SOURCES OF WATER

Sources of water can be divided into 2 types

① Surface Sources of water
② Sub Surfaces Sources.

Surface Sources :- These are classified into Streams, lakes, ponds, rivers and imponded reservoirs, stored rain water, cisterns.

Sub Surfaces Sources :- Wells, springs, infiteration galleries porous pipe galires.

Streams :- In mountaines region streams are formed by runoff, The discharging streams is much in rainy season than other season. those streams which dry up in summer and contain water only during rainfall are known as "Raining streams". All the suspended impurities can be removed in settling tanks upto certain extent. But the disolved impurites required special Treatment.

Lakes :- In mountains at some places natural basins are formed with impermiable beds.

* Water from streams and streams generally flows towards this basin and lakes are formed.
* The Quantity of water in the lakes depends on its basin Capacity, Catch ment area, annual rainfall, porosity of the ground. etc.

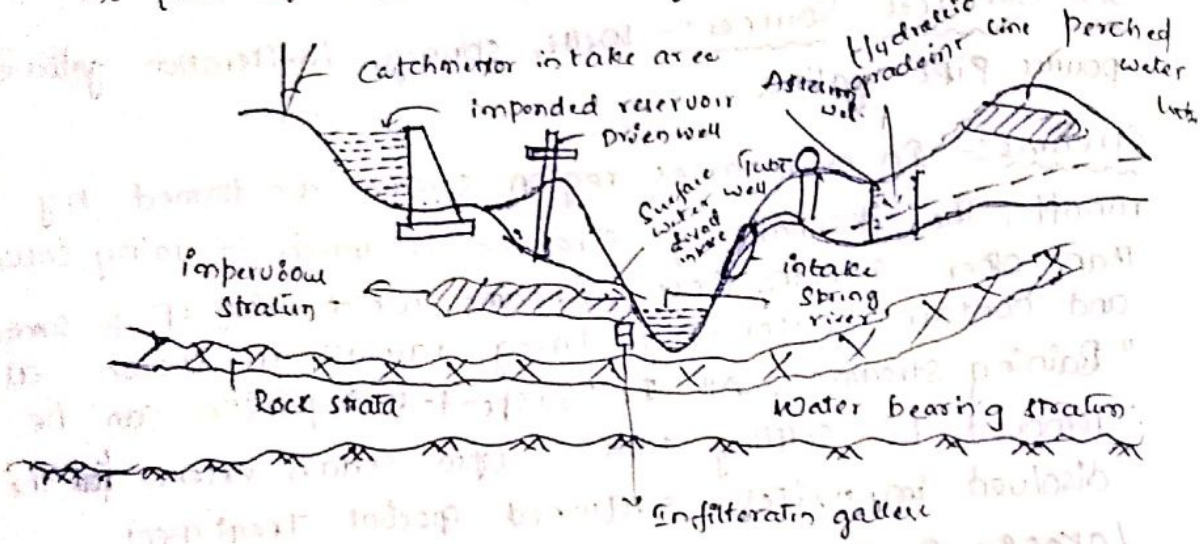
Ponds :-

* There are dippresions in planes like lakes & mountains in which the water is collected during rainy season.
* Some times ponds are formed when much excavation is done for Constructing Kaccha houses in villages and embankment for roads, railways and manufacturing of bricks
* The water of ponds is used for washing clothes and animal bathing and drinking in some villages people also take bath in dirty water of ponds. backward
* The water of ponds cannot be used for water supply purposes due to its limited Quantity and large amount of impurities.

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Rivers:- Rivers are born in the hills ... large no of springs and streams combined together.

* Rivers are the only sources of water which have maximum quantity of water which can be easily taken at the very ancient times the town and cities started developing along the banks of rivers.
* River water has self purification action due to which it automatically becomes clean in some distance travell from the point of disposal of sewage.



