

Water Supply & Sanitary Engineering (DI05006021)

Unit 7: Drains and Sewers

Lecture 26: Sewer Joints and Materials

GTU Diploma Engineering

Agenda

- Importance of Sewer Joints
- Requirements of a Good Joint
- Types of Sewer Joints (Bell & Spigot, Collar, Mechanical, Flexible)
- Selection Criteria for Sewer Materials
- Common Sewer Materials (Stoneware, Concrete, Cast Iron, Plastics)
- Advantages and Disadvantages of Materials

Importance of Sewer Joints

- Preventing Infiltration: Leaky joints allow groundwater to enter the sewer (infiltration). This unnecessarily increases the hydraulic load on the pumping stations and treatment plants.
- Preventing Exfiltration: Leaky joints allow toxic sewage to escape (exfiltration), which can contaminate the surrounding soil and groundwater aquifers.
- Root Intrusion: Poorly sealed joints allow tree roots to enter the pipe in search of moisture, leading to severe blockages and structural pipe damage.

Requirements of a Good Sewer Joint

- Watertightness: Must be strictly impermeable to prevent infiltration and exfiltration.
- Durability and Chemical Resistance: Must withstand corrosive sewage gases (like Hydrogen Sulfide, H_2S) and industrial effluents.
- Flexibility: Should ideally allow slight angular deflection without breaking, accommodating minor soil settlements or seismic vibrations.
- Constructability: Must be easy to assemble in the field, often in narrow, deep, and wet trench conditions.

Types of Sewer Joints

- Sewer joints are selected based on the pipe material, internal pressure, and environmental conditions.
- 1. Bell and Spigot Joint (Socket and Spigot)
- 2. Collar Joint (Sleeve Joint)
- 3. Mechanical Joint (Flanged Joint)
- 4. Flexible Joint
- 5. Simplex Joint (for Asbestos Cement pipes)

Bell and Spigot Joint

- Also known as Socket and Spigot joint. The most widely used joint for cast iron, stoneware, and concrete pipes.
- Mechanism: The plain end (spigot) of one pipe is pushed into the enlarged end (bell/socket) of the next pipe.
- Construction: Jute yarn dipped in cement slurry is caulked tightly into the inner annular space. The remaining outer space is packed with 1:1 or 1:2 cement mortar.
- The mortar is finished smoothly at a 45-degree angle to the pipe surface.

Collar Joint

- Used for joining plain-ended (spigot-spigot) pipes, primarily RCC or asbestos cement sewers.
- Mechanism: The ends of two pipes are brought together in perfect alignment. A separate loose collar (sleeve) slightly larger than the pipes is slipped over the junction.
- Construction: The annular space between the pipe ends and the inner face of the collar is packed tightly with cement mortar.
- This joint is rigid and mostly used for large diameter gravity sewers.

Mechanical and Flexible Joints

- Mechanical (Flanged) Joint: Used for pipes under pressure (force mains) or subject to vibration (e.g., laid on bridges). Involves bolting two flanged ends together with a rubber gasket in between.
- Flexible Joint: Adopted in areas prone to uneven soil settlement or seismic activity.
- Uses a compressed rubber O-ring or tyton gasket inside the socket. When the spigot is pushed in, the gasket compresses, forming a watertight seal that allows slight angular deflection.

Materials for Sewers: Selection Criteria

- Structural Strength: Must resist heavy superimposed loads (traffic) and deep earth cover.
- Corrosion Resistance: Must withstand highly corrosive sewer gases (H_2S converting to sulfuric acid) and industrial chemicals.
- Hydraulic Smoothness: A lower Manning's 'n' value (smooth inner surface) is required to maintain self-cleansing velocity.
- Imperviousness: Material itself must not be porous to prevent leakage.
- Cost and Availability: Must be economically viable in long lengths to minimize the number of joints.

Stoneware (Vitrified Clay) Pipes

- Characteristics: Manufactured from clay and shale, fired at high temperatures, and salt-glazed for a smooth finish.
- Advantages: Exceptionally resistant to corrosion, acid attacks, and erosion. Extremely durable with a long service life.
- Disadvantages: Highly brittle and fragile (can break during transport). Manufactured only in short lengths (0.6 to 1.2 m), meaning many joints are required.
- Usage: The absolute best choice for small diameter (up to 600mm) sanitary branch sewers carrying highly foul domestic sewage.

Concrete and RCC Pipes

- Characteristics: Plain concrete is used for small diameters; Reinforced Cement Concrete (RCC) is used for large diameters.
- Advantages: Very strong under heavy loads. Can be cast-in-situ for massive profiles (e.g., horseshoe sewers). Economical for large sizes.
- Disadvantages: Highly susceptible to 'Crown Corrosion' caused by H₂S gas. Heavy to transport and handle.
- Usage: Widely used for large trunk sewers and storm drains. In sanitary sewers, they must be lined with protective coatings (PVC, epoxy, or high-alumina cement).

Cast Iron (CI) and Ductile Iron (DI) Pipes

- Advantages: Very high structural strength, can withstand high internal pressure and heavy external traffic loads. Available in long lengths (100% watertight joints).
- Disadvantages: Expensive and susceptible to corrosion if not properly coated (usually cement mortar lined internally).
- Usage: Used specifically for Force Mains (where sewage is pumped under pressure), outfall sewers, or gravity sewers laid beneath railway tracks or heavy traffic roads.

Plastic Pipes (PVC, HDPE)

- Polyvinyl Chloride (PVC) and High-Density Polyethylene (HDPE) are increasingly replacing traditional materials.
- Advantages: Absolute resistance to chemical corrosion and H₂S gas. Very lightweight, easy to handle. Exceptionally smooth interior (excellent hydraulics). Available in very long lengths.
- Disadvantages: Lower structural strength compared to RCC/CI. Can deform under heavy soil loads if trench bedding is not perfectly compacted.
- Usage: Highly popular for house connections and small to medium diameter municipal branch sewers.

Summary

- Sewer joints must be watertight to prevent infiltration (groundwater entering) and exfiltration (sewage escaping).
- Bell and spigot joints with cement mortar are traditional, but flexible rubber gasket joints are preferred to accommodate soil settlement.
- Stoneware is chemically excellent but brittle. RCC is structurally strong but vulnerable to corrosion.
- Plastic pipes (PVC/HDPE) offer a modern compromise of excellent chemical resistance and smooth hydraulics, though they require careful bedding.

Next Lecture Preview

- Manholes and Flushing Tanks
- Introduction to Sewer Appurtenances.
- Why manholes are needed, where they are placed, and their types (shallow, deep, drop).
- How flushing tanks maintain self-cleansing velocity in flat sewer lines.