

# Drainage System

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KHUSHHAL

Asst.Prof.

Civil engineering department

RPS CET,BALANA

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# *Drainage system*

- It is the arrangement provided in a house or a building for collecting and conveying waste water through drain pipes by gravity to join a public sewer or a domestic septic tank is termed as building drainage or house drainage.

Or

- The drainage system is designed to carry waste water from a building to the main sewage network.



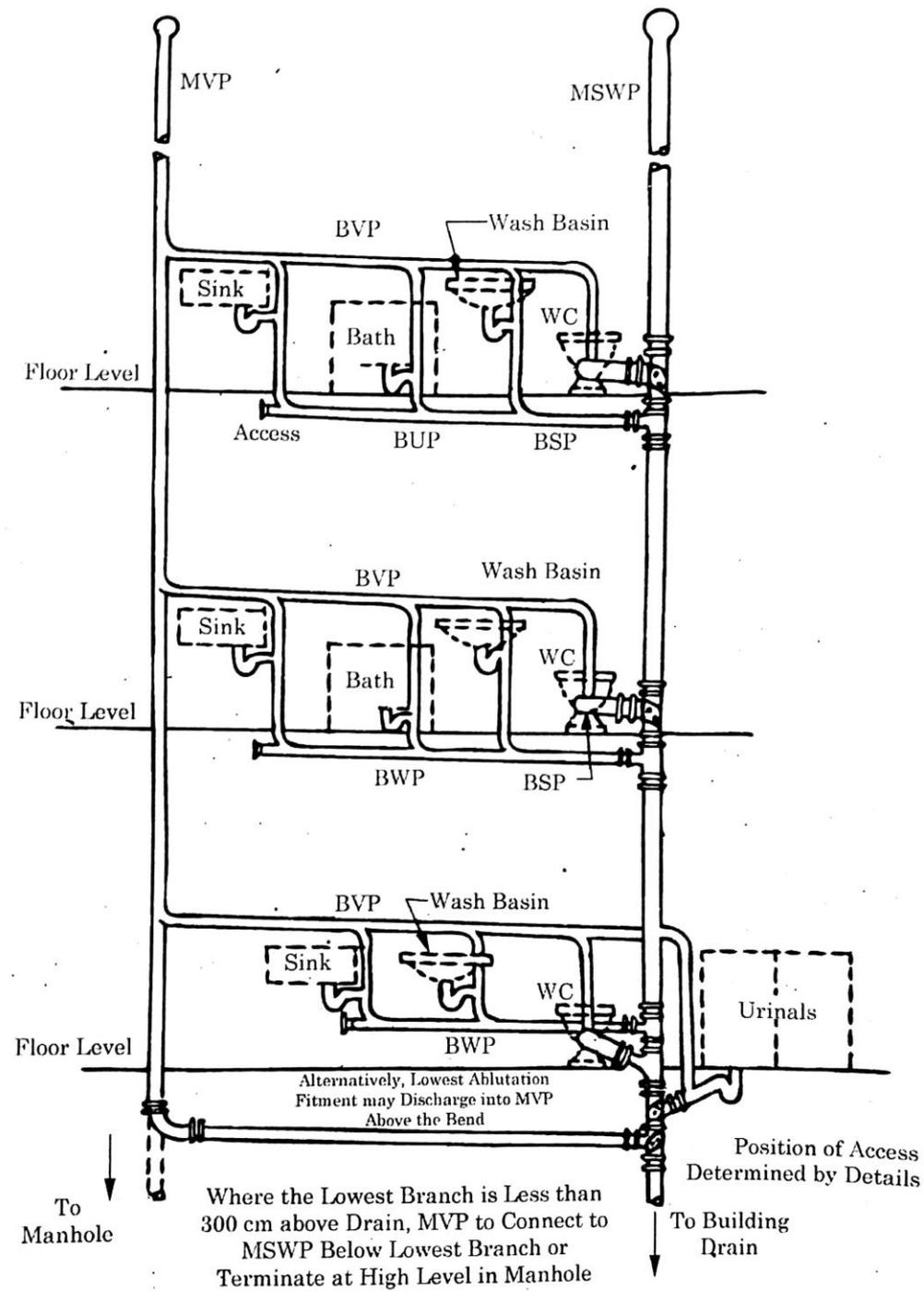
# There are four different systems of plumbing

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1. One pipe system
2. Two pipe system
3. Single stack system
4. Partially ventilated single stack system

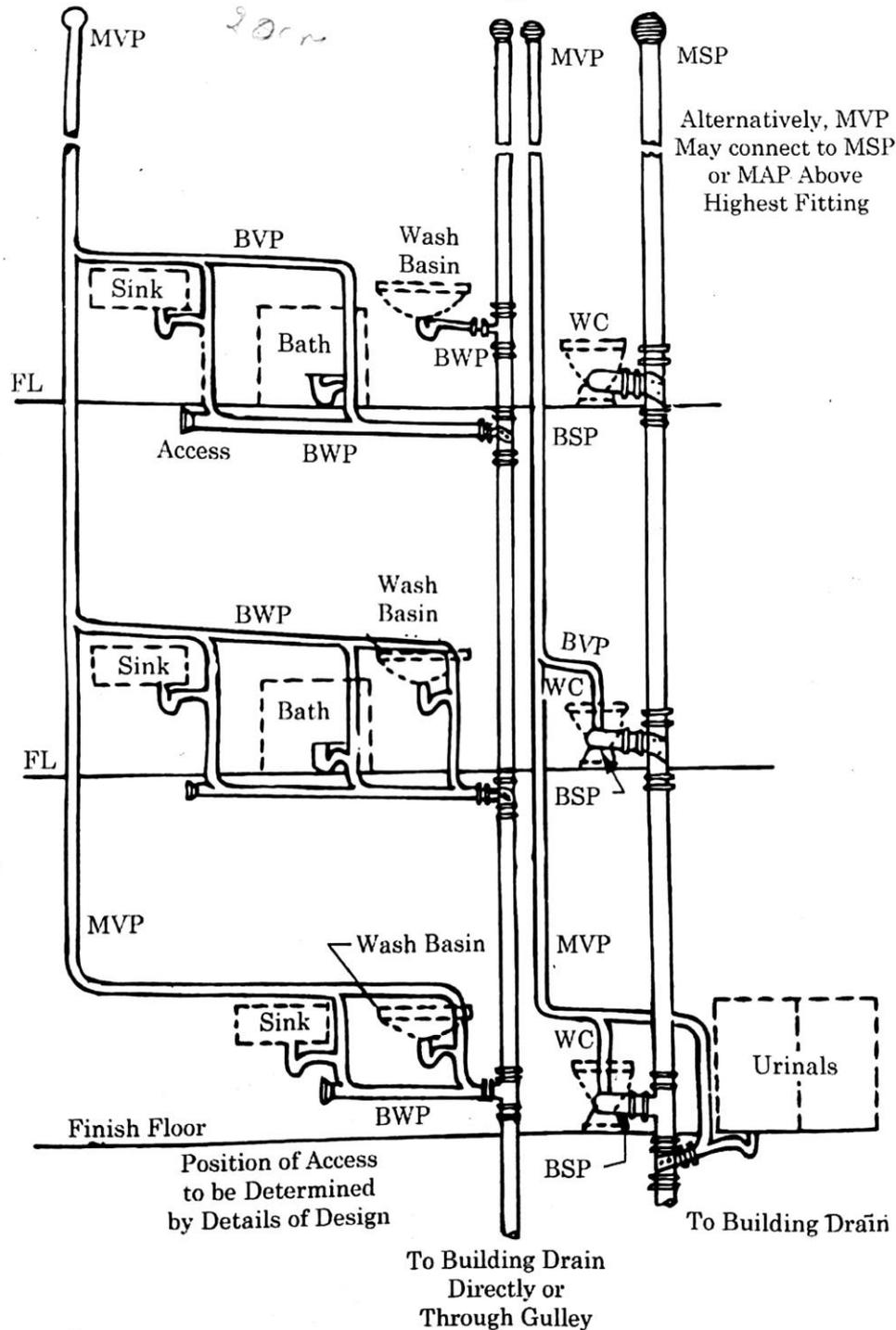
# One Pipe system

- In one pipe system only one pipe is provided for discharge waste water from wash basin, sinks, water closet, urinal and kitchen, etc.
  - Such pipe is called soil cum waste pipe because it carries both sullage and night soil.
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- A separate ventilation pipe is provided to all floor traps, gully traps are not provided in this system.
  - This method is more economical and is used where all types of waste water taken together in a common sewer line to the place of disposal.
  - While adopting this system the following points should be kept in mind:-
    1. Deep water seal of 75 mm depth should be provided in traps.
    2. Diameter of ventilation pipe should not be less than 50 mm.
    3. Air tight joint should be provided to the waste pipe.



