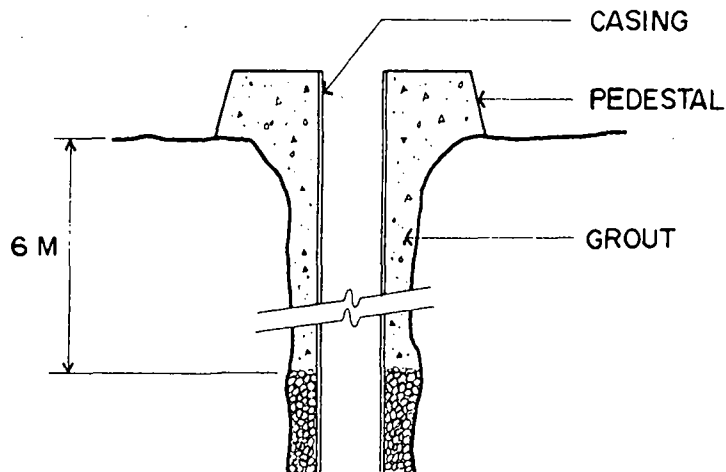


FIGURE 1.1.a

### 1.1.b The Grout

A cement grout stretches normally from the surface about 6 m in limestone, 3 m in loose material. Because the intention is to make a water tight connection between the outside of the casing and the inside of the hole, one must know if the open

spaces are filled with the grouting material. This is possible by estimating the free space during the installation of the casing and by checking the quantity of grouting material which is used.

When the drill hole is much wider than the outside of the casing, it is necessary to stop this gap at the end of the casing with paper, clay or other materials in order to prevent the grouting material to fall completely down the hole. In this case it may also be advisable to build up the grout slowly so that the lower portion sets and carries the later added materials.

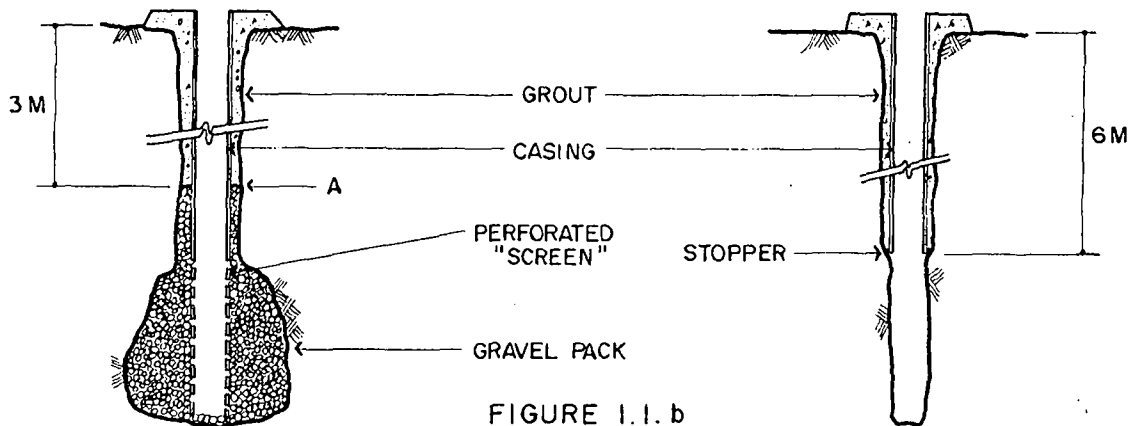


FIGURE 1.1.b

In case that the casing goes all the way down, a gravel pack of selected gravel,  $\phi$  about 5-10 mm, is used. The gravel should reach above the screen, so that leaking grouting material does not obstruct openings of the screen. If volumes of opening and applied gravel are known, it is possible to estimate the level of point A.

Casing only in upper portion of drill hole in cases where the formation stands permanently as is the case with limestone.

## 1.2 Materials to be Used for Casing and Size

Commonly used materials for casing are the cast or galvanized iron pipes and the newly developed PolyVinyl Chloride (PVC) pipes. The size of the pipe casing is determined by the size of the cylinder pump and the diameter of the hole.

Regularly, 3"-diameter PVC pipe is sufficient. A 4"-casing does not give very much advantage. If the water table is deeper than 10 m below the surface and a motorized pump is planned, a 6"-casing is necessary.

### 1.3 Advantages of Using PVC Pipe for Casing

- 1.3.1 Compared with iron pipes the PVC pipes are resistant to corrosion and sufficiently strong to withstand soil pressures for a longer period.
- 1.3.2 Much lighter to carry during installation.
- 1.3.3 Installed without special tools.
- 1.3.4 Somewhat cheaper.

### 1.4 Preparation of PVC Pipe Casing

- 1.4.1 Perforation. See Fig. 1.2

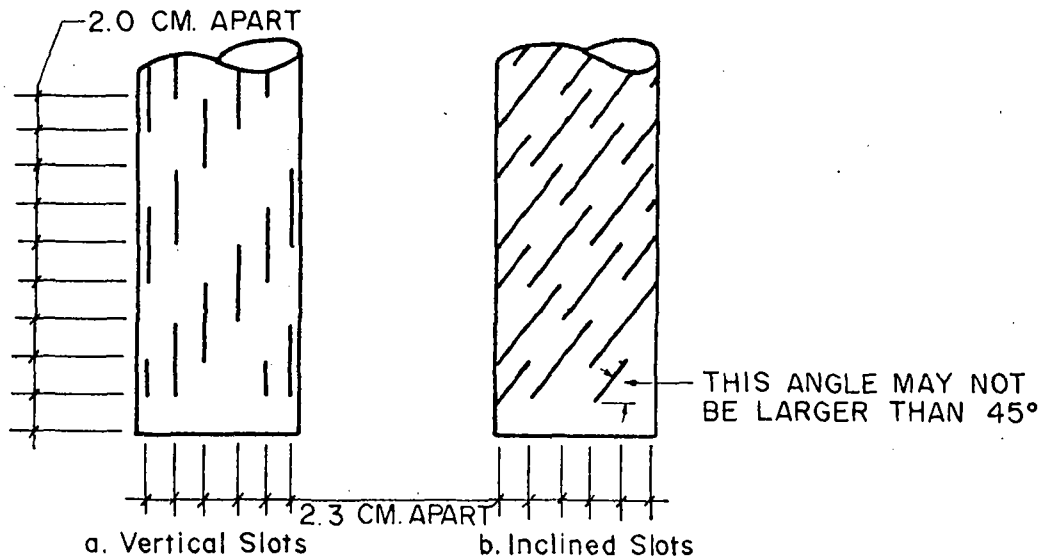


FIGURE 1.2

- a. Mark lines on one end of the pipe with pencil or pen as shown.
- b. Drill holes of about 8 mm diameter at each end of the dark lines.
- c. Cut the dark lines with a "jigsaw"

Or with an ordinary small saw. The finished slots should be 6-8 mm wide.

(note: For inclined slots b drilling the holes may not be necessary. It is namely possible to cut two parallel cuts and break away the strip between the cuts.)

#### 1.4.2 Methods of Connecting the Casing

- a. Measure as accurately as possible the depth of the well (from the top of the bearing plate slab to the bottom) so that the number of lengths of pipe casing can be estimated.
- b. Clean one end of a pipe using acetone or lacquer thinner and clean cloth. Clean the inside of a coupling. Apply the solvent on the end of the pipe and in one half of the coupling. Slip coupling on the pipe and turn it a quarter-turn to distribute the solvent well.
- c. Connect one coupling to each pipe which you think to use.

(note: It is advisable to leave one casing pipe without coupling connected to avoid waste in case of miscalculation of the number of lengths to be used.)

#### 1.5 Disadvantages of PVC Casing

- 1.5.1 It is obvious that PVC Casing cannot be driven. So on loose materials the use of a temporary casing is necessary. The inside diameter of the temporary casing must be about 1" larger than the outside diameter of the PVC coupling. Withdrawal of the temporary casing probably is best done together with the grouting.

1.5.2 For deep wells in loose materials, i.e. deeper than 20 meters in loose material it is necessary to compare the possible soil pressure with the strength of the PVC casing. In extreme cases it is possible that a PVC casing collapses.

1.5.3 For deep wells where eventually a grout would stretch over more than 10 m the head developed during the hardening of the cement may locally weaken the PVC which becomes soft at 60°C. To avoid problems, the grouting should not be made longer than 10 m or done in shifts so that the mortar has time to set and no large pressures build up.

#### 1.6 Installation of PVC Pipe Casing

1.6.1 For drilled or open-dug wells with depths not more than 10 meters the pipe casing can be installed easily. Cement the 3-4 pieces of casing together to one pipe. Do this on the ground. Up to 10 meters PVC casing can then be lowered in the hole in one piece. Accurate measurement of well depth is very important.



1.6.2 For drilled-wells with depths more than 10 meters the following steps are important:

- a. Arrange all the pipes including the perforated pipe according to where the coupling is connected. Put the end without a coupling closer to the drilled-hole. It may be advantageous to cement 2 lengths together, so that all prepared pipes are 6 meters long.
- b. Take the perforated pipe first and hold it with a clamp or rope firmly with the coupling at the upper end.

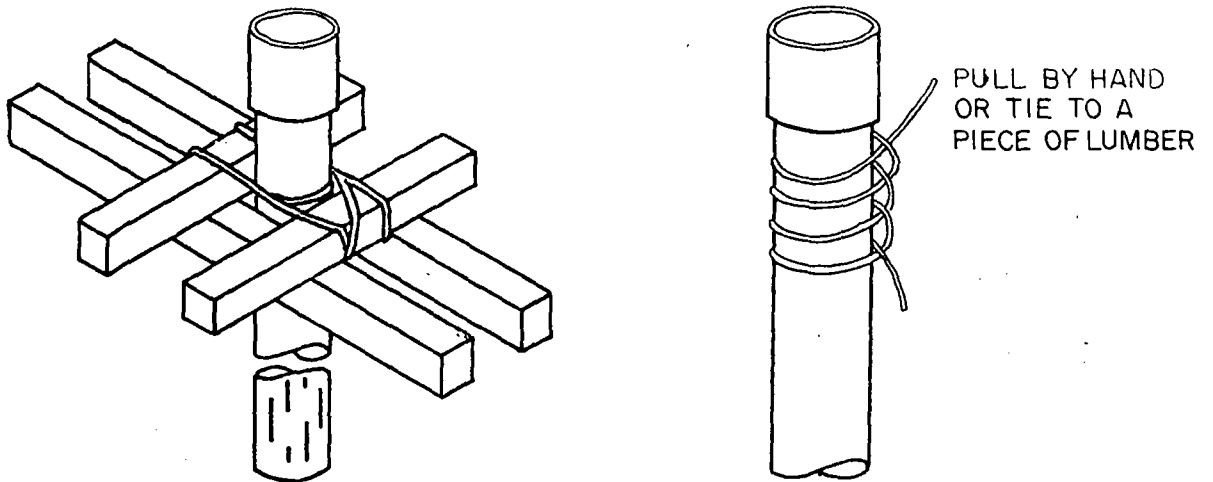


FIGURE 1.3

- c. Take another length of pipe with a coupling at the upper end and apply solvent cement to connect the pipes together as explained in 1.4.2.
- d. Give the cement time to become strong, about 10 minutes.
- e. Gently lower the casing in the hole. Be careful not to loose it.
- f. Take the succeeding length of pipe with the coupling always at the top and follow the same procedures as mentioned above.

(note: The pipe casing left without coupling on its upper end must be connected last. Leave the extra piece protruding until the column is constructed.)

## 2. CONCRETE COLUMN AND BEARING PLATE SLAB

### 2.1 Forms

It is more convenient and economical to use reusable removable forms braced with angle bars for the column. Important dimensions can be readily checked and errors may not be repeated.

#### 2.1.1 Materials to be used for forms:

- a. one sheet 1/2" x 4' x 8' marine plywood
- b. one length 1/8" x 1" x 1" x 1" angular bar
- c. 3/4" long wood screws

#### 2.1.2 Procedure in making the forms:

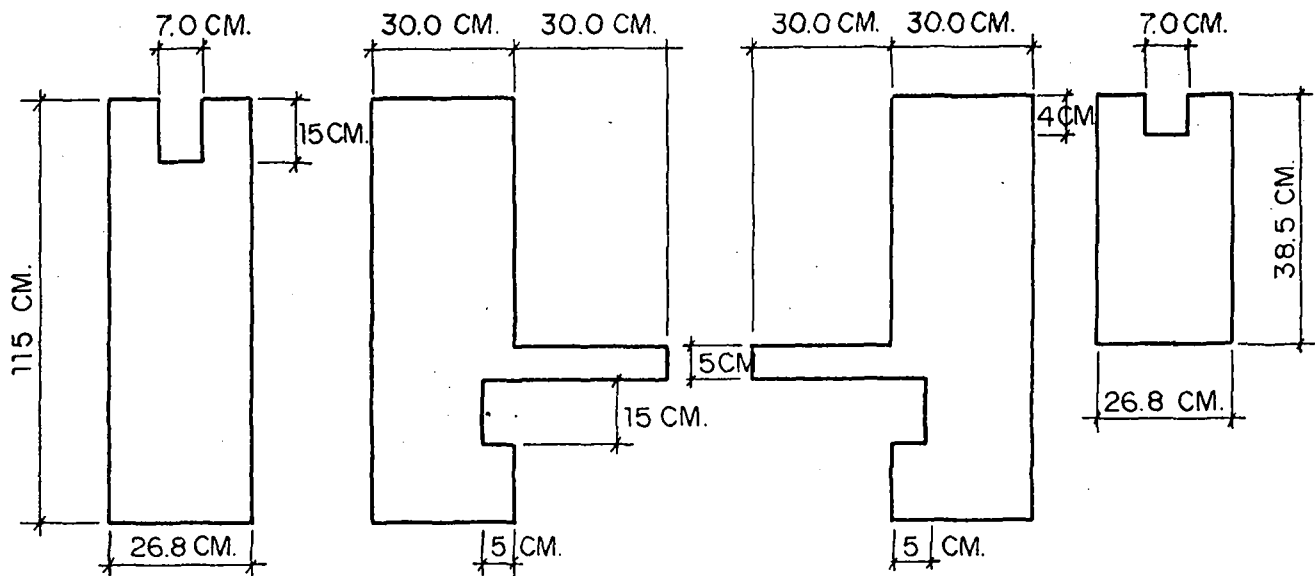


FIGURE 2.1

- a. Make a sketch of the forms on the plywood according to the form and dimension given in Fig. 2.1

b. Cut the plywood accurately.

