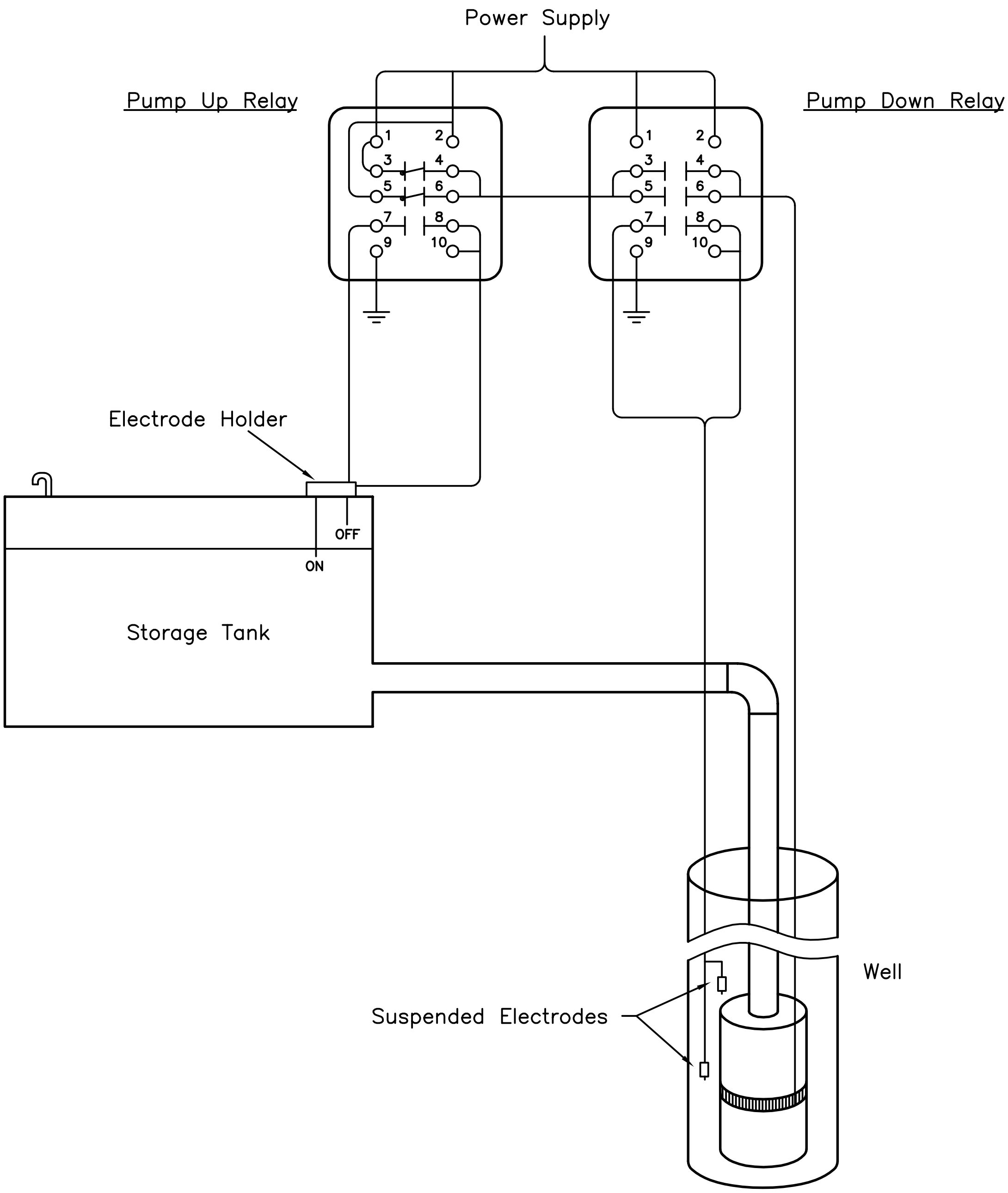
A mechanism to control a pump based on water levels in both well and tank is shown in Figure 8.18. This should be used where water level in the well must control the pump.

Figure 8.18
SWITCH CONTROL OF
WATER LEVEL IN STORAGE TANK AND IN WELL



8.6.2 Remote Control Pump Float Switch

A float switch at a remote storage tank is connected to a pump relay switch via low voltage telephone line or signal wires. The wires may be underground or aboveground. Used telephone wires might be used aboveground. Figure 3.5 illustrates this type of system. This is the most preferred type of system for very high pressure pipelines. The storage tank is located at the highest point in the system.

Figure 8.19 illustrates typical switching equipment for a remote tank. Figure 8.20 shows various kinds of float switches that might be used in the storage tank.

A mercury float level control on a cable is a simple reliable mechanism. The pumping differential is controlled by the length of free cable.

Figure 8.19
REMOTE TANK FLOAT OPERATED SWITCHING EQUIPMENT

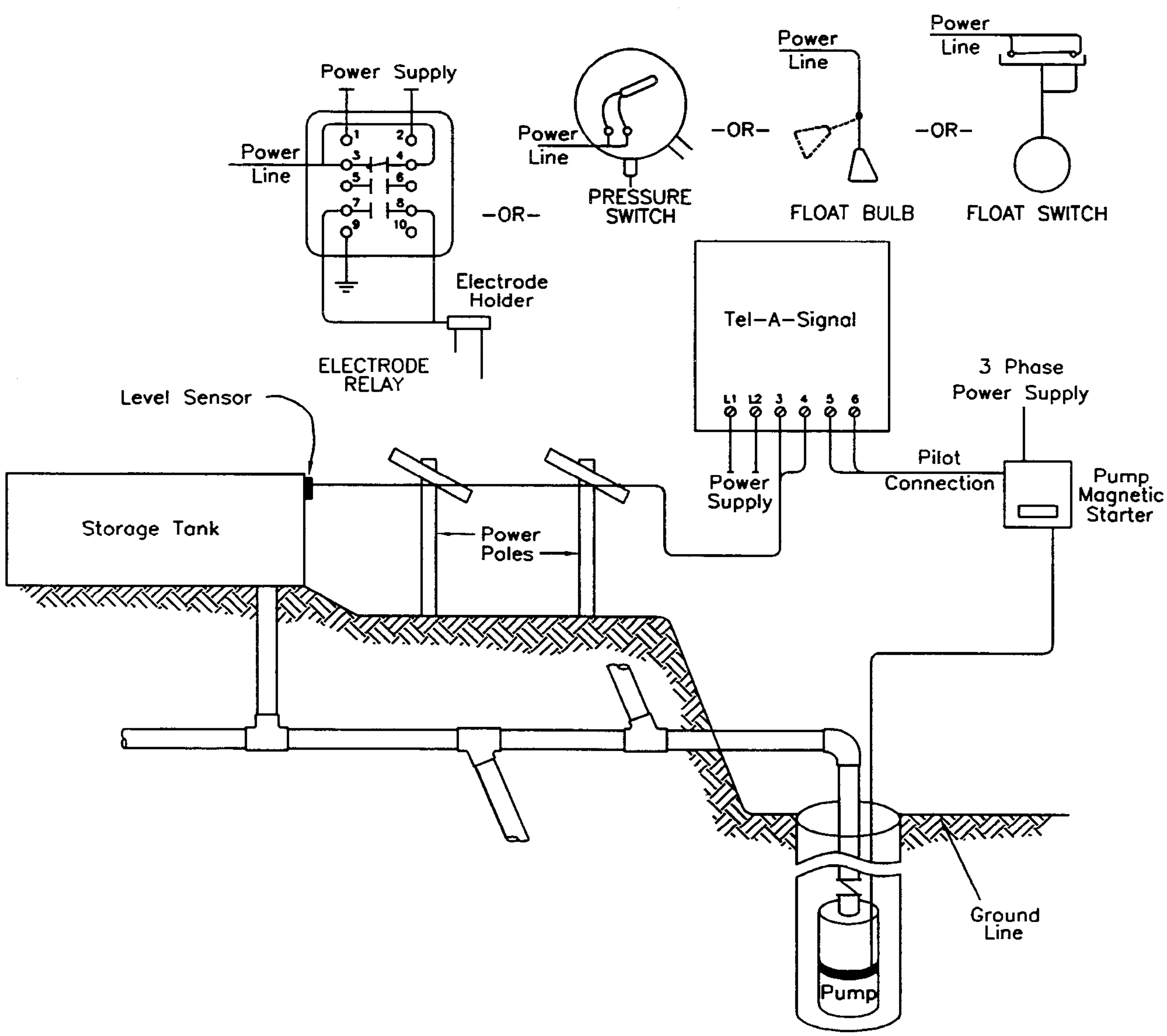
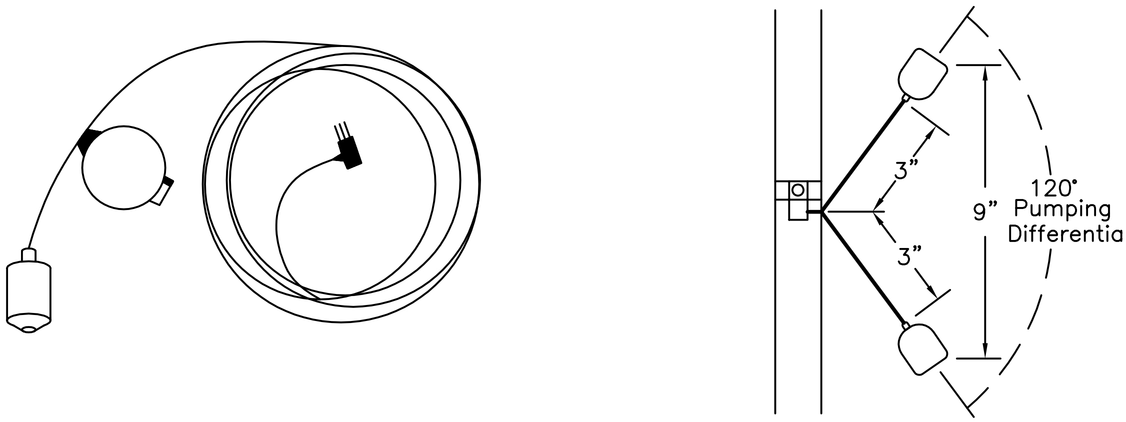
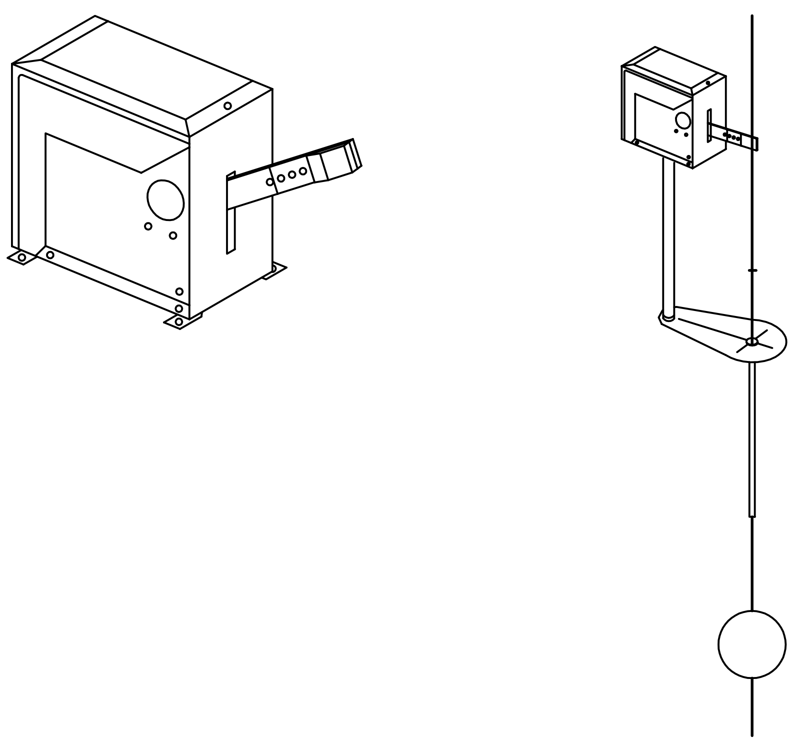


Figure 8.20
WATER LEVEL CONTROL SWITCHES



MERCURY FLOAT LEVEL CONTROL



MECHANICAL FLOAT SWITCH

8.7 STOCKWATER TANKS

Stockwater tanks come in an almost infinite number of shapes and sizes and are made from many different materials. Almost anything which will hold water and can be reached by an animal has been used.

It takes careful consideration to design a stock tank that will serve its function, be cost effective and last for at least a reasonable length of time. A stock tank must withstand a very hostile environment. Water used by livestock is often corrosive; ice and frost heave tend to damage the tank and foundations; animals step in tanks and rub up against them; people shoot at them; and animals tromp away the soil around a tank. All of these factors working together can make a tank short lived if proper precautions are not taken.

