INTAKES FOR COLLECTING SURFACE WATER:

The main function of the intakes works is to collect water from the surface source and then discharge water so collected, by means of pumps or directly to the treatment water. Intakes are structures which essentially consist of opening, grating or strainer through which the raw water from river, canal or reservoir enters and carried to the sump well by means of conducts water from the sump well is pumped through the rising mains to the treatment plant.

The following points should be kept in mind while selecting a site for intake works.

1. Where the best quality of water available so that water is purified economically in less time.

2. At site there should not be heavy current of water, which may damage the intake structure.

3. The intake can draw sufficient quantity of water even in the worst condition, when the discharge of the source is minimum.

4. The site of the work should be easily approachable without any obstruction

5. The site should not be located in navigation channels

6. As per as possible the intake should be near the treatment plant so that conveyance cost is reduced from source to the water works

7. As per as possible the intake should not be located in the vicinity of the point of sewage disposal for avoiding the pollution of water.

8. At the site sufficient quantity should be available for the future expansion of the water-works.

Types of Intake structures:

Depending upon the source of water the intake works are classified as following

1. Lake Intake

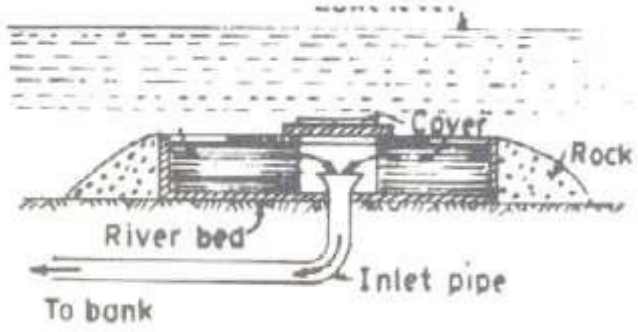
2. Reservoir Intake

3. River Intake

4. Canal Intake

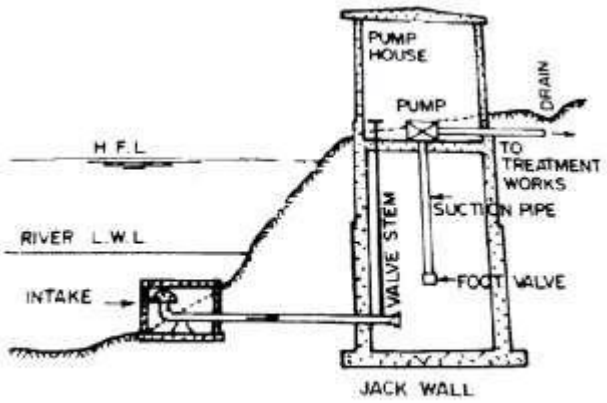
1. LAKE INTAKE:

For obtaining water from lakes mostly submersible intakes are used. These intakes are constructed in the bed of the lake below the water level; so as to draw water in dry season also. These intakes have so many advantages such as no obstruction to the navigation, no danger from the floating bodies and no trouble due to ice. As these intakes draw small quantity of water, these are not used in big water supply schemes or on rivers or reservoirs. The main reason being that they are not easily approachable for maintenance.



2. RIVER INTAKE:

Water from the rivers is always drawn from the upstream side, because it is free from the contamination caused by the disposal of sewage in it. It is circular masonary tower of 4 to 7 m in diameter constructed along the bank of the river at such place from where required quantity of water can be obtained even in the dry period. The water enters in the lower portion of the intake known as sump well from penstocks.

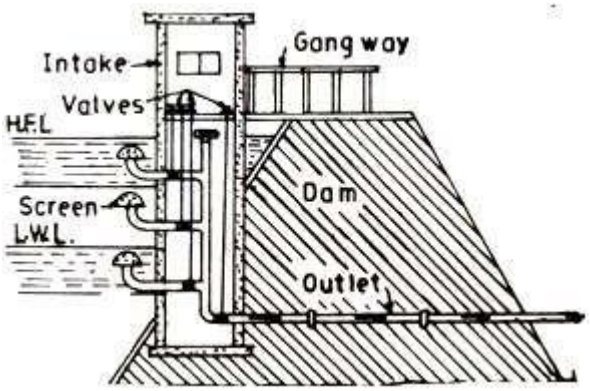


River Intake

3. RESERVOIR INTAKE:

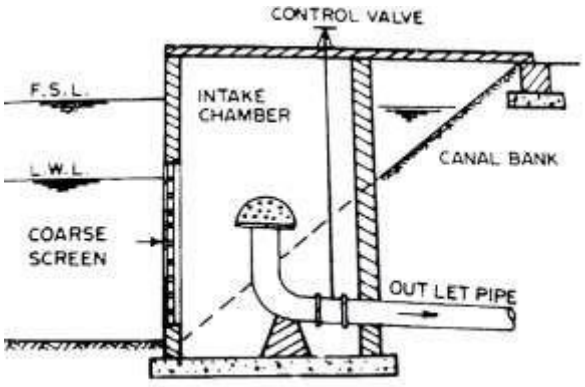
It consists of an intake well, which is placed near the dam and connected to the top of dam by foot bridge. The intake pipes are located at different levels with common vertical pipe. The valves of intake pipes are operated from the top and they are installed in a valve room. Each intake pipe is provided with bell mouth entry with perforations of fine screen on its surface. The outlet pipe is taken out through the body of dam. The outlet pipe should be suitably supported. The location of intake pipes at different levels

ensures supply of water from a level lower than the surface level of water. When the valve of an intake pipe is opened the water is drawn off from the reservoir to the outlet pipe through the common vertical pipe. To reach upto the bottom of intake from the floor of valve room, the steps should be provided in Zigzag manner.



