DRILLING ROCK

ABSTRACT

This heavy drilling bit has enabled hand drilling through sedimentary stone layers.

TOOLS AND MATERIALS

Steel bar about 7 cm. in diameter, about 1 1/2 m. long, weighing about 80 kilograms.
Stellite (A very hard variety of tool steel) insert for cutting edge
Anvil and Hammers for shaping
2 1/2 cm. x 2 cm. x 50 cm. steel for bail
Welding equipment

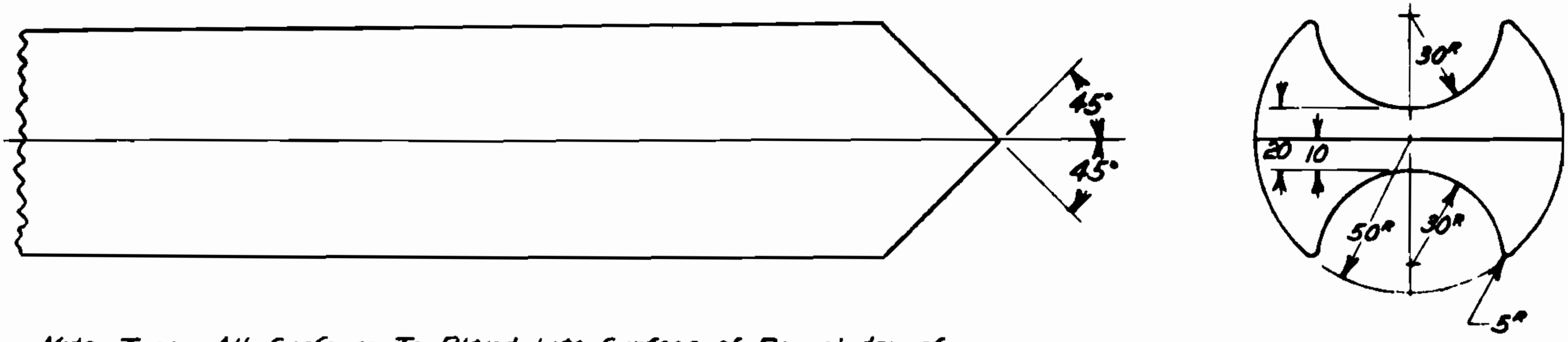
Figure 1

DETAILS

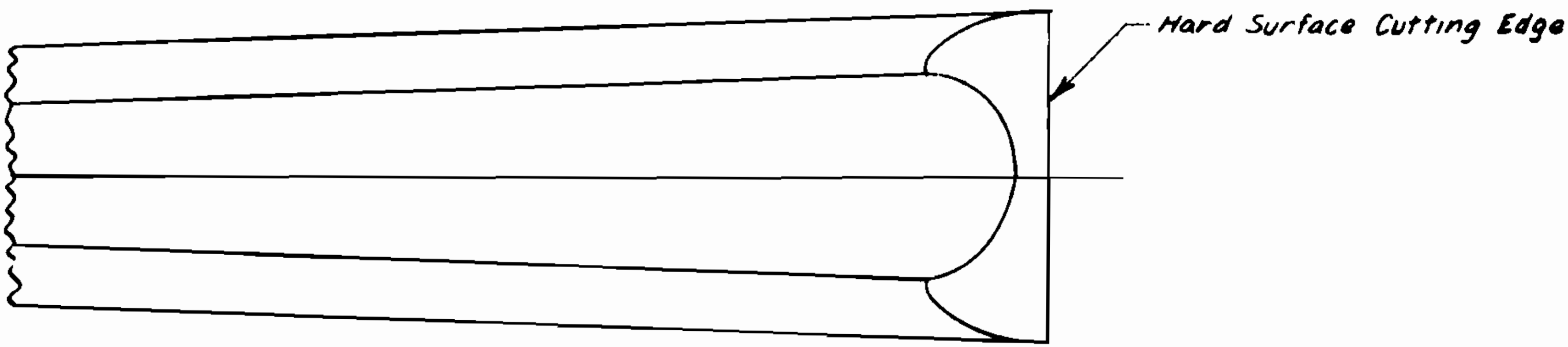
The drill bit for cutting through stone and hard formations was made from a mild steel bar weighing about 80 kilograms (175 pounds). The 90° cutting edge was hard surfaced with stellite and a bail was welded to the top for attaching a rope. The bail should be made large enough to facilitate "fishing" if the rope should ever break. See Figure 1 and 2. Originally a 1" rope was used. However, this was subject to considerable wear when working in mud and water, so recently a 1 cm. steel cable was substituted which thus far seems to be working out well. It is still too soon, though, to tell which is most suitable. A swivel is mounted between the bit and the rope or cable to allow the bit freedom to turn.

Since in some cases, a bar this size may be difficult to find or prohibitively expensive, it probably would be possible to fabricate a bit by welding a short steel cutting end on to a piece of pipe which was filled with concrete to give it the desired weight. This, however, has not yet been tried.

When stone or other substances which cannot be penetrated by the auger are encountered, the drilling bit must be used. The pulley is put in place as with the bailing bucket, and the bit is attached to its rope or cable and lowered into the well. Since the bit is heavy, a practice should be made of wrapping the rope once or twice around the back leg of the tripod, so that the bit cannot "get away" from the workers with the chance of someone being hurt or the equipment getting damaged. It was found that the easiest way to raise and drop the bit was to run the rope through the pulley and then straight back to a tree or post where it is attached at shoulder height or slightly lower. The workers then line up along the rope and raise the bit by pressing down on the rope and then drop it by quickly allowing the rope to return to its original position (Figure 3). This requires five to seven men, and in the villages occasionally more were used. Frequent rests are necessary; usually after



Note: Taper All Surfaces To Blend Into Surface of Remainder of Bar 400-500 mm Behind Cutting Head.



"Dimensions shown in millimeters."

Drill Bit Cutting Edge

Scale: ½ Size   Mat'l: Mild Steel

Fig. 2

every 50 to 100 strokes. Since the work is harder near the ends of the rope then in the middle, the positions of the workers should be rotated in order for the work to be evenly distributed.

A small amount of water should be kept in the hole for lubrication, and so that the pulverized stone will form a paste with the water which can be removed at intervals with the bailing bucket. Too much water will impede the cutting of the stone, but if it is flowing into the well at a rapid rate, there is not much that can be done about this. The speed of drilling is, of course, dependent on the type of stone encountered. In the soft water-bearing stone of the Ban Me Thuot area it was possible to drill several meters per day. However, when hard stone such as basalt in encountered, progress is measured in centimeters. The decision must then be made whether to continue trying to penetrate the rock or to start over in a new location. Experience in the past has indicated that one should not be too hasty in abandoning a location, since on several occasions what were apparently thin layers of hard rock, were penetrated and drilling then continued at a good rate.

Figure 3

On occasion the bit has become stuck in the well and it has been necessary to use a lever arrangement consisting of a long pole attached to the rope to free it. On other occasions a crude windless was used consisting of a horizontal pole which was used to wrap the rope around a vertical pole pivoted on the ground and held in place by several men. When the above two failed, it was necessary to borrow a chain hoist. Twice when the rope was allowed to become too worn, it was broken when trying to retrieve a stuck bit. It was then necessary to fit a hook to one of the auger extensions, attach enough extensions together to reach the desired depth, and after hooking the bit, to pull with the chain hoist. A rope or cable may also be used for this purpose, but it is considerably more difficult to hook onto the bit.

A method for raising and dropping the bit mechanically, not used on this project, but used elsewhere successfully is as follows: One rear wheel of a car is jacked up, and the wheel replaced by a small drum. The rope attached to the bit and coming from the pulley on the tripod is wrapped around the drum loosely. When the drum is set in motion and the unattached end of the rope is pulled taut, the rope will move with the drum and the bit will be raised. When the rope end is quickly let slack, the bit will drop. To get the desired coefficient of friction, it will probably be necessary to polish and/or grease the drum.

EVALUATION - This equipment has been used to penetrate layers of sedimentary stone up to 11 meters thick.

Material From - Richard G. Koegel, International Voluntary Services
Ban Me Thuot, Viet Nam, April, 1959.

WELL DRILLING TRIPOD AND PULLEY

ABSTRACT

This tripod is a necessary part of the equipment for drilling and supporting drill line.

FIGURE 1

TOOLS AND MATERIALS

3 poles, 15 cm. diameter, 4.25 m. long
Wood 1.1 m. x 12 cm. square, for cross bar
Pulley wheel - wood 25 cm. diameter 5 cm. thick, 5 cm. piece of 1/2" pipe
Axle bolt - fits close inside 1/2" pipe
80 cm. angle iron, 50 cm. webbs, 5 mm. thick
4 - 12 mm. bolts, 14 cm. long, nuts and washers
1 - 16 mm. bolt, 40 cm. long, nuts and washers
2 - 16 mm. bolts, 25 cm. long, nuts and washers

DETAILS

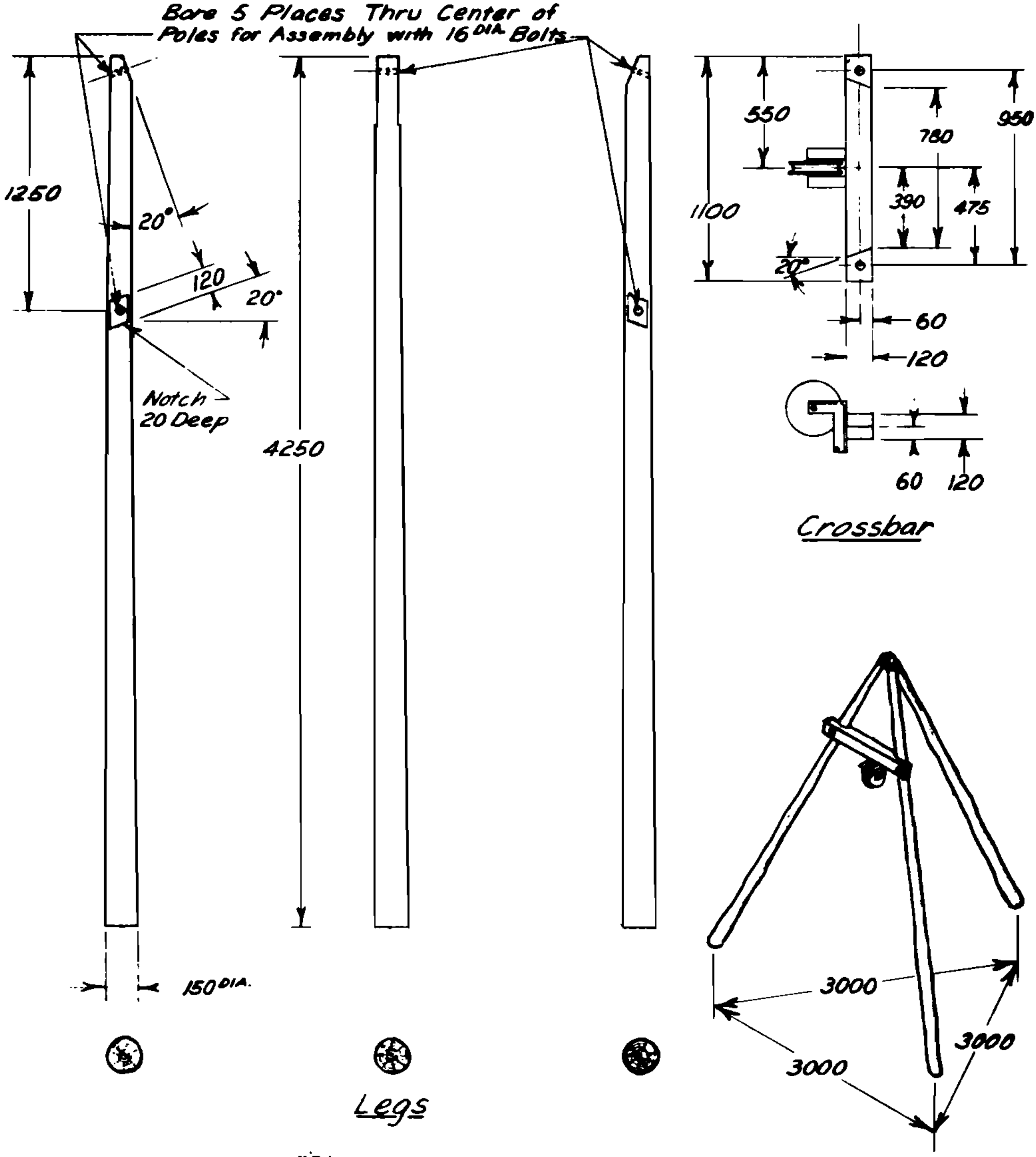
The tripod (Figure 1 and 2) which is made of poles and assembled with 16 mm. bolts serves three purposes: (1) to steady the extension of the auger when it is extending far above ground. (2) To provide a mounting for the pulley (Figure 3 and 5) used in connection with the drill bit and bailing bucket and (3) to provide a tall place for leaning long pieces of casing, pipe for pumps, or auger extensions while they are being put into or taken out of the well.

When a pin or bolt is put through the holes in the two ends of the "L" shaped pulley bracket (Figure 1 and 4) which extend horizontally beyond the front of the tripod crossbar a loose guide for the upper part of the auger extension is formed.

EVALUATION

Equipment designed has been used successfully in Viet Nam. At least three sets have had fairly extensive use.

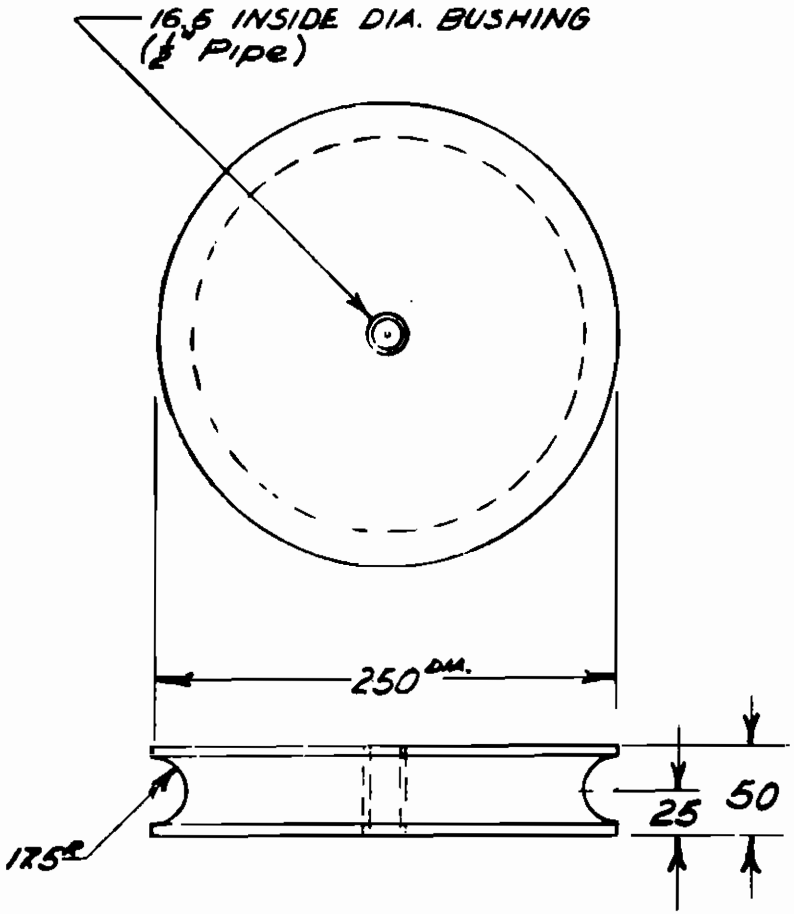
Material From - Richard G. Koegel
International Voluntary Services
Ban Me Thuot, Viet Nam, April, 1959.

