Urban Utilities Planning: Water Supply, Sanitation and Drainage

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Module – 02
Urban Water Supply
Lecture - 07
Types of Urban Water Demand

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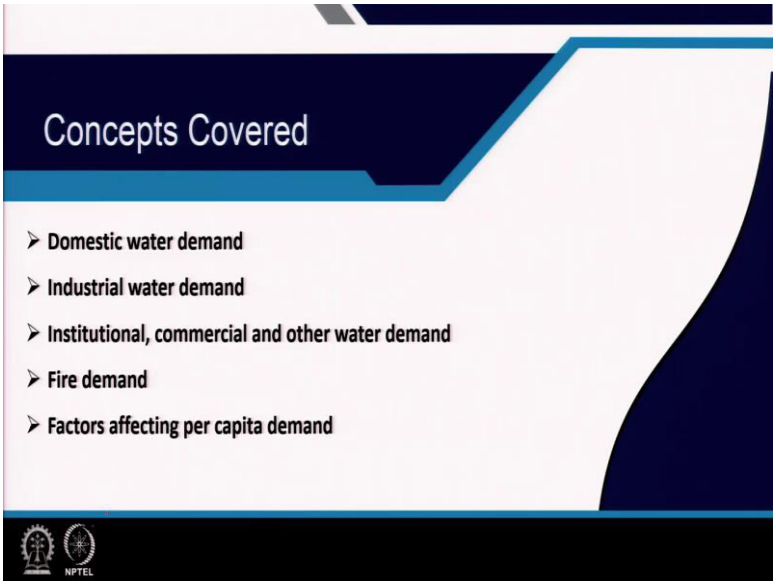

In lecture 7, Types of water demand will be covered such as:

- Domestic water demand
- Industrial water demand
- Institutional, commercial and other water demand
- Fire demand
- Factors affecting per capita demand

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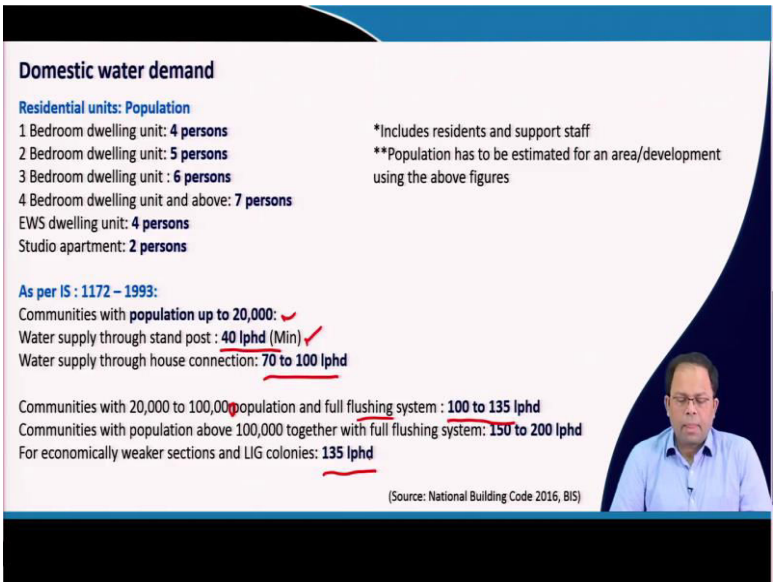

Demand forecasting is done for both long term and short term periods. Different countries or governments define specific standards for water demand.

In India, Wwater demand estimation is based on the guidelines (IS - 1172-1993) set by the Bureau of Indian Standards. These standards are to be considered while designing Water Supply and Sanitation related infrastructure. It is also important these standards are updated at appropriate intervals. Government uses forecasting to determine the specific standard to be set for an urban area for a certain time period and has toThe government uses forecasting to determine the specific standard to set for an urban area for a certain period and must be followed while designing the infrastructure.

It is required to understand water demand for the different projects such as a real estate project, a township project, an entire urban area or extension of an urban area like a satellite township, CBD development project, an industrial park development project, etc. Most of these are covered in standards, and in casef it’s not covered in the standards, forecasting methods can be adopted.

Domestic water demand

Determining the population is the first requirement to calculate water demand. This is mainly done on the basis of the residential unit such as 1 BHK or a 1 bedroom dwelling unit, 2 bedroom dwelling units etc.

