Pumping of waste water:-

→ Generally the entire sewage is passing by gravity upto disposal point.

→ But in the case of ~~large~~ sewage is passing into the large area in flat ground, lower elevation (or) widely undulating topography It may be essential to employ pumping station for passeage of sewage in to treatment plant.

→ sewage and storm water is required to be lifted up from a lower level to a higher level at various places in a sewerage system.

→ Pumping of sewage is also generally required at the sewage treatment plant.

Pumping station:-

→ Pumping stations is sewage collection systems, also called. lift stations, are designed to handle raw sewage to lift from underground gravity pipelines.

→ ~~They are used to move waste waters to higher elevations need of Pumping stations~~

~~The need of pumping stations arises when.~~ (causes)

→ The stations are used to lift the waste water to higher elevations

The pumping stations automatically arise when

→ 2 (or) more sewers are combined to gether. in lower levels to create high gravity sewer

→ Basements are too low

→ The sewage must be raised there will be passing of this sewage by gravity in to the treatment plant

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→ Discharge outlets are below the level of the receiving body of water the sewage will be dirty

→ on sewerage system the the gravity flow is not available to provide a pumping station

→ The pumping stations are required where pumping of

- untreated domestic waste water.
- storm water run off
- combined domestic waste water & storm water run off
- sludge at a waste water treatment plant
- treated domestic waste water &
- recycling treated water & (or) mixed liquor at treatment plant

→ Generally pumping station should contain at least three pumping units of such capacity to handle the maximum sewage flow in the largest unit is out of ~~sewer~~ service

→ All pumping stations should have an alarm system to signal power of pump failure & every effort should be made to prevent (or) minimize flow.

→ The site selection for the pumping station is important and the area should never get flooded. The station should be easily accessible in all weathers.

→ After finalized the location of the pumping station should be finalized considering the feature expansion and expected increase in the sewage flow

→ Generally design period upto 15 years is considered for pumps.

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(2.2) Location :-

→ ~~which type of~~ Pumping station location should be ~~selected~~ choosen for suitable location.

→ The location is ~~not~~ choosen when floods are coming The location it means pumping station location is not effected.

→ The location ~~is~~ should preferably storm relief stations result break down of pumping, sewage can overflow it is occured and also In that case it should not affected people who live near by

(2.3) components :- → Parts

The component Parts of a large pumping station are given below

1) Grit Channel of detritus pit
2) screens, coarse & Fine
3) Sumps (or) wet wells (or) Receiving wells
4) Power units and pumping sets with float-switch arrangements
5) Inlet (or) low level sewer and raising main to outlet or high level sewer
6) Emergency overflows (or) by-Pass to remove sewage during emergencies
7) Flow recorders
8) ventilation arrangements such as extraction fans.

(1) Grit Channel :-

The Grit Channel must be removed. Grit before pumping of sewage. to other treatment units otherwise it will cause an obstruction to the flow

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→ Grit chamber consist of 10-17 m long narrow open channel

→ The sewage flows in this chamber horizontally with constant velocity b/w 0.24 to 0.3 m/sec so large and heavier grit particles may settle down on the bottom but lighter organic solides can escape out with the sewage

→ the depth of liquid in these chambers is usually kept b/w 1-1.3m.

→ Mostly grid chambers are designed to capture particles with specific gravity of 2.65 and a diameter of 2x10⁻²cm

screens

screens are two types- Coarse and fine screens.

→ It is usual to provide both types in large installations

→ The sewage passing first coarse screen. after that passing through the fine screens

→ In coarse screen. Large openings of 5-10 cm intercepts large particles

→ In fine screen. opening of 2.5 cm intercepts small particles

→ The intercepted particles can be cleaned mechanically by roller running over sprockets. This rollers ends attached fingers

→ This roller moving very slowly and collected this waste in sealed bins for quick disposal

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sumps (or) wet wells :-

→ The functions performed by a sump are to act of a suction pit

→ In that sump a pump is fixed in that sump sewage will reach certain level. operates a float-switch which starts the power of the pumping unit and sewage is pumped out

→ If the capacity of the sump is small, the operation of the power unit is to be done at very frequent intervals, result operation becomes expansive

→ The capacity usually recommended is 15 to 30 minutes of the peak flow.

ventilation :-

→ In that sewage accumulation of gases due to decomposition of sewage in the sump while removing of these dangerous gases to provide some ventilation.

Types of Pumps and their suitability with regard to waste waters :-

The following types of pumps are used in the sewage system for sewerage system for pumping of sewage, sewage sludge, grit matter, etc. as per the suitability.

(a) Radial-flow centrifugal pumps
(b) Axial-flow and mixed flow centrifugal pumps
(c) Reciprocating pistons (or) plunger pumps
~~(d) Diaphragm pumps~~
(e) pneumatic ejectors and
(f) Air-lift pumps

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(a) Radial-flow centrifugal pumps:-

These pumps consists of two parts

1) Casing and
2) Impeller

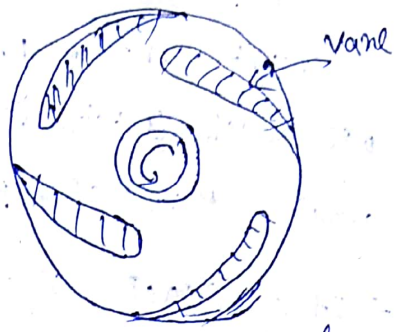


Fig centrifugal pump

These pumps work on the principle of centrifugal force.

The centrifugal pump consists of 2 main parts

1) The casing and
2) The Impeller.

→ The Impeller of the pump rotates at high speed inside the casing.

→ sewage is drawn from the suction pipe on to the pump. The vanes of rotating centrifugal force is developed.

In Radial flow pumps

→ The liquid entering the centre of the impeller, and out on to spiral ~~volute~~ casing.

→ The impellers of all centrifugal pumps can be closed, semi-open (or) open depending on the application.

→ open impeller type pumps are more suitable, in the case of seperated solids and floating matter present in the sewage. can be easily pumped with out clogging.

→ These pumps can have a horizontal (or) vertical design

→ These pumps are commonly used for any capacity and head.

→ These pumps have low specific speed upto 4000

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(4)

(b) Axial flow centrifugal pumps :-

Axial flow centrifugal pumps can be design. Large capacities of discharge flow.

→ the flow will be entering axially. and are usually used for capacity more than 2000 m³/hr and head less than 9m.

→ These pumps are of vertical type.

→ The axial flow pumps have relatively high specific speeds from 8000 - 16000.

→ the water enters in this pump axially and the head is developed by the propelling action of the impeller. vanes

Mixed flow pumps :-

These pumps developed head partly by centrifugal action and partly by the lift of the impeller vane on the liquid.

→ These pumps have single inlet impeller with flow entering axially and discharging in an axial and radial direction.

→ These pumps are upto used for medium head of 4200 to 9000

→ These are used for medium heads ranging from 8m to 15m.

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(c) Reciprocating Pumps :-

These are not suitable for sewage pumping because solids and fibrous materials clog them even after passing the sewage through screens

→ These are high initial cost, difficult in maintenance. have low efficiency and cause much wear and tear of valves, therefore not used in sewage pumping.

(d) Pneumatic Ejectors :-

→ Centrifugal pumps are suitable for pumping large quantity of sewage. These are not suitable for pumping small quantity of sewage. why because for pumping small quantity of sewage we required small size

At such places pneumatic ejectors are most suitable. These pneumatic ejectors can be provided under the following situations

(i) when centrifugal pump may clog due to small quantity of sewage

(ii) when the sewage from low-lying areas is to be lifted up to main sewer construction of pumping station is not economical.

