Water Supply Engineering
Prof. Manoj Kumar Tiwari
School of Water Resources, IIT Kharagpur

Module No # 10
Lecture No # 50
Continuous (24*7) Water Supply Systems

Hi friends we are now in the tenth week for this course water supply engineering and so far we have covered all the basic aspects of conventional water supply system starting from the uptake from the source then water treatment storage system and distribution systems. Now what we are going to discuss now is some of the advanced approaches that are adopted for water distribution network designs. So we will be discussing about some of these approaches and in these particular weeks and then in next week we are going to talk about some more like automation kind of system.

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So this particular class we will be talking about what are the various advances in the water distribution network design. We will talk about the 24, 7 supply systems particularly in this class. So what are they what are their design guidelines then framework for conversion of intermittent system into 24 into 7 systems so this is what will be discussing?

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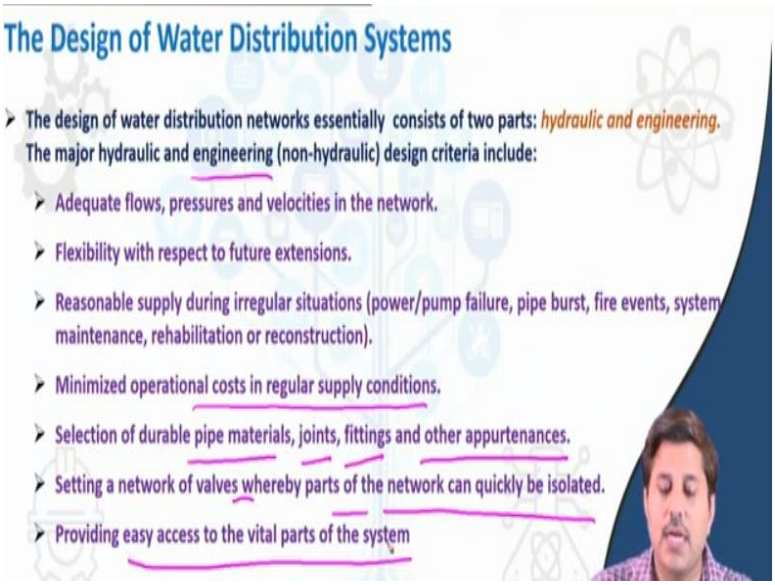

Now the design of water distribution system essentially as we discussed earlier also we consists of 2 parts we need to look at the hydrologic design parameter and engineering design parameter. Hydraulics is also although a kind of engineering but we can then say hydraulic and non-hydraulic design criteria's for distribution system design. So the obvious hydraulic design criteria are the adequate flows pressure and velocity in the network that has to be maintained these are the one of the most basic hydraulic design criteria.

We have to ensure that the adequate amount of flow is going into the pipes pressure is maintained velocities are in the range preferred. So that is going to be the basic hydraulic design criteria's. Apart from that various other hydraulic and non-hydraulic design criteria's are they are like we need to see the flexibility with respect to the future expansion. That is one of the very important point we are actually going to install a system and the age of network is predefined as say we take a design period of 30 year, 25 year, 40 year that way and what if there is a need of future expansion in between that period.

And particularly with the distribution network because right now we may have a city with a boundary of this and as we know that city expands on the periphery. So we need to basically expand our system so more so over about the distribution system there has to be provision of future expansion in the distribution systems. If we lay our mains so that there is no further scope of future expenses and then once the new population reasons come up how we are going to feed them. So that becomes a very important criteria then a reasonable supply during irregular situations.

So when we have say power or pump failure pipe burst fire event so all that emergencies we have to provision for the reasonable supply at least the minimum supply has to be met in there then minimum operational cost in the regular supply conditions. So the operational cost is also like should be minimized that should be one of the design criteria's when the operating utility is running normally what is going to the operational cost.

So if we can minimize that then like some of the structural criteria or non-hydraulic criteria would be the duration durability of the pipe material joint, fittings and other appurtenances and then setting of the network walls whereby we can basically part the network part of the network can be isolated. So the kind of segmentation within the network so we should have had a we should actually have a provision of this kind of things which is very helpful during the repair or during the various other conditions okay testing repair those kind of system

And we should be like the system should be able to provide easy access to the vital part of the system. So, these are the some of the criteria's which should be considered while designing a network.