A floating bird board or equivalent in a stockwater tank will help prevent the accidental drowning of birds and other small animals. Rodent escape boards are also beneficial. This will also help to reduce contamination of water supply.

8.7.1 Tank Materials

Materials should be chosen not only for economic reasons, but to resist attack by the particular environmental hazards existing at the site.

Concrete Tanks

Concrete is one of the most durable materials that can be used to build stock tanks. To be durable though, concrete must be made and placed properly. The two environmental factors that will rapidly deteriorate concrete are freeze-thaw action and sulfates in the water.

High sulfate concentrations are present in many waters used for stock-watering in Missouri. It is important to become aware of this if you are working in an area where sulfate is a problem.

Since stock tanks are often used during freezing weather, they are in an ideal environment for damage due to freezing and thawing. Pores in the concrete fill with water, freeze, and as a result the concrete will spall.

There are practical things that should be done to make quality concrete that will resist these elements:

1. Use a low water cement ratio. Use the minimum amount of water in the concrete that is possible consistent with being able to place the concrete. Use a minimum of 6 bags of cement per cubic yard of concrete.

2. Place the concrete within 1-1/2 hours after adding water to the cement. This is sometimes a challenge when using readymix concrete at remote sites. If travel time between batch plant and the site is a problem, add the cement and water at the site. Adding water to make concrete placeable after it has been in the truck too long is a leading cause of poor concrete.

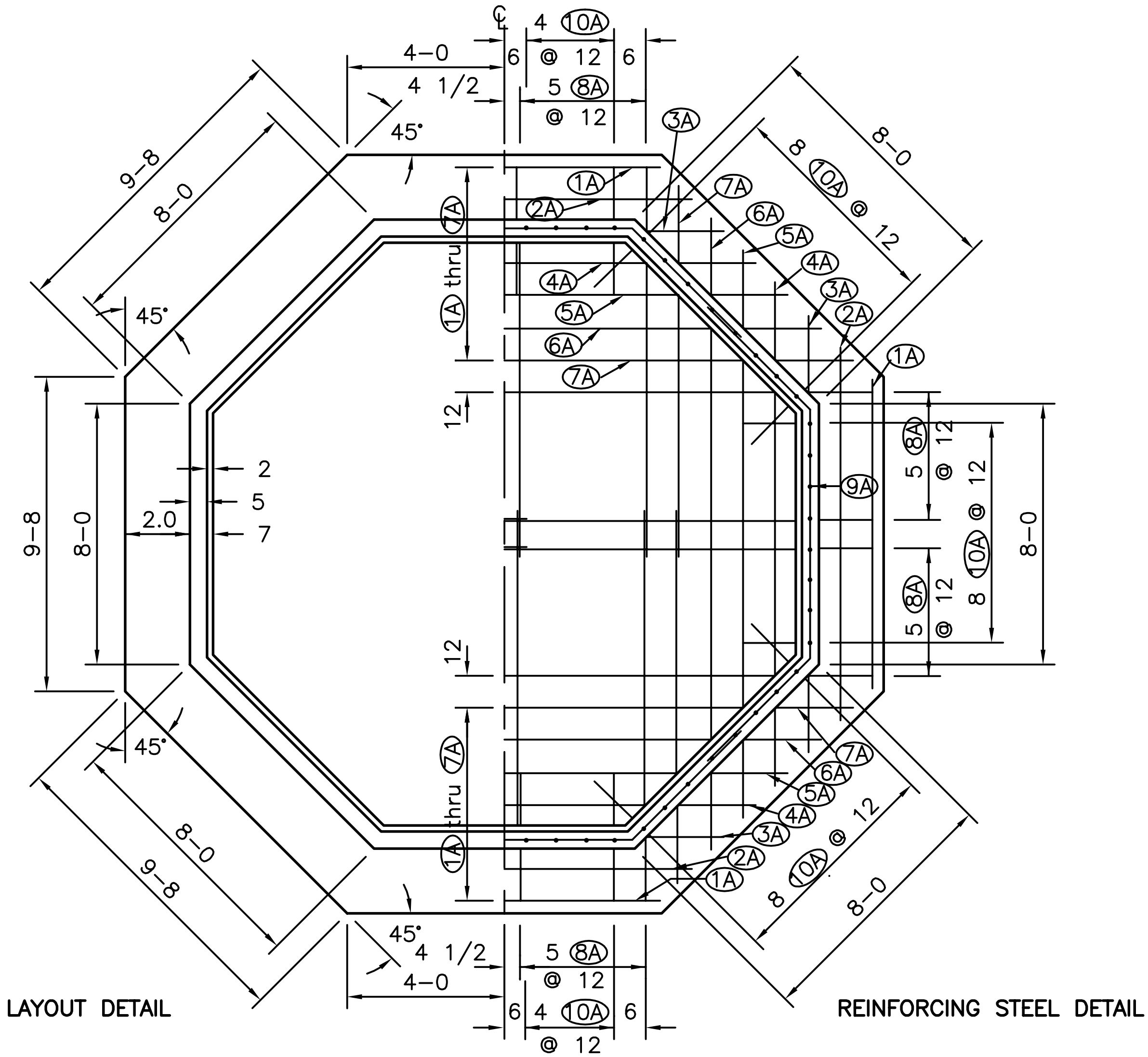
3. Use air entrained concrete with air content within NRCS specification range. Air entrainment can be obtained by using cement with built-in air entrainment additives, or by adding admixtures at the concrete batch plant. Cement with air additives built-in is cement type IIA.

Foundation frost heave can also be a problem, particularly if the foundation is wet when the ground freezes. The solution is to build the tank so there will be good drainage away from the tank, provide proper overflow drains for the tanks, and provide a well drained base material under the tank.

Figure 8.21 illustrates a typical concrete tank. Figure 8.22 details a concrete trough. Figure 8.23 illustrates a tank made out of a section of large diameter concrete pipe. Figure 8.31 shows plans for a concrete frost free tank.

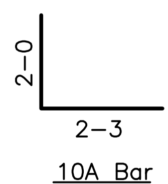
These tanks all require some skill to construct. If multiple copies of the same tank are to be constructed, costs can be reduced and quality increased by constructing reusable concrete forms.

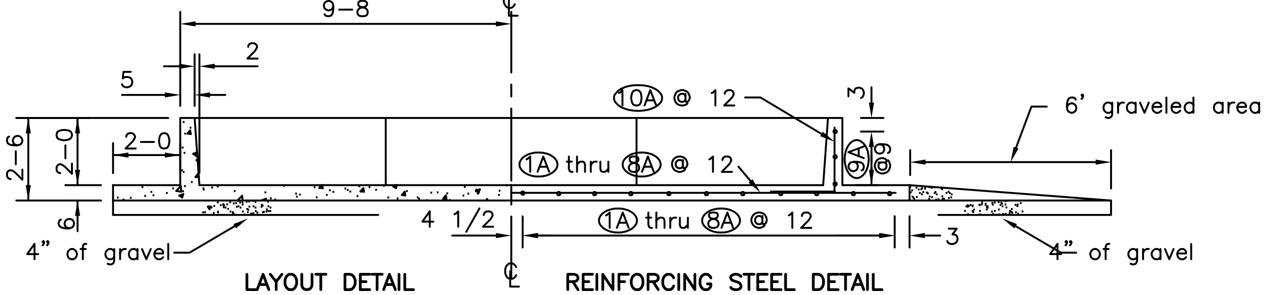
Figure 8.21
CONCRETE TANK



PLAN

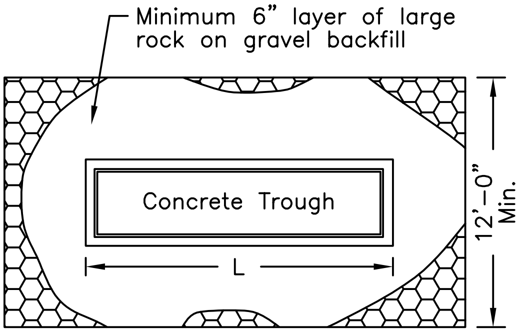
Notes:
1. Unless otherwise shown reinforcing steel shall be #4 bars at 12" C.C. in both directions.
2. Bar splices shall be 30 bar diameters (15 inches).
3. Steel shall not be closer than 3 inches from bottom floor slab or 2 inches from top of floor slab or outside wall surface.





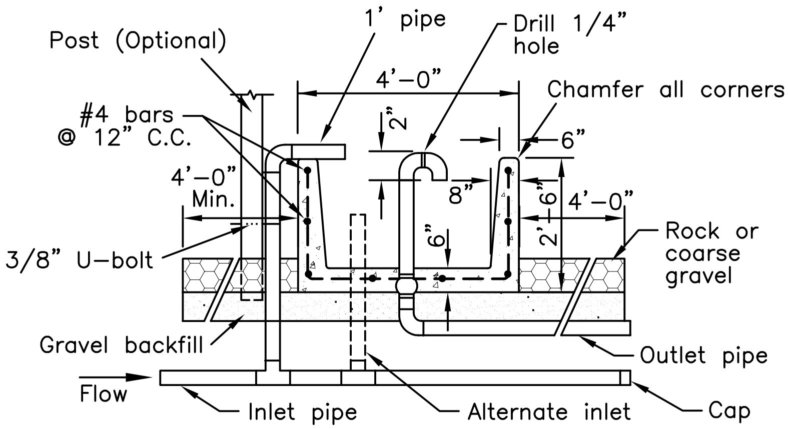
SECTIONAL ELEVATION

Figure 8.22
CONCRETE TROUGH

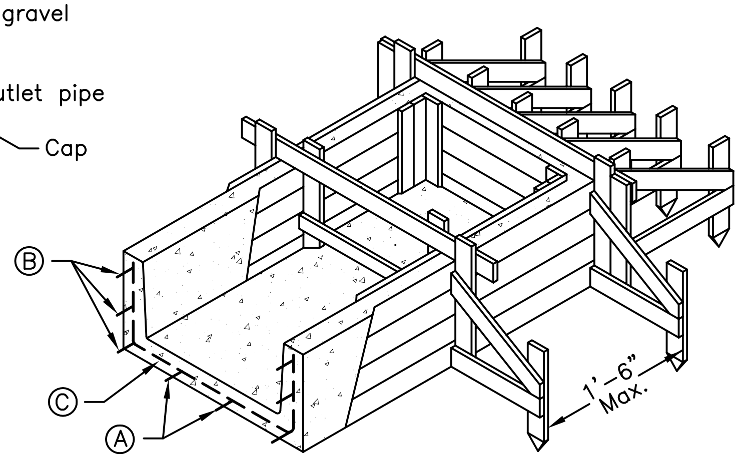


PLAN

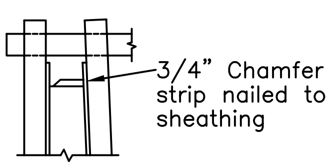
MATERIALS FOR VARYING LEGTHS OF TROUGHS				
Length Feet	Total Steel Length	Total Steel Weight	Concrete Cu. Yds.	Gals. of Water
6	120	80.0	1.15	225
7	135	90.3	1.31	267
8	151	100.9	1.47	310
9	166	110.9	1.63	353
10	182	121.3	1.79	396
11	187	131.8	1.95	459
12	215	142.3	2.11	482
13	228	152.3	2.27	525
14	244	163.0	2.44	560
15	260	173.8	2.73	611
G.I. outlet pipe consists of three 2" Ells, one 2" coupling, one short nipple, one 2" pipe- 2'-3" long, and one 2" pipe 6'-0" to 10'-0" long.				