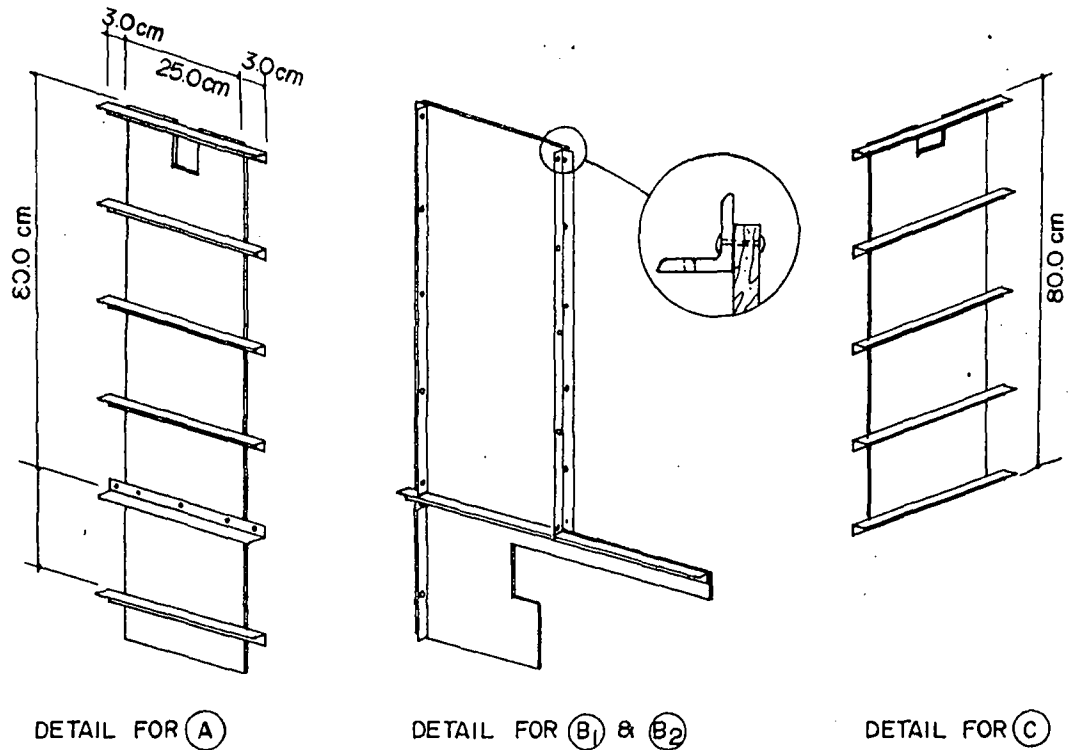


FIGURE 2.2

- Note:
1. Angle bars are placed at 20.0 cm O.C.
  2. Holes drilled in the protruding ends of angle bars of A and C must coincide or be in line with the holes drilled in B<sub>1</sub> and B<sub>2</sub> to make it easy to connect them with tie wires.
- c. Cut the angle bars as shown in Fig. 2.2 leaving an allowance of about an inch at each end of the bars for A and C of Fig. 2.1.
- d. Drill holes in each piece of the angular bar at a maximum distance of 10 cm.
- e. Screw the bars on the plywood piece. See Fig. 2.2.

## 2.2 Reinforcing Bars

### 2.2.1 Materials Needed

- a. 2 pcs - 3/8"  $\emptyset$  deformed bars  
(smallest available) for main reinforcement
- b. 2 pcs - 1/4"  $\emptyset$  round bars for ties or rings
- c. 1/4 kilos - #16 common tie wire

### 2.2.2 Preparation of Reinforcing Bars

(See Fig. 2.3)

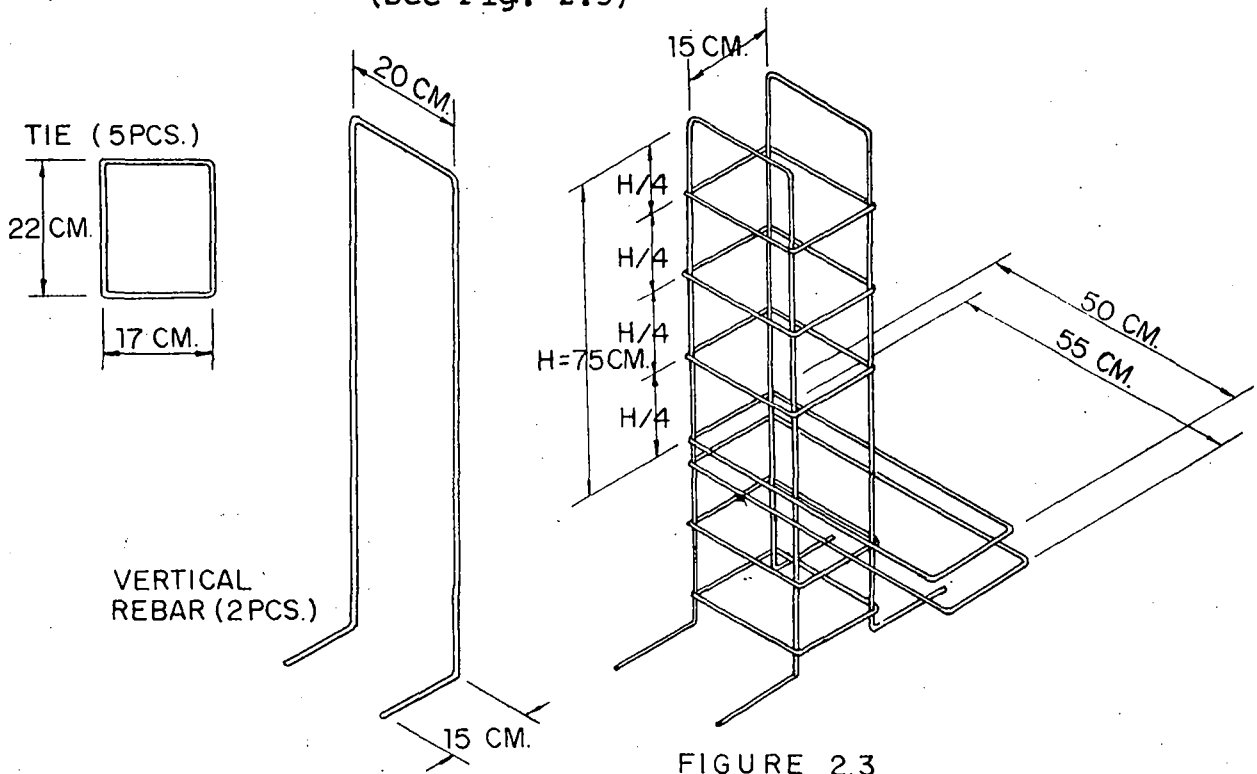


FIGURE 2.3

- a. Cut the main reinforcement bars.  
(See column dimensions for accurate measurements.)
- b. Form the ties (1/4"  $\emptyset$ ) to rectangular shape and the vertical reinforcing bars as shown in Fig. 2.3a and Fig. 2.3b respectively.
- c. Assemble the bars as shown in Fig. 2.3c.

### 2.3 Foundation Bolts

There are two locations where foundation bolts are used: for the bearing blocks use 12" long bolts, for the bearing plate 8" bolts.

Common machine bolts of about 1/2"  $\phi$  are sufficient but manufacturing bolts from ordinary round bars may turn out to be more economical. Detail drawing of bolts which can be made out of ordinary reinforcing bars. See Fig. 2.4.

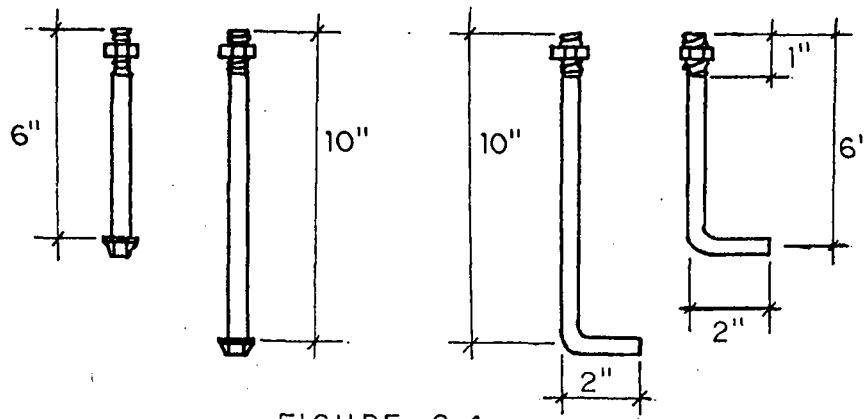


FIGURE 2.4

#### 2.3.1 Preparation of Bearing Plate Foundation Bolts

- a. Cut a bearing plate pattern using a small piece of 1/4" thick plywood.  
(refer all dimensions to drawing #2)
- b. Drill the holes as shown in Fig. 2.5.

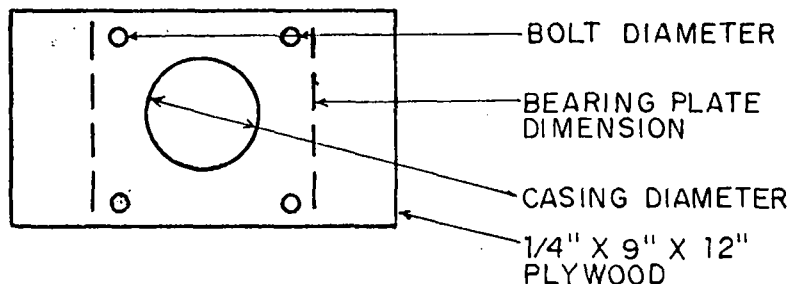


FIGURE 2.5

c. Insert the foundation bolts in the four holes.

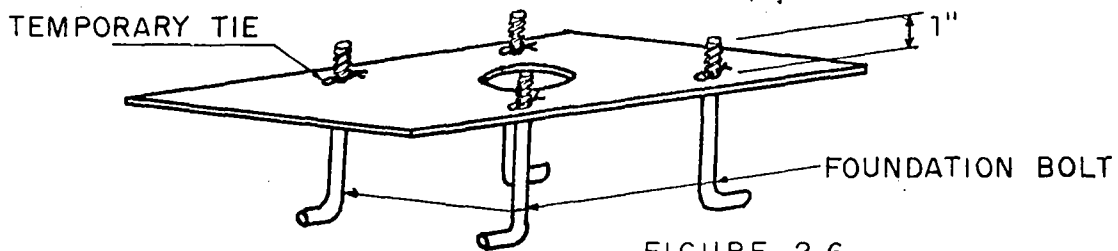


FIGURE 2.6

### 2.3.2 Preparation of Bearing Block Foundation Bolts.

Assemble the bolts and wooden bearing block as shown:

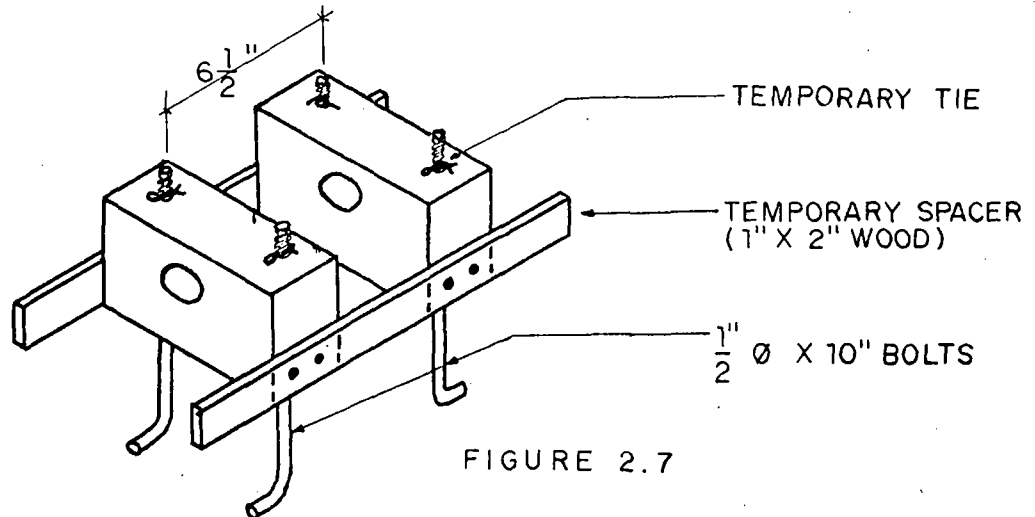


FIGURE 2.7

## 2.4 Concreting and Preparations

- 2.4.1 For drilled wells, select the most preferable position for the beam. For open dug wells, the location of the beam must depend on the most suitable place for the riser pipe in case the hole is not perfectly vertical.
- 2.4.2 For open dug wells only, provide space for manhole. (refer to drawing #14)

- 2.4.3 Apply any oil or lubricant on the inside faces of the forms.

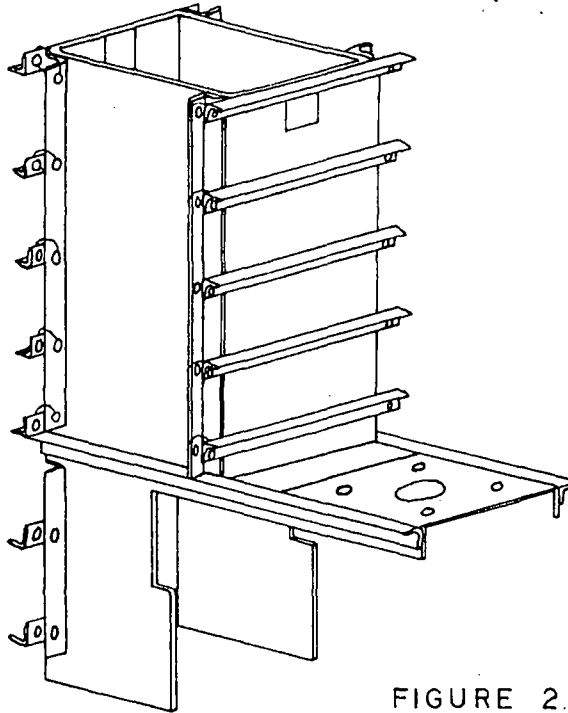


FIGURE 2.8

- 2.4.4 Assemble the reusable removable form by using tie wire as shown. Refer to drawing #14 for the proper position of foundation bolts.
- 2.4.5 Place the pre-assembled reinforcements inside the form.
- 2.4.6 Make all the necessary form works with the removable form in place. For accurate dimensions, refer to drawing #14.
- 2.4.7 Concreting can now be done. Recommended concrete mixture is 1:1-1/2:3 or 1 part cement to 1-1/2 parts sand and 3 parts gravel. For this particular concreting work, 1-1/2 bag of cement is enough.
- 2.4.8 Remove the forms after 2-3 days. If the finished concreting appears to be very rough, plastering may be done.
- (note: For continuous use of water, construct the manhole slab after the pump is installed.)

3. THE PUMP CYLINDER

3.1 Cylinder pumps can be made out of any type of pipe with essentially smooth inside surfaces to give longer life for cups. In many cases, brass pipes are used because of its durability and resistance to salty water. High quality PVC pipes are now developed for pump cylinders.

3.2 The pump cylinder set should be considered the most important part in the whole set-up.

3.2.1 Special check-up of the inside parts must be made.

3.2.2 The plunger is subjected to continuous up and down movement, it is important to check that all the connections are tight.

3.2.3 Rubber or leather cups must fit exactly in the cylinder. Lose cups cause inefficient discharge.

(note: Refer to working drawing #10 for names of the different parts.)



