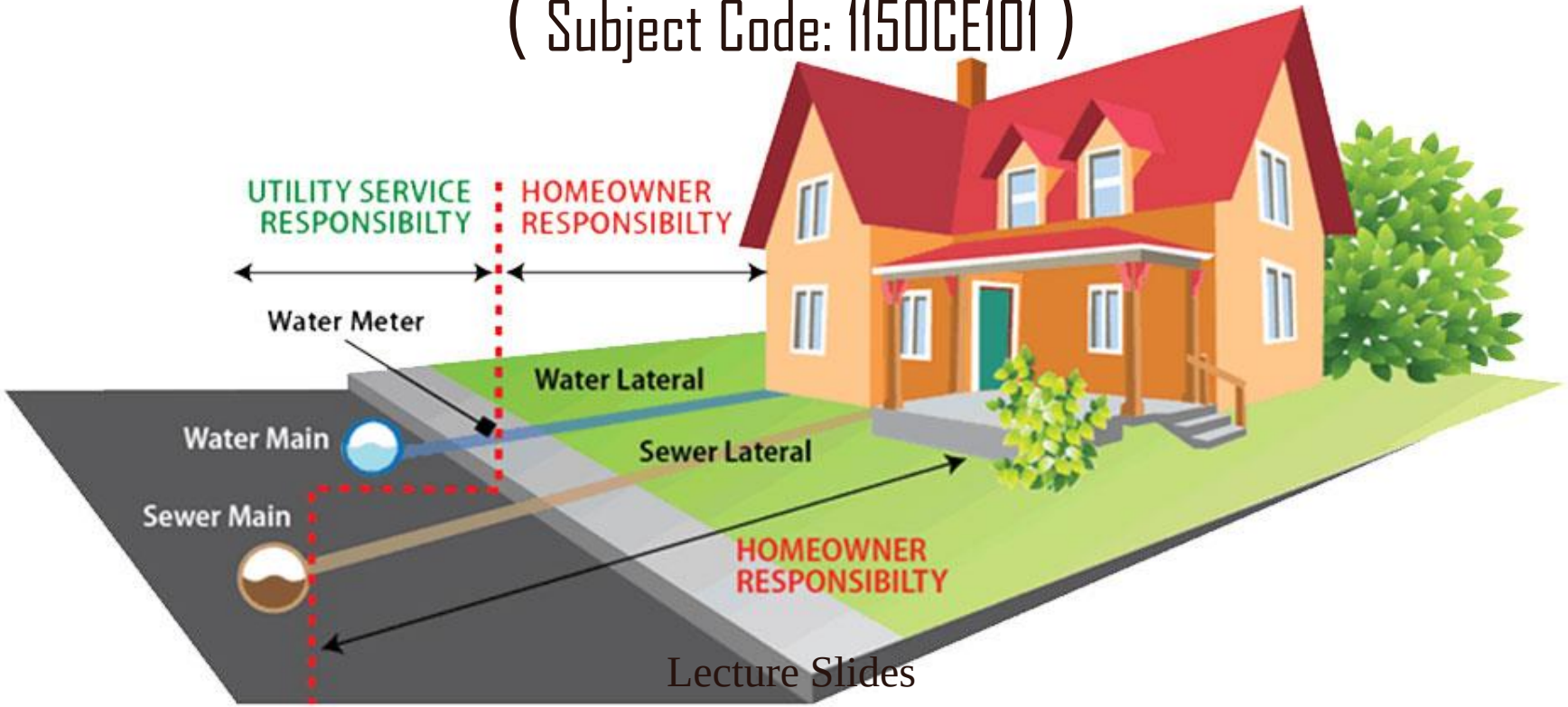
Basic Civil Engineering

(Subject Code: 1150CE101)



Lecture Slides

By

Department of Civil Engineering

Veltech Dr.RR & Dr.SR University

Syllabus

UNIT I: Building Materials

Introduction – Civil Engineering – Materials – Bricks – Composition – Classifications – Properties – Uses – Stone – Classification of Rocks – Quarrying – Dressing – Properties – Uses – Timber – Properties – Uses – Plywood –Cement – Grades – Types – Properties – Uses – Steel – Types – Mild Steel – Medium Steel – Hard Steel –Properties – Uses – Market Forms – Concrete – Grade designation – Properties – Uses – Advancements in Concrete – Pre-stressed Concrete – Pre fabricated concrete.

UNIT II: Building Components

Building – Selection of site – Classification – Components – Foundations – Functions – Classifications – Bearing Capacity – Flooring – Requirements – Selection – Types – Cement concrete marble – Terrazzo floorings – Roof – Types and requirements.

UNIT III: Planning Aspects and Regulations

Building types and design criteria – Space standards for residential, commercial and institutional categories – Building by-laws applicable for approval by the local governing body – Development control rules for Chennai Metropolitan Area. Basic guidelines for earthquake resistant structures.

UNIT IV: Water Supply and Sanitary Systems

Water supply – Objectives – Quantity/Quality of water –Sources – Standards of drinking water – Distribution system –Sewage – Classification – Technical terms – Septic tank – Components and functions – layout of external services –water supply – Sewage disposal – water supply and plumbing layout for a residential building.

UNIT V: Surveying and Transportation

Surveying – Objectives – Classification – Principles of Survey – Transportation – Classification – Cross section and components of road – Classification of roads – Railway – Cross section and components of permanent way – Functions – Water way – Docks and Harbors – Classification - Components – Bridges – Components of bridges.

Unit IV: Water Supply and Sanitary Systems

Water supply – Objectives – Quantity/Quality of water –Sources – Standards of drinking water – Distribution system – Sewage – Classification – Technical terms – Septic tank – Components and functions – layout of external services –water supply – Sewage disposal – water supply and plumbing layout for a residential building.

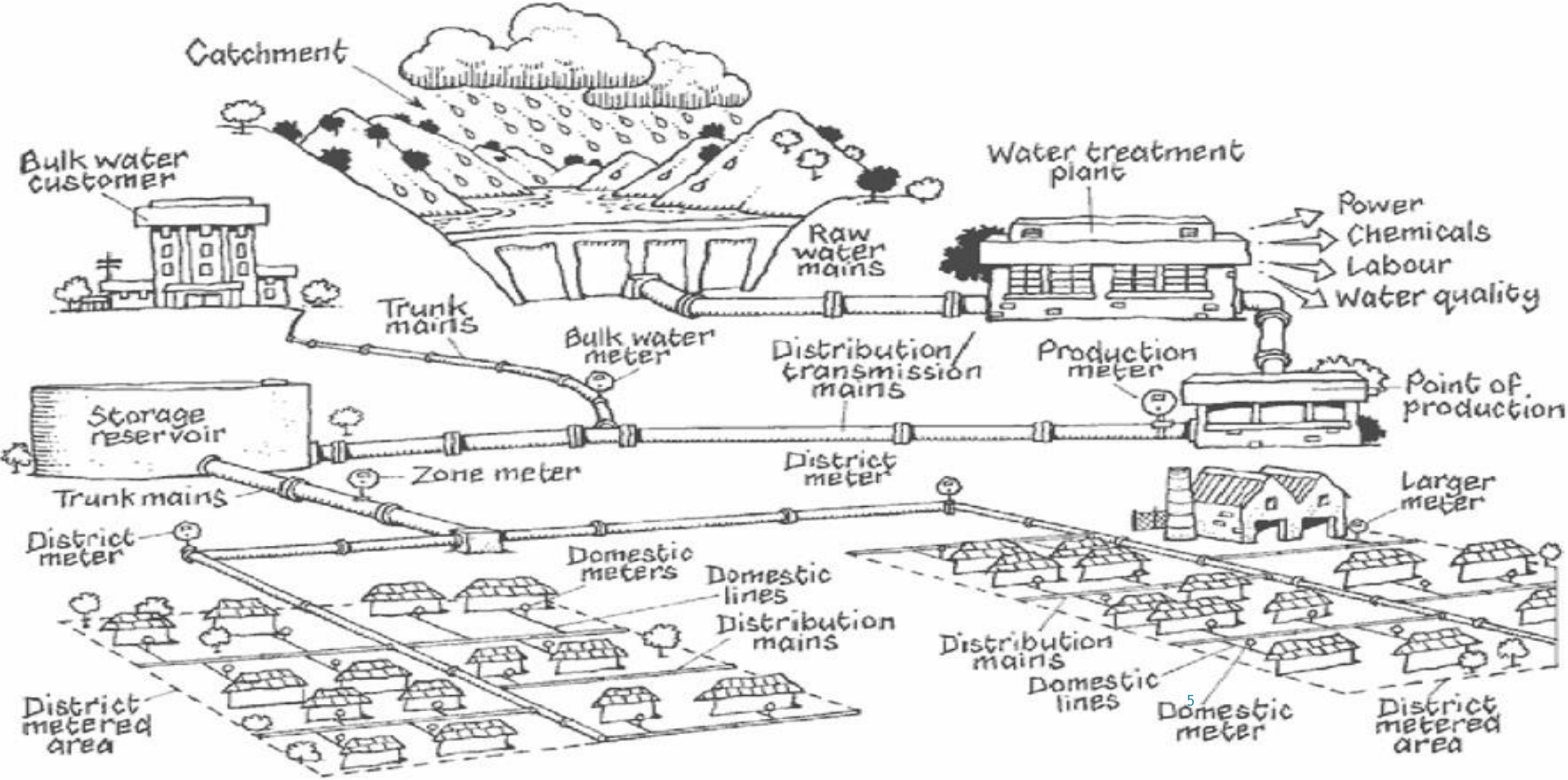
Water Supply System

A Public Water Supply System (PWS) is a system of network of pipes and other hydraulic structures for the provision of water for human consumption.