4. CANAL INTAKE:

An intake chamber is constructed in the canal section. This results in the reduction of water way which increases the velocity of flow. It therefore becomes necessary to provide pitching on the downstream and upstream portion of canal intake. The entry of water in the intake chamber takes through coarse screen and the top of outlet pipe is provided with fine screen. The inlet to outlet pipe is of bell-mouth shape with perforations of the fine screen on its surface. The outlet valve is operated from the top and it controls the entry of water into the outlet pipe from where it is taken to the treatment plant.



Canal Intake

CONDUITS FOR WATER:

Conduit, channel or pipe for conveying water or other fluid or for carrying out certain other purposes, such as protecting electric cables.

Various types of conduits

Depending upon the conditions and characteristics of flow, the conduits may be divided into i) Gravity conduits ii) Pressure conduits

Gravity conduits are those in which the water flows under the mere action of gravity. In such a conduit, the gradient line will coincide with the water surface and will be parallel to the bed of the conduit. In such a there is no pressure term in Bernoulli's equation.

Gravity conduits can flow the water is all along at atmospheric pressure and be in the form of canals, flumes and aqueducts.

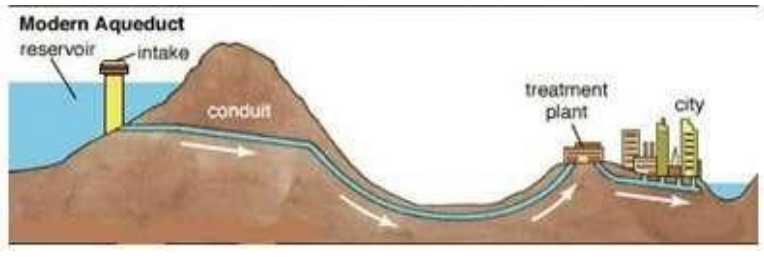
In pressure conduits, which are closed conduits and as such no air can enter into them, the water flows under pressure above the atmospheric pressure. The hydraulic gradient line for such a conduit can be obtained by joining the water surface elevations in the piezometers installed in the conduit at various places.

FLUMES:

A flume is man-made channel for water, in the form of an open inclined gravity chute whose walls are raised above the surrounding terrain.Used for the diversion of a stream of water from a river for purposes of irrigation

AQUEDUCT:

Closed – rectangular or Circular or horse shoe section built of masonry or R.C.C.They are generally designed as ½ or 3/4th full. When designed as grade aqueducts, should not made to run full under pressure. Because of tension developed – open out joints of masonry work endangering structural stability – causing serious leakage.



Pressure Conduit:

Closed conduits – no air can enter into it. Water flows under pressure above the atmospheric pressure. Pressure pipes follow the natural available ground surface. Moves freely up and down hills or can dip beneath valleys or mountains. Pressure aqueducts / Pressure tunnels – closed pipes or closed aqueducts and tunnels. Circular in shape always – Hydraulic and structural reason. Due to Circular shape – pressure conduits are termed as Pressure pipe. Pressure pipe – drops beneath a valley, stream or some other depression – So called Sag / Depressed pipe / Inverted siphon.

Hydraulics of Flow in Pipes:

There are many basic principles that must be considered when preparing the hydraulic profile through the plant.The hydraulic profiles are prepared at peak and average design flows and at minimum initial flow.The hydraulic profile is generally prepared for all main paths of flow through the plant. The head loss through the treatment plant is the sum of head losses in the treatment units and the connecting piping and appurtenances.

The head losses through the treatment unit include the following:

- Head losses at the influent structure.
- Head losses at the effluent structure.
- Head losses through the unit.

The total loss through the connecting piping's, channels and appurtenances is the sum of following:

- Head loss due to entrance.
- Head loss due to exit.
- Head loss due to contraction and enlargement.
- Head loss due to friction.
- Head loss due to bends, fittings, gates, valves, and meters.

Hydraulic Design:

The design of water supply conduits depends on the resistance to flow, available pressure or head, and allowable velocities of flow. Allowable velocity is normally between 0.9 m/sec to 1.5 m/sec but velocity of 3 m/sec to 6 m/sec can be resisted by the commonly available pipe materials.

The Head loss caused by pipe friction can be found by using either of the following formulae:

Darcy – Weisbach formula:

$$H_L = \frac{f' L V^2}{d\, 2g}$$

H_L=Head Loss in metres

L = Length of pipe in metres

d = Diameter of the pipe in metres

V = Mean velocity of flow through the pipe in m/sec

g = Acceleration due to gravity

f ' = Dimensionless friction factor generally varying between 0.02 (for new smooth pipes) to (old rough pipes) and depends upon Reynold number.

Manning's formula:

$$H_L = \frac{n^2 V^2 L}{R^{4/3}}$$

HL = Head loss in metres

n = Manning's rugosity coefficient

L = Length of pipes in metres

V = Mean velocity of flow through pipe in m/sec

R = Hydraulic mean depth of pipe (metres)

$$R = \frac{A}{P} = \frac{\frac{\pi d^2}{4}}{\pi d} = \frac{d}{4}$$

Hazen-William's formula:

$$V = 0.85 C_H . R^{0.63} . S^{0.54}$$

V = Mean velocity of flow through pipes in m/sec

R = Hydraulic mean depth of pipe (metres)

R =S = Slope of the energy line = HL/L

CH = Coefficient of hydraulic capacity Smoother the pipe – greater the CH value.

$$\frac{A}{P} = \frac{\frac{\pi d^2}{4}}{\pi d} = \frac{d}{4}$$

PIPES AND REQUIREMENTS:

Pipes convey raw water from the source to the treatment plants in the distribution system. Water is under pressure always and hence the pipe material and the fixture should withstand stresses due to the internal pressure, vaccum pressure, when the pipes are empty, water hammer when the values are closed and temperature stresses.