(iii) when the sewage is to be lifted up from deep tanks

(iv) For lifting the sewage from the basement of large buildings upto the street sewer.

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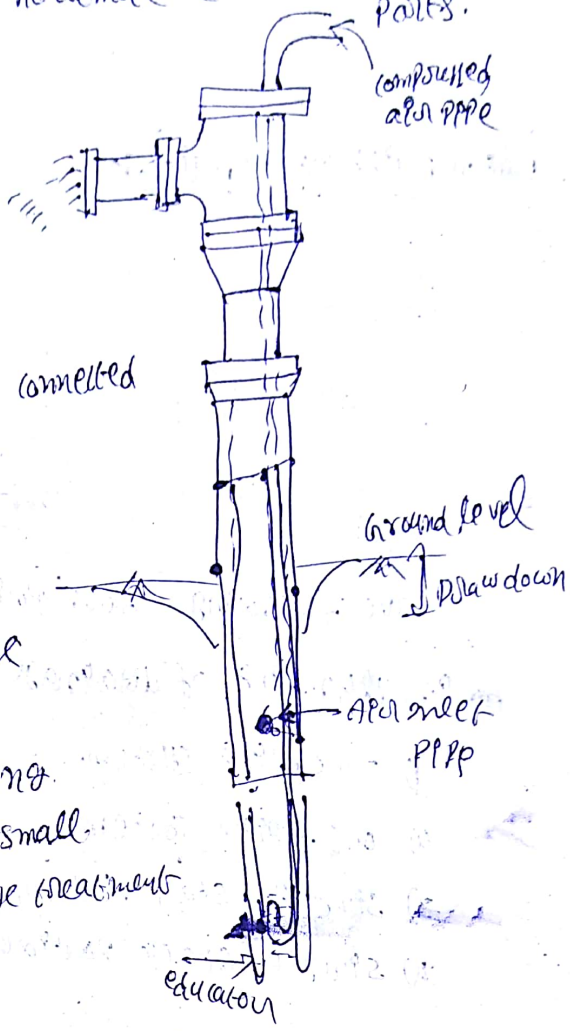
(5)

(5) AIR lift Pumps:-

→ These pumps work on compressed air and have no moving parts

→ This is most suitable for sewage pumping

→ These are simple in operation and give least trouble because they have no moving (or) submerged parts.



→ It consists of a vertical pipe known as "eductor pipe" placed inside the wet well. A

→ top end of the air inlet pipe is connected to the air compressor.

→ The pump should have working

→ The air lift pump very low efficiency and can lift sewage upto small height only.

→ This is suitable for pumping small quantity of sewage at small pumping station (or) at sewage treatment plant for moving sludge.

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House plumbing

↓ ↓

Def: fitting of pipes, valves, tanks into the house for transporting of waste removal and water delivery among those uses plumbing work.

water mains (street mains):-

2.5 systems of plumbing:-

The following four principle systems are used.

In plumbing of drainage work in a building; they are

1) Two-pipe system.
2) one-pipe system.
3) single stack system.
4) single stack partially ventilated system.

1) Two-pipe system:-

This is most common system in India.

→ In this system 2 pipes are provided one pipe called the foul soil and lavatory (సోకు) wastes where second pipe.

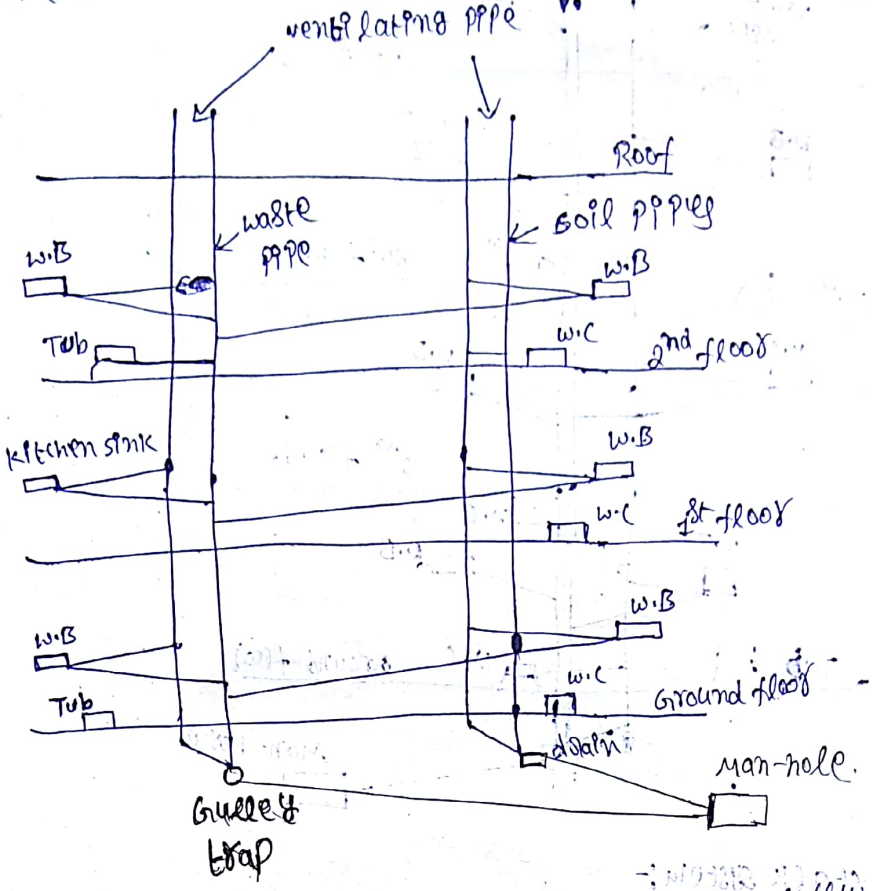
collects the unfoul water from kitchen, bathrooms, house washings, rain water etc

→ the soil pipes (pipes carrying the soil waste) are directly connected through the drain, where as the waste pipes (pipes carrying unfoul water) are connected through the trapped (వలయాకార) gully (వలయాకార రంధ్రము)

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→ All the traps used in this system are fully ventilated.



W.C (water closet) బాత్‌రూం
W.B (wash Basin)
K.S (Kitchen sink)

→ All the traps of the W.C, basin sinks, etc. are fully ventilated and connected to the ventilation pipe

→ But all gully traps and waste pipes are completely dispensed with. (తొలగించి)

(b) one-pipe system:-

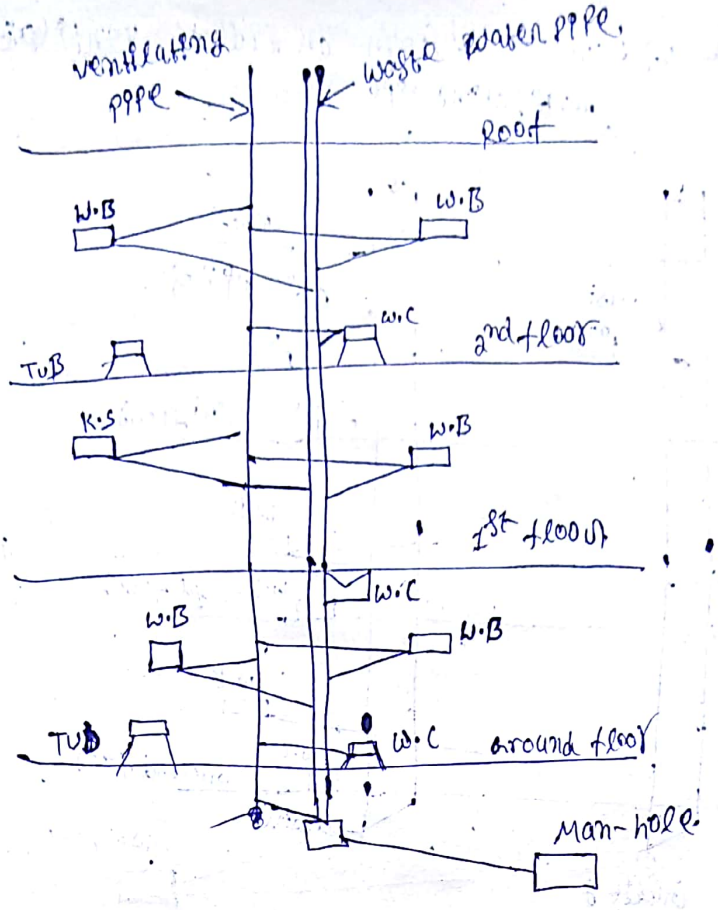
In this system only one main pipe is provided which collects both the foul soil waste as well as un foul waste from the buildings

