

## **Module 2: System of Sanitation**

### **Lecture 2: System of Sanitation**

## 2. SYSTEM OF SANITATION

### 2.1 BACKGROUND

For safe disposal of the sewage generated from a locality efficient collection, conveyance, adequate treatment and proper disposal of treated sewage is necessary. To achieve these following conditions should be satisfied:

1. Sewage should not pollute the drinking water source, either surface or ground water, or water bodies that are used for bathing or recreational purposes.
2. The untreated sewage during conveyance should not be exposed so as to have access to human being or animals and should not give unsightly appearances or odour nuisance, and should not become a place for breeding flies.
3. It should not cause harm to public health and adversely affect the receiving environment.

The collection system is meant for collection of the sewage generated from individual houses and transporting it to a common point where it can be treated as per the needs before disposal. In olden days waste generated from water closets was collected by conservancy methods and other liquid waste was transported through open drain to finally join natural drains. Since, the excreta was carried through carts, it was not hygienic method for transportation to the disposal point. Now, collection and conveyance of sewage is done in water carriage system, where it is transported in closed conduit using water as a medium.

### 2.2 TYPES OF SEWERAGE SYSTEM

The sewerage system can be of following three types.

**Combined system:** In combined system along with domestic sewage, the run-off resulting from storms is carried through the same sewers of sewerage system. In countries like India where actual rainy days are very few, this system will face the problem of maintaining self cleansing velocity in the sewers during dry season, as the sewage discharge may be far lower as compared to the design discharge after including storm water.

**Separate System:** In separate system, separate conduits are used; one carrying sewage and other carrying storm water run-off. The storm water collected can be directly discharged into the water body since the run-off is not as foul as sewage and no treatment is generally provided. Whereas, the sewage collected from the city is treated adequately before it is

discharged into the water body or used for irrigation to meet desired standards. Separate system is advantageous and economical for big towns.

***Partially separate system:*** In this system part of the storm water especially collected from roofs and paved courtyards of the buildings is admitted in the same drain along with sewage from residences and institutions, etc. The storm water from the other places is collected separately using separate conduits.

### ***2.2.1 Advantages and disadvantages of combined system***

#### ***Advantages***

- In an area where rainfall is spread throughout a year, there is no need of flushing of sewers, as self cleansing velocity will developed due to more quantity because of addition of storm water.
- Only one set of pipe will be required for house plumbing.
- In congested areas it is easy to lay only one pipe rather than two pipes as required in other systems.

#### ***Disadvantages***

- Not suitable for the area with small period of rainfall in a year, because dry weather flow will be small due to which self cleansing velocity may not develop in sewers, resulting in silting.
- Large flow is required to be treated at sewage treatment plant before disposal, hence resulting in higher capital and operating cost of the treatment plant.
- When pumping is required this system is uneconomical.
- During rains overflowing of sewers will spoil public hygiene.

### ***2.2.2 Advantages and disadvantages of separate system***

#### ***Advantages***

- As sewage flows in separate pipe, hence the quantity to be treated at sewage treatment plant is small, resulting in economy of treatment.
- This system may be less costly as only sanitary sewage is transported in closed conduit and storm water can be collected and conveyed through open drains.
- When pumping is required during disposal, this system is economical due to less flow.

**Disadvantages**

- Self cleansing velocity may not be developed at certain locations in sewers and hence flushing of sewers may be required.
- This system requires laying two sets of pipe, which may be difficult in congested area.
- This system will require maintenance of two sets of pipelines and hence maintenance cost is more.

**2.2.3 Advantages and disadvantages of partially separate system****Advantages**

- Economical and reasonable size sewers are required.
- Work of house plumbing is reduced as rain water from roofs, sullage from baths and kitchen, etc. are combined with discharge from water closets.
- Flushing of sewers may not be required as small portion of storm water is allowed to enter in sanitary sewage.

**Disadvantages**

- Increased cost of pumping as compared to separate system at treatment plants and intermediate pumping station wherever required.
- In dry weather self-cleansing velocity may not develop in the sewers.

**2.3 CONSIDERATIONS FOR THE TYPE OF SYSTEM**

Following points are considered before finalizing the type of collection system.