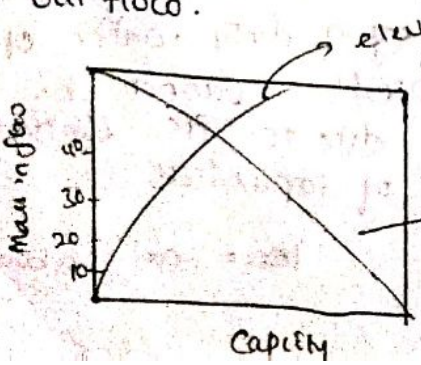
STORAGE RESERVOIR CAPACITY :- The most important physical characteristic of a reservoir is nothing but, it is storage capa

* the capacity computed from these verticle cross sections by the trapezoidal (or) prismoidal formula.

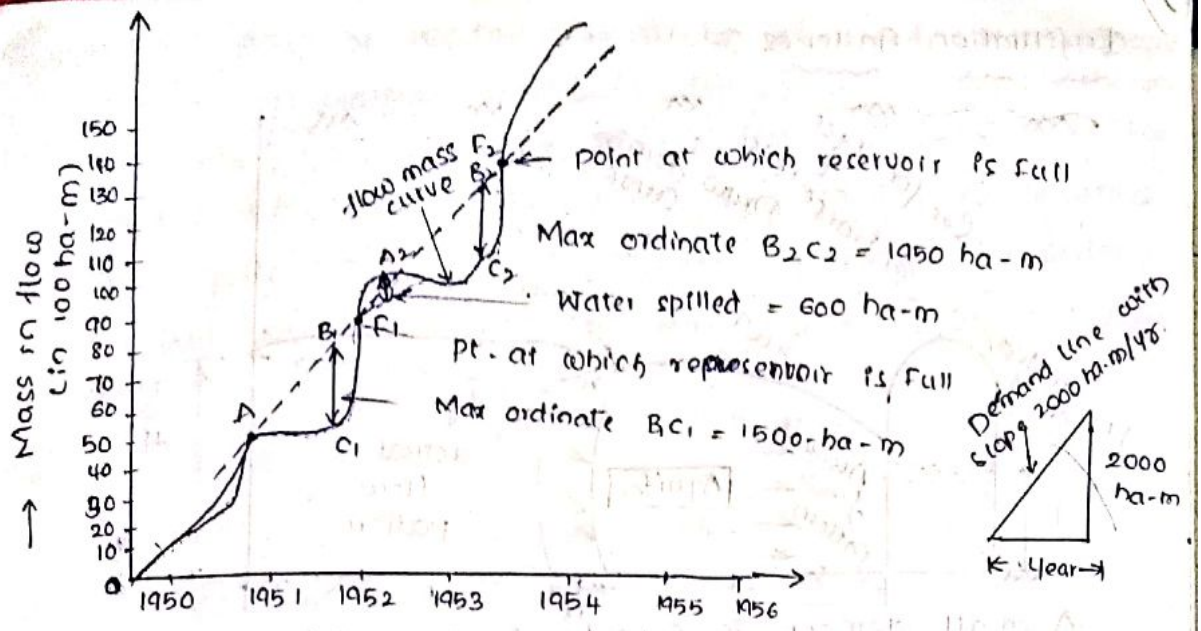
$$\therefore \text{Volume } (V) = (A_1 + A_n) + [4(A_2 + A_4 + \dots) + 2(A_3 + A_5 + \dots)]$$

where A_1, A_2, A_3 are the areas enclosed blw successive elevation lines.

Fixation of Reservoir capacity with the help of mass curve of inflow and outflow.



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Mass Curve Analysis

* Assuming the reservoir is to be full at A_1, it is depleted by outflow 1950 ha-m - 1500 ha-m = 450 ha-m, at C_1 and is again full at F_1
* The reservoir will be full at F_1 and A_2 In the Quantity of water spilled over spillway. is equal to 1600 ha-m.
* From A to the water starting reduced in the reservoir till it becomes fully empty at C_2.
* The water again starts collecting the reservoir and it is again full at F_2.