→ The main pipe is directly connected to the drainage system

→ If this system is provided in multi-storeyed buildings the lavatory blocks of various floors are so placed one over the other so that the waste water discharged from the different units can be carried through short branch drains

→ In this system instead of two seperate pipes (one soil pipe and second sullage pipe) only one main vertical pipe is provided which collect night soil as well as sullage water from respective through branch pipes

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(c) single stack system:-

This system is a single pipe system without providing any seperate ventilation pipe. so hence it uses only one pipe ~~in that one pipe internally another pipe having~~ which carries the sewage as well as sullage and is not provided with any seperate vent-pipe

→ this pipe is to be extended upto about 2m higher than the roof level and provided with a cowl, for removal of foul gases as shown in fig below (assignment)

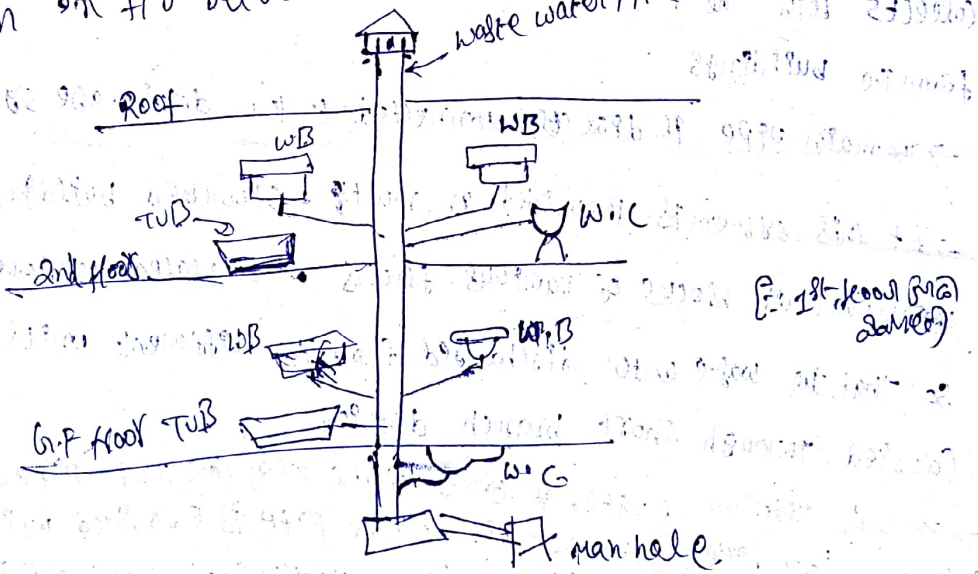


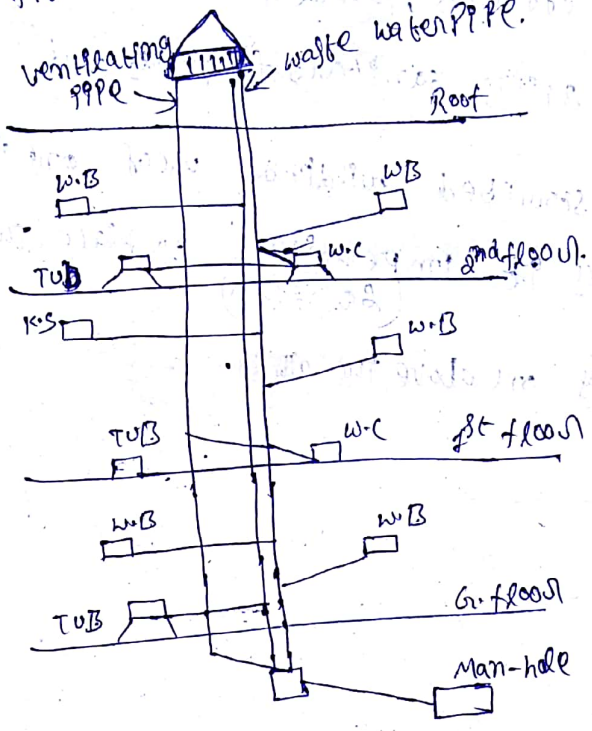
fig single stack system of plumbing.

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(d) single stack partially ventilated system:-

→ This is an improved ~~form~~ form of single stack system It means in this system the traps of the water closets are seperately ventilated by a seperate vent pipe. That pipe is called Relief vent pipe.

→ this system thus uses two pipes as in a single pipe but the cost of lateralls (branches) is considerably reduced compared to single pipe system only because the sullage fixtures are not connected to the vent pipe as shown in figure below.



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choice of a particular system of plumbing:-

The two pipe system is the best system for efficient conveyence of sanitary house wastes with minimum use of traps particularly for large and multi-storeyed buildings

This system however requires a large number of pipes and their connections and is hence costly and also it is difficult to find suitable place for accomodating so many pipes in small houses and buildings.

→ In that case, one pipe system is more economical and easy to accomodate. but requires sufficient safe guard. to make the drainage effective, in the form of proper ventilation

→ To fix these appliances sanitary fittings and soil pipe

→ In multi-storeyed buildings use of one pipe system. generally makes it imperative to place the lavatory blocks of various floors one above the other.

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Sanitary fittings and other accessories :-

In the building various types of sanitary fittings are required to collect the waste water

These all fittings can be broadly classified as

- Sanitary Fittings
  - Soil fittings
    1) water closets (w.c) and
    2) urinals
  - Ablution fittings
    1) Flushing cisterns of water closets
    2) Wash Basins (W.B)
    3) Baths and Bath tubs and
    4) kitchen sinks

(1) water closets (w.c) :-

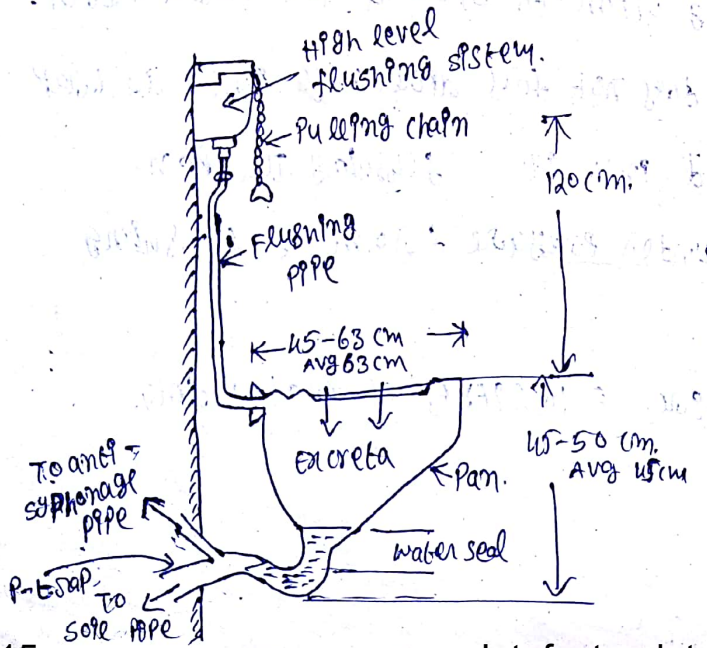
This is a sanitary appliance to receive the human excreta directly and is connected to the soil pipe by means of a trap

