ASPE Plumbing Trade Exhibition and Technical Symposium
High Rise Plumbing Design – Drew R. McFadden, CPD
About the Presenter

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- Principal / Partner, Alderson Engineering, Inc.
- B.S. Mechanical Engineering, Drexel University
- ASPE Member Since 2005
- Born & Raised in Northeast Philadelphia.
- 4 for 4 Philly Sports Guy
- 15+ years of mechanical, electrical, plumbing and fire protection design experience including high rise buildings.
Overview

- High Rise Plumbing Design
  - Definition of High Rise
  - Drainage Waste and Vent (DWV) Systems
  - Storm Water Systems
  - Domestic Water Systems
  - Domestic Water Booster Pumps
  - Domestic Hot Water Heating Systems
  - Hot Water Recirculation Systems
Overview

- Pipe Expansion and Contraction
- Natural Gas Systems
- Fuel Oil Systems
- Fire Protection

Questions / Comments
Definition of a High Rise

- Formally defined in “definitions” in IBC 2009.
- High Rise Building – occupied floor more than 75 feet above lowest level of fire dept. vehicle access
  - IBC 2018 does not consider occupied roof decks as an occupied floor.
- High Rise Buildings taller than 420 feet.
Definition of a High Rise

- Tall Building – more than 328 feet.
- Super Tall Building – more than 984 feet.
- Mega Tall Building – more than 2,000 feet.
DWV Systems

- Vent stack
- Vent pipe
- Lavatory drain
- Cold water supply
- Hot water supply
- Overflow pipe
- Shutoff valve
- Soil stack
- Toilet drain
- Trap
- Tub drain
DWV System Layout

- Sanitary, Waste and Vent Stack Location
  - Stacked floors
  - Within the building core
  - Adjacent to structural elements

- Parent and Child Stack Arrangement
  - Horizontal or vertical distribution on the floors
    - Adequate ceiling space for horizontal piping.

- Transition and collection floors
Drainage Terminal Velocity

- Terminal velocity is 10 – 15 FPS
- Terminal velocity is achieved within 10 - 15 feet of fall from the point of entry
- The velocity at the base of a 100-story stack is only slightly greater than the velocity at the base of a 3-story stack.

- Concerns
  - Weight of the vertical stack and its contents.
  - Waste entering the stack at lower levels.
Stable flow does not occur in the horizontal drain until a distance of up to 10X the pipe diameter.
Suds Pressure Zone

- Restriction in DWV system caused by suds that cannot be displaced by air.
- Avoid connections to these zones.

Figure 3-11  Suds Pressure Zones

Note: Double lines represent suds pressure zones. Shown are connections outside the pressure zones.
Suds Pressure Zone

Figure 11.11.2
THE LOCATIONS OF SUDS PRESSURE ZONES IN DRAIN AND VENT PIPING
Suds Pressure Zone

- Separate stacks when stack serves more than 6 floors.
- Lower (4) floors on one stack and the rest above that level on a separate stack.
P-904.4 Maximum fixture-unit load. The maximum number of fixture-units connected to a given size of house drain, horizontal branch, or vertical soil or waste stack, shall be determined by Table P-904.4.

P-904.4.1 Soil stack size. The size of a soil or waste stack is determined by the fixture-units on the stack plus the fixture-units on the horizontal branch from the base of the soil or waste stack connected to the house drain.

P-904.4.2 Horizontal branch size. The size of the horizontal branch from the base of the soil or waste stack connected to the house drain is determined by the fixture-units and gradient fall.

P-904.4.3 House drain size. The size of the house drain is determined by its gradient fall and total number of fixture-units.