Layout of PWS is “Source – Collection – Transportation – Treatment and Distribution”. So, Essential elements for a successful PWS should contains:

1. Intakes and Reservoirs
2. Water treatment plant (Screening, Sedimentation, Filtration, Disinfection, etc.)
3. Elevated Tanks and Stand Pipes (For Storage to meet peak demands)
4. Valves (For the controlled flow of water in the system)
5. Hydrants (For the connection necessary for fire fighting, street flushing)
6. Mains – Sub mains – Branch Lines – Service Lines (For Carrying water)

Water Supply System



Water Supply - Objectives

The Objectives of a water supply project should include the following:

- The provision of water for domestic consumption and personal hygiene in terms of the water related by-laws.
- The improvement of the quality of the existing supplies (Protection of the sources being the first consideration)
- The improvement of the availability of water to the community (both reliability & accessibility)
- The improvement of public health
- The improvement of the living standards of the community
- The development of local technical, financial and administrative skills
- The improvement of the economic potential of the community (e.g. small-scale agriculture and industries)

Sources of Water Supply

The various sources of water available on the earth can be classified into the following two categories:

(A) Surface Sources:

- Ponds and Lakes
- Streams and Rivers
- Storage Reservoirs
- Oceans (Generally, not used for water supplies)

(B) Sub-surface Sources:

- Springs
- Infiltration Galleries
- Infiltration Wells
- Wells and Tube wells

Surface Sources

Surface sources are those flows over the surface of the earth. And thus, it directly available for the supply. Important of these sources are:

- Natural Ponds and Lakes
- Streams and Rivers
- Impounding Reservoirs

Natural Ponds & Lakes:

A natural large sized depressions formed within the surface of the earth, when gets filled up with water, is forming a water body.

Pond: If the size of the depression is comparatively small, it may be termed as a Pond.

Lake: If the size of the depression is comparatively large, it may be termed as a Lake.

- Generally, Surface run-off through some stream channels forms Lakes/Ponds. Also Underground water through some springs forms Lakes/Ponds.

Surface Sources

Streams & Rivers:

- *Small streams* feed their water to the lakes or rivers. So, small streams are not suitable for water supply scheme.
- They are useful as sources of water only for small villages, especially hilly regions.
- *Rivers* are the most important sources of water for public water supply.
- The quality of water obtained from rivers is generally not reliable as it contains large amounts of silt, sand and suspended matter.

Reservoir:

- The water stored in the reservoir can be used easily not only for water supplies but also for other benefits.
- Multipurpose reservoirs are planned these days and operated so as to get optimum benefits.

Stream → River → Reservoir

Sub-surface Sources

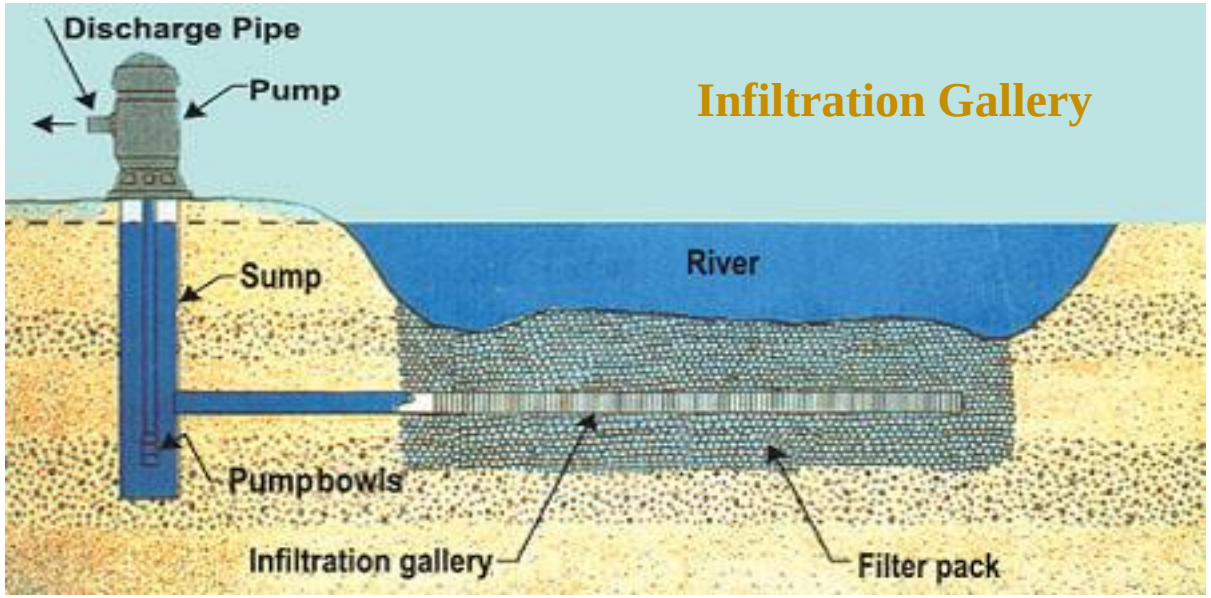
The underground water is available in the following forms:

- Infiltration Galleries
- Infiltration wells
- Springs
- Wells

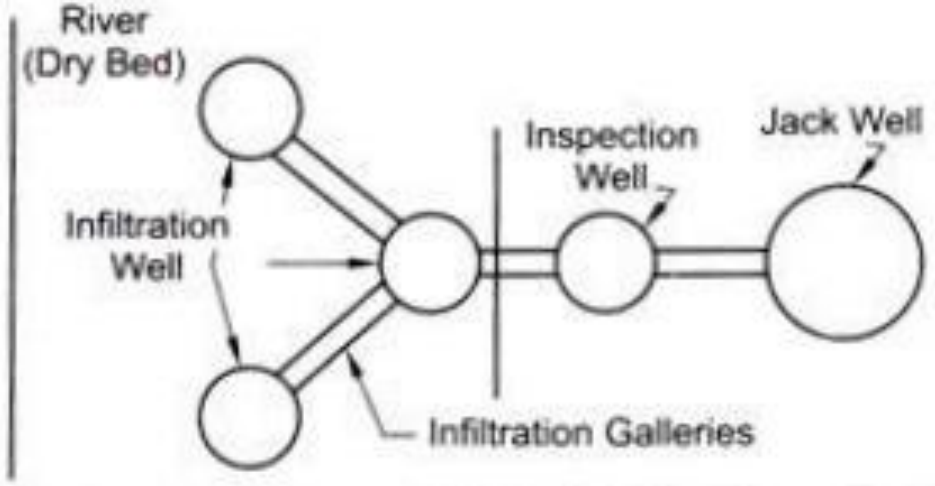
Infiltration Gallery:

- Infiltration galleries are the horizontal (or) nearly horizontal tunnels constructed at shallow depths (3 to 5m) along the river banks, through water bearing strata.
- Also called as Horizontal Wells.