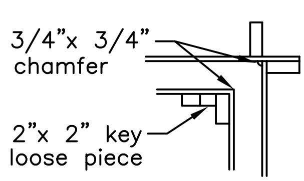
STEEL SCHEDULE			
Type	Location	No.	Bending
A	Floor	2	L-5" ; 2'-1" ⌐ 2'-1"
B	Walls	6	L-5" ; 2'-6" ⌐ 2'-6"
C	Floor & Walls	L+1	3-8 ; 2'-1" ⌐ 2'-1"



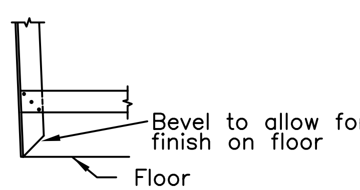
FORM FRAMING



TOP FORM



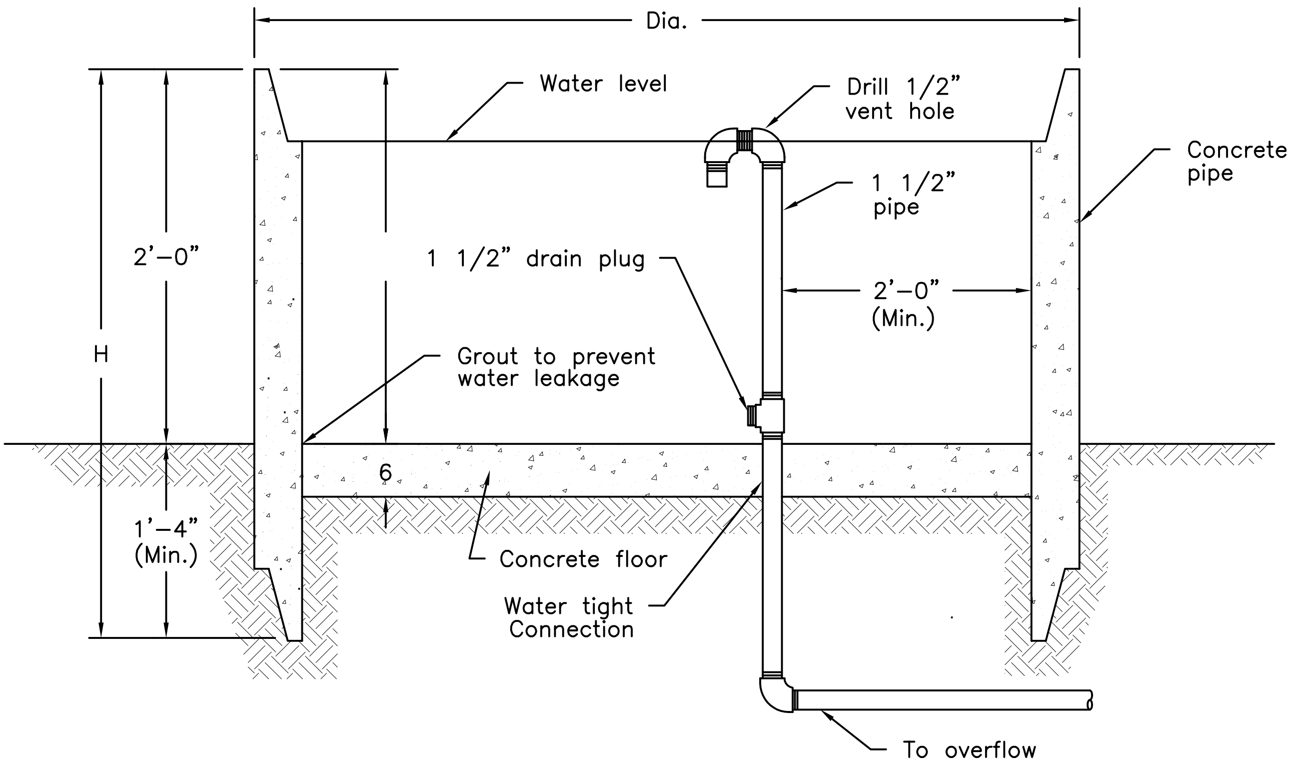
CORNER FORM



INSIDE BRACE

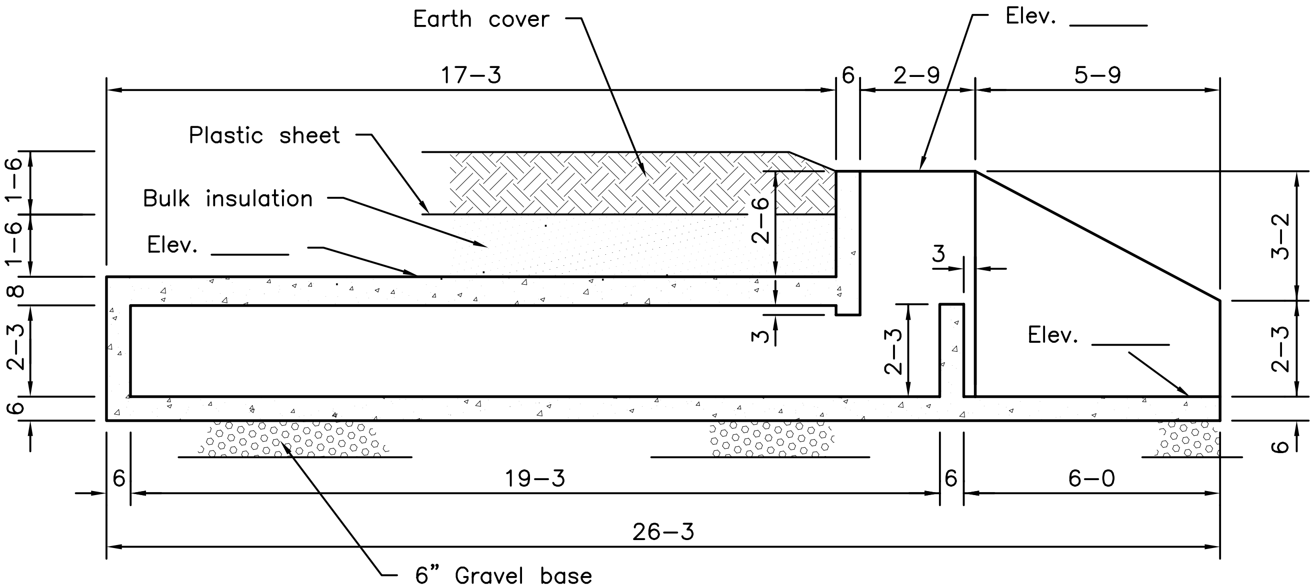
Notes:
1. Unless otherwise shown reinforcing steel shall be #4 bars at 12" C.C. in both directions.
2. Bar splices shall be 30 bar diameters (15 inches).
3. Steel shall not be closer than 3 inches from bottom floor slab or 2 inches from top of floor slab or outside wall surface.

Figure 8.23
TANK MADE FROM CONCRETE PIPE

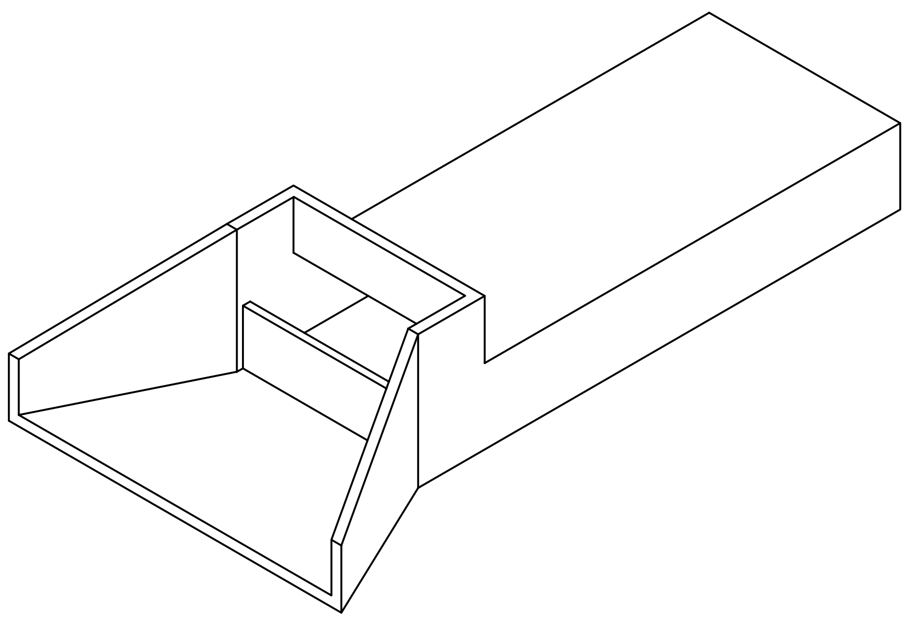


Note:
1. 1 1/2" pipe shall be galvanized steel or other pipe of equivalent strength and durability.
2. Precast concrete pipe or equivalent may be used for the tank.

Figure 8.24
FROST PROOF CONCRETE TANK



SECTION VIEW



ISOMETRIC VIEW

Not to Scale

Fiberglass Tanks

Many stock tanks are now made out of fiberglass. Fiberglass is very resistant to deterioration by chemical attack. It is also light and easy to install. It is however, subject to mechanical damage.

Since fiberglass is so light, wind and animals can easily move it out of place. If a large animal gets into a fiberglass tank, the tank bottom can be damaged and it might be difficult for the animal to get out.

For these reasons, it is important to provide hold downs and protective rails when installing a fiberglass tank.

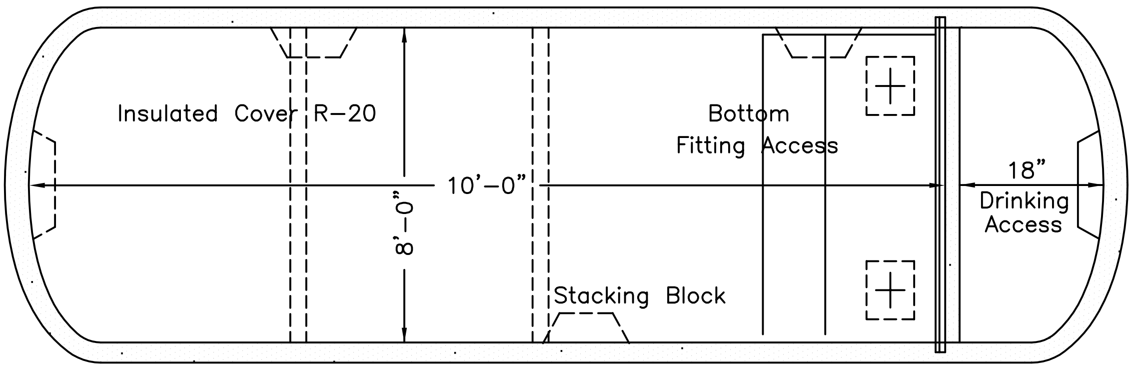
Thickness of fiberglass will determine how resistant the tank is to mechanical damage. It is possible to repair damaged fiberglass, which is one advantage of using this material.

Tank size is limited to what can be transported to the site. Sometimes this limitation is overcome by combining tanks built-up from two or more component parts. Several tanks can also be put together in series to get the total gallons required. Figure 8.25 details a frost free tank made out of fiberglass

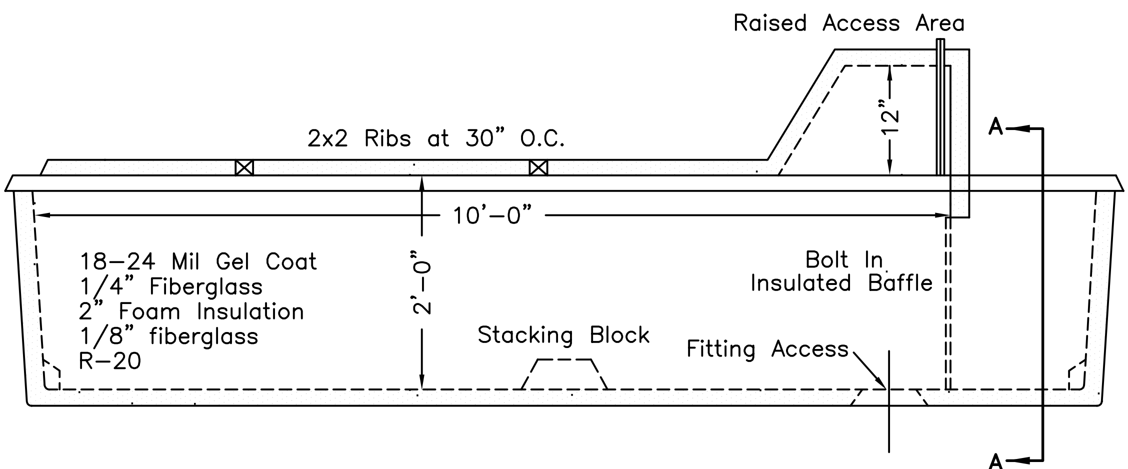
Plastic Tanks

Some tanks and troughs are now being made out of high strength plastics without fiberglass reinforcement. The science of plastics is very complex and it is difficult to know what the life will be of any given plastic formulation and tank configuration. Some companies manufacture tanks out of polyethylene.

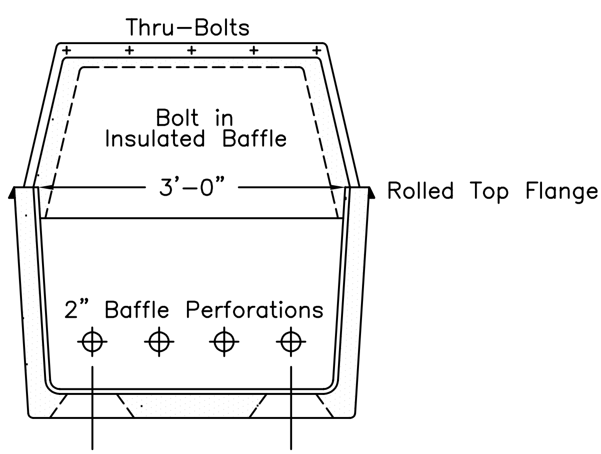
Figure 8.25
FROST FREE FIBERGLASS TANK



PLAN VIEW



ELEVATION



SECTION–AA

Galvanized Steel Tanks

There are generally two kinds of galvanized steel tanks: (1) Those assembled at the site from standard corrugated or formed steel segments and (2) Completely self contained manufactured tanks.