Two types of water closets are common use these days

i) squatting type (or) Indian type and

ii) wash-down pedestal (or) the European type

(1) squating type (or) Indian type :-



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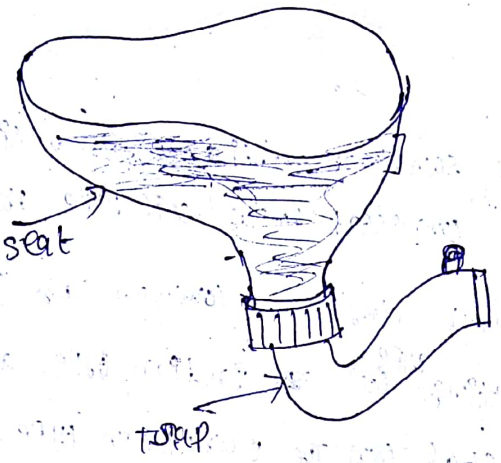
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The Indian type water closets has a squatting pan 45 cm to 63 cm in overall length and (ఇండియన్ వాటర్ క్లోసెట్ 45 నుండి 63 సెం.మీ)
45 to 50 cm in height. The pan is fitted either with a P-trap (or) S-trap which is then connected to the soil pipe as shown in figure

The squatting type (or) Indian type

→ Long Pattern (length 450, 580, 680mm)
→ Orissa Pattern (length 580, 630, 680 mm)
→ Rural Pattern (length 425 mm)

The pan (seat) and the trap are in two different pieces and joined together from figure (a)



→ the trap has an opening for fixing an anti-siphonage pipe (or) vent-pipe.
→ the pan has a flushing rim to spread the flush water.
→ the human excreta does not fall directly into the trap and need to be forced into it flushing the pan with water released under pressure from the flushing cistern.
→ this water closets requires 5-10 litres of water for proper flushing.

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→ The pan is fixed in a squatting (or) sitting position at the floor level (or) slightly raised level. In raised level will provide a pair of foot-rests for the convenience of depecting in a

(ii) wash-down, Pedestal (or) the European type water closets:-

- The European type water closets sometimes called "washdown type of water closets" is mostly used in the houses of western countries (or) high class buildings and hotels in India.
→ It is provided with a wide flushing rim and a 50mm trap.
→ It is one piece construction in which the pan and the trap are not seperate like Indian type
→ The water closets may be provided with a 'P-trap (or) S-trap depending upon the outlet existing in the wall. (or) the floor respectively.
→ This type of water closets occupies less space than the Indian type water closets and also can be located along with the bath in the same room.

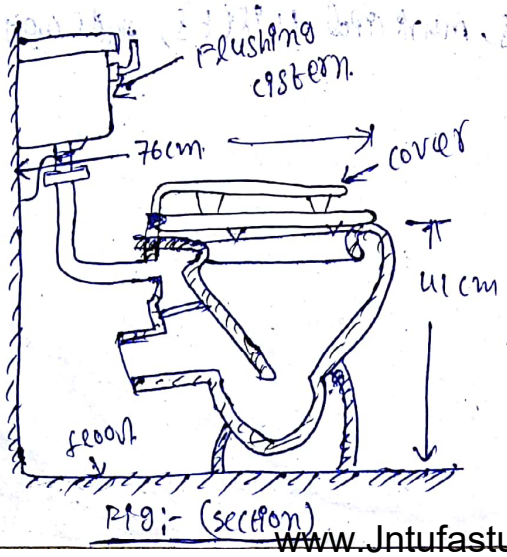
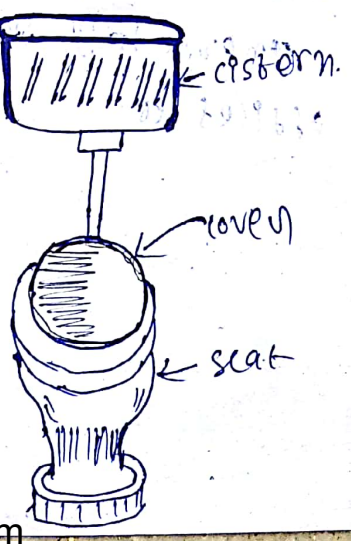


Fig:- (section)



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(2) Urinals :-

SNO	Pattern	Sizes
1	Bowl shape.	430mm Min x 360mm Min
2.	(i) Flat back (ii) Angle back	
2.	slab	
3	stall	
4.	squatting plate.	

We will be having different forms and shapes of urinals The most commonly used varieties are

(i) The bowl type (or) basin type.
(ii) The stall type.
(iii) The squatting plate.

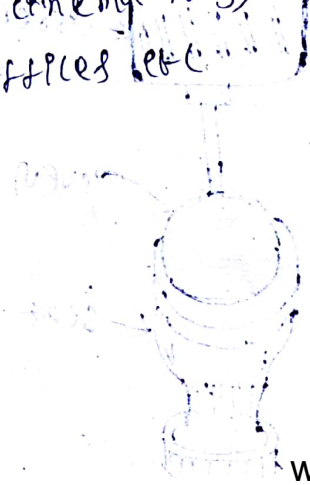
(1) The bowl type urinal

The bowl type is generally used for private houses (or) buildings and the stall type is generally used for public buildings, and municipal toilets.

→ The squatting plate type urinals are used specifically for ladies toilets only in high class

→ The bowl type (or) The basin type of urinals are more costly but are better appearance and convenient to use as compared to the slab type.

→ The stall type urinals are cheaper and are used in cinema halls, restaurants, municipal toilets, railway stations offices etc.





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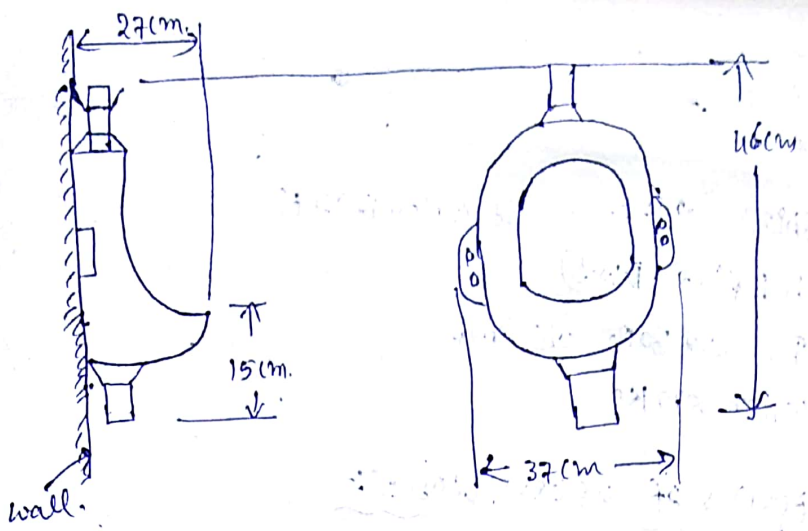