Requirements of pipe material:

1. It should be capable of withstanding internal and external pressures
2. It should have facility of easy joints
3. It should be available in all sizes, transport and erection should be easy.
4. It should be durable
5. It should not react with water to alter its quality
6. Cost of pipes should be less
7. Frictional head loss should be minimum.
8. The damaged units should be replaced easily.

Pipeline materials:

1. Cast iron
2. Wrought iron
3. Steel
4. Galvanized iron
5. Cement concrete
6. Asbestos cement
7. Plastic
8. Copper
9. Lead

1. Cast iron pipe

Cast iron pipes are used i n great majority of water in distribution mains because of centuries of satisfactory experience with it. Cast –iron pipe is resistant to corrosion and accordingly is long lived –its life may be over 100 years. Cast iron pipes are manufactured by two methods (i) ordinary sand moulding process (ii) centrifugal process.

Advantages of C.I pipes

- C.I pipes are of moderate cost.
- Their jointing is easier.
- They are resistant to corrosion

- They have long life.

Dis -advantages

- They are subject to tuberculation in certain waters, due to which their carrying Capacity is reduced to as much as 70%.
- They are heavier and hence uneconomical when their diameter is more than 120cm.
- They cannot be used for pressures greater than 7 Kg/cm2
- They are fragile.

2. Wrought iron pipe

Wrought iron pipes are manufactured by rolling flat plates of the such pipes are much lighter than the C.I pipes and can be more easily cut , threaded and worked. They look much neater, but are much costlier.

3. Steel pipes

Steel pipes of small diameter can be made from the solid, but the larger sizes are made by riveting together the edges of suitably –curved plates, the sockets being formed later in a press. The joints may be either transverse or longitudinal or transverse and spiral.

4. Galvanized Iron pipes

- The pipes are cheap
- Light in weight and easy to handle
- The pipes are easy to join

Disadvantage

- The pipes are affected by acidic or alkaline waters
- The useful life of pipes is short about 7 to 10 years.

5. Cement concrete pipes

Cement Concrete pipes may be either plain or reinforced and are best made by spinning process. They may be either pre-cast, or may be prepared at the site. The plain cement concrete pipes are used for heads up to 7 m while reinforced cement concrete pipes are normally used for heads 60 m.

Advantages

- They are more suitable to resist the external loads due to backfilling.
- They maintenance cost is low
- The inside surface of pipes can be made smooth,thus reducing the frictional losses.
- The problem of corrosion is not here.

- Pipes can be cast at site, and hence the transportation problems are reduced.
- Due to their heavy weight, the problem of floatation is not here when they are empty.

Disadvantages

- Un-reinforce d pipes are liable to tensile cracks, and they cannot withstand high pressure.
- The tendency of leakage is not ruled out as a result of its porosity and shrinkage cracks.
- It is very difficult to repair them.
- Pre-cast pipes are very heavy, and it is difficult to transport them.

6. Asbestos cement pipes

Asbestos cement pipes are manufactured from asbestos fiber and Portland cement combined under pressure to form a dense homogenous structure having strong bond between cement and the fiber. Such a pipe is claimed to be completely impervious to passage of water through its walls.

Advantages

- They have smooth internal surface, due to which the frictional losses are reduced.
- They are light and can be easily transported.
- They can be easily cut, fitted or jointed.
- Service connections can be easily taken, since they can be easily drilled and tapped
- They are anti-corrosive.

Disadvantages

- They are soft and brittle. they are very weak under impact loading due to moving traffic.
- They are cannot be laid in exposed places.
- They are not durable.
- They are costly.

7. P.V.C. Pipes

- Pipes are cheap

- The pipes are durable
- The pipes are flexible
- The pipes are free from corrosion
- The pipes are good electric insulators
- The pipes are light in weight and it can easy to mould any shape

Disadvantage

- The co-effcient of expansion for plastic is high
- It is difficult to obtain the plastic pipes of uniform composition
- The pipes are less resistance to heat
- Some types of plastic impart taste to the water.

8.Copper pipes

- Widely used for service connections

Advanatgaes

- Cheap, light in weight and easy to handle and transport.
- Easy to join

Disadvantages

- Liable for incrustation & easily affected by acidic or alkaline water.
- The useful life of pipe is pipe is short about 7 to 10 years.

9. Lead pipes

- Not adopted for conveyance of water due to lead poisoning
- It can be easily bent.
- Apparatus required for alum & chlorine discharge- can not water.
- It can be bent due to hot water.

LAYING OF PIPELINE:

The laying of pipeline should be done according to the following stages

1. Detailed map preparation.
2. Centre line marking.
3. Unloading.
4. Storing.
5. Cutting.
6. Trenches.
7. Laying
8. Back filling and tamping

1. Detailed map preparation.
   - Map showing all roads, cable lines, lanes etc., is prepared.
   - Pipe line with size and length is marked.
   - The position of existing pipe lines, curb lines, sewer lines will also be marked

2. Centre line marking.
   - Transformation from map to site.
   - Stakes driven at 30m interval on straight line .
   - stakes will be 7-15m on curves.
3. Unloading.
   - Up to 60kg – 2persons .
   - Above 60 kg – wagon/truck by holding it in rope and slides over planks set not steeper than 45°.
   - One pipe at a time.
   - It may use carriers or be dragged or rolled along hard surfaces
4. Storing.
   - To avoid damage.
   - It should be stored horizontaly .
   - It should be stored in layer

5. Cutting.
    - Mark with a chalk at the point o cut.
    - Cut with carpenter's saw or hack saw .
    - It must be a proper uniform cut.
6. Trenches.
    - Mark with a chalk at the point o cut.
    - Cut with carpenter's saw or hack saw .
    - It must be a proper uniform cut.
    - It may be done either hand or machine.