P-904.4.4 High-rise buildings. If the building is 75 feet in height and not more than 160 feet in height above the grade level at the curb, the vertical soil or waste stacks connected to the house drain or to any of its branches shall be one size larger than given in Table P-904.4, and this shall also apply when the soil or waste stacks are connected to a horizontal branch pipe that discharges into a soil or waste stack. If the building is more than 160 feet in height, the vertical soil or waste stacks connected to the house drain or to any of its branches shall be two sizes larger than given in Table P-904.4, and this shall also apply when the vertical soil or waste stacks are connected to the horizontal branch pipe that discharges into a soil or waste stack. The size of the main soil stack shall be sized according to the largest branch entering the stack, except if the amount of fixture units requires a larger size. The developed length of the soil or waste stacks shall be determined by measuring the distance between the center line of the horizontal branch pipe and the roof. If a relief vent is installed on all horizontal branches below the top floor and between the soil or waste stacks and the first fixture on the horizontal branch, the soil or waste stack sizes shall be in accordance with Table P-904.4, regardless of the height of the building. The size of the branch line and its stack shall be determined by the developed length of the stack. (See Figure P-1101.0)
Offsets are required in vertical stacks due to floor plan changes or obstructions.
Stack Offsets

Figure 12.3.3 - A
ONE STACK VENT FOR HORIZONTAL OFFSETS IN DRAIN STACKS

NOTES:
1. The vent stack must be sized for the entire DFU load on the drain stack per Table 12.16.4.
2. The pressure relief vents for the upper and lower portions of the drain stack are required to relieve pressure from the hydraulic effect of the offset. The relief vents must be the same size as the vent stack.
3. The vent stack must connect to the base of the drain stack, either below the lowest branch connection above the base of the stack or within 10 pipe diameters downstream from the base of the stack.
Venting

- Common Venting Schemes
  - Single Stack System – Philadelphia, IPC or NSPC version
  - Sovent System
  - IPC / NSPC Vent Schemes
    - Wet Vent
    - Waste Stack Vent
    - Combination Waste & Vent
    - Reduced Size Vent (Engineering System)
Relief Venting

- A relief vent pipe shall be installed on the main drain before the main house trap inside the building and be connected to the nearest vent line for any building 75 feet or higher.
- On main drains of 8 inches or less, the vent shall be a minimum of 4 inches.
- On main drains 10 inches and over, the relief vent shall be a minimum of 5 inches.
Main House Drain Relief Venting

PPC 2004 – P-1103.4
PPC 2018 – P-1002.6
Relief Venting

Soil and waste stacks in buildings having more than 10 branch intervals shall be provided with a relief vent at each tenth interval installed, beginning with the top floor.
Velocity Breaks

- Velocity breaks shall be required in soil stacks in buildings more than 30 stories above grade to impede the velocity of the waste.
- At each velocity break, the stack shall be offset by two 45-degree breaks.
- A relief vent one-half the size of the soil stack shall be installed at the top of the second 45-degree break and shall be connected to the nearest vent stack.
- Velocity breaks shall be installed at maximum 10-story intervals above the 30th floor.

PPC 2004 – P-1104.1
PPC 2018 – P-919.4
Venting – Common Issues

- Floor plan changes that cause additional venting (i.e. flat offsets).
  - Common in single stack systems
- Lack of roof area to locate vent through roof terminals.
- Too many sanitary stacks and vent stacks connected to a common vent through the roof.
DWV Systems - Pipe Materials

- **Below Grade**
  - H&S Cast Iron Pipe
    - Lead & Oakum Joints or mechanical couplings*

- **Above Grade**
  - No-Hub Cast Iron Pipe
    - Standard or extra heavy couplings
  - H&S Cast Iron Pipe
    - Lead & Oakum Joints or mechanical couplings

- Smaller branch piping (< 2")
  - “DWV” copper
DWV Systems - Pipe Materials

- Below Grade
  - Cast Iron Pipe
  - Schedule 40 PVC
- Above Grade
  - Cast Iron Pipe
  - Schedule 40 PVC
- Smaller branch piping (< 2”)
  - “DWV” copper
  - Schedule 40 PVC
Additional Design Consideration

- Sewage Ejector and Sump Pumps for subterranean levels.
- RPZ backflow preventer failure
  - Properly sized waste receptor for 100+ GPM.
- Sprinkler system drain down provisions.
  - 150 - 250 GPM discharge
- Diesel fire pump engine radiator discharge
  - 25-40 GPM into a floor drain
- Indirect waste receptors for AC condensate.
- Water heater drip pans and leak drain pans.
Storm Water Systems

- Primary and secondary system sized the same as a low rise building.