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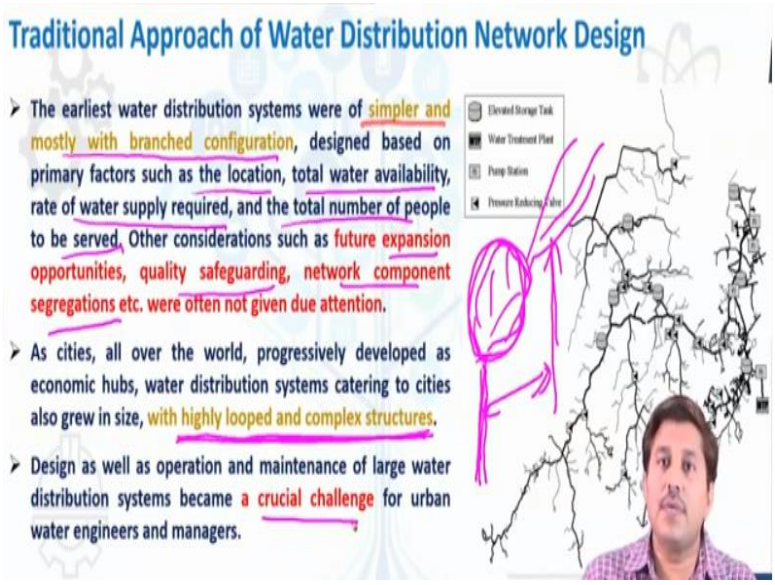

Now if you look at the very traditional approach of water distribution network design. So traditional approach like the earlier water distribution systems were very simple there were simple systems and generally like they have the mostly with the standard branch configurations they were designed that way and as and when there is a need of expansion that branch network would be kept keep on kind of extending that network.

And design were basically based on a various primary factors such as the location the total water availability the rate of water supply which is needed so that flow rate required and the total number of people to be served. So these are some of the primary criteria's which were kept for the design the various other considerations like the future expansion aspect. What we were just talking about like the quality safeguarding of the water treated water which is fed into the distribution system network components segregations.

These were not often given the due attention during the earlier era when the systems were designed for the cities or town or urban areas. Now what happened like these cities progressively grew. So all over the world in fact there was progressive development of these cities as a economic hub and then water distribution systems catering to these cities obviously will also grow. So the systems also grew in size and these branch network systems generally become highly looped and complex networks okay.

Because branch network as we know that there is a limitation particularly in the expansion if say this is my city size and this is a network line which is providing which is feeding these branch. Now what happens that the water this pipe is carrying water only for this much reason or this much area if expansion further takes then you cannot provide the water through the same pipe.

Because this is not within the capacity of that pipe so this branch network as these one of the like very basic limitation regarding the extension options. So then other pipeline connected, and then were given to this and these pipelines started getting interconnected and that way like we got to develop a highly looped and complex structures of pipe particularly in the large cities. Now design as well as operation and maintenance of these, large distribution system is very crucial challenge for urban water engineers and managers.

Because they are very they are complex in nature and various factors governing equations are involved in that and how do we deal or how do we manage all those things is a big challenge.

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Now with growing complexities in this water distribution system there are various advanced approaches also started being investigated people have started researching on what are the best option or best way to tool to design manage operate handle these kind of distribution network particularly the large urban distribution network and some of these includes that is if towards 24 7 water supply system majority of the earlier water supply systems were intermittent supply systems with fixed supply hours.

Let us say 2 hours, 4 hours or many times less than 2 hours and in water scale reason even just few times in a week okay. So they do not even used to get the daily water supply so that was the condition in the intermittent supply so there was a like shift there was a tendency to shift towards 24 7 water supply system for better management. Then zoning and sectorization of the bigger distribution network into smaller size using district metered areas DMA's.

So we will talk DMA's in the next class in much more detail then use of software tools for network design and analysis. So various software were developed okay a very basic software like loop and those things to the very advanced state software's EPANET water GEMS and some other like recent developments has also taken place in this domain then use of sensing tools for net monitoring and leak detection okay.