    - It must be done with required gradient and depth.
    - When it is under a road way minimum cover of 1m is recommended.
    - Width at the base not less than 200mm on both side of the pipe.
    - Width may extend for joints .
7. LAYING
    - Pipes shall be lowered into the trenches by means of suitable pulley blocks , shear legs, chains, ropes .
    - in no case the pipe shall be rolled and
8. Dropped into the trench.
    - Spigot of one pipe is carefully centred into the socket of other pipe.
    - In some clay soil (black cotton soil) envelope of 10 cm minimum tamped sand shall be made around the pipe line.

9. Back filling and tamping

- Back filling must be done carefully to avoid damages in pipe form falling of boulders, lifting of pipes from sudden floods.
- Soil under and around the pipe line is tamped to give continuous supports to the pipe.
- It may be done by tamping rod or water consolidation.
- The initial backfill done for 10 cm thick.

TESTING OF PIPE:

Step 1: From section to section. One section at a time.

Step 2: Downstream valve is closed, upstream valve is opened to fill the water. Air valves must be properly operated during filling.

Step 3: Both the sluice gates are closed.

Step 4: Pressure gauge is fitted along the length of the pipes at holes which is left for this purpose.

Step 5:Section is connected to the delivery side of the pump through a small By- pass valve to develop pressure in the section.

Step 6: By-pass valve is closed.

Step 7: It kept under pressure for 24 hours and inspected for possible defects

,leakages and joints.

Step 8: Pipe line is disinfected . Add chlorine 50mg/l for 12 hours and the pipe is emptied and flushed with treated water.

PIPE JOINTS:

For the facilities in handling, transporting and placing in position, pipes are manufactured in small lengths of 2 to 6mts. These small pieces of pipes are then joined together after placing in position, to make one continuous length of pipe line. The design of these joints mainly depends on the condition of the pipe, internal water pressure and the condition of the support

Various types of joints which are mostly used are as:

(i) Spigot and socket joint.

(ii) Expansion joint.

(iii) Flanged joint

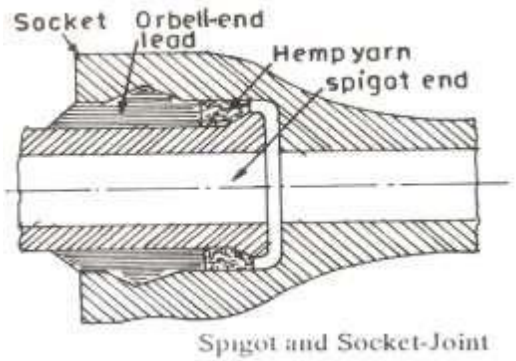
(iv) Screwed joint.

(v) Collar joint.

(vi) Flexible joint.

SPIGOT AND SOCKET JOINT

Sometimes this is called bell and spigot joint. This type of joint is mostly used for cast iron pipes. For the construction of tins joint the spigot or normal end of one pipe is slipped in socket or bell end of the other pipe until contact is made at the base of the bell. After this yarn of hemp is wrapped around the spigot end of the pipe and is tightly filled in the joint by means of yarning iron upto 5 cm depth. The hemp is tightly packed to maintain regular annular space and for preventing jointing material from falling inside the pipe.

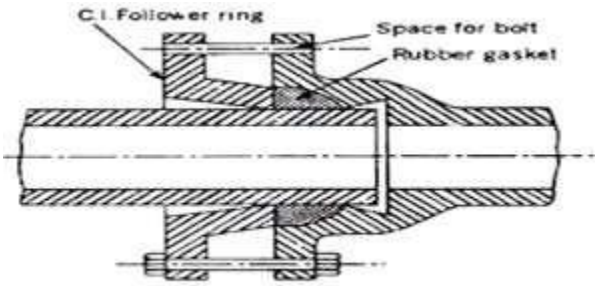


Spigot and Socket-Joint

After packing of hemp a gasket or joint runner is clamped in place round the joint so that it fits tightly against the outer edge of the bell. Sometimes wet clay is used to make tight contact between the runner and the pipe. The molten lead is poured into the v shaped opening left in the top by the clamped joint runner.

EXPANSION JOINT

This joint is used at such places where pipes expand or contract due to change in atmospheric temperature and thus checks the setting of thermal stresses in the pipes. In this joint the socket end is flanged with cast iron follower ring, which can freely slide on the spigot end or plat end of other pipe. An elastic rubber gasket is tightly pressed between the annular space of socket and spigot by means of bolts as shown in the figure. In the beginning while fixing the follower ring some space is left between the socket base and the spigot end for the free movement of the pipes under variation of temperatures.



Expansion Joint.

In this way when the pipe expands the socket end moves forward and when pipes contract, it moves backward in the space provided for it. The elastic rubber gasket in every position keeps the joint watertight.

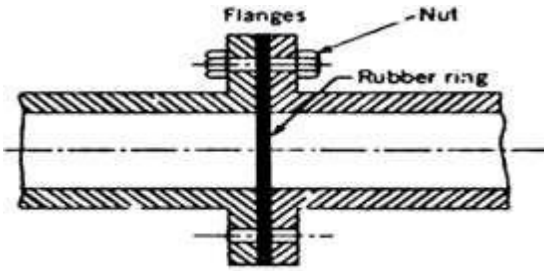
FLANGED JOINT

A flange can also be a plate or ring to form a rim at the end of a pipe when fastened to the pipe. A blind flange is a plate for covering or closing the end of a pipe. A flange joint is a connection of pipes, where the connecting pieces have flanges by which the parts are bolted together.

Used in places where disjointing is done.

Strong but rigid – cannot with stand vibrations.

Expensive – used in indoor works

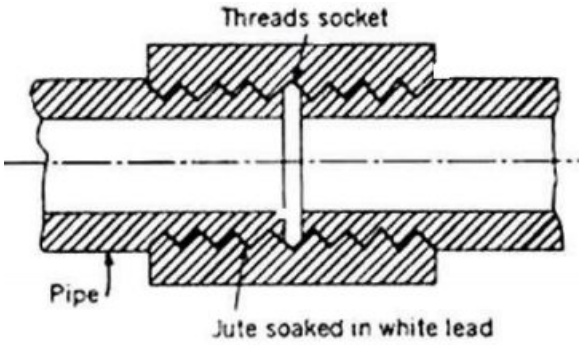


Flanged Joint.