Population can be determined considering the type of dwelling unit or vice versa, i.e.

if the overall population is known, number of each kind of dwelling unit can be understood based on surveys. 4 persons can be assumed to occupy 1 bedroom dwelling unit; 5 persons for 2 bedroom dwelling unit; 6 persons for 3 bedroom dwelling unit; 7 persons for 4 bedroom dwelling unit and above; 4 persons for EWS dwelling unit; 2 persons for Studio apartment and so on. These figures includes the residents as well as the support staff who work in these units.

As per the Indian Standards (IS 1172-1993), for a population up to 20,000, 40 lphd water can be supplied if water is supplied through stand post and 70 to 100 litres per capita per head per day has to be supplied if the water supply is through house connections. This may not be sufficient in case of such a community in an urban setting as water may be needed for non-domestic uses also such as for watering a roof garden, such as for watering a roof garden, etc. Hence, it is required to supply more in such cases based on extra demand other than for the domestic use. SimilarlyThus, for

communities with a population of 20,000 to 1 lakh, 100 to 135 litres per head per day has to be supplied in case of a full flushing system asi.e., in case of a water carriage system, whereas, 150-200 lphd has to be supplied for communities with a population above 1 lakh. For economically weaker sections and LIG colonies, 135 litres per head per day is considered adequate. Even though such standards set can be adhered to, it is important to understand that

the demand may depend on various other factors such as economic status, f. For example, a high -end residential apartments would need more water to be supplied.

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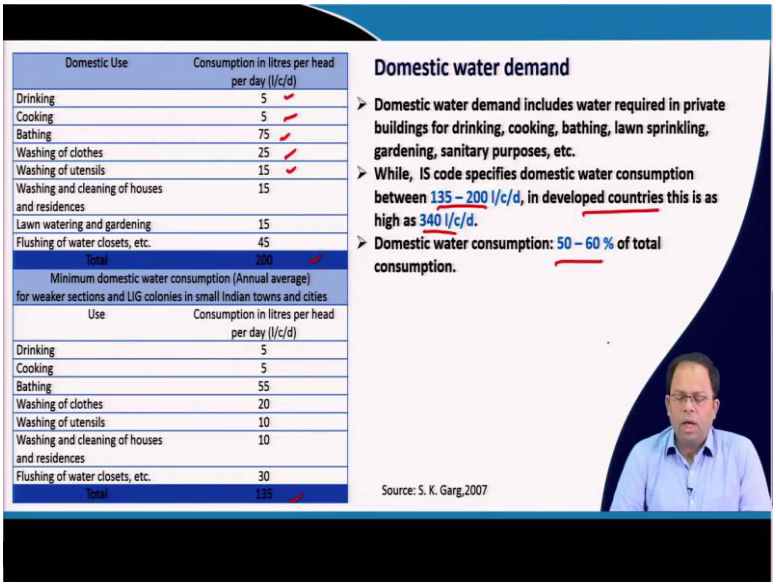

Domestic Use	Consumption in litres per head per day (l/c/d)
Drinking	5
Cooking	5
Bathing	75
Washing of clothes	25
Washing of utensils	15
Washing and cleaning of houses and residences	15
Lawn watering and gardening	15
Flushing of water closets, etc.	45
Total	200

Minimum domestic water consumption (Annual average) for weaker sections and LIG colonies in small Indian towns and cities	
Use	Consumption in litres per head per day (l/c/d)
Drinking	5
Cooking	5
Bathing	55
Washing of clothes	20
Washing of utensils	10
Washing and cleaning of houses and residences	10
Flushing of water closets, etc.	30
Total	135

Domestic water use can be divided into different components such as 5 lpcd for drinking, 5 lpcd for cooking, 75 lpcd for bathing, 25 for washing clothes, 15 lpcd for washing utensils, 45 lpcd for flushing of water closets and so on accounting to a total of around 200 lpcd. This is the quantity of water that is required for standard uses. F

or poor communities, it can be observed that the water demand is around 135 lpcd. These estimates covers only the domestic water requirement and does not cover needs such as for the a garden areawater requirement in , only the domestic water requirement and do not cover needs such as the watering of a garden area, water requirement in public amenities, parks, etc. It is important to note that even though the standard domestic water demand is supplied by municipal sourcesmunicipal sources supply the standard domestic water demand, people also depend on other sources such as wells or tube wells to meet their extraadditional needs or in casef the municipal water supply is not adequate.