# Two Pipe system

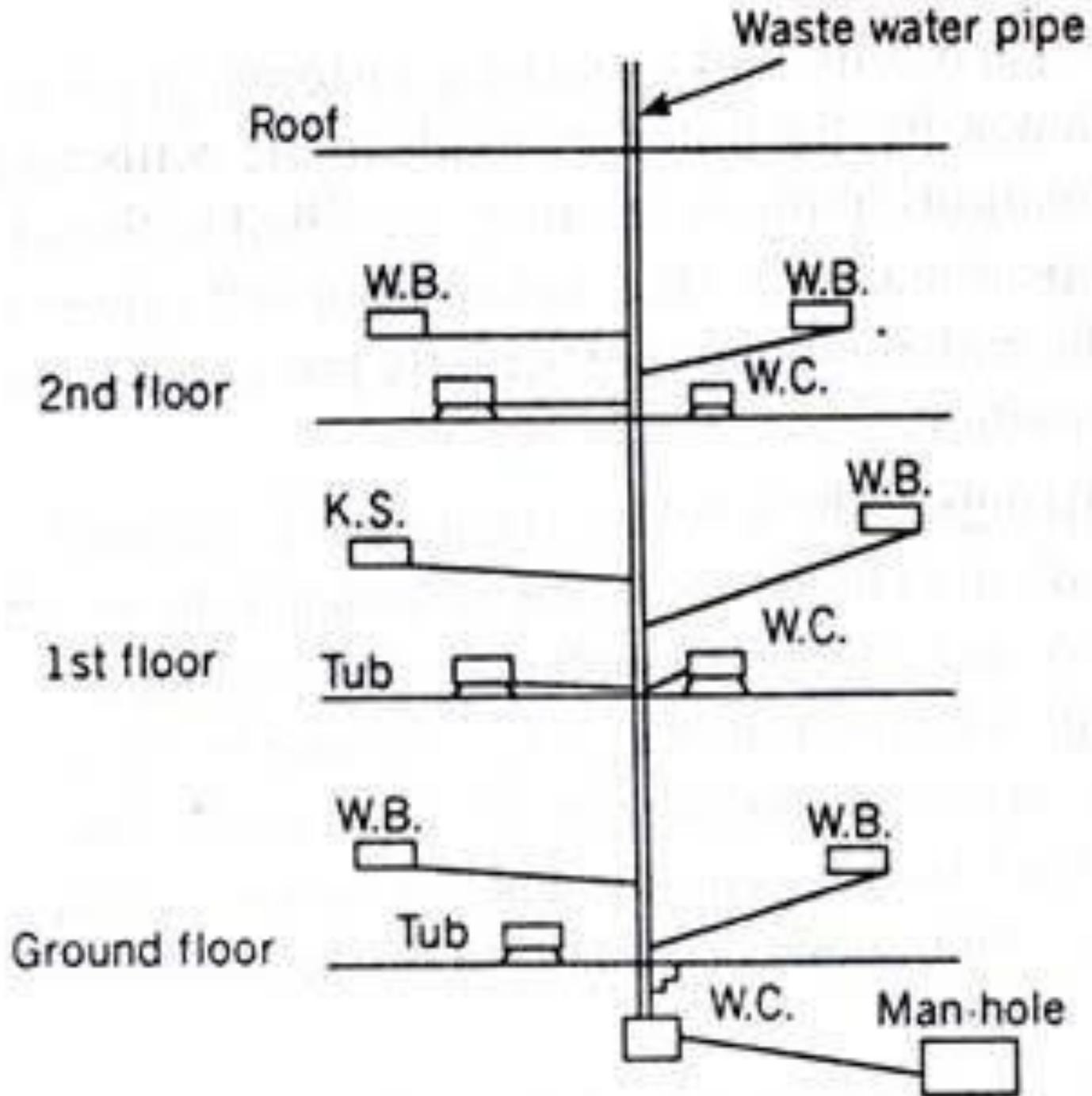
- In this system, two pipes are provided, one pipe(i.e. soil pipe) discharges the foul material from W.C. and urinal whereas the other pipe (i.e. waste pipe) discharges waste water from kitchen, bath, wash basin and sink.
- The soil pipe is directly connected to the drainage system and waste pipe is connected to drainage system through gully trap.
- In this two ventilation pipes are connected to each stack.
- Thus in two pipes system four pipes are needed.
- In this system chances of blockage will be reduced.
- Four pipes required thus costly.
- They may be difficult to accommodate.



# Single stack system

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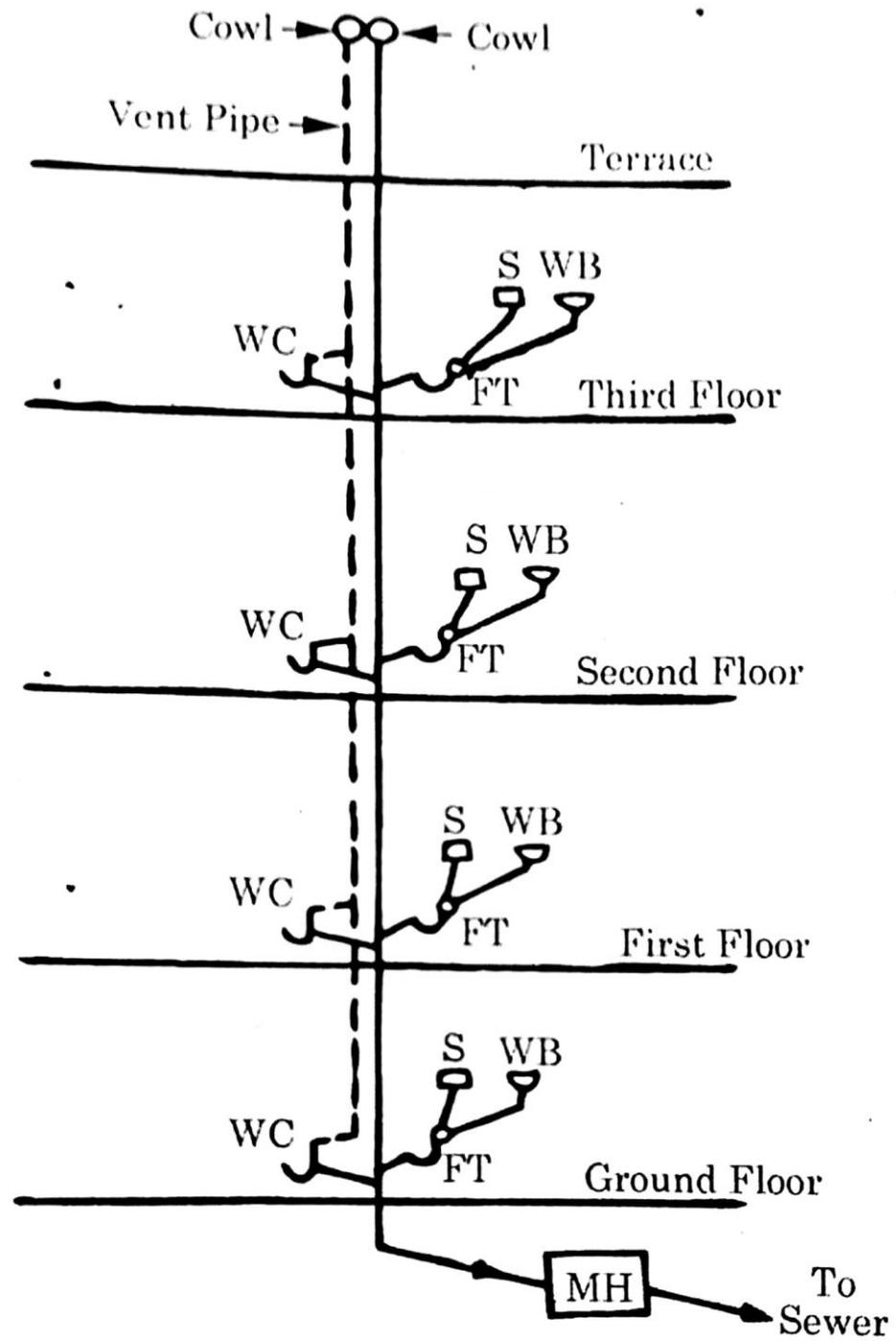
- It is a simplified form of one pipe system.
- This system is having a single pipe for night soil and waste without separate ventilation pipe.
- It uses only one pipe which carries night soil as well as sullage and the same pipe is extended 2 m above roof level with a cowl.



# Partially ventilated single stack system

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- This is an improved form of single stack system.
- All the soil and waste fittings discharges waste water into a single soil cum waste pipe.
- In this system traps of soil fittings i.e. W.C. and urinal are ventilated through a separate ventilating pipe called relief vent pipe



# Trap

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- It is defined as a bend provided in a drainage system which is always full of water to prevent the entry of foul gases in the atmosphere is known as trap.
- A trap prevents the entry of foul gases into the building from sewer but it allows the sewage to flow through it.
- Water seal:-

The vertical distance between inside lowest point or dip and inside highest point or crown weir is called seal or water seal.

# Requirements of good trap

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- It should be made up of non absorbent material.
- It should provide an adequate water seal.
- Its inner surface should be smooth.
- Its fixing should be easy.
- It should be constructed of best enamelled substance so that human excreta may not stick to it.

# Causes of breaking of seal

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1. The seal may break due to faulty joints.
2. The seal may break due to crack in bottom of seal from atmospheric agency.
3. The seal may break due to creation of partial vacuum in sewer fittings.
4. The seal may break due to increase in pressure of sewer gases.