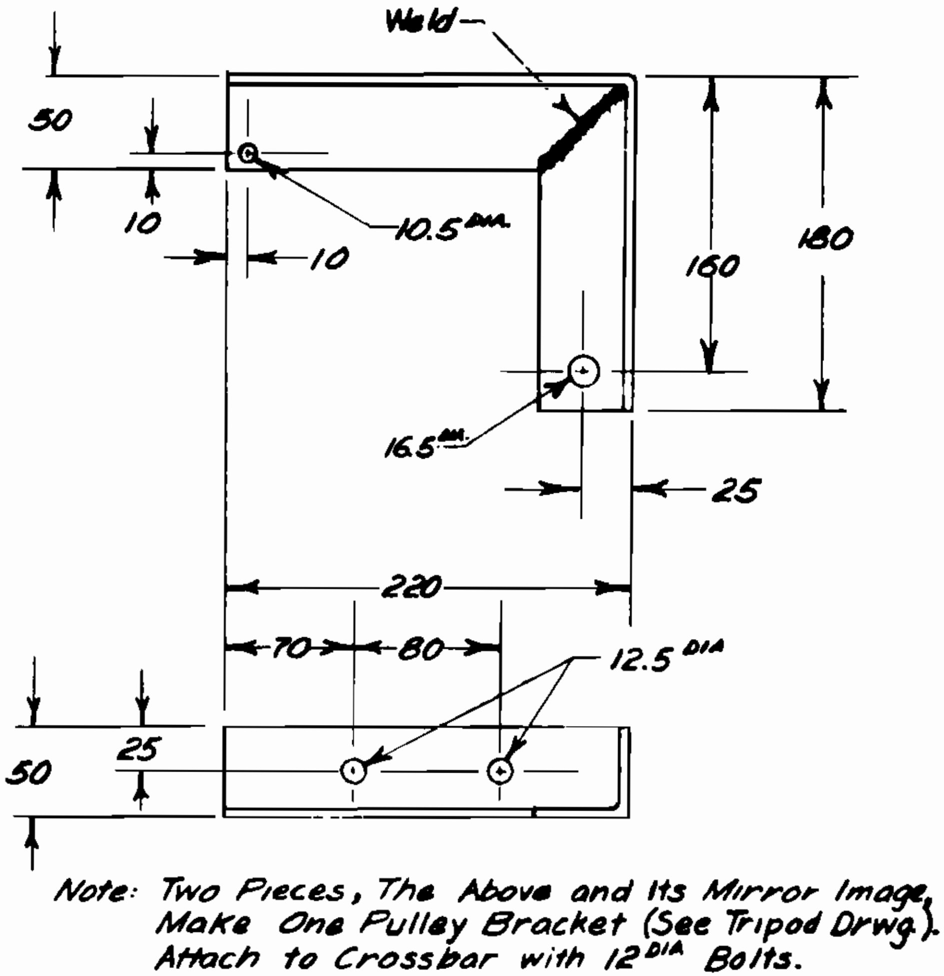


"Dimensions shown in millimeters."

Tripod

Fig. 2





"Dimensions shown in millimeters."

Pulley

Scale: ¼ Size   Mat'l: Hardwood

Fig. 3

Pulley Bracket

Scale: ¼ Size   Mat'l: Mild Steel

Fig. 4

Fig. 5

BAILING BUCKET

ABSTRACT

This device allows drilling to continue when cuttings are too loose (Figure 1) to be removed with the auger.

TOOLS AND MATERIALS

Pipe - 1 to 2 cm. smaller in diameter than the auger - say 8.5 cm. diameter; 180 cm. long
10 cm. diameter steel rod, 25 cm. long (for Bail)
Steel plate, 10 cm. square, 4 mm. thick
Steel bar, 10 cm. long, 5 mm. thick 1 cm. wide
Machine screw, nut, washer - 3 mm. diameter, 16 mm. long
Truck innertube, 4 mm. thick, 10 mm. square
Welding equipment
Drill, hacksaw, hammer vise, file

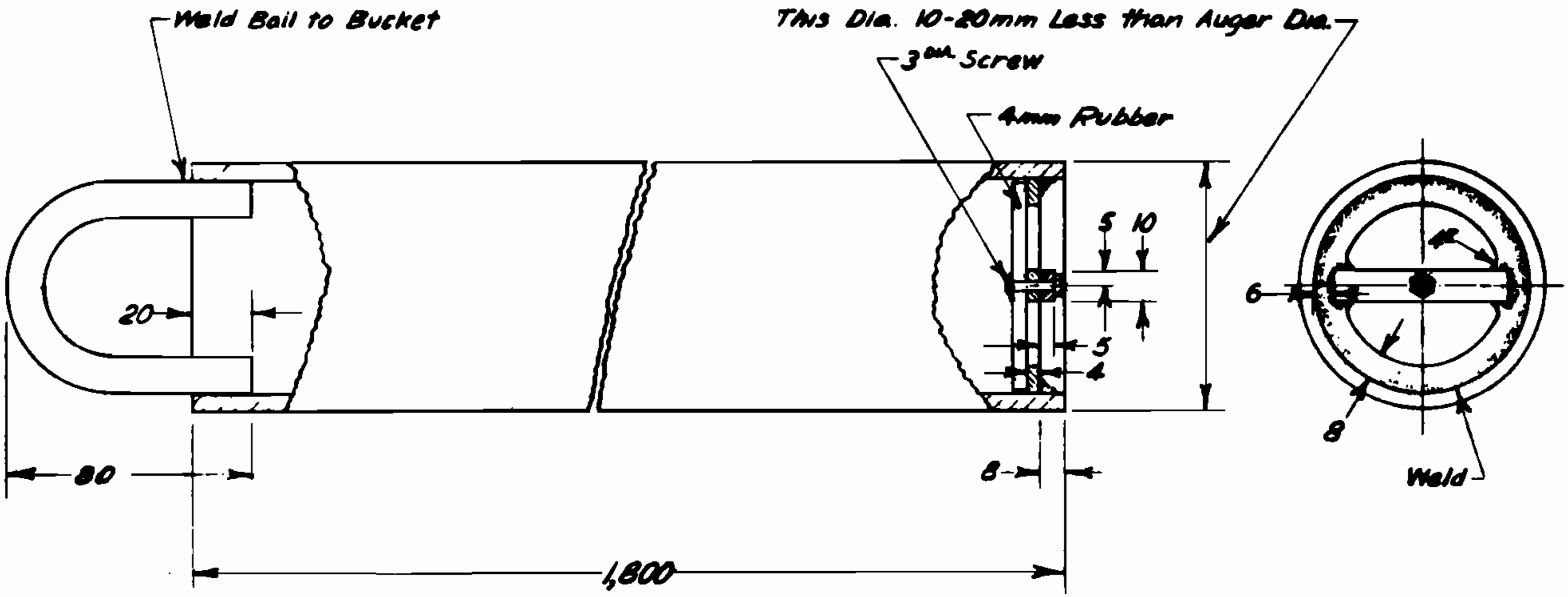
FIGURE 1

DETAILS

Both standard weight pipe and thin-walled tubing were tried for the bailing bucket. The former, being heavier, was harder to use, but did a better job and stood up better under use. Both the steel bottom of the bucket and the rubber valve should be made heavy enough since they receive hard usage. In addition, as seen in Figure 1 and Figure 2 the metal bottom is re-inforced with a crosspiece welded in place.

When water is reached, the cuttings are no longer firm enough to be brought up in the auger, and the bailing bucket must be used for cleaning out the well as work progresses. For using the bailing bucket the pulley is mounted in the pulley bracket with a 16 mm. bolt as axle. The rope which is attached to the bailing bucket can then be run over the pulley and the bucket lowered into the well. It should be noted that the pulley bracket is so designed that the rope coming off the pulley lines up vertically with the well, so that there is no need to shift the tripod.

The bucket is lowered into the well by preferably two men and allowed to drop the last meter or meter and one-half so that it will hit the bottom with a little velocity and some of the solids at the bottom of the well will be forced up into the bucket by the impact. The bucket should be then repeatedly raised and dropped one to two meters to pick



"Dimensions shown in millimeters."

Bailing Bucket

Scale: ½ Size Mat'l.: Mild Steel

Fig. 2

up additional material. Experience will best indicate how long this should be continued for maximum results before raising and emptying the bucket. Two or more men can raise the bucket which should be carried far enough from the well before dumping to avoid messy working conditions. If the cuttings are too thin to be brought up with the auger, but too thick to enter the bucket, they can be diluted by pouring a little water down the well.

EVALUATION

Equipment designed has been used successfully in Viet Nam. At least three sets have had fairly extensive use.

Material From - Richard G. Koegel
International Voluntary Services
Ban Me Thuot, Viet Nam, April, 1959.

WELL CASING AND PLATFORMS

ABSTRACT

Although plastic casing appears an ideal material, it was unavailable necessitating the development of galvanized iron and concrete casings described here.

TOOLS AND MATERIALS

230 cm. wooden V block
2 sections steel angle iron 230 cm. long
10 cm. diameter pipe, 230 cm. long
Clamps
Wooden mallet
Soldering equipment

DETAILS

In home or village wells, casing usually serves two purposes: (1) to prevent any caving in of the well sides and (2) as a seal to prevent entrance of any polluted surface water into the well. Four suggestions in regard to casing are offered, the first two of which have been used successfully in connection with this project. It is proposed that the remaining two be tried, but as yet time has not permitted.

Plastic Casing - Black plastic pipe of the type used for sewers and drains proved to be almost ideal. Its friction joints could be quickly slipped together and sealed with a chemical solvent; it was light enough to be lowered into the well by hand, it could be easily sawed or drilled by hand to make a screen; and from all appearances, it was extremely durable.

Galvanized Sheet Metal Casing - Since galvanized sheet metal was readily available in the Banmethuot area, it was decided to make sheet metal casing similar to down-spouting. The thickness of the material was 0.4 mm. (.016 inch) but a somewhat thicker gauge would have been preferable had it been available. Since the sheet metal itself would not last indefinitely, the well hole was made oversize and the annular space around the casing was poured full of a thin concrete mixture which when it hardened formed a cast concrete casing and seal outside of the sheet metal.

The metal was purchased in sheets of one meter by two meters and split into three equal pieces lengthwise which yielded three, two meter lengths of 10 cm. diameter pipe. The edges of the strips were first formed in preparation for making the seam. Since no sheet metal brake was available, this was accomplished by clamping the edges between two angle irons slightly longer than two meters and pounding the edge over with a wooden mallet. The resulting strip when seen from the end would appear as follows:

The seam is made slightly wider at one end than at the other, so that the resulting pipe has a slight taper allowing successive lengths to be slipped a short distance inside one another.

This strip was rolled up by bridging it over a two meter long wooden V block and applying pressure from above with a length of two inch pipe (Figure 1). The sheet metal strip was shifted from side to side over the V block as bending continued to get as uniform a surface as possible. When the strip had been bent enough the two edges were hooked together and the two-inch pipe was slipped inside. The ends of the two-inch pipe were then set up on wooden blocks so that it formed an anvil, and the seam was firmly crimped over as shown.

After the seam was finished any irregularities in the pipe were removed by applying pressure by hand and by use of the wooden mallet and pipe anvil. A local tinsmith and his helper were able to make six to eight lengths (12-16 meters) of the pipe per day. Three lengths of pipe were slipped together and soldered as they were made, and the remaining joints had to be soldered as the casing was lowered into the well. The lower end of the pipe was perforated with a hand drill to form a screen. After the casing was lowered to the bottom of the well, fine gravel was packed around the perforated portion of the casing to above the water level.

The cement grouting which was used around the casings varied from pure cement to a 1:1 1/2 cement : sand ratio mixed with water to a very plastic consistency. The grout was put around the casing by gravity and a strip of bamboo about ten meters long was used to "rod" the grout into place. A comparison of volume around the casing and volume of grouting used indicated that there may have been some voids left probably below the reach of the bamboo rod. These are not serious however, as long as a good seal is obtained for the first eight to ten meters down from the surface. In general, the greater proportion of cementused and the greater the space around the casing, the better seemed to be the results obtained. However, insufficient experience has been obtained to reach any final conclusions. In addition, economic considerations limit both of these factors.

It should be pointed out that some care must be taken in pouring the grout. In one case where two sections of casing were not assembled perfectly straight, the casing, as a result was not centered in the well, the pressure of the grouting was not equal all the way around, and the casing collapsed. Reasonable care and pouring the grout in several stages, allowing it to set in-between, should eliminate this. The grouting, however, cannot be poured in too many stages, since a considerable amount sticks to the sides of the well each time reducing the space for successive pourings to pass through.

A proposed modification of the above method which has not yet been tried is as follows: In areas such as Ban Me Thuot, where the structure of the material through which the well is drilled is such that there is little or no danger of cave in, the casing serves only one purpose, as a sanitary seal. It is therefore proposed that the well be cased only approximately eight meters down from the ground surface. To do this the well would be drilled to the desired depth with a diameter roughly the same as that of the casing. The well would then be reamed out to a diameter five to six centimeters larger than the casing down to the depth the casing will go. A flange fitted at the bottom of the casing with an outside diameter about equal to that of the reamed hole would serve to center the casing in the hole and to support the casing on the shoulder where the reaming stopped. Grouting would then be poured as in the original method. This modification would (1) save considerable costly material, (2) allow the well to be made a smaller diameter except near the top, (3) lessen grouting difficulties, and (4) still provide adequate protection against pollution.

Concrete Tile Casing - If the well is enlarged to an adequate diameter, precast concrete tile with suitable joints could be used as casing. This would require a device for lowering the tile into the well one by one and releasing them at the bottom. Mortar would have to be used to seal the joints above the water level, the mortar being spread on each successive joint before it was lowered. Asbestos cement casing would also be a possibility where it was available with suitable joints.

No Casing - The last possibility would be to use no casing at all. It is felt that when finances or skills do not permit the well to be cased, there are certain circumstances under which an uncased well would be superior to no well at all. This is particularly true in localities where the custom is to boil or make tea out of all water before drinking it, where sanitation is greatly hampered by insufficient water supply, and where small scale hand irrigation from wells can greatly improve the diet by making gardens possible in the dry season.

The danger of pollution in an uncased well can be minimized by: (1) choosing a favorable site for the well and (2) making a platform with drain leading away from the well which eliminates all spilled water.

Such a well should be tested frequently for pollution, and if found to be unsafe, a notice to this effect should be posted conspicuously near the well.

Well Platform - In the work in the Ban Me Thuot areas, a flat square slab of concrete (1.75 meter x 1.75 meter) was used around each well. However, under village conditions, this proved toleave much to be desired. Large quantities of water were spilled, seemingly in part due to the enthusiasm of the villagers for having a plentiful water supply, and the areas around wells became quite muddy.

The conclusion was reached that the only really satisfactory platform would be a round, slightly convex one with a small gutter around the outer edge. The gutter should lead to a concreted drain which takes the water a considerable distance from the well.