Fig: Bowl type urinals

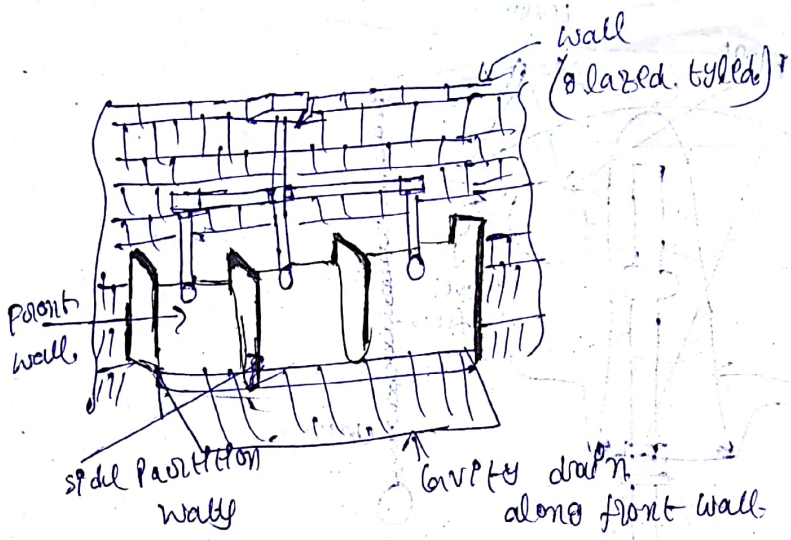


Fig: stall urinals

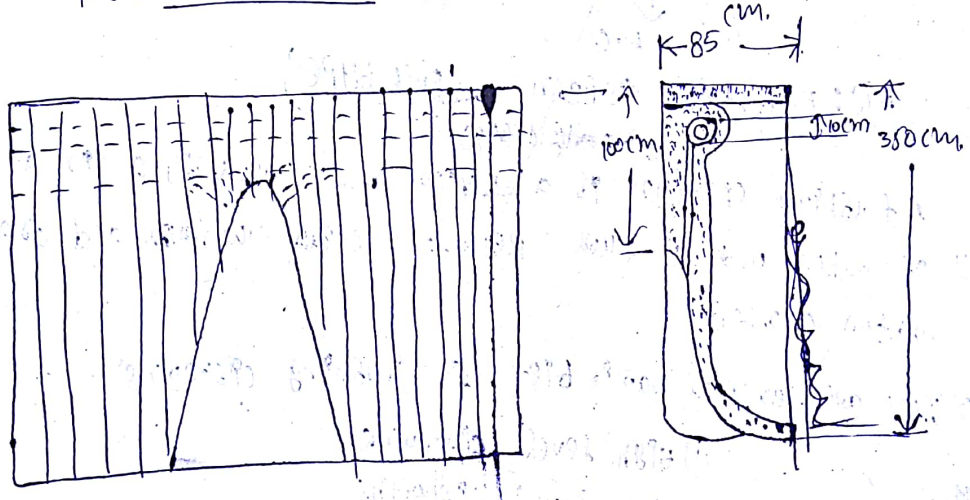


Fig: Slabbing plate urinals

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Ablution fittings :-

1) Flushing cisterns of water closets
2) Wash Basins (W.B)
3) Baths and Bath Tubs and.
4) Kitchen sinks

1) Flushing cisterns of water closets :-

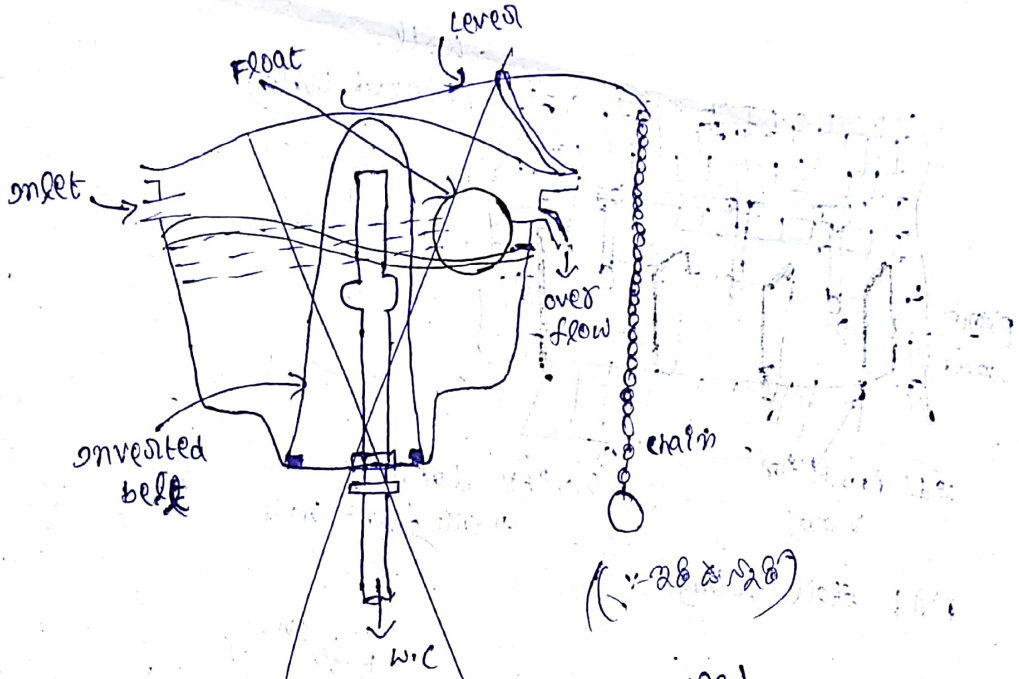


Fig: Flushing cistern (Bell type)

A flushing cistern is a device which releases a fixed quantity of water under pressure Result clean the pan and trap of a water closet.

→ There are several varieties of flushing cisterns

1) High level cisterns
2) Low-level cisterns

→ High level cisterns are intended to operate with a minimum height of 125 cm between the top of the pan and the underside of the cistern

→ Low-level cisterns are intended to operate at a height not more than 30 cm between the top of the pan and the underside of the cistern

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→ The cisteon made upof cast iron, glazed earthen ware, glazed vitreous ware (or) pressed steel (or) any other impervious material. Now a days plastic cisteons are also available in the market

There are two types of cisteons are most commonly used in now a days

(i) Bell type without valve
(ii) Flat-bottom type fitted with valve

(i) Bell type without valve

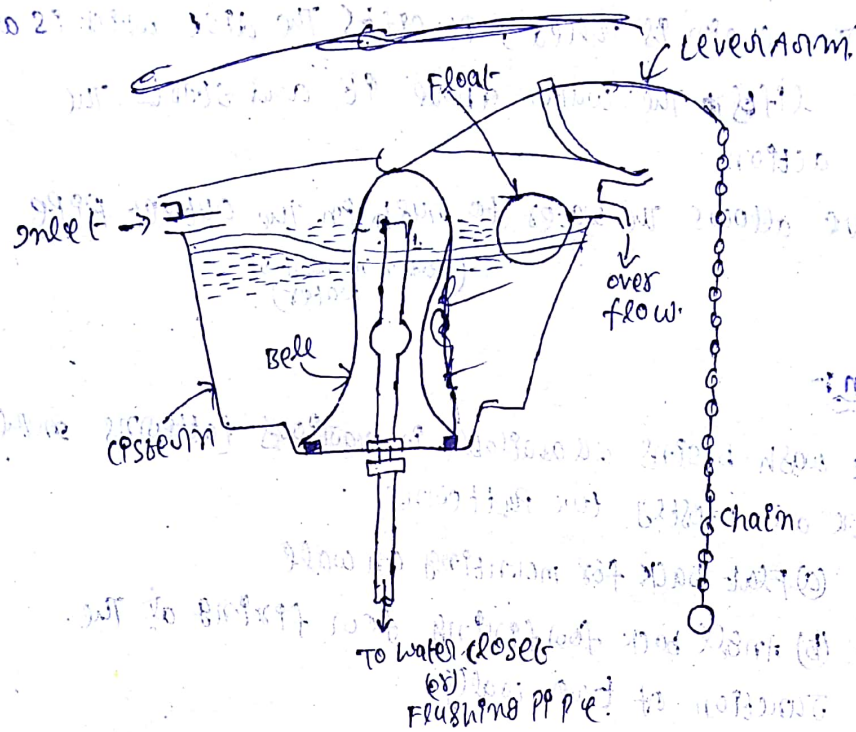


Fig (Bell type) Flushing cisteons

→ In bell type flushing cisteon the bell is kept over the outlet pipe the outlet end slightly above the water level.