GROUND WATER SOURCES :-

Infiltration wells :-

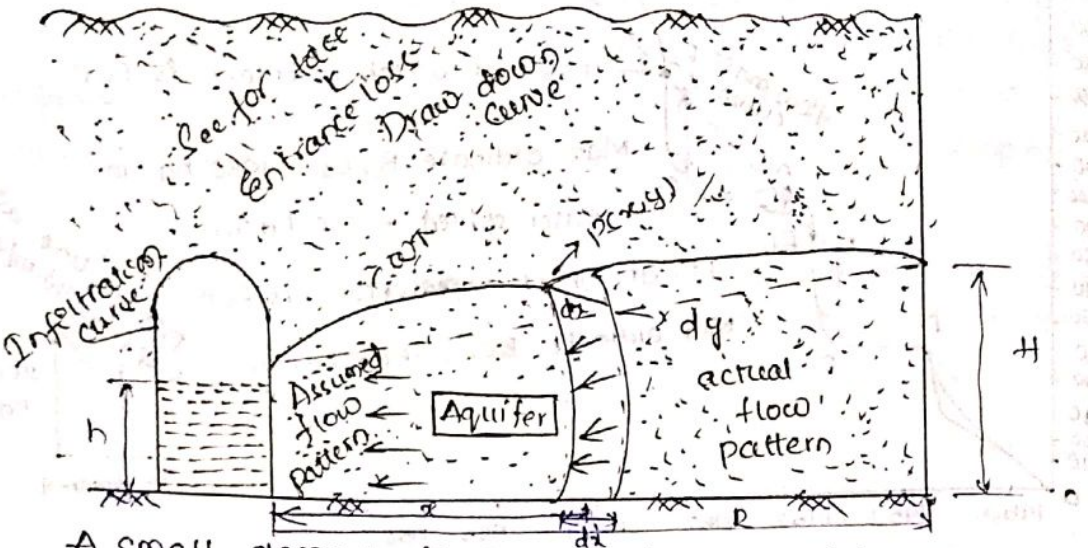
* These are shallow wells constructed under beds of rivers and nallas.
* Deposits of sand exist at least 3m deep in river beds as the water percolater down, impurities are removed Quality of water is better than river water.

Aquifer :- A permeable stratum (or) a geological formation of permeable material which is capable of yeilding appreasiable quantities of Grand water Under gravity is known as 'Aquifer'

2 Types → ① Unconfined (or) Non Aretesian
② Confined (or) Artesian

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Infiltration Galleries :-



A small element is considered of width and the area of Soil through which flow will occur is (y x L) it is not visible in above figure

where

Q = discharge , K = co-efficient of permeabil

i = head gradient (dy/dx)

A = Area , H = static water level above the bottom of the gallery.

h = depth of water in the gallery on pumpin

R = Radius of influence. equili

$$Q = KiA$$

$$i = \frac{dy}{dx} \quad \text{and} \quad A = y \times L$$

$$Q = K\left(\frac{dy}{dx}\right)(y \times L)$$

and here

$$Q\,dx = K\,dy\,(y \times L)$$

Apply intigration on both side

$$Q \int dx = K.L \int_h^H y\,dy$$

$$Q\,[x]_0^R = K.L\left[\frac{H^2-h^2}{2}\right]$$

$$Q\,[R] = K.L\left[\frac{H^2-h^2}{2}\right]$$

$$Q = K.L\left[\frac{H^2-h^2}{2R}\right]$$

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(*) 600 m^3/day of water is to be obtained from a proposed infiltration gallary which is placed at 6m depth from subsurface water table. The co-efficient permeability of the soil aquifer 100 m/day find the length of the gallery if the drawon down curve in the gallery on pumping is not exceed 4m. The radius of the influence may be assumed to be 100m.

Sol:- Given data is

discharge (Q) = 600 m^3/day.

co-efficient of soil aquifer permiability (K) = 100 m/day

Radius of influence (R) = 100 m.

Static water level in gallery (H) = 6m.

