

INTRODUCTION

"Best of all things is water"

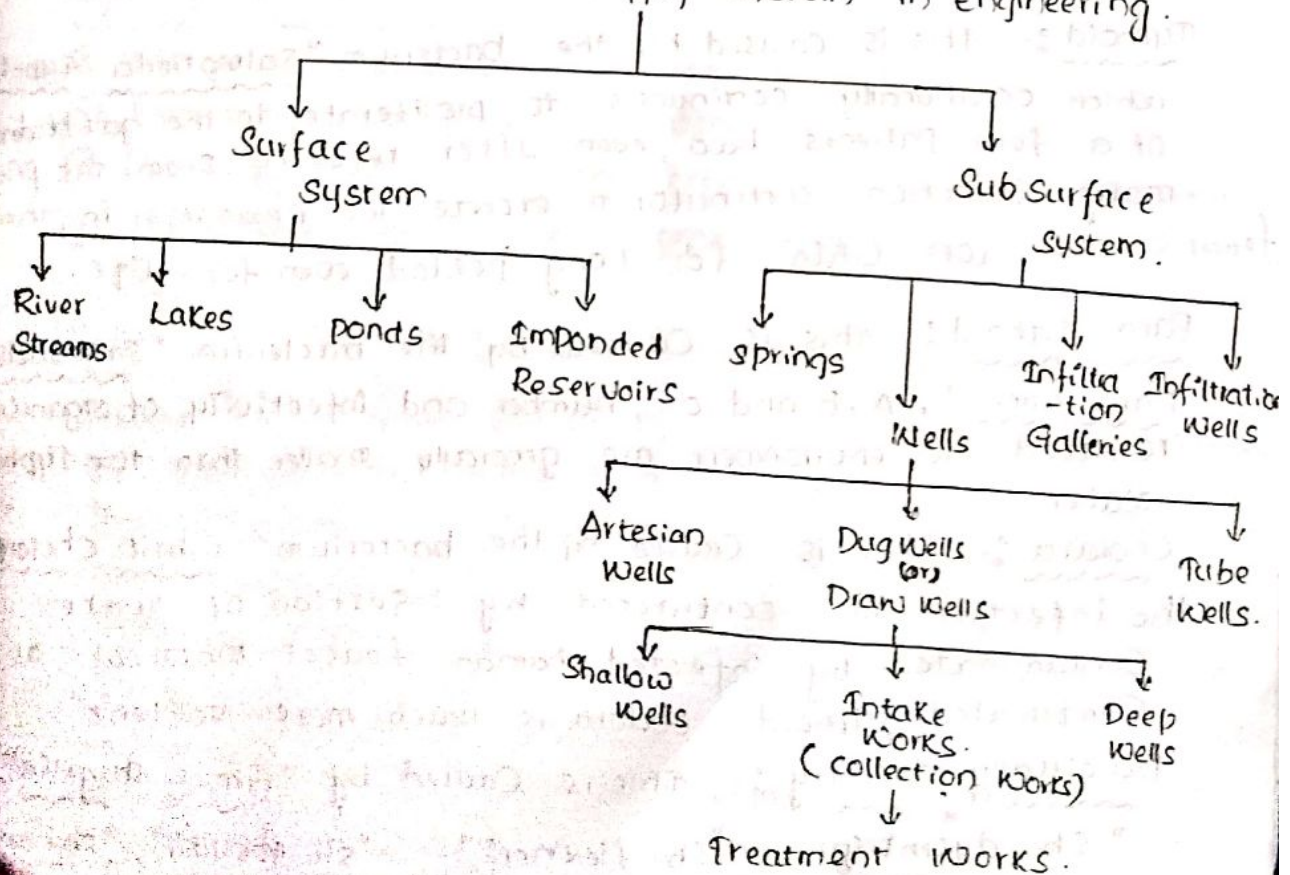
Importance and necessity of water supply system:-