→ When the chain is pulled the bell is lifted causing the to spill over the outlet pipe and starting the siphonic action. due to which the whole water rushes (a sudden impulse moment of water) to words the outlet and flushes the water closet

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(1f) Flat bottom type fitted with valve :-

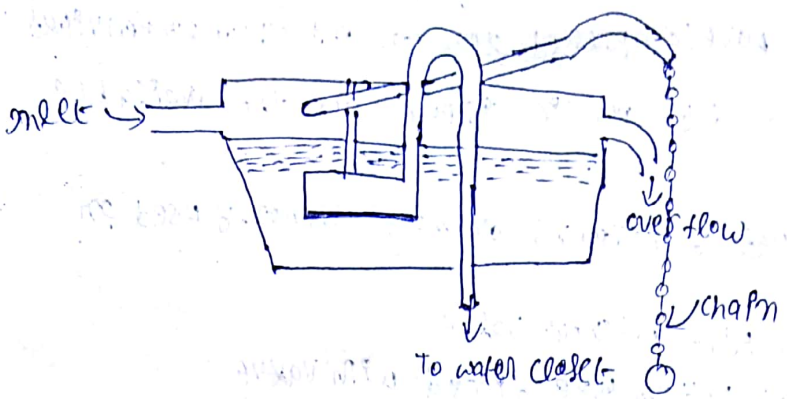


Fig: Flat bottom type flushing cistern

→ The Flat bottom type flushing cistern provided with valve.

→ when the chain is pulled, it lifts the disc which is also suddenly lifts the water above it and starts the siphonic action.

→ the valve allows the water to rush in the outlet pipe (sudden moment of water)

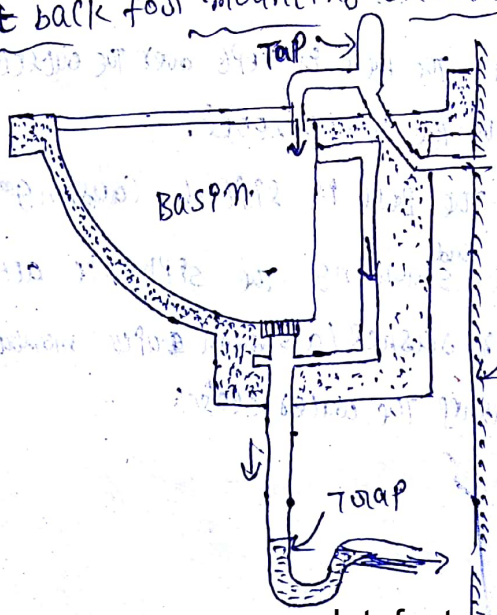
(2) wash basin :-

The wash basins are available in various patterns in the market there are mostly two patterns

(a) Flat back for mounting on wall

(b) Angle back for fixing for fixing at the Junction of two walls

(a) Flat back for mounting on wall :-



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→ Flat back basins are provided with double (or) single tap holes

→ All the wash basins should be of one piece construction.

→ All the internal angles are designed so as to facilitate cleaning

→ The wash basins are provided with a circular waste hole on the bottom as shown in above.

→ This wash basins should have a overflow hole.

→ These wash basins are made of fire-clay, stone ware, earthen ware (or) vitreous china. (resistance of high temperature)

→ But now a days steel, aluminium and plastic wash basins are also available in the market which is very popular

→ These pans are having rectangular, square, circular, oblong

→ These are fixing support on the wall

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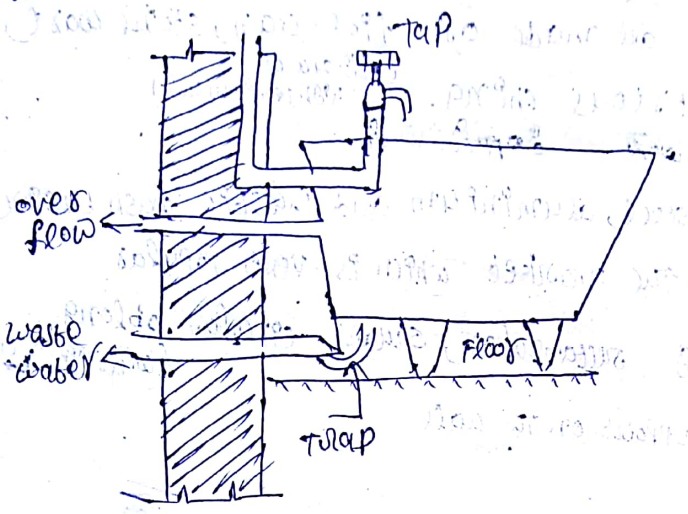
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(3) Bath and Bath Tubs :-

→ Bath tubs are made of various materials such as enamelled iron, plastic, cast iron, marble (or) fire clay etc.

→ For high class residential buildings marble, plastic (or) enamelled iron (or) fibre glass baths are used.

→ For public places glazed fire-clay (or) porcelain enamelled cast iron baths are used



→ The bath may be parallel (or) taper

→ It is to be provided with one outlet of 4 to 8 cm and one inlet pipe for filling.

→ In some cases two taps are provided. one for hot and another for cold water supply.

→ The bath should also provided one over-flow pipe to take excessive water

→ The waste pipe of bath is provided with a trap to prevent the foul gases from entering in the bath room.

→ The usual dimensions of bath are length 1.7 to 1.85 m. width 70 to 75 cm depth near waste pipe side 45 to 45 cm overall height with 58 to 60 cm

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4) Kitchen sinks:-

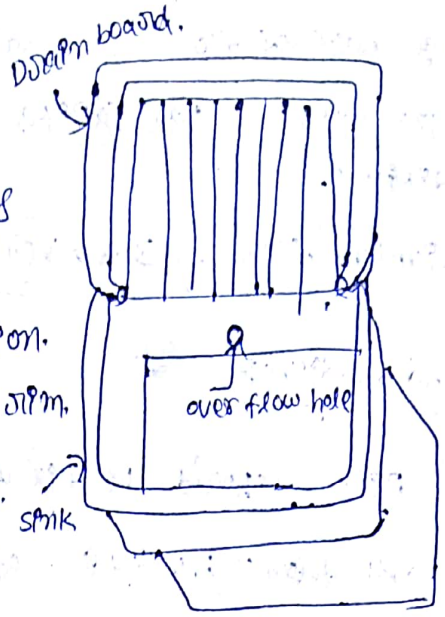


Fig: Kitchen sink

→ kitchen sinks are rectangular shallow vessels shown in fig.

→ They are one piece construction. provided with (or) without rim.

→ The floor of the sink is given a slope towards the waste outlet.

→ These sinks are provided with a circular waste hole

→ All the kitchen sinks are provided with a draining board which is fixed on the right of the user.

→ weir type overflow slots are also provided in some sinks

→ these sinks are made of glazed earthenware (or) stone ware.