pumping should not exceed 4m

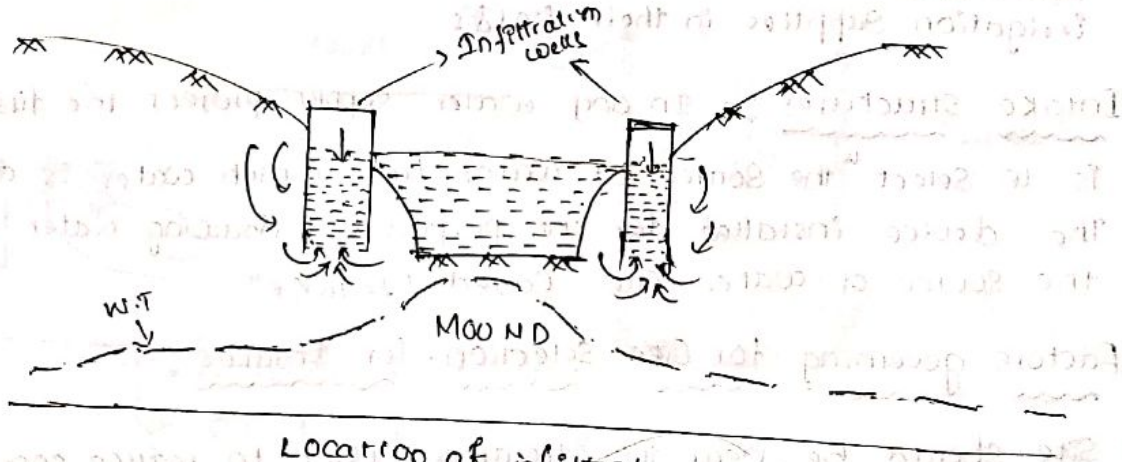
$\therefore h = H - 4m = 6m - 4m = 2m$

$$Q = K L \left[\frac{H^2 - h^2}{2R} \right]$$

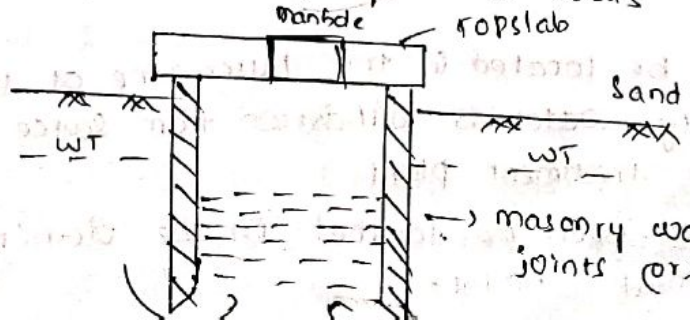
$$600 = 100 \times L \left[\frac{6^2 - 2^2}{2 \times 100} \right]$$

$$\therefore L = 37.5 m$$

INFILTRATION WELLS:-



Location of infiltration wells



Section of infiltration wells.

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Springs :- The Natural outflow of ground water at the earth Surface is said to form a springs. These are three types

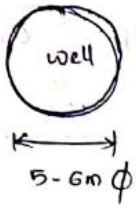
1. Gravity springs
2. Surface Springs
3. Artesian springs, etc.

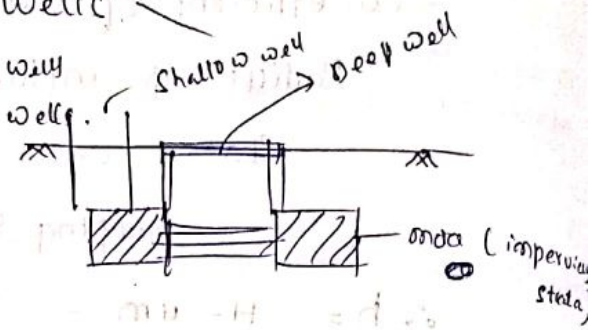
Wells :- A water well is a hole usually vertical excavated to the earth stratum for lifting ground water through the Surface. These are classified into 2 types.

1. Open wells
2. Tube wells

Open wells :-

- Shallow open well
- Deep open well.





Construction of wells :-

1. Impervious Lining (such as masonary lining)
2. Pervious Lining (such as brick stone lining)
3. No Lining (i.e Kacha wells)

Pervious Lining :- The water enters from the sides through the pores in the Lining. The flow is radial.

Kacha wells :- These wells are formed by Cultivators. to uph irrigation supplies in their fields.

Intake Structures :- In any water supply project the first step is to select the source of water from which water is drawn The device installed for the purpose of drawing water from the source of water are called "Intake"

Factors governing for Site selection for Intakes :-

* Site should be near the treatment plant to reduce conveyance cost.
* Intake must be located in the purer zone of the source so the best Quality water is withdrawn from source to reduce the load on the treatment plant
* Intake must never be located in the vicinity of waste water disposal point.