D

omestic water demand includes water required in private buildings for drinking, cooking, bathing, lawn sprinkling, gardening, sanitary purposes, etc. While, IS code specifies domestic water consumption between 135 – 200 l/c/d, in developed countries, this is as high as 340 l/c/d. This trend is observed in India as well. Domestic water consumption is around 50 to 60 percent of the total consumption.

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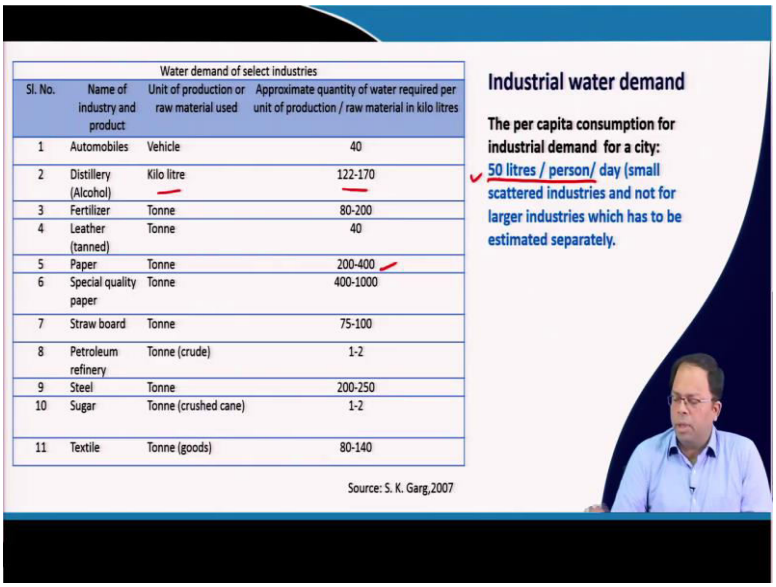

Industrial water demand

The per capita consumption for industrial demand is around 50 litres per person per day if there are few samall industries industries scattered all around in the city is around 50 litres per person per day in addition to the domestic water demand. This is not for the case of a primarily industrial city or cities with for large industries such as a steel plant, a petroleum refinery or an automobile manufacturing factory, an automobile manufacturing factory, etc. This

water requirement may be met by the water supply from the municipal corporation or the arrangement done by the industries itself, like extracting water fromusing a deep tube well. In case of large industries, the water requirement has to be separately estimated and tthe case of large industries, the water requirement has to be separately estimated. The water supply may

be met by pumping water directly from the river; Careful estimation has to be done because the water may be from the surrounding aquifers or frommust be done because the water may be from the surrounding aquifers or the surrounding surface water sources.

The table given in the above figure giveshows the water demand for unit production or raw material used for select industries.

For producing 1 vehicle, 40 kilolitres of water is required;

For producing 1 kilolitre of alcohol in a distillery, around 122 to 170 kilolitres of water is required; For producing 1 tonne of fertilizer, around 80 to 200 kilolitres is required; For 1 tonne leather tannery, 40 kilolitres water is required; For 1 ton of paper to be made, about 200 to 400 kilolitres of water is requirneeded and so on.

Thus, the industrial water demand for an urban area can be estimated considering these standards in excess to the standard water demand of 50 lpcd.

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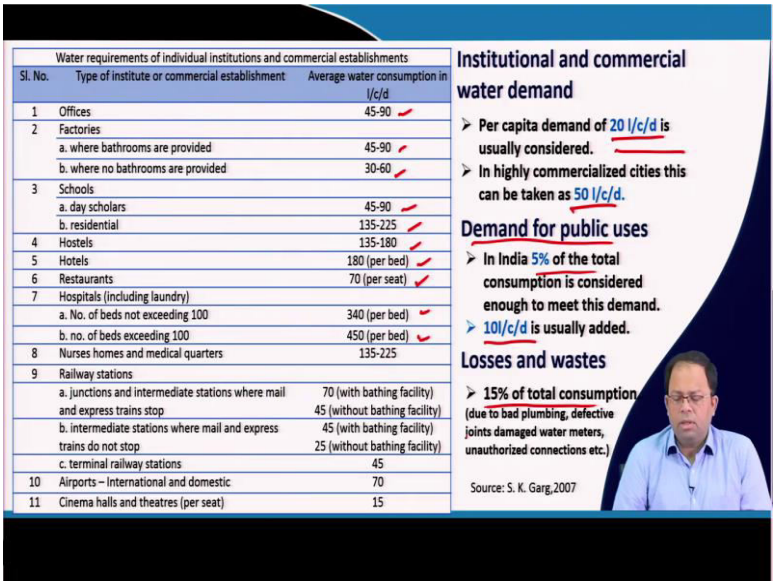

