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CLASS - 7A

USN - 1CR15CV047

SUBJECT - MRIWWE

Q.1) Explain the separate and combined system of sewage with their merits and demerits.

Ans: SEPARATE SYSTEM

In this system 2 sets of sewers are laid. The sanitary sewage is carried through one set of sewers called sanitary sewers while the storm water is carried through another set of conduits called drains. The sewage is carried to the treatment plant and the storm water is directly discharged into the natural rivers or streams for disposal.

MERITS

1) The sizes of sewers are small.
2) Sewage load on treatment units is less.
3) Rivers or streams are not polluted.
4) Storm water may be discharged into stream without any treatment.

DEMERITS

1) Sewers being small cleaning is difficult.
2) Frequent choking problem will be there.
3) The system proves costly as it involves 2 sets of sewers.
4) The use of storm sewer is only partial because during monsoon seasons, they will be idle & forms the dumping place to garbage.

2) COMBINED SYSTEM

When only one set of sewers are used to convey both sanitary w/w and storm water, the system is called combined system. The sewage & storm water both are carried to the treatment plant. The sewers used are called as combined sewers.

* MERITS

1] The sizes of sewers being large choking problems are less & easy to clean.

2] It proves economical as only one set of sewers are laid.

3] Because of dilution of w/w with storm water, nuisance potential is greatly reduced.

* DEMERITS

1] Sizes being large, difficult in handling & transportation.

2] The load on treatment plant is unnecessarily increased

3] Unnecessarily storm water is polluted.

Q2) Explain the tests to be conducted for the sewers before putting them under service.

thus It is necessary to test the sewers after in laying for water tightness before backfilling the excavated earth.

1] SMOKE TEST - This test is performed for soil types, rent types laid above ground. The test is conducted under a pressure of 2.5 m of water and maintained for 15 minutes. After all trap seal have been filled with water, the smoke is

produced by burning paper or oil water in combustion chamber of a smoke machine. If the pipes leak then it has to be repaired or replaced.

2] WATER TEST OR TEST FOR DRA LEAKAGE

Test for leakage is performed for underground sewer pipes before backfilling is done. The test should be carried out by suitably plugging the lower end of the drain & filling the system with water. A elbow bend shall be temporarily jointed at the top end a sufficient length of vertical pipe is jointed so as to provide the required test.

Subsidence of water in the knuckle bend may be due to.

i] absorption of water by pipe & joints. etc.

3] TEST FOR STRAIGHTNESS OF ALIGNMENT AND OBSTRUCTION

For this test, a mirror is placed infront of one end of the sewer & image of the section is observed.

If the sewer line is straight, the image should be circular it is not a complete circle then it is not straight.

For testing obstruction by inserting a smooth steel ball at upper end & if there is no obstruction in the sewer line, the ball will emerge out from the lower end.

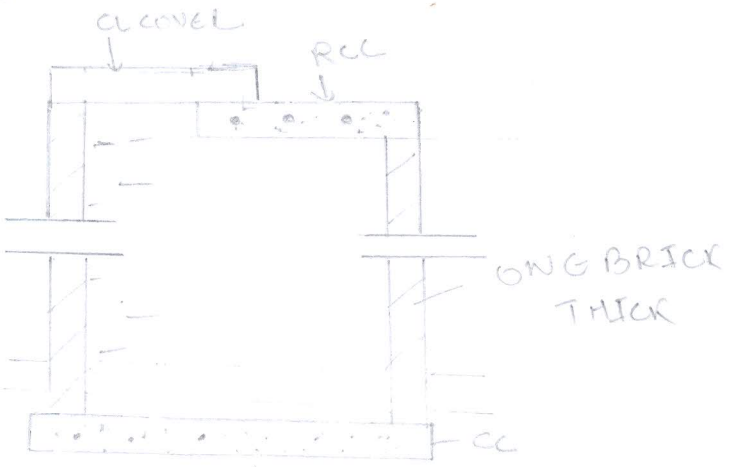
(5) what are sewer appurtenances? list them and explain catch basin and manhole with neat sketch.

Ans The structures which are constructed at suitable intervals along the sewage system to help its efficient operation and maintenance are called as sewer appurtenances. These include.

(1) Manholes (2) Drop manholes (3) Lamp holes. (4) Clean outs (5) Street inlet called Gullies. (6) Catch basins. (7) Flushing Tanks (8) Grease & Oil traps (9) Inverted Siphons and (10) Storm Regulators.

