

Water Supply & Sanitary Engineering (DI05006021)

Unit 4: Conveyance of water

Lecture 15: Types of Pipes for Water Supply

GTU Diploma Engineering

Requirements of a Good Pipe Material

- Must have carrying capacity adequate for the design life.
- Should be durable, structurally strong, and resistant to wear and tear.
- Must be resistant to internal and external corrosion.
- Should not impart taste, color, or odor to the water.
- Ease of transportation, handling, and jointing is essential.

Common Types of Pipes

- Cast Iron (CI) Pipes
- Ductile Iron (DI) Pipes
- Steel Pipes
- Concrete Pipes (RCC & PSC)
- Asbestos Cement (AC) Pipes
- Plastic Pipes (PVC, HDPE)

Cast Iron (CI) Pipes

- Historically the most widely used material for water distribution.
- Manufactured by sand casting or centrifugal casting (spun iron pipes).
- Advantages: Highly resistant to corrosion, long service life (100+ years), moderate cost.
- Disadvantages: Heavy to handle, brittle (subject to breakage during transport), high internal friction if unlined.

Ductile Iron (DI) Pipes

- An evolution of CI pipes where graphite is present in nodular form instead of flakes.
- Provides the corrosion resistance of CI with the tensile strength and flexibility of steel.
- Advantages: High impact strength, lighter than CI, can withstand high water hammer pressure.
- Widely replaces CI in modern municipal water distribution networks.

Steel Pipes

- Used for very large diameter transmission mains where pressure is extremely high.
- Advantages: High tensile strength, lightweight compared to CI/Concrete, easy to transport and weld.
- Disadvantages: Highly susceptible to corrosion; requires internal lining (cement mortar) and external coating (epoxy or wrapping).
- Prone to failure under external loads or vacuum conditions if not properly stiffened.

Concrete Pipes (RCC)

- Reinforced Cement Concrete (RCC) pipes are used for gravity mains or low-pressure pumping mains.
- Advantages: No corrosion issues, low maintenance, smooth internal surface initially.
- Disadvantages: Extremely heavy, difficult to repair, susceptible to acid attacks.
- Joints are usually made with cement mortar or rubber gaskets.

Prestressed Concrete (PSC) Pipes

- High tensile steel wire is wrapped around a concrete core under tension.
- Can withstand much higher internal pressures than standard RCC.
- Often used in large diameter transmission mains (e.g., Narmada canal bulk pipelines).
- More economical than steel for large diameters, though still heavy and difficult to tap for service connections.

Asbestos Cement (AC) Pipes

- Made from a mix of asbestos fiber, silica, and cement.
- Advantages: Very smooth interior (low friction loss), light weight, highly corrosion-resistant.
- Disadvantages: Brittle (easily damaged in handling), structurally weak against heavy earth loads.
- Health Concerns: Asbestos fibers in drinking water and dust during cutting/laying have led to its ban in many countries.

Plastic Pipes - PVC & CPVC

- Polyvinyl Chloride (PVC) is extensively used for secondary distribution and house plumbing.
- Advantages: Very cheap, extremely lightweight, completely immune to galvanic/soil corrosion, very smooth (Hazen-Williams $C=150$).
- Disadvantages: Loses strength at high temperatures, degrades under prolonged UV exposure (sunlight).
- CPVC (Chlorinated PVC) can handle hot water and is preferred for indoor plumbing.

High-Density Polyethylene (HDPE) Pipes

- Tough, flexible plastic pipes, usually black with blue stripes for water.
- Advantages: Can bend around obstacles without joints (delivered in coils), excellent resistance to soil movements and earthquakes.
- Joints are made via butt-fusion or electrofusion, creating a monolithic, leak-proof system.
- Increasingly replacing PVC in urban distribution grids due to fewer joints and higher durability.

Comparison of Pipe Materials

Concept 1

Concept 2

Cost: PVC/HDPE (Low) ; DI (Medium) ; Steel/PSC (High for small diam)

Life Span: CI/DI (100 yrs) ; Plastics (50-100 yrs) ; Steel (Depends on coating)

Friction Loss: Plastics (Lowest) ; AC ; DI (Cement lined) ; CI (Unlined - Highest)

Ease of Tapping: DI/CI (Easy) ; Steel (Requires welding) ; Plastics (Requires special saddles)

Summary of Pipe Types

- Cast Iron and Ductile Iron are traditional, durable choices for distribution mains.
- Steel and PSC are reserved for large diameter, high-pressure bulk transmission.
- Plastic pipes (PVC, HDPE) dominate smaller distribution networks due to cost, flow characteristics, and corrosion resistance.
- Material selection depends on pressure, soil conditions, budget, and water chemistry.