4. SPOUT ASSEMBLY

4.1 Functions and Descriptions of the Different Parts.

- 4.1.1 The bearing plate - it is a half inch thick metal steel plate welded to the riser pipe. It acts as the principal support of the whole pipe column.
- 4.1.2 Riser pipe of larger diameter - it eliminates the use of stuffing box. Normally a stuffing box is used to prevent water from coming out at the top of the riser pipe instead of going straight to the downspout. By increasing the pipe size, the velocity of flow is reduced.
- 4.1.3 PVC bushing or adaptor - replaces the stuffing box and prevents direct contact between the push rod and G.I. piece.

(note: For the construction refer to drawing #1.)

4.2 Installation

- 4.2.1 Tighten all threaded connections.
- 4.2.2 Try out installing the bearing plate to ensure that the foundation bolts fit in the holes.
- 4.2.3 Make the necessary adjustments of the bolts.
- 4.2.4 Remove the assembly and connect it to the last pipe of the riser pipe.

## 5. RISER PIPES AND PUSH RODS

### 5.1 Recommended Pipe and Rod Sizes

- riser pipe - 1-1/4"  $\emptyset$  GI pipe schedule 40
- push rod - 1/2"  $\emptyset$  cold rolled steel

### 5.2 Preparation

- 5.2.1 Measure the depth of well so that the number of lengths of riser pipe and push rod can be known. (Refer to drawing #11)
- 5.2.2 Cut the extra pipe length except the push rod.
- 5.2.3 Insert each push rod in each riser pipe before pipes are connected.
- 5.2.4 Thread the riser pipes and push rods. Rethreading may be done to assure perfect fitting and problems of fitting during installation can be eliminated.

(note: For push rods use 1/4"  $\emptyset$  pipe threader)

- 5.2.5 Connect a coupling to one end of each riser pipe and to one end of each push rod with couplings of both riser pipe and push rod on the same side.

### 5.3 Installation

- 5.3.1 The installation of riser pipes and push rods requires careful attention and can only be done when proper equipments are used:
  - a. wooden ladder or tripod about 15' high
  - b. 2-18" long pipe wrenches
  - c. 1-12" long pipe wrench
  - d. 1-10" long adjustable wrench
  - e. 1 pipe vise
  - f. 2 pipe clamps
  - g. 1 250-kg chain block (optional)

(note: Refer to drawing #17 and #18 for ladder and clamp details respectively.)

5.3.2 As explained in 1.5 for PVC pipe casing, the riser pipes and push rods can be installed similarly.

(note: While work is going on at any length of pipe which hangs in the hole, make sure that the pipe vise is tightly clamped around the pipe in addition to the pipe vises which are used for screwing, tightening, etc. If the riser pipe slips down the hole, you lose more time and sweat to recover it than you ever will spend on tightening vises. And if you do not succeed in recovering the dropped items, the whole well is useless.)

- a. Connect the push rod to the plunger and the riser pipe to the pump cylinder, while still on the ground.
- b. Place the ladder or tripod in position over the hole. Be sure it is stable enough.
- c. Lower the pipe down to the hole with the pump cylinder first. This may be done by just holding by hand. One person should be at the top of the ladder and at least one at the well opening.
- d. Hold the pipe with a vise or clamp at about one meter from the top end.
- e. Finally, hold the pipe with another clamp or vise near the coupling and let it rest on the concrete slab after removing the first clamp.
- f. Take another length of pipe and rod as prepared with the coupling end at the top. Connect the rod first and the pipe later.

(note: At least 1/2" of the threaded portion is holding the coupling.)

g. Bring the pipe down by first clamping at the top at a distance that can be reached by hand when standing. Lift the clamp up to be sure that it is holding the pipe and release the other clamp which is still resting on the concrete slab. Bring the pipe down and let the clamp rest on the slab. Repeat this procedure until the next coupling is reached.

h. Take another length of pipe and rod and repeat the above procedures. If the pipes become too heavy, use chain block or pulley to hold the pipe.

(Precaution: Be sure that clamp at the top is tight before the clamp at the bottom is released.)

6. BEAM SET AND PIVOT

6.1 Length of Beam

Deeper wells require longer beams. Not using the right length of beam makes the pumping work inconvenient. The following table is important to get the right proportion of the length of beam to well depth:

<u>Well Depth</u> (feet)	<u>Length of Beam from</u> <u>the pivot point (feet)</u>
25 -40	5
41 -55	6
56 -70	7
71 -95	8
96 -110	9
111-125	10
126-above	11

6.2 Materials Used

Both the beam and pivot are practically made out of wood and of a few metal parts. Thus, facilitating the replacement of worn-out parts.

6.3 Preparation

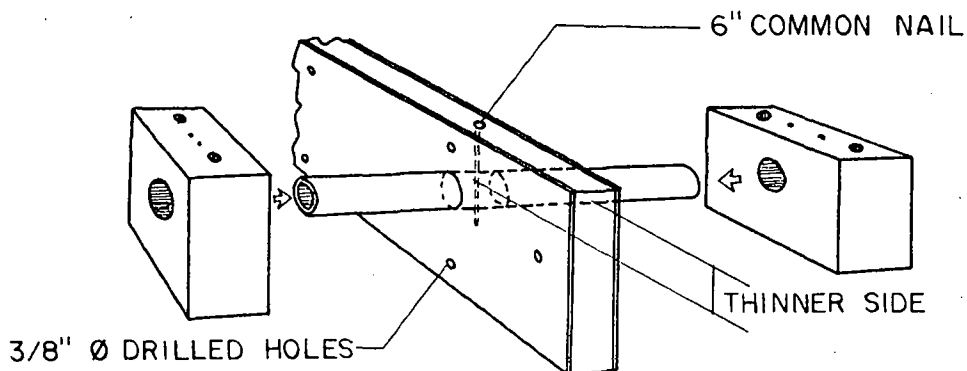


FIGURE 6.1

6.3.1 Drill a hole in a piece of 2" x 6" x length of wooden beam of about 1-1/4"  $\phi$ . Refer to drawing #5. The 1 1/4" GI pipe may fit tightly in this hole.

- 6.3.2 Insert a piece of GI pipe 1-1/4"  $\varnothing$  x 11' long in the drilled hole.
- 6.3.3 Put the two plates at both sides of the wooden beam and clamp together. Check if the GI pipe is perpendicular to the beam.
- 6.3.4 Drill smaller holes across the wooden beam coinciding with the existing holes in the plates.
- 6.3.5 Bolt the two plates to the beam and remove the clamp.
- 6.3.6 Drill a hole in the beam (thinner side) passing through the two walls of the GI pipe. Put a 6" long nail into the hole to prevent the GI pipe from turning in the wooden beam.
- 6.3.7 Slip the wooden blocks at both ends over the GI pipe.
- 6.3.8 See to it that the GI pipe moves in the wooden blocks and not in the beam. These wooden blocks are easier and for less expenses to replace.

#### 6.4 Installation

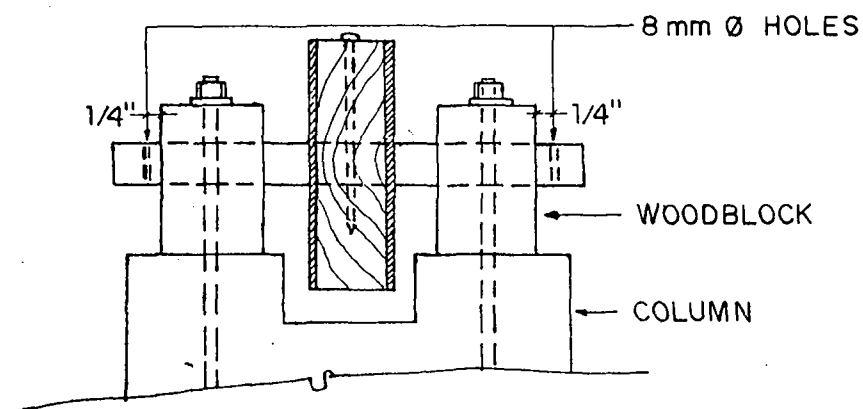


FIGURE 6.2

- 6.4.1 Measure the distances between the two pairs of foundation bolts. These must coincide with the distances of the two holes in the wooden blocks. Make the necessary adjustments.

- 6.4.2 Get the beam set into position and place the nut and washers. Tighten the set-up.
- 6.4.3 Center the axis of the beam by making several trials of the up and down movement. No portion of the beam must hit the wooden block or the concrete column.
- 6.4.4 After centering, hold the beam and drill holes in both ends of the GI pipe at about 1/4" from the outer faces of the wooden blocks.
- 6.4.5 Place the washers and fit the cotter pins in the new holes. Refer to drawing #13.

7. PROCEDURES IN CONNECTING THE PUSH ROD TO THE YOKE

- 7.1 Gently push the rod down until the plunger touches the bottom of the cylinder.
- 7.2 Put a mark on the push rod with a hack saw.
- 7.3 Bring the push rod up and hold it with a clamp or vise tightly.
- 7.4 Measure 1" from the mark down and cut the rod. This prevents the push rod from hitting the bottom of the pump cylinder.
- 7.5 Thread the end of the push rod and place the "bushing plug".

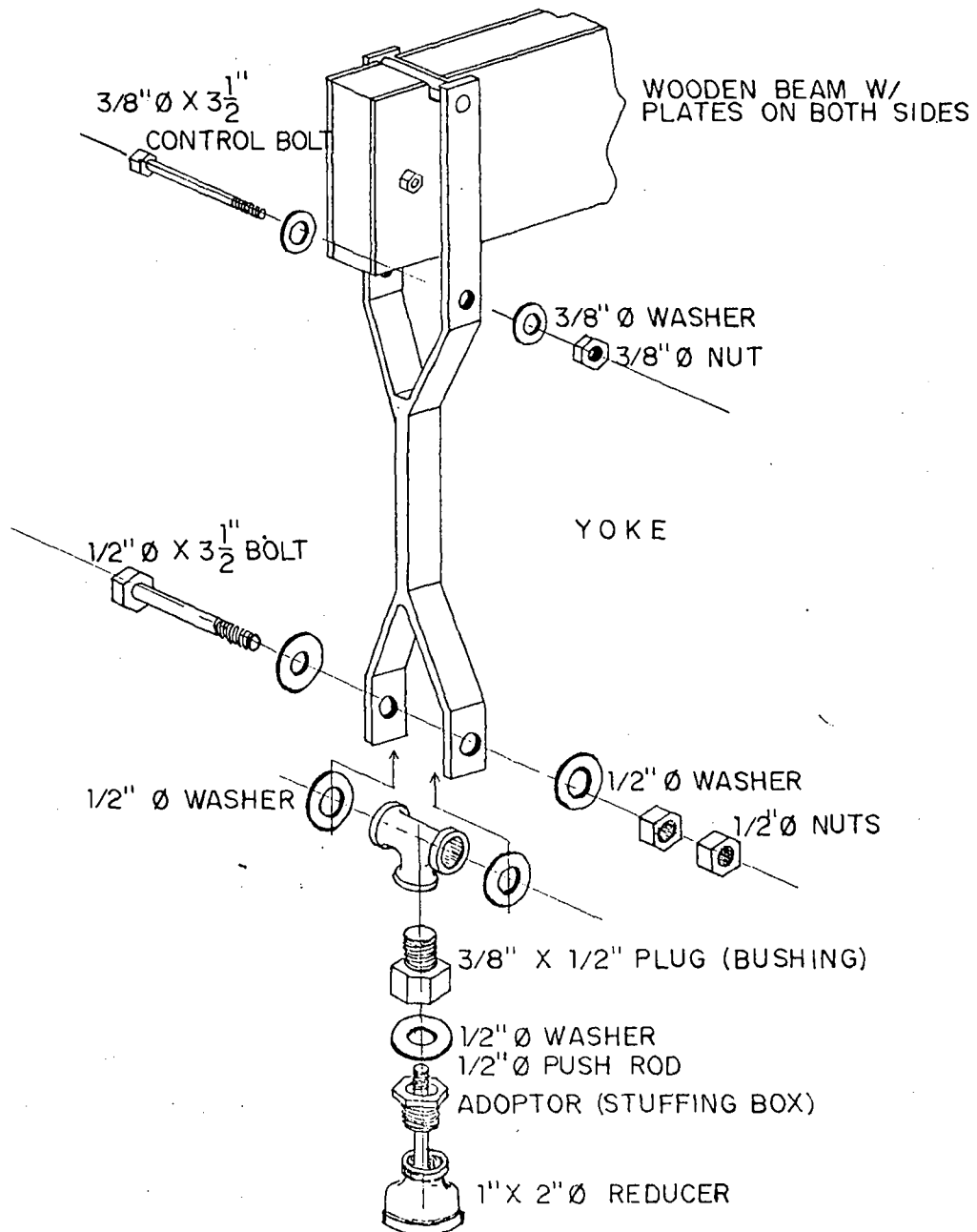


FIGURE 7.1



- 7.6 Connect the GI "TEE" fitting to the "bushing plug" and place the yoke by bolting the different parts together.
  - 7.7 Hang the yoke to the beam and place the control bolt to prevent the yoke from slipping over.
  - 7.8 Release the vise and the pump is now ready.
- (Important: Lubricate all the moving parts with oil.)

