COMPONENT OF MUNICIPAL WATER DEMAND

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It is self – evident that a large population will use more water than a small one and that the water use must be, in some measure, related to population. While this certainly true, and while water consumption estimates have been historically on population projections, such techniques are not always satisfactory.

WATER DEMAND

As is noted below, water consumptions is also influenced by factors such as climate, economic level, population density, degree of industrialization, cost, pressure, and the quality of the supply.

WATER DEMAND

A number of multivariate projection techniques have been developed which relate water use to one or more of these factors in addition to population. When such methods can be shown to be applicable to a particular community they should be used in preference to the procedures presented in this course..

WATER DEMAND

An analysis of the future demand of a particular community should always begin by considering present use. TO the extent possible, consumption should be broken down by classes of users (domestic, commercial, industrial, public), area of the city, economic level of the users, season of the year, etc.

WATER DEMAND

The rather common procedure of dividing total use by to total population to derive a per capita consumption should be applied only with great care, since (1) the entire population may not be served by the municipal system (2) there may be large industrial users which will not change with population, and (3) the characteristics as well as the size of the population may be changing. (Terence J. McGhee, Sixth Edition)

Water Consumption For Various Purposes:

It is very difficult to precisely assess the quantity of water demanded by the public, since there are many variable factors affecting water consumption. The various types of water demands, which a city may have, may be broken into following classes:

1- Domestic water demand.

2- Industrial demand.

3- Institution and commercial demand.

4- Demand for public use.

5- Fire demand.

6- Loses and wastes.

	Types of Consumption	Normal Range (lit/capita/day)	Average	%
1	Domestic Consumption	65-300	160	35
2	Industrial and Commercial Demand	45-450	135	30
3	Public Uses including Fire Demand	20-90	45	10
4	Losses and Waste	45-150	62	25

1- Domestic water demand: water required in the houses for drinking, bathing, cooking, washing etc. mainly depends upon the habits, social status, climatic conditions and customs of the people. The details of the domestic consumption purposes is Drinking ,Cooking ,Bathing ,Clothes washing ,Utensils washing ,House washing.

2- Industrial demand: The water required in the industries mainly depends on the type of industries, which are existing in the city. The water required by factories, paper mills, Cloth mills, Cotton mills, Breweries, Sugar refineries etc. comes under industrial use. The quantity of water demand for industrial purpose is around 20 to 25% of the total demand of the city.

3- Institution and commercial demand: Universities, Institution, commercial buildings and commercial centers including office buildings, warehouses, stores, hotels, shopping centers, health centers, schools, temple, cinema houses, railway and bus stations etc comes under this category.

4- Demand for public use: Quantity of water required for public utility purposes such as for washing and sprinkling on roads, cleaning of sewers, watering of public parks, gardens, public fountains etc. comes under public demand. To meet the water demand for public use, provision of 5% of the total consumption is made designing the water works for a city.

5-Fire demand: During the fire breakdown large quantity of water is required for throwing it over the fire to extinguish it, therefore provision is made in the water work to supply sufficient quantity of water or keep as reserve in the water mains for this purpose. The quantity of water required for fire fighting is generally calculated by using different empirical formulae.

6- Loses and wastes: Losses due to defective pipe joints, cracked and broken pipes, faulty valves and fittings. Losses due to, continuous wastage of water. Losses due to unauthorized and illegal connections. While estimating the total quantity of water of a town; allowance of 15% of total quantity of water is made to compensate for losses, thefts and wastage of water.

Factors affecting water consumption per capita:

1- Size of the city: In small cities, it was found that the per capita per day water consumption was small due to the fact that there are only limited uses of water in those cities. Small cities have larger area that is inadequately served by both water and sewer systems than larger cities.

2- Industries and commerce: The presence of industries in a city has a great effect upon total consumption and since industrial use has no direct relation to population , great care must be taken when estimating present or future water consumption in any restricted portion of a city.

3- Climatic conditions: Warm dry regions have higher consumption rates than cooler regions. In addition, water usage is affected by the precipitation levels in the region.

4-Characteristics of the population: Domestic use of water was found to vary widely. This is largely dependent upon the economic status of the consumers, which will differ greatly in various sections of a city. In high value residential areas of a city the water consumption per capita will be high and vice versa.

