

Excerpts on “Small Bore Sewer System” (settled sewerage) and “Shallow Sewers” (simplified sewerage) from *Manual on Sewerage and Sewage Treatment*, 2nd edition, Ministry of Urban Development, New Delhi, 1993 (pages 66 and 70-72)

Apologies for the far from perfect scanning!

3.6 SMALL BORE SEWER SYSTEM

3.6.1 System Description

Small bore sewer system is designed to collect and transport only the liquid portion of the domestic wastewater for off-site treatment and disposal. The solids are separated from the wastewater in septic

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tanks or aqua privies installed upstream of every connection to the small bore sewers. Where conventional sewers would be inappropriate or infeasible, this system provides an alternative. This system also provides an economical way to upgrade the existing on-site sanitation facilities to a level of service comparable to conventional sewers. Since the small bore sewer collects only settled wastewater, it needs reduced water requirements and reduced velocities of flow. This in turn reduces the cost of excavation, material and treatment.

3.6.2 Components of the System

The small bore sewer system consists of house connections, interceptor tanks, sewers, cleanouts and manholes, vents and in some cases lift stations.

3.6.3 Suitability of the System

This system is suitable under the following conditions : Where

1. effluent from pour-flush toilets and household sullage cannot be disposed off on-site
2. installation of new schemes is taken up, especially for fringe areas
3. a planned sequence of incremental sanitation improvements with small bore sewers as a first stage is contemplated
4. existing septic tank systems have failed or where there are a number of septic tanks requiring the effluent to be discharged but soil and ground water conditions do not permit such a discharge.

3.6.4 Design Criteria

Each house sewer is usually connected to an interceptor tank which is designed as a septic tank. The optimum number of house sewers to be connected to an interceptor tank can be worked out for each case. The effluent from the tank is discharged into the small bore sewer system, where flow occurs by gravity utilising the head resulting from the difference in elevation of its upstream and downstream ends. The sewer should be set deep enough to carry these flows.

A design peak flow factor of 2.0 is adopted. At peak flow, the sewer is to flow full. Where pumping is to be done, the peak flow rate will be equal to the pump discharge rate, unless the pumping cycle is less than five minutes. Unlike conventional gravity sewers which are designed for open channel flow, small bore sewers may be installed with sections depressed below the hydraulic grade line. Design decisions regarding the location, depth, size and gradient of the sewer must be carefully made to hold hydraulic losses within the limits of available head. Minimum pipe diameter of 100 mm is recommended. Maintenance of strict sewer gradients to ensure minimum self-cleansing velocities is not necessary. Minimum velocities in the range of 0.3 - 0.6 m/s may be used. The sewer may be constructed with any profile as long as the hydraulic gradient remains below all interceptor tank outlet inverts.

Ventilation is not necessary for small bore sewers, if they are laid on a falling gradient. A vent cleanout to release air may be provided at every hump.

3.6.5 Appurtenances

Cleanouts are used in place of manholes, except at major junctions and should be located at all upstream ends, intersections of sewer lines, major changes in direction, at high points and at intervals of 60-100 m in straight reaches to long flat sections. Pumping may be provided to overcome elevation conditions or to raise collected wastewater from one drainage zone to another. Long pumping intervals should be avoided to prevent excessively surcharged conditions in the small bore sewers.

3.6.6 Disposal of Effluent

The effluent from small bore sewers can be discharged into conventional sewerage system if possible; otherwise the effluent from small bore sewers can be treated through waste stabilisation ponds, any other low cost treatment followed by fish ponds, or land treatment with the usual precautions.

3.6.7 Limitations

1. The interceptor tanks need periodical cleaning and disposal of solids. This requires an organisation for maintenance of these interceptors to ensure satisfactory performance of the system.
2. Special precautions should be taken to prevent illegal direct connections into sewers without interceptor and dumping of solid waste into interceptors, cleanouts and manholes.

One or more houses may be connected to an interceptor tank through house connections.

3.7 SHALLOW SEWERS

3.7.1 System Description

Shallow sewers are designed to receive domestic sewage for off-site treatment and disposal. They are a modification of the surface drain with covers and consist of a network of pipes laid at flat gradients in locations away from heavy imposed loads (usually in backyards, sidewalks and lanes of planned and unplanned settlements). They are usually laid at a minimum depth of 0.4 m. Where vehicular loading is present and the invert depth of sewer is less than 0.8 m, a concrete encasement is provided for the sewer.

3.7.2 Components of the System

The shallow sewer system, like the conventional sewer system consists of house connections, inspection chambers, laterals, street collector sewers, pumping stations where necessary and treatment plants. Low volume pour-flush or cistern-flush waterseal toilets are connected to the inspection chamber by means of a 75 mm diameter sewer. A vertical ventilation column of the same diameter is provided on the house connection. The sullage water generated in the house is also connected to the inspection chamber directly when water consumption is more than 75 lpcd. Where the water consumption is lesser and where grit is used for cleaning purpose, it is connected through a grit/grease trap. Inspection chambers are provided along the street collector sewers and along the length of the laterals at intervals not exceeding 40 m. Usually one chamber is provided for each house. However two or more houses may share a single inspection chamber. The chamber is provided with a tight-fitting RCC cover.

The laterals are of small diameters (min.100 mm) and of stoneware or concrete which are buried in a shallow trench. The minimum depth of pipe invert is 0.4 m. In general, they have straight alignment between inspection chambers and are suitably aligned around existing buildings. They may even pass under property boundary walls and also under future building areas. The inspection chamber however is located in an open area.

The street collector sewer has a usual minimum diameter of 150 mm, however 100 mm sewers may also be used if hydraulic capacities permit. Where community septic tanks are provided at the exit of lateral sewers, the street sewers should be designed as small-bore sewers.

Pumping stations should, as far as possible, be eliminated.

3.7.3 Applicability

Shallow sewers are suitable where

1. high density slums and squatter settlements (usually 100 to 160 persons per hectare) exist
2. adverse ground conditions exist and on-site disposal is not possible
3. sullage also has to be disposed off and where the minimum water consumption rate is 25 lpcd.

3.7.4 Limitations

Shallow sewerage system is suitable where adequate ground slopes are available. Since these sewers are laid at flat gradients the solids are likely to get deposited unless flushed at peakflow conditions. Otherwise these sewers may get clogged and require frequent cleaning.