Sub-surface Sources

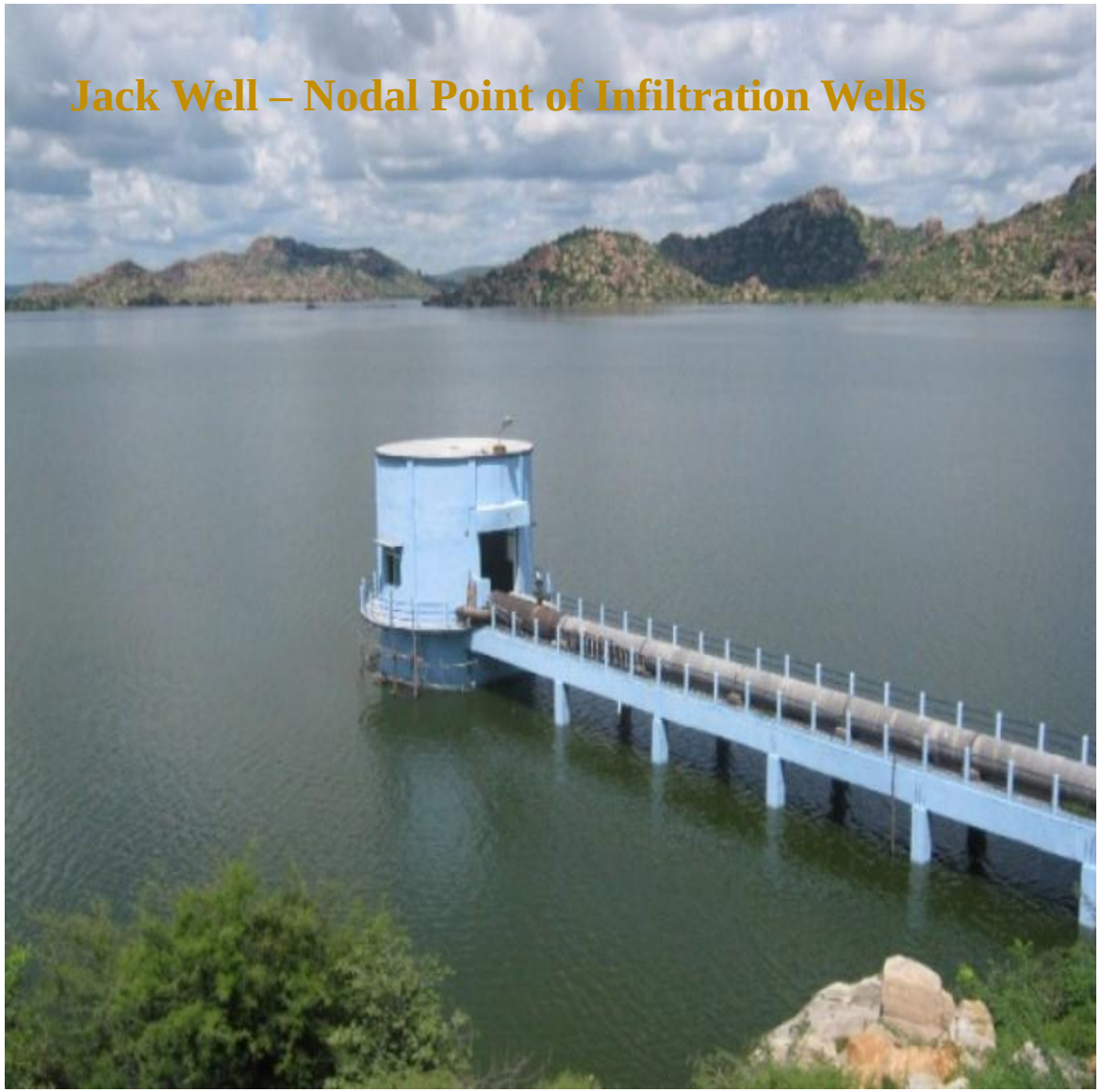


Infiltration Gallery



Infiltration Well

Jack Well – Nodal Point of Infiltration Wells



Sub-surface Sources

Infiltration Wells:

- Infiltration wells are the shallow wells constructed in series along the banks of a river, in order to collect the river water seeping through their bottoms.
- These wells are constructed of brick masonry, usually covered at the top and kept open at the bottom.

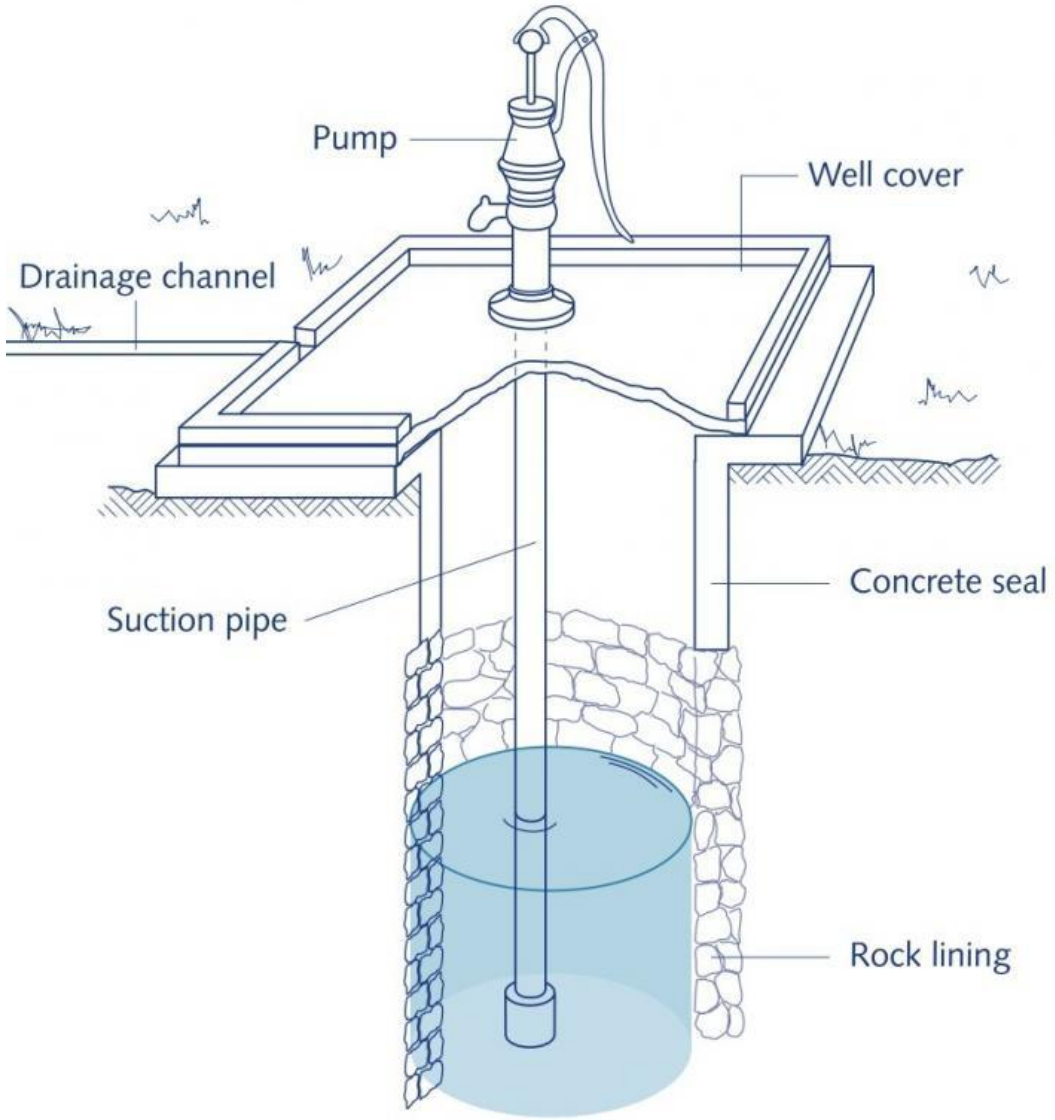
Springs:

- The natural outflow of ground water at the earth's surface is said to form a spring.
- A pervious layer sandwiched between two impervious layers, give rise to natural spring.

Wells:

- A water well is a hole usually vertical, excavated in the earth for bringing groundwater to the surface. The wells may be classified into two types: *Open wells, Tube wells*

Sub-surface Sources



Dug Well

Tube Well runs on solar energy

Quantity / Quality

Source	Quantity	Quality
Ponds & lakes	- Small - Depends on catchment area, annual rainfall, geological formation	- Good and does not need much purification - Larger & older lakes provides good water compared with smaller and newer lakes
Streams & Rivers	- Larger and perennial streams may be used as sources of water supply - Perennial rivers may be used as a direct source for supply - Non perennial rivers may be used as a source with the provision of storage reservoir	- Not reliable - Contains large silt, sand and lot of suspended matter - River water has to be analysed and well treated before the supply
Storage Reservoir	- Abundant quantity - Can be used not only for water supply but also for multiple purpose	- Same as that of a lake water
Underground water	- Adequate quantity for individual needs - Not suitable for public supply - Availability varies with terrain	- Not much contaminated due to availability of natural filtration - Can be used for drinking with RO

Standards of Drinking water

- As per IS 10500, the standards of drinking water for human consumption are given as follows:

----------*Essential Characteristics*----------			
S.No	**Parameters**	**Desirable Limit (mg/l)**	**Permissible Limit (mg/l)**
1	Colour (Hazen Unit)	5	25
2	Odour	Unobjectionable	-
3	Taste	Agreeable	-
4	Turbidity (NTU)	10	25
5	pH	6.5 – 8.5	No Relaxation
6	Total Hardness, $CaCO_3$	300	600
7	Iron	0.3	1.0
8	Chloride	250	1000
9	Residual Chlorine	0.2	-
10	Fluoride	0.6	1.5

NTU – Nephlometric Turbidity Unit

Water Distribution System

Definition:

Water distribution network is a system of conduits, pipes and valves connected together to convey the water from surface reservoir to individual consumer.