5- Quality of water: If water is aesthetically and medically safe, the consumption will increase as people will not resort to private wells, etc.

6- Efficiency of water works administration: Leaks in water mains and services; and unauthorized use of water can be kept to a minimum by surveys.

7- Cost of water.

8- Metering and charging method: Water tax is charged in two different ways: on the basis of meter reading and on the basis of certain fixed monthly rate. Communities that are metered usually show a lower and more stable water use pattern.

Variations In Rate Of Water Consumption :

An average amount of water per day over a period of year that the community on the basis of one person will require, does not remains uniform throughout the year but it varies from season to season, even from hour to hour. Variation in demand may be termed as:

1.Seasonal or Monthly Variations. **2.**Daily Variation. **3.**Hourly Variation.

Seasonal Variation:

The water demand varies from season to season. Seasonal variation are prominent in tropical countries like India, Pakistan. The rate of consumption reaches a maximum during the summer season owing to greater use of water for street and lawn sprinkling etc. It goes down during the succeeding months and becomes minimum during winter season. The fluctuation in the rate of consumption may be as much as 150 per cent of the average annual consumption.

Daily Variation:

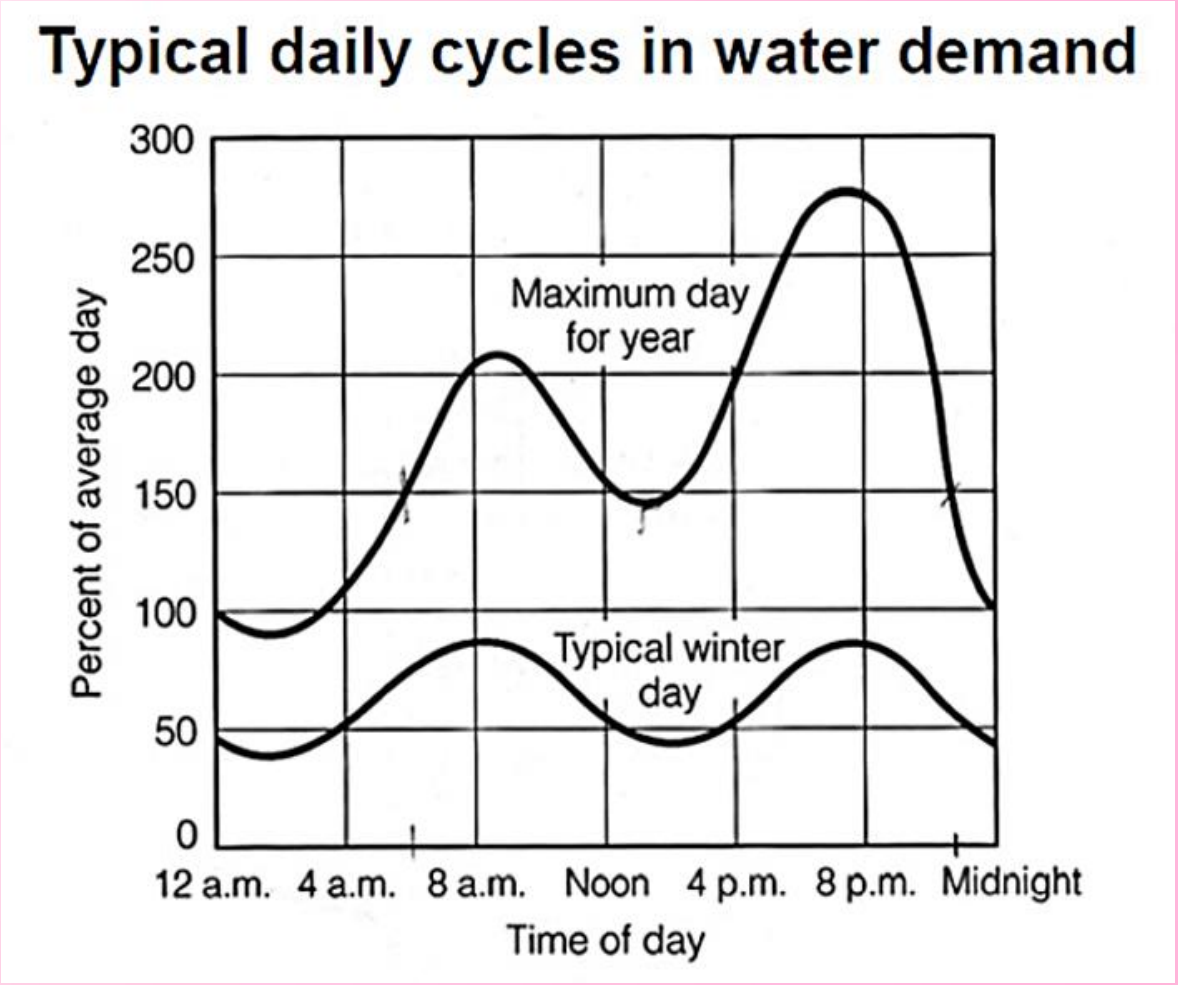
The rate of demand for water may vary from day to day also. This is due to habits of consumers, climate conditions, holidays etc.