If the well platform is too big and smooth, there is a great temptation on the part of the villagers to do their laundry and other washing around the well. This should be discouraged. In villages where animals run loose it is necessary to build a small fence around the well to keep out animals, especially poultry and pigs, which are very eager to get water, but have a tendency to mess up the surroundings.

EVALUATION

Wells were installed for about $16.90 of material plus labor. This does not include a pump:

COST OF WELLS

No charge for labor has been included below, since thus far the wells have been a cooperative venture by the villagers. Assuming about 20 meters (65 feet) depth:

	VN Piasters	U.S. Dollars
Depreciation on Equipment	100	1.35
Casing, sheet metal @27.5$VN/meter x 20 m.	550	7.44
Cement and Sand for Grouting.	250	3.38
Cement and Sand for Platform.	350	4.73
TOTAL - - - -	1,250$VN	$16.90

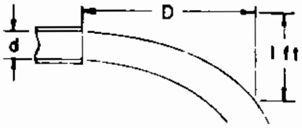
Using other forms of casing the cost would be slightly higher or lower.

Material From - Richard G. Koegel
International Voluntary Services
Ban Me Thuot, Viet Nam, 1959

WATER FLOW FROM HORIZONTAL PIPES

ABSTRACT

If you have a horizontal pipe discharging a full stream of water, this chart will allow you to estimate the rate of flow.



TOOLS AND MATERIALS

Ruler, pencil

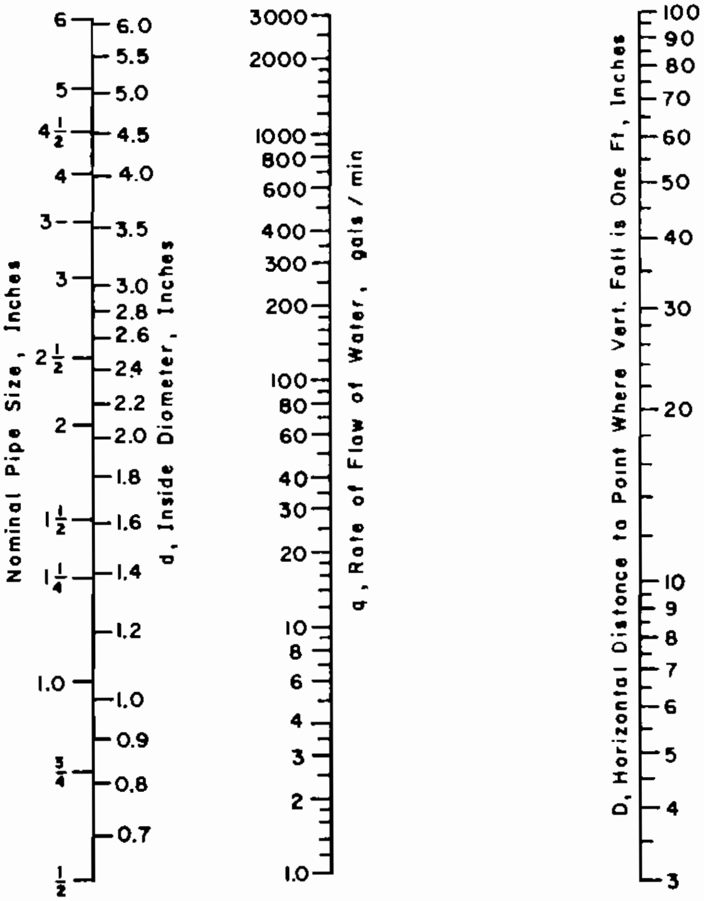
DETAILS

The pipe should not have a constricting or enlarging fitting near or at the pipe end for most accurate results, and the water must completely fill the pipe opening. The following example is plotted on the nomograph: Water is flowing out of a horizontal pipe with a one inch internal diameter. The stream drops one foot at a point ten inches from the end of the pipe. Connect the 1" inside diameter point on the d scale with the 10" point of the D scale. This line intersects the q scale at about 8 gallons per minute.

EVALUATION

Standard engineering information used to estimate flows; it will normally give results within 10% of measured flow rates.

Material Adapted From -
C. L. Duckworth, Chemical Processing, June 1959.



FLOW OF WATER IN PARTIALLY FILLED PIPES

ABSTRACT

The flow of water in partially filled horizontal pipes or circular channels can be determined--if you know the diameter of the pipe and the depth of the water flowing--by using this alignment chart (nomograph).

TOOLS AND MATERIALS

Ruler to measure water depth - if ruler units are millimeters, multiply by 0.0394 to convert to inches.
Straight edge - use with nomograph

DETAILS

The nomograph applies to one to six inch diameter pipes, 20 to 60% full of water, and having a reasonably smooth surface (iron, steel, or concrete sewer pipe). The pipe or channel must be reasonably horizontal if the result is to be accurate. The eye, aided by a plumb bob line to give a vertical reference, is a sufficiently good judge. If the pipe is not horizontal another method will have to be used. To use the nomograph simply connect the proper point on the "K" line with the proper point of the "d" line by means of the straight edge.

q = rate of flow of water, gallons per minute 8.33 pounds = 1 gallon.

d = internal diameter of pipe, inches.

K = decimal fraction of vertical diameter under water. Figure K by measuring the depth of water (h) and dividing it by the pipe diameter (d) or $K = \frac{h}{d}$.

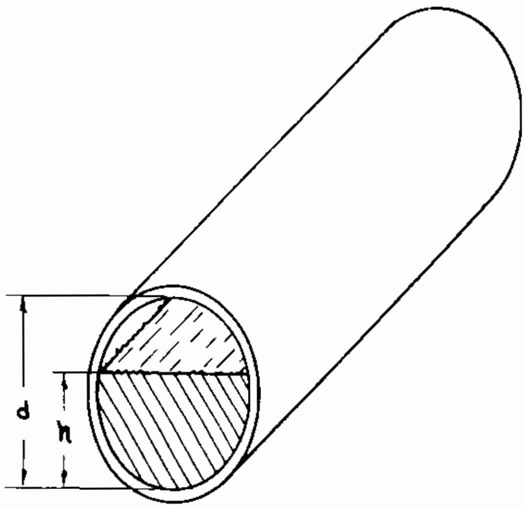
EXAMPLE

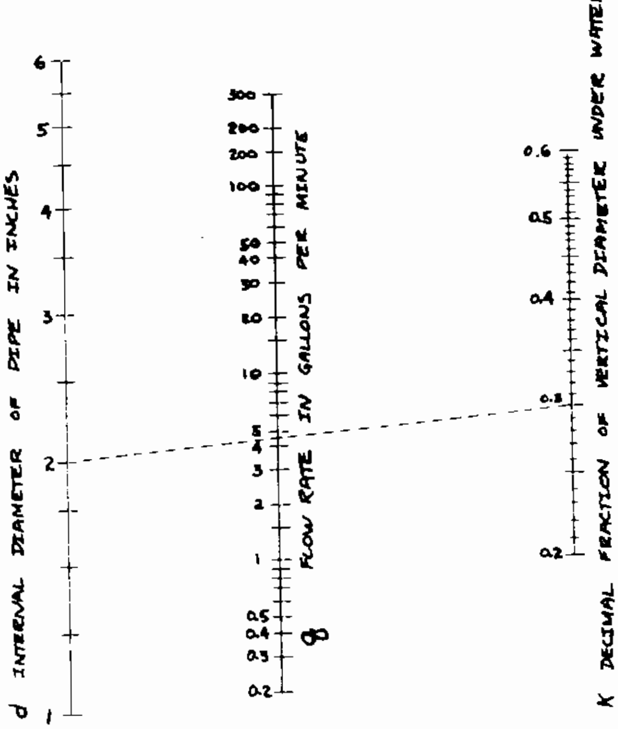
What is the rate of flow of water in a pipe with an interal diameter of 2", running 0.3 full? A straight line connecting 2 on the d-scale with 0.3 on the K-scale intersects the q-scale at a flow of 4.7 gal/min.

EVALUATION

This can be checked for low flow rates and small pipes by measuring the time required to fill a bucket or drum with a weighed quantity of water.

Material From - Greve Bulletin, Purdue University (12, No. 5, 1928, Bulletin 32.)




d INTERNAL DIAMETER OF PIPE IN INCHES
q FLOW RATE IN GALLONS PER MINUTE
K DECIMAL FRACTION OF VERTICAL DIAMETER UNDER WATER

VELOCITY OF WATER IN PIPES

ABSTRACT

Use this chart to compute the pipe size needed for your water system.

TOOLS AND MATERIALS

None

DETAILS

One of the first steps in designing a water system is to choose a pipe size. Practical water systems use water velocities from 4 to 6 feet per second. Too fast flow leads to excessive pressure drop requiring high pressure pumps which in turn require large motors and use excessive power. Too low velocities are overly expensive since larger pipe diameters must be used. To use the chart, first locate the flow you need on the Q scale. Then, see what pipe diameter is needed for 6 feet per second flow rate. Choose the nearest standard weight pipe.

It may be advisable to calculate the cost of two or more systems based on different size pipe. Remember, it is usually wise to choose a little larger pipe if higher flows are expected in the next 5 or 10 years. In addition, water pipes often build up rust and scale reducing the diameter and thereby increasing the velocity and pump pressure required to maintain flow at the original rate. If extra capacity is designed into the piping system, more water can be delivered by adding to the pump capacity without changing all the piping.

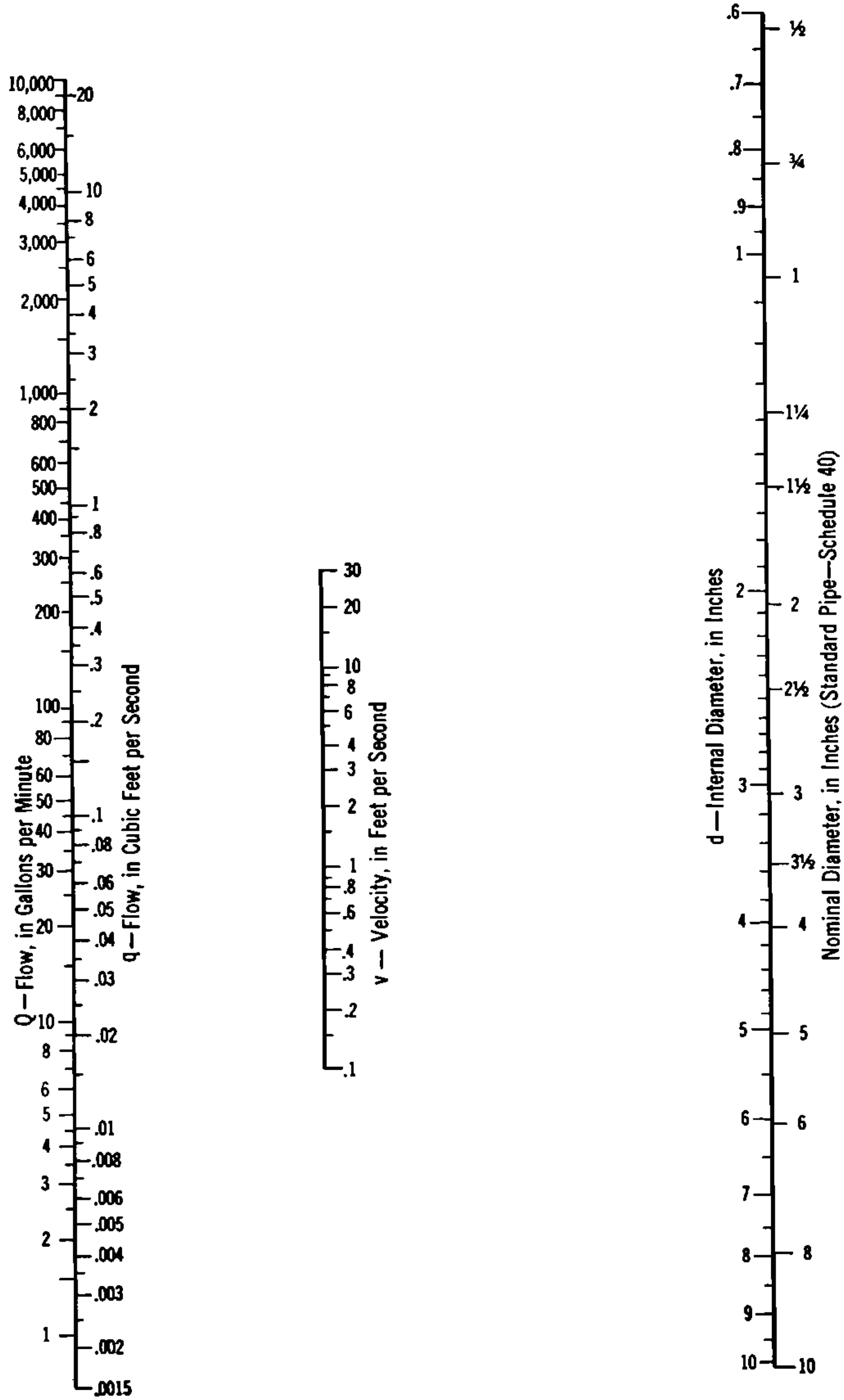
Suppose you needed a flow of 10 gallons per minute at the time of peak demand. Join 10 gallons per minute on the Q scale with 5 feet per second on the v scale. Notice that this intersects the d scale at about .88. If expansion was anticipated, it would probably be sensible to choose 1" standard pipe; however 3/4" pipe would handle the flow.

EVALUATION

This is one of the most common first steps used for quick design of a simple water system.

Material From - adapted from Crane Company
Technical Paper #409, pp. 46, 47.

Velocity of Water in Pipes



FLOW RESISTANCE OF PIPE FITTINGS

ABSTRACT

This chart provides a simple way to estimate the resistance of valves and fittings to liquid flow. It gives the equivalent length of straight pipe that would have the same resistance.

TOOLS AND MATERIALS - ruler

DETAILS

Rather than calculate the pressure drop for each valve or fitting separately, this chart will give the equivalent length of straight pipe. The actual pipe length plus the equivalent length of each fitting and valve is then used to determine the total friction loss in the piping system. For an example of the use of the friction loss, see the entry "Pump Size and Horsepower Requirement."

Gate valve - full opening valve; can see through it when open; used for complete shut off of flow.
Globe valve - cannot see through it when open; used for regulating flow.
Angle valve - like the globe, used for regulating flow.
Swing Check valve - a flapper opens to allow flow in one direction but closes when water tries to flow in the opposite direction.

Study the variety of tees and elbows; note carefully the direction of flow through the tee. Note the difference in friction loss depending on how far open the valve is. To determine the equivalent length of a fitting, (a) pick proper dot on "fitting" line, (b) connect with inside diameter of pipe, using a straight edge; read equivalent length of straight pipe in feet, (c) add the fitting equivalent length to the actual length of pipe being used. Example below.

