Distribution Review

System Design and Layout

Design and Layout Training Objectives

To gain an understanding of:
- Distribution system vocabulary
- What makes a water system “Public” and identify the different types of PWS's
- Distribution system design considerations which include:
  - Type of water usage
  - Water storage requirements
  - The different system layout designs

Distribution System Vocabulary

**Average Day Demand**
The total water used by a system for one year divided by 365 days.

\[
\text{Total Annual Volume} = \frac{365}{365}
\]
Distribution System Vocabulary

**Per-capita Water Use**
The average day demand divided by the total number of residents connected to the system.

\[
\text{Average Day Demand} \div \text{Population}
\]

Distribution System Vocabulary

**Maximum Day Demand**
The highest water use during a 24 hour period for the year.

![Graph of Maximum Day Demand]

Distribution System Vocabulary

**Peak Hour Demand**
The highest water use for 1 hour in a given year.

![Graph of Peak Hour Demand]
**Arterial-loop System**

A distribution system with a complete loop of arterial mains around the area being served. This design minimizes dead ends.

**Grid System**

A distribution system layout in which all ends of the mains are connected to eliminate dead ends.

**Tree System**

A distribution system that centers around a single arterial main. Branches are taken off at right angles and have dead ends.
**Distribution System Vocabulary**

**Transmission Line**
A large pipeline or aqueduct used to transport water over long distances. Usually carries raw water to a treatment plant or treated water to the distribution system.

**Arterial Main**
Large diameter pipe (8 inches or greater) that carries water into a service area. “Branches” or Distribution mains come off of the Arterial Main.

**Distribution Main**
Any pipe in a distribution system other than a service line.
Distribution System Vocabulary

**Thrust Block**
A mass of concrete or similar material placed around a pipe to prevent movement when the pipe is carrying water. Usually located at bends and valve structures.

Distribution System Vocabulary

**C Value (C Factor)**
The measure of the smoothness of a pipe's interior surface. The higher the value, the smoother the surface – less friction.

Public Water Systems

**Public Water System**
A piped water system that serves water for consumption to 15 or more service connections or serves 25 or more people for 60 or more days each year.
Public Water Systems

Types of Public Water Systems

Community
- 15 service connections by all-year residents
- Regularly serves 25 all-year residents
Examples: municipal, rural, mobile home park

Non-community
- Any public system not classified as “community”

Public Water Systems

Types of Non-Community Systems

Transient Non-community
- Does not serve 25 of same people over a 6 month period
Examples: campground, gas station, motel, restaurant

Nontransient Non-community
- Regularly serves the same 25 or more people over a 6 month period
Examples: schools, factories, office buildings

System Design (Design Considerations)

Design Considerations:
- Source of water
- Population density
- Economic condition of community
- Geographical location
- Elevation changes within the community
System Design (Design Use)

Design Use:
- Residential use
- Industrial use
- Fire protection
- Pressure and velocity requirements

System Design (Design Considerations)

Residential use

Residential use is a small portion of most system’s flow in comparison to industrial and fire flow requirements.

System Design (Design Considerations)

Industrial use

Industrial and commercial water use can be quite large.

Uses include:
- Cooling Water
- Process Water
- Incorporated into products
System Design (Design Considerations)

Fire protection
The main consideration for system design (fire protection)
Fire flow requirements dictate:
Water main pipe size
Water storage facility size
Pumping station capacity

Fire protection requirements set by ISO
General Minimum Requirements:
Residential mains - 6 inch diameter
Commercial mains – 8 inch diameter
Fire hydrant supply – 6 inch diameter

System Design (Design Considerations)

Water pressure and velocity requirements
Normal pressure range: 35 psi – 65 psi
Maximum pressure: 80 psi
Minimum pressure: 20 psi
Maximum velocity: 5 fps

Systems with varying elevations must have different pressure zones. Water is supplied to the higher pressure zones and pressure reducing valves reduce system pressure to supply water to the lower elevations.

System Design (Water Storage)

Purpose of water storage:
Equalize the supply and demand
Increase operating flexibility
Provide water during power or pump failure
Provide surge volume to reduce water hammer
Provide disinfection contact time
System Design (Water Storage)

Design considerations for storage capacity:
- Based on maximum or peak water demand
- Based on Fire protection needs
- Based on industrial demand in service area

Types of storage facilities:
- Elevated Tanks
- Stand pipes
- Reservoirs
- Hydropneumatic tank

More about storage facilities in “Water Storage”

System Layout (Types of Systems)

Three main types:
- Arterial-loop system
- Grid system
- Tree system
System Layout (Types of Systems)

Arterial-loop system:
- Large-diameter mains around service area
- Water supplied from 4 directions
- Good flow throughout system

Transmission lines
Arterial main
Distribution main

System Layout (Types of Systems)

Grid system:
- Most of the water mains are interconnected
- Reinforced with larger arterial mains
- Flow usually good if mains are 6 in. or more
- Flow is drawn from 2 or 3 directions

Transmission line
Arterial main
Distribution main

System Layout (Types of Systems)

Tree system:
- Transmission line delivers water to an area
- Distribution main branches are not connected
- Dead ends result in poor water quality

Transmission line
Arterial main
Distribution main
Review the lecture handout and then complete the quiz. This will help you remember the information we just covered.