Institutional and commercial water demand

In any urban area, 20 lpcd can be considered as the water demand from various institutes, offices, retail stores etc. In case it is a

highly commercialized city with a major portion of the landue dedicated to either institutes and commerce, then 50 lpcd can be considered. Thus, such water demand will account for 20 to 50 lpcd. Since it's a large range, it may result in enormous variation in the estimate and the actual demand. So, to do a correct and detailed estimate, the figures given in the above figure can be considered based on the number of different kinds of building use such as offices (45 to 90 lpcd), factories where bathrooms are provided (45-90 lpcd), factories without bathroom provision (30-60 lpcd), schools with day scholars (45- 90 lpcd), residential schools (135-225 lpcd), hostels (135 to 180 lpcd), hotels (180 per bed), restaurants (70 per seat), hospitals with lesser than 100 beds (340 per bed), hospitals with more than 100 beds (450 per bed), airports (70 lpcd), cinema halls (15 lpcd) etc. These constitutes the additional water demand to be considered apart from the residential water demand. For instance, a person may spend some of his time in the office and the rest of his time in his residence, so, both the demands hasve to be calculated.

Demand for public uses

There are a lot of areas that are dedicated for public use, like landscape areas, plazas, public parks, plantations etc.

Around 5 percent of the total consumption is considered enough to meet this demand in India or 10 lpcd is added to the total consumption.

Losses and wastes

Some amount of water is lost in the system because of leaks due to bad plumbing or defective joints. Similarly, damaged water meters, unauthorized connections etc. results in water waste. These are considered around 15 percent of total consumption. This value may be appropriate for new infrastructure but in case of, but in old networks, the value may range from 30 to even 50 percent. This is called as the unaccounted water, indicating that it is difficult to measure the amount of water that is lost.

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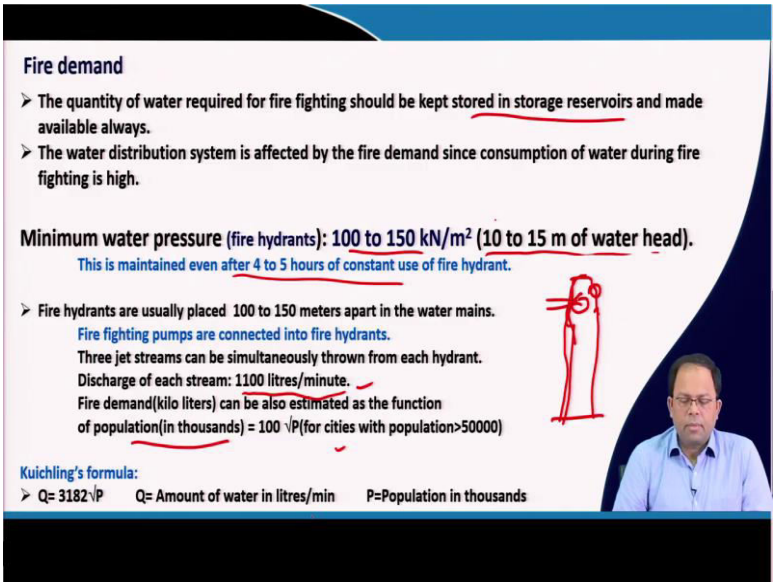

Fire Demand

Water requirement to fight fire causes a sudden and huge demand apart from the normal use.

The quantity of water required for fire fighting has to be kept stored in a storage reservoir and made available always. Thus it is not that, the water meant for domestic use is not redirected for firefighting when the fire breaks out. T

he water distribution system gets is affected by fire demand since water consumption during fire fighting is high because water is drawn at a high rate and supplied at a high pressure. This has to be considered while the distribution system is designed.

Fire hydrants are usually placed around 100 to 150 meters apart along with the water mains because there is adequate water available. Even though the water is drawn from this

particular line, there would not be too much fluctuation or too much reduction in pressure. Fire hydrants are usually located on the sides of the f=road and hasve three outlets to which the fire fighting pumps can be connected.