So for monitoring purposes various flow sensors pressure sensors and to some extent even quality sensors were developed then has installed in the distribution lines to monitor regular monitor of the network okay. They these flow sensors and pressure sensors helps in the leak detection as well and then automation and IoT. IoT is internet of things so automation and internet of things for monitoring and control of the water supply operation.

So SCADA and those kind of features were also developed and now it is being very frequently used in the water supply and our water treatment setups. So these were some of the kind of advances that has taken place okay.

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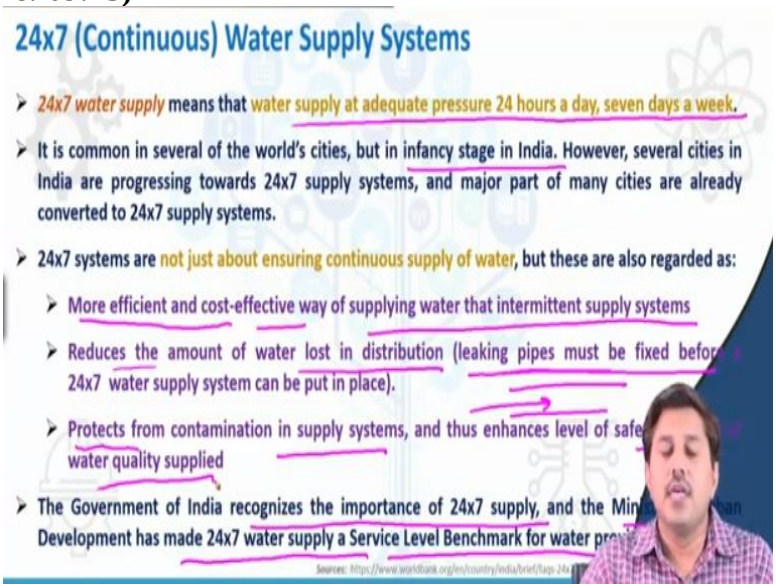

Now 24 7 supply system what we were just discussing is basically one of the approaches which people are considering to adopt now. And there is a tendency to shift from intermittent systems to 24 7 water supply system. What 24 7 supply water system essentially mean is that water is supplied at adequate pressure 24 hours a day 7 days that why we call it 24 into 7.

This is also known as the continuous water supply means anytime you open the tap you should get the direct supply in your tap okay. Usually what is the common practices particularly in the India is that we get water for some hours in the morning some hours in the evening but 24 7 supply systems ensures that there is always water in the tap and that to at adequate pressure okay.

Now it is common in these several parts of the world mostly like the developed cities all over you will see that the water supply is 24 7 okay. There is no household storage or those kind of setup is needed okay. But this kind of system is in infancy stage in India we are still like there is almost no city with full 24 7 supply systems. There are several cities and major part of several cities has already been converted to 24 7 system various cities in Gujarat, Ahmadabad, Pune, Nagpur, Delhi, Jamshedpur.

So there are quite a few cities which already have 24 7 supply system in parts okay it is not full coverage yet probably okay. So but many places it is still not there and several cities in

India is planning to progress towards 24 7 supply system. DPR's are being designed and framed so that the projects are being awarded and there is in fact the Government of India has also recognize the importance of this 24 7 supply system.

And the Ministry of urban development has made 24 7 water supply as a service level benchmark for water providers. So that is why there is so much focus on the 24 7 supply system now 24 7 supply systems are not just about ensuring continuity of supply of water okay. It is not just about continuous supply of water and that is why it is being it is getting more attention.

Because it is not just about like making water available 24 7 to the tap that anyway like most of the people are managing by storing water. So you have a overhead storage tank you store water there and then when there is no water in the direct supply tap you can open the overhead storage taps connected to the overhead storage and get water in your homes. So indirect 24 7 supply anyway like is being managed at several places.

But the idea of utilities are government or state is to provide 24 7 direct supply and that is because it is better in many other ways also this 24 7 systems are considered more efficient and cost effective way of supplying water than intermittent supply systems. Intermittent supply systems are considered more costlier in fact okay the installation might be like with the existing system.