Purpose of Distribution system:

- To deliver water to the consumers with appropriate quality, quantity and pressure.
- To describe the facilities collectively used to supply water from source to point of usage

Water Distribution System

Requirements of a good distribution system:

- Water quality should not get deteriorated in the distribution pipes.
- It should be capable of supplying water at all the intended places with sufficient pressure head.
- It should be capable of supplying adequate amount of water during fire fight.
- The layout should be such a way that no consumer would be without water, during the repair of any section of the system.
- All the distribution pipes should be preferably laid one meter away (or) above the sewer lines.
- It should be fairly water-tight so as to keep the leakage losses to the minimum.

Water Distribution System

Layouts of Distribution Network:

- The distribution pipes are generally laid below the road pavements, and as such their layouts generally follow the layouts of roads.
- In general, there are four different types of pipe networks; any one of which either singly or in combinations, can be used for a particular place.
- The types of water distribution network are:

(i) Dead End System

(ii) Radial System

(iii) Grid Iron System

(iv) Ring System

Distribution Layout – Dead End System

This layout is suitable for old towns and cities having no definite pattern of roads (or) irregular road pattern.

Advantages:

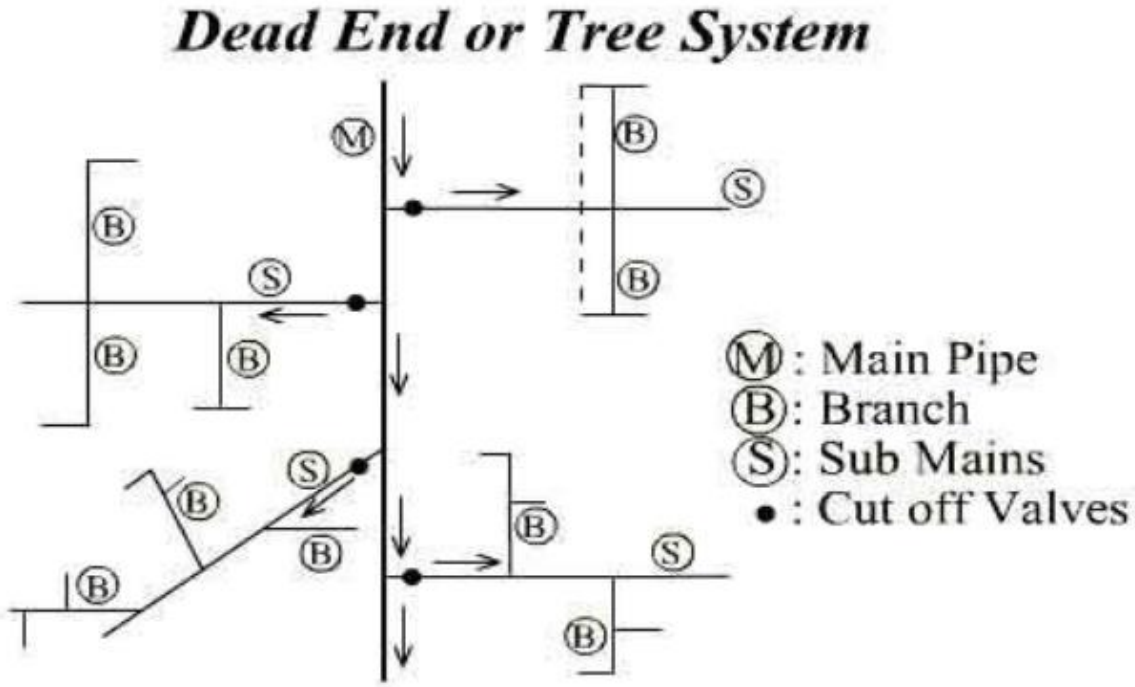
(i) Relatively Cheap

(ii) Determination of discharge and pressure is easier due to less number of valves.

Disadvantages:

(i) Due to many dead ends, stagnation of water occurs in pipes.

(ii) Water scarcity during repairs at a section



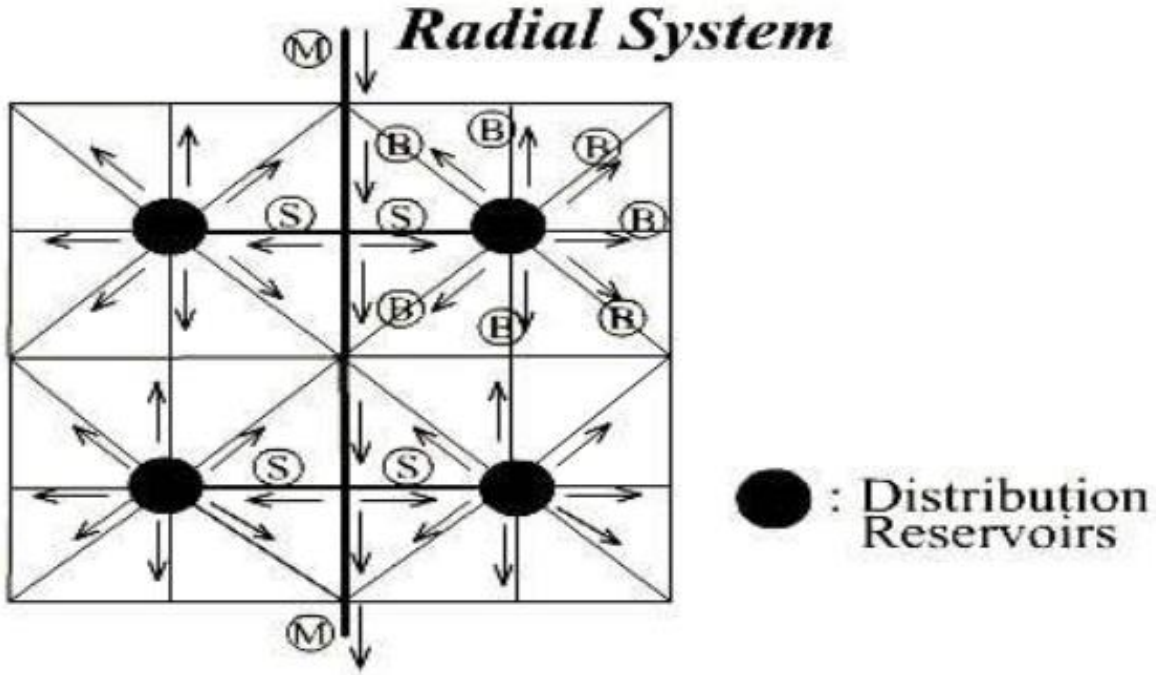
Distribution Layout – Radial / Star System

- In this system, area is divided into different zones.
- Water is pumped into the distribution reservoir kept in the middle of each zone.
- The supply pipes are laid radially ending towards the periphery.

Advantages:

(i) It gives quick service.

(ii) Water scarcity during repairs is avoided.



Distribution Layout – Grid Iron System

This layout is suitable for the cities with rectangular layout, where the water mains and branches are laid in rectangles.