SCREWED JOINT

Screwed piping is commonly used in low-cost, noncritical applications such as domestic water, fire protection, and industrial cooling water systems.

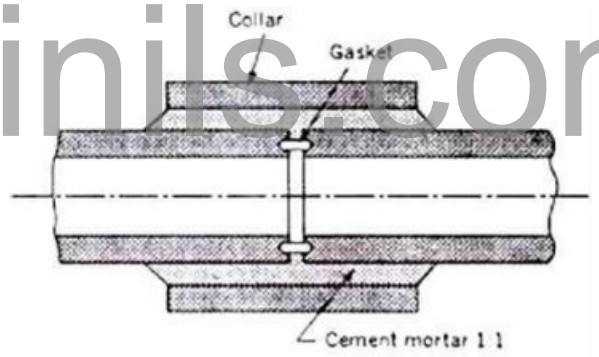
Installation productivity is moderately high, and specialized installation skill requirements are not extensive. Leakage integrity is good for low-pressure, low-temperature installations where vibration is not encountered.



Screwed Joint.

COLLAR JOINT

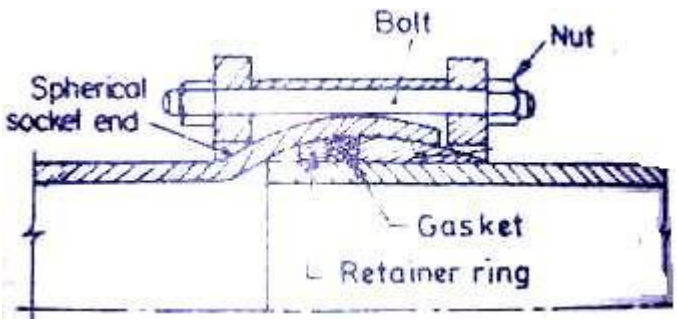
This type of joint is mostly used for joining big diameter concrete and asbestos cement pipes. The ends of the two pipes are brought in one level before each other. A gasket is placed between the grooves of the pipes and a collar is placed properly at the joint. Then the space between the pipes and the collar is filled up with cement mortar (1:1) and the surface is finished at an angle of 45°.



Collar Joint.

FLEXIBLE JOINT

This type of joint is recommended for the places where the settlement of the pipe line may occur. For this joint one pipe has spigot end with a beat and the other pipe has socket end with spherical shape and it consists of several holes for nuts and bolts.



Flexible joint

Pipe Appurtenances:

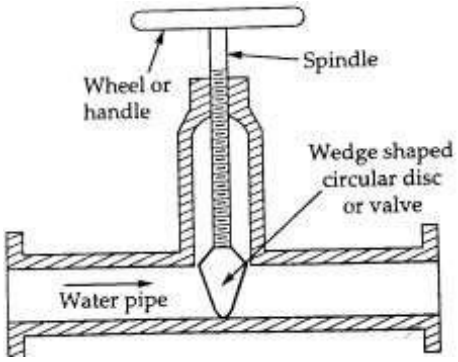
Pipe appurtenances are components attached in pipe line which aid in proper functioning of pipe network. Role of appurtenances are ceasing, controlling, diversion and regulating flows through the pipe network.

The necessities of the various appurtenances in distribution system are as follows

1. To control the rate of flow of water
2. To release or admit air into pipeline according to the situation
3. To prevent or detect leakages
4. To meet the demand during emergency and
5. Ultimately to improve the efficiency of the distribution.

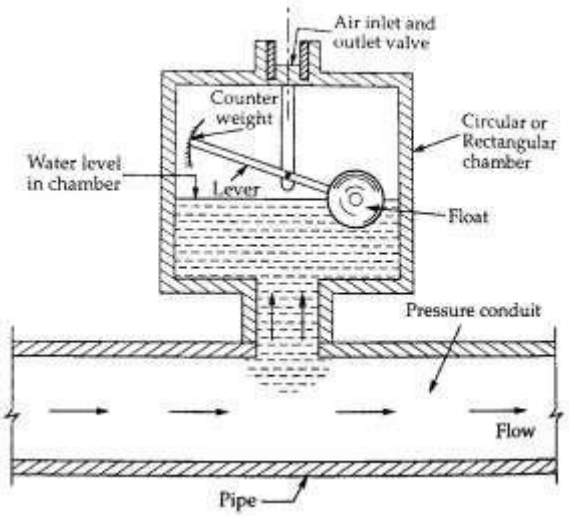
Sluice valve or gate valve:

These are also known as shut off valves or stop valves. They are extensively used in the distribution system to shut off the supplies whenever desired. they are also helpful in dividing the water mains into suitable sections. The spacing of such valves may between 150 to 300 meters. They are also placed at street corners or where two pipe lines intersect. they posses the advantage over most other types of valves, of combining relatively low cost and offering almost no resistance to f low of water when the valve is wide open.



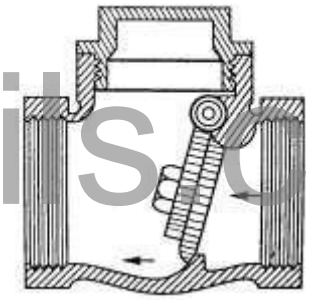
Air relief valves:

The water flowing through the pipe lines always contain some air. This air rises to accumulate at high points, and may interfere with flow. Air valves are also required to discharge air when a main is being filled and to admit air when it is being emptied. The admission of air on emptying the main is of great importance on steel mains, which may flatten if the pressure falls below that of the atmosphere.



