Water Supply and Sewerage Network

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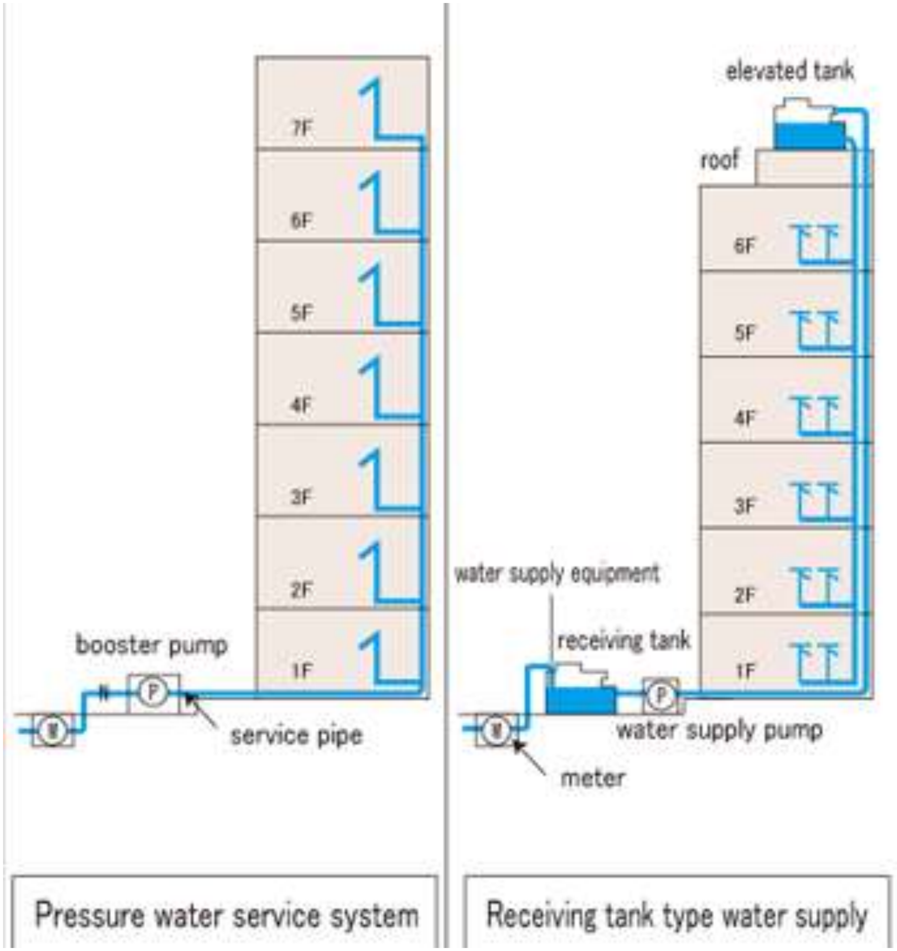
Water Distribution Systems in Buildings

Cold and hot water may be conveyed to plumbing fixtures under the pressure of a water source, such as a public water main, by pumps, or by gravity flow from elevated storage tanks.

The water-distribution system should be so laid out that, at each plumbing fixture requiring both hot and cold water, the pressures at the outlets for both supplies should be nearly equal. This is especially desirable where mixing valves may be installed, to prevent the supply at a higher pressure from forcing its way into the lower-pressure supply when the valves are opened to mix hot and cold water.

Pipe sizes and types should be selected to balance loss of pressure head due to friction in the hot and cold-water pipes, despite differences in pipe lengths and sudden large demands for water from either supply.



Plumbing Fixtures and Equipment

Two methods have evolved in the world that, when used where applicable, have proven to give satisfactory results. They are the empirical method and method of probability. The empirical method is based upon arbitrary decisions arrived at from experience and judgment. It is useful only for small groups of fixtures. The method of probability is based upon the theory of probabilities and is most accurate for large groups of fixtures.

The water-supply system of a building distributes water to plumbing fixtures at points of use. Fixtures include kitchen sinks, water closets, urinals, bathtubs, showers, lavatories, drinking fountains, laundry trays, and slop (service) sinks. To ensure maximum sanitation and health protection, most building codes have rigid requirements for fixtures. The plumbing fixtures are at the terminals of the water-supply system and the start of the wastewater system. To a large extent, the flow from the fixtures determines the quantities of wastewater to be drained from the building.