→ The height of the top of the sink from the floor should be 90 cm

PG No 569 BC Punmia:-

(2.8) Design of Building drainage:-

In the design of building drainage, we must go through the following aspects

1) quantity of flow
2) pipe sizes and gradients
3) sewerage plans of buildings.

(1) quantity of flow:-

→ The flow in the drainage pipes of a house sewerage system is irregular in nature and is not continuous flow. and the quantity of flow also small

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→ The average rate of flow is usually based on a water supply of 135 lpcd per capita per day for average Indian conditions.

Maximum flow = 3 * Average flow

(2) Pipe sizes and Gradient:-

→ The lateral pipes should be fix with suffecient gradient to prevent ~~any deposit~~ blockage of solid matter.

→ The recommended gradients for sewers carying maximum flow when running half full and with minimum self cleaning velocity of 0.75 m/s and the corresponding discharge are given in table.

Dia of pipe	Gradient	Discharge in m^3/minute (m^3/day)
100	1 in 35	0.18 (259)
150	1 in 65	0.42 (605)
230	1 in 120	0.93 (1339)
300	1 in 200	1.66 (2390)

→ The commonly adopted sizes for house drains, for average conditions are as follows

Soil pipe = 100 mm ø

Sullage pipe (vertical) = 75 mm ø

Sullage pipe (Horizontal) = 32 mm to 50 mm ø

Vent pipe = 50 mm ø

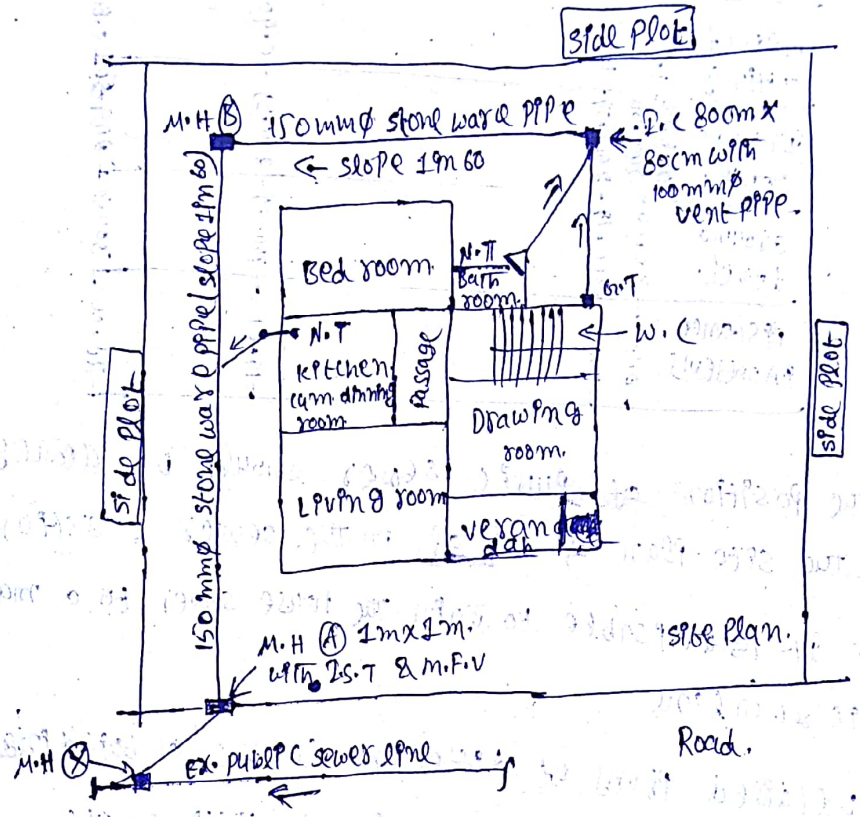
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(3) Sewerage plans of a buildings :-

It is generally convenient and necessary to prepare the detailed plans of house sewerage system and to get it approved from the municipalities while preparing such plans, the following points kept in mind.

(i) The site plan of the building should be drawn to a convenient scale and positions of Gully traps (G.T) should be marked on it as shown in figure below.



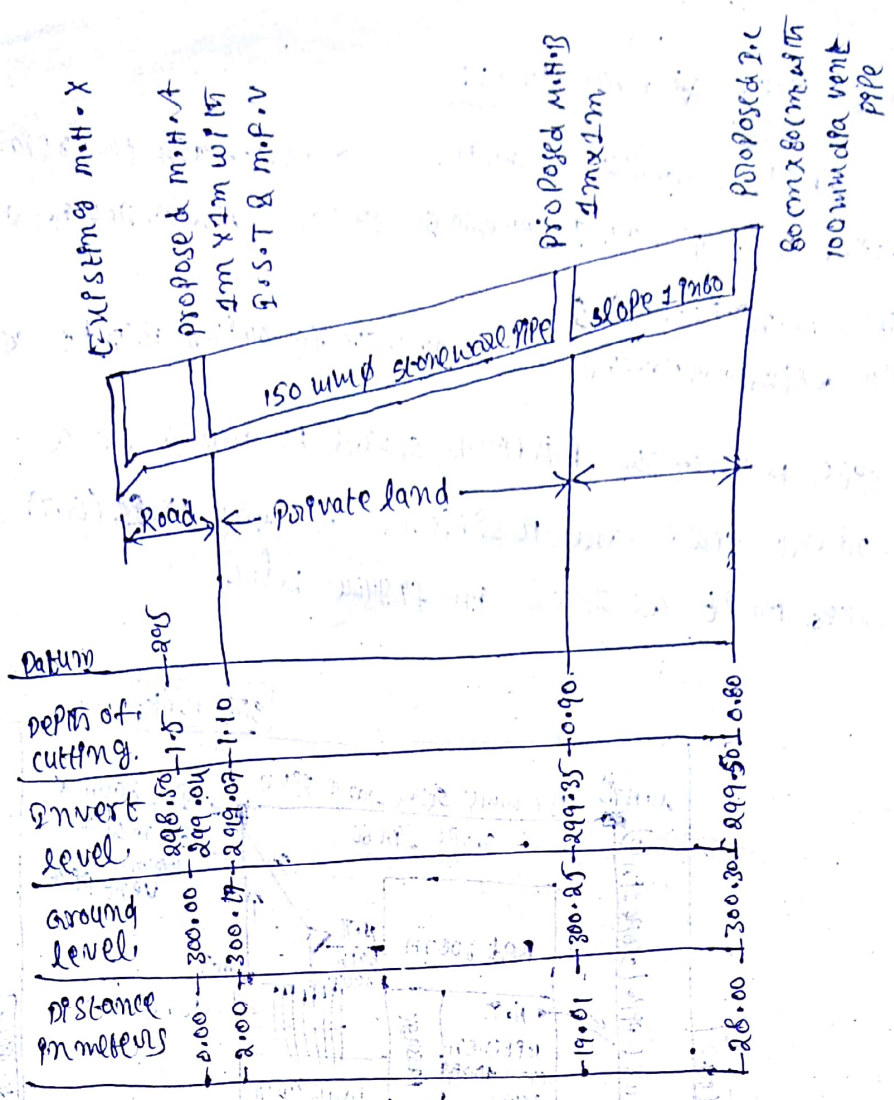
(ii) The L-section sewer drawing to used.

→ Generally L-sections of drawing larger than 150mmφ

→ The L-section should show distances, ground levels, invert levels, depth of cutting, sizes of manholes, sizes and gradients of pipes etc. are shown in figure below

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→ The position of public sewer should be clearly marked on the site plan as well as on the sewer L-section.