- Vertical projections
  - 50% of the vertical projection surface area is added to the sizing of the roof drain.
  - Very tall vertical projections will not shed all of their water onto the horizontal surface below.

- Low and High Roofs should not connect to the same vertical riser.
Storm Water Systems

- **Secondary Systems**
  - Required by IPC 2015 & 2018, PPC 2018
  - PPC 2018 exemption for existing buildings.
  - Not required in New Jersey.
- Consider scuppers as the secondary system.
  - More likely to have primary drain clogs from trash, debris or bird “waste”.
  - Watch out for icicles forming where scuppers are located.
Water Re-Use Systems

- Rainwater Harvesting Systems
- AC and Steam Condensate Recovery Systems

Uses
- Cooling Tower and HVAC system make-up water; Evaporative Cooling Systems
- Irrigation Systems, Green Roofs
- Decorative Fountains
- Toilet and urinal flushing
- Fire Protection Back-up
Domestic Water Systems
Domestic Water Systems

- High rise buildings present essentially two problems in the design of the domestic water system.
  - Provide a means to develop and maintain adequate pressure at the plumbing fixtures or mechanical equipment in the highest portion of the building.
  - Provide a means to avoid exceeding the fixture and equipment pressure requirements in the lower portions of a building.
Domestic Water Systems

- Upfeed or Downfeed System
- Mechanical or gravity pumping

Configuration Considerations
- Building Use, Type and Height
- Water Heating Plant Location
- Critical Equipment at top of building (i.e. cooling towers, HW mixing valves).
- Emergency water requirements (NYC).
- Water Pendulum or Mass Tuned Damper
Domestic Water Systems

Figure 5-2 Simplified Downfeed Water Supply System with Simplified Elevated Water Tank
Downfeed Water System

- Incoming water service is connected to a main house pump system.
- House pump system pumps water up to the gravity tank at the top of the building or multiple gravity tanks in the building.
- Water is supplied to the fixtures from the gravity tank(s).
- Booster pump from tank discharge provides adequate pressure to fixtures on closest floors below the tank until gravity can take over.
Downfeed Water System

- To limit pressure to acceptable levels, the building is divided into multiple vertical zones with either tanks or pressure zones.
- Common system in NYC since 1800’s.
  - WTC 1 (Freedom Tower) has 16 gravity tanks.
- Tanks are usually 5,000 to 10,000 gallons.
- Reference Project - Two Liberty Place
  - (2) 7,500 gallon tanks on 38th and 58th Floors.
  - 5,000 gallons for potable water, 15,000 gallons for fire water.
Downfeed Water System

Figure 5-3  Piping Arrangement of an Elevated Water Tank
Continuous Upfeed System

- Incoming water service is connected to a water pressure boosting system.
- Water pressure boosting system maintains flow and pressure to all fixtures and equipment.
- Water pressure boosting system uses variable speed pumps.
- Hydro-pneumatic tank provides buffer for incidental flows so pumps don’t always use.
- To limit pressure to acceptable levels, the building is divided into multiple vertical zones.
Pressure Zones

- To limit pressure to acceptable levels, the building is divided into multiple vertical zones.
- This is accomplished by pressure-reducing stations that limit the zones to 7-10 floors depending on floor to floor height while maintaining the pressure at the lowest floor of the zone at an allowable value that will permit any connected water fixtures to operate properly.
- This maximum pressure is usually between 60 to 75 psi.
Single Pressure Zone
Multiple Pressure Zones
Pressure Reducing Stations