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* Intake must never be located near the navigation channels so as to reduce chances of pollution due to waste discharge from ships.
* The site should be selected such as to permit greater withdrawl of water, if required in future.

Selecting Location of Intake Structure :-

* Intake must be located at a place from where it can draw water even during the driest period of the year.
* The intake site should remain easily accessible during floods and should not get flooded.
* In meandering rivers, the intakes should not be located on curves or atleast on sharp curves.

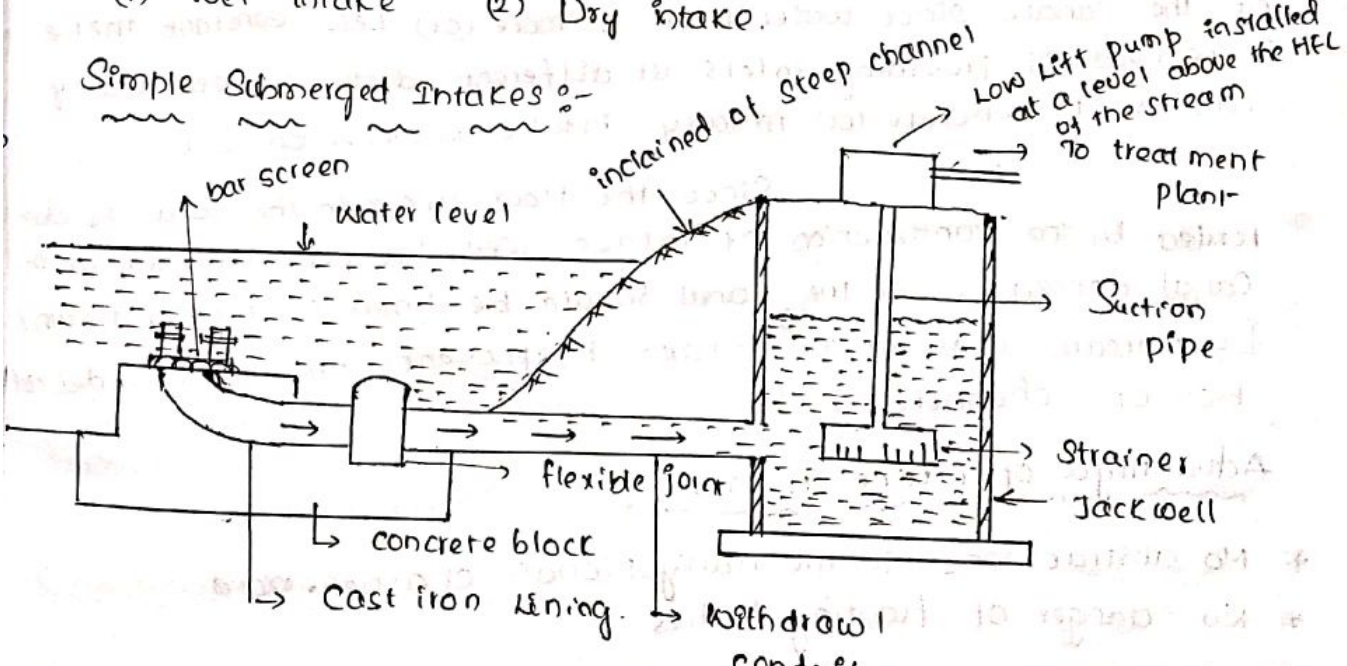
Types of Intake Structures :-

⇒ According to type of Source.
* River intake * Canal intake * Reservoir intake.
* Lake intake.

⇒ According to position of intake.
(1) Simple Submerged intake
(2) Exposed intake

⇒ According to presence of water in the tower
(1) Wet intake (2) Dry intake.

Simple Submerged Intakes :-



* It consists of a simple concrete block or a rock filled timber crib supporting the starting end of the withdrawal pipe.
* The intake opening is generally covered by screen so as to prevent the entry of debris, ice etc. in to the withdrawl conduit.