Note:- It is advisable to join the house sewer to a manhole on public sewer line

→ Detailed plans of different floors of buildings show the positions of floor traps, sanitary fittings etc

→ The house drains are fitted in to the house as per approved by sewerage plans of the building

→ House drains are tested for water-tightness and the trenches in walls (or) floors are filled up after testing of water-tightness.

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PGNO 394

Power of the pumping units:-

The power of the pumping units to be installed on the sewage pumping station depends on the following

(i) The maximum total head under which pumping is to be done including loss of heads

(ii) The maximum pumping rate (or) discharge of pumping

(iii) The efficiency of the pumping unit

(iv) The factor of safety required for operating stand by pumps in case of emergency.

→ The loss of head due to friction is determined by the well known hydraulic formula as

$$H_f = \frac{4 f L v^2}{2 g d}$$

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Horse Power

The horse-Power (H.P) of a pump can be determined by calculating the work done by a pump in raising the water upto "H" height

Let the pump raise "w" kg of water to height "H" m.

Then work done by pump = w (kg) × H (m)

= w × Q × H m·kg/sec

where w = density of water in kg/m³

Q = water discharge by pump in m³/sec

Then water Horse power = $\frac{\text{Discharge (kg/sec)} \times \text{Total Head (H)}}{75}$

$W.H.P = \frac{w \times Q \times H}{75}$

But Brake Horse power = $\frac{W.H.P}{\text{Efficiency } (\eta)}$ [∵ H.P = $\frac{wQH}{75}$]

$B.H.P = \frac{w \times Q \times H}{75 \times \eta}$

Problems

1) A centrifugal pump is required to lift 2.5 cubic metres of water per second to height of 7 metres. Assuming total loss of head in pipes of 0.3 metres. Calculate the minimum horse power of driving engine to run the pump if its efficiency is 70%.

Sol: Total head against which pump has to lift the water

= 7 + 0.3

= 7.3 metres

Horse power

$W.H.P = \frac{w \times Q \times H}{75} = \frac{1000 \times 2.5 \times 7.3}{75} = 243.3$ H.P

[∵ density of water (w) = 1000 kg/m³ constant value]

$B.H.P = \frac{w \times Q \times H}{75 \times \eta} = \frac{w \times Q \times P}{75 \times \eta} \left[\frac{w \times Q \times H}{75}\right] \times \frac{1}{\eta} = 243.3 \times \frac{1}{0.7}$

$= \left[\frac{w \times Q \times P}{75}\right] \frac{1}{\eta} = \frac{243.3}{0.7}$

= 348 H.P

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(2)

P8 NO 87 Bindra & Bindra

3) water has to be supplied to a town with one lakh population at the rate of 150 litres/capita/day from a river 8000 m away the difference in elevation between the lowest water level in the sump and reservoir is 36m. If the demand has to be supplied in 8 hours. determine the size of the main and the B.H.P (Brake Horse Power) of the pumps required. Assume maximum demand as 1.5 times the average demand. Assume $f = 0.0075$ velocity in the pipe 2.4 m/sec and efficiency of pump 60%.

Sol:

Population of the town = 1,00,000 (given in problem).

per capita demand = 150 litres/day

the average demand of the town = $1,00,000 \times 150$ litres/day

$= 15 \times 10^6$ litres/day

maximum daily demand = $1.5 \times 15 \times 10^6$ litres/day

As the full demand is to be supplied through pumps in 8 hours

discharge required = $\frac{22.5 \times 10^6}{8}$ litres/hour [$\because 15 \times 1.5 = 22.5$]

$= \frac{22.5 \times 10^6}{8 \times 3600 \times 10^3}$ cu.m/sec (1 liter = 0.001 cu.m $= \frac{1}{1000}$; $1000 \times 60 \times 60$)

$= 0.781 \ m^3/sec$

The maximum velocity in the pipe is given as 2.4 m/sec

cross-sectional area of the pipe required

$= \frac{Q}{V}$

$= \frac{0.781}{2.4} = 0.325$ sq.m.

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If diameter of the pipe be "d"

$$\frac{\pi}{4} d^2 = 0.325$$

$$d = \sqrt{\frac{0.325 \times 4}{\pi}}$$

$d = 0.643$ m.

$\simeq 0.65$ m. Ans

2000 m.

$2 \times 1000 = 2000$ m.

=

The total lift is given as 36 m.

Friction loss of head in the pipe

Constants

$$H_1 = \frac{4 f' L V^2}{2 g d}$$

[$\because g = 9.81$]

$$= \frac{4 * 0.0075 * 2000 * (2.4)^2}{2 * 9.81 * 0.65}$$

$$= 27.099 \text{ m}$$

Net total lift against which pump has to lift water

$$= 36 + 27.099$$

$$= 63.099 \text{ m}$$

$$\text{B.H.P of the pump} = \frac{w * Q * H}{75 \times \eta}$$

density of water in kg/m^3 — Constant value

$$= \frac{1000 * 0.781 * 63.099}{75 * 0.8}$$

(η) efficiency = 80% = $\frac{80}{100} = 0.8$]

$$= 821.337$$

$$= 822 \text{ HP}$$

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Pg No 60 Bipolde Bipolde water is clear చెప్పుకోవచ్చు అనుకుంటా

3) From a clean water reservoir 3.0 m deep and maximum water level at 30.00 m, water is pumped to an elevated reservoir at 75.00 at the constant rate of 9,00,000 lits/hour. The distance is 1500m. Give the economical diameter of the rising main and the water horse power of the pump. Neglect the minor losses and take $f = 0.01$?

Sol:

Required discharge of the pump

$(Q) = 9 \times 10^5$ litres/hour

$= \frac{9 \times 10^5}{60 \times 60 \times 10^3}$ cu.m/sec

$= 0.25$ cu.m/sec

1 liter $= 0.001$ cu.m

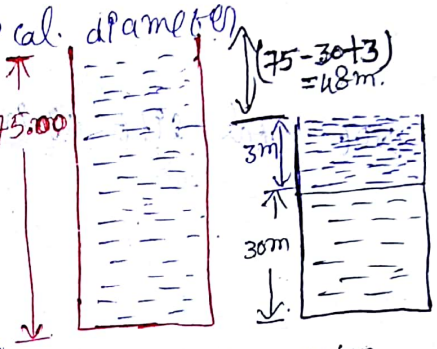
$= \frac{1}{1000}$ cu.m

using Leals formula for the economical diameter of the rising main

$D = 1.22\sqrt{Q}$

$= 1.22\sqrt{0.25}$

$= 0.61$ m



velocity in the pipe $= \frac{Q}{A}$

$= \frac{0.25}{\frac{\pi}{4}(0.61)^2} = 0.855$ m/sec

[∵ distance b/w these two reservoirs is 1500m]

[∵ Discharge = Area × velocity
$Q = AV$
$V = \frac{Q}{A}$]

Head against which pump has to lift the water

$= (75.00 - 30.00 + 3)$

$= 48$ m.

Friction losses in the pipe $(H) = \frac{4 f l v^2}{2 g d}$

(where $d = D = 0.61$ m)

$= \frac{4 * 0.01 * 1500 * (0.855)^2}{2 * 9.81 * 0.61}$

$= 3.665$ m.

[∵ constant value
$g = 9.81$]
↓
acceleration due to gravity

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Now the total head against which the pump has to work

$$(H) = (48 + 3.665)$$

$$= 51.665\ m$$

water Horse Power of the pump

$$= \frac{w * Q * H}{75}$$

[∵ constant value
w = density of water
= 1000 kg/m³]

$$= \frac{1000 * 0.25 * 51.665}{75}$$

$$= 172.22$$

$$\simeq 173\ HP\ (say)$$

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