If you already have a system 24 intermittent system that is fine but otherwise like going for a 24 7 system with all the way pressure management metering and all that might prove a costly system. But operational cost is reduced substantially that way. Now it reduces the amount of water lost in the distribution. So 24 7 is very good for leakage prevention in intermittent system.

There is a lot of chances of leakage because many times pipes are under pressure during supply hours and then when the supply hours are cut off these are not under pressure many times vacuum may be created. So there is an extra like extra force that goes onto the valves fittings like many times. There will be under pressure many times they might be actually under vacuum okay.

So because of this there is a lot of chances of pipe breaks failures of various water facets leakages those kind of things possibilities are there more in the intermittent system as

opposed to the 24 7 systems. Moreover once we go for a 24 7 system either new 24 7 system or we want to convert an existing system into 24 7 system. We must ensure that all the pipes that are leaking should be fixed before we convert it.

So once they are fixed and we convert it to 24 7 system so the loss water leakage or water loss is anyway reduced. Further one of the important point is protect from the contamination in the supply systems and thus enhances the level of safety in terms of water quality supplied.

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So what happens that in if you see the quality aspect particularly what happens in 24 7 system. The water is always under pressure and because water is always under pressure pipe is always pressurised. So any contaminant it will or any type of pollutant dust particle or say the ground water will not enter into the pipe even if there is a small crack or small fracture is there.

Because water is under pressure and it will basically push out those contaminates it will not allow that to come in whereas in intermittent system once water is supply it is under pressure but once the supply is cut off and people have basically pumped water. So we may have a situation when there is not much water pipeline is empty and many times if somebody is sucking water.

So there is a possibility of vacuum creation and if there is vacuum any contaminant outside or groundwater or those kind of things like groundwater from surrounding areas may be sucked in and it can bring in with the wastewater from home or the drains or other stuff as well within the water supply pipeline and this has been observed ok. We have seen at few places

people complained about getting the contaminated water in the water supply line and that is one of the prime reason is because of this kind of system.

Where if there is a pipe is not sound enough if there are cracks leakages in the pipe and what are ones basically water is being pulled out with the pumping is stopped. We may see a vacuum created in the pipe and that vacuum might suck these kind of contaminants in the pipe. If the pipes are continuously filled with and supplying there is it full of water and under pressure so there is a less chance of contaminant entering in the water. So that way the continuous supply systems helps better to basically control water quality or prevent from the decontamination of the treated water.

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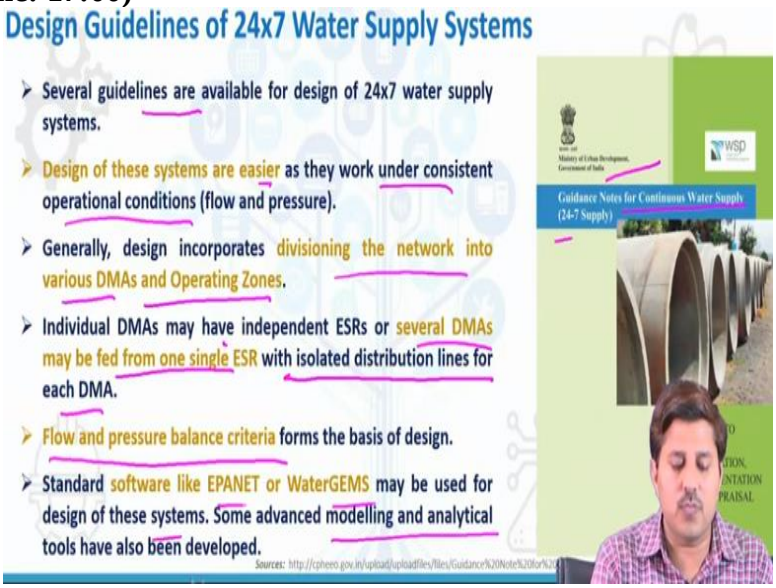

Now how we design these 24 7 systems well the concepts are similar. So again the flow and pressure balance criteria's that we discussed earlier are for used these are the one that forms the basis of the design. There are several guidelines available one of these is basically guideline note for the continuous water supply from the ministry of urban development Government of India okay.

