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Subject: Environmental Engineering (CE-602)

Unit: IV

Topic: Design of Sewers

Unit- IV /Lecture-07

Design of Sewers

MATERIALS FOR SEWERS

Sewers may be made of one of the following materials: (1) Asbestos cement (2) plain or reinforced cement concrete (3) Vitrified clay or stoneware (4) Brick (5) Cast iron (6) Steel (7) Plastic

WHILE SELECTING A PARTICULAR MATERIAL OF A SEWER, THE FOLLOWING FACTORS MUST BE CAREFULLY CONSIDERED:

1. **Hydraulic efficiency:** The material selected should be such that value of Manning's coefficient N is as low as possible so that a hydraulically efficient surface is available.
2. **Resistance to abrasion:** The flowing sewage may contain a lot of solids such as grit and sand particles. At a high velocity at the sewage invert, erosion of sewer material may take place due to abrasion. For a longer life, the sewer material must possess high degree of resistance to abrasion.
3. **Resistance to corrosion:** the composition of sewage may be such that the sewer material may get corroded. For longer life, the sewer material may get corroded. For longer life, the sewer material should possess enough resistance to corrosion.
4. **Strength:** The sewers are generally laid underground and hence they are subjected to a number of external forces, including the weight of overburden and the vehicular/live loads. The material should of strong enough to resist all such external forces.
5. **Durability:** The sewer material should be durable so that expenditure due to its frequent replacement is minimum.
6. **Cast:** the cost of the mater4ial should be less so that overall economy is minimum.
7. **Weight:** The material should be light in weight so that it can be easily handled and transportation costs are also less.
8. **Imperviousness:** The sewer material should be impervious and should not allow seepage of the sewage from the sewer.

SHAPES OF THE SEWER PIPES

- The sewer pipes are normally circular in section, although some other sections such as basket handle shape, egg shape, horse shoe shape, parabolic shape, semicircular shape, semi elliptical shape, rectangular shape, etc. may also be used under special necessities of a particular project.
- Out of these remaining shapes also, egg shape sections may be preferred for combined sewer, and rectangular shaped sewer are preferably constructed at site and normally used as independent covered storm water surface drains, and not as sewers.
- All other forms of sewers are almost outdated and rarely used these days. The various forms of sewers, which can possibly be constructed and the circumstances in which each one is preferred,

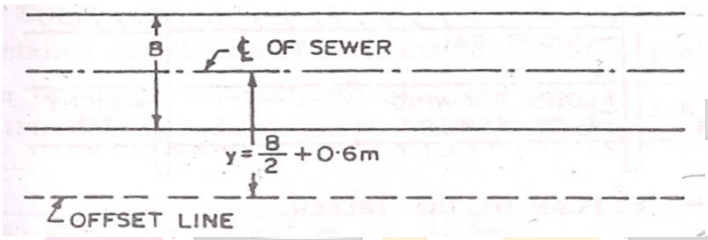
LAYOUT AND CONSTRUCTION OF SEWER LINES

The various steps involved in the layout and construction of sewer lines are:

[1] Setting out
[2] Alignment and gradient
[3] Excavation of trenches, timbering and dewatering
[4] Laying and jointing
[5] Testing and
[6] Backfilling.

1. Setting out.

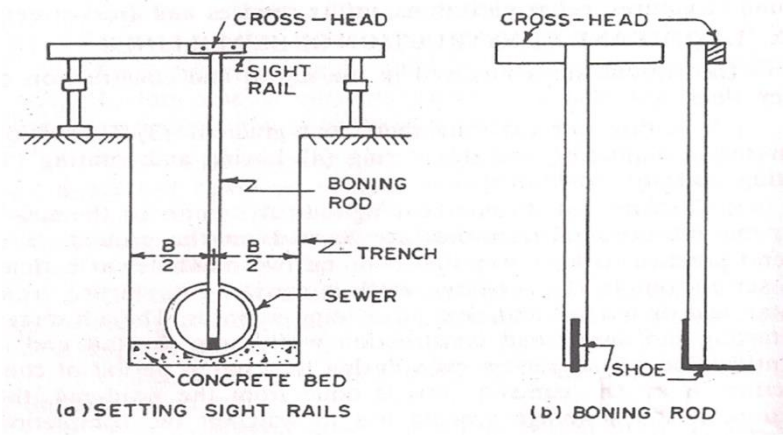
- From the longitudinal section of the sewer line, the positions of manholes are located on the ground. It is general practice to lay sewer line between tow manholes a time. The setting out in the sewerage work is carried out, staring from the tail end or out-fall end, and proceeding upwards.
  The advantage of staring the layout and construction work from the tail end is the utilization of tail sewers even during the initial period of construction. If on the contrary, this is done from the head-end, the function of the sewerage scheme has to wait till the completion of the entire scheme.