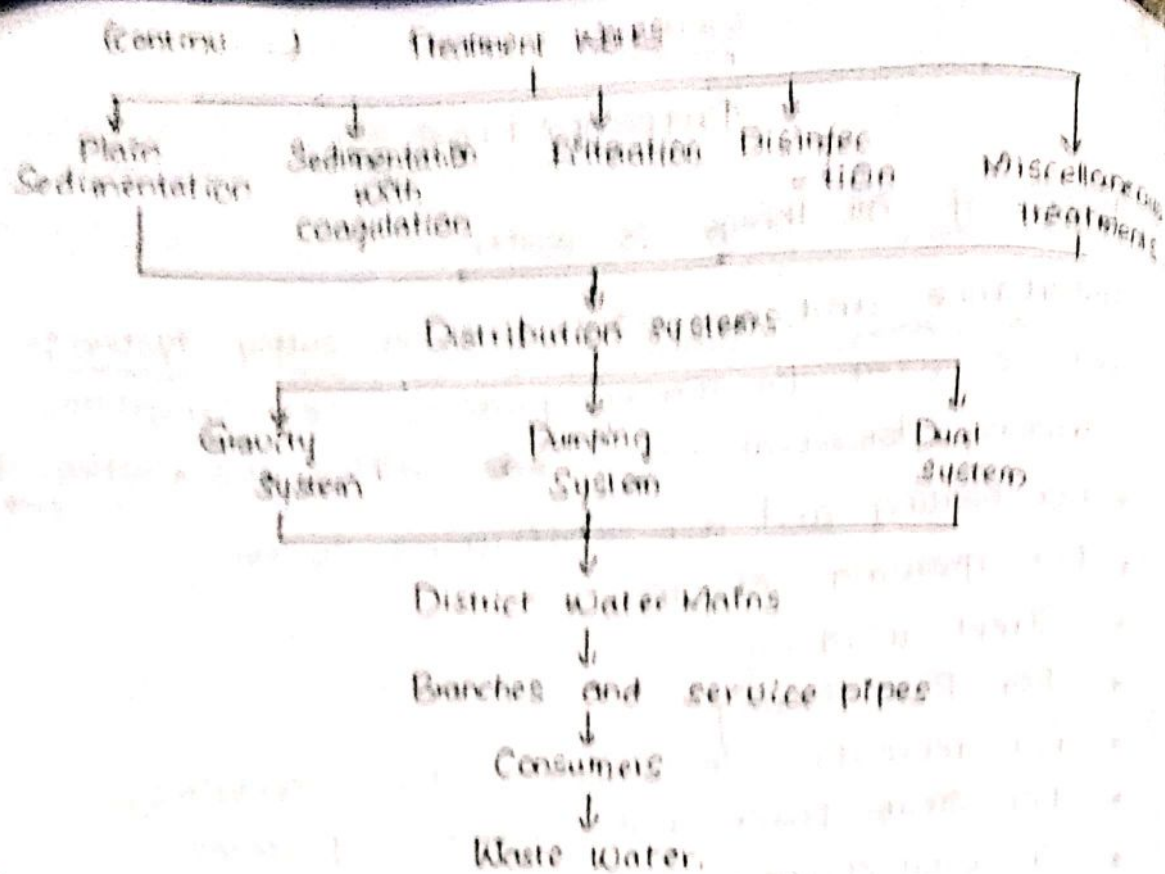
Water is used for various purposes like irrigation, drinking, domestical uses, ~~and~~ bathing and washings of clothes.

- * For heating and air conditioning system.
- * For growing of crops.
- * Street Washing
- * For fire fighting.
- * For recreation in swimming pools, fountains.
- * For steam power and industrial purposes.
- * In civil engineering purpose the total knowledge of designing, construction, and maintenance of water supply system, treatment plants as a basic knowledge of environmental engineering.

Flow chart of public water supply system:-

Water Supply System in Engineering.





