

Water Supply & Sanitary Engineering (DI05006021)

Unit 4: Conveyance of water

Lecture 18: Methods of Water Supply and Storage

GTU Diploma Engineering

Gravity System

- Used when the source of water (lake, reservoir) is located at a much higher elevation than the distribution area.
- Water flows entirely under the force of gravity.
- Advantages: No pumping costs, highly reliable, simple operation, no power failures to worry about.
- Disadvantages: Dependent entirely on topography. High pressure near the source might require Pressure Reducing Valves (PRVs).

Direct Pumping System

- Treated water is pumped directly into the distribution mains without storing it in elevated tanks.
- Pumps must operate 24/7. Pump speed varies to match the fluctuating consumer demand.
- Advantages: No cost of constructing large Elevated Service Reservoirs (ESRs).
- Disadvantages: Highly vulnerable to power outages. Constant operation of pumps causes wear and tear.

Combined Gravity and Pumping System

- The most common system worldwide.
- Treated water is pumped at a constant rate into an Elevated Service Reservoir (ESR).
- From the ESR, water flows to the consumers via gravity.
- The ESR acts as a buffer. Pumps run at a steady, efficient rate, while the ESR handles peak demand.

Advantages of Combined System

- Reliability: If power fails, the water stored in the ESR continues to supply the city by gravity.
- Efficiency: Pumps can operate at their Best Efficiency Point (BEP) constantly.
- Fire Reserve: A portion of the ESR capacity is always reserved for fire-fighting emergencies.
- Pressure buffering: The ESR dampens pressure surges (water hammer) from the pumps.

Systems of Supply: Time-based

- Apart from hydraulic methods, we classify supply based on timing:
 - 1. Continuous Supply System (24x7)
 - 2. Intermittent Supply System (Few hours a day)

Continuous Supply System (24x7)

- Water is available at the consumer's tap all day, every day.
- Advantages: Water is always fresh. Consumers don't need large household storage tanks. Less risk of contamination.
- Pipes are always under positive pressure, preventing groundwater infiltration.
- Disadvantages: High water wastage if leaks are not fixed. Requires a large, consistent water source.

Intermittent Supply System

- Water is supplied for fixed hours (e.g., 2 hours in morning, 2 hours in evening).
- Adopted when water source is limited or treatment capacity is insufficient.
- Advantages: Forces water conservation (rationing). Less water lost to continuous leaks.
- Disadvantages: Severe health risks. When pipes are empty, negative pressure sucks in sewage from surrounding soil.

Service Reservoirs (Distribution Reservoirs)

- Facilities used to store treated water just before distribution.
- Functions:
 - 1. Balancing or Equalizing demand fluctuations.
 - 2. Storing water for breakdowns (pumps/power failure).
 - 3. Storing reserve water for fire fighting.

Types of Service Reservoirs

- Surface Reservoirs (GSR - Ground Service Reservoirs): Built at ground level. Used when there is high natural ground available nearby.
- Elevated Service Reservoirs (ESR - Overhead Tanks): Constructed on towers (staging) to provide the necessary gravity head for flat terrain.
- Materials: Usually Reinforced Cement Concrete (RCC) or Steel.

Capacity of Service Reservoirs

- Total Capacity = Balancing Storage + Breakdown Storage + Fire Storage.
- Balancing Storage: Calculated using a Mass Curve (cumulative supply vs cumulative demand).
- Breakdown Storage: Usually 25% of total capacity to sustain supply during 4-6 hour power cuts.
- Fire Storage: Maintained at the bottom of the tank, reserved strictly for emergencies.

Appurtenances in Reservoirs

- Inlet pipe: Usually discharges at the top.
- Outlet pipe: Draws water from slightly above the floor (to avoid silt).
- Overflow pipe: Connected to drains to prevent flooding if pumps overflow.
- Washout/Scour valve: At the lowest point to drain the tank for cleaning.
- Ventilators: To allow air entry/exit as water level rises and falls, preventing structural collapse.

Summary of Methods of Supply

- The combined gravity and pumping system utilizing Elevated Service Reservoirs is the most practical and reliable system globally.
- Continuous (24x7) supply is structurally and hygienically vastly superior to intermittent supply.
- Service reservoirs act as critical buffers, balancing demand, handling emergencies, and maintaining pressure.