2. Alignment and gradient.

- The sewers are laid to correct alignment and gradient with the help of boning rods and sight rails. Modified levels of invert are first obtained by adding a suitable vertical length to the invert levels marked on the L-section.
- These modified levels are marked on the sight rails either by fixing nails on sight rails or by adjusting the top of sight rails to the modified invert levels of the sewer lines. Thus an imaginary line parallels to the proposed sewer line is obtained on the ground.

- A boning rod or a traveler is a vertical wooden post suitably shod with shoe iron and fitted with a cross-head or tee. Its length is made equal to the height of sight rail above the invert line of the sewer.
  The boning rod can move to and fro in the trench so as to give invert-line on the prepared bed of the sewer. Both the sight rail as well as boning rod has their center lines accurately marked with thin saw-cut and painted black and white for proper visibility



3. Excavation of trench, timbering and dewatering.

- The work of excavation is usually carried out in open cutting. The width of trench at or below the top of the sewer should be minimum necessary for its proper installation, with due consideration to its bedding.
- The width of trench form the top of the sewer to ground surface is primarily related to its effect upon the adjoining services and nearby surfaces. Wherever space is available, especially in undeveloped areas or open country, excavation is made with side slopes so that the slopes are stable. In many circumstances, however, it may be essential to restrict the top width of the trench, and hence the excavation has to be made with sides vertical.
- When the depth of trench exceeds 1.5 to 2 m, and when excavation is made with side vertical, it becomes necessary to support the side by sheeting and bracing. This operation is known as timbering of trench, which may be done with the help of following methods: (i) Stay bracing (ii) Box sheeting (iii) Vertical sheeting (iv) Runner sheeting (v) Sheet piling.

4. Laying and jointing.

- Before placing the sewer pipe, the grade of the bottom of the trench should be checked. The trench should be excavated up to a level equal to the bottom of embedding concrete (wherever concrete bedding is required) or up to the invert level of the sewer pipe if no embedding concrete is provided.
- Excavation or filling is carried out so as to bring the top of the boning rod in level with the string. Where large sewer lines are laid or where sloped trench walls result in top-of-trench width too great for practical use of sight rails or where soils are unstable, stakes set in the trench bottom itself on the sewer line, as rough grade for the sewer is completed, would sewer the purpose.
- A newer technique for maintaining both line and grade employs a laser beam generated at a manhole and directed down the pipe as it is placed. Accuracy of line and grade can be held to within 0.01 percent over a range of 300 m by the laser beam technique.

5. Hydraulic testing of pipes.

- Before backfilling, the pipes are hydraulically tested. The method of testing is explained in the next article.

6. Backfilling the trench.

Trenches should be backfilled immediately after the pipe is laid and tested, unless Class A bedding is used in which case the backfilling is delayed until the concrete has set up. No water should be permitted to raise in the unbackfilled trenches.

- The work of backfilling should be carried out with due care, particularly the selection of the soil used for backfilling around the sewer, so as to ensure the future safety of the sewer.
- The filling in the haunches and up to about 0.6 to 0.9 m above the crown or soffit of the sewer should be made in the finest selected material free of brush, debris, frozen material, large rocks and junk, placed carefully in layers of 15 cm thickness, watered and evenly rammed.
- After this, the excavated top soil, turf, pavement or road metal are replaced as the top filling material rammed and satisfactorily maintained till the surface has been got reinstated. At each stage the filling should be well rammed, consolidated and completely saturated with water and then only further line should be continued.

Before and during the backfilling of a trench, precautions should be taken against the flotation of the pipe line due to large quantities of water into the trench causing an uplift of the empty or the partly filled pipe line. Where trenches are in fields, the backfilling above the 600mm level is not tamped. All the earth is replace, and the resulting mound is allowed to settle naturally