# Classification of trap

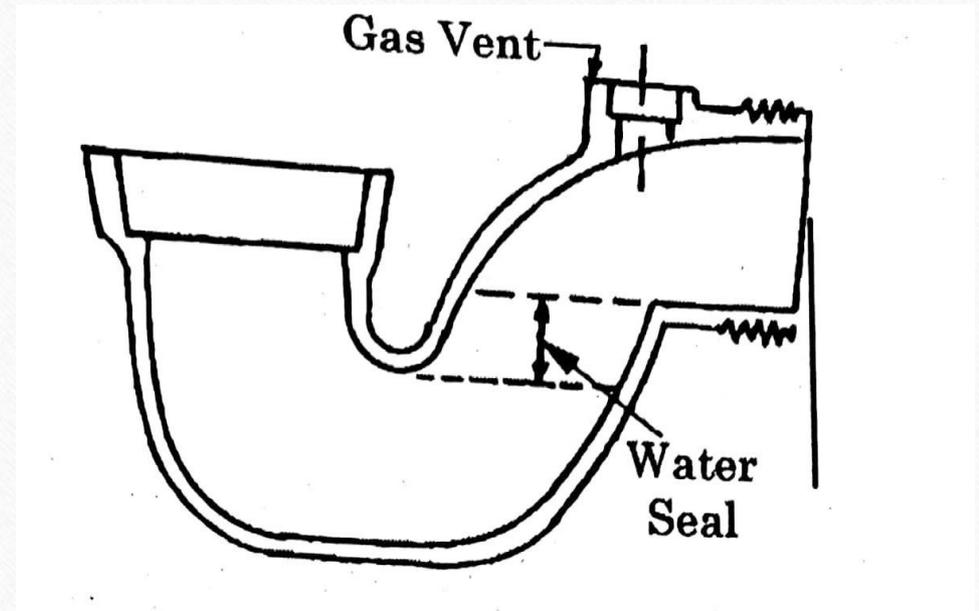
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- The traps are classified as:-
  1. On the basis of shape
  2. On the basis of use of trap

# On the basis of shape

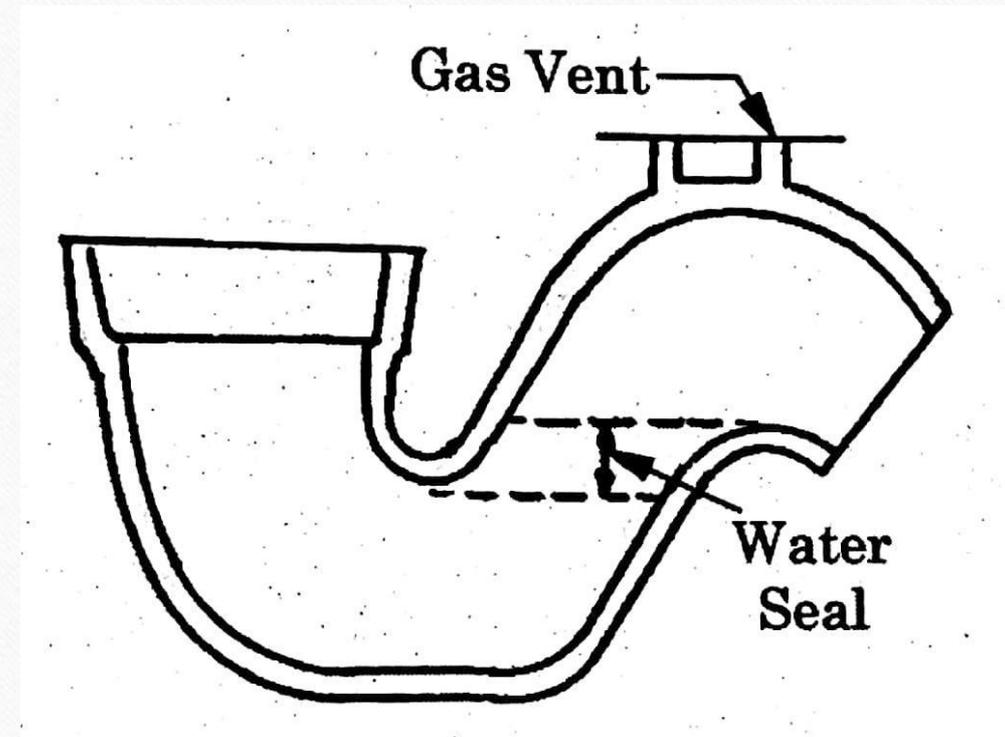
## 1. P-trap:-

- The trap having the P shape is called P-trap.
- In this case, the legs of the trap are perpendicular to each other.



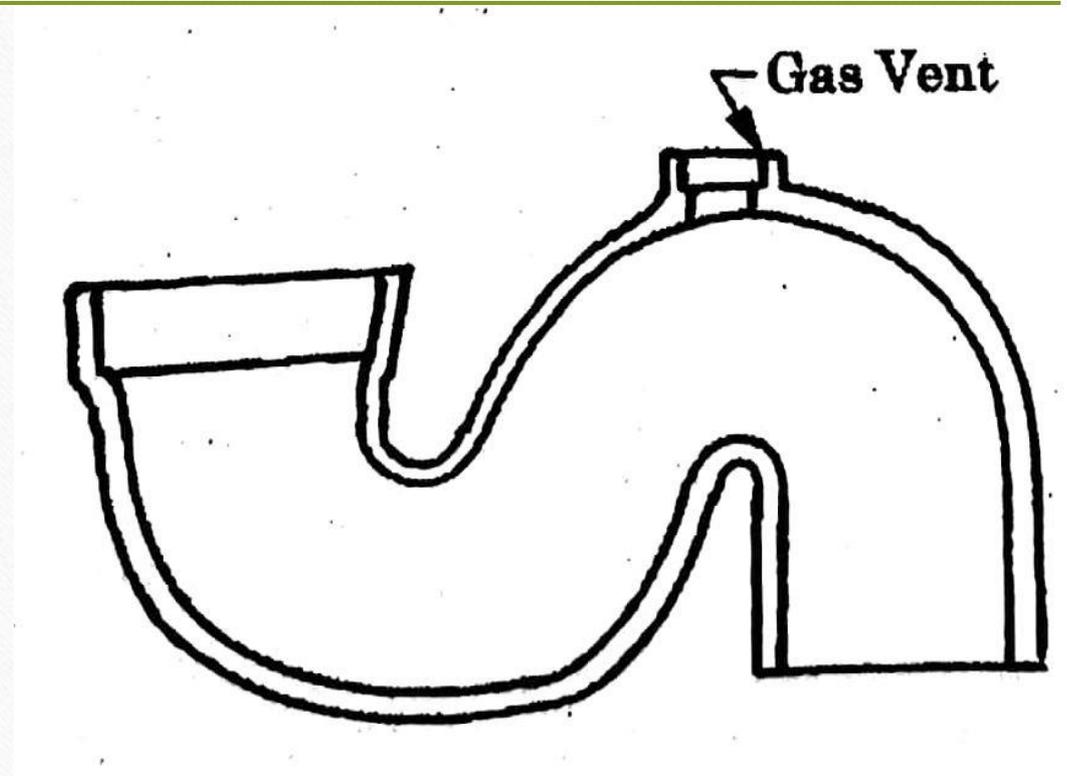
## 2. Q-trap:-

- The trap having the shape of letter Q is known as Q-trap.
- The legs of the trap meet at an angle other than  $90^\circ$ .



### 3. S-trap:-

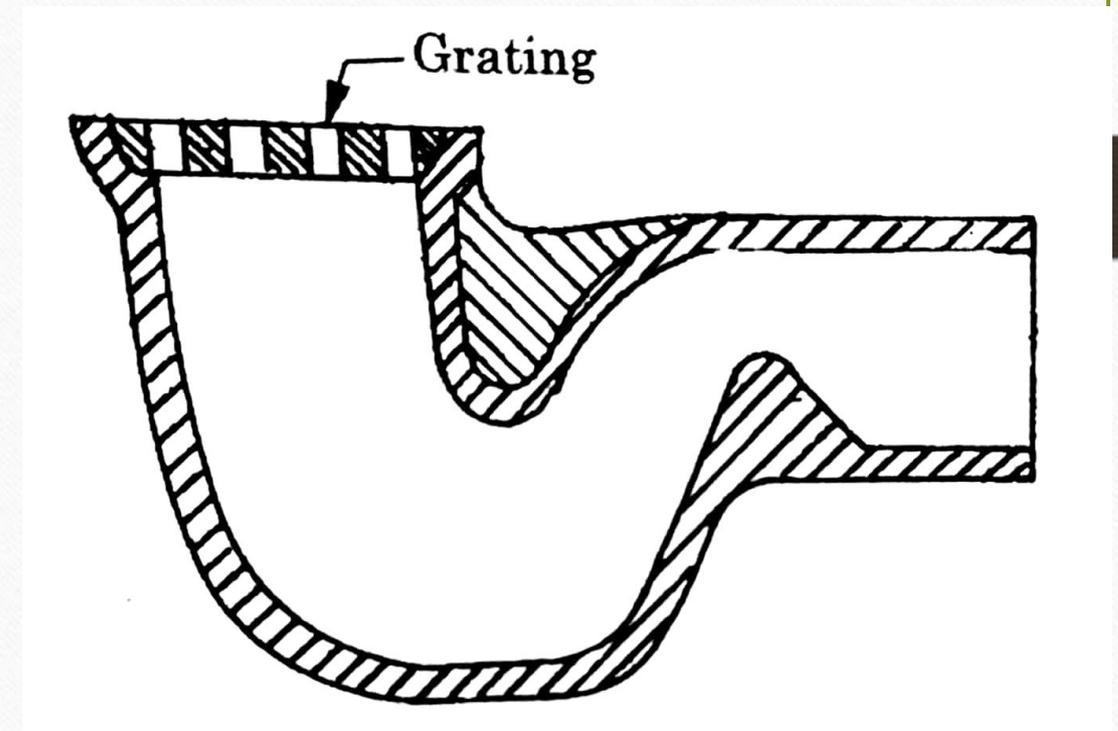
- The trap having the shape of letter S is known as S-trap.
- in this case the legs of trap are parallel.