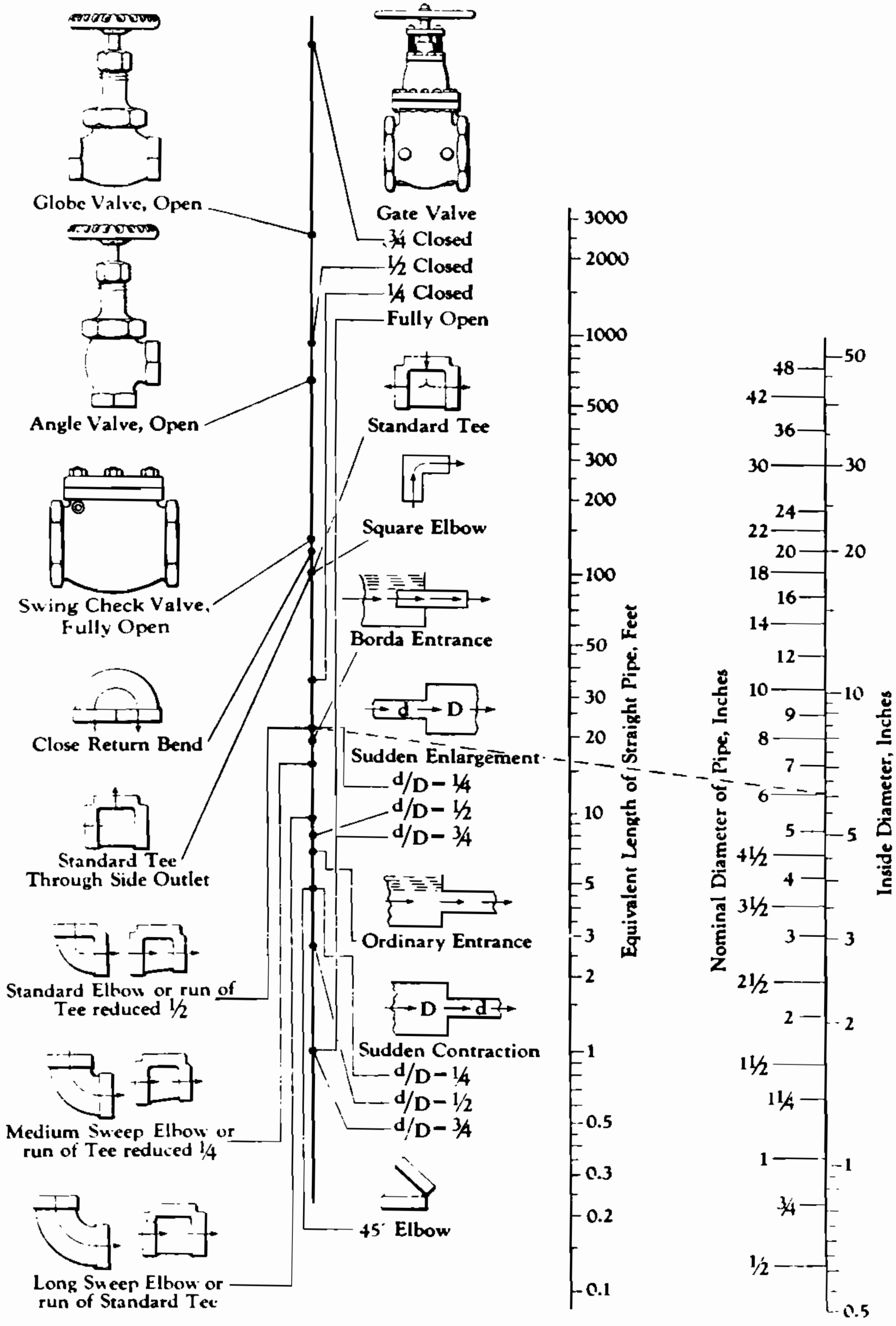
-2" pipe	-Equivalent length in feet-
Gate Valve (full open)	1
Flow into line - ordinary entrance	3
Pipe length	10
Sudden enlargement into 3" pipe (use d/D = 1/2 to be conservative)	3
TOTAL EQUIVALENT - 2" pipe	17
-3" Pipe	
Pipe length	10
Elbow (standard)	8
TOTAL EQUIVALENT - 3" pipe	18

EVALUATION

Extensive tests and long usage make this quick estimating method, when properly used, quite reliable.

Material From - Crane Company Technical Paper #409, pp. 20, 21.

Resistance of Valves and Fittings to Flow of Fluids



PUMP SIZE AND HORSEPOWER REQUIREMENT

ABSTRACT

Preliminary selection of pump and drive motor size may be made using this nomograph.

TOOLS AND MATERIALS

Straight edge for nomograph

DETAILS

For preliminary sizing of a pump used to lift liquid to a known height through simple piping, follow these steps:

(1) Determine the quantity of flow desired in gallons per minute. 8.33 pounds = 1 gallon.

(2) Measure the height of the lift required (from the point where the water enters the pump suction piping to where it discharges).

(3) Choose a pipe size, so that velocity through it will be about 6 feet per second (see entry on "Velocity of Water in Pipes").

(4) Estimate the pipe friction loss "head" (10 foot "head" represents the pressure at the bottom of a 10 foot high column of water) for both suction and discharge piping, using the following table.

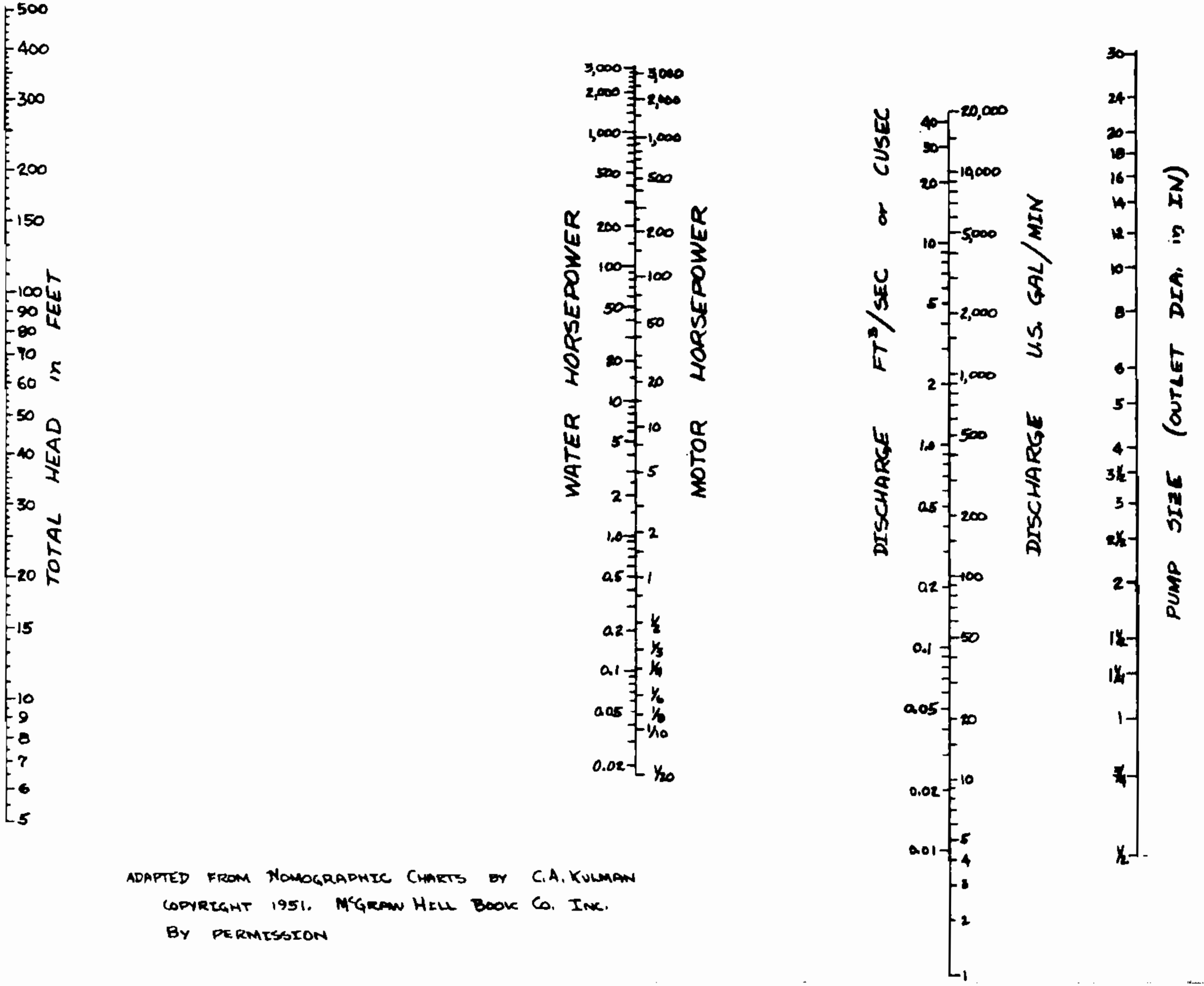
Average friction loss for water flowing through pipe when velocity is 6 ft./second.

Pipe inside diameter	1"	2"	3"	4"	6"	8"	12"	24"
F = approximate friction head (ft.) per 100 ft. pipe	16	7	5	3	2	$1\frac{1}{2}$	1	$\frac{1}{2}$

$$\text{Friction Loss Head} = \frac{\text{F x length of pipe}}{100}$$

Any bends, valves, constrictions, and enlargements (such as passing through a tank) add to friction. The equivalent pipe length of such "fittings" in the pipe line should be added to the pipe length used in the friction loss equation. A separate handbook entry gives a quick and easy estimate of equivalent lengths. For friction loss when velocity is greater than 6 feet per second.

PUMP SIZE AND HORSEPOWER REQUIREMENT



ADAPTED FROM NOMOGRAPHIC CHARTS BY C.A. KULMAN
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(5) Obtain "Total Head" as follows:

Total Head = height of lift + friction loss head

Using a straight edge connect the proper point on the "Total Head (ft.)" line with the proper point of the "Discharge U.S. gallon/minute" line. Read motor horsepower and pump size (diameter of discharge outlet), choosing the printed values just above the straight edge.

Note that water horsepower is less than motor horsepower. This is because of friction losses in the pump and motor. The nomograph should be used for rough estimate only. For an exact determination give all information on the flow and piping to the pump manufacturer. He has the exact data on his pump for various applications. Pump specifications can be tricky especially if suction piping is long and the suction lift is great.

EXAMPLE

Desired - to pump 100 gallons/minute 50 feet high, no fittings
Pipe Size - 3" (for 6 feet/second)
reference: Handbook entry "Velocity of Water in Pipes"
Friction loss head - about 3 feet.
Total head - 53 feet.
Pump size - 2".
Motor horsepower - 3 H.P.

If you plan to use human power for the pump, figure that a man can generate about 0.1 H.P. for a reasonably long period and 0.4 H.P. for short bursts. From this and the total head, you can predict the flow you should design the hand pump for.

EVALUATION

Tables and Nomographs are heavily used by U.S. engineers.

Material From - Reference, C. A. Kulman
Nomographic Charts, pp. 108-109,
McGraw-Hill, New York, 1951.

HEALTH AND SANITATION

LATRINE FOR VILLAGE USE

ABSTRACT

This low cost water seal latrine slab is a single concrete casting. It requires very little space, is sanitary, odorless, easy to install and maintain, and can be used to produce nightsoil fertilizer.

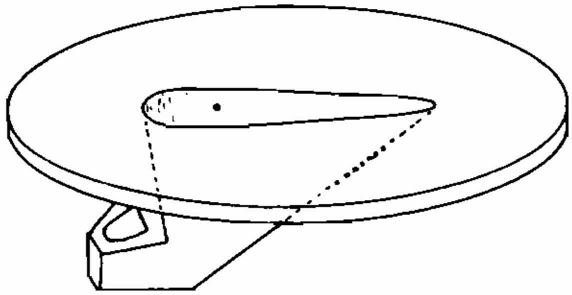


FIG. 1

TOOLS AND MATERIALS

Foot plate form - See Figures 2 and 3
Steel strap iron 2" wide, 9'7" long
3/8" bolt and nut 1" long to hold strap iron form
3/8" bolts 5" long for air vents
Outer form - made of wood detailed on Figure 6.
Inner form - made of wood detailed on Figure 4.
Clay to make water seal form
Cement, sand, stone aggregate up to 1" maximum.

DETAILS

In villages where space is a premium and the soil can absorb the flushing water, this latrine may be worth serious consideration. A 30" diameter hole eight feet deep is covered with a slab. Most soils have sufficient stability to support the slab. Very loose or sandy soils may require some type of lining. Any type of simple superstructure can be fitted over it for privacy. If the nightsoil must be used for fertilizer, this method can be used. After the first six months, a new hole is dug, and the slab moved. The first pit is covered with two feet of dirt. Six months later the nightsoil in the first pit has been converted to essentially non-pathogenic fertilizer and may be used with reasonable safety. Do not use any nightsoil fertilizer that has not been composted at least three months. The slab is moved back to the first hole and the second covered with two feet of dirt.

The latrine can be cleaned with only 1/2 gallon of water. When this is done, there is no odor nor any flies and it stays quite clean. Thus it is easy to use. Villagers must be urged to provide for a sufficient supply of water to be brought and stored at the latrine in a large container (eg. a 4 gallon kerosene tin). A quart container should also be provided. Instructions should be given in the proper method of flushing the latrine. If this is done improperly a large quantity of water will be wasted. Two quarts of water are sufficient to clear the latrine if the water is thrown with a fair amount of force from the narrow end of the latrine.

Installation is so simple that the untrained villager can do it easily. The round one piece construction facilitates moving the slab by rolling it. It is simple to make once the forms and methods are practiced. The materials cost about $1 for a latrine. One trained villager can make three slabs per day, using three forms. The wooden forms cost about $8 each.

A convex foot-plate form about 38" in diameter is made of wood, metal, or concrete. It must be 1" higher in the center then at the edge. See Figure 2.

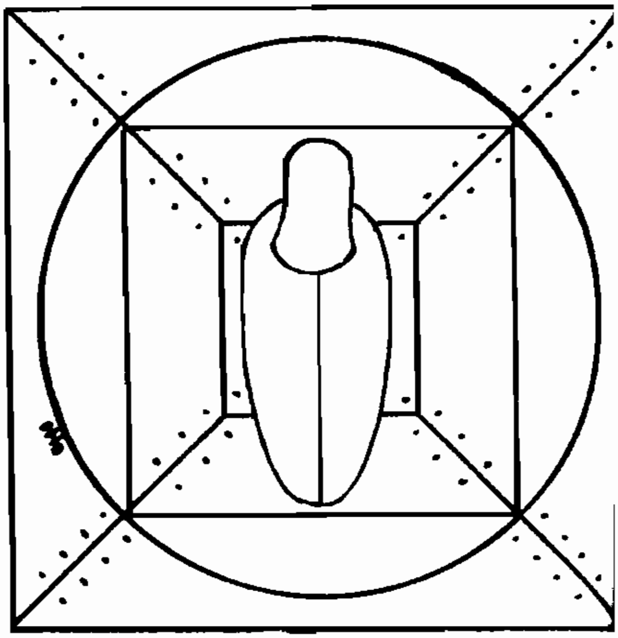


Figure 2
Wood and clay inner form in place on the base seen from above. Steel rim also in position.

Figure 3 shows the steel ring and inner form in place on the base. The ring is formed of two inch wide strap iron and fastened with a bolt for easy removal from the concrete slab. The collapsible wooden inner form is detailed in Figure 4.

The inner form has three pieces. Figure 4A shows the outline of the two side pieces of the form. These must be cut from wood 2 1/4" thick. The 18 1/8" sides and 3 3/4" sides stay nearly in contact. A wedge shaped piece of wood shown in Figure 4D holds corner G of the sides one inch apart. The wedge fits along the 9" side. The spring holds the form closed tight against the separation bars while the wedge is inserted and the inner form placed on the base. The dimensions shown for the inner form should only be used as a guide since some inconsistencies have been observed.