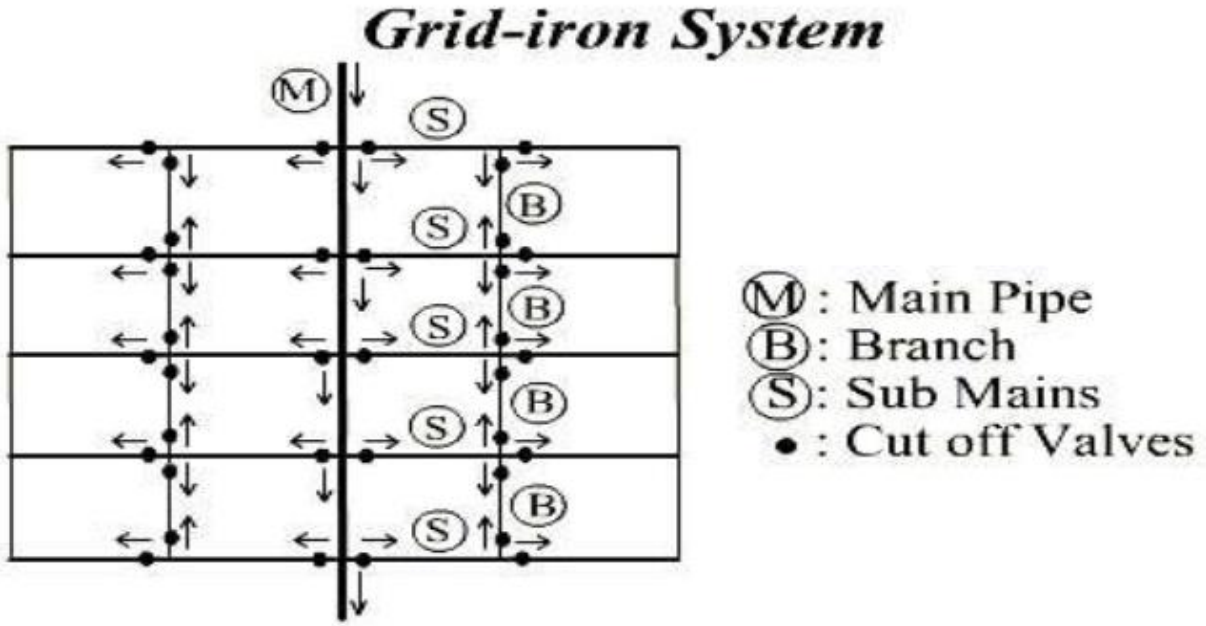
Advantages:

(i) Water is kept in good circulation due to the absence of dead ends.

(ii) In case of a breakdown in some section, water will be available from some other direction.

Disadvantages:

(i) Exact calculation of discharge of pipes is difficult due to provision of valves on all branches.

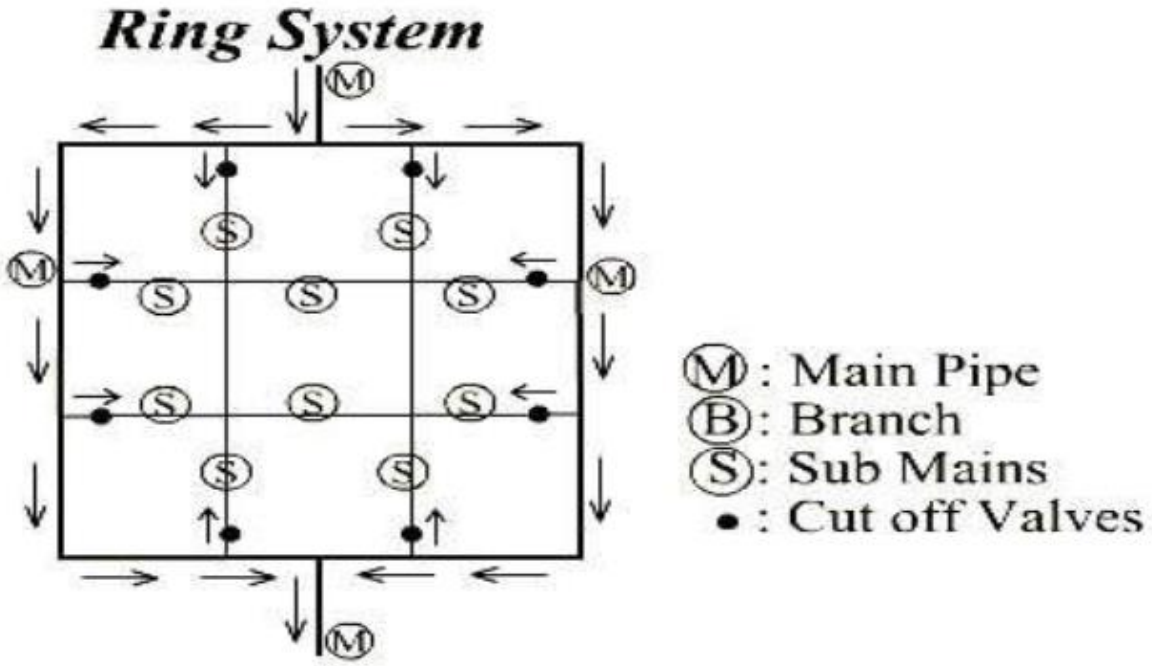


Distribution Layout – Ring System

- In this system, the supply main is laid along the peripheral roads and sub mains are branch out from the mains.
- This system follows the grid iron system in flow pattern, and follows the dead end system in character.

Advantages:

(i) Water can be supplied to any point from at least two directions.



Sewage

Definition:

It indicates the liquid waste originating from the domestic uses of water. It include sullage, discharge from toilets, urinals, wastewater generated from commercial establishments, institutions, industrial establishments and also the ground water and storm water that may enter into the sewers.

Classification of Sewage:

(i) Domestic Sewage: It consists of liquid wastes originating from urinals, latrines, bathrooms, kitchen sinks, wash basins, etc. of the residential, commercial or institutional buildings.

(ii) Industrial Sewage: It consists of liquid wastes originating from the industrial processes of various industries, such as Dyeing/Paper Making/Textile/Tannery etc.

(iii) Sanitary Sewage: The sum total of domestic and industrial sewage may be termed as Sanitary sewage or simply sewage.

(iv) Storm Sewage: The runoff resulting from the rain storms was used to be called as 'Storm Sewage' but in modern days, is called as 'Storm Drainage'.

Sanitary Engineering – Technical Terms

Refuse : It is a general term used to indicate what is rejected or left out as worthless. It may be in liquid, semi-solid or solid form. It is dived into six categories:

- Garbage - Rubbish - Sullage - Subsoil water - Storm water – Sewage.

Sullage: This refers to the wastewater generated from bathrooms, kitchens, washing place and wash basins, etc. Composition of this waste does not involve higher concentration of organic matter and it is less polluted water as compared to sewage.

Sewage: It indicates the liquid waste originating from the domestic uses of water. It include sullage, discharge from toilets, urinals, wastewater generated from commercial establishments, institutions, industrial establishments and also the ground water and storm water that may enter into the sewers.

Sub Soil water: Groundwater that enters into the sewers through leakage is called sub soil water.

Storm water: It indicates the rain water of the locality.

Sanitary Engineering – Technical Terms

Night Soil: It is a term used to indicate the human and animal excreta.

Sewer: It is an underground conduit or drain through which sewage is carried to a point of discharge or disposal.

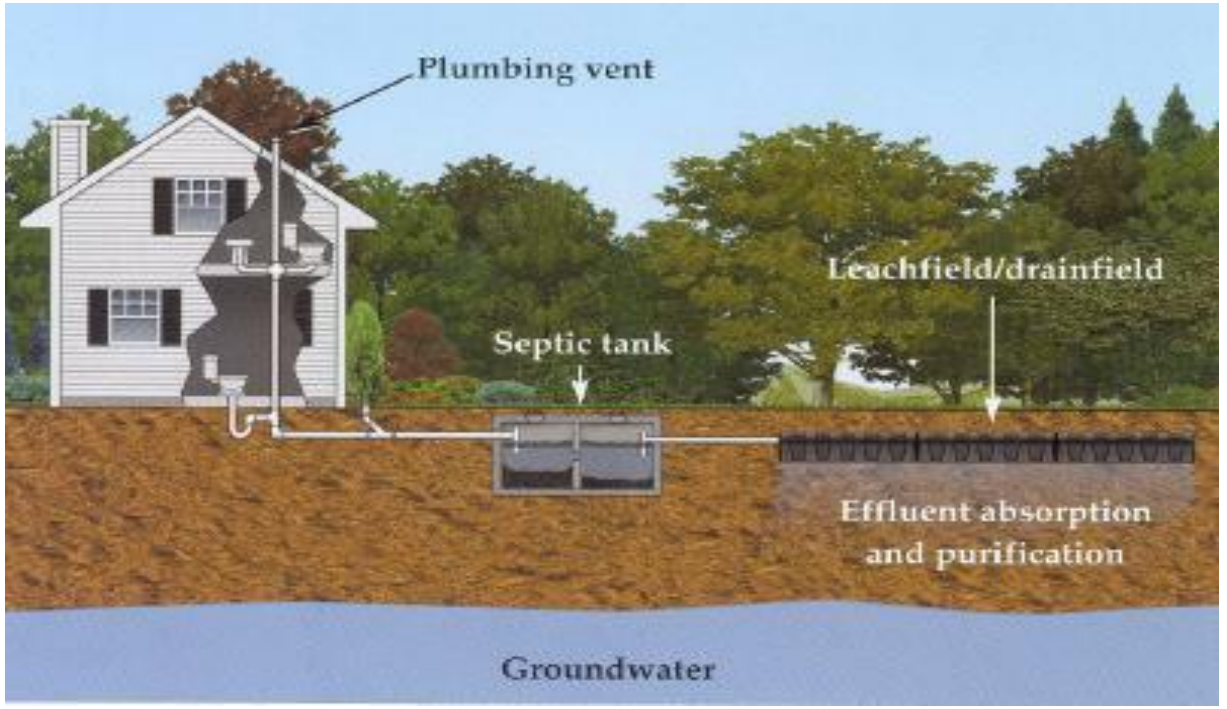
Sewerage: The term sewerage refers the infrastructure which includes device, equipment and appurtenances for the collection, transportation and pumping of sewage, but excluding works for the treatment of sewage.