Similarly are the other guidelines available from different other sources the design of these systems are generally easier as they work under consistent operational conditions there is no much variation in the pressure do not much variation in the flow. There always under similar more or less similar conditions whereas the intermittent system because conditions keep on changing. So that way it is easier like the design concepts become easier here.

However we need to ensure that there are other like sensing provisions are all adequate in the 24 7 supply system. Generally these design incorporates divisioning the networks into various DMA's and operating zones and then individual DMA's may be fed with the independent ESR's. So one DMA may have one ESR and it is being fed from that and many places there are several DMA's might be fed from one single ESR.

So the city might create say 100 DMA's and have 20 ESR are so almost like 5 DMA's will be fed from one single ESR many times higher the number okay. So that way like several DMA's might be fed from the single ESR's also. But in that case we ensure that there is like the isolated distribution lines are there for each DMA's and there are provision of valves and controls.

So that we can switch off and on the DMA's as we basically decide upon. There are many standard software's EPANET water GEMS it may be used for the designs of the systems there is again advanced modelling. And statistical tools are also being developed which helps in the designing of this is.

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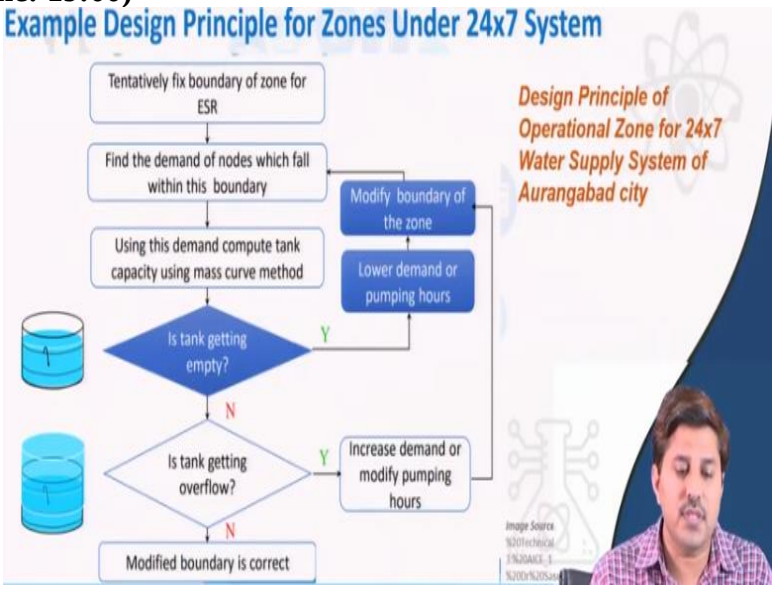

This an example design principle for zones under 24 7 system okay. So design principle this is for basically Aurangabad city and it says that tentatively like we fixed the boundary of the zone for the ESR. So we fixed boundary that this is going to be the say boundary of our zone we may have a ESR here. So from this ESR we fix the boundary or then we find the demand nodes so what are the various demand nodes in the city that fall within this boundary okay.

Then we using these demands we compute the tank capacity using the masker method as we discussed. So we can basically determine the tank capacity okay now if tank is getting okay is getting filled if it is okay. Then we like if it is getting filled and not provision then we decrease the nodal group demand modify the boundaries. And again basically get in the demand notes okay if it is fine if it is not getting full then we see again if the tank is okay and if it is fine then we can select it otherwise we can keep on doing this exercise again and again right so that is just one example okay.