# On the basis of use of trap

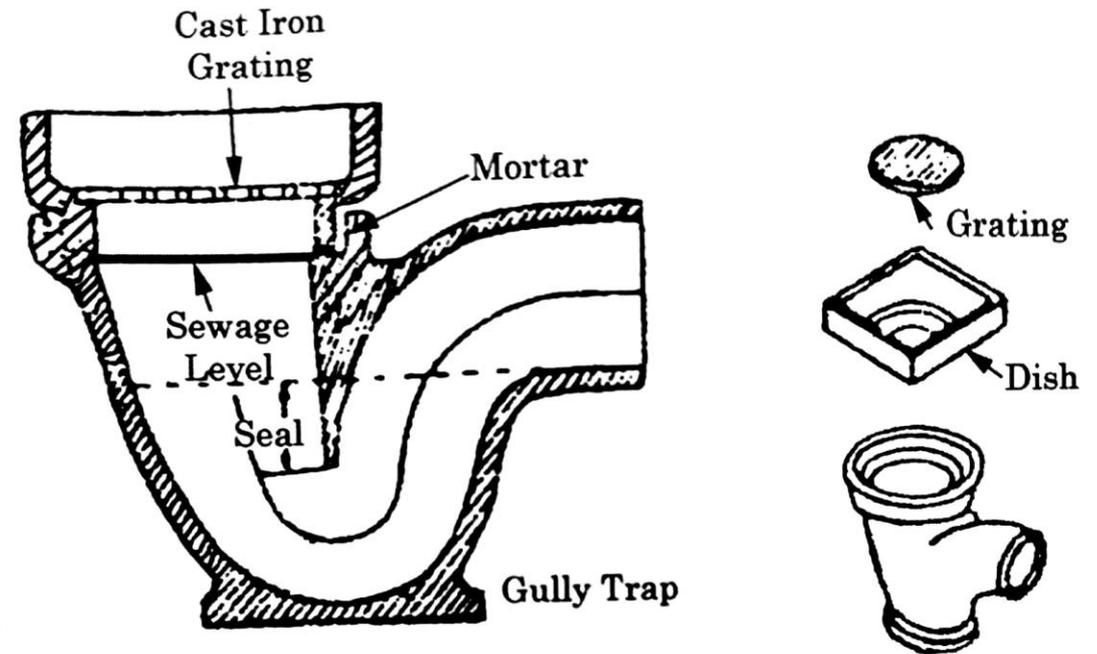
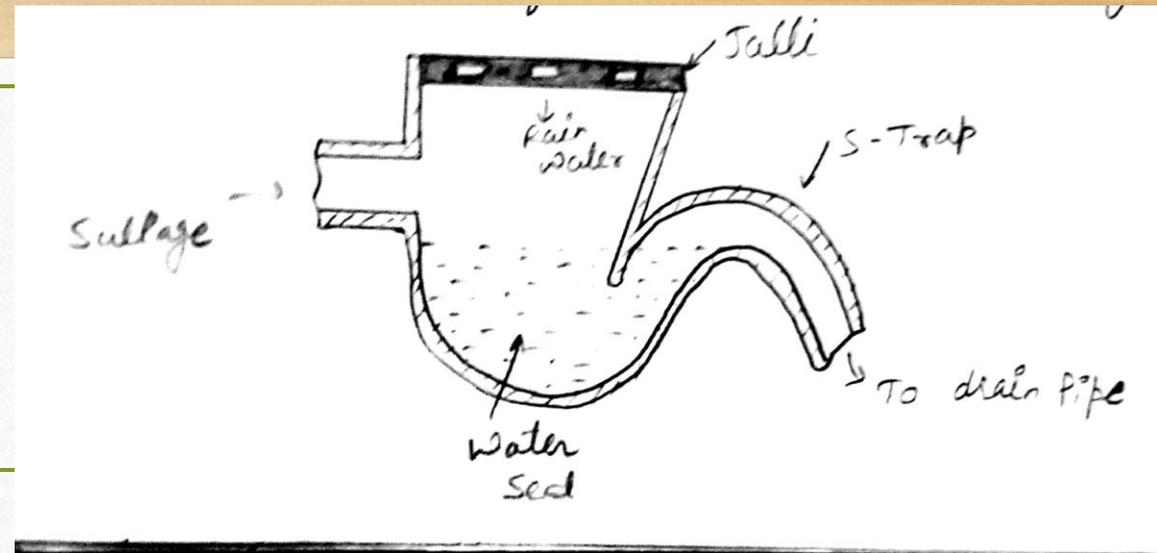
## 1. Floor trap:-

- It is a trap provided to collect waste water from floor of bathroom, kitchen, rooms, etc.
- They are provided at the starting point of waste water flow i.e. in bath rooms, kitchen and sink.
- At the top of it an iron grating is provided to prevent the entry of solid matter in it and for cleaning of trap.
- Floor trap is also called as Nahni trap.



## 2. Gully trap:-

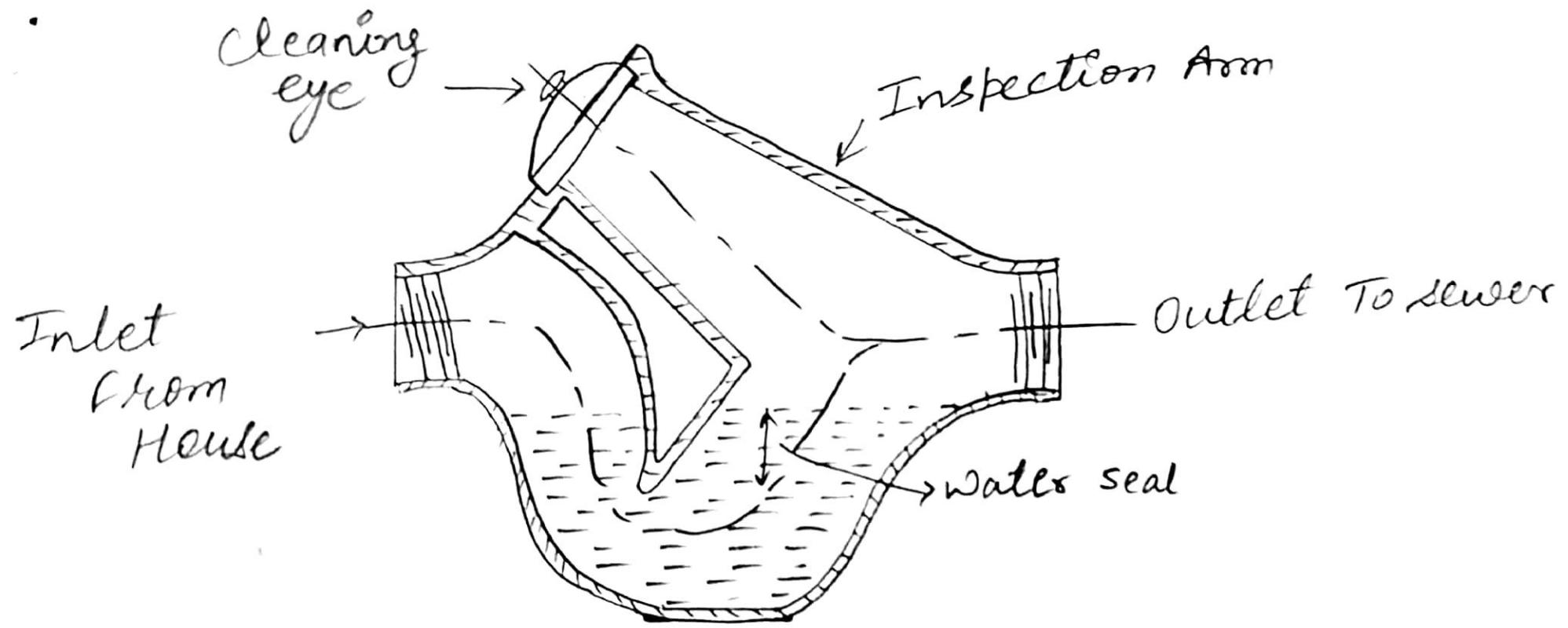
- These are provided at the junction of a room or a roof drain and other drain coming from bath, kitchen, etc.
- The sullage from bathroom, kitchen, etc. will enter through side inlet (called back inlet) and room water or rain water will enter from top.
- It may either S-trap type or P-trap type.
- It is generally made of stoneware with iron grating at the top.



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### 3. Intercepting trap:-

- This trap is provided at the junction of a house drain and a sewer is called an intercepting trap.
- It prevents the entry of foul gases from entering into the house sewer.
- It is provided In a small man hole constructed near the house.
- A plug is provided at the top of trap for removing silted matter from trap.
- The plug is called cleaning eye.
- The depth of water seal is about 100mm.



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## Advantages

- It helps in quick removal of foul matter into sewer.
- It helps in preventing the entry of foul gases from sewer in building.
- It prevents entry of harmful bacterias from sewer into the building.

## Disadvantages

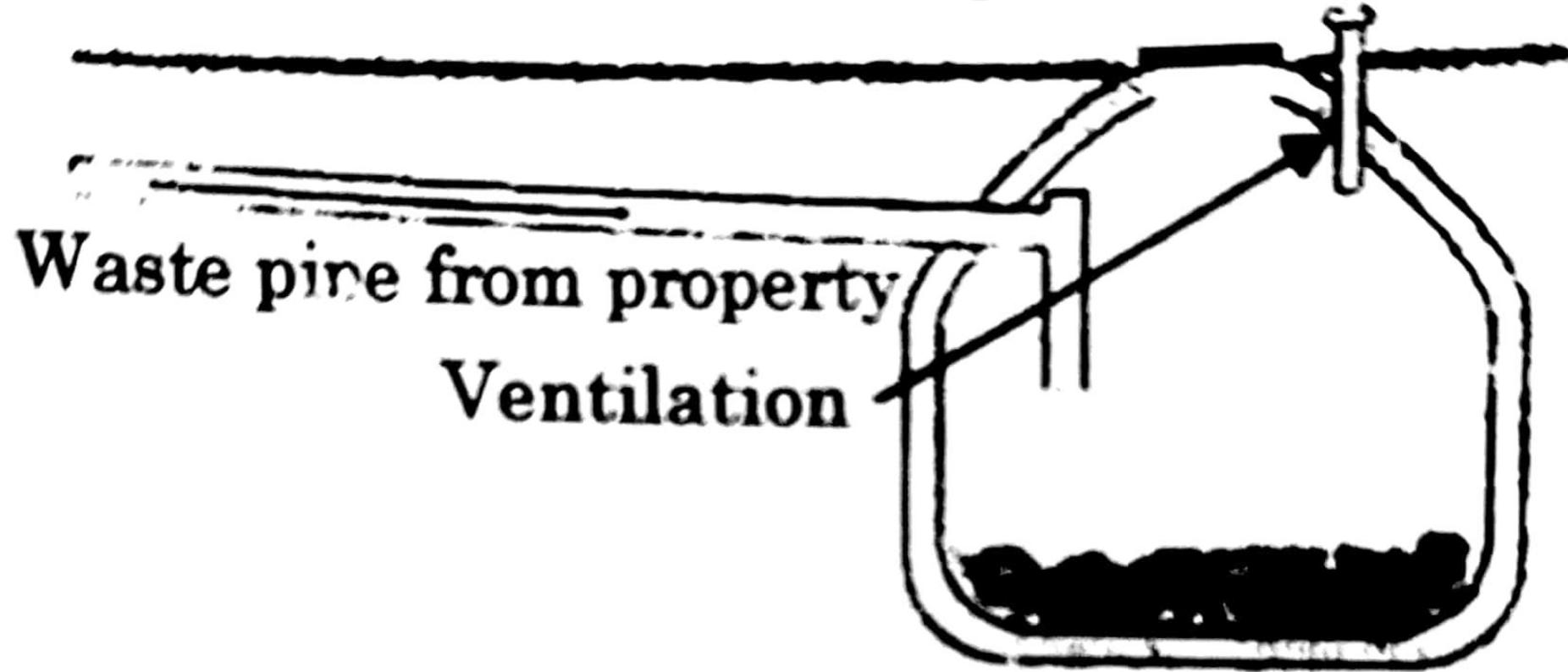
- It is difficult to clean trap through inspection arm.
- Ventilation of sewer is affected by it.
- When the discharge from building drain is less, then solid matter retained in the trap and it will start decomposing.