- For Example, the federal Energy Policy Act (EPACT92) established the following criteria for water use by fixture:

Demand at Individual Fixtures and Required Pressure

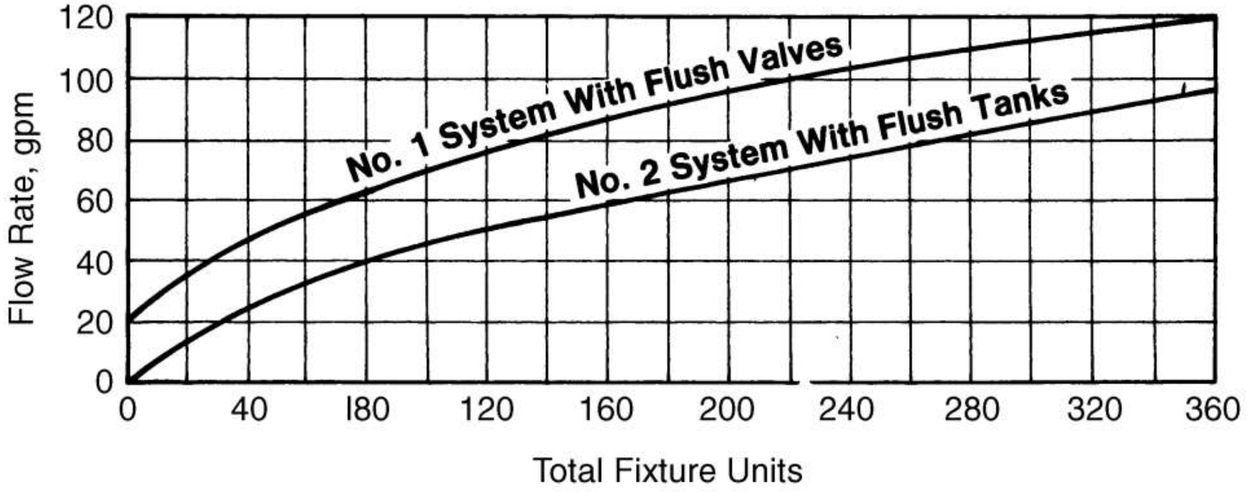
Fixture	Flow Pressure, psi	Flow Rate, gpm
Ordinary lavatory faucet	8	3.0
Self-closing lavatory faucet	12	2.5
Sink faucet, ⅜ in.	10	4.5
Sink faucet, ½ in.	5	4.5
Bathtub faucet	5	6.0
Laundry tub faucet, ½ in.	5	5.0
Shower head	12	5.0
Water closet flush tank	15	3.0
Water closet flush valve, 1 in.	10–25	15–45
Urinal flush valve, ¾ in.	15	15.0
Hose bibb or sill cock, ¾ in.	30	5.0

Demand Weight of Fixtures, in Fixture Units

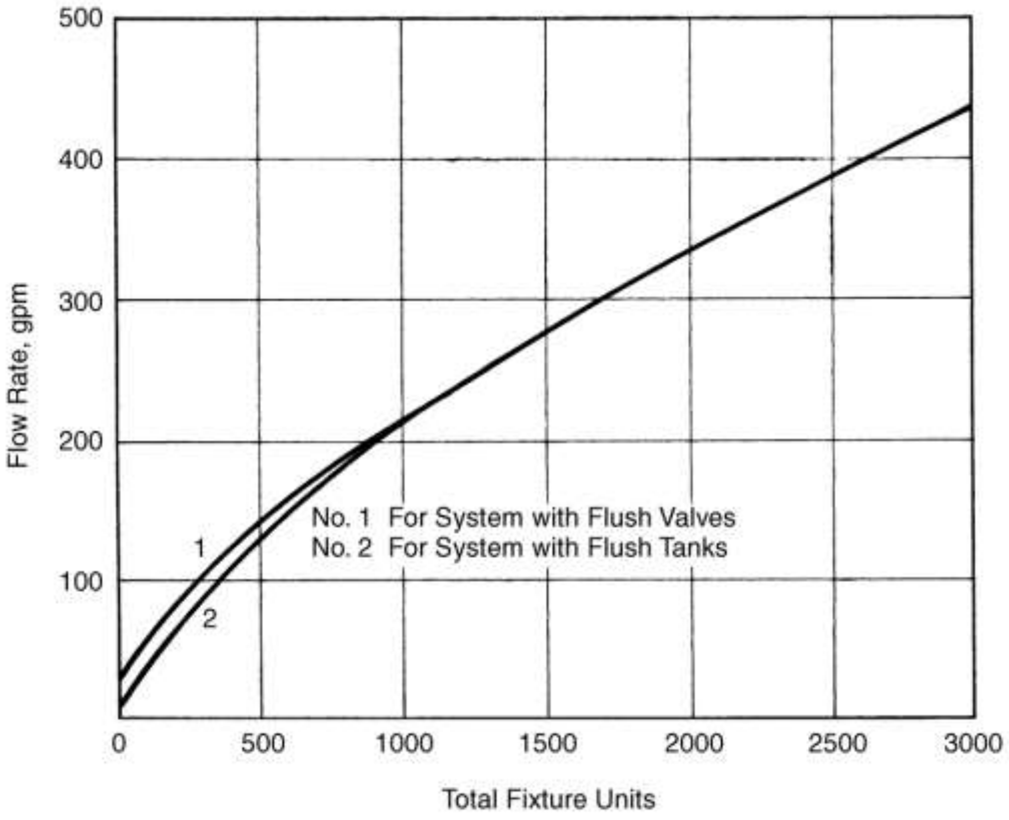
Fixture or Group	Occupancy	Type of Supply Control	Fixture Units		
			Hot	Cold	Total
Water closet	Public	Flush valve	—	10	10
Water closet	Public	Flush tank	—	5	5
Pedestal urinal	Public	Flush valve	—	10	10
Stall or wall urinal	Public	Flush valve	—	5	5
Stall or wall urinal	Public	Flush tank	—	3	3
Lavatory	Public	Faucet	1.5	1.5	2
Bathtub	Public	Faucet	3	3	4
Shower head	Public	Mixing valve	3	3	4
Service sink	Office, etc.	Faucet	3	3	4
Kitchen sink	Hotel or restaurant	Faucet	3	3	4
Water closet	Private	Flush valve	—	6	6
Water closet	Private	Flush tank	—	3	3
Lavatory	Private	Faucet	.75	.75	1
Bathtub	Private	Faucet	1.5	1.5	2
Shower head	Private	Mixing valve	1.5	1.5	2
Bathroom group	Private	Flush valve W.C.	2.25	6	8
Bathroom group	Private	Flush tank W.C.	2.25	4.5	6
Separate shower	Private	Mixing valve	1.5	1.5	2
Kitchen sink	Private	Faucet	1.5	1.5	2
Laundry tray	Private	Faucet	2	2	3
Combination fixture	Private	Faucet	2	2	3