- Single or multiple pressure reducing valves that lower water pressure from system pressure to low pressure for use by fixtures.
- Can be a single valve or multiple valves in series or parallel.
- In multiple valve configuration, pressure settings are staged to divert flow between high flow and low flow valves.
Pressure Reducing Stations

Use 90 Series

Pressure Ratio > 2.5:1 (2 in Series)
Pressure Drop > 150 (2 in Series)

Wide Flow Range (2 in Parallel)

2 1/2"

242 psi
142 psi
75 psi

1 1/2"
(Set 5+ psi higher)

142 psi

Consult factory for available spring ranges

Parallel

Series
Domestic Water Booster Pumps

- House, Tank Discharge or Boosting System
- No. of Pumps
  - Duplex, Triplex, Quaplex or Sixplex
- Types of Pumps
  - Closed Coupled Pumps or Stainless Steel Vertical Multi-Stage Pumps
- Sizing Pumps
  - Lead/Lag (100% redundancy)
  - Multiple pumps in parallel
    - (2) @ 60% flow, (3) at 40% of flow, (4) @ 30%
Domestic HW Heating Systems

- **Fuel Sources**
  - Natural Gas, Steam, Heating HW or Electric

- **Plant Location**
  - Top, middle or bottom of the building.
  - Gas heater venting length and termination limitations.
  - Hydrostatic head on water heaters.

- **Number of Plants**
  - (1) plant per pressure zone or single plant with multiple pressure zones.
Domestic HW Heating Systems

- Hot Water Generation
  - Tank-Type Water Heaters
    - With or without additional storage tanks.
  - Volume Water Heaters with Storage Tanks
  - Heating Water Boilers with Indirect Water Heaters
  - Steam-to-HW or HW-to-HW Heat Exchangers
    (Semi-Instantaneous or Instantaneous).

- Most vessels come with a T/P relief valve set at 125 PSIG. Option to get 150 PSIG.

- Indirect water heaters are available with higher working pressures.
Domestic HW Distribution

**Legend**
- Hot Water Supply
- Hot Water Return
- Shut Off Valve
- Check Valve
- Balancing Valve
- Memory Stop
- Air Relief Valve

**Figure 14.1** Upfeed Hot Water System with Heater at Bottom of System.

**Figure 14.6** Combination Downfeed and Upfeed Hot Water System with Heater at Top of System.

Note: This piping system increases the developed length of the HW system over the downfeed systems shown in Figures 14.2 and 14.4.

*See text for requirements for strainers.*
Domestic HW Distribution

Figure 14.3 Downfeed Hot Water System with Heater at Top of System:
* See text for requirements for assemblies.

Figure 14.4 Downfeed Hot Water System with Heater at Top of System.
* See text for requirements for assemblies.

Figure 14.5 Combination Upfeed and Downfeed Hot Water System with Heater at Bottom of System.
Note: This piping system minimizes the deadleg length of the HW system over the upfeed systems shown in Figures 14.1 and 14.3.
* See text for requirements for assemblies.
Domestic HWR Systems

- Building is a single pressure zone
  - With or without PRV’s at lower floors.

- Multi-Zone Recirculating System
  - Individual HW plant and recirculation pump per zone.
    - HW plant could be located in the zone or remote.
  - Single HW plant for whole building with reheater and circulation pump per zone.

- Self Regulating Heat Trace System
Single Zone HWR System
Single Zone HWR System
Multi-Zone HWR Systems
Multi-Zone HWR Systems
Multi-Zone HWR Systems
Self Regulating Heat Trace

Figure 15.4 Partial Simplified System Typical of Hospitals, Correctional Facilities, and Hotels.