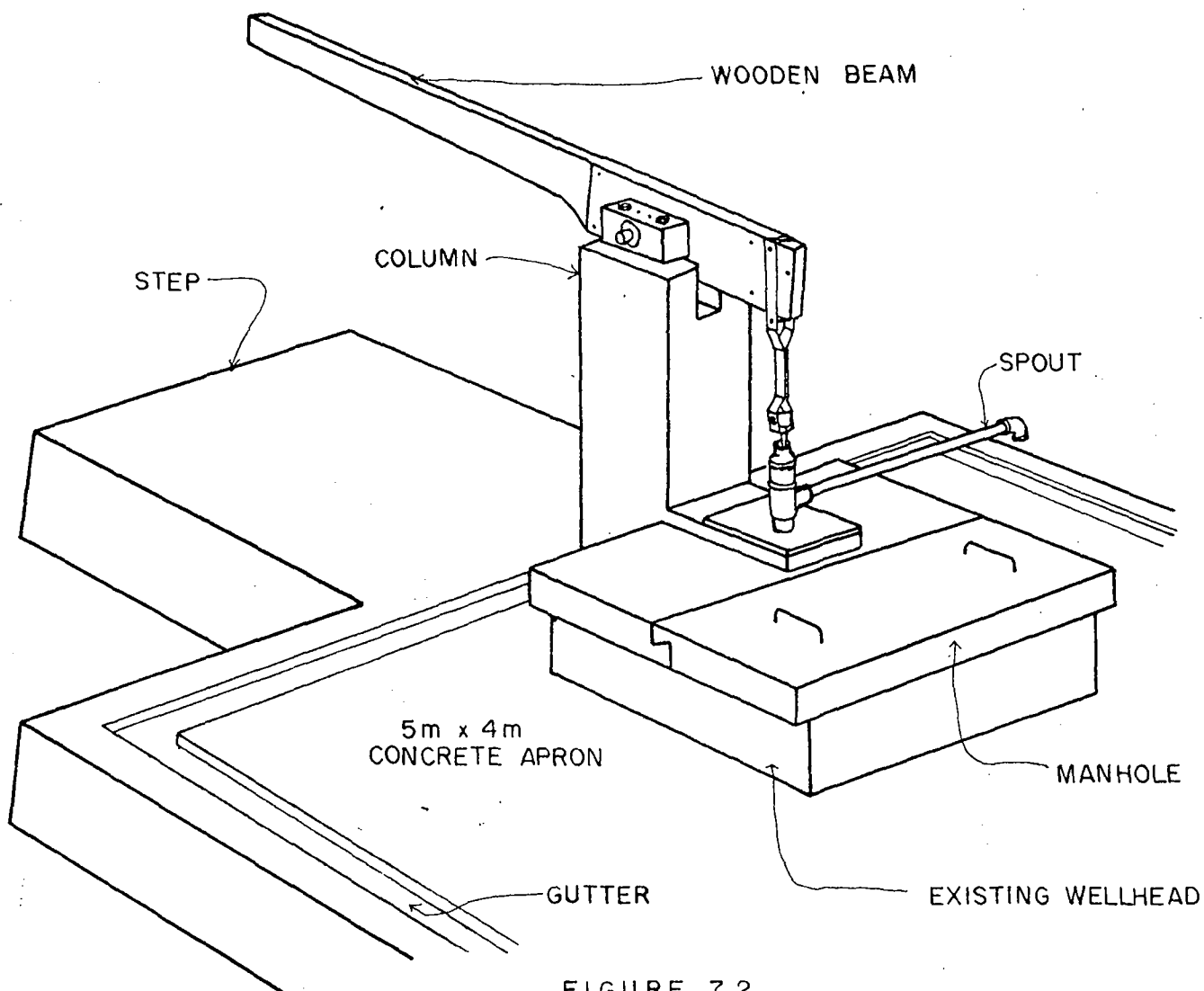


FIGURE 7.2

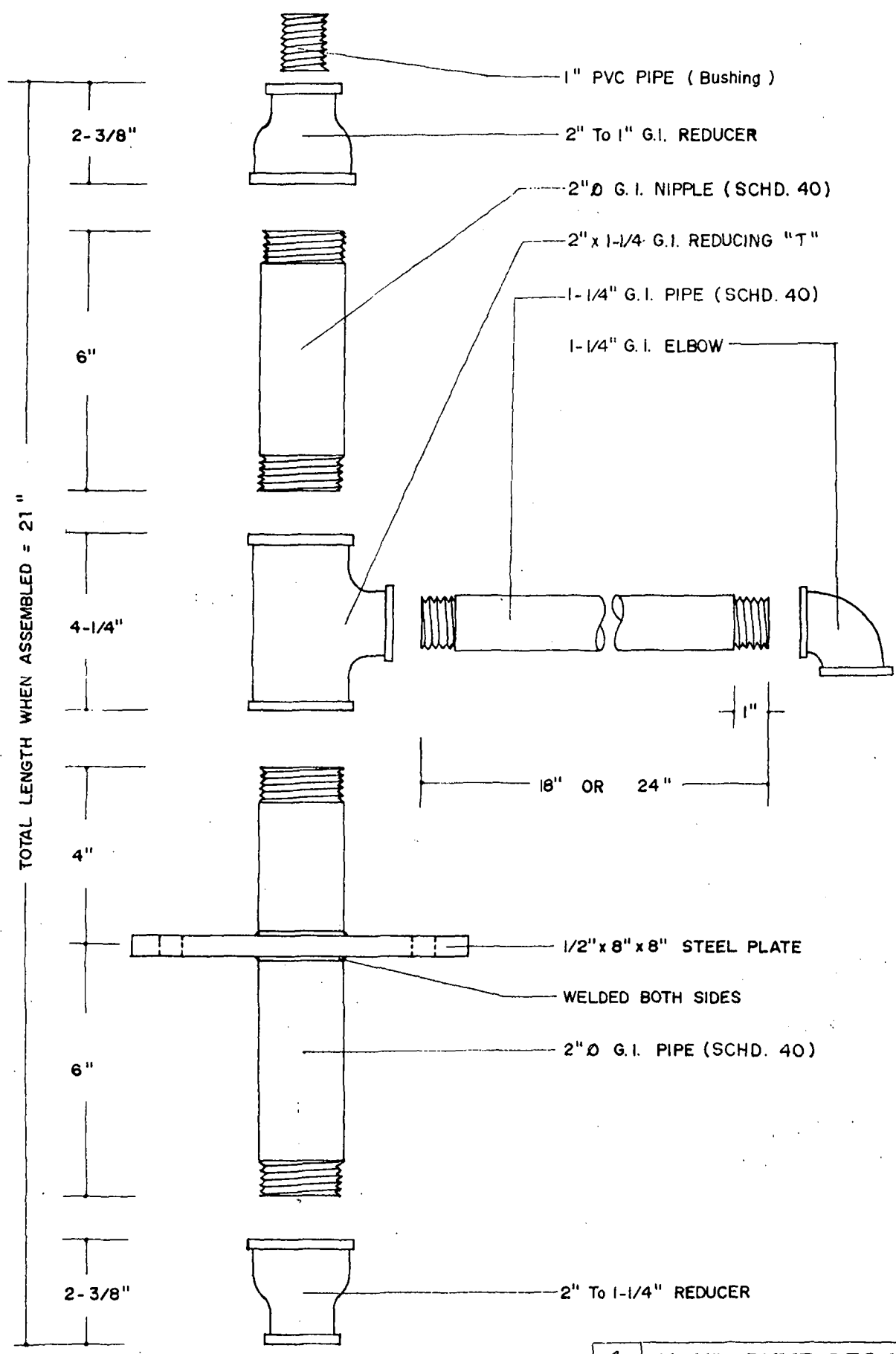
Additional Informations:

For Drilled Wells - Repair works such as replacing of cups or the pump cylinder as a whole, reverse the above procedures.


For Dug Wells - Replacing of cups or the pump cylinder may be easily executed by just letting one or two persons equipped with tools down into the hole and have the repair works done there.

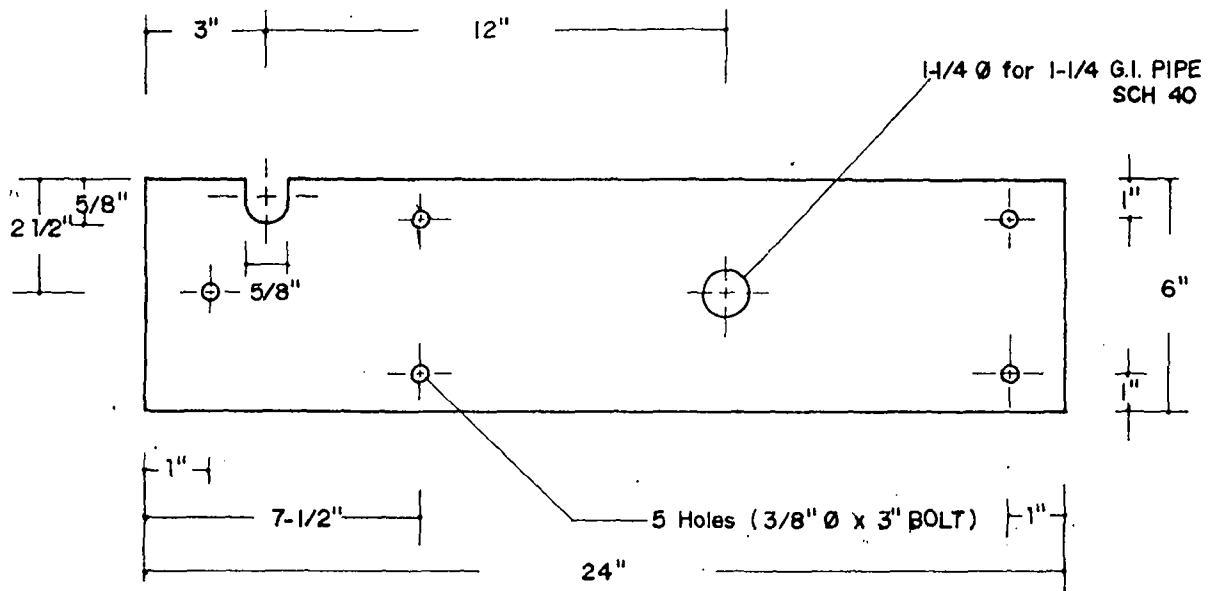
August 26, 1981

:jsv

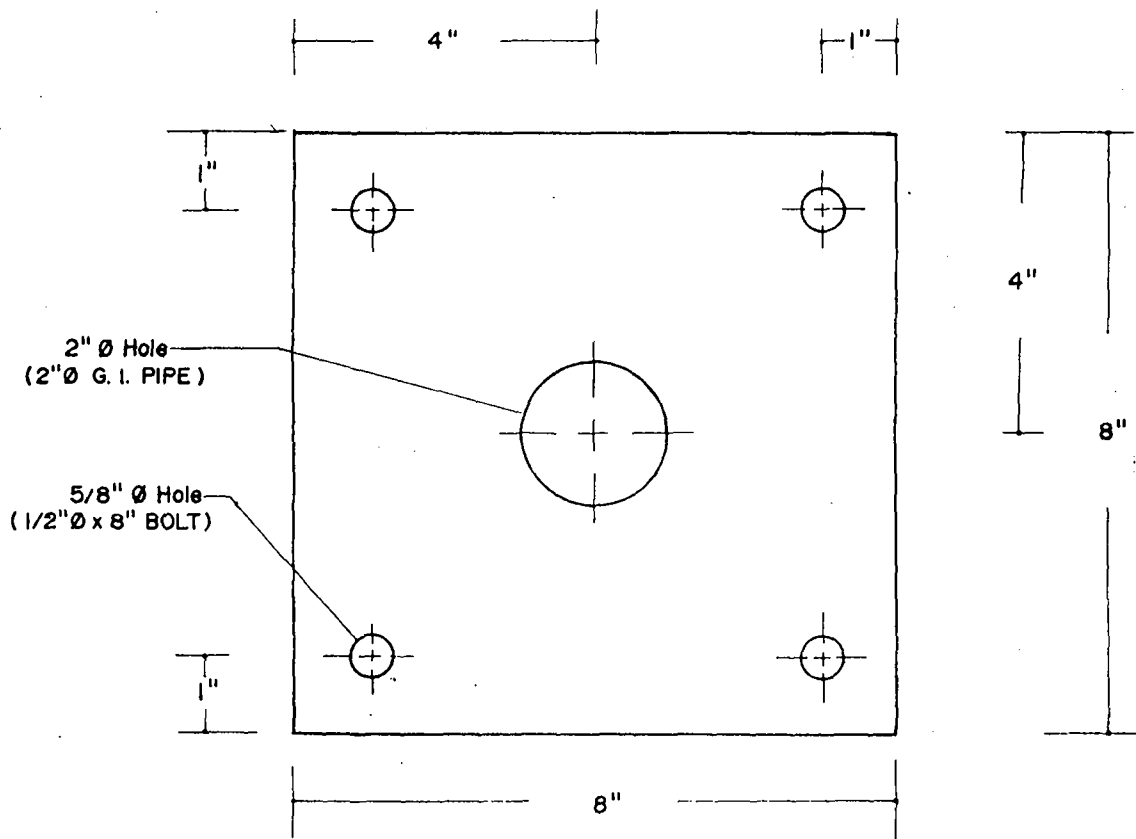


SPOUT ASSEMBLY

1	<b>HAND PUMP DESIGN</b>
 UNIVERSITY OF SAN CARLOS WATER RESOURCES CENTER	



PUMP BEAM PLATE - One Identical Plate, 3/16"x6"x24"



PUMP BEARING PLATE - 1/2"x8"x8"

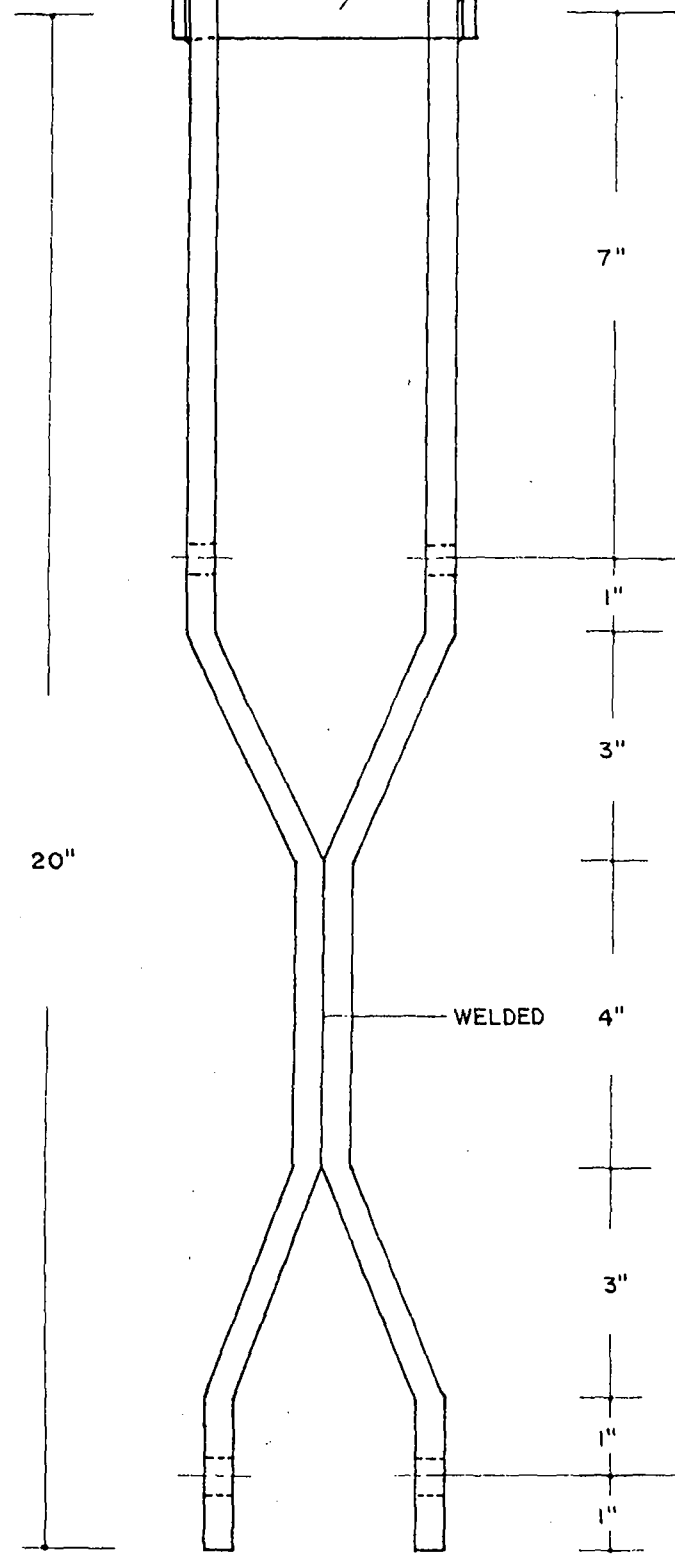


3/16" x 1 1/2" PLATE

2-5/8"

