



Fire Protection Hydraulics and Water Supply Analysis

FPST 2483 Chapter 7 Components of Water Supply Systems

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Module objective



- Upon completing this module, the student should be able to:
- List the sources of water used to supply water supply systems.
 - Describe the function of water treatment facilities in a water supply system.
- List and describe the three basic mechanisms for moving water through a water supply system.
- Describe the piping system used to distribute water throughout a water supply system.
- Reading materials
 - Brock's Book, chapter 7

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Four Basic Components Of Any Municipal Water Supply System



- 1. Water supply source
- 2. Water treatment facilities
- 3. Mechanism for forcing water through the system
- 4. System of piping to transport the water through the community



Water Supply System Uses



- Most communities single water distribution system that supplies domestic, industrial, and fire protection needs.
- A few larger cities separate water supply systems used solely for fire protection.
- Some larger industrial facilities independent fire protection water supply systems.

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Water Supply System Operators



- · Municipal government
- Public trust or authority
- Private contractor

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Private Water Supply Systems



- Used in large industrial, manufacturing, or office complexes
- Similar in design to municipal water supply systems
- May have separate domestic and fire protection systems



Three Important Rates Of Consumption



- Average daily consumption (ADC)
 - The average of the total amount of water used daily in a water distribution system over a period of one year.
- Maximum daily consumption (MDC)
 - The maximum total amount of water that was used during any 24-hour interval within a three-year period. Normally runs about one and one-half times the average daily consumption.
- Peak hourly consumption (PHC)
 - The maximum amount of water used in any one-hour interval over the course of a day. Typically varies from two to four times the normal hourly rate.

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Sources Of Surface Water



- Rivers
- Streams
- Lakes
- Ponds
- · Coastal waters



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Surface Water Guidelines



- Rivers and streams are most affected by droughts and must be constantly monitored for pollution.
- Lakes, ponds, and reservoirs replenish their supplies at varying rates depending on the tributaries that supply them.
- Coastal waters are most commonly used for fire protection-only systems.



Surface Water Sources Tend To



- Have softer water (less minerals) than ground water
- Have more suspended solids and color than ground water
- Have more bacterial contaminants than ground water
- Deplete more rapidly during periods of low rainfall

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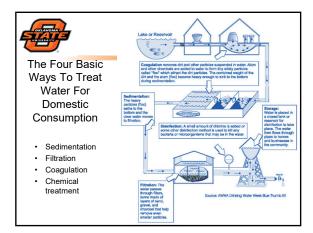


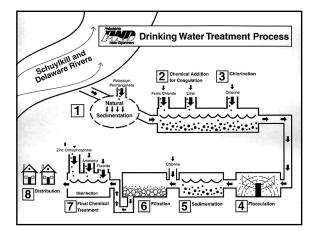
Ground Water Sources (Wells & Springs)



- Have harder water (more minerals) than surface water
- Be clearer (have less color) than surface water
- Have less bacteria than surface water and require less treatment
- Less affected by periods of decreased rainfall than surface water

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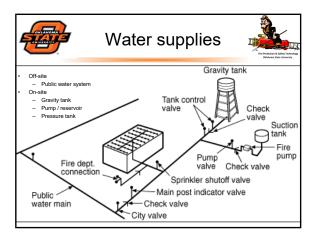


Types of Water Supplies



- Gravity
- Direct pumping
- Combination
- · City Supply
- City Supply with Booster Pumps
- Gravity Tanks, i.e., Elevated Storage Tank
- Ground Level Storage Tanks with Fire Pumps
- Reservoir, Lake, River, etc. (large body of water) with Vertical Turbine Pumps
- Pressure Tank

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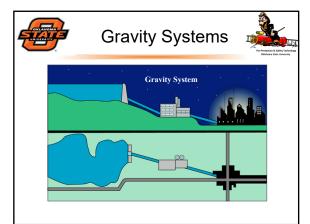


Gravity Systems



- Rely on the water source being well above the elevation of the distribution system
- Remember: 0.433 psi gained per foot of elevation drop
- Least common of the three systems

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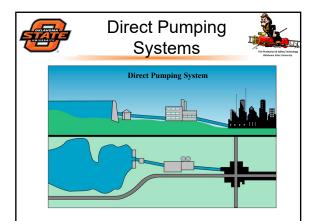


Direct Pumping Systems



- All system pressure is provided by a series of pumps.
- Electric pumps are the most common; some systems use diesel pumps.
- A combination of diesel and electric is best.