Method of Probability (Hunter Method)

The Hunter Method assigns a water supply fixture unit to each fixture. This fixture unit value is a probability factor used to determine the total use of water within a given system. Hunter developed a curve that establishes the flow rate for any given water supply fixture unit value.



Conversion of Fixture Units to gpm (enlarged-scale)



Conversion of Fixture Units to gpm

Example: Determine the peak demands for hot and cold and total water for an office building that has 60 flush valve water closets, 12 wall hung urinals, 40 lavatories, and 2 hose bibbs and requires 30 gpm for air-conditioning water makeup.

Solution:

From Table determine the FU values:

	Hot Water	Cold Water	Total (Hot & Cold)
60 WC x 10	—	600	600
12 UR x 5	—	60	60
40 Lavs x 2	—	—	80
40 Lavs x 1.5	60	60	—
	60 FU	720 FU	740 FU

From Figure:
60 FU = 32 gpm hot water demand
720 FU = 174 gpm cold water demand
740 FU = 177 gpm total water demand

To the cold water and total water demand must be added the continuous demand:

2 hose bibbs × 5(from Table)= 10 gpm
Air-conditioning makeup = 30 gpm
Total = 40 gpm

Then:

Hot water demand: = 32 gpm
Cold water demand: 174 + 40 = 214 gpm
Total water demand: 177 + 40 = 217 gpm

The Empirical Method

This method is preferred to applied in small building and not to be used for commercial or industrial facility.

$$Q = 8\sqrt{Q'}$$

Q … *the design flow in l/min* & Q' … *is total flow estimated by units* ($Q' > 64$ *l/min*)

Example: Determine the peak demands for 6-floors building that each floor contents 4 apartments. Each apartment has:-

1. Bathroom contents 1 Bathtub, 2 Lavatory, 1 Laundry tray, 1 Wall urinal.
2. Bathroom contents 1 Shower head, 2 Lavatory, 1 Wall urinal.
3. Kitchen contents 2 Kitchen sink.

Calculate the design flow for each apartment, floor and building by using both Probability and Empirical Method.

Fixtures	Units	Number of Units	Total Units	Q' (l/min)	$Total\ Q'$ (l/min)
Bathtub	2	1	2	6	6
Lavatory	1	4	4	3	12
Wall urinal	5	2	10	15	30
Shower head	2	1	2	5	5
Kitchen sink	2	2	4	4.5	9
Laundry tray	3	1	3	5	5
		Summation	25		67

Probability

For one Apartment …. Units are 25 … from figure Q = 18 gpm

For one Floor …. Units are 100 … from figure Q = 45 gpm

For Building …. Units are 600 … from figure Q = 130 gpm

Empirical

$$Q = 8\sqrt{Q'}$$

For one Apartment …. $Total\ Q'$ is 67

$$Q = 8\sqrt{67} = 65.5\ gpm$$

For one Floor …. $Total\ Q'$ is 268

$$Q = 8\sqrt{268} = 131\ gpm$$

For Building…. $Total\ Q'$ is 1608

$$Q = 8\sqrt{1608} = 230\ gpm$$

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