Water Supply & Sanitary Engineering (DI05006021)

Unit 2: Quantity and Quality of Water

Lecture 4: Fluctuation in Demand & Factors Affecting Demand

GTU Diploma Engineering

Agenda

- Factors Affecting Per Capita Demand
- Size of City, Climate, and Habits
- Impact of Metering and Pressure
- Introduction to Demand Fluctuations
- Seasonal and Daily Variations
- Hourly Variations and Peak Factors
- Coincident Draft

Factors Affecting Water Demand: Size and Characteristics

- Size of the City: Larger cities have higher per capita demand due to more commercial activities, sewer systems, and public uses.
- Characteristics of City: Industrial towns require vastly more water than purely residential towns.

Factors Affecting Water Demand: Climate and Habits

- Climatic Conditions: Hot and dry climates lead to more bathing, lawn watering, and air cooler usage, increasing demand.
- Habits of People: Higher socio-economic status generally correlates with more water usage (flush toilets, washing machines, car washing).

Factors Affecting Water Demand: Metering and Pressure

- System of Supply: Intermittent supply limits use, continuous supply increases it.
- Metering: Metered water costs money per unit; users tend to waste less, reducing demand by 15-20%.
- Pressure in System: Higher pressure leads to greater losses through leaks and open taps.

Factors Affecting Water Demand: Cost & Sewerage

- Cost of Water: High tariffs discourage excessive use and wastage.
- Presence of Sewerage System: Water-borne sewerage systems (flush toilets) drastically increase water consumption compared to dry latrines.

Introduction to Demand Fluctuations

- Water is not drawn at a uniform rate throughout the year, month, or day.
- Average Daily Demand (q) only gives a baseline.
- Facilities must be designed to handle the absolute peak requirements, not just the average.

Seasonal and Monthly Variations

- Demand peaks during summer months due to heat (bathing, cooling, lawn watering).
- Demand drops during winter and monsoon seasons.
- Maximum Daily Demand = 1.8 * Average Daily Demand.

Daily and Hourly Variations

- Even on the maximum day, hourly demand fluctuates.
- Peak hours are typically morning (6 AM - 10 AM) and evening (5 PM - 8 PM).
- Lowest demand occurs during the night.

Peak Factor & Maximum Hourly Demand

- Maximum Hourly Demand = 1.5 * Average Hourly Demand of the Maximum Day.
- Maximum Hourly Demand = 1.5 * (1.8 * Average Daily Demand / 24).
- Therefore, Peak Factor is 2.7 * Annual Average Hourly Demand.

Impact of City Size on Fluctuations

- Smaller towns have highly pronounced peaks because activities are synchronized.
- Larger cities have more uniform demand due to diverse demographics and staggered industrial shifts.
- Peak factor reduces as population increases.

Coincident Draft

- A critical condition where a fire breaks out during the peak daily demand.
- Coincident Draft = Maximum Daily Demand + Fire Demand.
- Total design capacity of the distribution system is the MAXIMUM of (Coincident Draft) OR (Maximum Hourly Demand).

Design Capacities of Components

- Source (Dams): Maximum Daily Demand
- Treatment Plant: Maximum Daily Demand
- Main Conveyance Pipe: Maximum Daily Demand
- Distribution Network: Maximum Hourly Demand or Coincident Draft

Summary

- Water demand varies by city size, climate, cost, and sewerage facilities.
- Demand fluctuates seasonally, daily, and hourly.
- Max Daily Demand = 1.8 * Avg Daily Demand.
- Distribution systems are designed for Max Hourly Demand or Coincident Draft, whichever is greater.