* MANHOLES

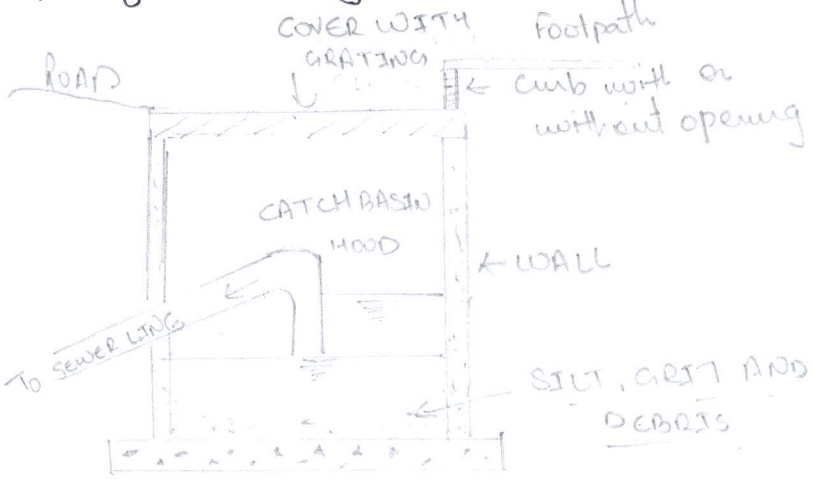
The manhole is masonary or RCC chamber constructed at suitable intervals along the sewer lines for gaining access into them. Thus, the manhole helps in inspection cleaning and maintenance of sewer. These are provided at every bend, junction, change of gradient or with even gradient. For straight sewer line b/w the two manhole are provided at regular interval depending upon the diameter of the sewer. A spacing allowance of 100m per 1m diameter of sewer is a general rule in case of very large sewers.



* CATCH BASINS

Catch basins are provided to stop the entry of heavy debris present in the storm water into the sewers. However, their use is discouraged because of the nuisance due to mosquito breeding apart from causing substantial maintenance

problems. At the bottom of the basin space is provided for the accumulation of impurities. A hood is provided to prevent escape of sewer gas.



(i) Explain the terms (i) self cleansing and non-scouring velocity
(ii) Time of concentration.

(i) Self cleansing Velocity

It is necessary to maintain a minimum velocity in a sewer line to ensure that suspended settleable solids do not deposit to cause choking problem, such a minimum velocity is called self-cleansing velocity. It is determined by considering the particle size & specific weight of suspended solids in waste water.

The self cleansing velocity can be found out by the following formula given by Shields

$$V_S = \sqrt{\frac{8K}{f}\left(\frac{S_s - S}{S}\right) g d} \quad \text{— (1)}$$

where f → Darcy's co-efficient of friction = 0.03
K → characteristics of solids.
K → 0.04 for inorganic solids
K = 0.06 for organic solids.

S_s - specific gravity of particles (2.65 generally)

S - specific gravity of sewage (1.0 generally)

g → acceleration due to gravity in m/sec^2

d → dia of particles in m

or

$$v_s = \frac{1}{n} R^{1/6} \sqrt{K \cdot d \left(\frac{S_s - S}{S}\right)}$$

where n → co-efficient of roughness

R → Hydraulic mean depth

K, S, S_s, d same as above.

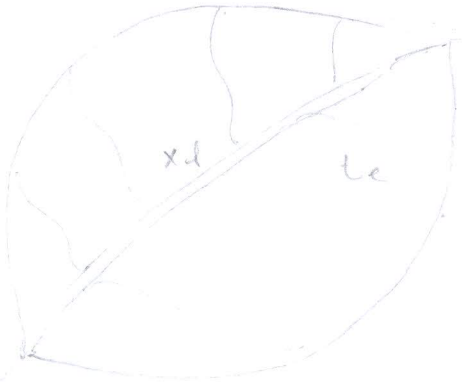
* Non-Scouring Velocity

Minimum velocity at which no scouring action or abrasion of the interior surface of the sewer takes place is known as non-scouring velocity. Such a velocity depends on the materials used for the construction of sewer.

Desirable values

Sl no	Sewer material	Non-scouring velocity m/s
1	Earth Channel	0.6 - 1.2
2	Ordinary brick lined sewer	1.5 - 2.5
3	Cement concrete sewer	2.5 - 3.0
4	Stoneware sewer	3.0 - 4.5
5	Cast iron sewer pipe	3.5 - 4.1
6	Vitrified tile	4.5 - 5.0

* TIME CONCENTRATION



$$Tc = te + tf$$

In order to determine the sizes of stormwater sewers, it is necessary to consider one more factor namely time of concentration (TC)

It is the time taken for the maximum run-off to develop and is equal to the time required for a drop of water to run from the most farthest point of the watershed to the point for which the runoff is to be calculated.