# *Cesspool*

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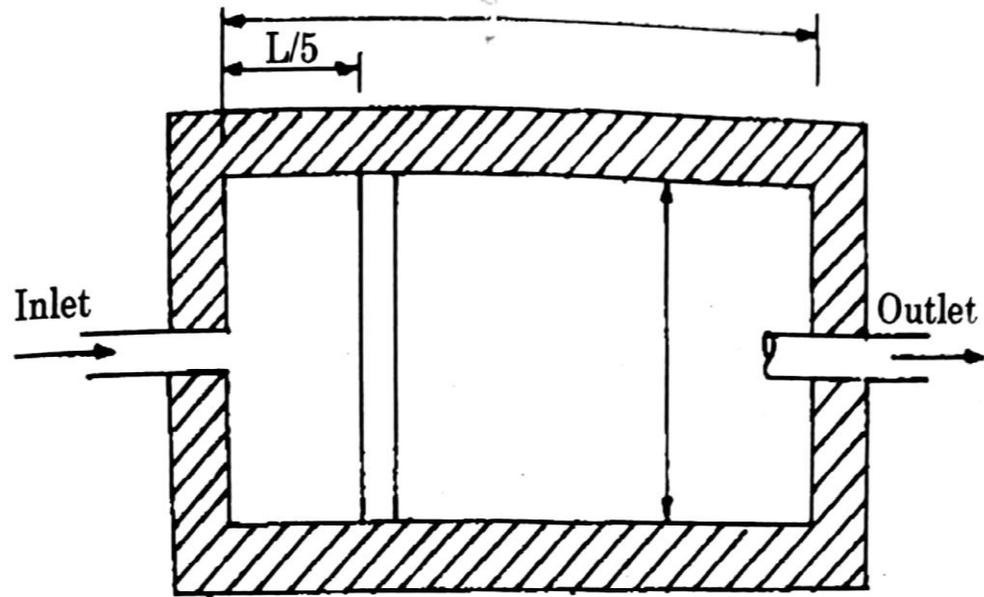
- Building is connected to the main sewage network for disposal of waste water.
- Sometimes building is located at a remote location and it is not possible to connect it to the sewage network.
- In such instance the waste water from building is collected in cesspool.
- A cesspool is a simple collection point for waste water from building. These are cylindrical pits dug in the ground of the owner and lined with bricks. This is located below ground level.
- The cesspool is required to be cleaned when it gets filled.

**Man hole cover**

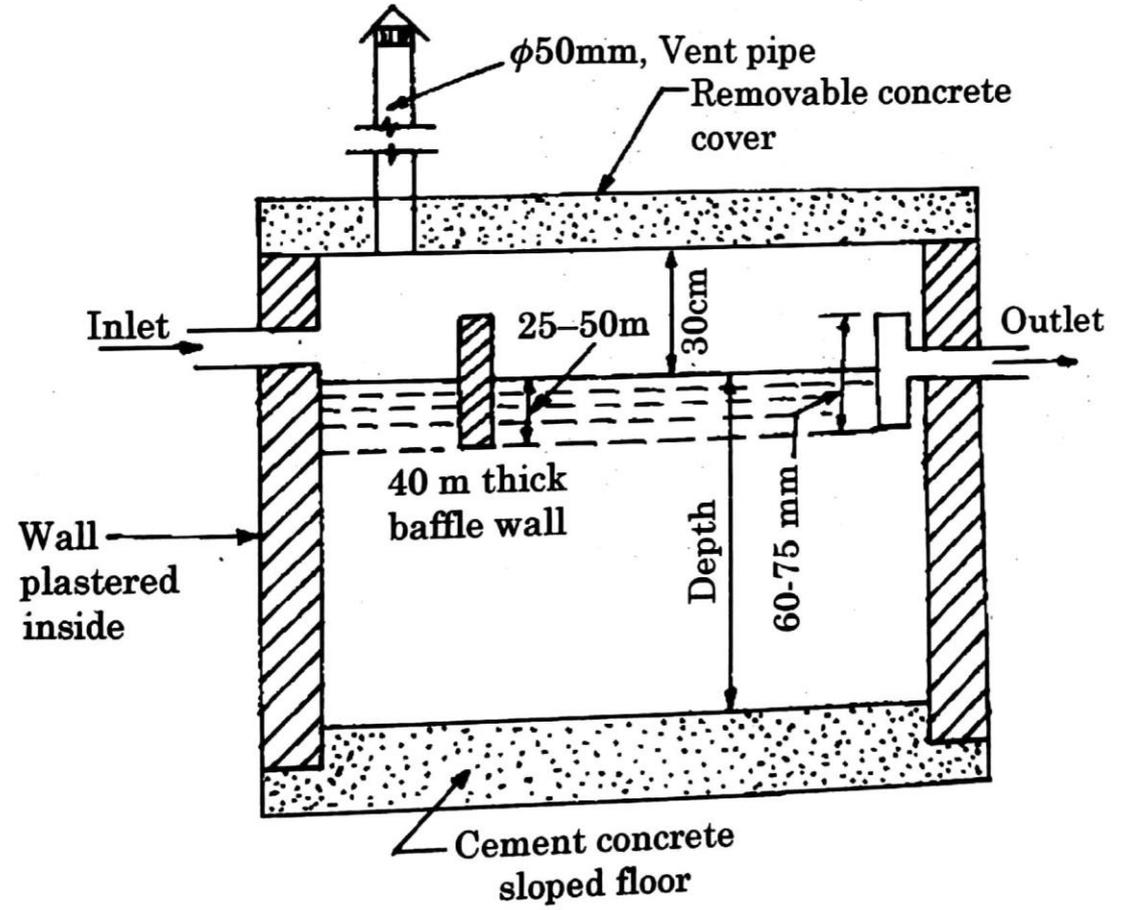


# *Septic tank*

- A septic tank is a masonry or concrete structure built below the ground level where bio chemical reaction take place due to an aerobic bacteria.
- The septic tank is a combined sedimentation cum digestion tank in which the suspended solids of sewage settles down to the bottom. This is further accompanied by the aerobic digestion of sludge. By this volume of sludge is reduced and foul gases like  $\text{CO}_2$ , methane and hydrogen sulphide are released.
- The effluent from septic tank should never be allowed in an open drainage system because it may cause health hazard.
- The septic tank should be cleaned after every 6 to 12 month.
- Air vent pipe should be provided for proper ventilation.
- The top of septic tank is covered with rcc slab and a manhole is provided for inspection purpose.



(a) Sectional plan



(b) Sectional elevation

Fig. 4.9: Septic tank

# Construction details of tank

The constructions details of the tanker as follows:

1. **A rectangular chamber** having the length and breadth in the ratio of 4:1 or 2 : 1.
2. **Liquid depth** of 100 cm for smaller tank and 180 cm for larger tanks with a free board of 30 to 50 cm for fixing of pipes, scum and gases etc.
3. **Inlets and outlets:** They are T-pipes submerged to a depth of 20 to 25 cm below liquid level.
4. **Baffles:** 1st one is provided at  $\frac{1}{3}$  from inlet pipe and secondly at  $\frac{2}{3}$  from outlet pipe. The baffles are provided at 20 to 30 cm from the inlet pipe and remains 15 cm above and 30 cm below the liquid level. Outlet baffle is provided in big tanks, where weir type outlet provided.

5. **Roof** of the tank is made of R.O.C. slab with cast iron manhole covers provided in it.
6. **Ventilation** is made by providing a vent pipe of about 10 cm diameter of A.C. or cast iron for taking out foul gases. Their taps are provided with cowls.
7. **The floor** of the septic tank is made of cement concrete having bottom slope towards one end.
8. **De sludging** pipe of 15 cm diameter laid horizontally below the sludge flow line.

## Merits and Demerits of Septic Tanks

The following are the merits and demerits of septic tank:

**(a) Merits:** They are as follows:

1. Its construction is easy and does not require any skilled labour.
2. It is not costly.
3. The suspended solids are removed by 85% and BOD by 90%.
4. The volume of sludge is less than the plain sedimentation tank i.e. about 70%.
5. The weight of sludge is also less than plain sedimentation tank i.e. about 40%.
6. The sludge can be disposed off without any nuisance.

**(b) Demerits:** They are as follows:

1. Its working is not uniform.
2. The removal of sludge is a difficult job.
3. The air gets polluted due to the leakage of gases through the top of the tank.
4. If the tank does not function properly, it will develop unhygienic conditions in the locality.