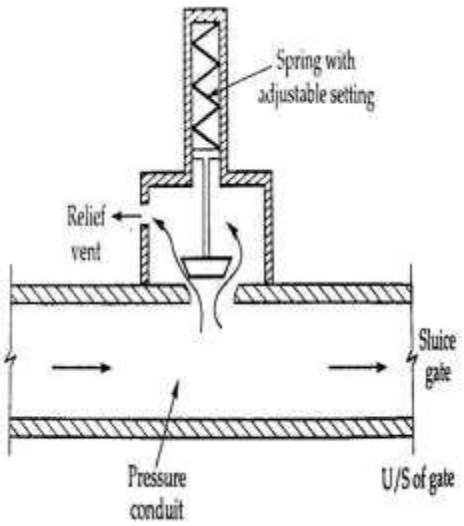
Reflux valves:

Reflux valves are also known as check valves or non-return valves. It is automatic device which allows water to flow in one direction only. They are placed in water pipes which obtain water directly from the pump. When the pump is stopped ,the water in the pipeline does not rush back and damage the pump.



Pressure relief valves

These are also known as automatic cutoff valves or safety valves. They are located at those points where pressure is likely to be maximum. When the line pressure increases above the pre-set valve operates automatically and the pressure is reduced.



Scour valves:

Scour valves or blow off valves or washout valves are ordinary sluice valves that are located either at the dead ends or at lowest points in the mains. They are operated to blow off or remove the sand and silt deposited in the pipe line. They are operated manually.

PIPE CORROSION – CAUSES AND PREVENTION:

The term pipe corrosion is used to indicate the loss of pipe material due to action of water (Internal pipe corrosion) and action of water logged soil above the pipe surface (external pipe corrosion) by the results of corrosion, troublesome to both the water authority and consumers. The various factors contributing to the pipe corrosion are

1. ACIDITY: The water having low PH value due to the presence of carbonic acid or other acids may cause corrosion

2. ALKANITY: The water possessing sufficient calcium bicarbonate alkanilinity is anti-corrosive in nature

3. BIOLOGICAL ACTION: The growth of iron-bacteria, and sulphur bacteria may develop aerobic and anaerobic corrosion respectively.

4. CHLORINATION: The presence of free chlorine or chloramines makes the water corrosive

5. ELECTRICAL CURRENTS: Corrosion canals also be developed by the union of dissimilar metals or by the earthing of electrical system to water pipes.

6. MINERAL AND ORGANIC CONSTITUENTS: The presence of high total solids in water accelerates the process of corrosion

7. OXYGEN: the presence of oxygen is found in both the corrosive and non-corrosive waters. The aeration infact is employed in some cases for prevention of corrosion.

EFFECTS OF PIPE CORROSION

1. Pipe corrosion may lead to the tuberculation (formation of small projections on the inside surface of pipe) which decreases carrying capacity of water

2. The pipe corrosion leads to the disintegration of pipeline and it demands heavy repairs

3. The pipe corrosion imparts colour, taste and odour to the flowing water

4. The pipe connections are seriously affected by pipe corrosion

5. The pipe corrosion may make the water dangerous for drinking and other purposes.

PREVENTION OF PIPE CORROSION

Pipe corrosion is not possible to completely eliminate but we can minimize by the following methods.

1. Cathodic protection: By connecting the pipe line to the negative pole of D.C. generator or to the anode metals like magnesium so that the entire pipe acts as cathode. This cathodic treatment is most effective. It is expensive and involves many practical problems

2. Proper pipe material: The alloys of Iron or steel with cromium, copper or nickel are found to be more resistance

3. Protective Linings: The pipe surface should be coated with asphalt, bitumen, cement mortar, paints, resins, tar, zinc etc.

4. Treatment of water: By proper treatment and adjustment of PH value, control of calcium carbonate, removal dissolved oxygen and carbon dioxide, addition of sodium silicate etc prevent the pipe corrosion.

PUMPS:

The function of pump is to leave the water or any fluid to higher elevation or at higher pressure. Pumps are driven by electricity, diesel or steam power. They are helpful in pumping water from the sources that is from intake to the treatment plant and from treatment plant to the distribution system or service reservoir. In homes also pumps are used to pump water to upper floors or to store water in tanks over the buildings. Based on the mechanical principle of water lifting pumps are classified as the Following

CENTRIFUGAL PUMPS

Centrifugal force is made use of in lifting water. Electrical energy is converted to potential or pressure energy of water.

COMPONENT PARTS OF CENTRIFUGAL PUMP

Centrifugal pump consists of the following parts

1. Casing: The impellor is enclosed in the casing, which is so designed that kinetic energy of the liquid is converted into pressure energy before it leaves the casing.

2. Delivery pipe

3. Delivery valve

4. Impeller

5. Prime mover

6. Suction pipe

7. Strainer and foot valve

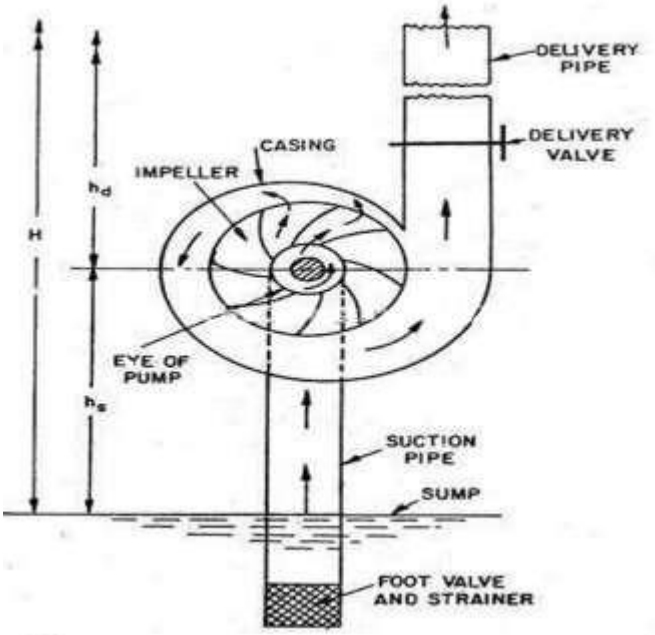
DESCRIPTION

The pump consists of a Impeller is enclosed in a water tight casing. Water at lower level is sucked into the impellor through a suction pipe. Suction pipe should be air tight and bends in this pipe should be avoided. A strainer foot valve is connected at the bottom of the suction pipe to prevent entry of foreign matter and to hold water during pumping . Suction pipe is kept larger in diameter than delivery pipe to reduce cavitations and losses due to friction. An electric motor is coupled to the central shaft to impart energy.