- Stock tanks made from corrugated steel segments large diameter stock tanks are made up of curved corrugated galvanized steel sheets which are bolted together. Mastic is used in the joints. The steel and galvanizing are usually heavy. The bottom of the tank can be made of reinforced concrete, bentonite, heavy plastic liner, or rubber sheeting material. This type of tank will usually last a long time if properly installed and cared for.

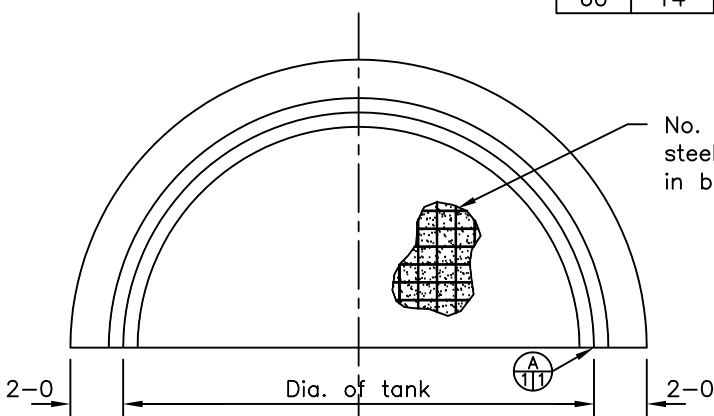
- Manufactured steel stock tanks

  The thickness of steel and galvanizing vary widely in manufactured steel tanks. The tanks are frequently small and made of light gauge steel with minimum galvanizing. As with fiberglass tanks, these must be properly tied down and protected from livestock. Do not use these tanks in locations where water or soil is corrosive to steel.

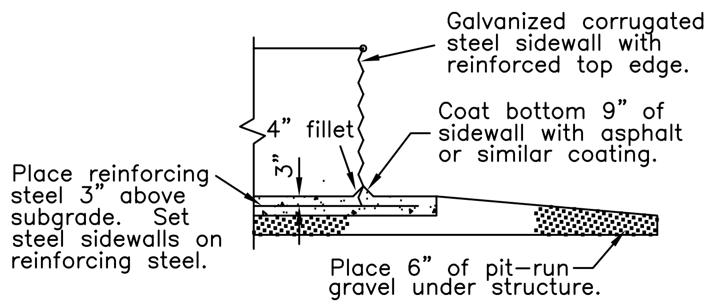
Figure 8.26 details a tank made from corrugated steel plate segments. Figure 8.27 illustrates typical manufactured steel tanks. Figure 8.28 shows a commercially available frost free steel tank which is fabricated from corrugated steel pipe.

Figure 8.26
TANK MADE FROM CORRUGATED STEEL SEGMENTS

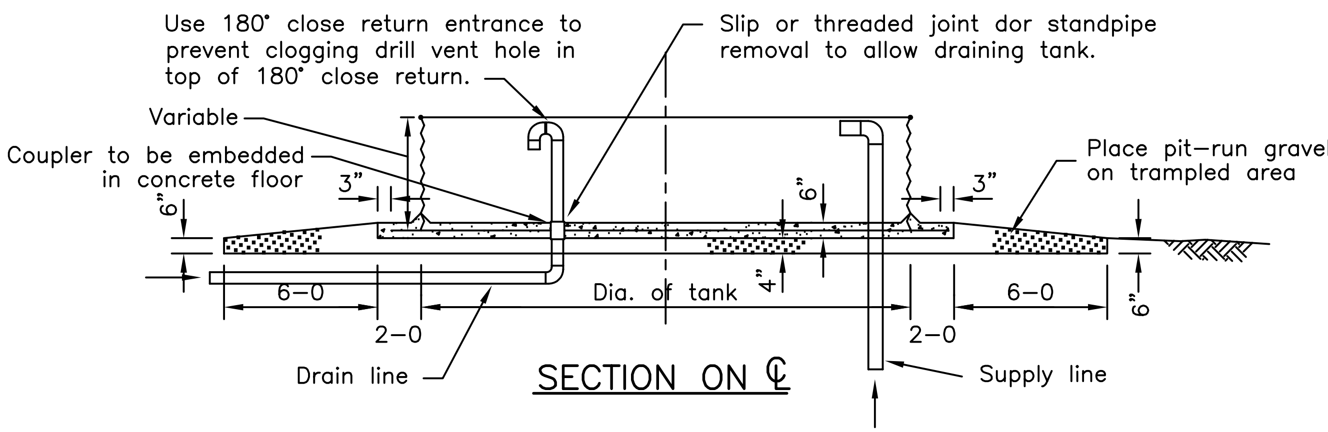
BILL OF MATERIALS					
DIA. (Ft.)	MIN. Gage	CAPACITY (Gal.) Per inch depth	CONCRETE (Cu. Yds.)	REINFORCING STEEL (Lbs.)	GRAVEL (Cu. Yds.)
10	16	589	3.0	245	15
12	16	848	3.9	320	17
14	16	1154	4.9	389	19
16	16	1508	6.0	512	21
18	16	1909	7.2	615	23
20	16	2356	8.7	688	26
22	16	2851	10.1	815	28
24	16	3393	11.7	986	31
25	16	3682	12.5	1030	32
30	16	5301	17.2	1514	40
40	14	9425	28.7	2507	56
50	14	14,726	43.1	3750	75
60	14	21,206	60.4	5285	98



HALF PLAN



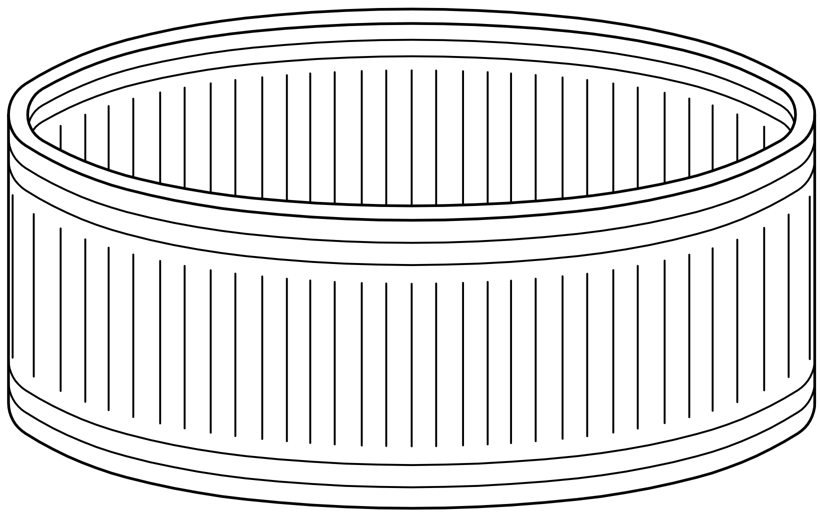
DETAIL A/1



SECTION ON ℄

Notes:
1. Unless otherwise shown reinforcing steel shall be #4 bars at 12" C.C. in both directions.
2. Bar splices shall be 30 bar diameters (15 inches).
3. Steel shall not be closer than 3 inches from bottom floor slab or 2 inches from top of floor slab.

Figure 8.27
MANUFACTURED STEEL TANK



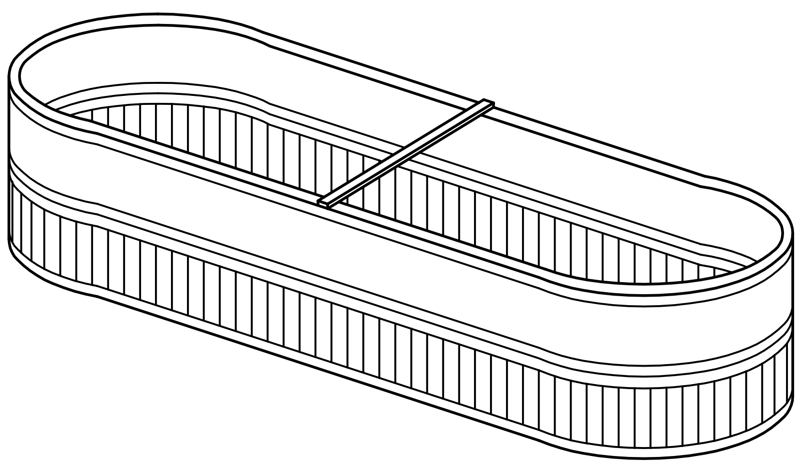
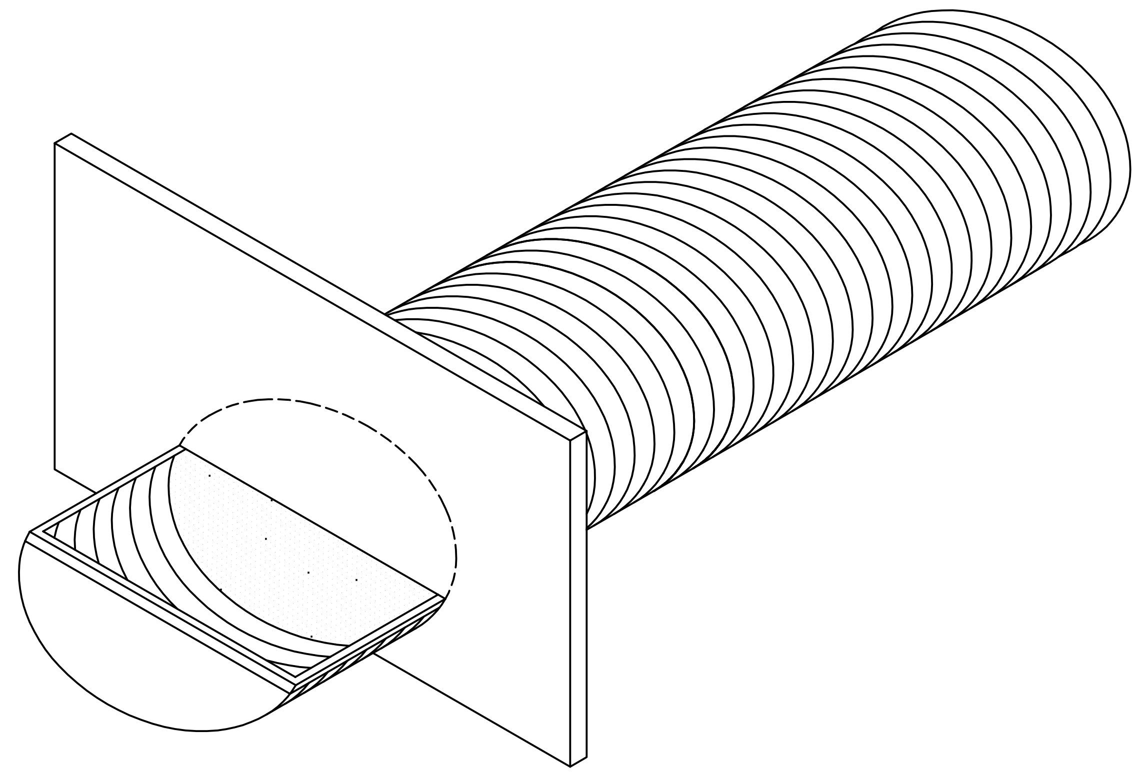


Figure 8.28
FROST FREE STEEL TANK



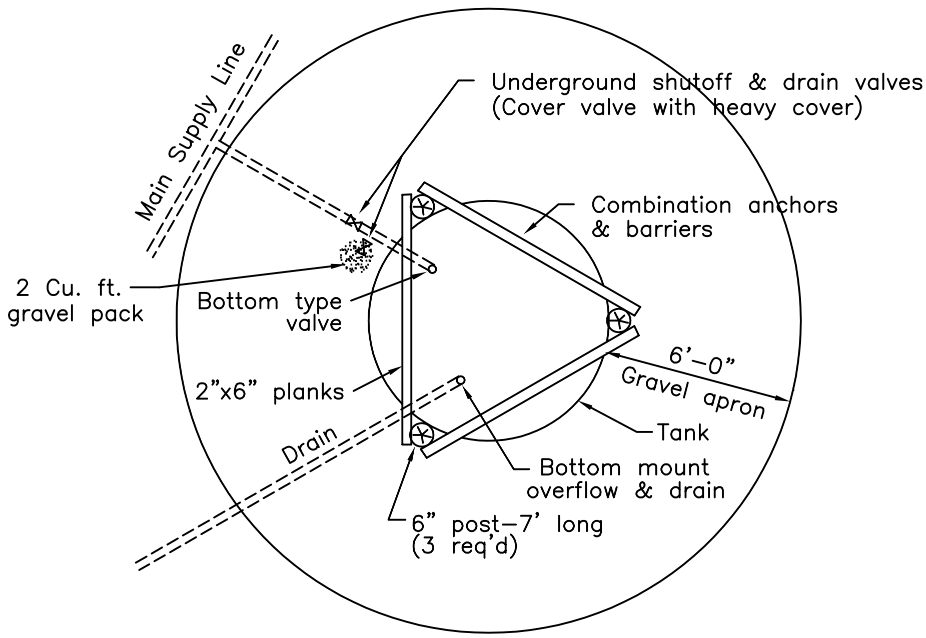
8.7.2 Water Inlet Protection including Float Valves

Water inlets must be protected from mechanical damage by animals and from freezing. One way to do this is to install the inlet under the water at the bottom of the tank. Float valves can be installed below water level with the float floating at the water surface on a chain. Water level valves are also available which are controlled by water depth induced pressure.

