

Introduction to Plumbing Systems

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Designed for students, apprentices, or anyone new to building services engineering.

1. What Is a Plumbing System?

Aspect	Description
Definition	A network of pipes, fixtures, and fittings that delivers water for domestic, commercial, or industrial use and removes waste water.
Primary Functions	Supply – Bring clean (potable) water to fixtures. Distribution – Provide adequate pressure and flow to each outlet. Drainage – Carry used water and solids away safely.
Typical Sub-systems	• Water Supply (cold, hot, and sometimes mixed) • Ventilation (air flow to prevent siphoning) • Sanitary Drainage (waste & sewage) • Storm Drainage (rain water) • Gas Piping (where applicable)

2. Core Components

Component	Function	Common Materials
Pipes	Transport fluids; must resist pressure, corrosion, and temperature.	Copper, CPVC, PEX, PVC, Galvanized steel, HDPE
Fittings	Connect, change direction, or terminate pipes (elbows, tees, couplings).	Same material as pipe or compatible alloys
Valves	Control flow (on/off, throttling).	Ball, gate, globe, check, pressure-reducing
Fixtures	End-use devices (sinks, toilets, showers, bathtubs).	Typically brass or stainless steel
Traps	Water seal that blocks sewer gases.	P-trap, S-trap, bottle trap
Vent Pipes	Allow air entry, equalize pressure, prevent siphonage.	Usually PVC or ABS

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Component	Function	Common Materials
Water Heater	Raise temperature of domestic hot water.	Tank?type, tankless, solar, heat? pump
Backflow Preventer	Protect potable water from contamination.	Double?check, reduced pressure zone (RPZ)

3. System Design Basics

3.1. Sizing Pipes

1. **Determine Flow Demand** – Use fixture unit (FU) counts (e.g., 1 FU = 1.0?gpm).
2. **Apply the **Hunter’s Curve** or **D’Arcy?Weisbach** equation to size for acceptable velocity (typically 4–8?ft/s for supply, ?10?ft/s for drain).
3. **Select Pipe Size** – Refer to local code tables (e.g., International Plumbing Code, UPC).

3.2. Pressure & Head Loss

- **Total Dynamic Head (TDH)** = Static head + friction loss + fittings loss.
- **Friction loss** = $(f \frac{L}{D} \frac{V^2}{2g})$ (Darcy?Weisbach) where f is the friction factor.
- Keep pressure at fixtures between 40–80?psi (typical residential range).

3.3. Drainage Design

- **Gravity?driven** – Slope of 1/4" per foot for 3?inch pipe (0.5%); 1/8" per foot for larger pipe.
- **Maximum Length** – Limited by venting and fixture spacing (see code tables).
- **Vent Placement** – Within 6?ft of the fixture trap (or as required by local code).

3.