And each of these streams discharges around 1100 litres of water per minute. AmMinimum water pressure of 100 to 150 kN/m^2 (10 to 15 m of water head) has to be maintained in the fire hydrants.

That means one can direct the water upwards to a height of around 10 meters to 15 meters with this pressure. The fire fighting has to be maintained for around 4 to 5 hours.

The amount of water for firefighting is a function of the number of fire hydrants connected, the number of hours it continues and the discharge from each of the stream. For example, The amount of water for 4 hours of firefighting can be calculated based on the number of hydrants (consider 3) connected as:

1100 litres per minute x (4 x 60 minutes) x 3

In case of multiple fires, multiple fire hydrants will be used.

So the number of hydrants involved in the firefighting is considered for estimating the amount of water required. This method of estimation is suitable for cities with a population of less than 50000.

If the population is more than 50000, fire demand in kilolitres can be estimated as **100 √P where** P is the population in thousands. Also, there

are several empirical formulas (equations deduced by researchers based on observed values for prediction), such as the Kuichling's formula for estimating the fire demand.

Kuichling's formula: Amount of water in litres/min, Q is given as:

Q= 3182√P, where P is the population in thousands.

Actual demand can be obtained by multiplying this value with the duration of firefighting in minutes. Thus, the total amount of water that has to be stored can also be known.

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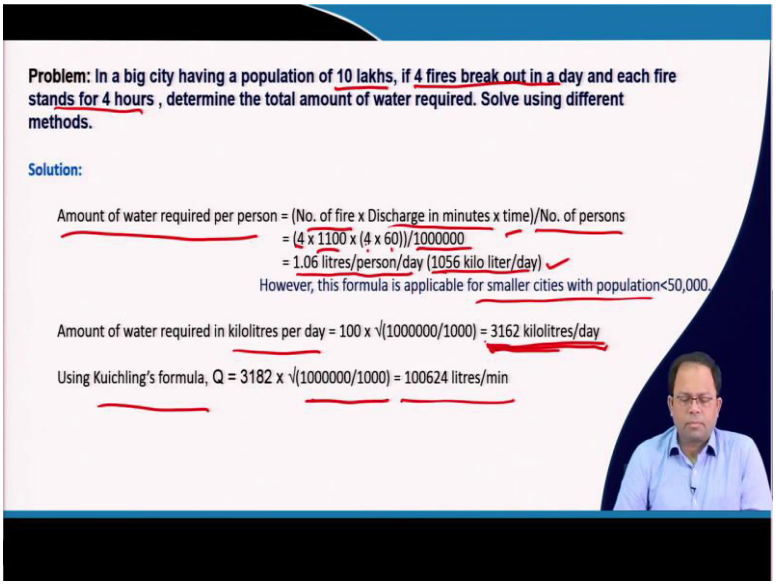

Problem:

In a big city having a population of 10 lakhs, if four fires break out in a day and each fire stands for 4 hours, determine the total amount of water that would be required. Solve using different methods.

Method 1

Amount of water required per person = (No. of fire x Discharge in minutes x time)/No. of persons

= (4 x 1100 x (4 x 60))/1000000

= 1.06 litres/person/day (1056 kilo liters/day). This method is applicable only for smaller cities with a population of less than 50000

Method II

Amount of water required in kilolitres per day = 100 x √(1000000/1000)

= 3162 kilolitres/day. This gives a larger value than the first method as it is not considering specific information like the number of fires, duration of fire etc. and as it is for a large city.

Method III

Using Kuichling's formula, Q = 3182 x √(1000000/1000) = 100624 litres/min

So, these methods explain on how to estimate the fire demand for a particular area. Another 1 to 3 lpcd has to be added to the overall demand for fire.

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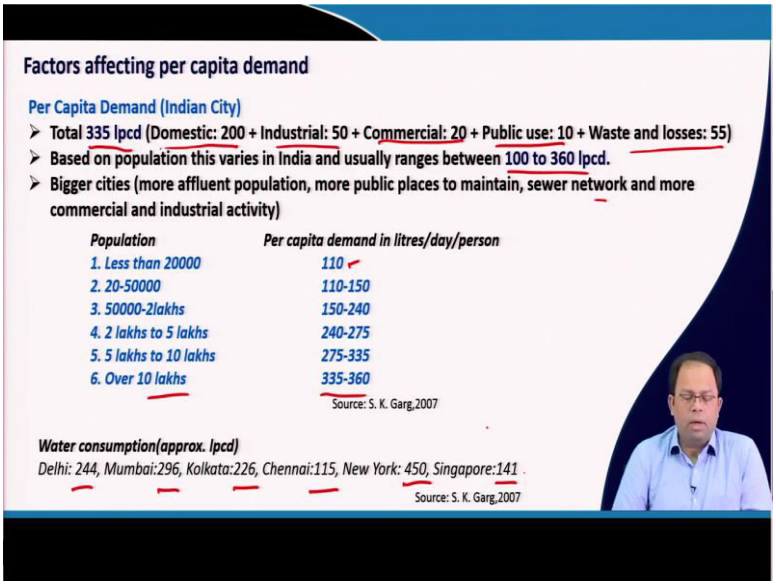