Water borne diseases :-

- | | |
|----------------------|----------------------|
| ① Bacterial Diseases | ② Protozoal Diseases |
| ③ Virus Diseases | ④ Helminthic |

① Bacterial Diseases :- four types

- | | | |
|-----------------------|----------------|-----------|
| ① Typhoid | ② Para-Typhoid | ③ cholera |
| ④ Bacillary dysentery | | |

Typhoid :- this is caused by the bacterium "Salmonella typhi" which occasionally continues to proliferate in the gall bladder of a few patients too, even after recovery from the primary infection continuously to excrete the organism's in their faecal species, (or) Urine, for long period, even for life.

Para-Typhoid :- this is caused by the bacterium "Salmonella para typhi". "A, B and c", number and infectivity of organism released to environment are generally smaller than the typhoid water.

Cholera :- this is caused by the bacterium "Vibrio cholera". the infection is contracted by ingestion of water contaminated by infected human faecal material. as compared to typhoid, cholera is much more violent.

Bacillary dysentery :- This is caused by "Genus shigella", "Sh. dysenteriae", "Sh. flexneri", "Sh. boydii", "Sh. sonnei".

② Protozoal Diseases :- This is caused by "Protozoan entamoeba histolytica". They live in the human large intestine forming Schist which are excreted in the bowl discharge infected person and which will live for long period.

③ Virus Diseases :-

- ① Coxsackie viruses ② Echo viruses
- ③ Polio viruses ④ The viruses of infectious
- ⑤ Hepatitis ⑥ Adino viruses ⑦ Reo viruses.
- ⑧ The Common diseases Schistosomiasis and Swimmer itch.

Role of environmental Engineer :-

The environmental engineers designing construction and maintenance of diff water supply systems (or) Schemes. They have some knowledge of above particulars.

- * An environmental engineer is to make public aware about the environmental degradation and also to impart training in such a way so that people participate in the programmes of keeping environment clean.
- * They also protect natural resources from the effect of disposal of hazardous waste.

Agency Activities :-

- ① designing waste water treatment plants.
- ② monitoring air pollution & operating control equipment.
- ③ Developing pollution control technologies for diff industries.
- ④ Predicting movement of contaminants in air water and soil.

Types of Demands :- While designing the water supply scheme for a town (or) city, it is necessary to determine the quantity of water required for various purposes by the city. There are diff types of demands for determining water demand of a town, (or) city by using the formulae of empirical formulae and thumb rules.

- Domestic Water Demand
- Commercial & Industrial demand.
- Fire demand
- Demand for public use
- Compensate losses & demands.

Public Use - 25 Litre / day / capita.

Business (or) Trade - 15 Litre / day / Capita.

Losses and wastage - 55 Litre / capita / day.

Total / capita / day 270 Litres.

Design period :- The no of years per which the design of the water work have been done is known as "design period" following factors should be kept in view while fixing the design period.

- Ⓐ Funds available for completion of project. If more funds are available the design period shall be less.
- Ⓑ Life of the pipe and other structural materials used in the water supply scheme.
- Ⓒ The design period should be equal to the material used in the water supply works.
- Ⓓ Rate of interest on the loans take into complete the project. If the rate of interest is less. It will be good to keep design period is more.
- Ⓔ Anticipated expansion rate of the town.

Population Forecasting :- The future development of town depends on trade expansion, development of industries and surrounding countries etc.

The following are the standard methods by which the forecasting of population is done.

- * Arithmetical increase method.
- * Geometrical increase method.
- * Incremental increase method.
- * Decreasing rate method.
- * Simple graphical method.
- * Comparative graphical method.
- * Master plan method. / zoning method.
- * Logistic Curve method.
- * The apportionment method / Graphical method.

Arithmetical increase method :-

$$P_n = P + nI$$

Where P = Present population.

P_n = population at the end of n es

where n = no of years

Problems:- I = Average increase per year. (population)

* The following data have been noted from the census development.

Year	1940	1950	1960	1970
population	8000	12000	17000	22500

Calculate probable population in the years 1980, 1990, 2000 ?