# *Manhole*

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- It is an opening provided in a sewer for the purpose of permitting a man to enter in the sewer.
- Objectives of manhole
- To provide an excess for inspection purpose
- It provides ventilation to sewer.
- It allows the jointing of savers.

# Location Of manhole

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- At the junction of main and branch sewer line
- At sufficient distances varying from 50m to 200m if length is straight.
- At all changes of direction.
- At all changes of gradient.

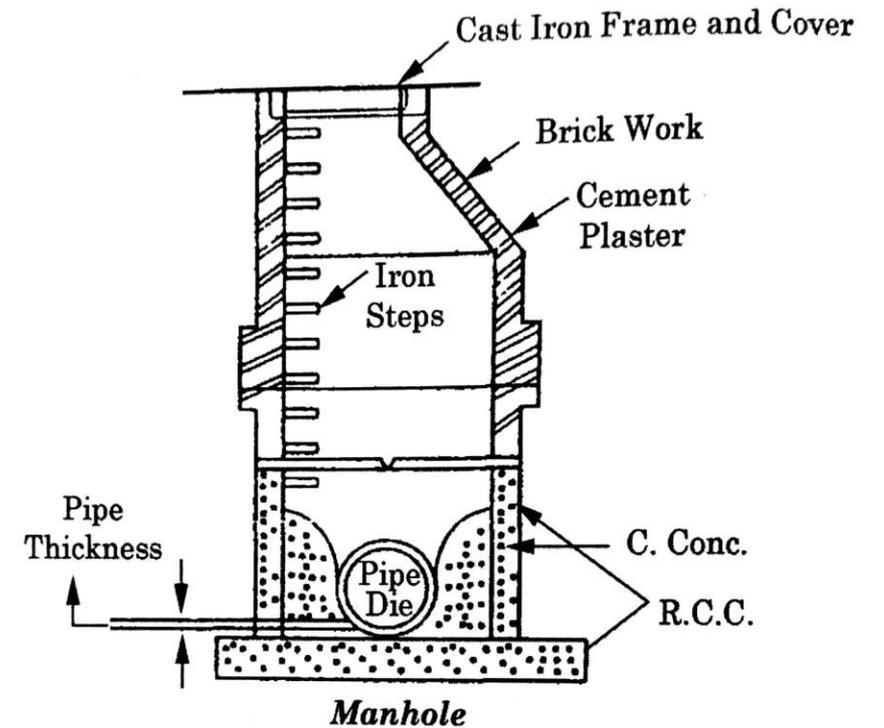
# Classification of manhole

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- Shallow manhole
- These are Having depth about 0.7 to 0.9m.
- Medium manhole
- These are having depth about 1.5 m.
- Deep manhole
- These are having dept more than 1.5 m.

# Constructional features of manholes

- Cover and frame
- These are provided at the top of manhole.
- The cover and frame are made of cast iron.
- These are mostly circular in shape.



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- Access shaft

- The upper portion of the manhole is known as access shaft.
- It provides an entry for working chamber.
- The minimum size of access shaft is 75cm × 60cm for rectangular shape and 60 to 75 cm in diameter in case of circular shape.

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- Working chamber

- The lower portion of the manhole is called working chamber.
- It may be rectangular or circular.
- It provides space for cleaning and inspection of sewer line.
- The height of working chamber should not less than 1.8 metre.
- For circular manhole its diameter is about 1.2 m.

- **Bottom or invert**

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- It is the lowermost part of the manhole.
- It is made of concrete bed 15 to 30 cm thick.
- A semicircular channel is constructed having diameter equal to sewer.
- **Steps or ladder**
- These are provided to facilitate entry and exit of workers into the manhole these are made of cast iron Sidewall and base The side walls are generally made of brickwork it may be of stone masonry or RCC. Base is the bottom part of manhole made of plain cement concrete

# *Cleaning blocked pipes and drain*

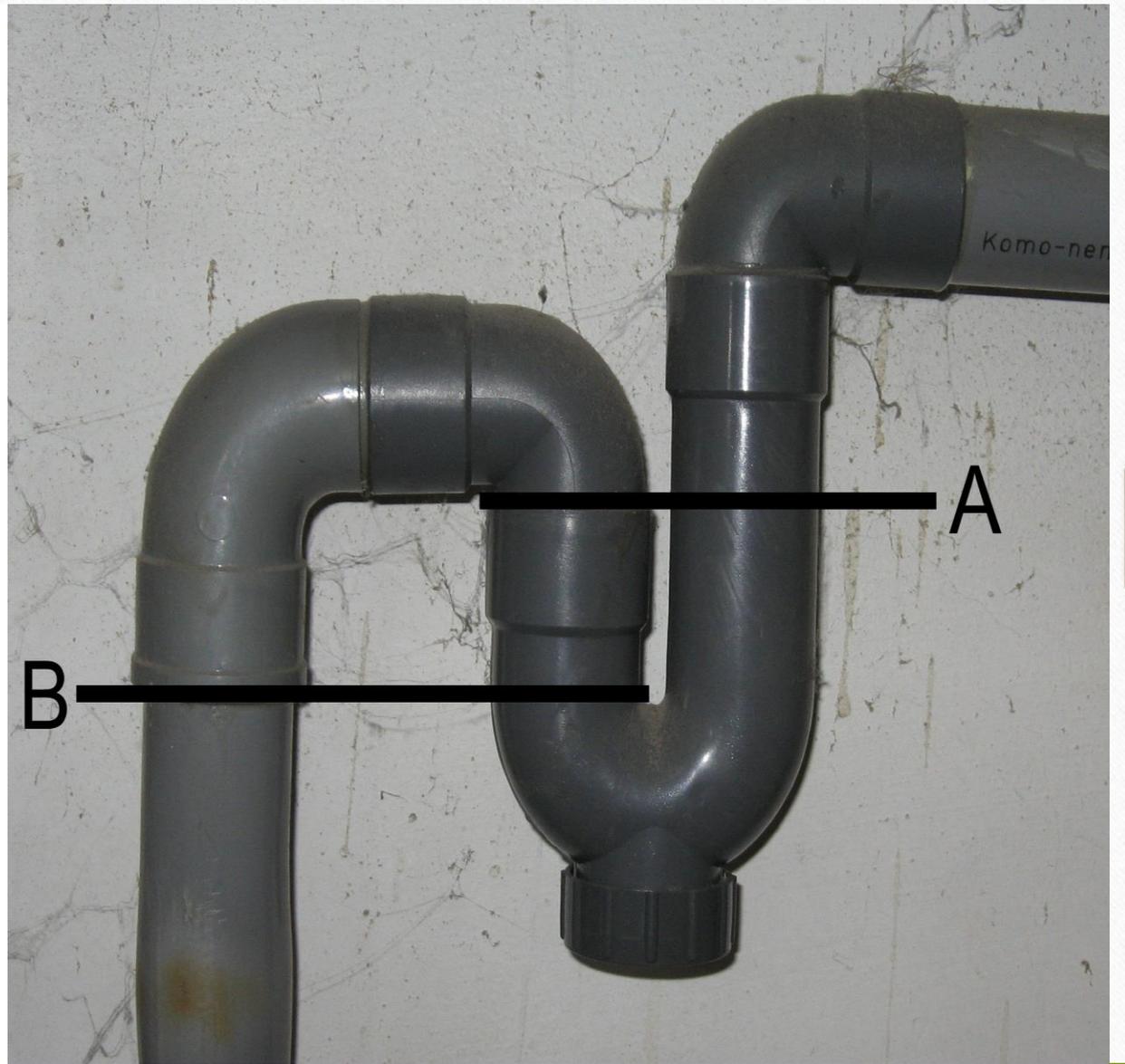
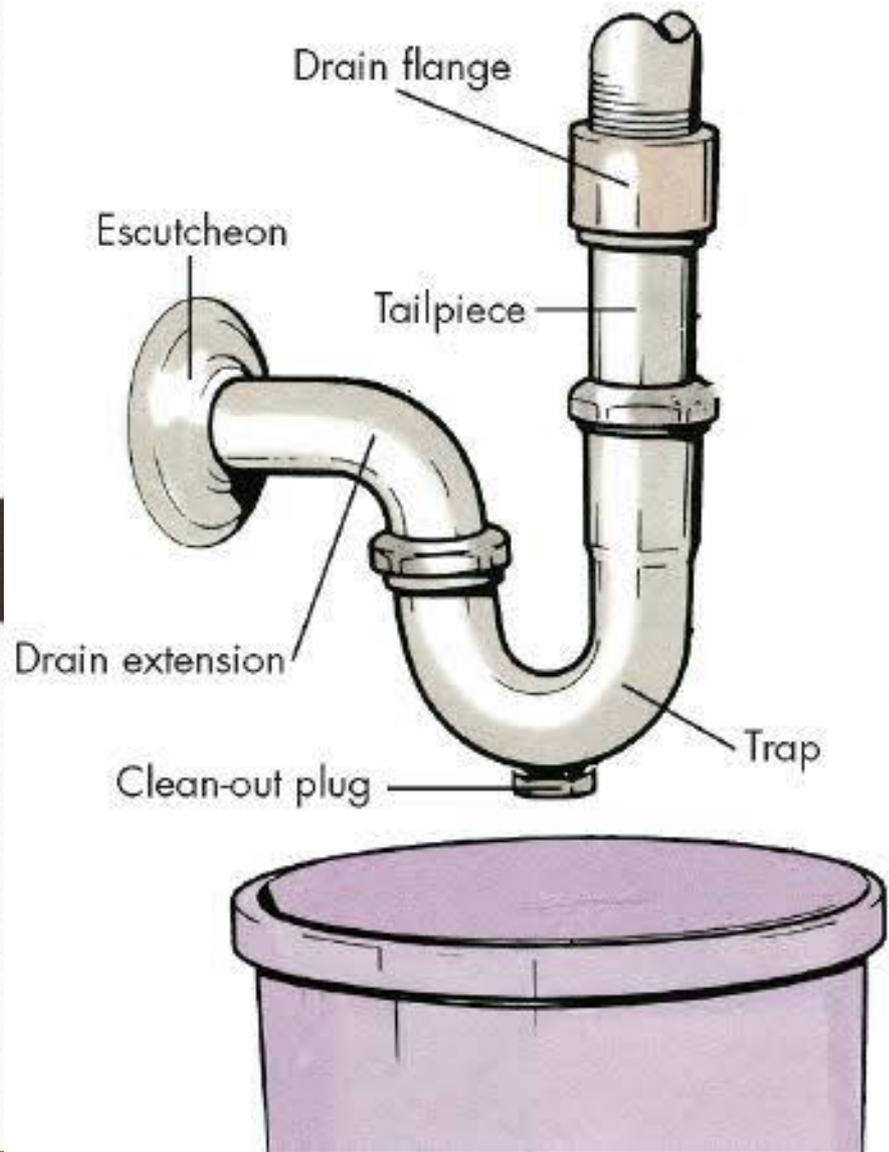
- After certain time with hair,grease,Kitchen waste etc. waste pipes may easily become blocked. The water will cease to flow and also smell from the drain and rotting materials becomes inside the building if not cleared.