Source: Courtesy of Thermon Manufacturing Co.
Domestic HWR Systems

- **Main Recirculation Pump Sizing**
  - Calculate heat loss in supply and return piping to determine flow rate.
    - Pump Flow = Heat Loss / 500 x 10°F delta T.
    - Minimum flow is driven by hot water mixing valve requirements.
  - Pump head – pipe friction through balancing valves and piping downstream of most remote fixture / riser. Street pressure or system pressure does the work to get the water to this point.
Domestic HWR Systems

- Pressure Zone Recirculation Pump Sizing
  - Pump flow - 1 GPM per vertical riser. Simulate a low flow faucet running.
  - Pump head – pipe friction through balancing valves and piping downstream of most remote fixture. Street pressure or system pressure does the work to get the water to this point.
Domestic HWR Systems

- Pressure Zone Reheater Sizing
  - Electric Water Heater or Indirect Hot Water Heater
  - Capacity
    - BTU/hr. = Pump Flow (GPM) x 500 x 5-10°F delta T.
    - 25 GPM x 500 x 10°F = 125,000 BTU/hr. = 37 kW
  - Use smallest tank available. Not looking for any storage capacity.
  - Usually needs to be ASME rated due size of heating element.
Hot Water Delivery

- IECC ‘15, ’18 requirements.
- Keep HW sources (water heater or riser) close to fixtures.
- More risers on projects.

<table>
<thead>
<tr>
<th>NOMINAL PIPE SIZE (inches)</th>
<th>VOLUME (liquid ounces per foot length)</th>
<th>MAXIMUM PIPING LENGTH (feet)</th>
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<tr>
<td>1/2</td>
<td>18</td>
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</table>

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 liquid ounce = 0.030 L, 1 gallon = 128 ounces.
Pipe Materials

- ≤ 3-inch – Type “L” copper with soldered or press joints.
- 4-inch or larger – Type ”L” copper or stainless steel with grooved coupling joints.
- Fittings and valves need to be rated for the application pressure
  - 125 or 250 PSIG.

High Rise Buildings up to 150 feet can use non-metallic piping in a dwelling unit.
Pipe Expansion and Contraction

- Piping expands due to temperature change.
  - Fluid temperature vs. ambient temperature.
  - Cold weather or hot weather installation.
- Tall vertical stacks expand and contract.
- Storm water piping sees the biggest change in temperature
  - Snow melting at 32 degrees, pipe is at ambient temperature – 65-70°F.
Pipe Expansion and Contraction

- DWV system – 50°F differential
- DHW system – 80°F differential

<table>
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<tr>
<th>Material</th>
<th>Coefficient of Thermal Expansion, in./in./°F x 10^4</th>
<th>Modulus of Elasticity, psi x 10^6</th>
<th>Expansion or Contraction, in./100 ft./10°F</th>
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<td>Austenitic stainless steel</td>
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Source: ASME 831.9
Pipe Expansion and Contraction

200 foot tall cast iron stack expands 0.672” at 50 degree temperature rise.

200 foot tall PVC stack expands 3.6” at 50 degree temperature rise.
Natural Gas

- High Rise Challenges for Natural Gas
  - Supplying adequate pressure to all appliances and equipment.
  - Overcoming stack effect – natural gas is lighter than air, therefore, gas pressure rises in the building.
  - Gas pressure rises 0.1 inch of water column for roughly every 12.5 feet of building height.
  - Optimizing pipe sizing due to pressures and diversity factor on equipment.
  - Space planning for booster pumps and/or high pressure gas service.
  - Natural Gas Odorant Fade
Natural Gas

- **Natural Gas Booster Pumps or High Pressure Gas**
  - Gas loads in the basement and on the roof.
  - Need booster pump for loads in basement since gas pressure rises to the top of building.