Two inches of well mixed concrete (cement 1, sand 2, stone chips 3) is placed in the ring and tamped well to compact it. Next the wooden outer form is set up around the inner liner. See Figures 5 and 6. There should be a clearance of not less than 1/2" between the inner liner and the wooden outer forms. A cement sand mixture (cement 1, sand 2) of plastic consistency is placed in this inner space and compacted. A 3/8" bolt through the outer wood form and into the inner form provides an antisyphon vent and helps to hold the inner form in place. See Figures 8, 10, and 11.

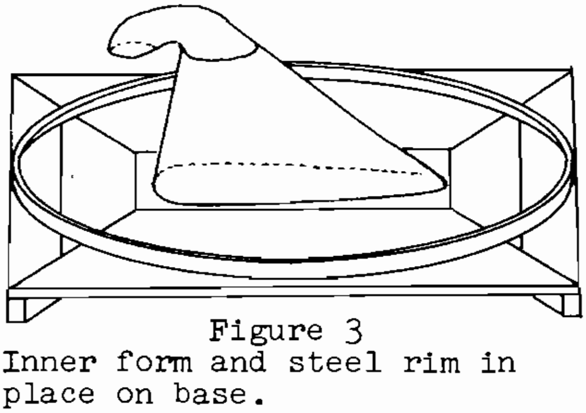
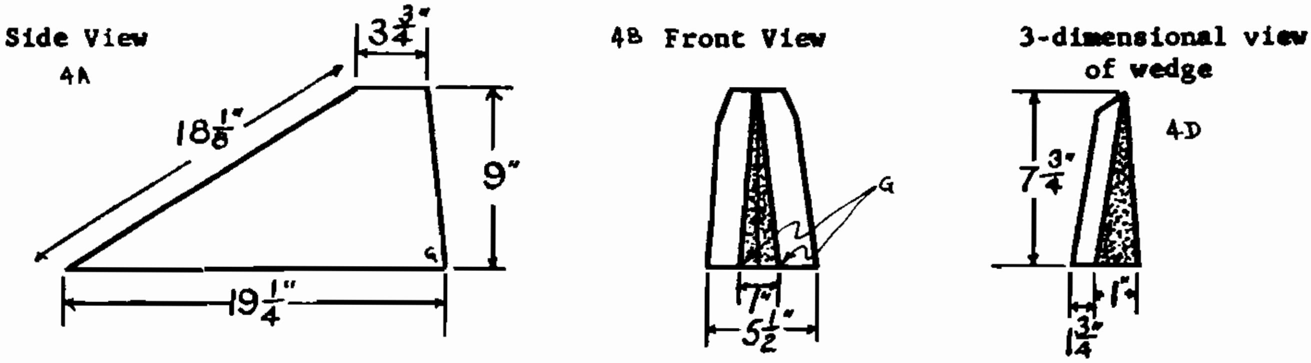


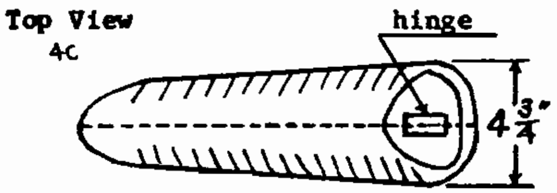
Figure 3
Inner form and steel rim in place on base.

After 48 hours the casting may be placed on blocks. The clay siphon and wooden inner form removed, and a finish of cement plaster added to cover any imperfections. When this is set a final coat of pure cement is put on. If there is any defect in the seal it may easily be repaired by putting a little cement slurry (cement and water in creamy consistency) over the defect and adding at once cement plaster to fill the defect.

EVALUATION

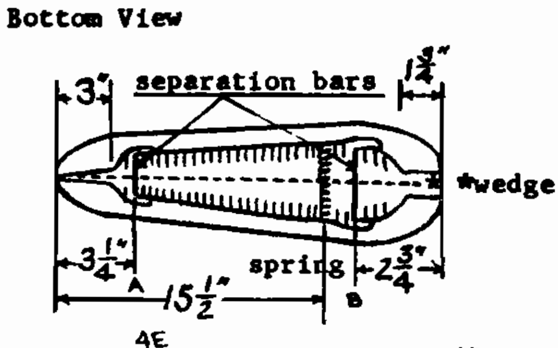
The American Friends Service Committee Barpali project has developed this unit and have many in use. They are teaching a 10 day course in latrine construction to villagers and selling forms at cost to the villagers completing the course. More than 25 persons have completed this course.





* is a wooden wedge, used to hold form tight. To remove form from concrete latrine, one knocks out wedge, then removes separation bars; the bottom of the form then contracts.

If the wood is not hard and smooth, a tin outer coating may be hammered on to wooden form.



Width of mold at A & B are $4\frac{1}{4}$" and $5\frac{1}{2}$" respectively. The separation bars at A & B are $2\frac{1}{2}$" & 4" long respectively.

Finished bowl-seal form, ready for placing on wooden base. The water-seal form has been molded from clay, by hand, and placed on top of the wooden bowl form. The size and configuration of the water-seal form must be shaped carefully, as shown. This is not difficult.

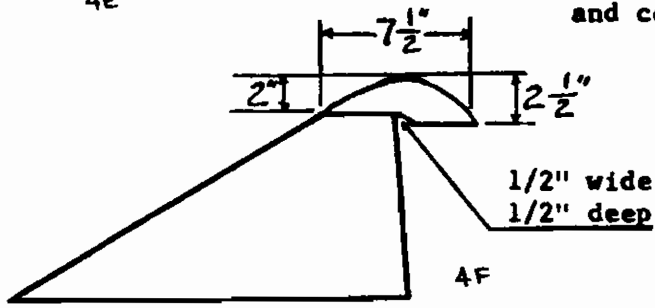


FIGURE 4

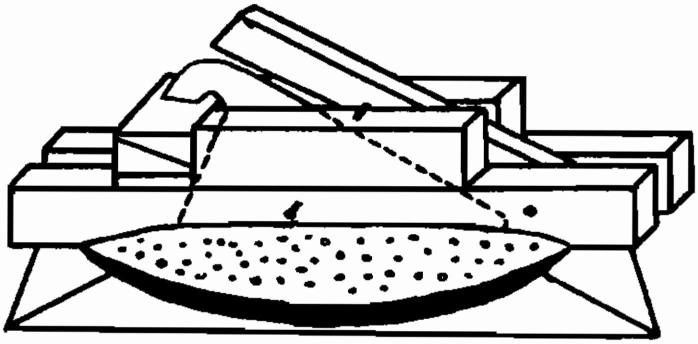


Figure 5
Concrete slab has been poured; part of the exterior sectional mold has been placed in its position.

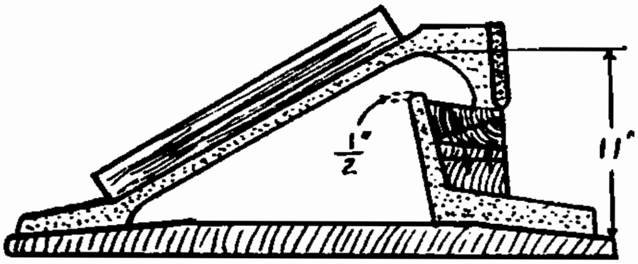


Figure 7
Sectional view after pouring the cement in bowl and trap. Note the concave shape of the base plate.

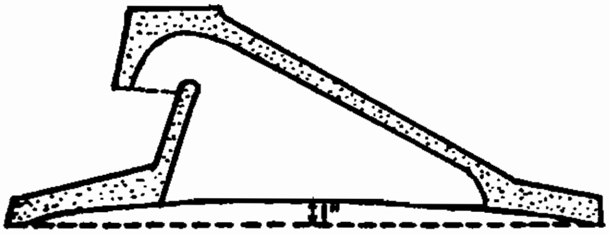


Figure 9
Section of the casting after removal of the forms.

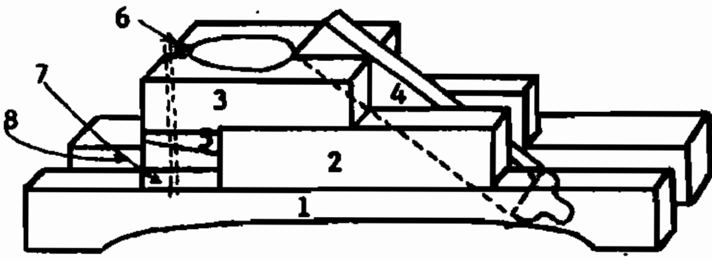


Figure 6
Rough exterior knock-apart mold made to fit around the clay core with a clearance of 1/2" to 3/4".

Wooden constituents of above mold.

1. 4" x 4" x 36" - 2 pieces
2. 3" x 4" x 16" - 2 pieces
3. 3" x 4" x 16" - 2 pieces
4. 3" x 3" x 21" - 1 piece
5. 2" x 5" x 13" - 1 piece
6. 4" x 4" x 1" - 1 piece
7. 5" x 13" x 1" - 1 piece
8. 3" x 4" x 4" - 1 piece

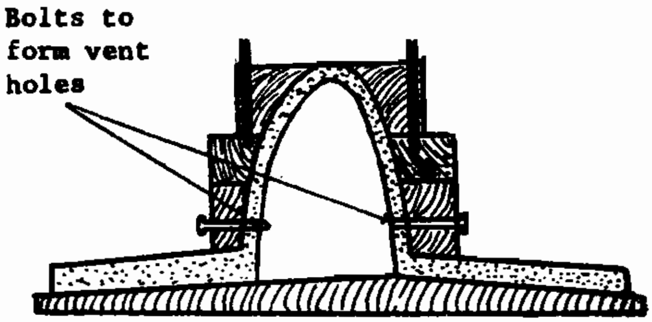


Figure 8
Transverse section of the casting with forms in place.

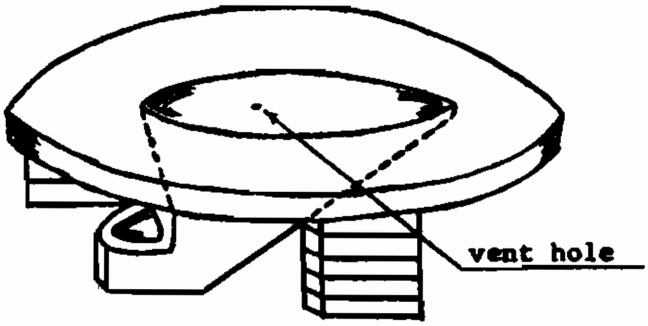


Figure 10
Completed casting set up on bricks where the wooden inner form is removed and clay siphon lining dug out. The final finish of cement plaster and neat cement polish is applied.

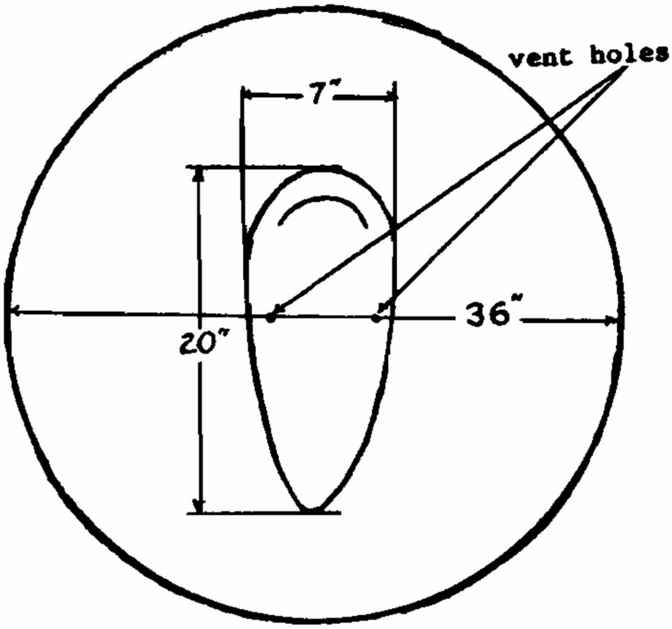


Figure 11
The completed casting from
above showing the dimensions.

Material From - "Latrines for Village Use" Report on Work in the Field of Sanitary Engineering, by Edwin Abbott, M.D.

ABSTRACT

This concrete water-seal slab is most useful for widescale privy programs. It is used to cover an ordinary pit privy.

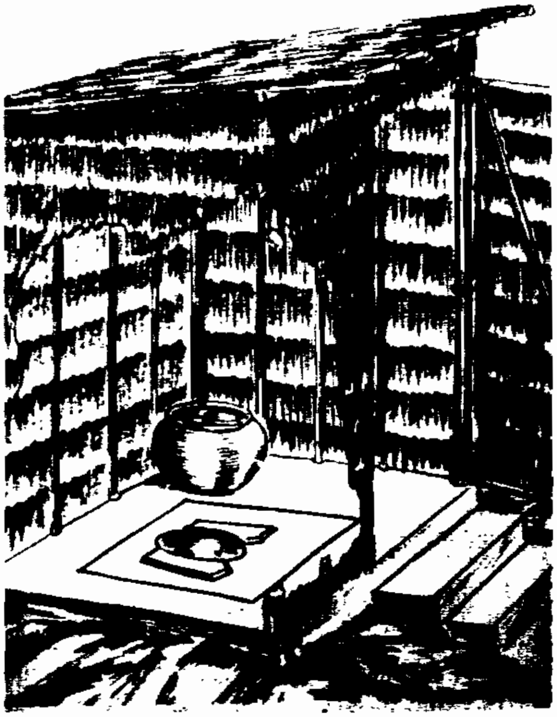


FIGURE 1 SKETCH OF FINISHED PRIVY

TOOLS AND MATERIALS

Master molds - Can be purchased from Village Health and Sanitation Project, Ministry of Public Health, Department of Health, Bangkok, Thailand. This aluminum master mold weighs 24 pounds and costs $7.50 plus shipping charges. Master molds can be made using the entry "Master Molds for the Thailand Water-Seal Privy".
Concrete making materials
Wood for platform forms
Reinforcing rod and wire
Clay
Crankcase oil
Beeswax and kerosene (optional)
3/4" x 3/4" x 5" steel bars

DETAILS

The basic method used for making these water-seal slabs is to cast the slab, bowl, and water-seal trap using three forms:

(1) A wooden form for shaping the slab.
(2) A concrete bowl core for shaping the inside of the bowl.
(3) A concrete core for shaping the inside of the water-seal trap.

Since the three parts of the slab are all cast at one time, the finished privy slab is quite strong. The water-seal trap is curved back under the bowl as shown in Figure 2a.

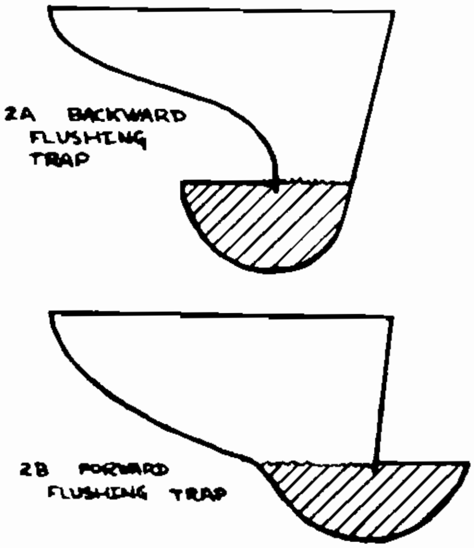


FIGURE 2 WATER SEAL TRAPS

This makes flushing more difficult, but prevents erosion of the back of the pit on loose soil. The same general method could be used to make a forward flushing trap, Figure 2b.