WORKING PRINCIPLE

When the impellor starts rotating it creates reduction of pressure at the eye of the impellor, which sucks in water through the suction pipe. Water on entering the eye is caught between the vanes of the impeller. Rapid rotation of the impellor sets up a centrifugal force and forces the water at high velocity outwards against the causing

convert the velocity energy into pressure energy which is utilized to overcome the delivery head



OPERATION AND MAINTENANCE

Priming – Priming means filling up of the suction and casing completely with water. Pressure and suction developed by the impellor is proportional to the density of the fluid and the speed of rotation. Impellor running in air will produce only negligible negative pressure on the head. Hence it is required that is the casing and impellor is filled with water through a funnel and cock. Trapped air is released through pet cock. Initially the delivery valve is closed and the pump started. The rotation impellor pushes the water in the casing into the delivery pipe and the water in the casing into the delivery pipe and the resulting vacuum is filled by water raising through the suction pipe. The pass valve is opened while closing the bypass valve , while stopping the pump delivery valve is closed first and the pump switched off. Maintenance may be

1) Preventive maintenance 2) Break down maintenance.

Preventive maintenance

Locates the sources of trouble and keep the equipment in good operating condition. It involves oiling, greasing of stuffing boxes, observing the temperature of the motor and the pump bearings, checking the valves, strainer, electrical contacts, earthings etc.

Break down maintenance

Involves replacement of worn out components and testing . Sufficient amount of spares of impellors, bearings, slip-ring brushes, stater-contacts, gland packing, greases, oils, jointing materials, valves are to be kept in stock to attend to the emergencies. It is usual to have one stand by pump in addition to the required number of pumps.

RECIPROCATING PUMP

- A reciprocating pumps consists of a plunger or a piston that moves forward and backward inside a cylinder with the help of a connecting rod and a crank. The crank is rotated by an external source of power.
- The cylinder is connected to the sump by a suction pipe and to the delivery tank by a delivery pipe.
- At the cylinder ends of these pipes, non-return valves are provided. A non-return valve allows the liquid to pass in only one direction.
- Through suction valve, liquid can only be admitted into the cylinder and through the delivery valve, liquid can only be discharged into the delivery pipe.

Working of Reciprocating pump

- When the piston moves from the left to the right, a suction pressure is produced in the cylinder. If the pump is started for the first time or after a long period, air from the suction pipe is sucked during the suction stroke, while the delivery valve is closed. Liquid rises into the suction pipe by a small height due to atmospheric pressure on the sump liquid.
- During the delivery stroke, air in the cylinder is pushed out into the delivery pipe by the thrust of the piston, while the suction valve is closed. When all the air from the suction pipe has been exhausted, the liquid from the sump is able to rise and enter the cylinder.
- During the delivery stroke it is displaced into the delivery pipe. Thus the liquid is delivered into the delivery tank intermittently, i.e. during the delivery stroke only.

Following are the main types of reciprocating pumps:

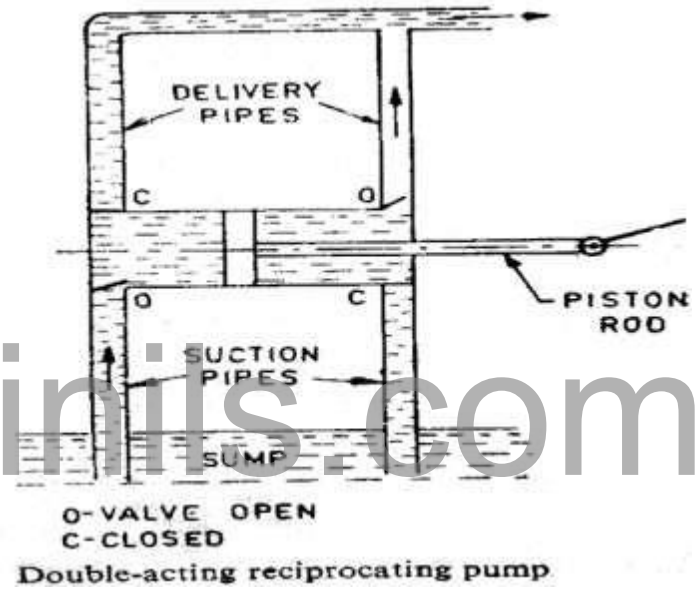
According to use of piston sides:

- Single acting Reciprocating Pump:

If there is only one suction and one delivery pipe and the liquid is filled only on one side of the piston, it is called a single-acting reciprocating pump.

- Double acting Reciprocating Pump:

A double-acting reciprocating pump has two suction and two delivery pipes, Liquid is receiving on both sides of the piston in the cylinder and is delivered into the respective delivery pipes.



Double-acting reciprocating pump

AIR LIFT PUMP

Its main function is to lift water from a deep well or sump by using compressed air. By buoyancy the air, which has a lower density than the liquid, rises quickly. By fluid pressure, the liquid is taken in the ascendant air flow and moves in the same direction as the air.