Water demand on Sundays is generally more than other days of the week w.r.t. domestic use. On Sunday, everybody takes bath leisurely, washes his clothes etc.

More over on the day of mass marriages as well as on hot and dry day, water consumption will be more as compared to a rainy day.

Hourly Variation:

The rate of demand for water during 24 hours does not remain uniform and it varies according to hours of the day. On Sundays and other holidays the peak hours may be about 8am due to late awakening whereas it may be 6am on other working days. The peak flows may be between 6am to 10am and 4pm to 8pm and minimum between 12M.N. to 4 am.



Daily variation

So, an adequate quantity of water must be available to meet the peak demand. To meet all the fluctuations, the supply pipes, service reservoirs and distribution pipes must be properly proportioned. The water is supplied by pumping directly and the pumps and distribution system must be designed to meet the peak demand. The effect of monthly variation influences the design of storage reservoirs and the hourly variations influences the design of pumps and service reservoirs. As the population decreases, the fluctuation rate increases.

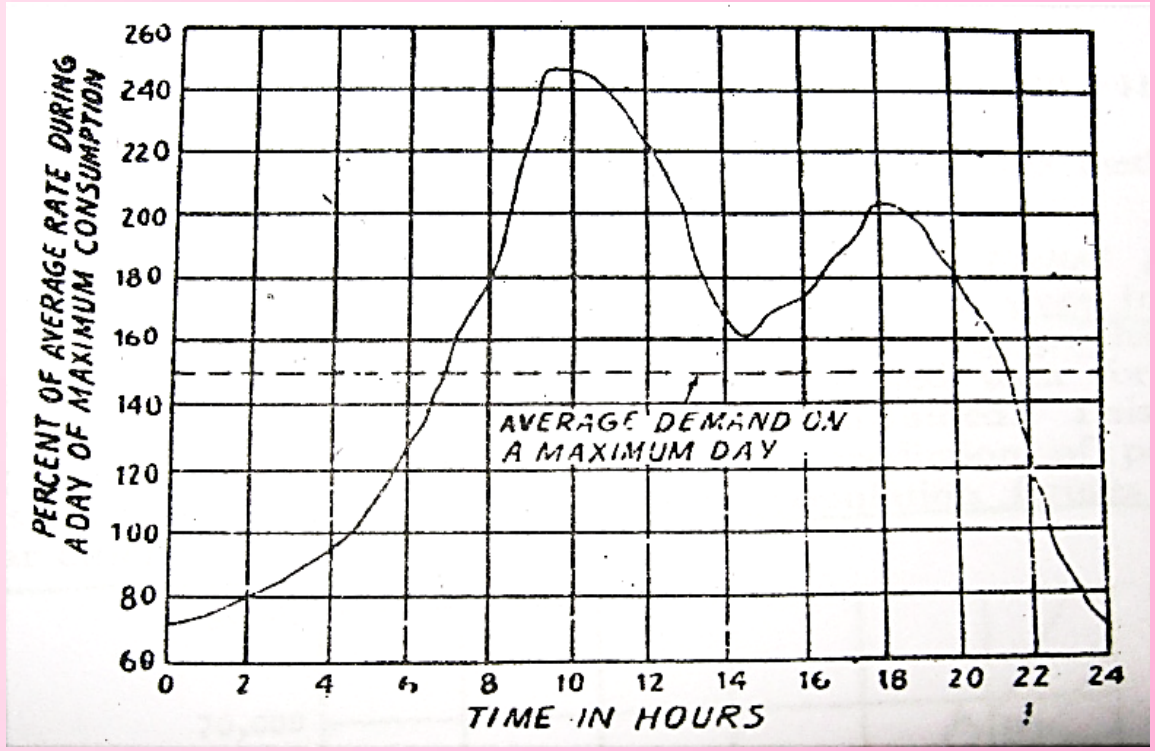
The formula suggested by **R.O. Goodrich** is convenient for estimating consumption and is :