Sol:-

Here $n = 1$ decade

S. NO	Years	population
~~1~~	1940	8000
~~2~~	1950	12,000
~~3~~	1960	17000
~~4~~	1970	22,500

$$\left. \begin{array}{l} 8000 - 12000 = 4000 \\ 12000 - 17000 = 5000 \\ 17000 - 22500 = 5500 \end{array} \right\} \begin{array}{l} \\ \\ \hline 14500 \end{array}$$

$$\therefore \text{Average total} = \frac{14500}{3} = 4833.3$$

Arithmetic increase method :-

$$\text{We know that } P_n = P + nI$$

$$1980 = 22500 + (1 \times 4833.3)$$

Incr. Population in $\rightarrow 1980 = 27333$

$$P_n = P + nI$$

$$1990 = 27333 + (1 \times 4833.3)$$

$$\therefore 1990 = 32166$$

$$\text{Increase population in 2000} = 32166 + (1 \times 4833)$$

$$\therefore 2000 = 36999$$

* The present population of city is 1,00,000 the past population for the last three decades were as follows. Compute the expected population after one, two and three decades by arithmetical increase method?

Sol:-

present population = 1,00,000

One decade before = 95,000

two decade before = 90,500

three Decade before = 86,500

Sol:-

S.No	No of Decades	population	Difference	Average
1	present year	100,000		
2	one decade	95,000	5000	$\frac{13500}{3}$ $= 4500$
3	two decades	90,500	4500	
4	three decades	86,500	4000	

Arithmetic Increase method:-

W.K. that $P_n = P + nI$

∴ One decade = $100000 + 1 \times 4500$
= 104500

∴ Two decades = $104500 + 1 \times 4500$
= 109000

∴ Three decades = $109000 + 1 \times 4500$
= 113500

- ⊛ Estimate the population of the year 2011 for the town whose census data are given below by applying the Arithmetic increasing method.

Year	1931	1941	1951	1961	1971	1981
Popula- -tion	187440	210890	245450	291120	347900	415790

Sol:-

S.No	No of Years	Population - n	Difference (population)	population Average (n)
1	1931	187440	23450	$\bar{A} = 45670$
2	1941	210890	34560	
3	1951	245450	45670	
4	1961	291120	56780	
5	1971	347900	67890	
6	1981	415790		

Arithmetic Increase method:-

W.K. that $P_n = P + nI$

2011 population = $415790 + 3 \times 45670$

Increased in 2011 $\rightarrow$ 552800
population

Geometrical Increase method:-

It is calculated by

$$P_n = P \left[1 + \frac{I.G}{100} \right]^n$$

Where

P_n = Increased population at the end of yr.

$I.G$ = Avg. % growth

P = present population

(*) The following data have been noted from the census development. Calculate population in 1980, 1990, 2000?

Year	1940	1950	1960	1970
Population	8000	12000	17000	22500

by using Geometrical Increase method?

Sol:-

Year	Population	Increase in Population	Percentage increase in population
1940	8000		
1950	12000	4000	$\frac{4000}{8000} \times 100 = 50\%$
1960	17000	5000	$\frac{5000}{12000} \times 100 = 41.6\%$
1970	22500	5500	$\frac{5500}{17000} \times 100 = 32.3\%$

Avg = 433.33

Avg:- 41.3%

Geometrical increase method:-

$$P_n = P \left[1 + \frac{I.G}{100} \right]^n$$

$$\therefore P_{1980} = 22500 \left[1 + \frac{41.3}{100} \right]^1 = 31794.7$$

$$\therefore P_{1990} = 31794.7 \left[1 + \frac{41.3}{100} \right]^1 = 4425.48$$

$$\therefore P_{2000} = 4425.48 \left[1 + \frac{41.3}{100} \right]^1 = 63419.5$$

(*) Incremental increase method:-

It is calculated by

$$P_n = P + n [I_a + I_c]$$

Where I_a = Arithmetic Increase.

I_c = Average incremental increase.