The forms used when making a slab must stay in place till the concrete has gained enough strength to allow their removal. This is usually 24 hours. For this reason, many sets of forms are necessary if a reasonable number of slabs are to be cast every day. Here is where the master molds are needed. One is used to cast the bowl core, and two are needed to cast the trap core.

Casting the Bowl Core

1. Oil the inside of the master bowl mold and insert a 3/4" x 3/4" x 5" steel bar into the bottom.

2. Add a fairly loose mixture of cement and water, called neat cement, to a depth of about 6". Then fill to brim with a 1:1 cement sand mixture. The 1:1 should be firm, not runny, and should be laid into the loose neat cement without stirring to insure a smooth finish on the bowl core.

3. After the bowl core has become firm enough, scoop a depression into the surface to install the two steel hooks made from the reinforcing rod. They should be about 9" apart, and should not protrude above the surface of the concrete. See Figure 3.

4. Allow the concrete to set at least 24 hours before removing the bowl core from the master mold. The bowl core can be used to make another master mold and vice versa.

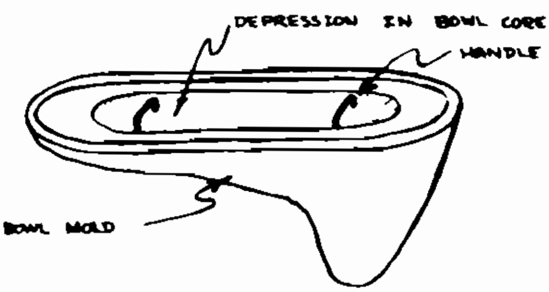


FIGURE 3 BOWL CORE HANDLES

Casting the Trap Core

Make the trap core using the pair of master molds, which consist of the trap master mold and the insert mold.

1. Add about 1" of 1:1 cement sand mix to the oiled trap master mold and put in some wire for reinforcing. Then fill it with 1:1 almost to the brim. See Figure 4.

2. Put the oiled insert mold into place and scrape off excess. See Figure 5.

3. After 45 minutes remove the insert and add a square sheet metal pipe 3/4" high made by wrapping sheet metal around a 3/4" x 3/4" steel bar.

4. Remove the finished trap core by gently tapping the master mold with a wooden block.

FIGURE 4 REINFORCING THE TRAP CORE

FIGURE 5 PLACING THE INSERT MOLD

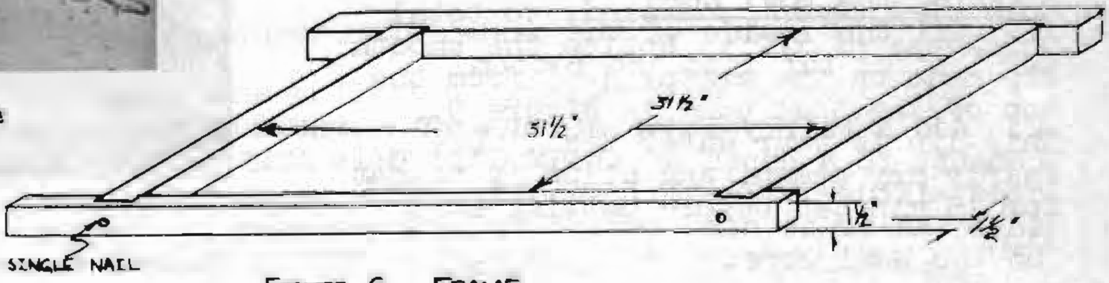


FIGURE 6 FRAME

Construction of the Wooden Slab Form

1. Make a frame of 1 1/2" x 1 1/2" wood with an inside diameter of 80 cm x 80 cm. A notch and single nail on each corner works well. See Figure 6.
2. Make a wooden platform 90 cm x 90 cm out of 1" thick planks. Gouge 1/2" deep footrests if these are desired. See the outline in Figure 7.

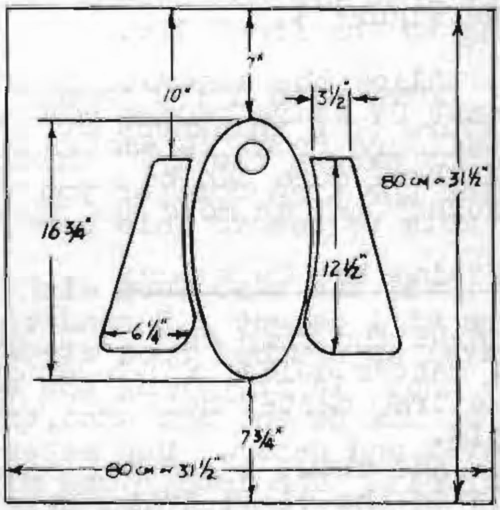


FIGURE 7 PRIVY SLAB OUTLINE

Casting the Slab

With these three forms finished you are ready to cast the first water-seal slab.

1. Use a paintbrush to coat the bowl core and the trap core with a layer of wax about 1/8" thick. Prepare the wax by dissolving 1 kilogram of melted beeswax in 1/2 liter of kerosene. The wax coating will last 5 or 6 castings adding 1¢ to the cost of each slab. Wax makes removing the cores much easier, but isn't absolutely necessary.

2. Place the bowl core on the wooden slab form and fill all cracks with clay. See Figure 8.

3. Oil the bowl, platform and frame.

4. Apply a 1/4" thick coat of pasty cement and water mixture to the bowl core and platform. (Many Thai people prefer to spend 25¢ more for an attractive polished slab. To do this, instead of using a mixture of cement and

FIGURE 8 SEALING CRACKS WITH CLAY

water, use a mix of 5 cement : 5 color : 1 granite chips. After the forms are removed, polish with a carborundum stone and plenty of water.)

5. Cover the bowl core with a mixture of 1 cement : 2 sand, to total thickness of 1/2". Notice the smooth lip made on the cement 3/8" from the top of the bowl core in Figure 9. This lip is your water seal. Use fairly dry cement and allow it to set for 15 minutes before cutting this lip.

FIGURE 9 MOUNTING THE TRAP CORE

6. Place the trap core on the bowl core and seal the crack with clay. Also add a little clay on each side of the form (near the thumb in Figure 9) to prevent cement from getting to the front lip.

7. Cover with 1 : 2 cement sand mixture to a thickness of 1/2". Do not exceed the 1/2" thickness below the trap core or you will not be able to remove this core.

FIGURE 10 PLACING REINFORCING ROD

8. Fill the slab form with a mixture of 1 cement : 2 sand : 3 clean gravel or crushed rock almost to the top. In preparing the concrete, first mix cement and sand, then add gravel and water. Use water conservatively. The looser the mixture, the weaker the concrete will be.

9. Press in 4 pieces of 1/4" steel rod reinforcing. See Figure 10.

10. Fill to top of frame and smooth. Allow at least 24 hours for setting.

11. Remove the frame by tapping lightly with hammer.

FIGURE 11 REMOVING THE BOWL CORE

12. Turn the slab form over on a wooden stand and use simple levers to remove the bowl core. You must remove the bowl core before the trap core. See Figure 11.

13. Tap the trap core gently and slip it out. Add a little water and check to see if your seal is 3/8".

14. Keep the slab damp and covered for a minimum of 3 days and preferably a week to gain strength.

EVALUATION

This method represents the collected experience of a long established privy program in Thailand. The general method should be applicable to other water-seal slab designs.

Material From - Thailand's Water-Seal Privy Program, by Barry Karlin, MPH Sanitation Advisor, USOM/Lprat. Thailand.

MASTER MOLDS FOR THE THAILAND WATER-SEAL PRIVY

ABSTRACT

This paper describes how to make the three master molds, from which any number of cores can be cast. These cores are used for casting the water seal privy slabs.

TOOLS AND MATERIALS

Concrete making materials
3/4" square steel rod
Sheet metal (tin can metal is satisfactory)
Clay
Crankcase oil (used oil is satisfactory)
Paintbrush

DETAILS

It may be necessary to make master molds rather than to purchase them. Study the entry "Thailand Water-Seal Privy" before starting to make these master molds.

Making the Master Bowl Mold

1. Cut out profiles of the bowl outline from Figure 1, which is full size.

2. Shape a mound of clay using the cardboard profiles as a guide.

3. Form a little square pipe, 3/4" long, of sheet metal on the 3/4" square steel rod. Make several of these as they will be used later when casting the cores. Fill the square pipe with clay and press it into the top of the clay mound a little bit. This will be used later to "key" the cores together. See Figure 2.

4. Paint the clay mound with crankcase oil.

5. Cover the clay mound with a stiff mixture of cement and water to a thickness of 1/2". If the clay mound was properly prepared, the inside finish of the bowl mold will need no further smoothing.

6. After this cement has set 30 minutes, build up the thickness to 1 1/2" with 1 : 1cement sand mix. Let this set 24 hours and carefully lift the finished master bowl mold from the clay mound. The finished bowl mold is shown in Figure 3.

FIGURE 2 CLAY MOUND

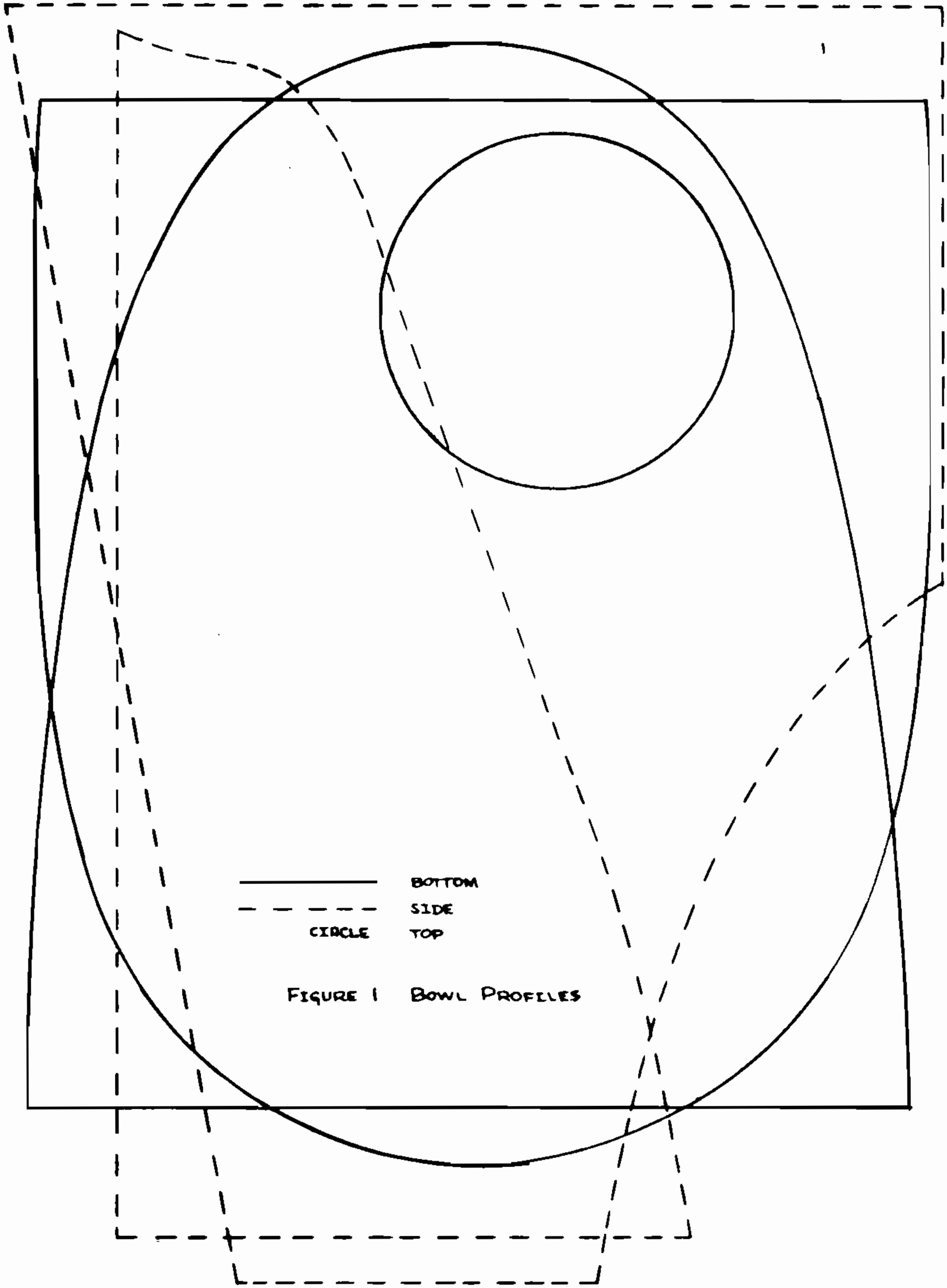


FIGURE 1 BOWL PROFILES

The next step is to make the pair of master molds used to cast the trap core, which consist of the master trap mold and the insert.

FIGURE 3 BOWL MOLD

Making the Master Trap Mold

1. Make cardboard profiles of the trap from Figure 4, which is full size. Shape the outside of the trap from clay, and let it harden overnight.

2. Shape the under side with trowel and hand using the master insert profile from Figure 4 and Figure 5 as a guide. Mark the location for a 3/4" square metal pipe by holding the clay trap over the clay mound used to shape the bowl mold, and letting the square sheet metal cube mark the trap.

FIGURE 5 CLAY TRAP

3. Insert the sheet metal pipe into the clay trap and scoop out the clay from inside. See Figure 5. Check the clay trap on the bowl mound again to be sure it lines up properly.

4. Oil the clay trap.

5. Put a heel shaped piece of clay under the clay trap and trim the sides. This will prevent the cement from running under the mold. See Figure 6.

6. Cover with cement and water to 3/4", add steel reinforcing wire, and cover with 3/4" more of 1 : 1 cement sand mixture.