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* Intakes, where silt tends to settle down, the intake opening is generally kept at about 2 to 2.5 m above the lake bed level to avoid entry of silt.
* they are cheap & do not obstruct navigation.
* They are widely used for small water supply projects.
* Limitations is that they are not easily accessible for cleaning & Repairing.

River Intakes:- A River intake is located on the upstream side of the city to get comparatively better Quality of water. They are either located sufficiently inside the river so that necessary demand of water can be met in all the seasons of the year.

* The intake tower permits the entry of water through several entry ports located at various levels to cope with fluctuations in the water levels during different Seasons.
* This are also called as "penstocks" The penstocks are covered with Suitable design Screens to prevent entry of floating impurities.

Canal Intakes:-

In case of small town a nearby irrigation canal can be used as source of water. The intake well is generally located in the bank of the canal. since water level is more (or) Less constant there is no need of providing inlets at different depth. It essentially consists of concrete (or) masonry intake chamber (or) well.

Since the flow area in the canal is decreased by the construction of intake well, the flow velocity in the Canal decreases, so the canal should be lined on the upstream Downstream side of the intake to prevent erosion of sides & bed of channel.

Advantages of Intake Structures:-

* No abstructions to the navigational channel.
* No danger of floating bodies

Design procedure for Intake:-

* If population is given and rate of water supply is given the discharge required by the city (or) town
* Q = Population * Rate of Supply.
* The Screens (Coarse Screen) is assumed around 0.15 Lit/sec

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and also the verticle bars are 15 to 20 mm dia. and center to center spacing 20 to 50 mm.

* Area of screens = discharge / velocity of screen.

$$Q = \text{Area} * \text{velocity}$$

* Length of screen = $\frac{\text{Area}}{\text{height}}$ @ the assuming value of the bell mouth velocity 0.3 to 0.35

Design of intake conduit :-

* Asume the velocity of flow through conduit, generally 1.0 to 1.5 m/sec
* find $A = \frac{Q}{V}$ then using Hazen william formula. find the head loss and slope. reauired charts can be used.

* Design a bellmouth canal intake for a city of 75,000 persons drawing water from a canal which runs only for 10 hours a day with a depth of 1.5 m also calculate the head loss in the intake conduit if the treatment works are 1/4 th km away. given average consumption per person equal to 150 lit/day. assume the velocity through screen and bell mouth to be less than 16 cm/sec and 32 cm/sec respectively?

Sol:- Given data is

Depth of bell mouth (d) = 1.5 m

Population

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Conveyance of water :- When water is transport from the to the treatment plant. The conveyance of water is divided into 2 parts ① Gravity conduits ② pressure conduits (or) pipe conduits

Gravity Conduits :- The water is enter to the conduit under gravity. The are the following forms.

① Canals (0.6-0.9 m/sec) ② flumes manmade structures (high velocity) ③ Aquiduts. (Horse shoe shape) - economical (0.9 m/sec)

* "Gravity conduits" (or) "open channel conduits"

Pressure conduits :- These are also known as "pipe conduits" The water enter into the conduits under pressure. These pipes manufacturing from different materials, cast iron, steel, Rcc etc.

* The velocities is 0.6 to 0.8 m/sec

Pipe materials :-

The selection of pipe materials the following considerations

* Water carrying capacity.
* Strength
* Durability
* Quality of water. to be conveyed and its corrosion effect.
* Intial cost and maitenance cost.
* Availability of material and easily transportation.

● Various materials used for pipe lines :-

* Cast iron pipes * Steel pipes * Concrete pipes
* Asbestos pipes * Galvanized iron pipes.
* Plastic pipes.

Cast iron pipes :- These are in circular shape.

(2) The cast iron pipes are manufactured by sand moulding (or) centrifugal process.

(3) The cast iron pipes having the joints are used Socket (or) Spigot joints are used and also flanged joints are used The expansion joints are used at particular places.

(4) As per the ISI (Indian standard institute - 1536 (or) the Socket and Spigot lengths are → 2.0 m, 3.8 m, 20., 4.8, 5.0, 5.5 m flanged joints

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ends are 2.0, 3.6, 4.8, 5.5 m

ADVANTAGES OF CAST IRON :-

* Strong * durable (life span of cast iron pipes are 100 years)
* Economical * Easily jointed * Resisted to corrosion

DISADVANTAGES :-

* Easily to brake during the transportation.
* Due to tubarculation the water carrying capacity is reduced. (Pipe inner surface is ruff)
* Cannot be used high pressure above 7 Kg/cm

Steel pipes :- * These are manufactured by welding the sheets.