- **Pipe Sizing**
  - Using high pressure gas with high pressure drop can reduce size of vertical riser.
  - Example - 15,000 MBH / 150 developed feet
    - 8” pipe (< 2 PSI, 0.3” W.C pressure drop)
    - 3” pipe (2 PSI, 1 PSI pressure drop)
Diversity Factor

Exhibit G

Diversity Factors

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<td>65%</td>
<td>60%</td>
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<td>50%</td>
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30 Ranges @ 65 MBH each = 1,950 MBH (682.5 MBH with diversity)
100 developed feet of pipe = 3” riser / 2” riser (with diversity)
Gas Service Space Planning

High Pressure Gas Service
Natural Gas Odorant Fade

- Odorant - Mercaptan Family Compounds
- Odorant Fade Causes
  - Physical and chemical processes in the pipe.
  - Gas stagnation and pipe oversizing.
  - Intermittent or low flow.
  - More pronounced in systems with new steel pipe or long runs of piping.
- Correction Methods
  - Proper pipe sizing.
  - Conditioning “pickling” or coating of piping.
Fuel Oil Systems

- Types of Equipment
  - Diesel Standby Generators
  - Dual Fuel (Gas/Oil) Boilers & Water Heaters
  - Diesel Fire Pumps

- High Rise Challenges
  - Fill port locations
  - Pumping fuel to the equipment fuel tank.
  - Fuel oil return to the primary fuel tank.
  - Fuel storage limitations
    - Thresholds - 660 gal., 1,320 gal. & > 1,320 gal.
Fuel Oil – Generator(s)
Fuel Oil – Dual Fuel Boilers
Fuel Oil – Diesel Fire Pumps
Structural Coordination

- Coordinate DWV and water riser locations with columns, structural beams, rebar within the slab.
- Toilets, showers, bathtubs, floor drains, mop sink drain outlets on top of horizontal structural elements.
- Coordinate penetrations through link beams, deep columns, grade beams and mat slab foundations.
Fire Protection

- Sprinkler Systems

- High rise buildings shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 (NFPA 13 system) and a secondary water supply where required by Section 403.3.3.

- Each sprinkler system zone in buildings that are more than 420 feet in building height shall be supplied by not fewer than two risers. Each riser shall supply sprinklers on alternate floors. If more than two risers are provided for a zone, sprinklers on adjacent floors shall not be supplied from the same riser.
Water Supply per IBC 2015 & 2018

Buildings 420 feet and taller are required to be supplied by connections to not fewer than two water mains located in different streets.

Separate supply piping shall be provided between each connection to the water main and the pumps.

Each connection and the supply piping between the connection and the pumps shall be sized to supply the flow and pressure required for the pumps to operate.
Secondary Water Supply

- High rise buildings assigned to Seismic Design Category C, D, E or F as determined by IBC 2018 Section 1613 shall have an automatic secondary on-site water supply having a capacity not less than the hydraulically calculated sprinkler demand, including the hose stream requirement.

- The secondary water supply shall have a duration of not less than 30 minutes.

- Additional pumps are not required unless needed to provide adequate pressure at the fire pump inlet.
Fire Protection

- Secondary Water Supply
Fire Protection

- Sprinkler and Standpipe Systems
  - Sprinklers and wet standpipes required in all new construction high rise buildings.
  - Hose connection from wet standpipes required at the primary or alternate stair landing in each egress stair tower or horizontal exit.
Fire Protection

- Fire Department Connections
  - Two (2) remotely located fire department connections are required for each standpipe zone.
  - Standpipe zones with an auxiliary water supply and/or back-up fire pump above the pumping limits of the fire department are not required to have a fire department connection
    - 250 feet (in height) is the pumping limit of the Philadelphia Fire Department.
Fire Protection

- Fire Department Connections
Fire Protection

- Fire Pumps
  - Required when insufficient pressure is available for sprinkler or standpipe systems.
  - Fire pumps only **INCREASE** pressure, not flow.
  - Pump starts when system pressure significantly drops below a defined set point due to sprinkler heads releasing water or standpipe use.
Fire Protection

- Fire Pumps
  - One pump per standpipe zone.
  - Redundant pumps are required for pressure zones that are beyond the pumping capabilities of fire department.
    - 250 feet (in height) is the pumping limit of the Philadelphia Fire Department.
  - Pumps must be rigidly connected to building. No vibration isolation (concrete inertia base).
Fire Protection