- * The population figures of a town as per the census records are given below for the years 1911 to 1971, assuming that the scheme of water supply will be commenced to function from 1976. It is required to estimate the population after 30 years, i.e., in 2006 and also intermediate population, i.e., 15 years after 1976.

Year	1911	1921	1931	1941	1951	1961	1971
population	40185	44522	60395	75614	98886	124230	158800

Sol:-

Year	population	Increase in population (I_a)	Incremental (I_c) Increase
1911	40185		
1921	44522	4335	(15811 - 4315)
1931	60395	15873	11536
1941	75614	15218	655
1951	98886	23272	8054
1961	124230	25344	2072
1971	158800	34570	9226

$$I_a = 19769$$

$$I_c = 6046.6$$

Incremental Increase Method:-

We know that

$$P_n = P_0 [1 + I_a + I_c]$$

$$P_n = 158800 * 1.5 [19769 + 6046.6]$$

$$P_{1976} = 171707.8$$

for 30 years

$$P_{2006} = 171707.8$$

$$P_{2006} = 25815.8 * 3 [19769 + 6046.6]$$

$$P_{2006} = 249154.6$$

Intermediate after

$$1971 + 15 \text{ years } P_{1991} = 249154.6 + 1.5 [19769 + 6046.6]$$

$$P_{1991} = 287878$$

Decreasing rate method :-

- * The population of 5 decades from 1940 to 1980 is given. find out the population 1990, 2000 and 2010. by using decreasing rate of growth method?

Year	1940	1950	1960	1970	1980
Population	25000	28000	32500	40,000	45000

Sol:-

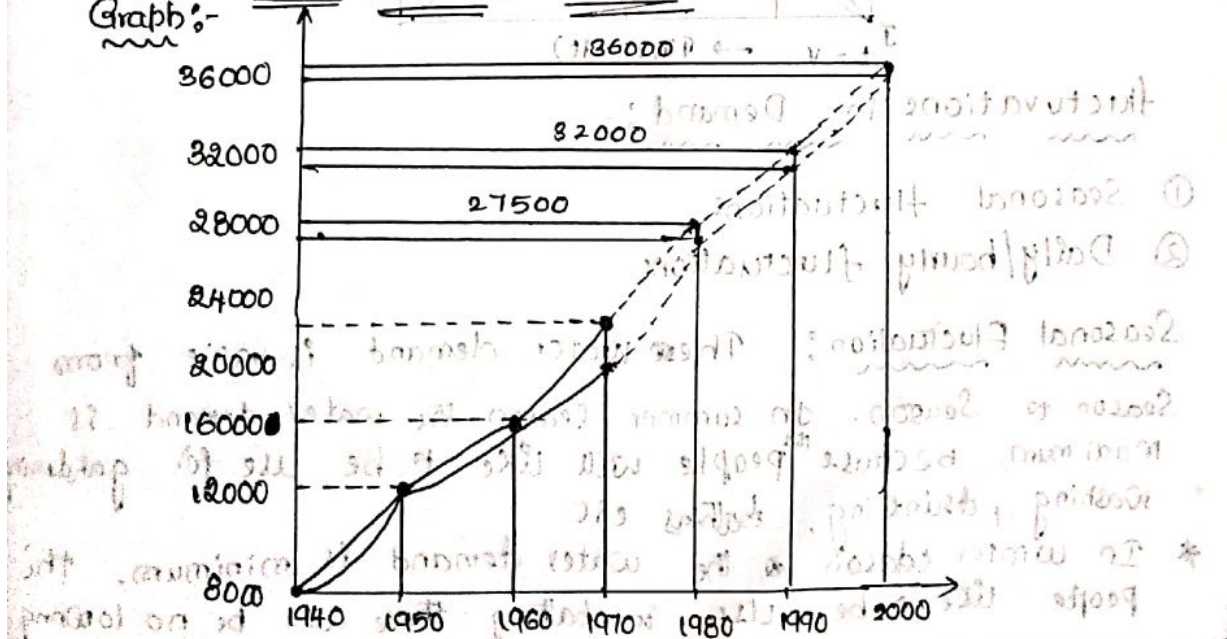
Year	Population	Increase in Population	% increase in population	decreasing in population
1940	25000			
1950	28000	3000	12 %	-4.1 %
1960	32500	4500	16.07 %	-7.1 %
1970	40,000	7500	23.07 %	+10.6 %
1980	45000	5000	12.5 %	
Total Avg	20,000	5,000	25 %	-0.6 %