* These pipes are coated with anti corrosive coatings (cement & mortar)
* The expansion jointed are used for temparature stresses.

ADVANTAGES OF STEEL PIPES :-

* Compared to cast iron pipes these are strong and cheap.
* Easy to handle to transport.
* Obtainable large lengths to minimize the NO of joints.

DISADVANTAGES :-

* Susceptable for corrosion.
* Life is short Unless protected by the Special Coatings

Concrete pipes (PCC and RCC) :-

* These are prepared by plane concrete and Reinforced cement concrete and prestressed cement concrete
* For smaller diameter 610 mm plain concrete is used
* For large diameter 2.5 m they are reinforced cement concrete with steel reinforcing.
* And prestressed cement Concrete 0.08 to 0.18 meters.

ADVANTAGES :-

* Strong and easy to resist external loads.
* The life span is 75 years
* The internal Surface is very Smooth and Reduce frictional losses Easy to construct, do not required expansion joints.

Disadvantages :-

* These pipes are heavy to handle, to transport.
* Leakage due to shrinkage and Cracks difficult to repair.
* joints the pipes is difficult.

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(4) Cost is Economical.

Asbestos cement pipes (or) AC pipes :-

* The Asbestos cement pipes manufacturing by rotating on steel mandrel mixing with the cement and asbestos fibre to the desirable thickness and compacted b/w steel pressure rollers.
* The available diameter from 5 to 90 cm

ADVANTAGES :-

* Easy to handle and to transport.
* Economical in laying and jointing
* It is suitable for small size distribution pipes
* Highly resistance to corrosion, tuberculation action of acids, alkalis and electrolosic.

DISADVANTAGE :-

* These are very costly pipes.
* Brittle and hence unsuitable.
* It cannot be used for high pressure.
* easily break on damage by excavating tools.

Pipe JOINTS :-

(1) Spigot & socket joint
(2) flanged joint
(3) joints for concrete & AC pipes
(4) Expansion joint
(5) Mechanical joints.

Biological impurities for finding Bacterial test :-

There are 3 methods for finding the biological impurties.

① Total count method
② E-coil test
③ Membrane filter method.

* E-coil test is determining in two coarses those are

① E-coil
② MPN value test

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Standards for Water based on WHO and I.S

S.No	characteristics	Highest desirable level	Max possible level.
1	Turbidity units on jaccion scale	5	10
2	colour units on platinum	5	50
3	Taste & odour	Unobjectionable	Unobjectionable
4	pH units	7 - 8.5	6.5 - 9.2
5	Total solids	500	1500
6	chlorides	200	600
7	Sulphates	200	400
8	Total Hardness (as CaCO3)	200	600
9	Nitrates	45	45
10	Flourides	1.0	1.5
11	Iron.	0.1	1.0
12	Managnese	0.05	0.5
13	copper	0.05	1.5
14	Zinc	5	15
15	Calcium	75	200
16	Magnesium	30	150
17	phenol	0.001	0.002
18	Anionic detergent	0.02	1.0
19	Arsenic	0.05	0.05
20	cadmium	0.01	0.01
21	Hexavalent chromium	0.05	0.05
22	cyanides	0.05	0.05
23	Lead	0.1	0.1
24	selenium	0.01	0.01
25	Mercury	0.001	0.001
26	Gross alpha Activity (pCi/l)	3	3
27	Gross Beta Activity (pCi/l)	30	30

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Water borne dieseases and their control :-

(1) Presence of Micro organisms :-

(2) Presence of parasitic ova

(3) presence of inorganic matter.

(4) presence of organic matter.

(5) Controlling :- The complete controll of water borne diseases Prove instituting an environmental health programme. that incarporate personnel and house hold and higen, control of fly spicies and other insects and monitoring of food processing immunization of populace where possible and dropper scientific waste disposal and water treatment, to removal of harmful, constituents.

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