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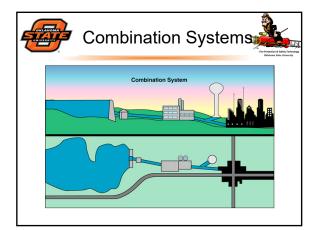
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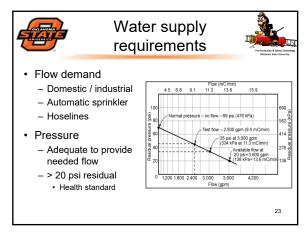


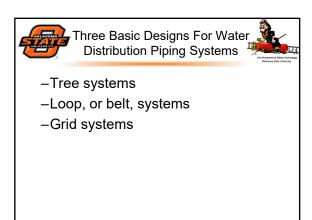
Combination Systems

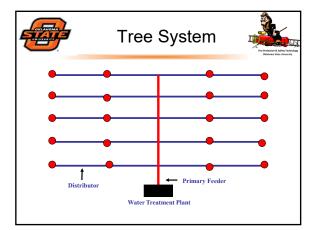


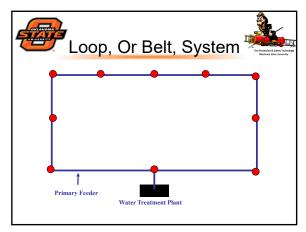
- Use pumps to impart primary pressure
- Use water stored in elevated tanks to supplement the system during peak demands or pump stoppages
- Fill during low demand periods
- · Most common of the three systems

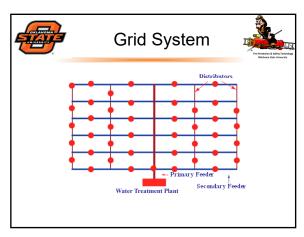














Common Types Of Pipe In Water Systems



- · Cast iron
- Ductile iron
- · Asbestos cement
- Steel
- Plastic
- Concrete

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Sources Of Friction In Water System Pipes



- · Pipe's internal surface
- Encrustation
- Sedimentation

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Water System Valves



- Used to control flow through system
- Should be located fairly close to each other to minimize the amount of the system that must be shut down during leaks
- Should be operated once per year to ensure proper operation





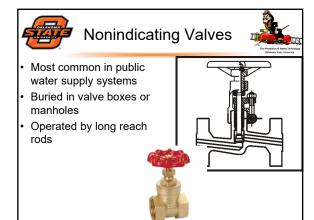
Indicating Valves



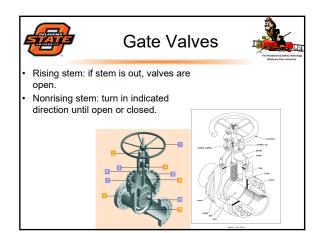
- Not common in public water supply systems
- Post indicator valves (PIV)
- Outside stem and yoke valves (OS&Y)



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Fire Hydrants

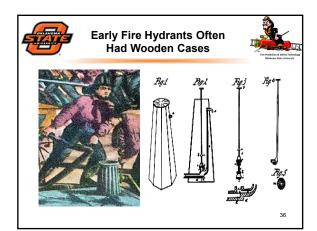


- Standard
 - One 4 ½-inch and two 2 ½-inch discharges
 - Five-inch valve opening
 - Six-inch water main connection
- Many jurisdictions have non-standard hydrants based on local needs



In the photo at left is a shattered section of wooden water main that was dug up in recent years. The hole bored into it is believed to be that of a "fire plug", city of Cincinnati, Ohio, early 1800s.