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- So cleaning of pipe is necessary to prevent blockage and to maintain hygienic environment in the building.

# Clearing U-Bend trap

- This is situated below the plug hole of all sinks, bath and wash basins. This band trap is filled with water at all times to prevent drain smells from escaping inside the building. When an object Falls between the gaps of the plug hole, it will lie at the bottom of trap rather than flowing down the waste pipe to the sewer.
- The simplest way to clear a blocked U Bend is to unscrew the retaining Caps using a wrench. The trap falls into the bucket first. Then empty the water and clear using a length of wire. Flush the bend with a little detergent to ensure that the bacteria is removed before reconnecting.



# Clearing waste pipe

- When the wash basin is not draining the water properly and the U-bend has been checked and found to be not at fault then it is likely that a blockage has formed in the waste pipe work at some point. The best way is to use chemical drain cleaner. This process will take a sufficient time to remove the blockage.
- If thin blockage is not removed by chemical cleaner then try a sink plunger. Firmly hold the plunger over the plug hole. Fill the wash basin with water enough to cover the rubber cup. Place a wet cloth into the overflow outlet. Pump the plunger up and down a number of times. This process is repeated till the water runs smoothly from the appliance.



# Unblocking the soil pipe and W.C. Pans

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- When the toilet is blocked this can be cleared by using a large plunger known as cooper's plunger.
- Put the plunger into the Water closet pan. Check that the rubber Cup is in the U-bend. Move the handle of the plunger till the blockage is removed. This will be noticeable as the water level will drop.



# Cleaning bottle trap

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- It is easy to clean such type of trap. Remove the base cap to find access to the pipe. Use a wrench to free the fittings if the fittings are stiff. Clean the cap and trap pipe with detergent to remove bacteria if any before reconnecting.

# Cleaning blocked Gully or Hopper

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- When the bath is drained and we notice that the gully or Hopper is overflowing it indicates that T is blocked with leaves. To clean it take off the grill and remove all the debris by using a gloves on hand. Clear the bottom of the gully pipe clean it also by pouring some disinfectant down the Hopper pipe and gully pipe to remove any bacteria. If the flooded gully appears to be clear of debris but still continues to flood then check the blockage at the nearest chamber.

# *Laying sanitary and sewer pipe*



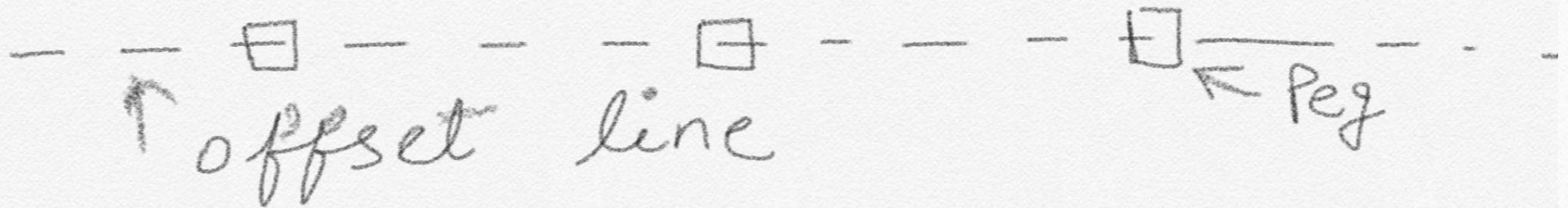
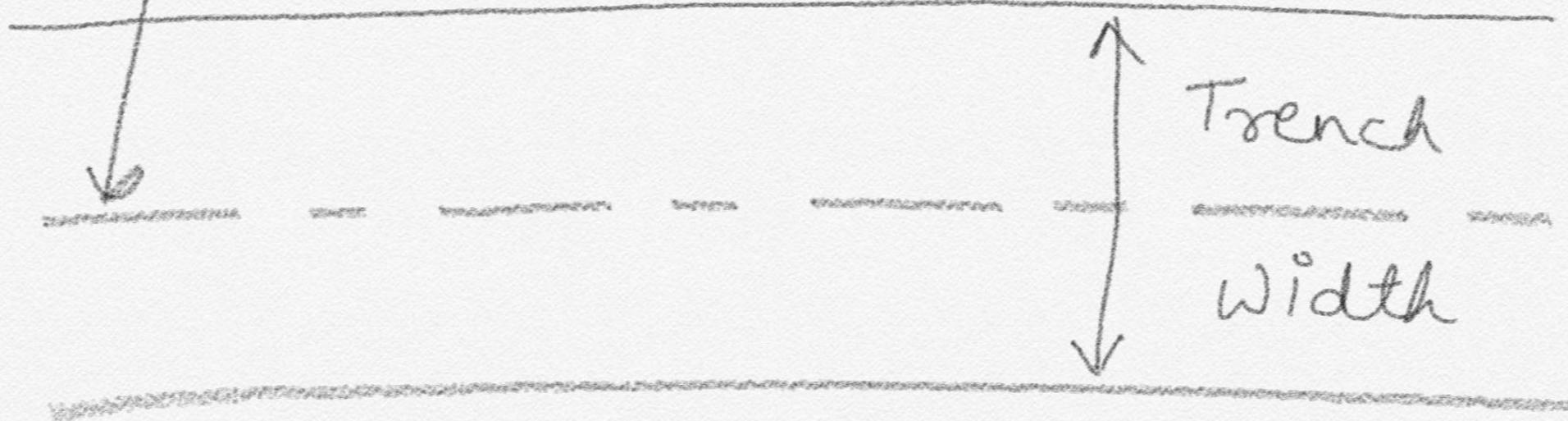
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- The process of placing sewer at the correct alignment with proper gradient known as laying of sewer.
  - Laying of sewer pipes is generally started from their tail and towards the starting end.

# Setting out centre Line of sewer

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- An offset line parallel to sewer Centre line is marked on the ground at a distance of 2 to 3m from centre line.
- Along offset line pegs are driven at an interval of 15m. When excavation is carried out this line will help in locating the center line for sewer.

Centre line of sewer



# Excavation of Trench

- After swtting out alignment, the next step is excavation of Trench.
- Trench is excavated upto the required depth with proper gradient.
- Excavation is carried out by pick axes and power shovel.
- The excavated soil is deposited on one side of trench other side is used for lowering of sewer.



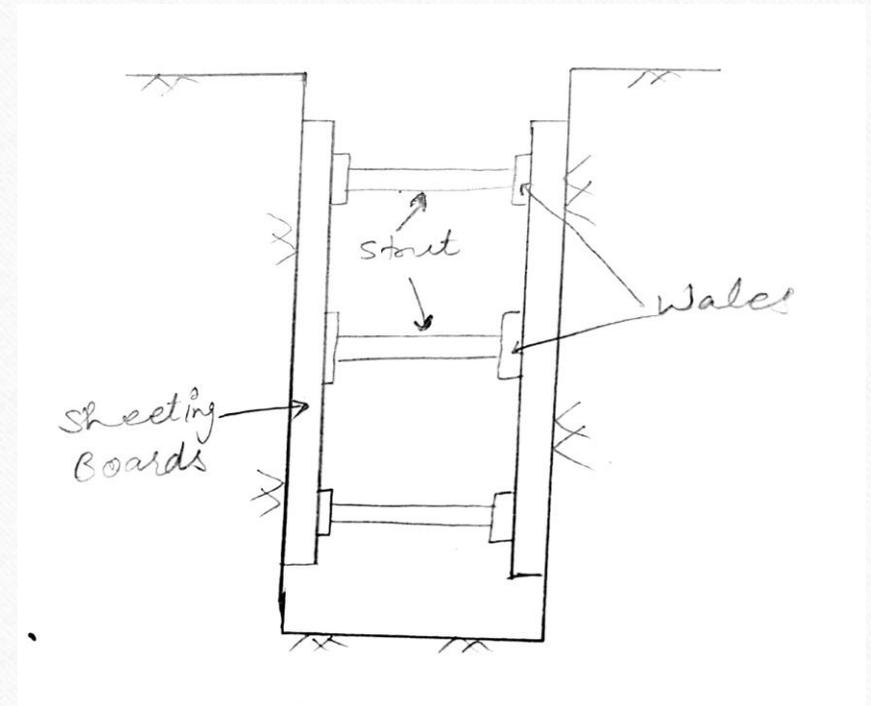
# Checking the gradient of sewer line

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- The sewer must be laid at a suitable gradient to ensure gravity flow this is done with the help of boning rods and dumpy level.

# Timbering of Trench

- In this step the side of trench are supported.
- Requirement of timbering depends upon the type of soil and depth of Trench.
- To prevent the soil from falling into trench timbering is done.