5/8" Ø ROD

WELDED



7"

3/8" Ø HOLES  
(3/8" Ø x 3" BOLT)

1"

3"

20"

WELDED

4"

3"

5/8" Ø HOLES

1"

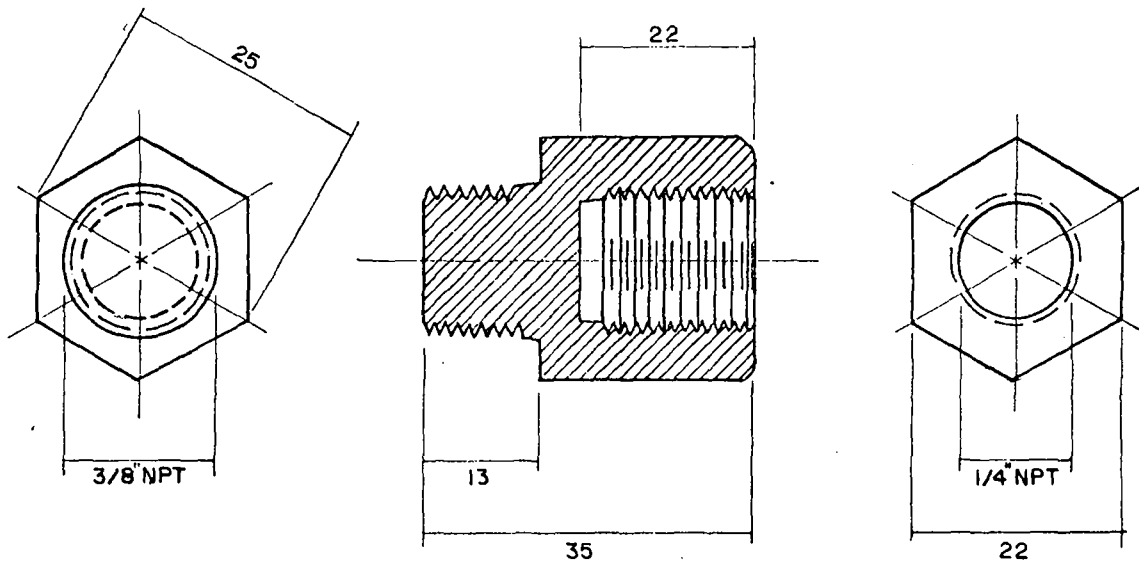
1"

YOKE

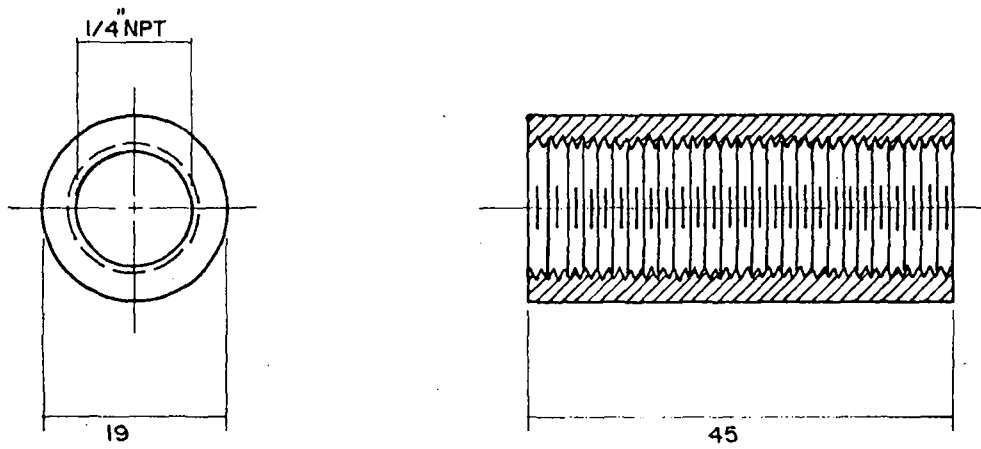
2-1/8"

3 HAND PUMP DESIGN

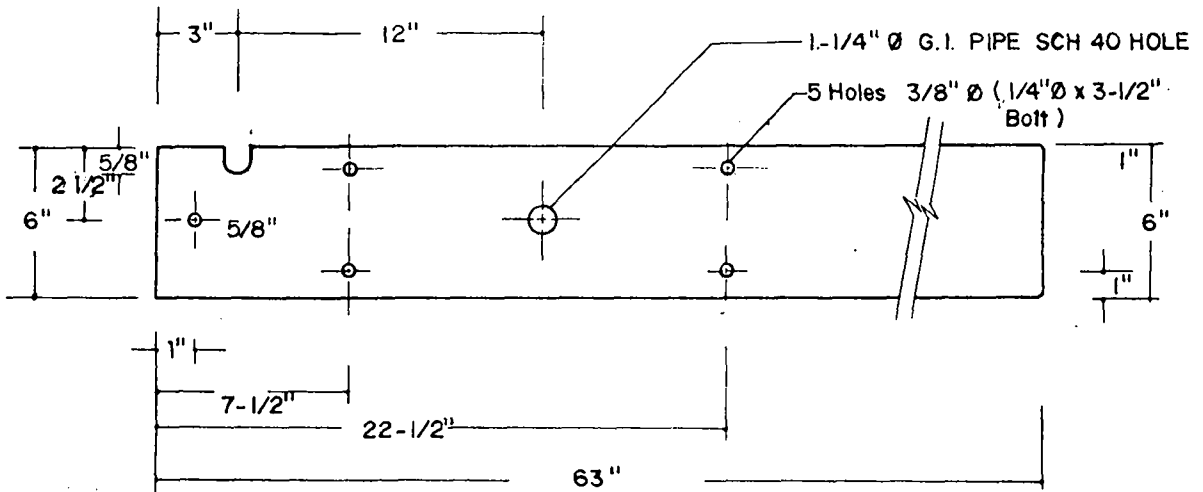
UNIVERSITY OF SAN CARLOS  
WATER RESOURCES CENTER



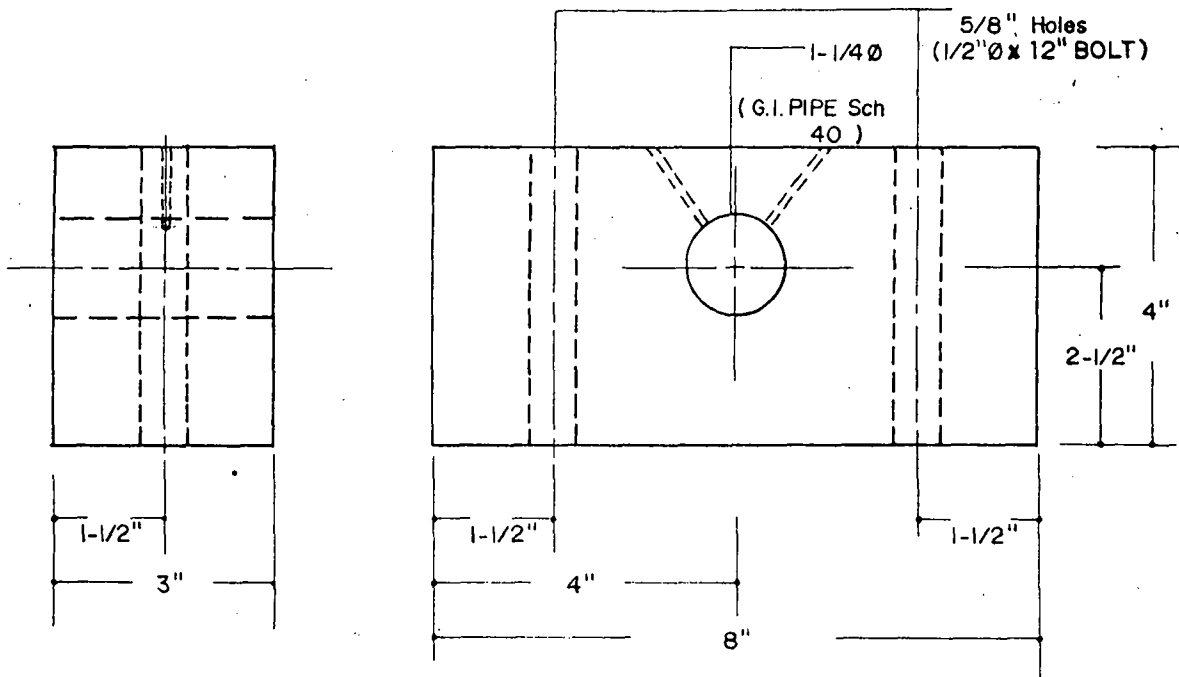
**BUSHING DETAIL**



**PUSH ROD COUPLING DETAIL**  
DIMENSIONS ARE IN MILLIMETERS



HARDWOOD BEAM (Yacal)



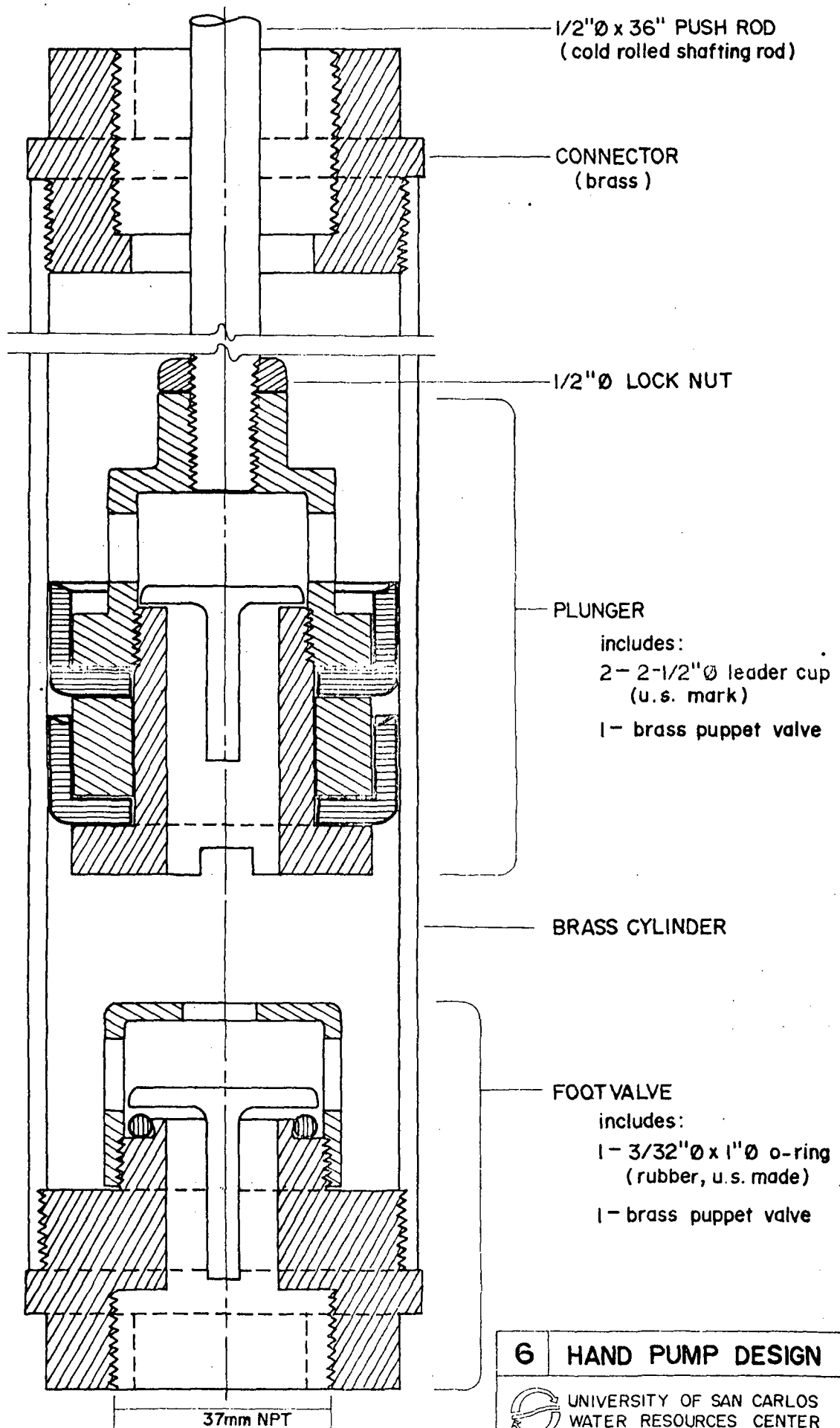
HARDWOOD BEARING BLOCK (Yacal)