Sewage Treatment Plant is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water body or land.

Septic Tank

A **septic tank** is a watertight chamber made of concrete through which domestic wastewater (sewage) flows for primary treatment.

A septic system is a self-contained, underground wastewater treatment system that is designed to hold, treat and dispose of household wastewater.



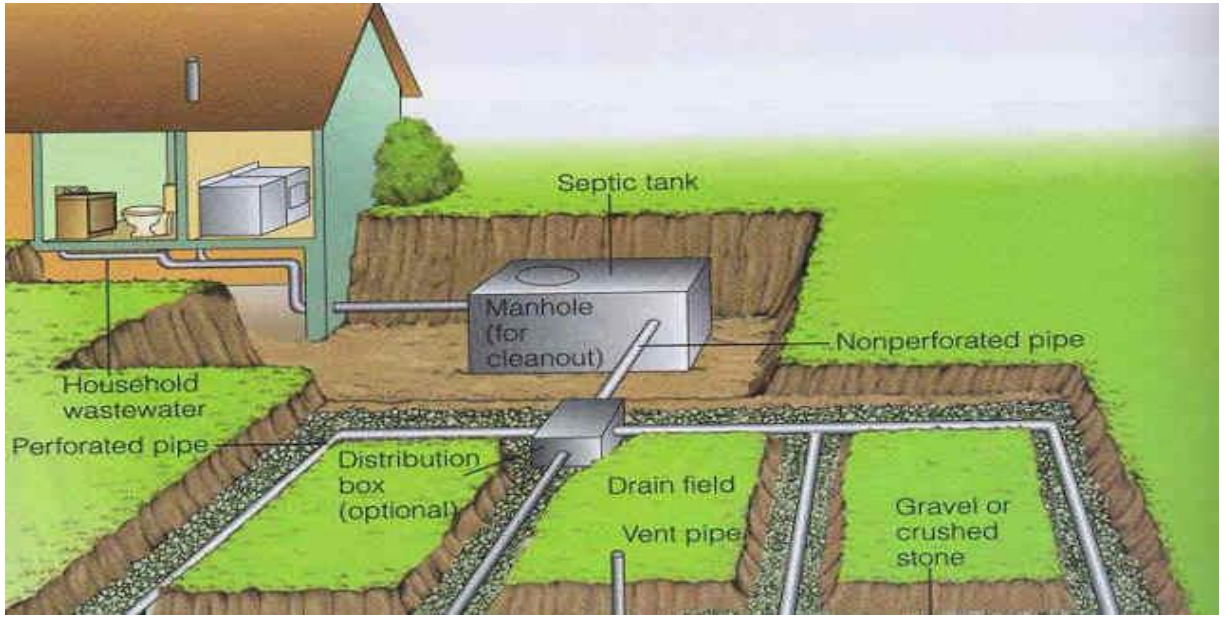
Components of Septic Tank:

(i) Plumbing work from the house

(ii) Septic tank

(iii) Drain field / Leach field / Dispersion field

(iv) Soil



Septic Tank

Function:

(i) Pipe from the house:

All of the household wastewater exits the home through a pipe to the septic tank.

(ii) Septic Tank:

- The septic tank is buried, watertight container typically made of concrete.
- It holds the wastewater long enough to allow solids to settle out, forming sludge, and oil and grease to float to the surface as scum.
- It also allows partial decompositions of the solid materials.
- Compartments and a T-shaped outlet in the septic tank prevent the sludge and scum from leaving the tank and traveling into the leach field/drain field area.

Septic Tank

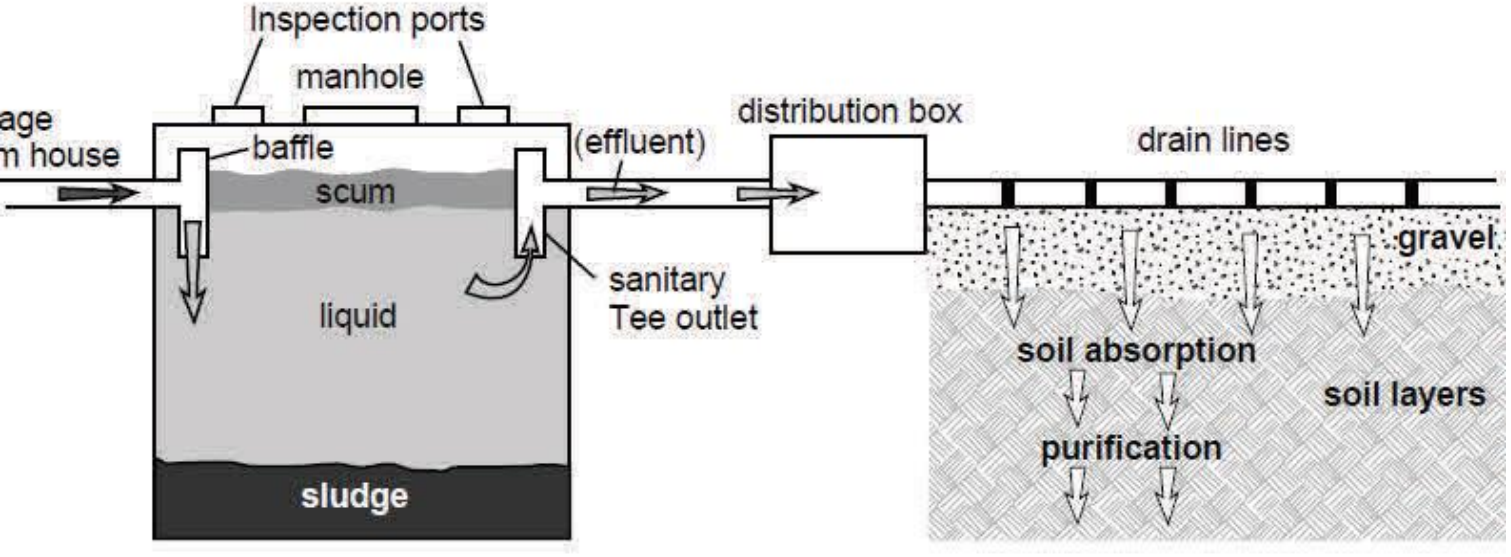
(iii) Dispersion Field:

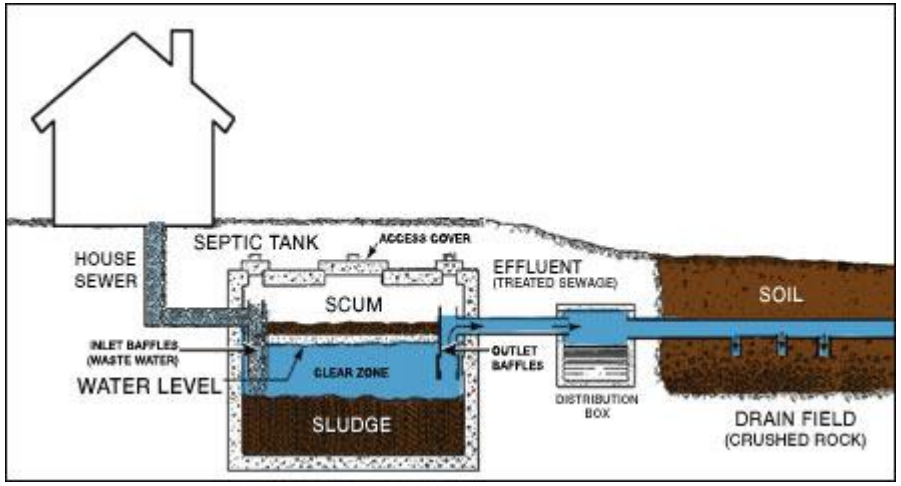
The partially treated wastewater is pushed along into the leachfield/drain field for further treatment everytime new wastewater enters the tank.

The most common leachfield/drain field consists of a series of trenches containing perforated pipe surrounded by septic rock, or gravel, and covered with mesh and dirt. The effluent entering the leachfield/drain field is partially absorbed into the soil and partially evaporated.

(iv) Soil:

Septic tank wastewater flows to the leachfield/drain field, where it percolates into the soil, which provides final treatment by removing harmful bacteria, viruses, and nutrients. Suitable soil is necessary for successful wastewater treatment.