for Calculating 1990, 1990, 2000 we know

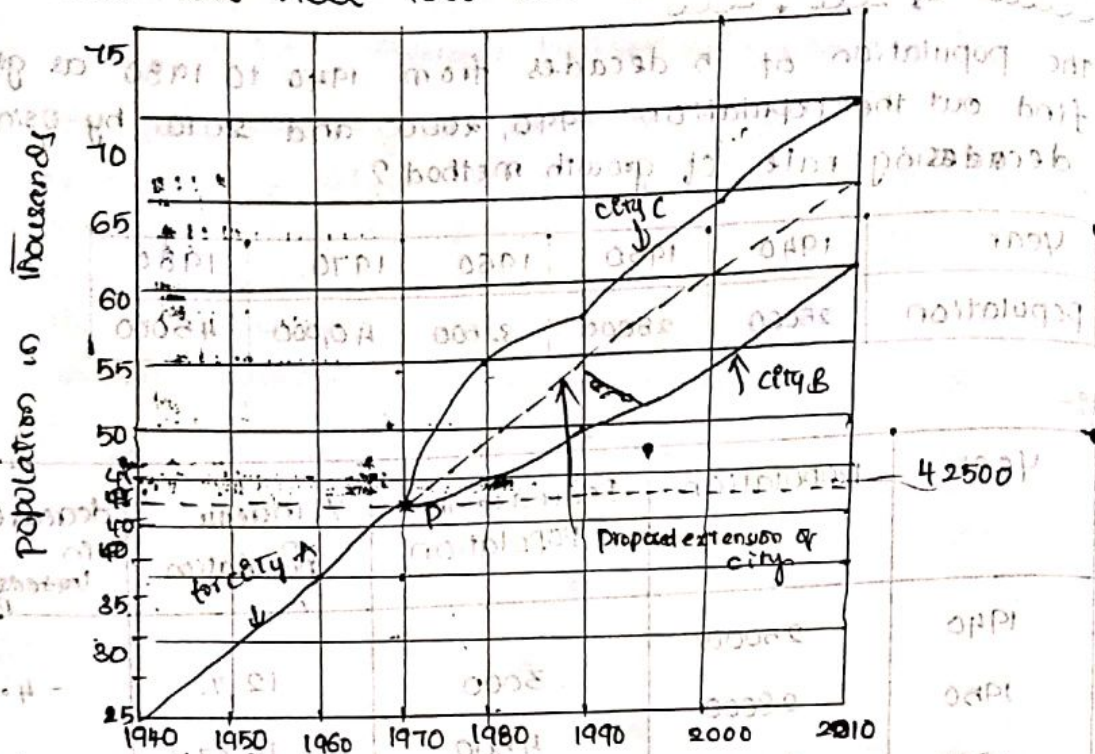
Year	Net % of population	Population
1990	$12.5 - (-0.2\%) = 12.7\%$	$45000 + \frac{12.7}{100} \times 45000$ $= 50715$
2000	$12.7 - (-0.2\%) = 12.9\%$	$50715 + \frac{12.9}{100} \times 50715$ $= 101430.12$
2010	$12.9 - (-0.2\%) = 13.1\%$	$101430.12 + \frac{13.1}{100} \times 101430.12$ $= 114717.46$