5 HAND PUMP DESIGN

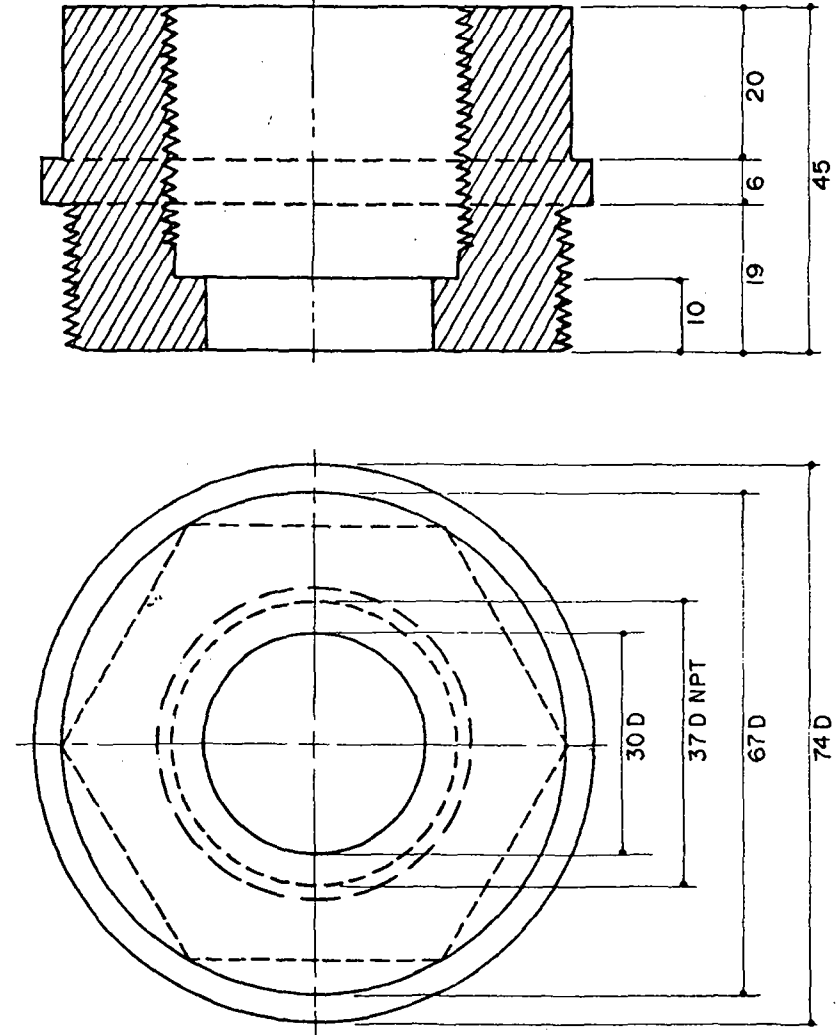
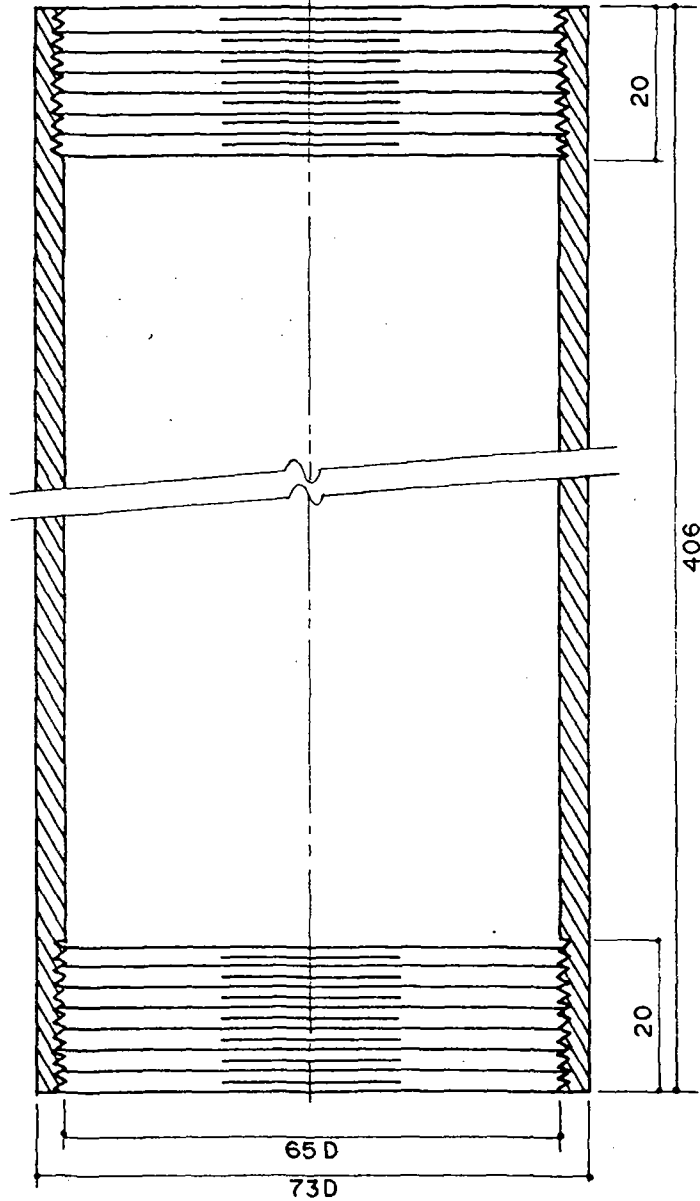


UNIVERSITY OF SAN CARLOS  
WATER RESOURCES CENTER

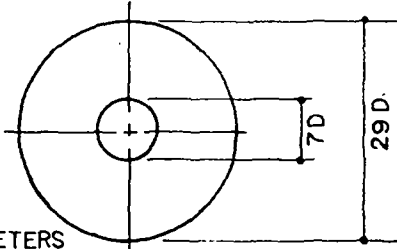
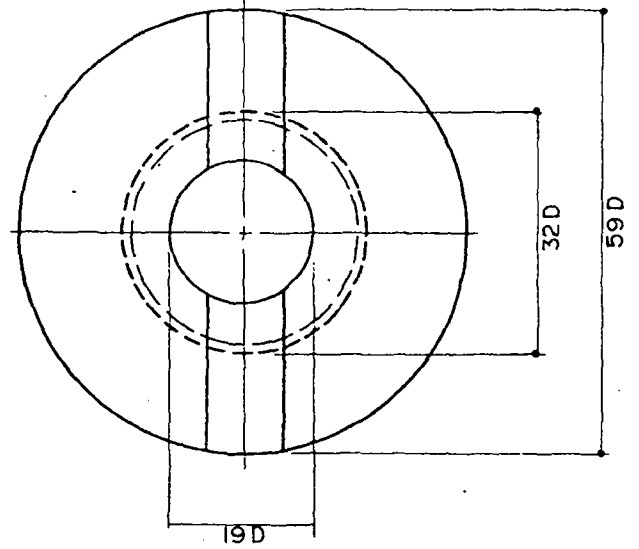
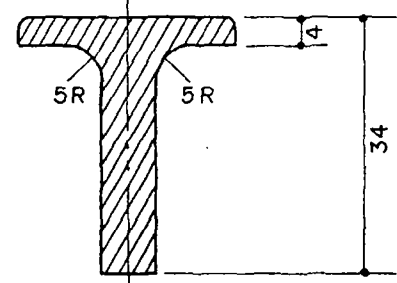
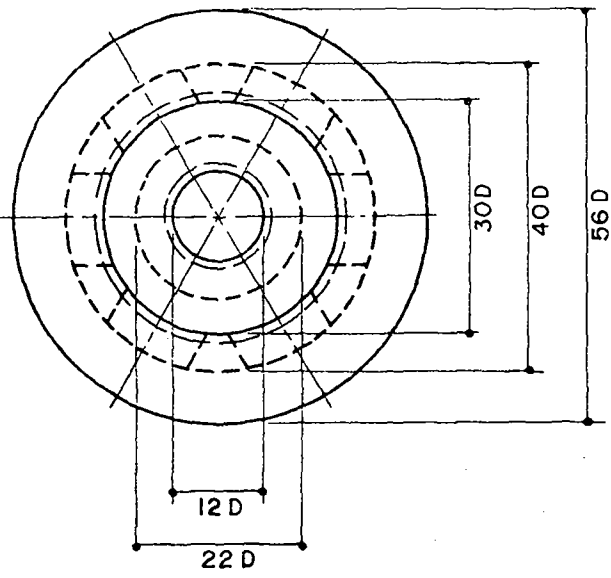
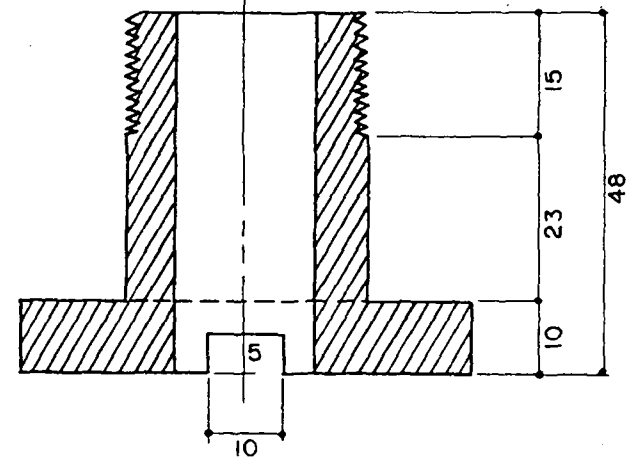
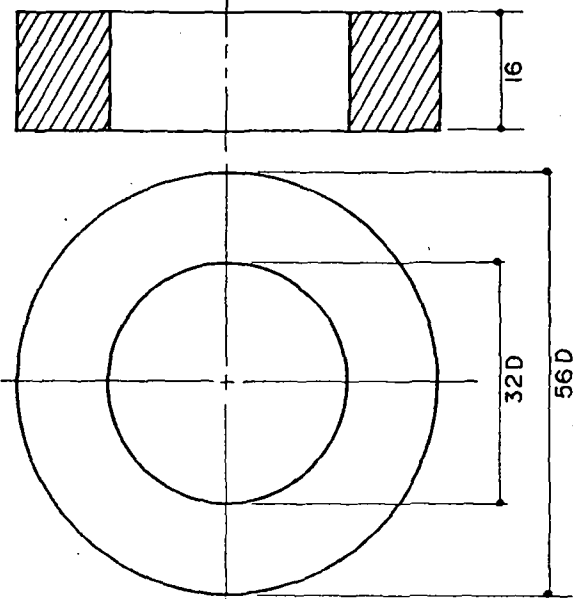
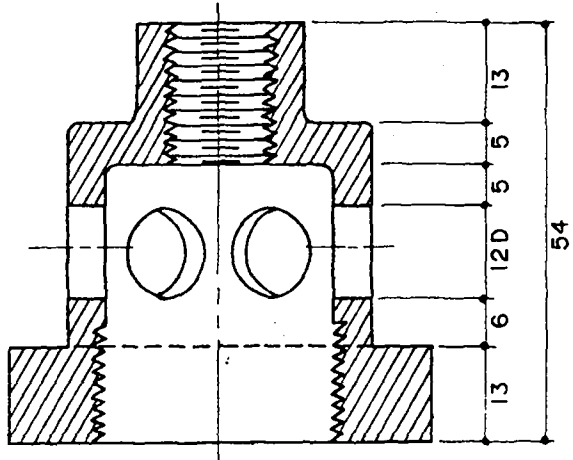
**BRASS CYLINDER PUMP ASSEMBLY**  
 NOTE: ALL THREADINGS ARE COARSE THREAD (NC)



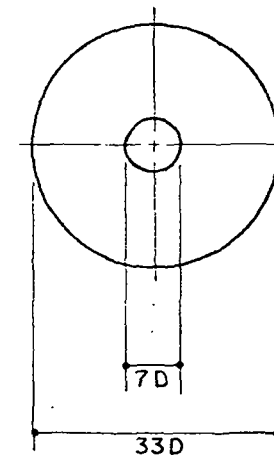
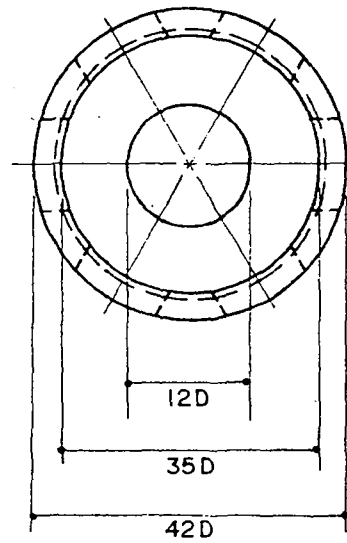
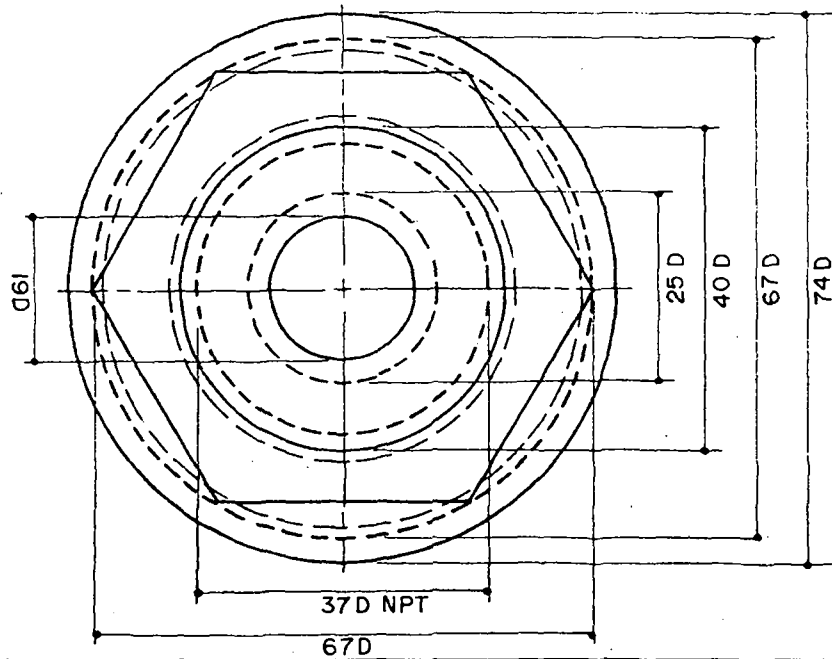
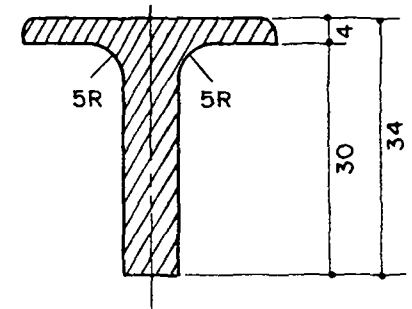
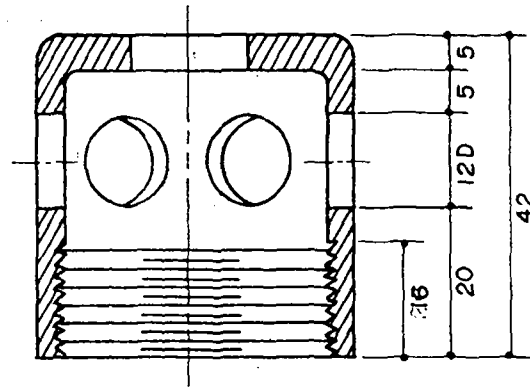
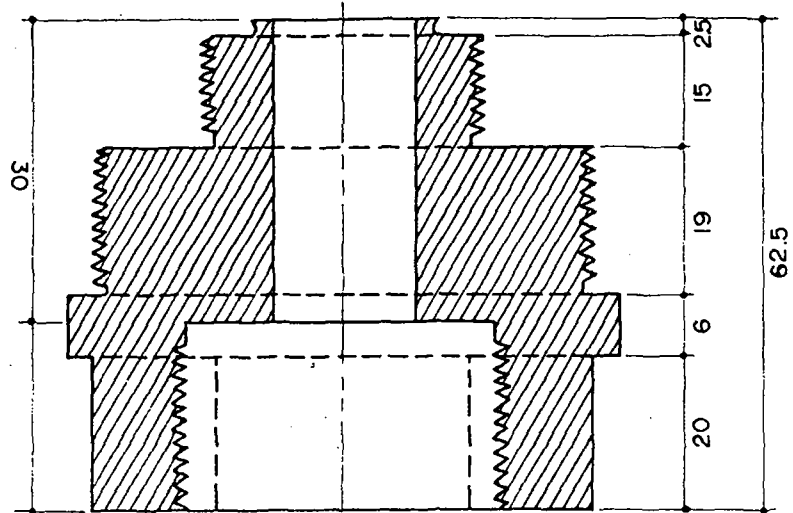