$$P = 180\ t^{0.1}$$

Where **P** is the percentage of the annual average consumption for the time **t** in days .

Maximum daily demand = 1.8 x average daily demand

Maximum hourly demand = 1.5 x average hourly demand



Hourly Variations

Fire Demand:

It is the quantity of water required for fighting a fire outbreak. Although the amount of water used in year for fire fighting is small the rate of use is large. The quantity of water required for fire should be easily available and kept stored in storage reservoir. In the city area fire hydrants are provided on the water mains at 100m to 150m apart. The minimum water pressure available at fire hydrants should be 1.0 to 1.5 kg/cm2.The quantity of water required for fire can be found by using:

1- Insurance Services Office Formula (ISO, 1980):

$$F = 18C\sqrt{A} \quad \text{..... (In British units)}$$

$$F = 220C\sqrt{A} \quad \text{..... (In SI units)}$$

$$TF = F\,O\,(X + P)$$

Where **F** = Fire Demand in liter/min , gal/min .

A = Area of Floors in m2 (Effective floor area).

C = A constant with different values according to Construction

O = Occupancy factor (ranging from 0.75 to 1.25)

TF = Total required fire flow

2- National Board of Fire Underwriters Formula:

$$Q\ (gallon\ US/min) = 1020\sqrt{P}\ (1 - 0.01\sqrt{P})$$

3.Freeman Formula:

$$Q = 1136.5\ (\frac{P}{5} + 10)$$

4. Kuichling's Formula:

$$Q = 3182\ P$$

Where Q = Fire Demand in litter/min.

P = Population in Thousands

Class of Construction	Description	C	Max. C_i(L/min)
1	Frame	1.5	30,000
2	Joisted masonry	1.0	30,000
3	Noncombustible	0.8	23,000
4	Masonry, noncombustible	0.8	23,000
5	Modified fire resistive	0.6	23,000
6	Fire resistive	0.6	23,000

Construction Coefficient, C.

Example 4:

A community with population of 30000 capita has an average consumption of 750 Lcpd and fire flow by a building of ordinary construction with a floor area of $1000m^2$ and a height of 6 stories. Determine the maximum water rate and the total water flow for domestic and fire demand:

Solution :

$$\boldsymbol{P} = 180\, t^{0.1} \Rightarrow \quad P = 180\,(1)^{0.1} = 1.8$$

$$\boldsymbol{Max.daily\ consumption} = 1.8 \times 750 \times 30000 = 40.5 \times 10^6 \text{ L/d}$$

$$\boldsymbol{F} = 220C\sqrt{A} \quad \Rightarrow \quad \boldsymbol{F} = 220\,(1)\sqrt{1000 \times 6} = 17041\ L/\min = 24.5 \times 10^6 \text{ L/day}$$

$$\boldsymbol{Max\ water\ rate} = 40.5 \times 10^6 + 24.5 \times 10^6 = 65 \times 10^6 \text{ L/d}$$

Assuming fire duration is 10 hrs :

$$\boldsymbol{Total\ water\ flow} = 40.5 \times 10^6 \times \frac{24}{24} + 24.5 \times 10^6 \times \frac{10}{24} = 50.7 \times 10^6 \text{ L}$$

Design Periods:

The future period for which a provision is made in the water supply scheme is known as the design period. Design period is estimated based on the following:

1- Useful life of the component, considering obsolescence, wear, tear, etc.

2- Expandability aspect.

3- Anticipated rate of growth of population, including

industrial, commercial developments & migration - immigration.

4- Available resources.

5- Performance of the system during initial period.

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For listening