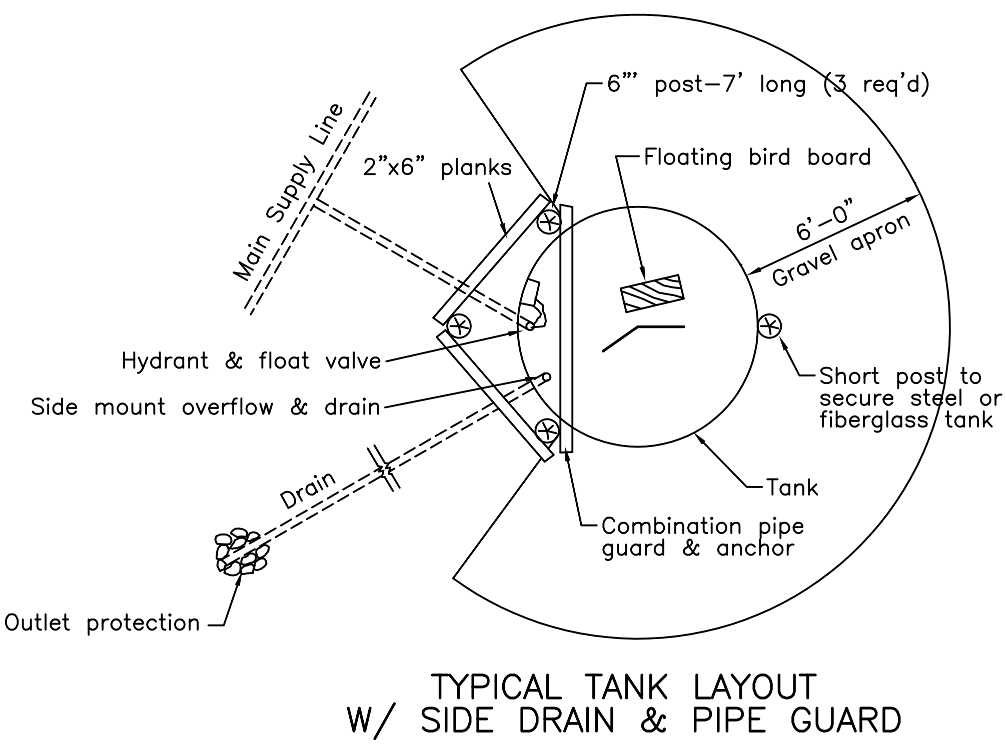
Combination float valves and thermostatically controlled valves are available which will open in the event that temperature of the water gets down to just above freezing. These are installed at the bottom of the tank. The valve opens to provide a constant flow during periods of freezing weather. It is very important to have an adequate overflow system when this type of valve is installed.

Figures 8.29 through 8.31 illustrate commonly used systems of tank and inlet protection.

Figure 8.29
TYPICAL TANK LAYOUT PLANS

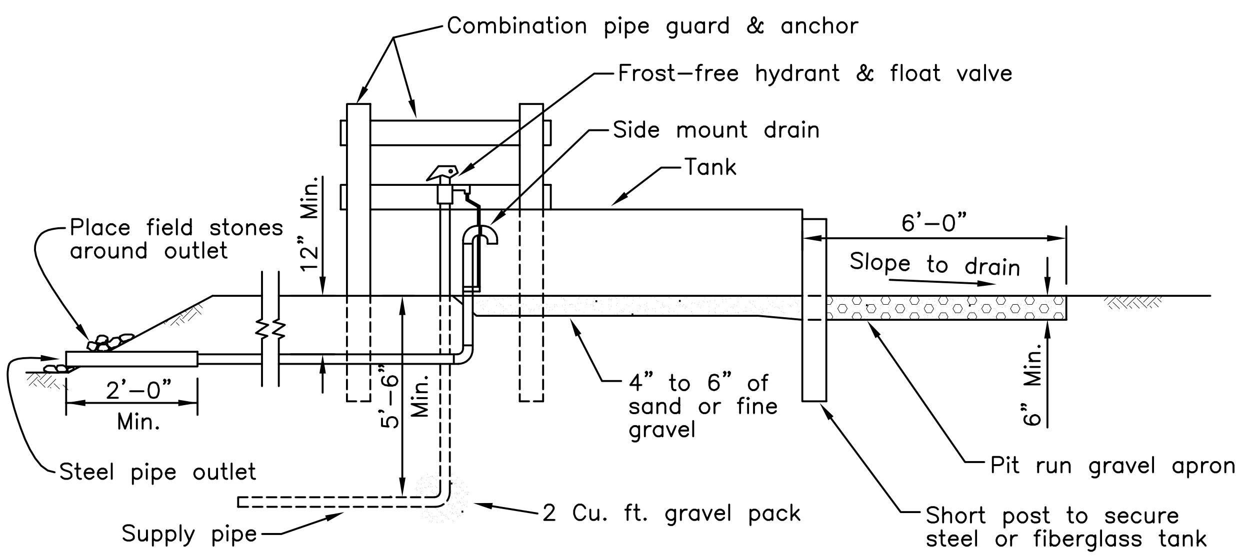


TYPICAL TANK LAYOUT
W/ BOTTOM VALVE & STOCK BARRIER

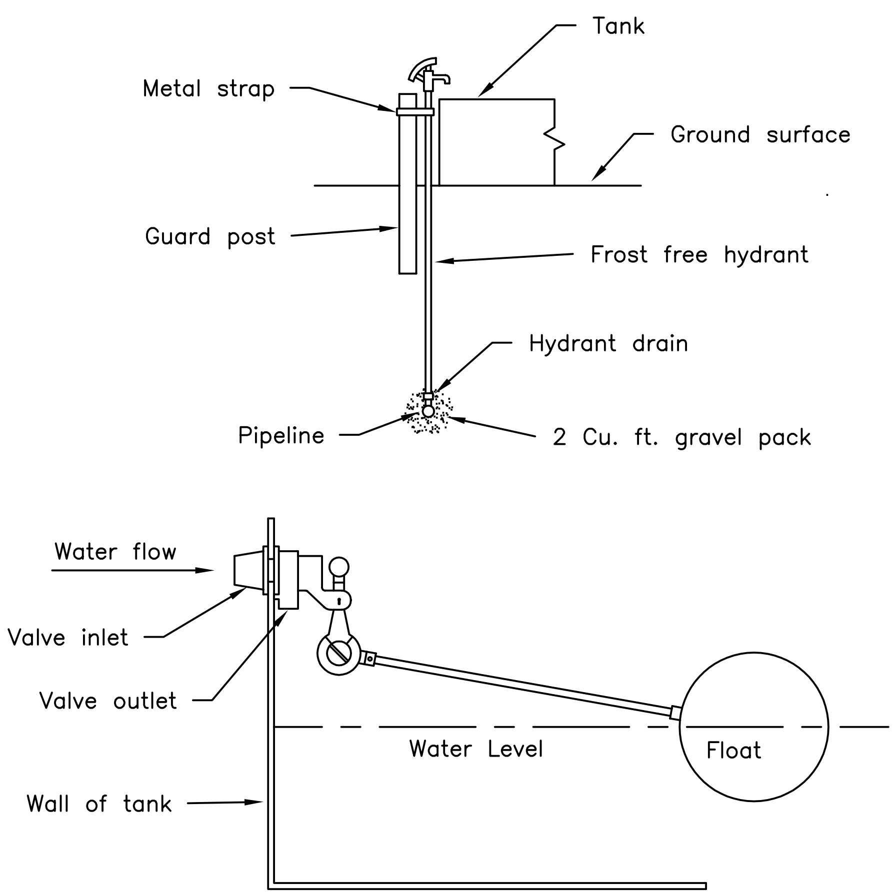


TYPICAL TANK LAYOUT
W/ SIDE DRAIN & PIPE GUARD

Figure 8.30
TANK DETAILS



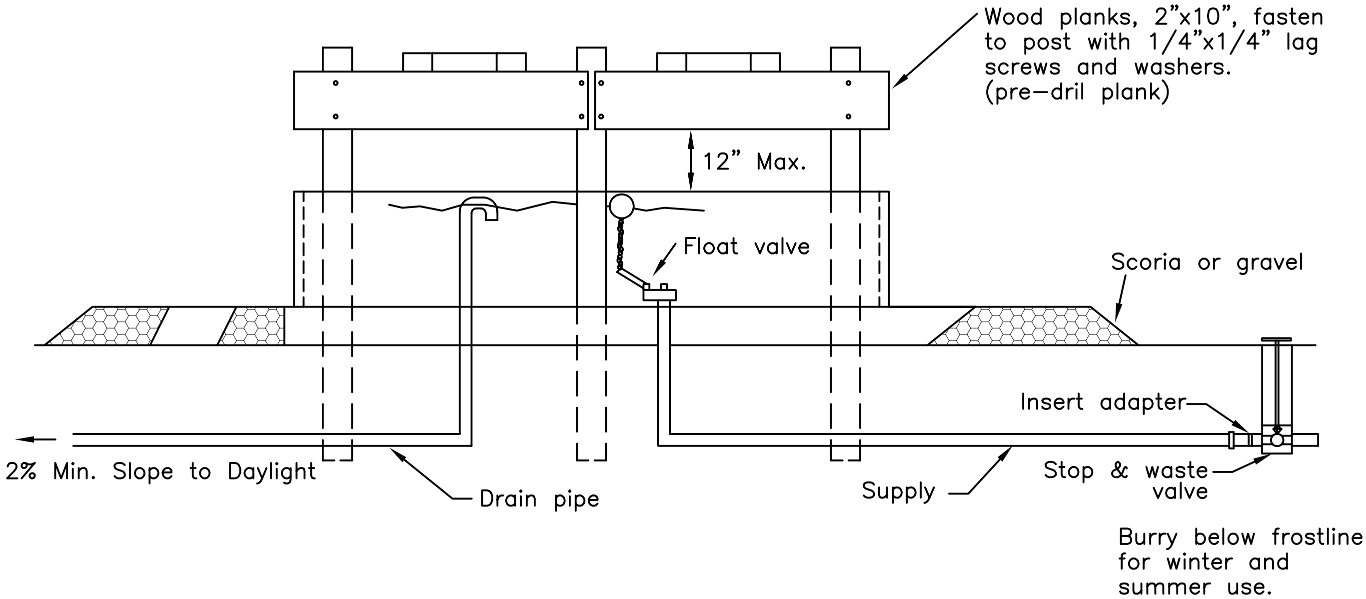
TYPICAL TANK SECTION

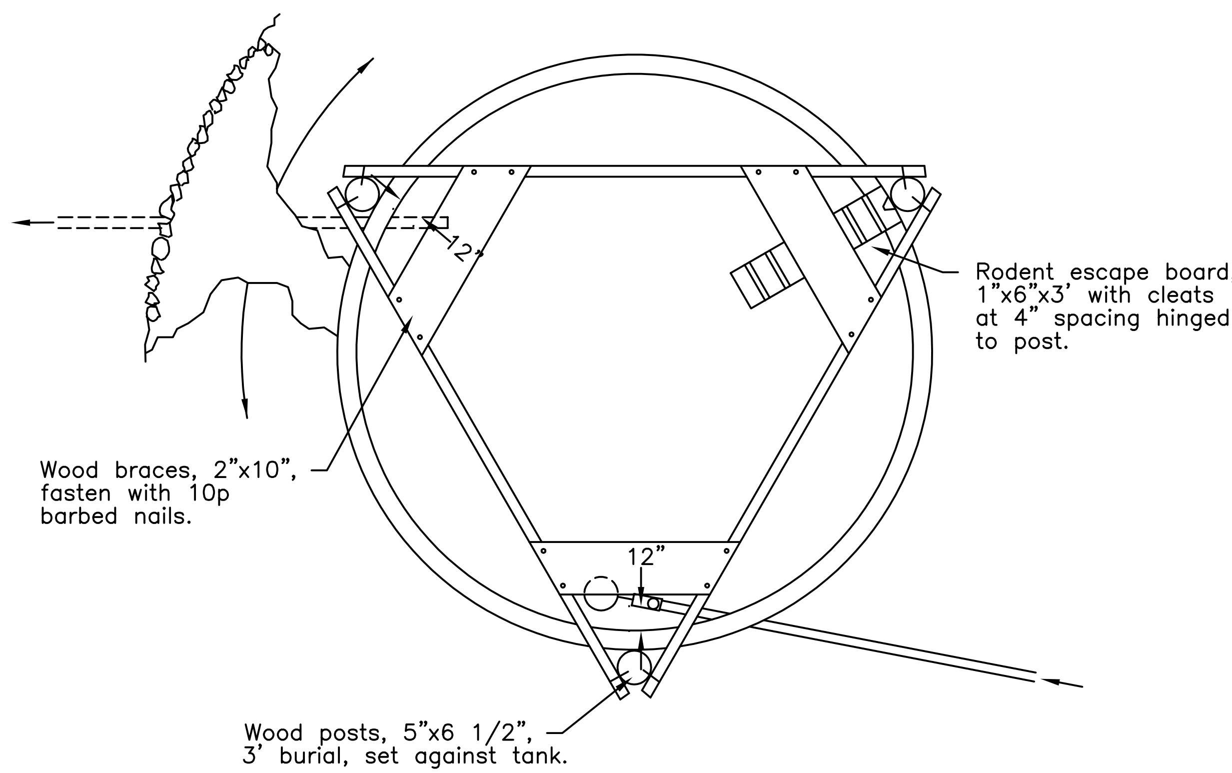


HYDRANT DETAILS

Note:
Alternate inlet shown on Figure 8.31.