**BRASS CYLINDER and CONNECTOR**  
 DIMENSIONS ARE IN MILLIMETERS



**PLUNGER DETAIL**  
DIMENSIONS ARE IN MILLIMETERS



**FOOTVALVE DETAIL**  
 DIMENSIONS ARE IN MILLIMETERS

# EXPLODED VIEW OF CYLINDER PUMP

RISER PIPE

G. I. COUPLING

C.R. SHAFTING ROD

LOCK NUT

RISER PIPE CONNECTOR

SHAFTING ROD CONNECTOR

LEATHER CUP

SPACER

LEATHER CUP

PUPPET VALVE

FOLLOWER

PLUNGER

BRASS CYLINDER

PUPPET VALVE CAGE

PUPPET VALVE

RUBBER SEALING O-RING

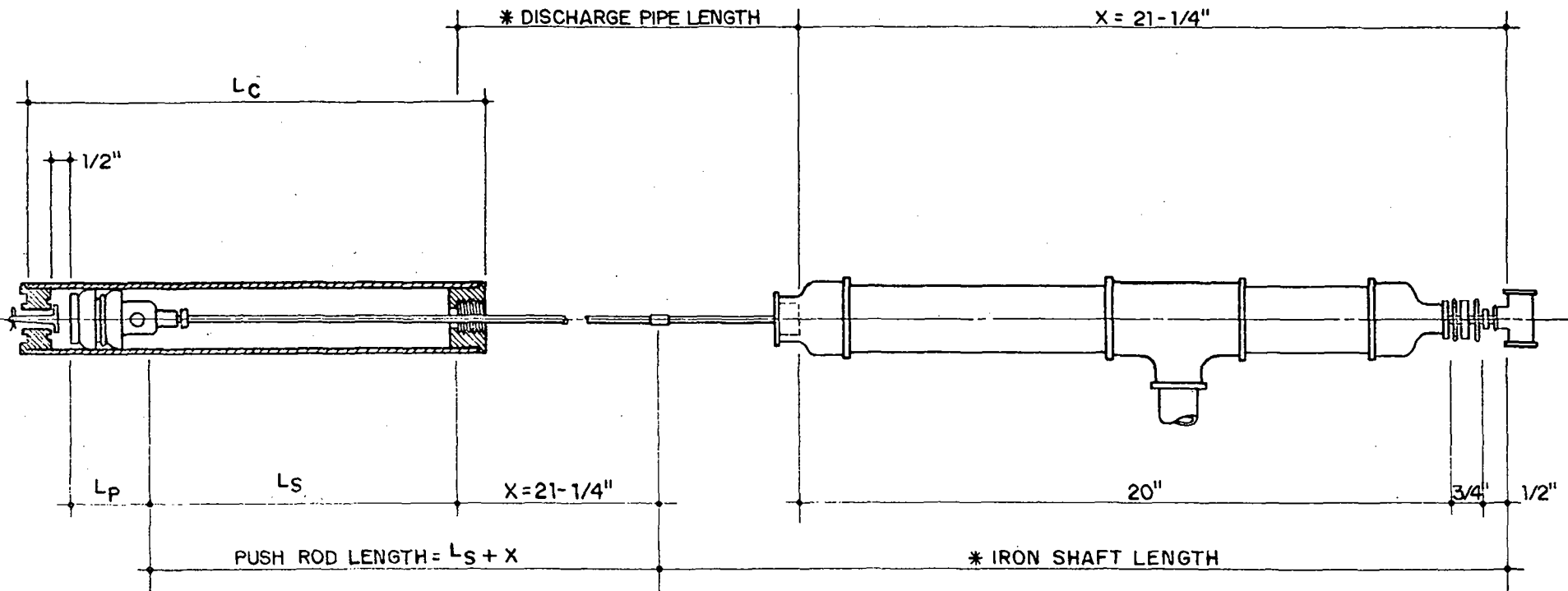
FOOTVALVE

BOTTOM PLUG

10 HAND PUMP DESIGN



UNIVERSITY OF SAN CARLOS  
WATER RESOURCES CENTER



\* DISCHARGE PIPE LENGTH = IRON SHAFT LENGTH  
 NOMINAL LENGTH: 20', 10', 5', 2'-6"

NOTE: LENGTH OF THREADING FOR 2"  $\emptyset$  AND 1-1/4"  $\emptyset$   
 PIPES IS 1 INCH AND FOR IRON SHAFT  
 IS 5/8"

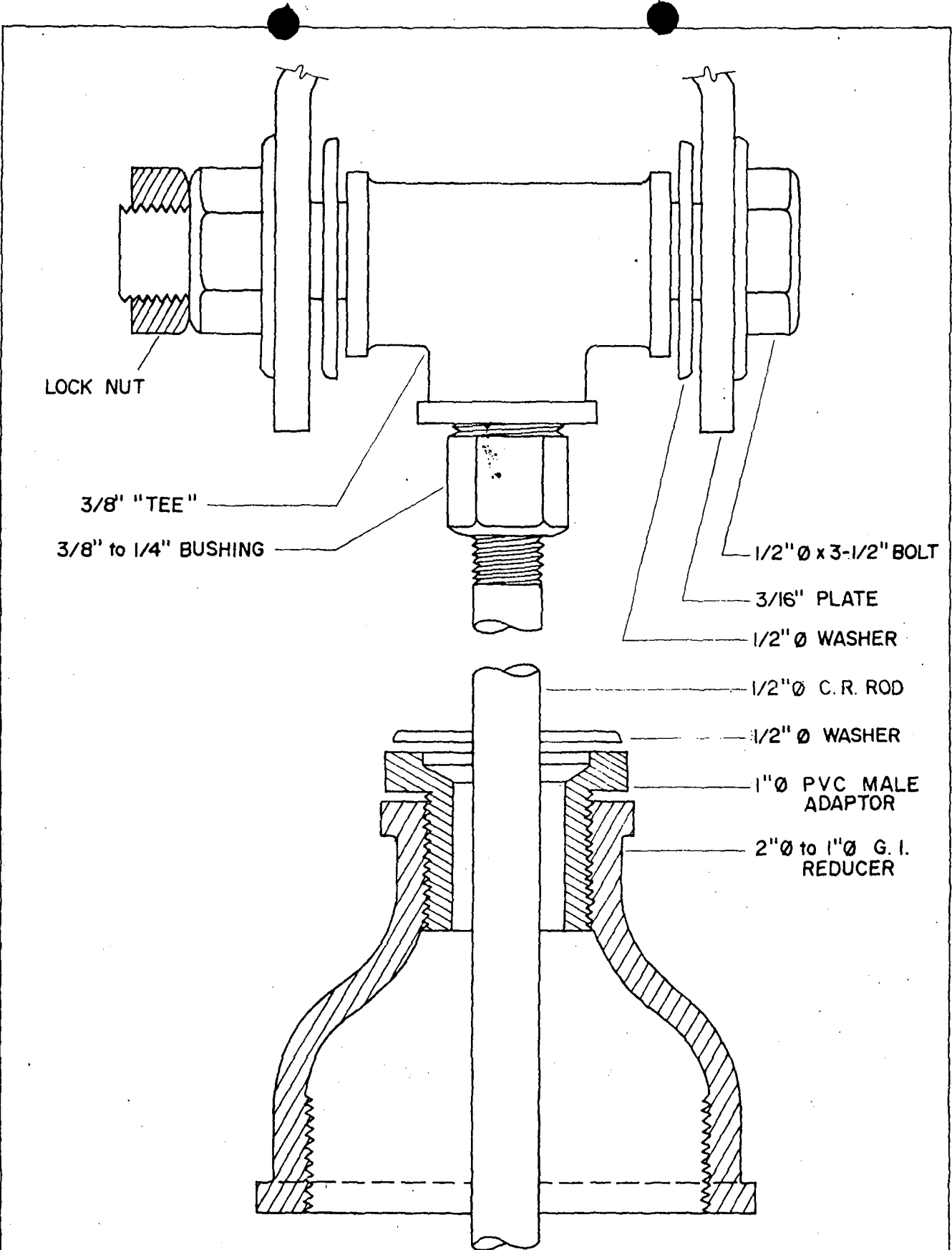
LEGEND:

$L_C$  = LENGTH OF CYLINDER  
 $L_P$  = LENGTH OF PLUNGER  
 $L_S$  = LENGTH OF STROKE

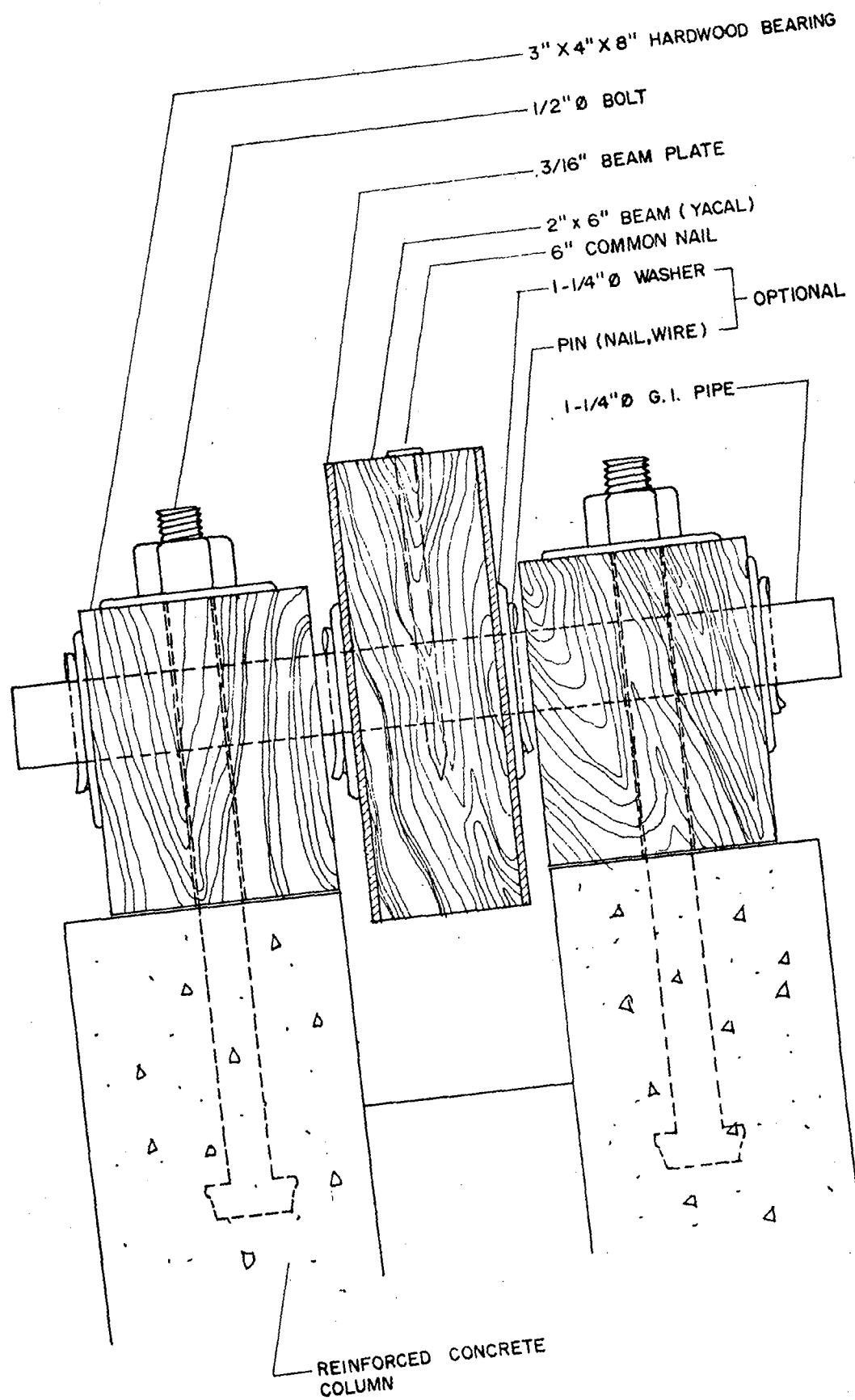
DETAIL FOR CYLINDER-SPOUT ASSEMBLY  
 CONNECTION

II HAND PUMP DESIGN

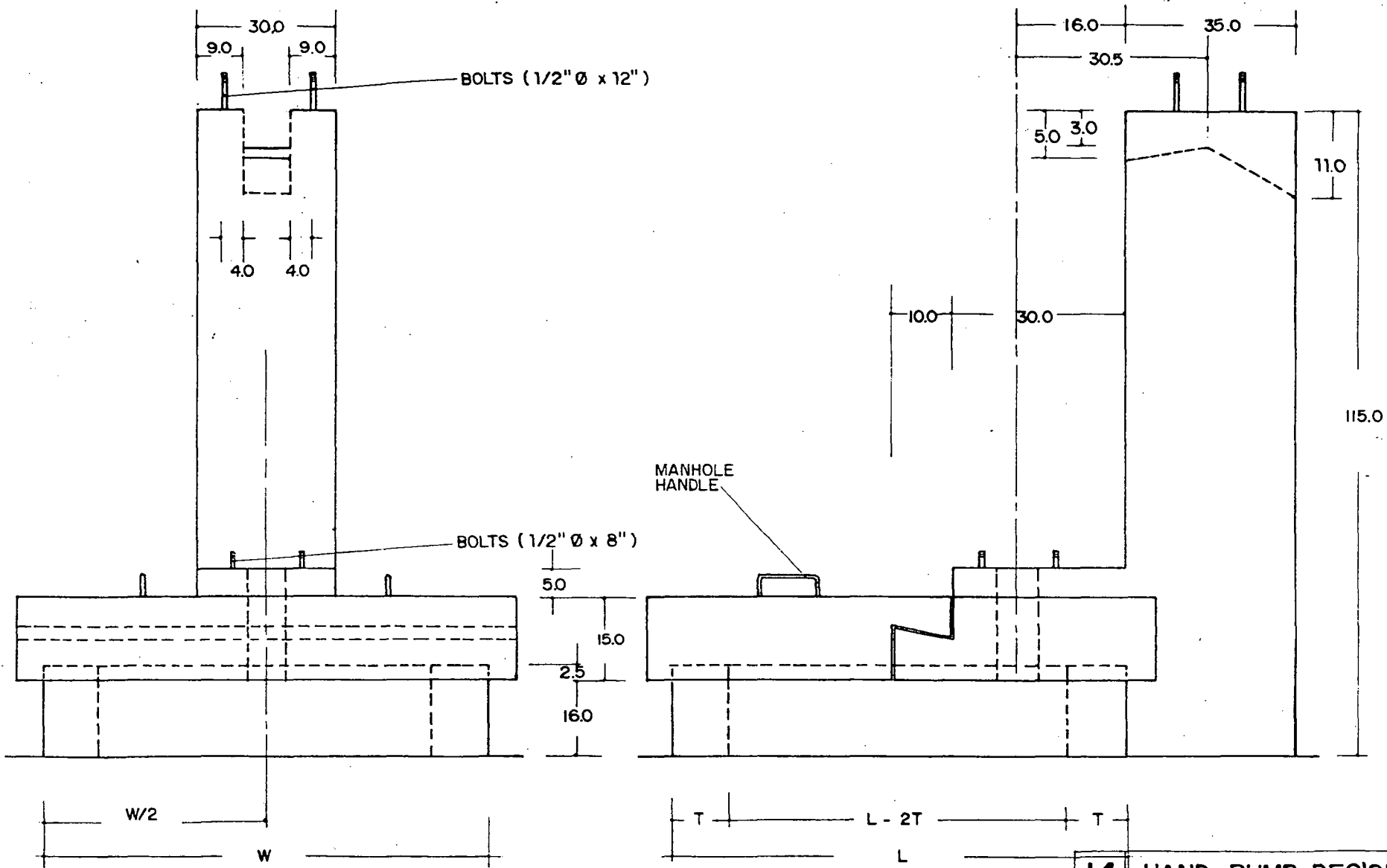
UNIVERSITY OF SAN CARLOS  
 WATER RESOURCES CENTER