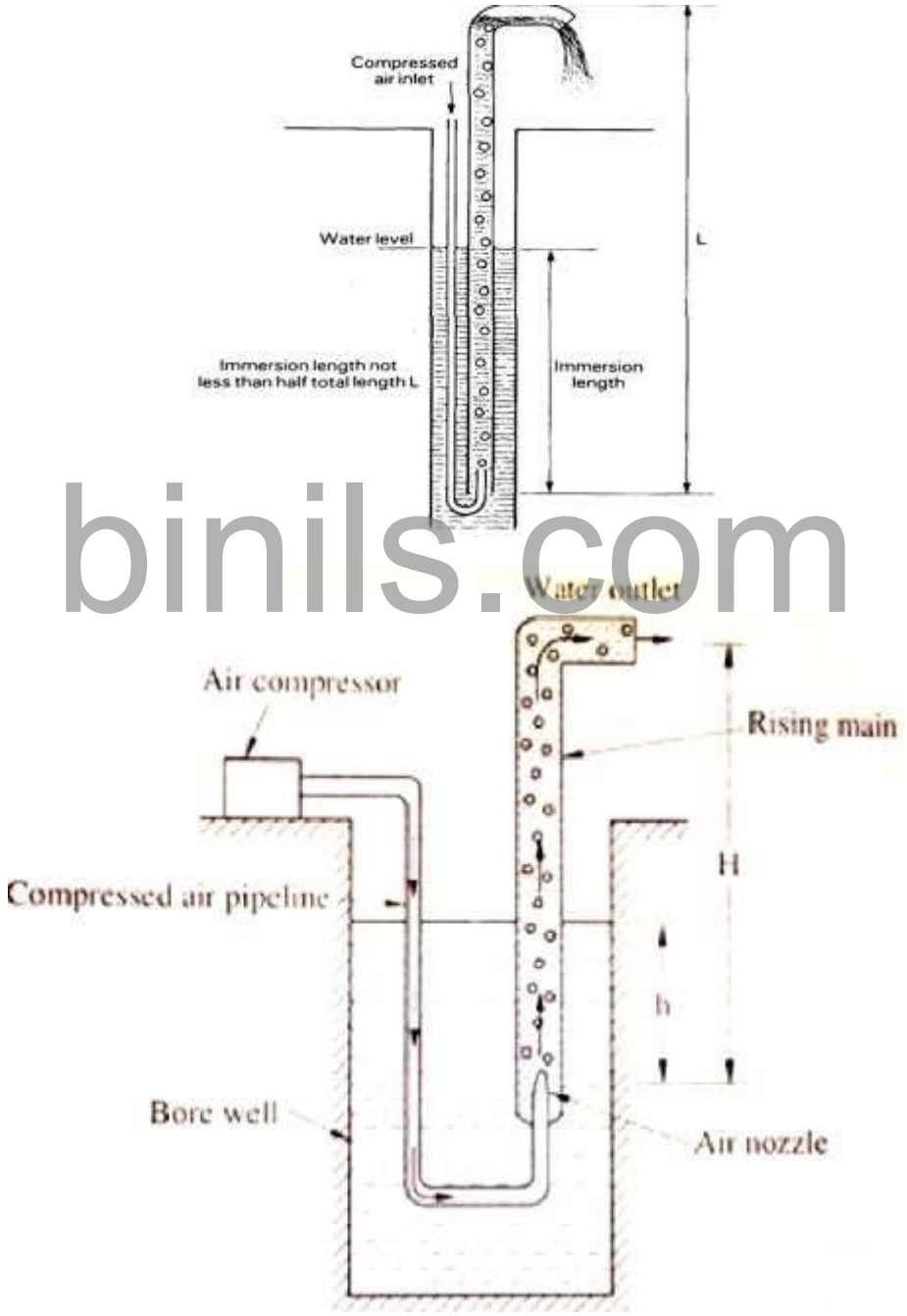
The main components are:

1. Air compressor to supply compress air
2. Air pipe fitted with one or more nozzles
3. Delivery pipe

The lower portion of delivery pipe dips into well and water gets discharge from the upper end of the delivery pipe.

Working:

The compressed air from compressor is bottom end of delivery pipe through air pipeline as a fine spray. Then, air gradually mixes with water in delivery pipe, so from that inside the delivery pipe density of air - water mixture decease. As soon as pressure in delivery pipe of height H becomes less than the pressure due to the height of water column h in outlet of the delivery pipe. As per this reason rising begins in the delivery pipe above the level of water outside the delivery pipe. And other reason that the water in delivery pipe lighter than outside of the delivery pipe.



Advantages:

The air lift pump is not having any moving parts below water level and hence there are no chances of suspended solid particles damaging the pump.

This pump can raise water through a bore hole of given diameter than any other pump.

This pump is very suitable where decompressed air is available.

Disadvantages:

Conventional airlift pumps have a flow rate that is very limited.

Very low efficiency, only 20 to 40% energy available in form of useful water horse-power.

It cannot lift water when the level of water in deep well goes down below limit.

The suction is limited.

Application:

Airlift pumps are often used in deep dirty wells where sand would quickly abrade mechanical parts.

It is also sometimes used in part of the process on a wastewater treatment plant if a small head is required (typically around 1 foot head).

POINT TO BE OBSERVED IN SELECTING A PUMP

1. Capacity and efficiency - The pump should have the capacity required and optimum efficiency.

2. Lift - Suction head from the water level to the pump level

3. Head – It is also called delivery head. Generally the total head (suction and delivery head) should meet all possible situations with respect to the head.

4. Reliability – A reputed manufacture or similar make pump already in use may give the failure rate and types of troubles.

5. Initial cost: The cost of the pump and its installation cost should be minimum.

6. Power – Power requirements should be less for operation

7. Maintenance – Maintenance cost should be minimum. Availability of spares and cost of spares are to be ascertained.