Simple Graphical method:-

Graph:-

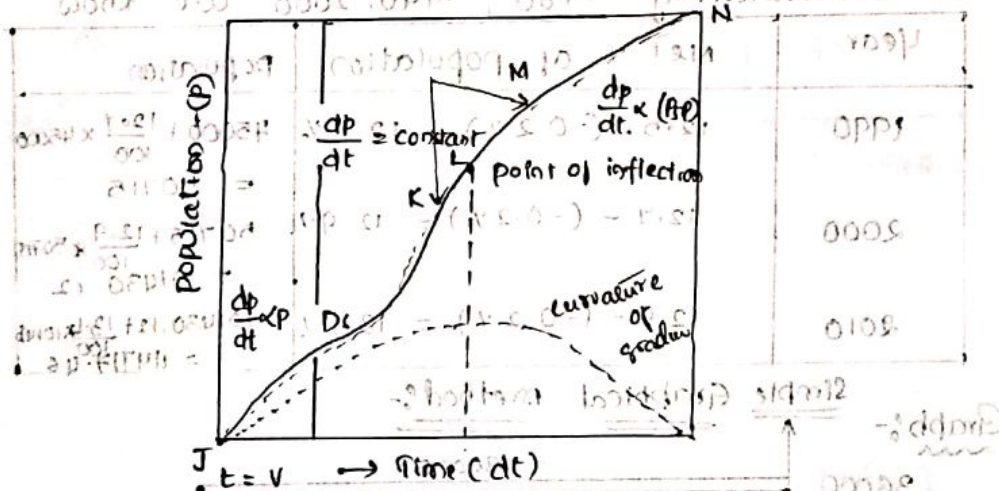


Comparative graphical method :-



The simple Graphical method is used for population forecasting to plot the Suitable Scale graph with respect to index.

LOGISTIC Method :-



Fluctuations in Demand :-

- ① Seasonal fluctuations
- ② Daily/hourly fluctuations

Seasonal Fluctuation :- There water demand is varies from Season to Season. In summer season the water demand is maximum, because people will like to be use for gardening, washing, drinking, bathing etc.
 * In winter season the water demand is minimum, the people like to be use in bathing there will be no laundry.

Daily / fluctuation (or) hourly fluctuation :-

Max. Daily or hourly fluctuations = $1.5 \times$ Avg hourly consent

* In Sunday's and other holidays the peak hours about ^{at the} ^{max. day} ^{part} due to late awakening where as it may be 6am-10am

Factors effecting of water demand :-

- ① climatic conditions
- ② size of community
- ③ Living standards of people
- ④ Industrial & Commercial activities
- ⑤ Pressure in the distribution system
- ⑥ System of Sanitation
- ⑦ Cost of water.

LOGISTIC CURVE :-

The point of fluctuation is "L"

$$\log_e \left(\frac{P_s - P}{P} \right) - \log_e \left[\frac{(P_s - P_0)}{P_0} \right] = -K \cdot P_s \cdot t$$

Where

P_s = Saturation population,

P_0 = The population of the town at point "j"

K = Constant

t = population at the time from the origin

(*)

Year	1960	1970	1980
Population	35000 _{P_0}	78000 _{P_1}	115000 _{P_2}

Sol:-

Given data is

$$t_0 = 0, t_1 = 10 \text{ and } t_2 = 20$$

$$P_s = \frac{2P_0 \times P_1 \times P_2 - P_1^2 (P_0 + P_2)}{P_0 \times P_2 - P_1^2}$$

$$P_s = \frac{2 \times 35000 \times 78000 - (78000)^2 (35000 + 115000)}{(35000 \times 115000) - (78000)^2}$$

$$\therefore P_s = 138271.0053$$

$$m = \frac{138271.005 - 35000}{35000} = 2.95$$

$$n = \frac{2.3}{t_1} \log_{10} \left[\frac{P_0 (P_s - P_1)}{P (P_s - P_0)} \right]$$

$$n = \left[\frac{35000 (138271.0053 - 78000)}{78000 (138271.0053 - 35000)} \right] \frac{2.3}{t_1} \log_{10}$$

$$n = 0.23 \log_{10} (0.2619)$$

$$n = 0.42$$

$$P = \frac{P_c}{1 + m \log_e^{-1} (n \cdot t)}$$