Figure 8.31
LAYOUT USING SUBMERGED FLOAT VALVE





8.7.3 Protection Around Tanks

Livestock can wear the ground down around a tank very rapidly, particularly under wet conditions. If the ground is not naturally gravelly, a gravel or concrete base should be installed around the base of the tank. Figures 8.29 through 8.31 show examples of good tank bases.

8.7.4 Tank Overflows

Tank overflows are required when there is no control on the amount of water coming into the tank. They are also highly recommended even when a float valve is used to control flow into the tank. Float valves occasionally do not close properly and an overflow is insurance against damage caused by overflow.

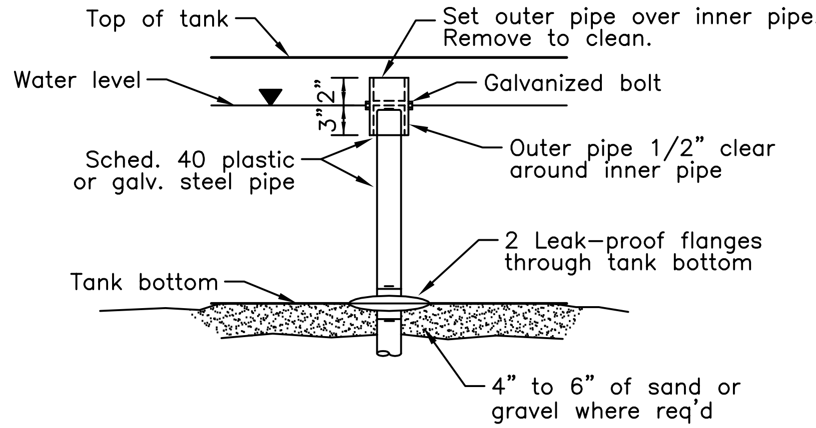
The purpose of an overflow is to carry excess water away so excess water does not make a bog around the tank. The overflow should be long enough to carry the water to a place where it will not cause a problem.

The inlet to the overflow should be constructed at the elevation of water level in the tank. The entrance should be designed so that floating debris, scum and ice will not clog it.

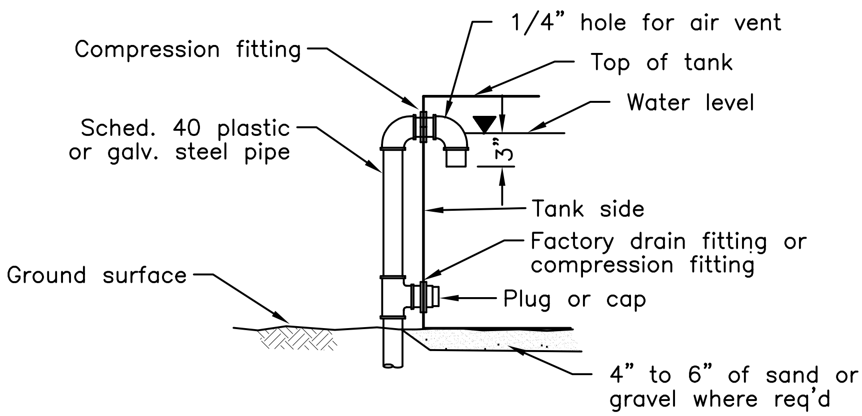
Figure 8.32 illustrates some commonly used overflow inlet systems.

The outlet end of the drain pipe should be protected from being damaged by livestock or from being run over by vehicles. Figure 8.37 shows one way that this can be accomplished.

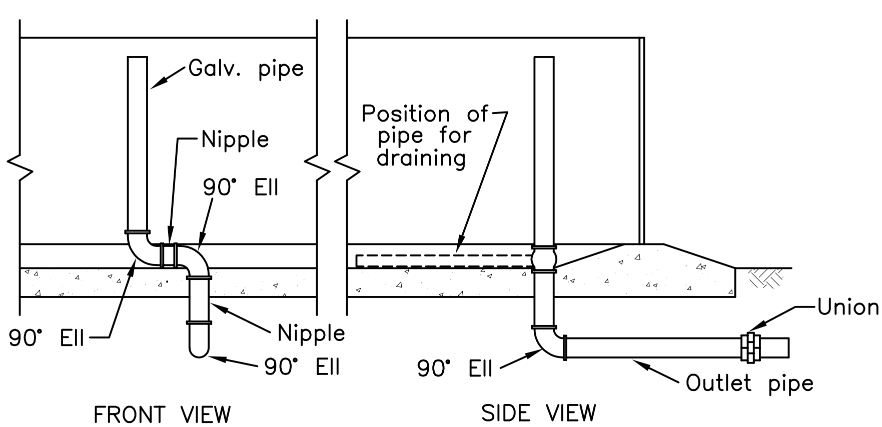
Figure 8.32
OVERFLOWS



TYPICAL BOTTOM MOUNT
OVERFLOW & DRAIN



TYPICAL SIDE MOUNT
OVERFLOW & DRAIN



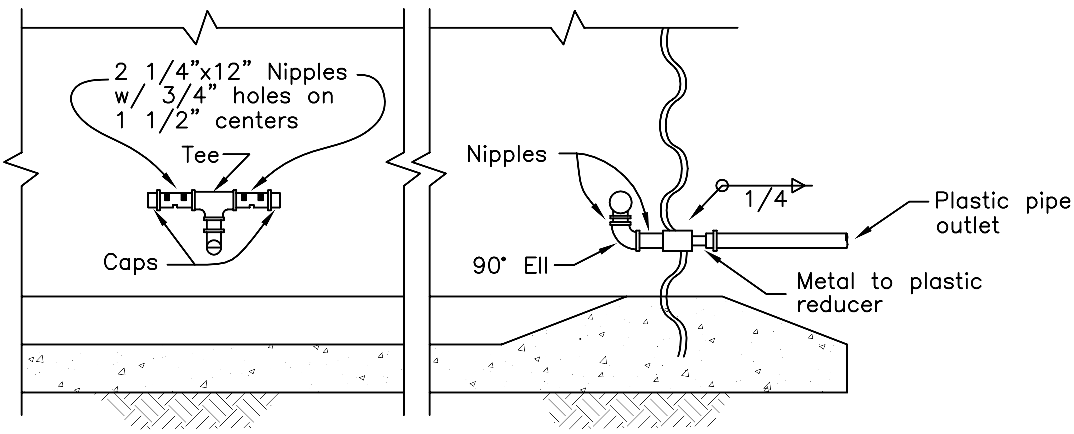
SWIVEL STORAGE TANK OUTLET

8.7.5 Inlet to Pipeline from Tank

When an inlet to a continuing pipeline is located in a tank, some form of inlet screen should be installed. Figure 8.33 illustrates two types of inlet designs.

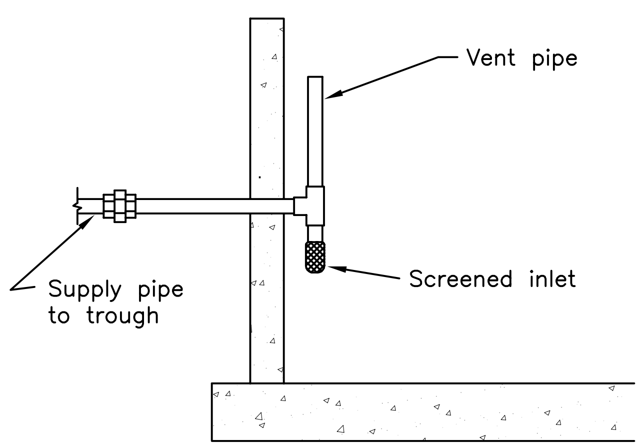
Figure 8.33

PIPELINE TANK INLET



FRONT VIEW SIDE VIEW

STORAGE TANK OUTLET



8.8 STORAGE TANKS

A large storage tank is sometimes used at the highest point in the pipeline as a reservoir to store water for distribution in a gravity pipeline. Another frequent use is for large volume storage for output from springs, windmills, solar pumps and engine powered pumps.

Used railroad tanker cars, used underground fuel storage tanks and other used tanks are sometimes used as storage tanks. These can be a bargain but they must be thoroughly cleaned and properly treated before they can be used. Leaded gasoline and various chemicals may not be adequately cleaned out by steam cleaning. State health regulations must be followed when using such tanks.

If a used tank is not coated on the inside, it will have a limited life, depending on the tanks condition and the corrosiveness of the water.

The site must be accessible enough to be able to move a large tank to the site.

Large diameter steel stock tanks are sometimes used. They have the advantage as being usable as stock tanks as well as for storage. The disadvantage is that they are open at the top and can collect debris and there may be considerable water loss due to evaporation.

Evaporation from large open tanks can be controlled by covering the tank with a floating cover. Floating covers constructed from low-density, closed cell (EPDM) synthetic rubber have proved to work well. The strips of foam are 1/4-inch thick and are glued together with contact cement. Half-inch in diameter bail holes are drilled in the foam to allow rainfall to drain from the surface.

Pits lined with commercial plastic lining material can be used. These must be fenced out to insure animals stay out of the pit. Floating plastic covers held up by floats under the plastic can be used to seal them.

Figure 8.34 depicts a commercial corrugated steel tank. This tank is similar to a grain bin except that it is designed to hold water. It has the advantage of being transportable to remote sites in pieces.

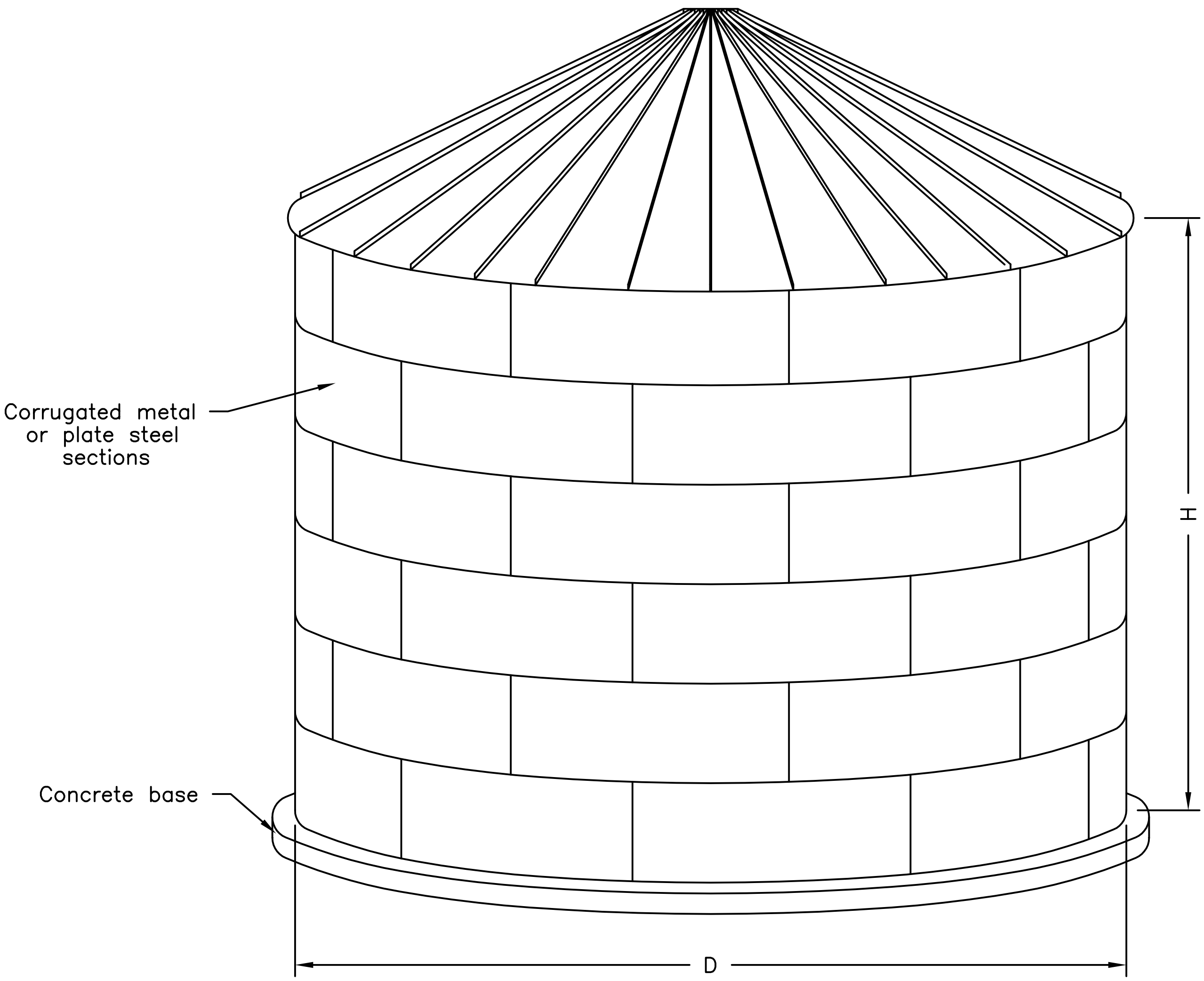
Figure 8.35 illustrates typical plans for a tank fabricated from sheet steel. The inside should be epoxy coated. The outside would be coated with coal tar material or epoxy. Cathodic protection may be needed depending on the corrosivity of the soil.