7. Flatten the top and insert wire handles. Let set at least 24 hours. This completes the master trap mold.

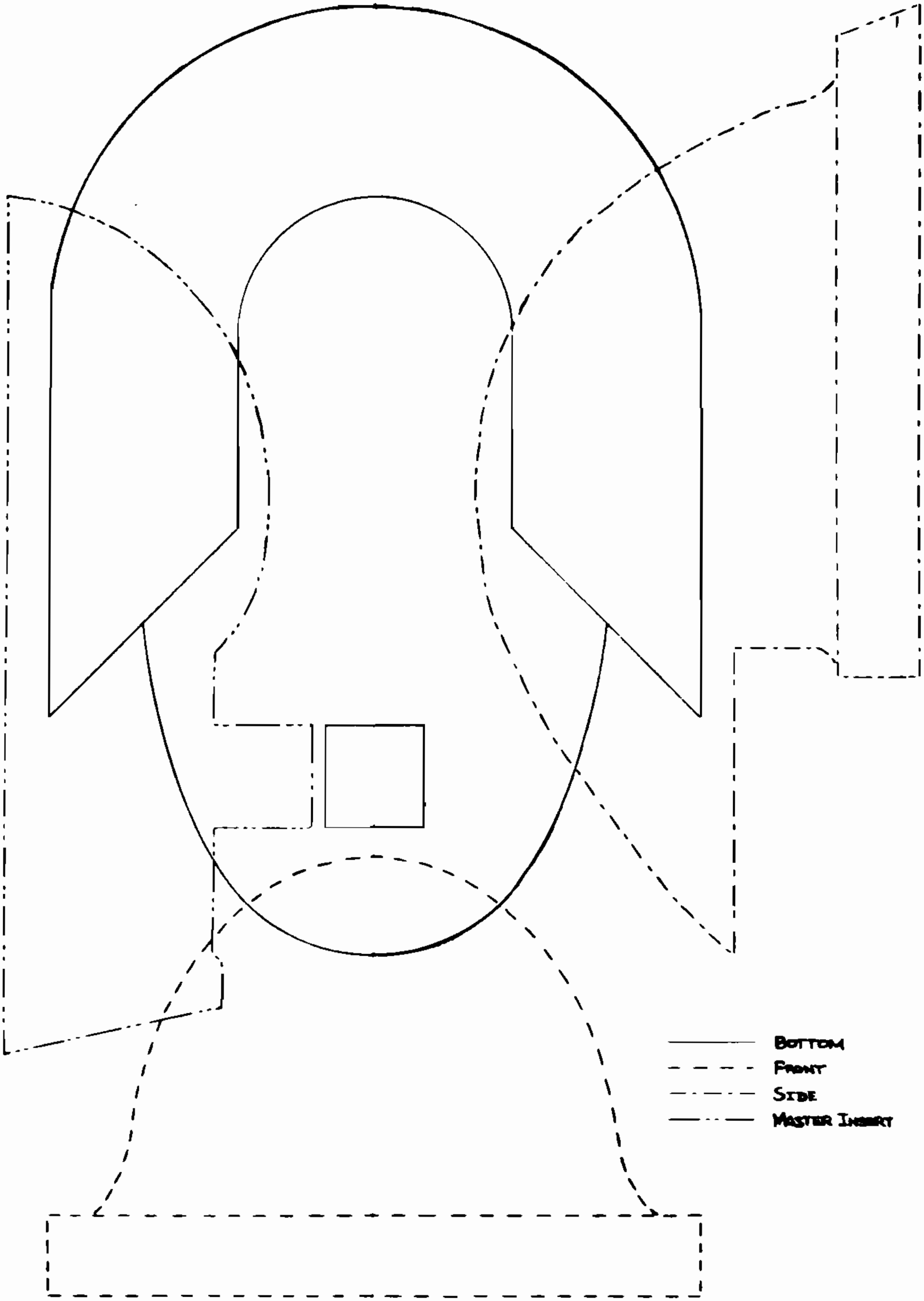
FIGURE 6 PREPARING CLAY TRAP FOR CASTING MOLD

Making the Trap Mold Insert

1. Turn the master trap mold over carefully, and remove the heel shaped clay plug.

2. Oil all inner surfaces and fill to the brim with 1 : 1.

FIGURE 4 - TRAP PROFILES



3. Insert a small wire handle and allow the concrete to set for at least 24 hours before separating the finished molds.

Figure 7 shows the completed master trap mold and insert.

FIG. 7 TRAP MOLD AND INSERT

EVALUATION

This method represents the collected experience of a long established privy program in Thailand. The general method should be applicable to other water-seal slab designs.

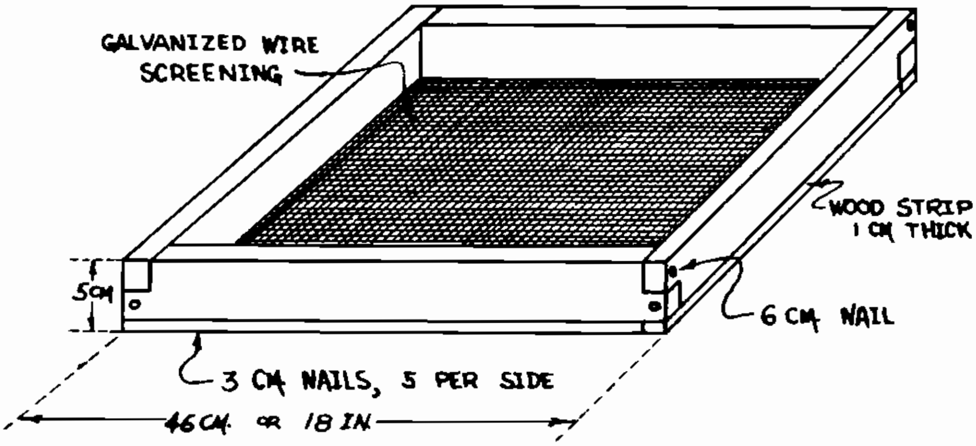
Material From - Thailand's Water-Seal Privy Program, by Barry Karlin, MPH Sanitation advisor, USOM/Lprat. Thailand.

AGRICULTURE

SEED CLEANING SIEVES

ABSTRACT

The set of sieves described here will clean your crop seeds effectively, which is an important step for improved crop production.



TOOLS AND MATERIALS

12 - boards
   2½ x 5 x 46 cm.
   1" x 2" x 18"
12 - wood strips
   1 x 2½ x 43½ cm.
   ¼" x 1" x 17"
1 - 46 cm (18 in.) square of ¼" galvanized screen.
1 - same but 3/16" screen
1 - same but 1/8" screen
Hammer, saw, nails.

DETAILS

The exact size of these sieves is not important, but 1/8", 3/16" and 1/4" mesh make convenient sizes for cleaning wheat, barley, corn and seeds of similar size. The sieves are also useful for grading certain seeds. Grading consists of removing the small, weak seeds which will produce small weak plants or will not grow at all. Less seed can be planted per acre, if it is properly cleaned and graded, and still produce a good crop.

EVALUATION

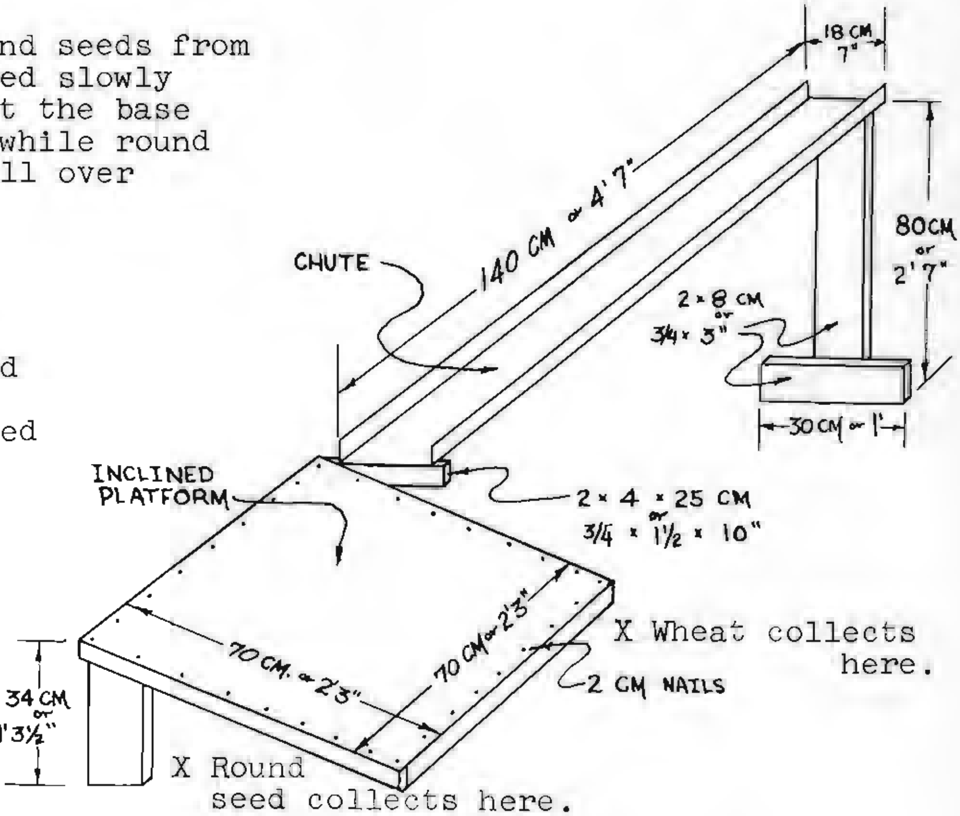
This old method finds use in many countries; the simple design described here was found useful in Afghanistan.

Material From - Dale Fritz, The Asia Foundation

GRAIN CLEANER

ABSTRACT

This device removes round seeds from wheat. Sieved grain poured slowly down the chute collects at the base of the inclined platform while round seeds, rolling faster, fall over the far side.



TOOLS AND MATERIAL

1 - 70 x 70 cm. galvanized iron
1 - 24 x 140 cm. galvanized iron
4 - 2 x 4 x 68 cm. wood
1 - 2 x 4 x 25 cm. wood
1 - 2 x 8 x 80 cm. wood
1 - 2 x 8 x 30 cm. wood
1 - 2 x 8 x 34 cm. wood
Hammer, saw, nails.

DETAILS

To operate the grain cleaner drop the seed very slowly into the upper end of the chute. The seed will roll down the chute but the round seed, because it is round, will roll much faster than the wheat seed. The speed of the round seed will cause it to roll compleately across the inclined platform while the wheat seed will collect on the ground near the end of the chute. The seed should first be cleaned with sieves to remove as much dirt and foreign material as possible.

EVALUATION

This device has found use in Afghanistan.

Material From - Dale Fritz,
The Asia Foundation

BUCKET SPRAYER

ABSTRACT

This simple sprayer works on the same principle as the inertia pump, and is designed so that local artisans can make it. Two people operate it; one sprays while the other pumps.

TOOLS AND MATERIALS

Galvanized iron 30 cm x 30 cm
  plus 10 cm x 20 cm
Barrel metal 10 cm x 20 cm
1/4" hose (high pressure) 4 m.
1/4" pipe (truck brake line may
  be used) 50 cm
Wood for handle 2 cm x 15 cm
  x 30 cm.
3/4" galvanized iron pipe (thin-
  wall) 120 cm long
4 mm wire-20 cm
Truck inner tube material 10 cm
  x 20 cm
1 mm galvanized wire 30 cm
4 - 3/16" bolts 1 cm long
2 - 3/16" bolts 3 1/2 cm long

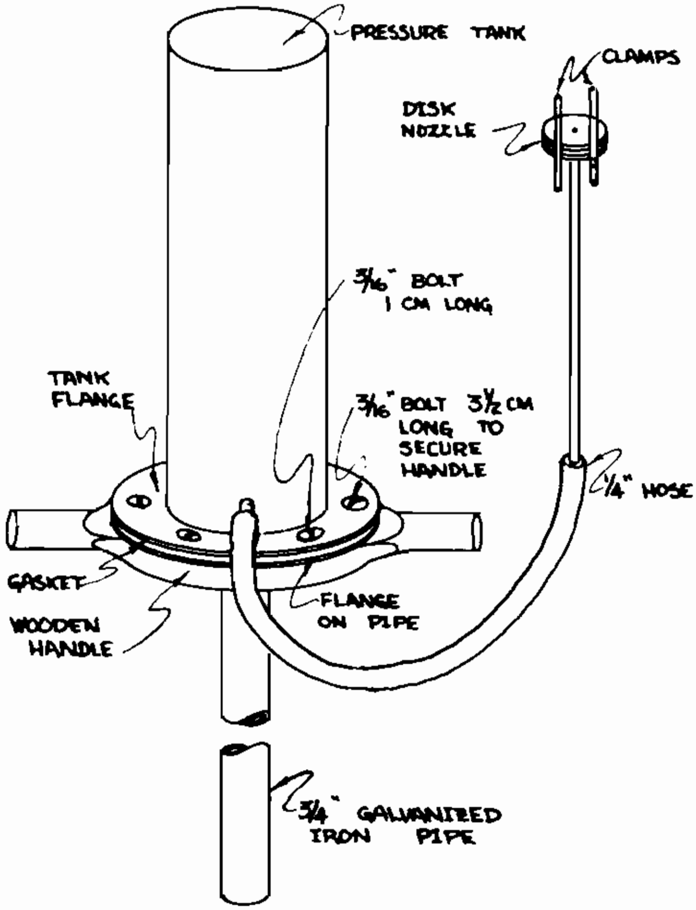


FIG 1

DETAILS

The bucket sprayer described here has been designed primarily to meet the need for a sprayer which can be built in an area where production facilities are limited. This sprayer can be made by the local artisans. It is intended only for water solutions of insecticides or fungicides.

The sprayer pump is of the inertia type which consists of a 3/4" iron pipe with the top plugged and a simple valve located 8 cm. from the top. The valve is a piece of truck inner tube rubber wrapped around the pipe and held in place by wire. One corner of the rubber is over a hole in the pipe. Some careful adjustment is necessary when placing the rubber to make sure it works properly and does not leak.

The pressure tank encloses the valve assembly and, as the liquid is pumped into the tank, builds up pressure sufficient to operate the simple disk type spray nozzle. The tank is built so that it can be removed in order to service the valve.