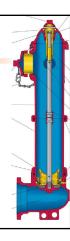
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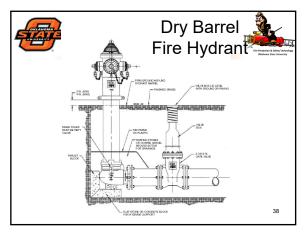


Dry Barrel Hydrants

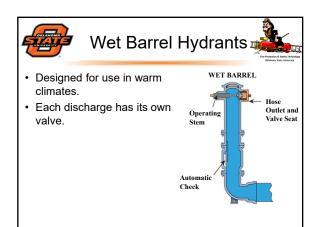
- Designed for locations where freezing is possible.
- Base valve is located below the frost line.
- One valve operates all discharges.
- Drains just above the base valve allow water to exit after valve is closed.
- Must be visually inspect to make sure it drains properly.

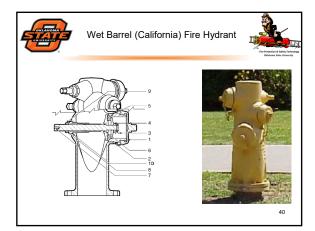


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	Water Dist Syste	Tria
Table 4.1 Hydrant Color Codes		
Hydrant Class	Color	Flow
Class AA	Light Blue	1,500 gpm or greater
Class A	Green	1,000 -1,499 gpm
Class B	Orange	500-999 gpm
Class C	Red	Less than 500 gpm

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Underground Distribution Piping



- Types of Pipe (A conservative maximum velocity for design purposes is 7 fps)
 Cast Iron

 - Ductile Iron
 - Plastic
 - Wood
- · Restraining Methods
 - Rods
 - Thrust Blocks
 - Other Mechanical Means



Piping materials



- · Piping/fittings materials
 - Ductile iron, steel, copper
 - Other types of pipe or tube listed for service
 CPVC, PB
- Piping sized to provide minimum water flow rate and pressure

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Piping



- What is the difference between Cast Iron and Ductile Iron?
- Cast Iron was introduced to the United States in 1817. Ductile Iron was introduced to the market in 1955. The metallurgy for Ductile Iron and Cast Iron is identical except that to produce Ductile Iron magnesium is added during the manufacturing process that changes the chemical composition of the graphite from flake form (Cast Iron) to spheroidal, or nodular, form (Ductile Iron).
- <u>Ductile Iron is approximately twice the strength</u> of cast iron and its tensile, impact strength, and elongation are many times greater than cast iron.

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Piping



- What is the maximum velocity recommended for cement-lined Ductile Iron pipe?
- Although there are differing opinions on this subject, a conservative maximum velocity for design purposes is 7 fps (feet per second).

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Fittings

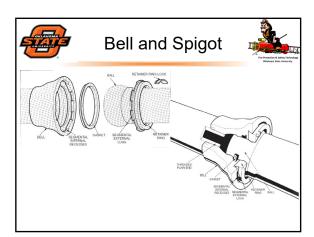


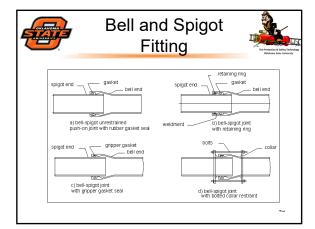
- Fittings
 - -Flange
 - -Grooved
 - -Threaded
 - -Bell and Spigot

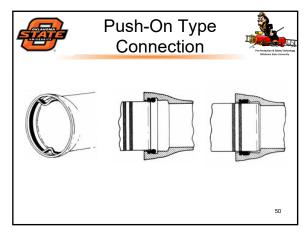
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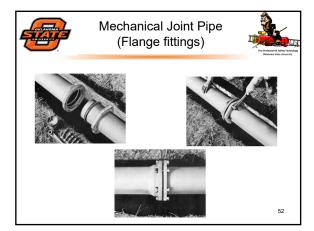
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Summary



- A community's water supply system is one of the most important elements in its overall fire protection system.
- Modern water supply systems incorporate four basic elements:
 - 1.A water supply source
 - 2. Water treatment facilities
 - 3.A mechanism for forcing water through the system
 - 4.A system of piping to transport the water through the community