Plumbing System for Residential Building – Water Supply

- The plumbing systems must be designed to provide uniform flow and pressure in all floors and place within certain practical limitations.
- Types of Plumbing system for water supply are:

(i) Plumbing system using direct supply

(ii) Plumbing system using Overhead tank

(iii) Plumbing system using Underground – overhead tank supply

(iv) Pumped System

(v) Continuous running system

Plumbing System for Residential Building – Water Supply

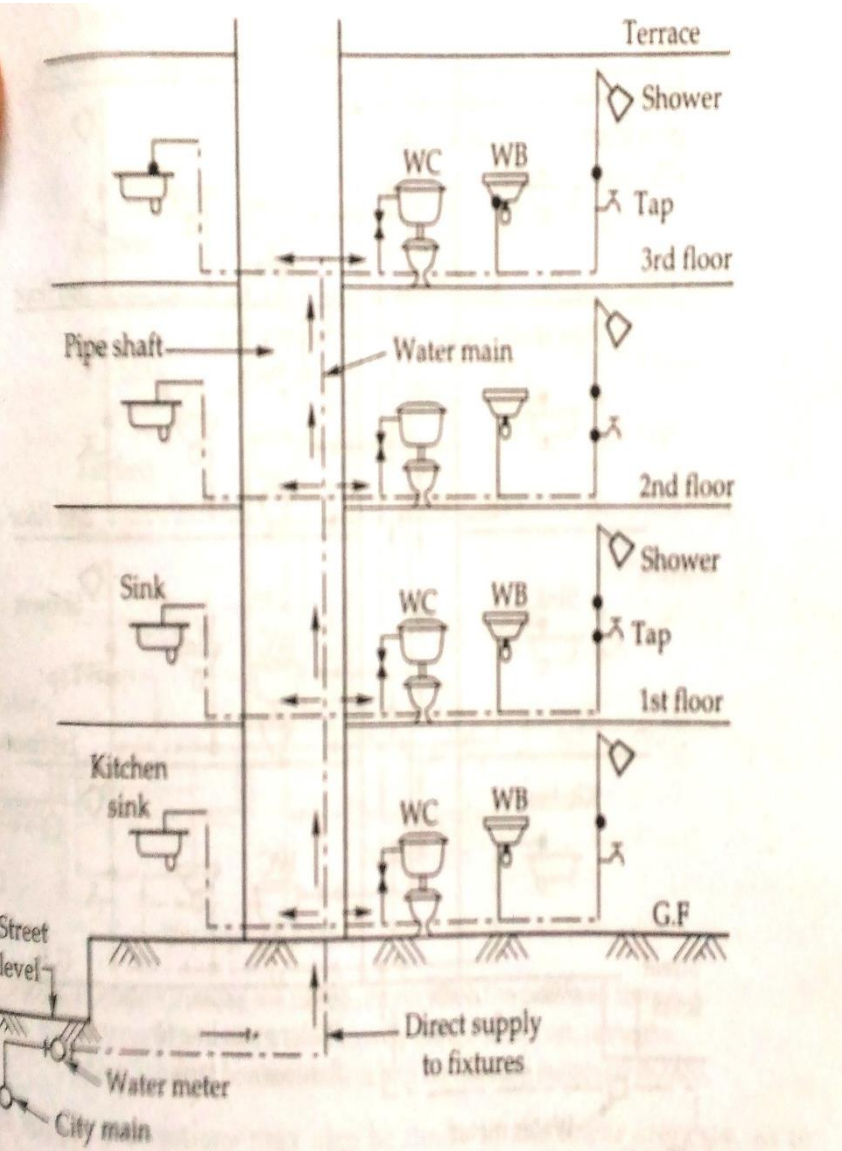


Fig. 11.9. Direct supply.

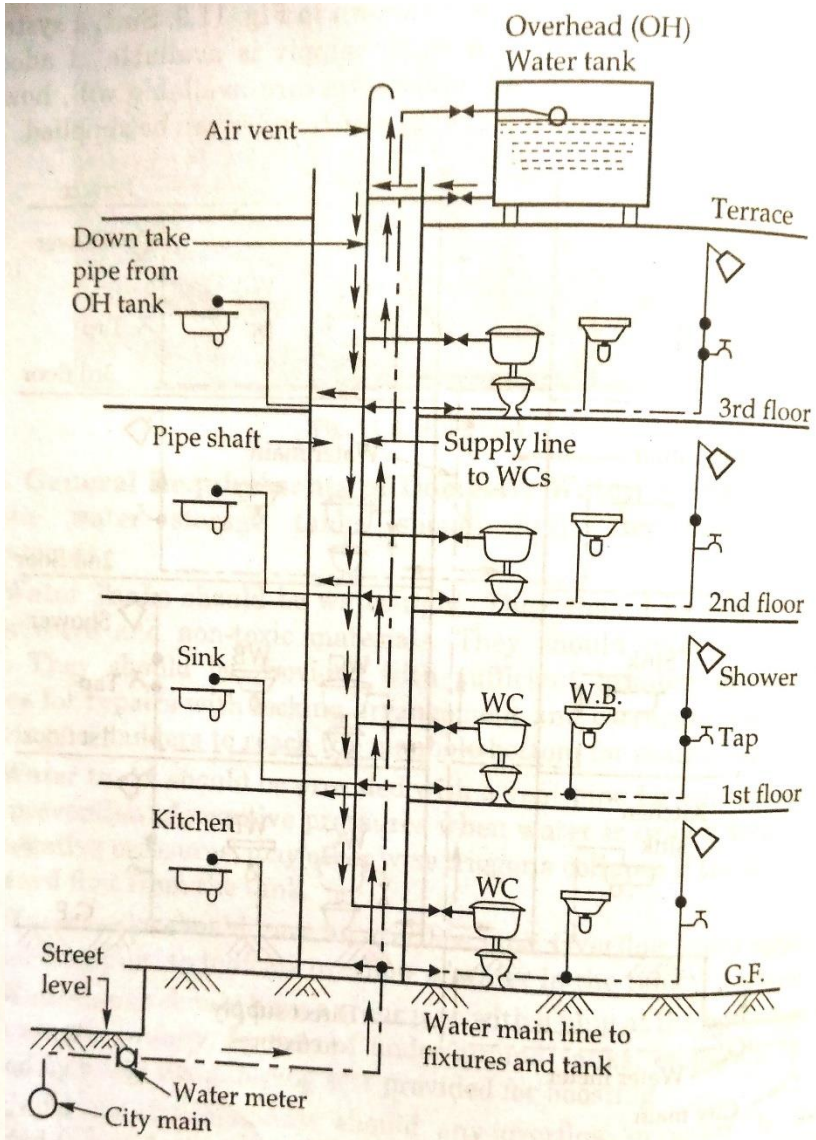


Fig. 11.10. Direct supply supplemented with an overhead tank supply.

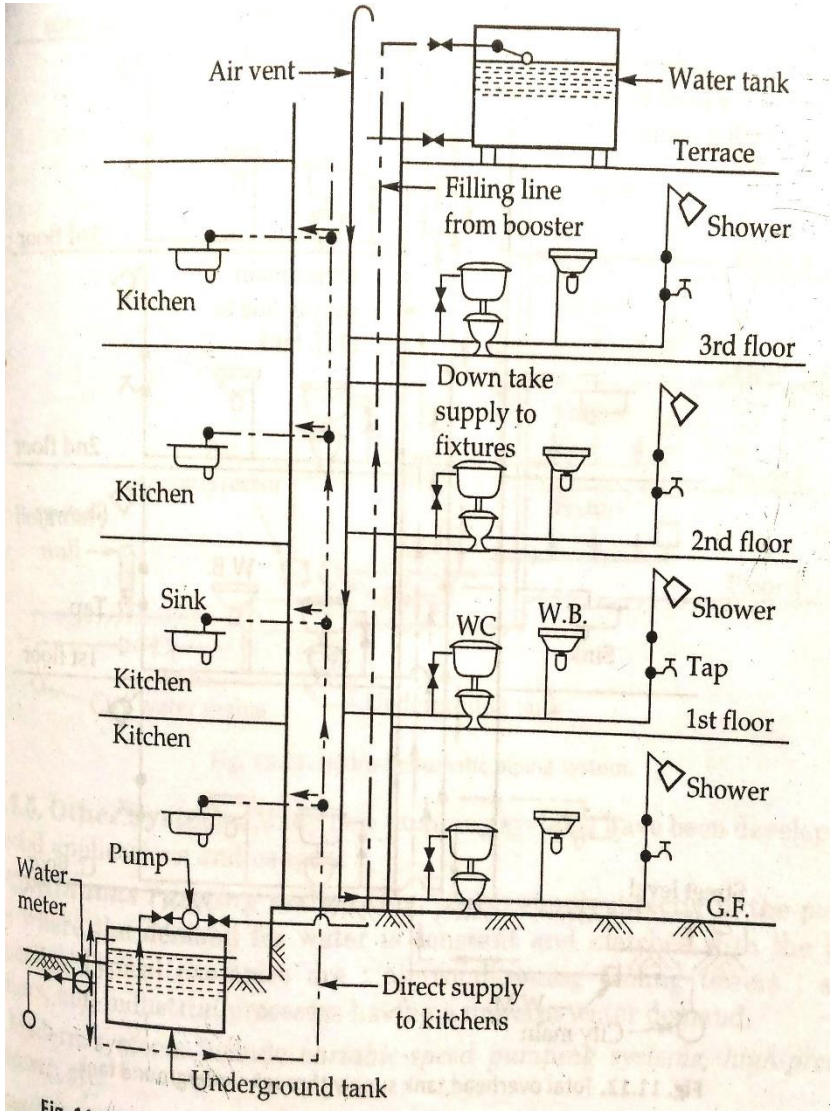


Fig. 11.11. Figure showing the piping system when the overhead storage is made through the underground tank by using a pump set, while the direct supply is used in kitchens and for drinking purposes.