- Jockey Pumps (Pressure Maintenance Pumps)
  - Maintain pressure in system.
  - Not required by code but good design practice for longevity of fire pump.
  - Design Flow = 10% of system flow
  - Design Pressure = 125% of system pressure
  - Electric driven and backed up by standby generator.
  - NFPA 20 rating not required.
Fire Protection

- Electric Power or Diesel Engine.
Fire Protection

- Fire Pump - Normal Power Sources
  - Electric fire pumps are required to have a reliable normal power source.
  - Electric fire pump connected to the utility service upstream of the building main disconnect switch.
  - Electric fire pumps can be tricky if the building is fed with primary service power (15 or 35 kV).
Fire Protection

- **Fire Pump - Alternate Power Sources**
  - Electric fire pumps in high rise buildings are required to have a standby power source.
  - Dedicated automatic transfer switch connected to the emergency generator.

- **Diesel Fire Pump**
  - Battery charger, block heater and radiator coolant system required to be on standby power.
Fire Protection

- Diesel Fire Pump Fuel Sources
  - Gravity fed double wall fuel tank located adjacent to the pump.
  - Fire pump is not allowed to directly receive pumped fuel from another tank. Must be gravity fed from a adjacent day tank.

- Tank Sizing
  - 1 gallon per horsepower plus 10%
  - Tank Sizes (Gallons) – 119, 187, 300, 359, 572, 849 & 1100
Fire Protection

- Fire Pump Test Header
  - Sized similar to a fire department connection.
  - Connected to discharge of pump.
  - Two bypasses around pump
    - Recirculation of water to pump.
    - Maintain system pressure during test.
Single Fire Pump Setup

**NOTE** THE CONTRACTOR SHALL PROVIDE A 3/4" CIRCULATION RELIEF VALVE ON THE DISCHARGE SIDE OF THE FIRE PUMP. THE RELIEF VALVE SHALL DISCHARGE TO THE NEAREST FLOOR DRAIN.

8" WATER FLOW SWITCH
3" FLANGED O.S. & Y GATE VALVE WITH TAMPER SWITCH (TYP)
LISTED 8" DOUBLE CHECK VALVE BACKFLOW PREVENTER. PROVIDE DRAIN PIPE TO NEAREST FLOOR DRAIN WITH AIR GAP FITTING
PRESSURE GAUGE (TYP)
4" FLOOR MOUNTED CONCRETE PUMP PAD
NEW 8" FIRE PROTECTION WATER SUPPLY PIPE FROM CITY WATER MAIN

8" WAFFER STYLE CHECK VALVE
8" BYPASS PIPING
CIRCULATION RELIEF VALVE AND AIR RELEASE VALVE ON DISCHARGE PUMP FITTING
8" TEST HEADER W/ FOUR 3-1/2" HOSE VALVES AND WATER FLOW METERING DEVICE. LOCATE HOSE VALVE OUTLETS AS SHOWN ON PLAN. FINAL LOCATION OF HOSE VALVES SHALL BE APPROVED BY THE LOCAL FIRE MARSHALL.

NEW INLINE FIRE PUMP
MASON SUPER W PAD (3/4"

6" PIPING TO SYSTEM (SEE PLAN FOR CONTINUATION)

FIRE SERVICE / FIRE PUMP CONNECTION DIAGRAM
SCALE: NOT TO SCALE

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Fire Pump Testing

- **Conditions**
  - No Flow (churn) – 10 minutes (elec.) / 30 minutes (diesel pump).
  - Rated Flow
  - 150% of pump flow capacity / 65% of pump head minimum.

- **Test Frequency**
  - Electric and Diesel Fire Pumps in High Rise Buildings – Weekly
Thank You!

Questions or Comments?
Bibliography

- ASPE Handbooks (Volume 1 through 4)
- ASPE Domestic Hot Water Design Guide
- ASHRAE Design Guide for Tall, Supertall & Megatall Building Systems
- ASHRAE Handbooks - HVAC Applications I-P Edition