Water Supply & Sanitary Engineering (DI05006021)

Unit 7: Drains and Sewers

Lecture 27: Manholes and Flushing Tanks

GTU Diploma Engineering

Agenda

- Introduction to Sewer Appurtenances
- Manholes: Purpose and Location Criteria
- Components of a Manhole
- Types of Manholes (Shallow, Normal, Deep)
- Drop Manholes: Design and Necessity
- Flushing Tanks: Purpose and Automatic Siphon Mechanism

Sewer Appurtenances

- Definition: Specialized masonry or concrete structures constructed at various intervals along a sewer line to assist in its proper operation and maintenance.
- Since sewers are underground closed conduits, they cannot be maintained without access points and regulating structures.
- Primary Appurtenances Include:
- - Manholes (Inspection and cleaning)
- - Flushing Tanks (Maintaining flow velocity)
- - Catch Basins and Street Inlets (Stormwater entry)
- - Inverted Siphons (Crossing obstructions)

Manholes: Purpose and Location

- Purpose: The primary access point for workers or equipment to inspect, clean, clear blockages, and ventilate the sewer line.
- Location Criteria: Manholes are mandatory at:
- 1. Every change of sewer alignment (straight lines only between manholes).
- 2. Every change of gradient or pipe diameter.
- 3. Every junction/intersection of two or more sewers.
- 4. Standard straight intervals depending on pipe size (e.g., 30m for small pipes up to 300m for very large outfall pipes).

Components of a Manhole

- Cover and Frame: Heavy-duty Cast Iron or RCC, designed to bear traffic loads without rattling.
- Access Shaft: Vertical passage (circular, usually 0.7 to 0.9m dia) leading down from the cover.
- Working Chamber: The expanded bottom portion providing sufficient room for a worker to stand and operate cleaning rods (min 1.2m diameter).
- Benching: The sloping floor inside the chamber that guides sewage directly into the semi-circular central channel, preventing sludge accumulation.
- Step Irons: Cast iron steps embedded in the wall to allow descent.

Shallow Manholes (Inspection Chambers)

- Depth: Typically less than 0.9 meters.
- Shape: Usually rectangular (e.g., 0.9m x 0.6m).
- Features: They do not have a separate access shaft and working chamber. The cover directly opens to the bottom channel.
- Application: Commonly constructed at the start of a branch sewer line or within house drainage systems before connecting to the municipal sewer.

Normal / Standard Manholes

- Depth: Varies between 0.9 meters and 2.0 meters.
- Shape: Can be rectangular or circular. Circular is preferred as it is structurally stronger under earth pressure.
- Features: Consists of a distinct working chamber (min 1.2m dia) to allow a worker to operate comfortably, and an access shaft connecting to the ground level.
- The roof of the working chamber is often designed as an eccentric cone or arch to narrow down to the access shaft.

Deep Manholes

- Depth: Greater than 2.0 meters, sometimes exceeding 5-6 meters in deep trunk sewers.
- Shape: Always circular to best resist massive lateral earth pressures.
- Features: Distinct access shaft and large working chamber. Heavy-duty cast iron step irons or fixed steel ladders are mandatory.
- In extremely deep manholes, intermediate 'Rest Chambers' or platforms are provided every few meters to prevent fatal falls and allow workers to rest.

Drop Manholes

- Constructed when a branch sewer connects to a main sewer at a significantly higher elevation (drop ¿ 0.6 meters).
- Problem without Drop Manhole: High-velocity sewage would fall freely, splashing in the chamber. This releases foul H2S gases and poses severe danger to workers.
- Solution: The branch sewer connects to a vertical 'drop pipe' outside or inside the manhole wall, discharging smoothly at the main sewer's invert level.
- An inspection/cleaning eye is provided straight ahead at the branch pipe level.

Flushing Tanks: Purpose

- Problem: In exceptionally flat terrains or at the dead ends of branch sewers, flow volumes are too low to maintain 'self-cleansing velocity' (0.6 m/s). Solid waste settles and blocks the pipe.
- Solution: Flushing tanks are installed to store water and periodically release it in a massive sudden surge to wash away deposited sludge.
- Location: Typically located at the extreme upstream ends (dead ends) of branch sewer lines where flow is naturally the lowest.

Automatic Siphon Flushing Tank

- Mechanism: Works entirely automatically without moving mechanical parts or manual intervention, using a siphonic bell and a U-trap.
- Clean water fills the tank slowly via a trickle tap. As water rises, air is compressed inside the bell.
- When the water reaches the critical discharge level, the compressed air forces water out of the U-trap (sniff hole), instantly starting a siphonic action.
- The entire tank volume is discharged into the sewer in seconds until air enters the bell, breaking the siphon.

Advantages & Disadvantages of Flushing Tanks

- Advantages:
- - Prevents foul odors and blockages in flat sewer networks.
- - Reduces manual maintenance requirements at dead ends.
- Disadvantages:
- - High initial construction cost.
- - Consumes a large volume of clean municipal water.
- - The siphonic mechanism can fail if the sniff hole is blocked by debris.
- Modern Trend: Often replaced by periodic manual flushing using fire hydrants, water tanker trucks, or high-pressure jetting machines.

Summary

- Manholes are essential access points placed at changes in alignment, size, or slope for sewer maintenance.
- Benching in manholes prevents sewage from pooling.
- Drop manholes safely connect high-level branch sewers to low-level main sewers to prevent splashing and gas release.
- Flushing tanks are used at dead ends with flat gradients to provide artificial surges to maintain self-cleansing velocity.

Next Lecture Preview

- Catch Basins and Other Appurtenances
- Understanding Stormwater Inlets and Catch Basins.
- How Inverted Siphons cross physical obstructions.
- Role of Grease and Oil traps in industrial and commercial sewers.