- The separate system requires laying of two sets of conduits whereas in combined system only one bigger size conduit is required.
- Laying of two separate conduits may be difficult in the congested streets.
- In combined system sewers are liable for silting during non-monsoon season, hence they are required to be laid at *steeper gradients*. Steeper gradients for the sewers may *require more number of pumping stations*, particularly for flat terrain, which may make the system costly.
- Large quantity of wastewater is required to be treated before discharge in case of combined system. Hence, large capacity treatment plant is required.
- In separate system, only sewage is treated before it is discharged in to natural water body or used for irrigation. No treatment is generally given to the rainwater collected before it is discharge in to natural water body.

- In case of separate system pumping is only required for sewage. Pumping can be avoided for storm water lines, as they are not very deep and normally laid along the natural slopes. In combined system large capacity pumping station is required to safely handle the flow that is likely to be generated during highest design storm considered.
- Based on site conditions the economy of the system needs to be evaluated and selection is made accordingly.

## 2.4 PATTERNS OF COLLECTION SYSTEM

The network of sewers consists of house sewers discharging the sewage to laterals. The lateral discharges the sewage into branch sewers or sub-mains and sub-mains discharge it into main sewer or trunk sewer. The trunk sewer carries sewage to the common point where adequate treatment is given to the sewage and then it is discharged. The patterns of collection system depend upon:

1. The topographical and hydrological features of the area.
2. The location and methods of treatment and disposal works.
3. The type of sewerage system employed, and
4. Extent of area to be served.

Following patterns can be adopted for collection systems as per the suitability (Birdie, 1990).

### a. Perpendicular pattern

- The shortest possible path is maintained for the rains carrying storm water and sewage (Figure 2.1).
- Suitable for separate system and partially separate system.
- This pattern is not suitable for combined system, because treatment plant is required to be installed at many places; otherwise it will pollute the water body where the sewage is discharged.

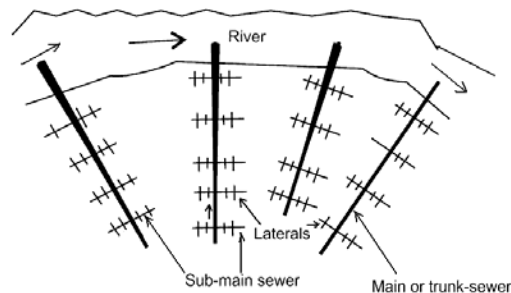


Figure 2.1 Perpendicular pattern of collection system

### b. Interceptor pattern

- Sewers are intercepted with large size sewers (Figure 2.2).
- Interceptor carries sewage to a common point, where it can be disposed off with or without treatment.
- Overflows should be provided to handle very large flow.

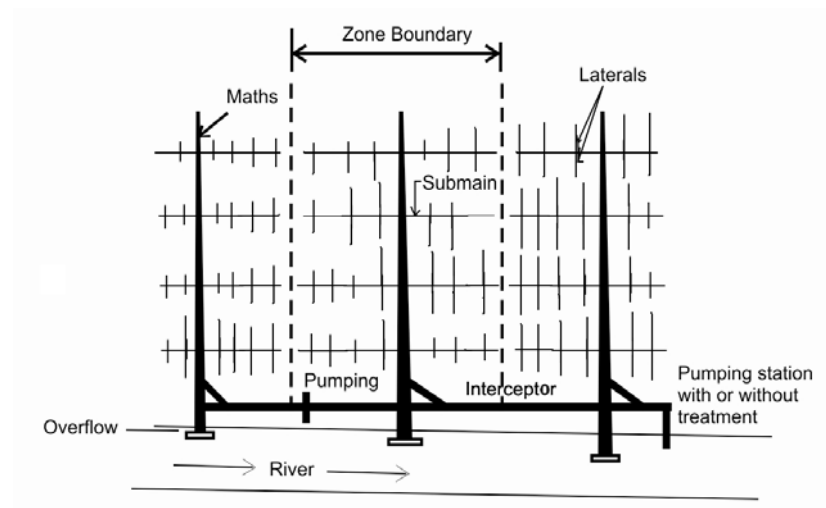


Figure 2.2 Interceptor pattern of collection system

### c. Radial Pattern

- It is suitable for land disposal.
- In this pattern sewers are laid radially outwards from the centre, hence this pattern is called as radial pattern (Figure 2.3).
- The drawback in this pattern is more number of disposal works is required.