Figure 8.36 illustrates a large steel tank constructed out of corrugated structural plates.

Figure 8.37 depicts one type of fiberglass storage tank.

Figure 8.38 illustrates a storage bag-type installation. A large rubberized fabric or plastic water storage bag is used for long-term storage. Figure 8.38 depicts such a bag used in conjunction with a water harvesting catchment system. This type of system can be used in remote areas where no other source of water is available and where it would cost too much to construct a pipeline from another area.

Figure 8.34
COMMERCIAL STEEL WATER STORAGE TANK



$$\text{Capacity} = \frac{\pi}{4}(D)^2 \times H \text{ (Cubic Ft.)} \times 7.5 \text{ gallons per cubic ft.}$$

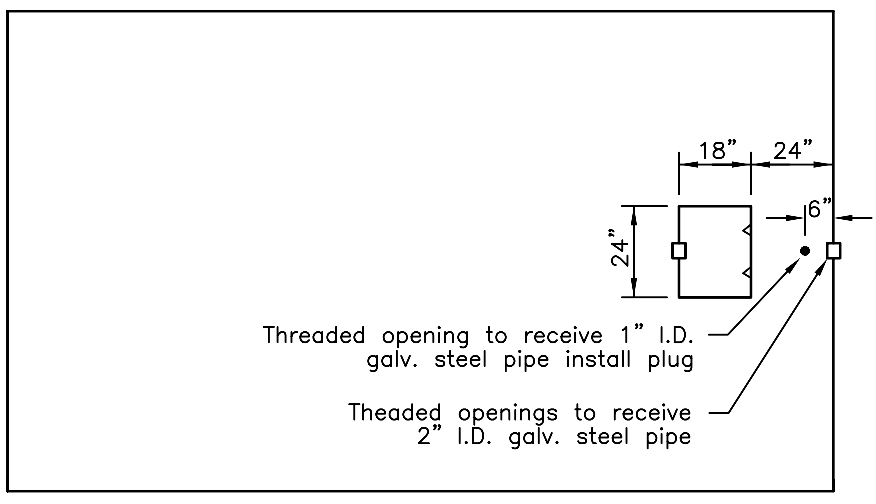
D=Diameter of tank (in feet)
H=Height of tank (in feet)

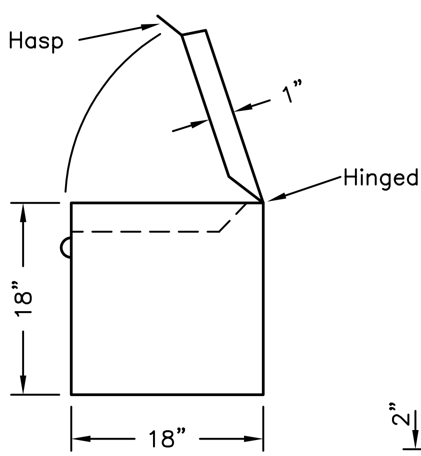
Notes:
1. Gage of metal and coating to be as recommended by manufacturer.
2. All joints shall be watertight. All joints shall be welded or bolted as recommended by manufacturer.

Figure 8.35
FABRICATED STEEL STORAGE TANK

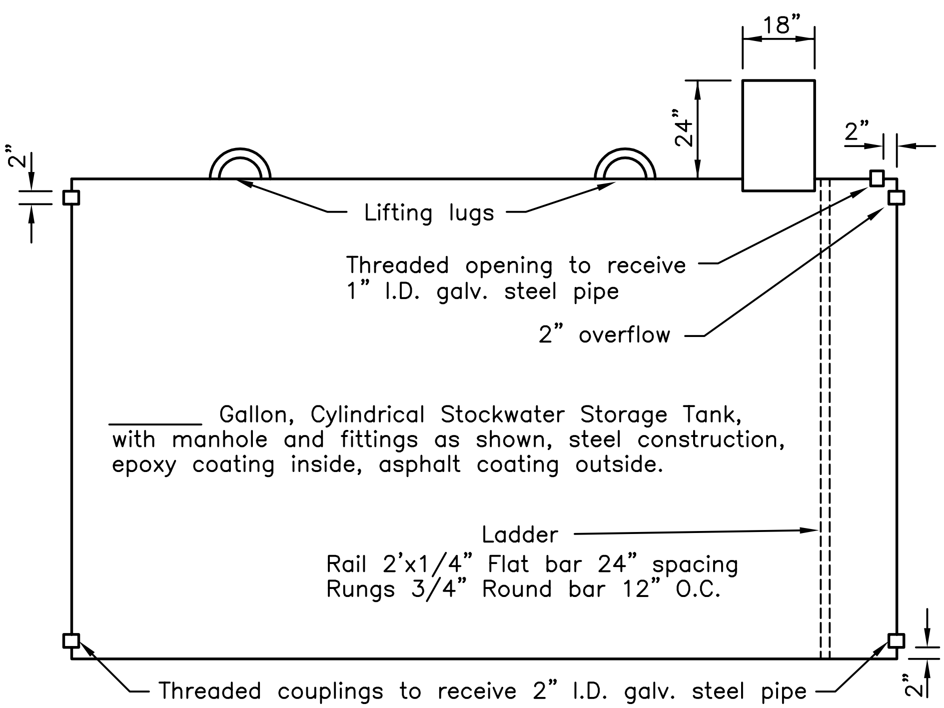
TANK SIZE			
Size (Gallons)	Diameter		Length
550	4'	x	6'
1000	4'	x	11'
2000	6'	x	12'
5000	8'	x	14'
6000	8'	x	16'
8000	8'	x	21'
10000	9'	x	21'
12000	9'	x	25'

STEEL GAUGE	
Gallons	Gauge Min.
to 560	12
561–1100	10
1101–4000	3/16"
4001–12000	1/4"
12001–20000	5/16"





Manhole Lid Detail



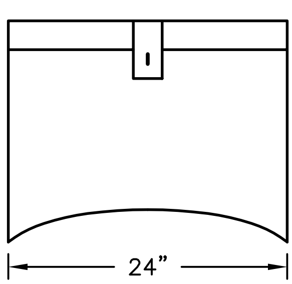
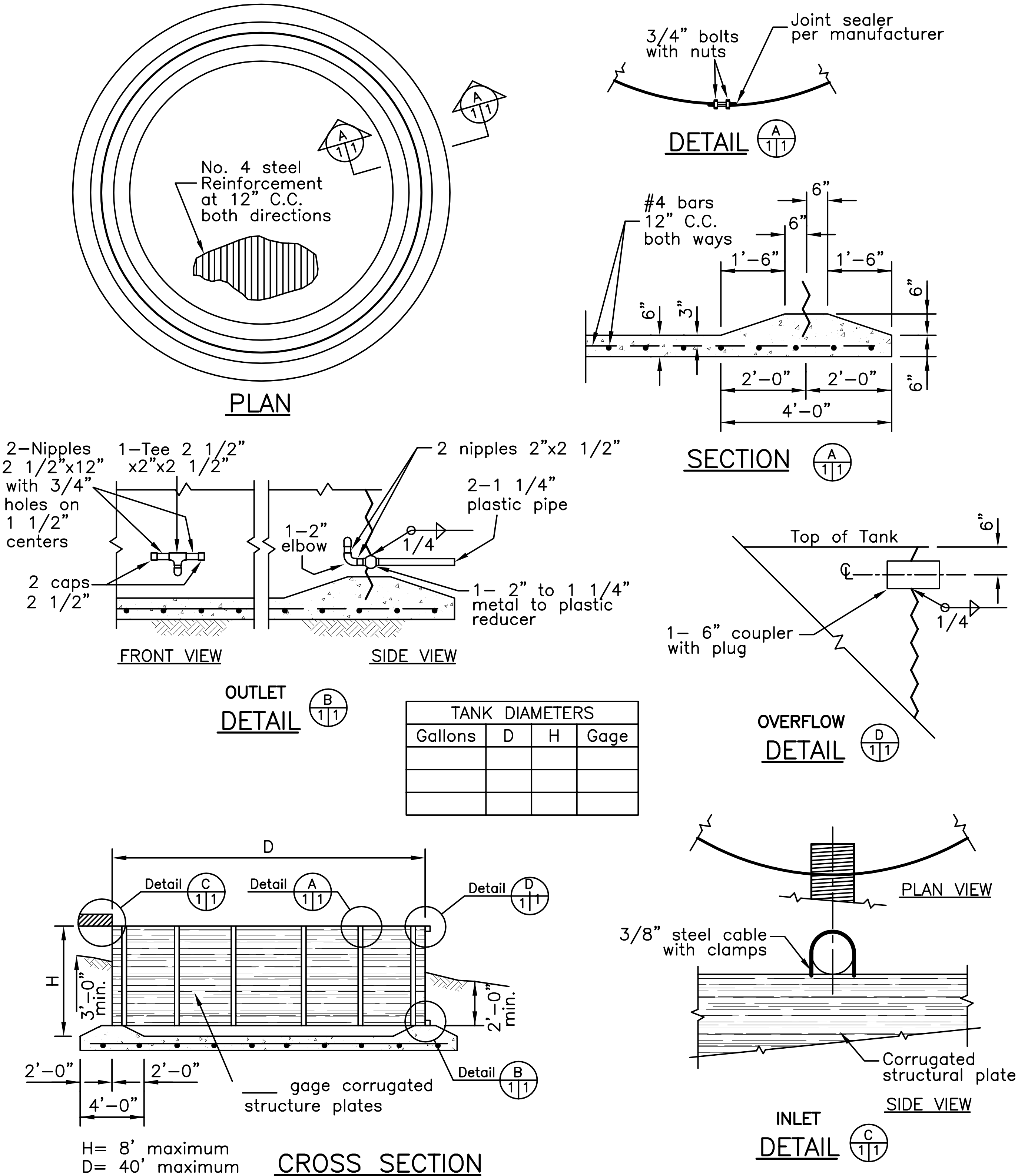