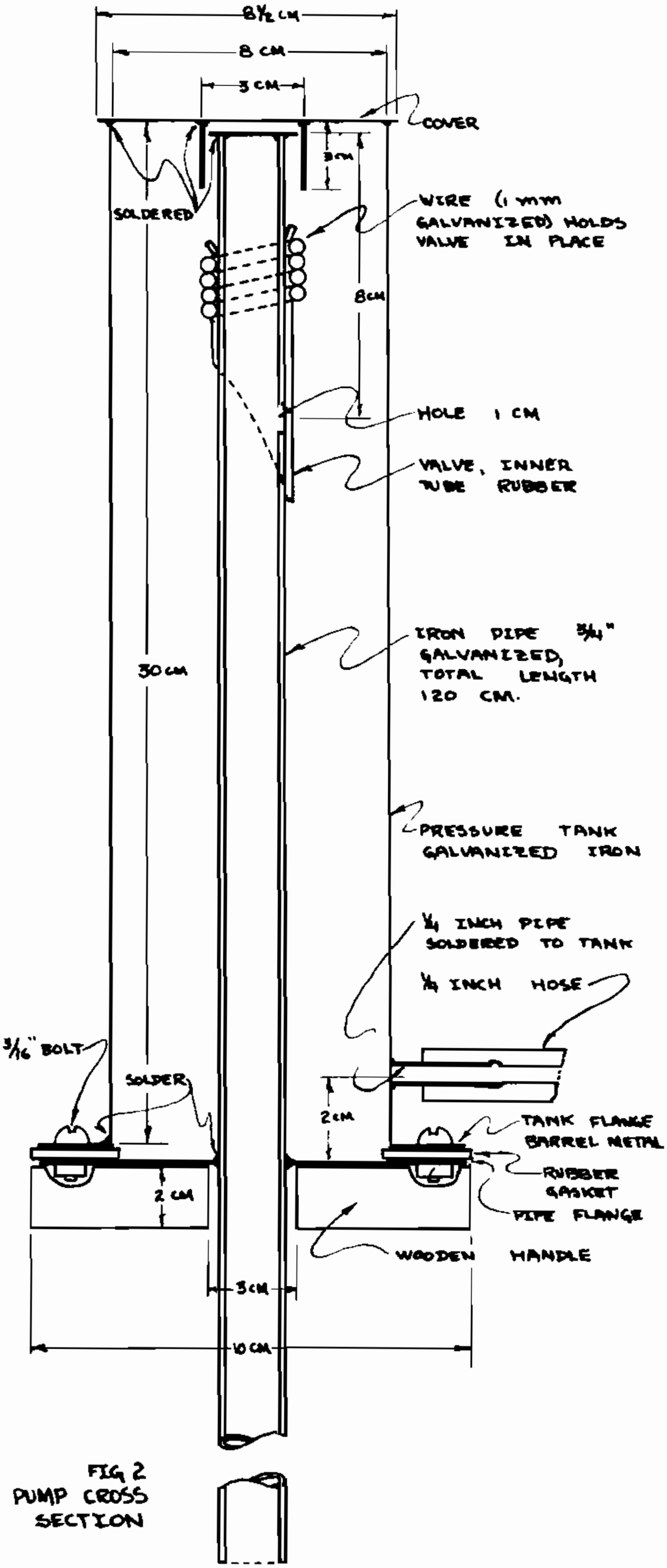


FIG 2
PUMP CROSS SECTION

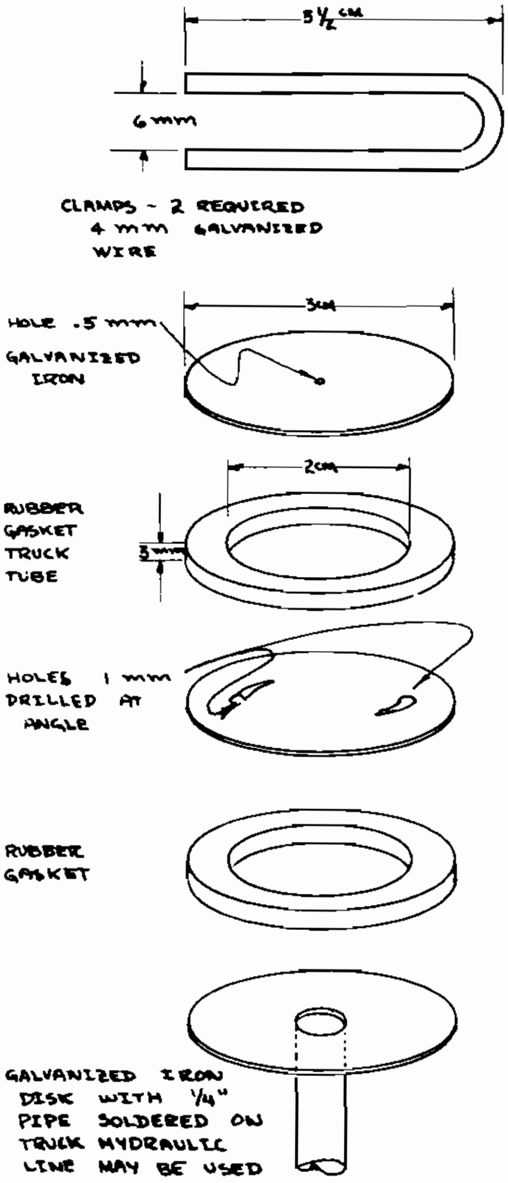


FIG. 3
DISK NOZZLE

The length of the hose can be determined by the maker of the sprayer but should be about 4 meters to allow the man doing the spraying to cover quite a large area before having to move the bucket. Also, the length of the small pipe and the angle of the spray nozzle will be determined by the kind of crops being sprayed.

At times it will be necessary to "prime" the sprayer pump. This is caused by two things. Either the valve rubber is too tight and the air cannot be forced through the valve, or the rubber is stuck to the pipe. To prime the pump turn it up-side-down and fill the pipe with water. Holding the thumb over the pipe, turn the pump over and lower it into the bucket of liquid and start pumping in the usual manner. If priming does not start the pump it will then be necessary to remove the pressure tank to inspect and repair the valve.

Only very clean water should be used to make the mixture for spraying and it should be strained through a cloth after mixing to remove any particles which might cause the nozzle to plug. If a very fine brass screen is available, it should be put in the nozzle to keep the dirt from plugging the holes.

EVALUATION

Have been useful in Afghanistan.

Material From - Dale B. Fritz, The Asia Foundation

BAMBOO POULTRY HOUSE

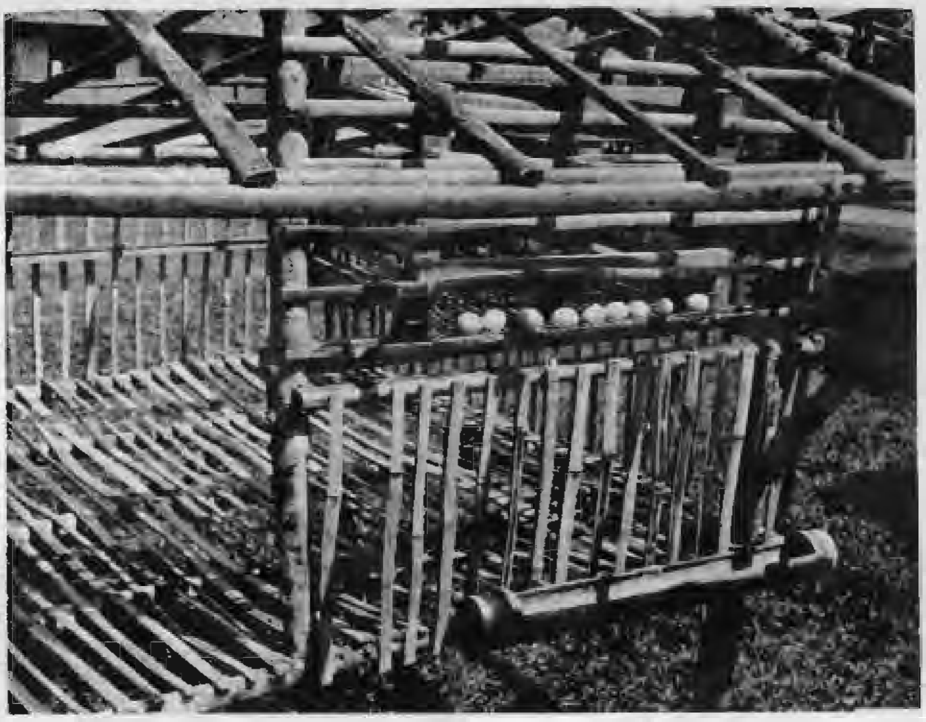


FIG. 1 SHOWS EGG CATCH AND FEED TROUGH

ABSTRACT

This bamboo poultry house has a thatch roof and slat walls tc provide good ventilation. The elevated slat floor keeps chick ens clean and healthy while the egg catch and feed troughs simplify maintenance.

TOOLS AND MATERIALS

Bamboo
Nails
Thatching materials
Small tools

DETAILS

The house is built on a frame of small poles, with floor poles raised about 3 feet from the ground. The floor poles are covered with large bamboo stalks, split into strips 1 1/2" wide, spaced 1 1/2" apart. Floors so constructed have several advantages: better ventilation, no problem of wet moldy litter during rainy season or dry dustry litter during dry season; droppings fall between split reeds to ground away from chickens. This eliminated parasites and diseases normally passed from hen to hen through droppings remaining warm and moist in litter. However, it has been suggested that wide spacing of floor and wall slats might invite marauders such as weasels and snakes.

Walls are constructed from vertical strips of bamboo 1 1/2" wide, spaced 2 1/2" to 3" apart. This also allows ample ventilation, needed to furnish oxygen to the chickens and to allow evaporation of excess moisture produced in the droppings. In the tropics the problem is to keep chickens cool, not warm. Using a closed or tight-walled poultry house with a solid floor would keep them too warm and result in lowered production and increased respiratory problems.

The roof must protect the chickens from the weather. In Liberia thatch roofing keeps the birds cool, but it must be replaced more often than most other materials. Since it is cheap and readily available to the small farmer or rural family, it is most likely to be used. Aluminum, which reflects the heat of the sun, and asbestos, an efficient insulator, are desirable roofing materials in the tropics. Zinc, which is commonly used to roof houses in Liberia, is undesirable for chicken houses because it is an efficient conductor of heat.

Whatever the roofing material, the roof must have an overhang of of 3' on all sides to prevent rain from blowing inside the house. It may be desirable to slope the overhang toward the ground.

Feeders and waterers are made from 4 to 5" diameter bamboo of the desired length. A node or joint must be left intact in each end of the bamboo section to keep the feed or water in. A section 3 to 4" wide around half the circumference of the bamboo, except for 3" sections on the ends, is removed to make a kind of trough. All nodes between the ends are removed. These feeders must be fastened at the base, to keep them from rolling.

The feeders are fastened to the outside of the walls about 6" above floor level. The hens place their heads through the bamboo strips to feed or drink, thus conserving floor space for additional chickens.

In laying houses nests are also constructed of split bamboo for unobstructed ventilation. Conventional lumber nests are hotter and may result in hens laying eggs on the floor instead of in the nests. This means more dirty eggs, more broken eggs, and more likelihood of the hens eating the broken eggs. The only way to cure a hen of eating eggs once the habit is formed, is to kill her. In addition, as the hens enter the nests they sit on eggs laid previously by other hens, keeping them warm. The quality of eggs deteriorates very fast under these conditions.

FIG. 2 NESTS IN BAMBOO POULTRY HOUSE

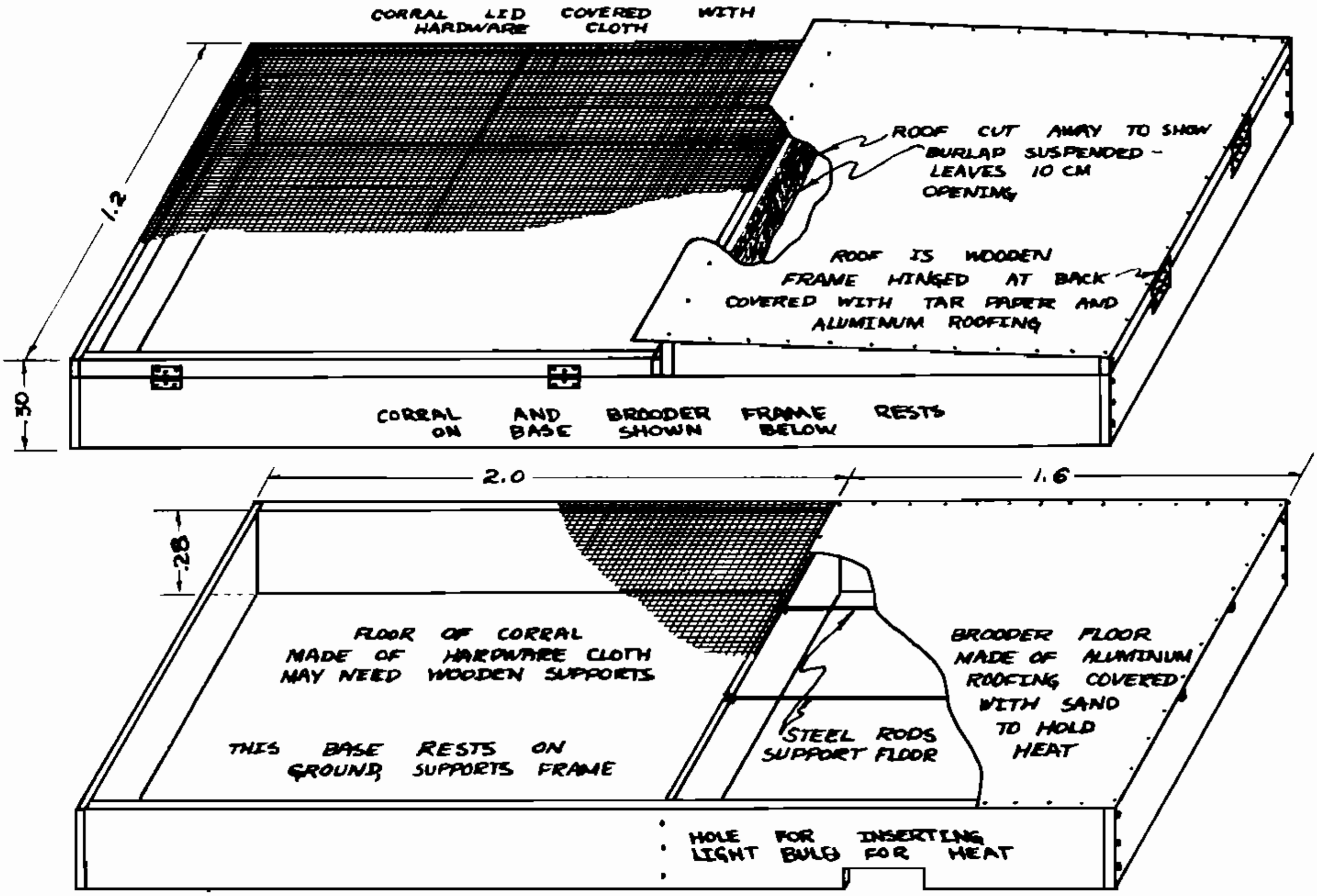
The demonstration nests are 15" long, 12" wide, and 14" high. The strips used on the floor of the nest are about 1/2" wide, spaced 1/2" apart, and must be very smooth. The floor slopes 1/2" from front to back, so that when the eggs are laid they will roll to the back of the nest. An opening 2" high at the back of the nest allows the eggs to roll out of the nest into an egg catch. This type of nest results in less egg breakage, cleaner eggs, better quality eggs, because they begin to cool as soon as they roll out of the nest. In addition, the eggs are outside the nest where egg eating hens cannot reach them. Placing the egg catch so it protrudes outside the wall of the house allows the eggs to be gathered from outside. Placing the nests 3' above the floor conserves floor space and permits more laying hens to be placed in the laying house. One nest is put in for every five hens.

EVALUATION

The poultry house costs nothing but labor to build and is certain to produce healthier, more productive chickens. It has been used successfully in the Philippines and Liberia.

Material From - USAID, Monrovia, Liberia, described in OTS Information Kit, Vol. I, No. 5, May 1961.

CHICKEN BROODER



ABSTRACT

This brooder is sufficient size for 200 chicks, and is hinged for easy access to corral and brooder. Dimensions are shown in meters.

TOOLS AND MATERIALS

Hardware cloth 1.2 x 2 m., 2 pieces this size needed.
Aluminum roofing - 1.2 m. x 1.6 m., 1.2 m. x 1.7 m.
Wood, approximately 30 cm x 2 cm x 20 m..
Steel rod 1 cm diameter x 3.2 m.
4 hinges about 8 cm long
Woodscrews for hinges
2 buckets clean dry sand
Nails, tacks, staples
Small tools

DETAILS

This chick brooder is heated by a regular electric light bulb, placed under the brooder floor. Sand placed on the floor of the brooder holds and distributes the heat, and helps keep the area clean and dry. Depending on the temperature rise required, the wattage of the light bulb will have to be chosen by experimentation. The metal floor and roof prevent predators such as rats from entering the brooder. If electric power is not available, an excavation can be made for a lantern. Be sure the lantern has adequate ventilation.

EVALUATION

This type of brooder has been used successfully in Ecuador and other places by the indigenous people to raise broilers for a cash crop.

Material From - Article by George Kreps in Rural Missions, Issue #122, published by Agricultural Missions, Inc.