Plumbing System for Residential Building – Sewage Disposal

Following are the four principle systems adopted in plumbing of drainage work in a building:

(i) Two pipe system

(ii) One pipe system

(iii) Single stack system

(iv) Partially ventilated single stack system

Two Pipe System: This is the best and the most improved type of system of plumbing. In this system, two sets of vertical pipes are laid, i.e. one for draining night soil, and the other for draining sullage.

One Pipe System: In this system, instead of using two separate pipes (for carrying sullage and night soil, as is done in two pipe system), only one main vertical pipe is provided, which collects the night soil as well as the sullage water from their respective fixtures through branch pipes.

Plumbing System for Residential Building – Sewage Disposal

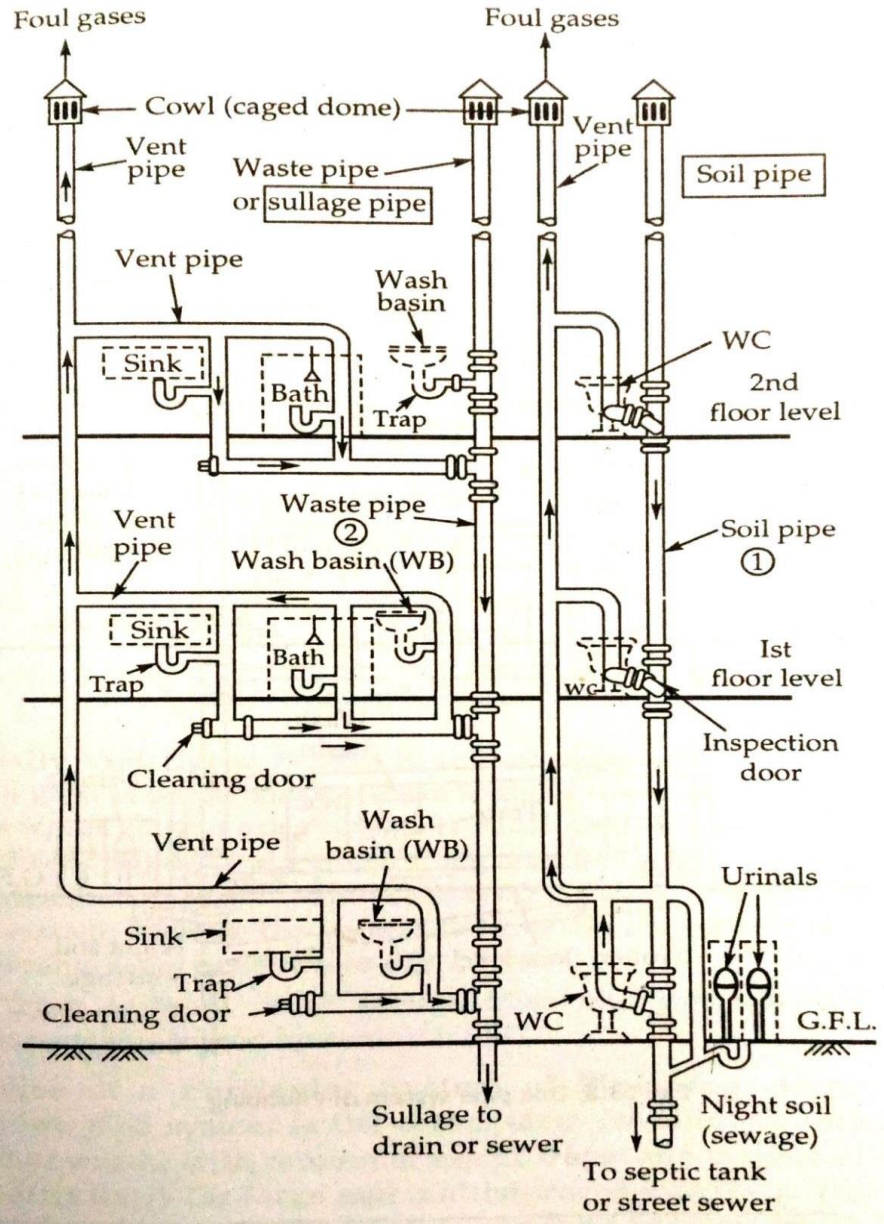


Fig. 13.7. Two pipe system of Plumbing.

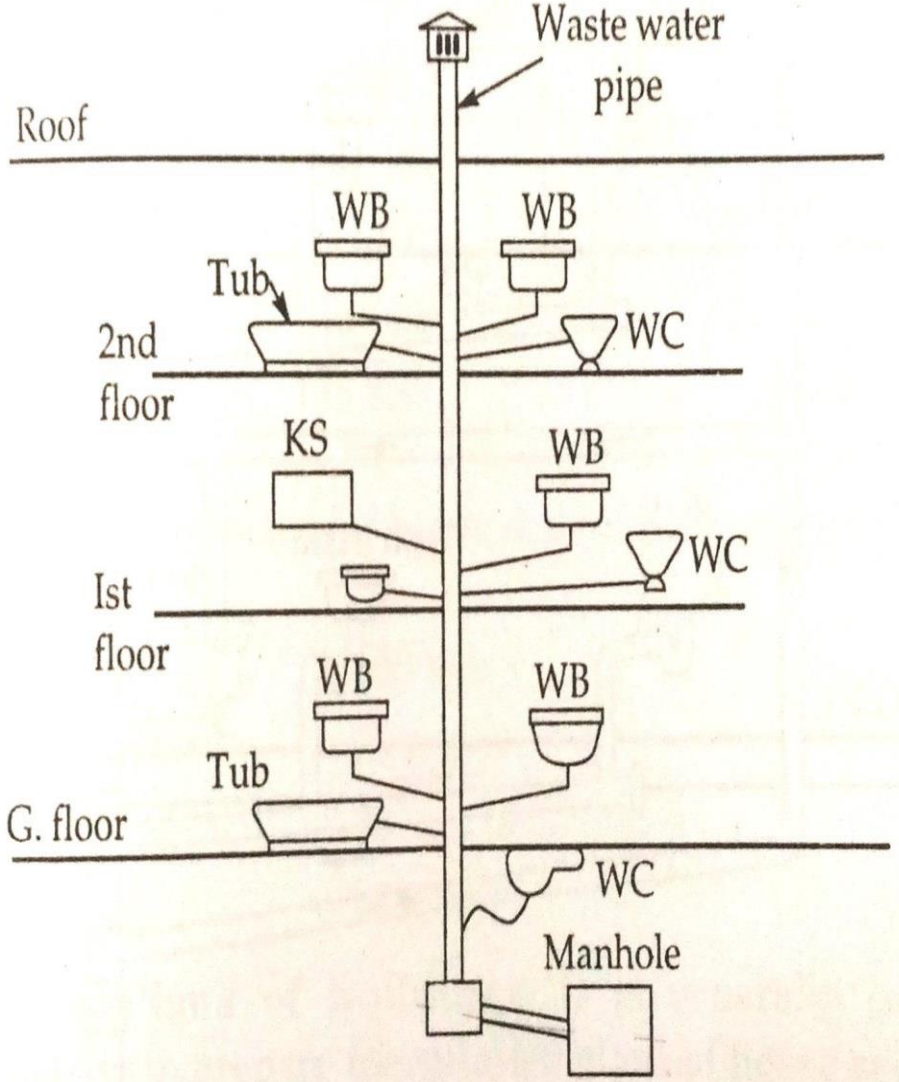


Fig. 13.9. Single stack system of Plumbing.