Factors affecting per capita demand

Different cities are of different characteristics, and thus, these require a different amount of water. Smaller cities usually shows lesser water demand than large cities owing to the presence of lesser water demand than large cities due to various landuses in a large city. In a small city, the demand is around 110 lpcd while it is 335-360 lpcd for a big city. Such variation is sometimes governed by various other factors as well such as the affluence of the

population, having more public spaces to maintain or having more commercial and industrial activities, presence of a sewer network etc. So,

there is variation in the amount of water that is required in different types of urban areas based on its population and various other factors as mentioned.

335 to 360 lpcd includes 200 lpcd for domestic use, 50 lpcd for industrial use, 20 lpcd for commercial use, 10 lpcd for public use and around 55 lpcd corresponding to waste and losses.

So, a range from 100 to or 110 to 360 lpcd water demand is noted in Indian cities. For Delhi, it is 244 lpcd, For Mumbai around 296 lpcd, For Kolkata around 226, For Chennai, it is as low as 115 lpcd which maybe because of the lcak of availability of water, etc. For

New York, it is as high as 450 lpcd some places whereas in Singapore, it is as low as 141 lpcd may be because of a lot of water reuse.

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The other factors which affects per capita demand are:

- Climatic conditions - consumption more in hot and dry places and due to contraction in pipes and alsomore in cold places due to the contraction in pipes and because people keep taps open to avoid freezing of waterwater freezing.

- Living standards (economic status) of people
- Industrial and commercial activities
- Quality of water supply
- Pressure in the distribution system (more leakage and more consumption by people in upper storeys) – High High-pressure water leaks out at the joints

- System of sanitation (more where there is a sewerage system)
- System of supply - whether it is intermittent or continuous
- Cost of water and metering - Metering reduces the pressure, and also there are losses over there because of leakages and increases the water requirement. CThe cost of water may not be that much, but still, it plays a role.

These are the different factors to be considered.

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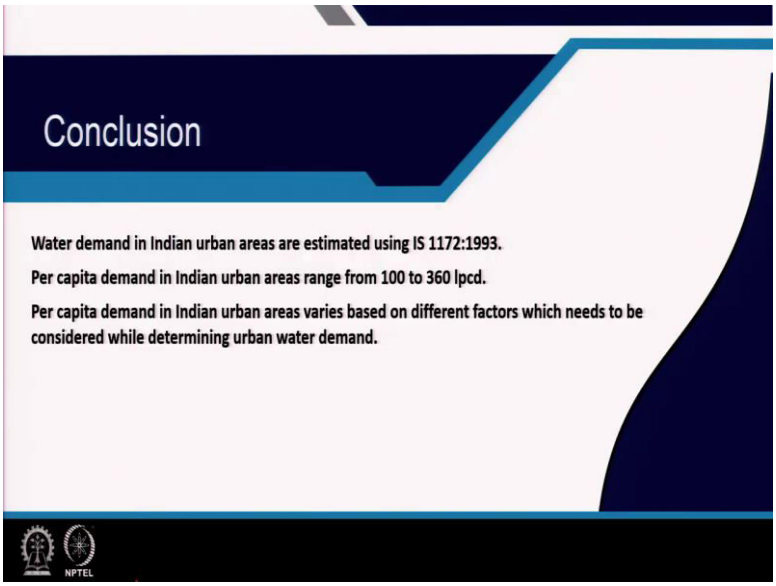

Conclusion

Water demand in Indian urban areas are estimated using IS 1172 1993. Per capita demand in Indian urban areas ranges for around 100 to 360 lpcd. And per capita demand in Indian urban areas varies based on different factors, which needs to be considered while determining urban water demand.

References

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