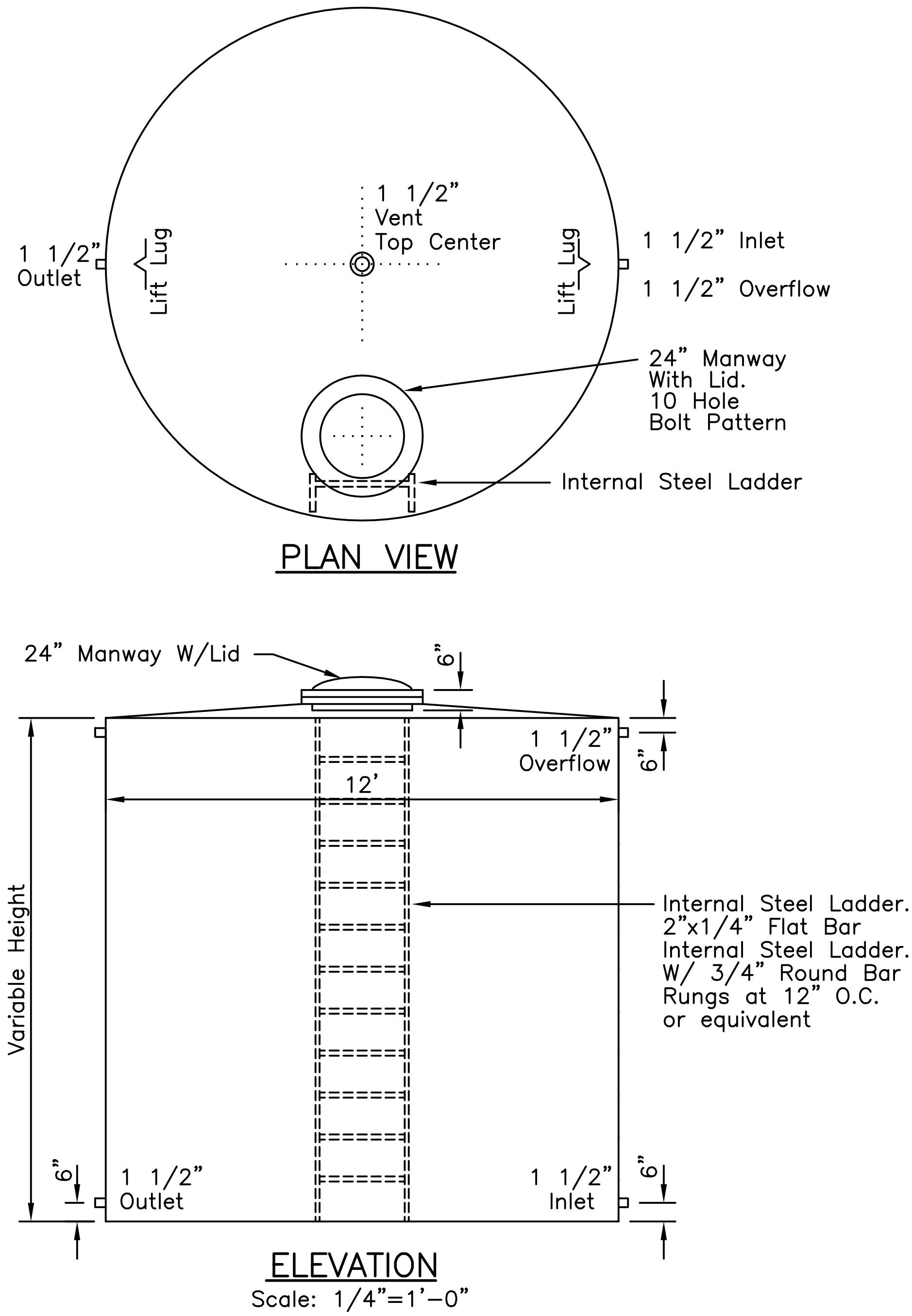
Figure 8.36
CONSTRUCTED CORRUGATED STEEL STORAGE TANK



TANK DIAMETERS			
Gallons	D	H	Gage

Notes:
1. Unless otherwise shown reinforcing steel shall be #4 bars at 12" C.C. in both directions.
2. Bar splices shall be 30 bar diameters (15 inches).
3. Steel shall not be closer than 3 inches from bottom floor slab or 2 inches from top of floor slab.

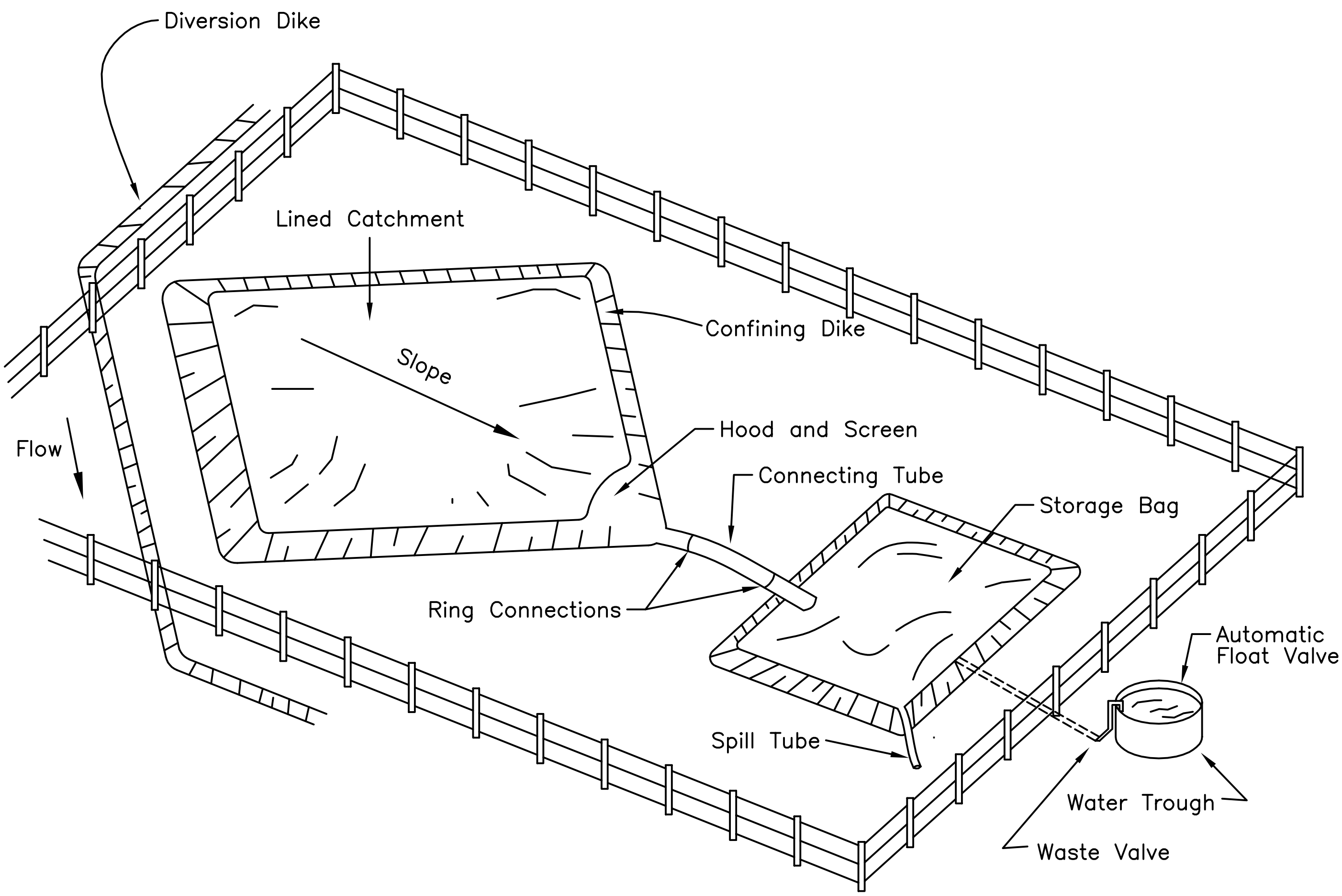
Figure 8.37
FIBERGLASS STORAGE TANK

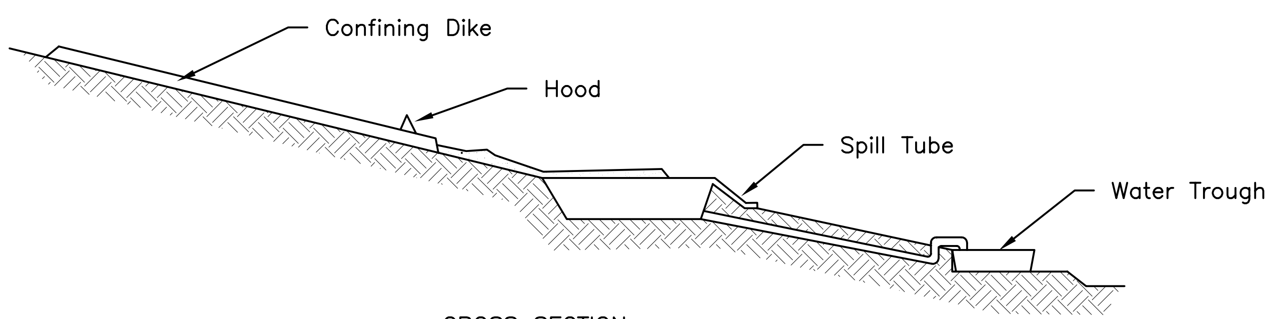


WALL THICKNESS TABLE

Distance From Top in Feet	Tank Diameter in Feet														
	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	7	8	9	10	11	12
	Wall Thickness in Inches														
2	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16
4	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16
6	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	1/4	1/4	1/4
8	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	3/16	1/4	1/4	1/4	1/4	1/4	1/4
10	3/16	3/16	3/16	3/16	3/16	3/16	3/16	1/4	1/4	1/4	1/4	1/4	5/16	5/16	5/16
12	3/16	3/16	3/16	3/16	3/16	1/4	1/4	1/4	1/4	1/4	5/16	5/16	5/16	5/16	3/8

Figure 8.38
WATER HARVESTING SYSTEM USING
RUBBERIZED FABRIC STORAGE BAG



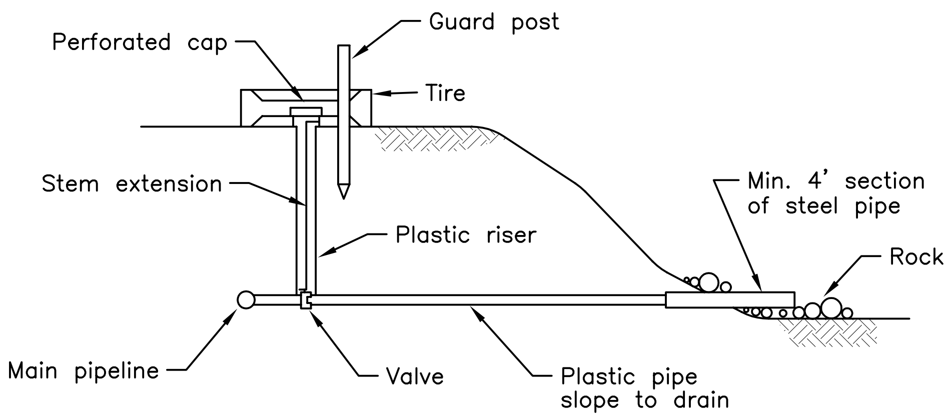


CROSS SECTION

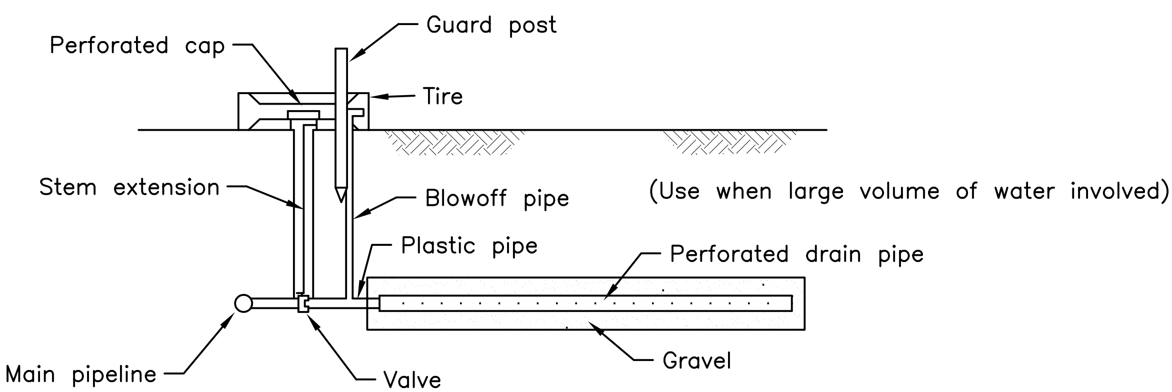
8.9 PIPELINE DRAINS

Pipeline drains are required at all low spots in pipelines that are subject to freezing. They are also sometimes installed in frost free pipelines where it is desired to have the ability to drain a pipeline for maintenance. When it is not possible to drain a pipeline by gravity, a blind drain or pumpout drain is required. Figure 8.39 illustrates typical drain details.

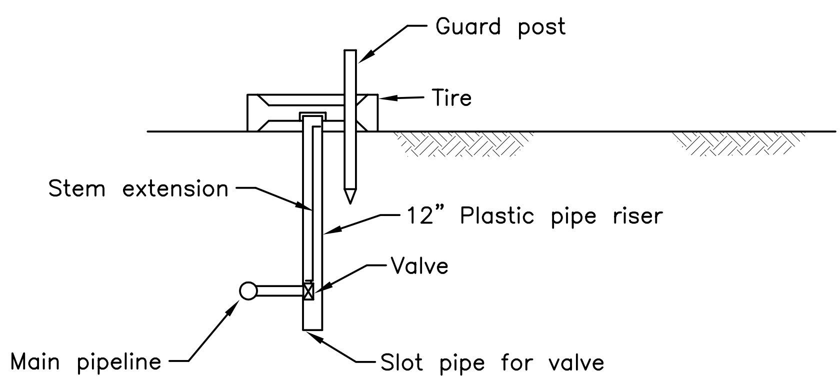
Figure 8.39
PIPELINE DRAINS



GRAVITY DRAIN



BLIND DRAIN



PUMPOUT