DETAIL FOR YOKE - PUSH ROD CONNECTION

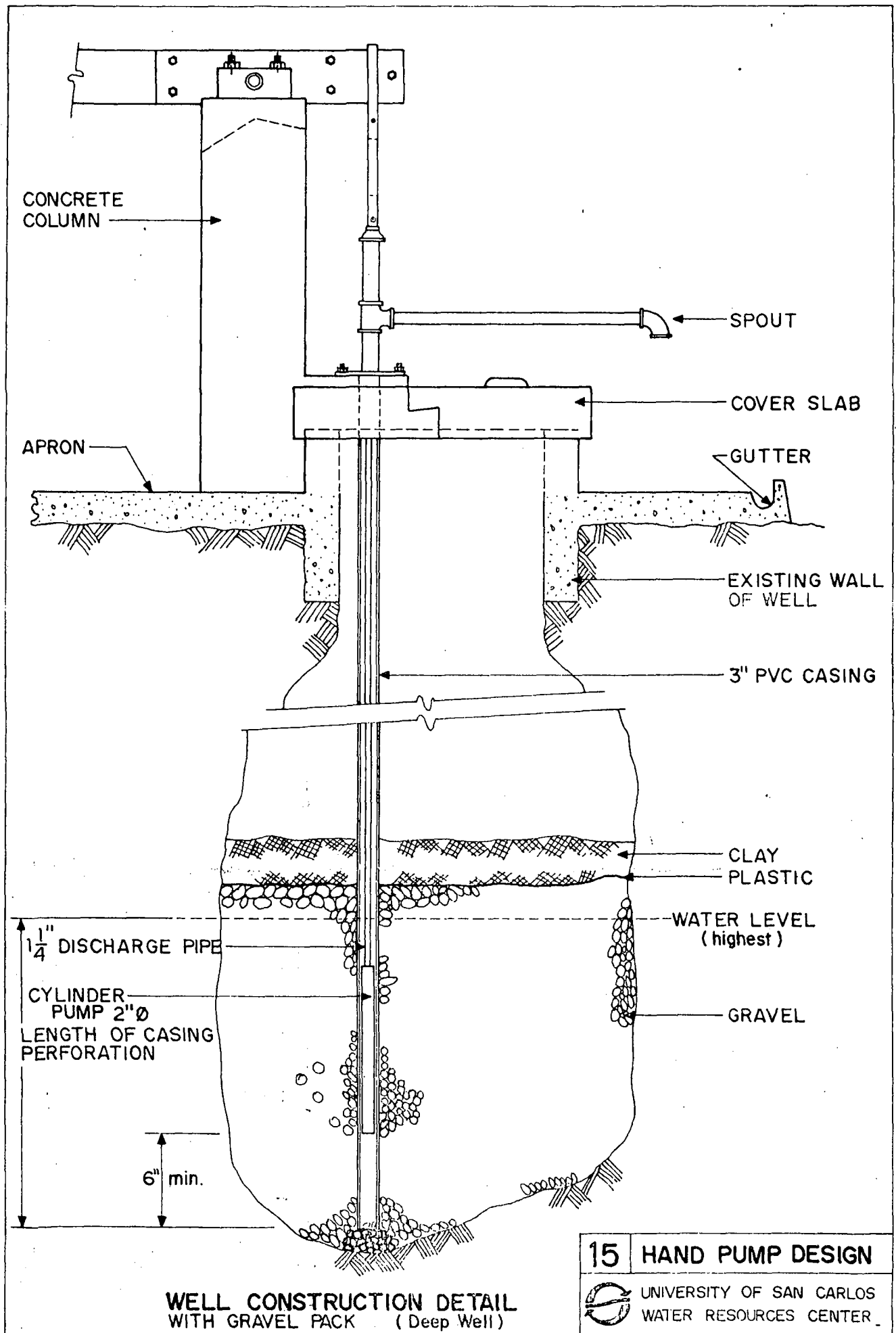


PIVOT ASSEMBLY



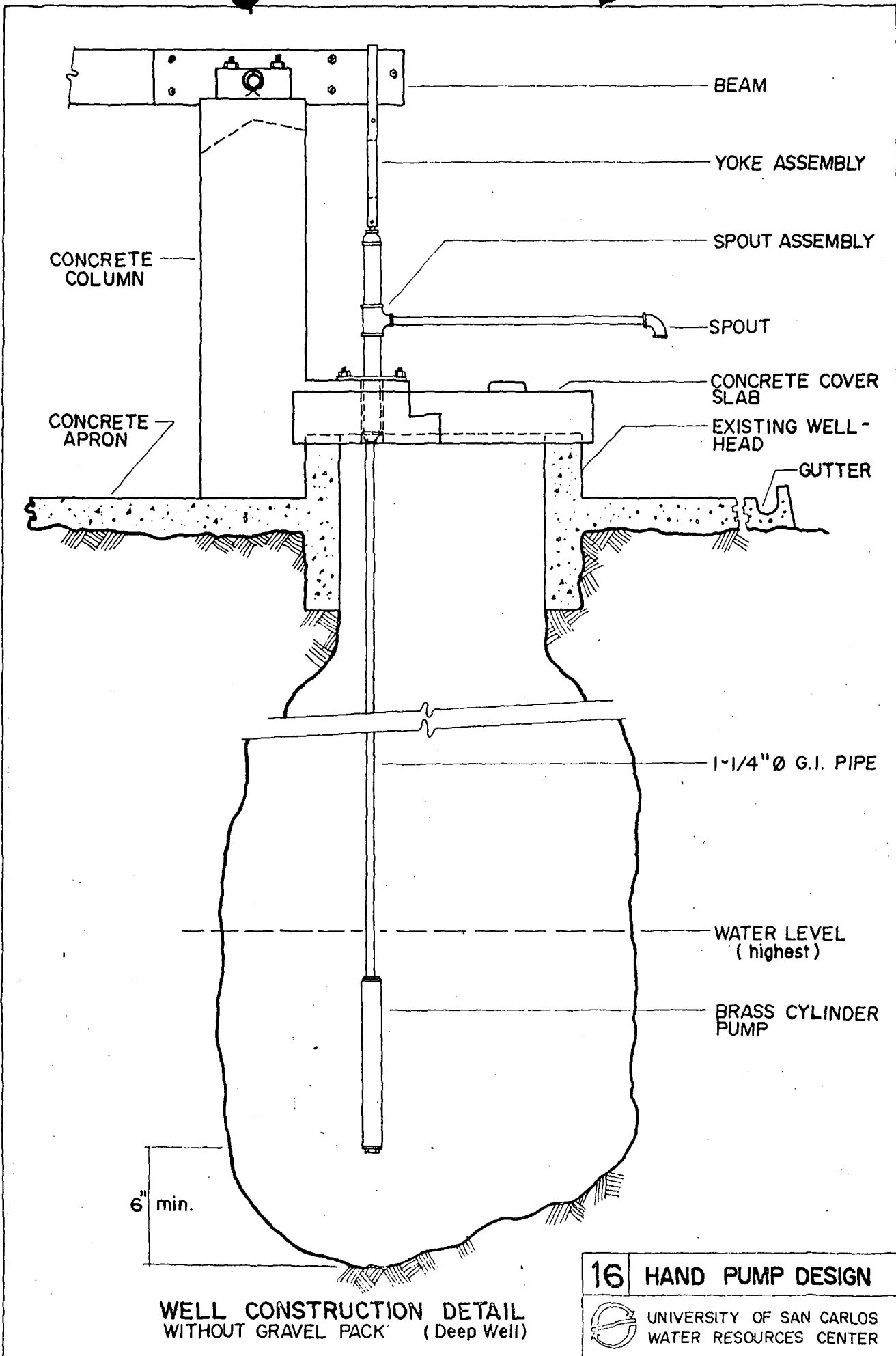
**OPEN DUG WELL PUMP BASE**  
 DIMENSIONS ARE IN CENTIMETERS



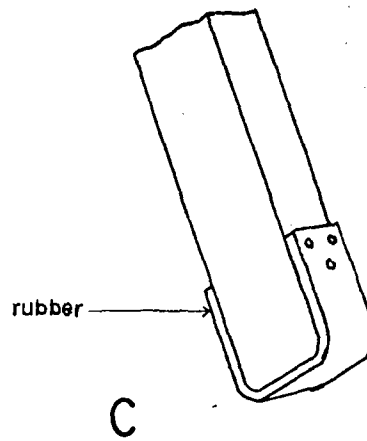
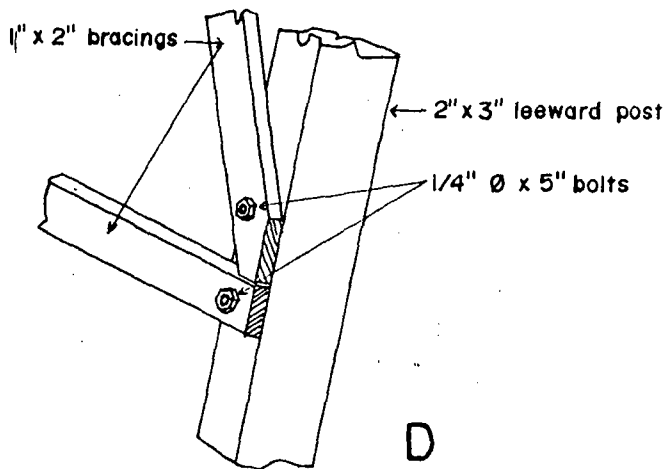
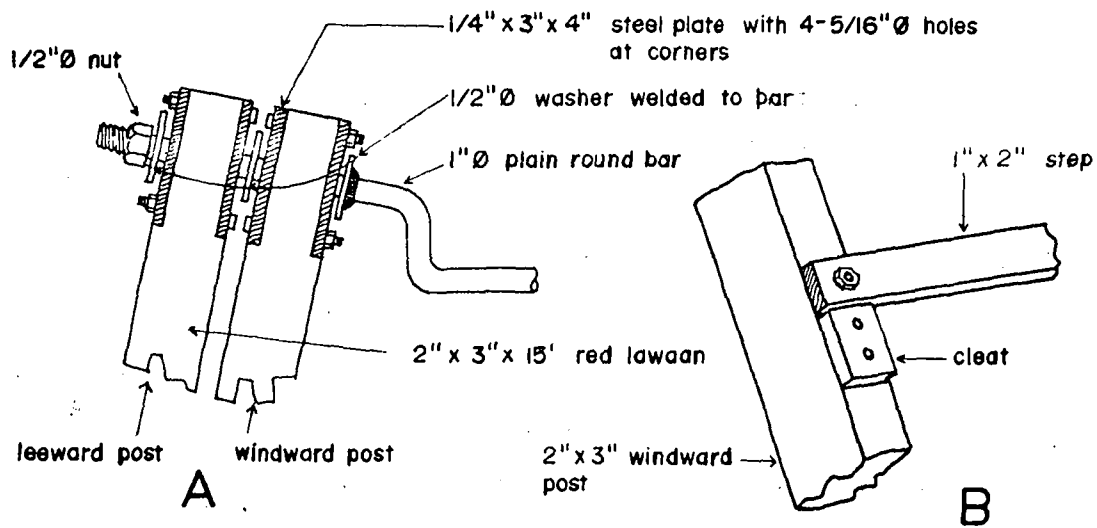
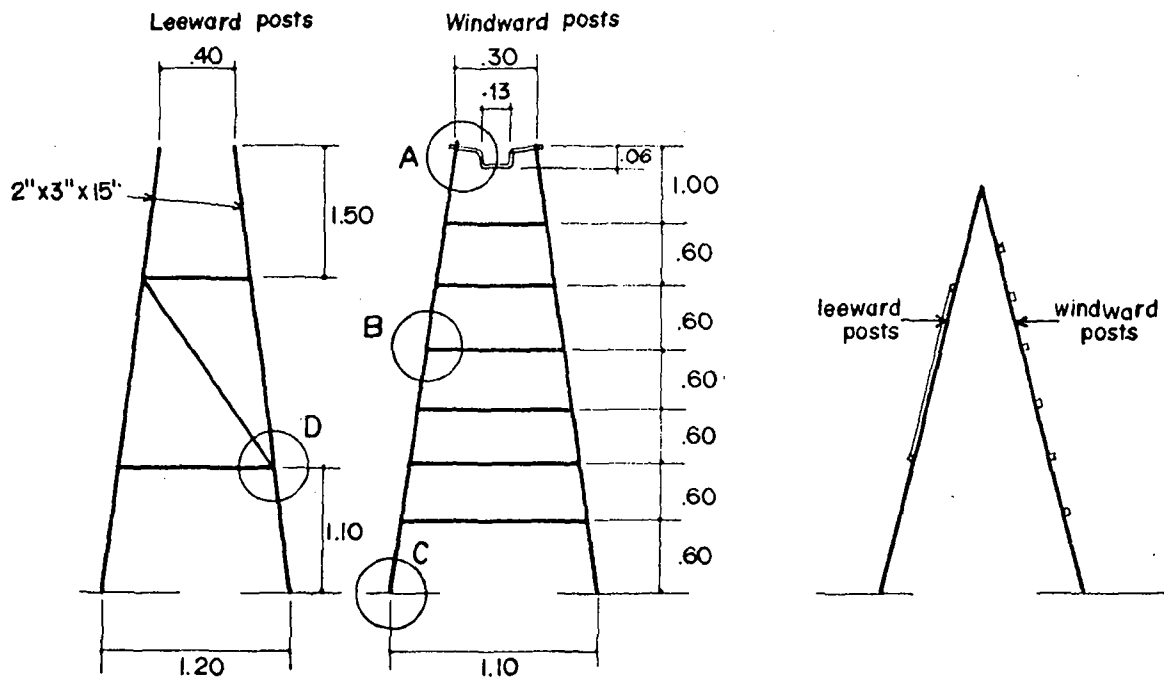


**WELL CONSTRUCTION DETAIL  
WITH GRAVEL PACK (Deep Well)**





**WELL CONSTRUCTION DETAIL**  
 WITHOUT GRAVEL PACK (Deep Well)



DETAIL OF LADDER  
DIMENSIONS ARE IN METERS