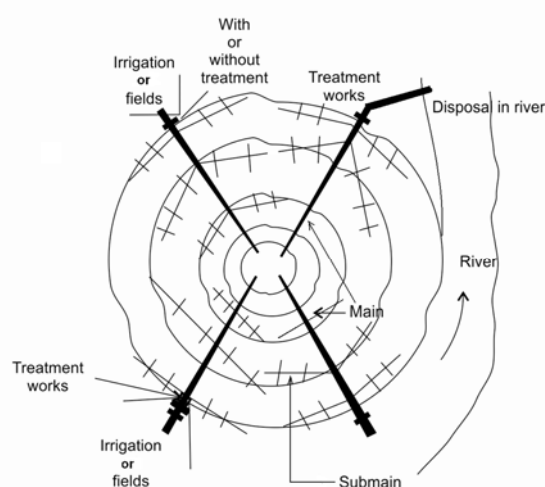


Figure 2.3 Radial pattern of collection system

#### d. Fan Pattern

- This pattern is suitable for a city situated at one side of the natural water body, such as river.
- The entire sewage flows to a common point where one treatment plant is located (Figure 2.4).
- In this number of converging main sewers and sub-mains are used forming a fan shape.
- Single treatment plant is required in this pattern.
- The drawback in this pattern is that larger diameter sewer is required near to the treatment plant as entire sewage is collected at a common point.
- In addition, with new development of the city the load on existing treatment plant increases.

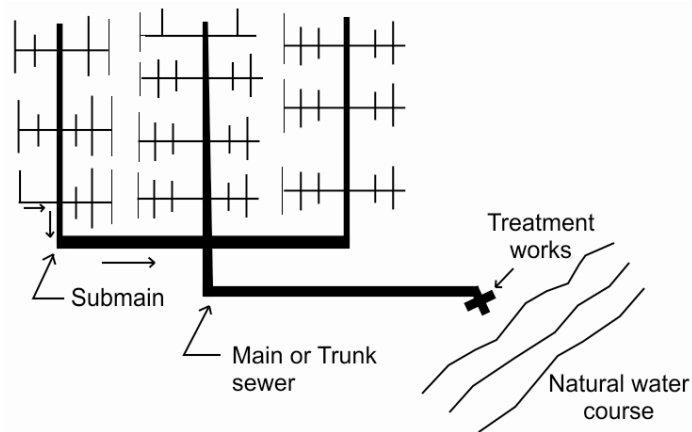


Figure 2.4 Fan pattern of collection system

#### e. Zone Pattern

- More numbers of interceptors are provided in this pattern (Figure 2.5).
- This pattern is suitable for sloping area than flat areas.

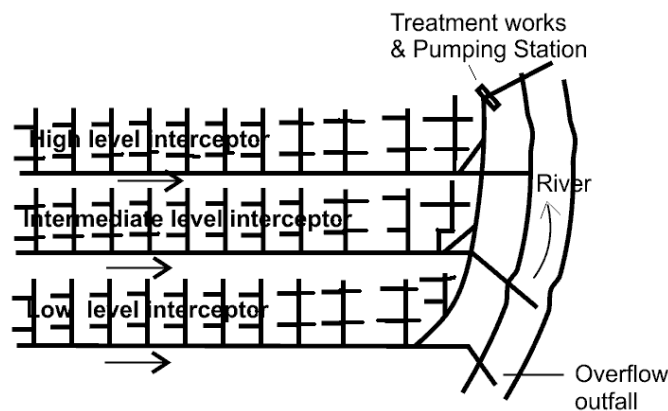


Figure 2.5 Zone pattern of collection system

**Questions**

1. Describe in brief various types of water carriage systems.
2. Describe merits and drawback of separate system, partially separate system and combined system.
3. What are the considerations while finalizing the type of sewerage system?
4. Write about various patterns of collection system.