This consists of

1) Time taken by rainfall to run off from the most distant point of watershed to the inlets of the sewer called the time of entry or inlet time

2) The time required for the flow of water in the sewers to the point under consideration called 'time of flow'.

Q.5) Explain self-purification of streams.

Ans. When sewage is discharged into a natural stream or river, the organic matter present in the sewage gets oxidized by bacteria and converted to simpler, inoffensive, stable substance

In this process of oxidation the dissolved oxygen (DO) content of the river or stream water is utilized. Due to this deficiency of dissolved oxygen is created in river or stream water.

The deficiency of dissolved oxygen thus created in river or stream water is filled up by the absorption of atmospheric oxygen. Thus dissolved oxygen of river or stream water is consumed by sewage discharged into it and at the same time it is replenished by the atmosphere.

The various actions involved in self purification process are physical, chemical and biological in nature. are as listed below.

1. Dilution
2. Oxidation
3. Reduction
4. Sedimentation
5. Action of Sunlight.

* Dilution

When sewage is discharged into a large volume of water flowing in a natural stream or river, it is dispersed and dilution takes place. Due to dilution the concentration of various constituents such as organic matter, BOD, suspend solids, etc.

* Oxidation

When sewage is discharged into a stream or river the organic matter present in the sewage is oxidised by aerobic

(3) Reduction

The organic matter of sewage settled at the bottom is reduced to liquids and gases due to hydrolysis either chemically or biologically.

(4) Sedimentation

The settleable solids contained in sewage drop down to the bottom of stream or river and are thus easily separated. Further the settleable solids are deposited in the form of sludge in which anaerobic decomposition may take place.

(5) Action of Sunlight

The sunlight has bleaching and stabilizing effects on bacteria. It also helps certain micro-organisms to derive energy from it, and through biological action convert themselves into food for other forms of life.

Q.6) The rate of water supply to a town covering an area of 100 hectares having a population of 50000 is 150 lpcd. 60% of which flows out as wastewater. The peak flow of wastewater may be taken as 2.5 times the average flow. The area of town is classified as

% of total area	Nature of surface	Runoff co-efficient
45	Hard pavement	0.8
20	Unpaved	0.4
20	Yards & lawn	0.25
15	Wooden area	0.15

Design a sewer section to develop a maximum velocity of 2·5 m/s, when it runs half full at peak combined flow. The time of concentration is 30 minutes.

Solution

(1) Calculation of wastewater flow.

A = 100 Hectare

Pop: 50,000

Rate of water supply = 150 lpcd

w/w flow = 80% of water supply

Peak flow = 2·5 × Avg flow.

∴ Peak (maximum) w/w flow: $\frac{50,000 \times 150 \times 0.8 \times 2.5}{1000 \times 24 \times 60 \times 60}$

$Q_1 = 0.1736\ m^3/sec.$

(2) Calculation of storm water flow using rational formula

$$Q = \frac{CiA}{360}$$

Intensity of rainfall, $i = \frac{762}{t+10}$ for t = 5 to 10 minutes

$= \frac{1016}{t+20}$ for t = 20 to 100 minutes

i = mm/hr

$i = \frac{1016}{30+20} = 20.32$ mm/hr

(3) Calculation of average coefficient of run-off

$$C = \frac{\Sigma CA}{\Sigma A} = \frac{C_1A_1 + C_2A_2 + \cdots + C_nA_n}{A_1 + A_2 + \cdots + A_n}$$

$$C = \frac{[0.45 \times 0.8 + 0.4 \times 0.2 + 0.25 \times 0.2 + 0.15 \times 0.15] \times 100}{100}$$

$C = 0.5125$

Substituting the value of C & i in the formula

$$Q_2 = \frac{CiA}{360}$$

$$Q_2 = \frac{0.5125 \times 20.32 \times 100}{360}$$

$$Q_2 = 2.893 \text{ m}^3/\text{sec}$$

Total combined flow: $Q_1 + Q_2$

$= 0.1736 + 2.893$

$Q = 3.066 \text{ m}^3/\text{sec}$

Given

$V = 2.5 \text{ m/sec}$ (circular section running half full)

$d = \frac{1}{2}D$

d → dia of w/w running

D → dia of sewer.

$Q = AV$

$3.066 = \frac{1}{2}\left(\frac{\pi d^2}{4}\right) \times 2.5$

$d = 1.767 \text{ m}$

∴ Diameter of the sewer section $d_{01} = 1.767 \text{ m}$

$1.767 \times D \Rightarrow D = 3.53 \text{ m}$ is complete dia of sewer.

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