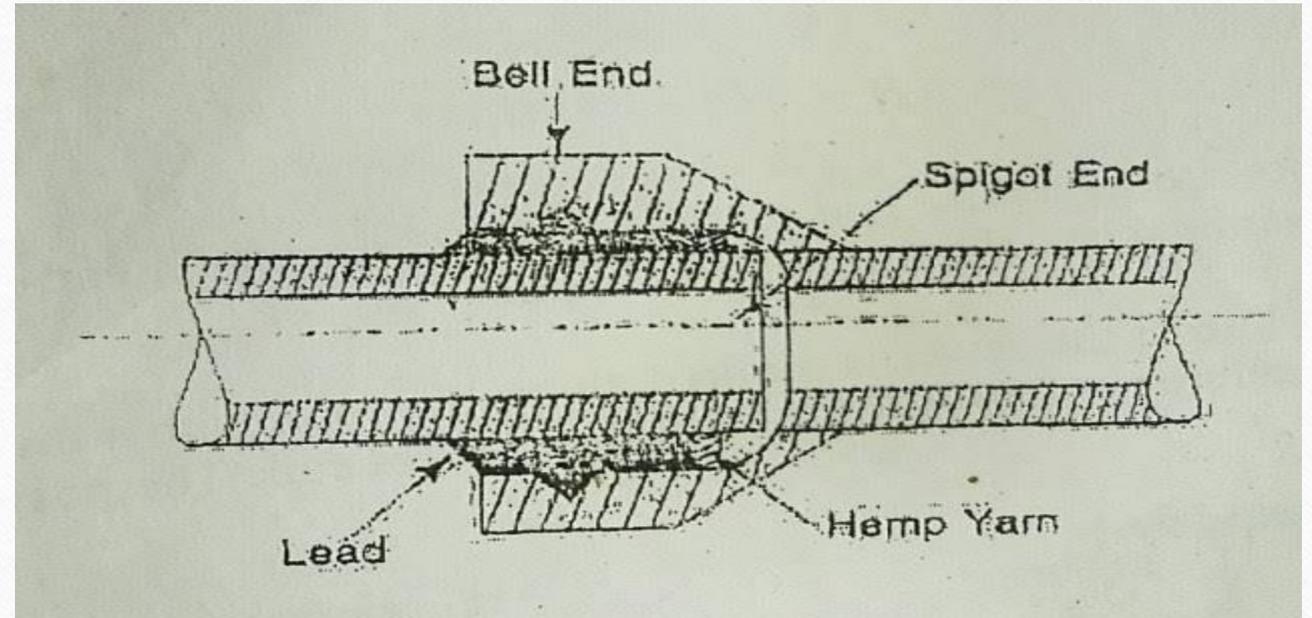
# Bedding of Trench

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- In this process the trench bed is compacted and levelled so that laying of pipes can be done easily and to provide proper gradient to the sewer line.
- It is necessary to prevent the unequal settlement.

# Jointing of sewer

- Sewer of smaller sizes are joined together by joints.
- The joints should be watertight .



# Back filling of Trench

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- The process of placing the excavated soil back into the trench after the construction and testing of sewer line is known as backfilling.
- The earth should be filled in layers of 15 cm thickness each layer should be properly watered and temped.
- The refilling earth should be free from pebbles, stone pieces.



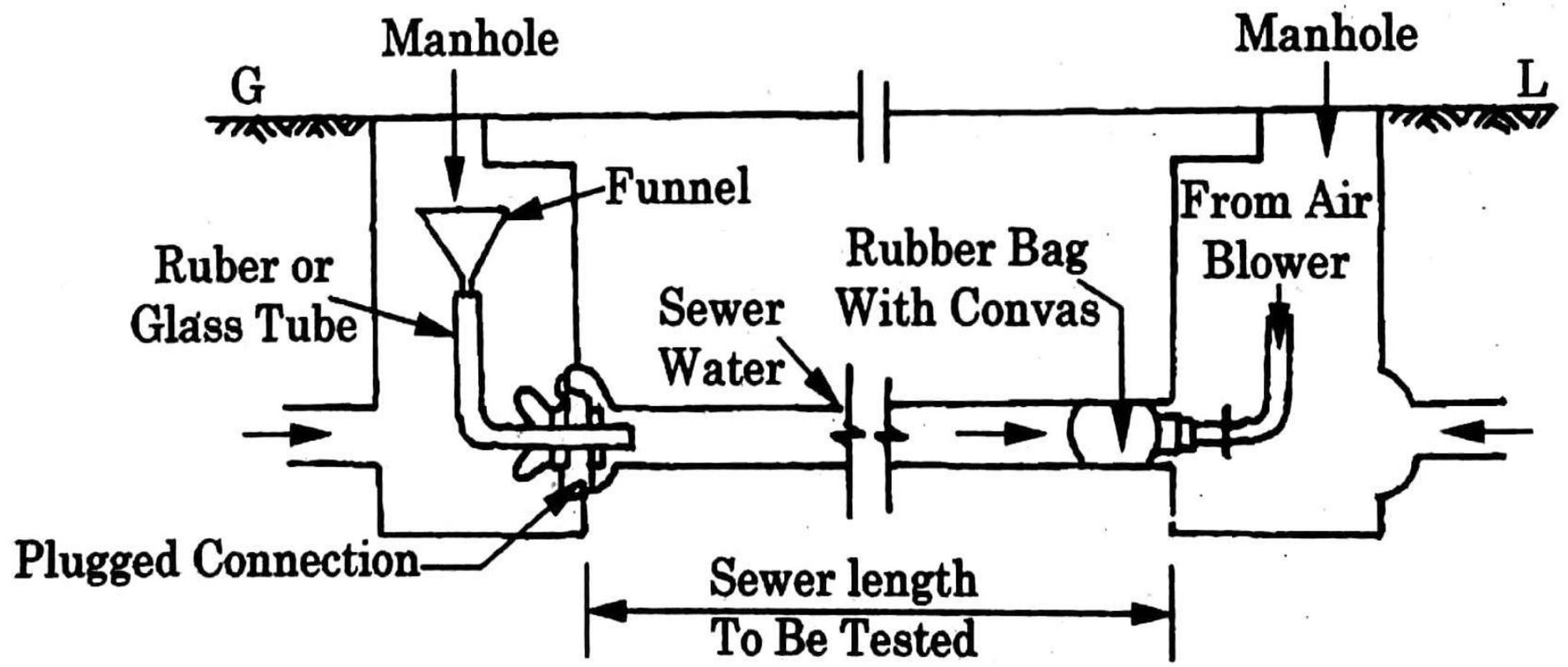
*Inspection*  
*and*  
*Testing of*  
*sewer pipe*



**A. Hydraulic or Water Test:** The test is performed for sewer line between two manholes. The steps of this test are as follows:

1. The lower end of sewer line is plugged by a rubber bag. Plugging is equipped with a canvas cover as shown in Fig. The rubber bag is connected to an air blower and it should be tightly fit with sewer pipe.
2. The upper end of the sewer in manhole is plugged with the funnel.
3. The whole sewer should be filled with water through the funnel. The funnel can be raised or lowered to maintain the required head. The head depends upon the material of sewer e.g for stone ware and concrete sewers 1.5 m and for cast iron sewers the head is generally 9m.
4. The water loss is checked after 30 minutes and it should not exceed 30 ml for large size and 15 ml for small size sewers per cm diameter of pipe per 100 m length *i.e. 15 or 30 ml/cm diameter of pipe/100 m length of sewer.*

*If the sufficient water is not available then water test cannot be performed. And in this case to check the sewer leakage, air test is performed.*



**B. Air test:** Air test is carried out to check the leakage in sewer pipe. This test is performed for larger diameter sewers where sufficient quantity of water is not available. In this test both the ends of sewers are plugged with hand pump and subjected an air pressure of 100 mm of water. To maintain a constant pressure of 75 mm, the joints of the sewers are assumed to be water tight. If the drop is more than 25 mm, the leakage of joints is traced out and so sewers should be repaired or replaced. The leakage point can be detected by applying soap solution to the joints and by viewing the presence of air bubbles.

*If the sewer or section of sewer does not fulfill the requirement of above tests, then it indicates the leakage of pipe or joints and the sewer should be repaired or replaces.*

**C. Test for Straightness and Obstruction:** The test can be performed by two methods as described below:

- (a) In first method, a smooth ball of diameter 10 mm or less than the internal diameter of sewer is placed at the upper end of the sewer. The ball will roll down and come out through the lower end of the sewer if there is no obstruction.
- (b) In the second method the straightness of sewer is to be checked. In it a mirror is placed at one end of the sewer and a lamp is placed at another end. The full circle of light can be observed if the sewer is in straight line. Also the obstruction can be observed in the mirror.

**D. Smoke test:** This test is generally done for testing of vertical drainage pipes. The test is performed in the soil pipes and waste pipes. All trap seals should be filled with water before conducting test. Generally the smoke is produced by burning oil waste in the combustion chamber. After that smoke is forced into the pipe with the help of blower. Leakage can easily be detected by seeing or smelling emitted smoke through leaky joints. The leaking joints can be repaired after detection.

# Problems in drainage

- The following problems are likely to arise if the pipes are not properly laid out or when the material used are of poor quality. It may occur due to poor workmanship.
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1. It causes foul smell.
  2. Health problem respiratory disorder to those lying in the building.
  3. Dampness in walls and floors.
  4. Damage to the structure of building.
  5. Leakage in pipes.
  6. Dipping faucet
  7. Clogged toilet, shower
  8. Low water pressure

# Maintenance

1. Phenyl or any other disinfectant should be used regularly to maintain good sanitary conditions.

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2. The washers of leaky taps should be replaced at regular intervals.
3. The entire system should be cleaned at least once in a month.
4. Use a drain guard on all your plug holes to reduce the amount of waste that gets washed down your sink.
5. One of the easiest way to maintain a healthy drain is to wash it with hot water once in a week.
6. Call a service provider.