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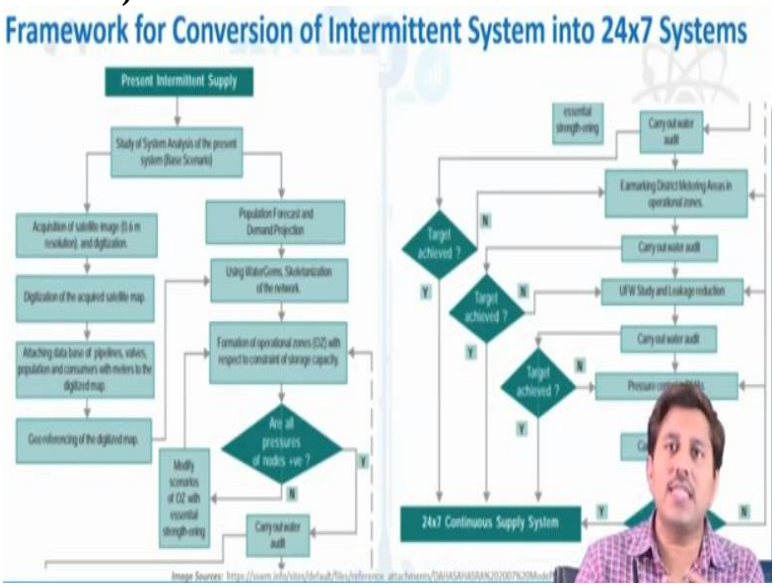

This is the framework for conversion of intermittent system into 24 7 systems okay again there are several frameworks available this is just an example framework okay. So let us say we have a present intermittent supply okay we study the system analysis in the present system which is basically the base scenario and then we basically acquire the satellite images digitalize the images.

So using like remote sensing those kind of in geo referencing we do the geo referencing and then we again get the population forecast and demand projection as usually we do and then we get this geo referencing of the digital map and then population forecast we overlap them and then using water GEMS or any other that kind of software. We can skeletonise the network so we can design and develop a skeleton of the network basic skeleton of the network okay.

Then we can do the formation of the various operational zones within the respect of the constraints. So operational zone and DMA's formation can be done here if all pressure nodes are positive fine we go to the next step carry out water audit if not then we modify this

scenario of the operational zones with the strength setting and do this exercise again. Now we carry out the water audit okay and then from water audit we earmark the district metering areas in the operational zones.

So within the operational zones we here mark what are going to our DMA's and we carry the water audit for these DMA's as well okay. Then we can use the unaccounted flow study and leakage reaction again we carry out water audit after that we do the pressure control in the DMA's carry out the water audit and in each of these stage like if we want to if you just want to start with the zone and we do not want to go to the DMA level.

We can just right away go here and if see our target is achieved we directly come to the 24 7 continuous supply system. We not need to basically go for the DMA demarcation if you are going for DMA and then again we carry out water audit if our target is achieved we come here otherwise we go to the next step. If again after study of the leakage reaction and those things we carry out water audit if our water audit is in the particular range we are satisfied we go for the like design of the system.

Otherwise we do this control pressure thing carry out water audit again if target is achieved we go here if not then we can go back to the any of these stages where we want. So we can either go back here or up to here up to this stage. So we have a flexibility of choosing from which state we want to revert and from that point onwards we can start carrying out this analysis again.

So this is just one kind of guide there are this is a broad approach and this is what typically is adopted for converting an intermittent system into 24 7 system. The conversion is done with an objective of that consumer gets a good quality of water supply in a better managed system for round the clock there are various misconception attached to the 24 7 system. That if we are going to get 24 7 system cost is going to be high that is actually a complete misconception for a well-managed utility.

Anyway people are getting the water which they need through storage system so if they get rid of those storage systems and rather pay the utility the tariffs proper tariffs. So the cost is not going to high for the 24 7 system the another like misconception is that people might consume more water if water is available around the clock again in many places as we were

just discussing water is anyway where water is available there is anyway enough water for using round the clock through the personal storage system.

So the amount of water people consuming is more or less going to remain same it might so like the past experience of 24 7 system at various places in the various countries or different cities have shown that there is a initial increase in the water consumption when we shift to the 24 7 system. But that eventually settles down that over a period of time and the users get back to the normal so in the 24 7 system as well.

So it is not that 24 7 system is going to have a increased demand or a higher cost these are kind of misconceptions which has been proven in not correct at many cases through several case studies. So with this we will conclude this particular lecture in the next class we will be talking about the DMA's demarcation. So how do we segregate the DMA's and what role they play what are the various features of the distinct metered areas which are used for the better control of the water distribution networks. So thank you for joining and see you in the next class.