Building Services I

Lecture 1

Building Services Engineering

Now before we get into water and water quality etc. first we need to understand what is building services. So building services they bring life to the structures without building services it is a shell. The building doesn't have anything until the services are put into the building. So the dynamics of the building comes into picture only when there is a services. So the building services only provide movement, communications facilities and comfort to a building. So building services primary aim is to provide safe and comfortable and environmentally friendly operations. So if you see in this slide you can see that I have given two pictures here so one the thing which is bright and good looking is the building which has the services incorporated and without the services you can see how the building will look like. So it is a very important subject when you take building services you can actually classify it into three major headings which is mechanical system, electrical system and the building operation system. So in mechanical systems you have the HVAC SYSTEMS, SITE DRAINAGE that is the site utilities, you have GAS SUPPLY, PLUMPING and FIRE PROTECTION. So this is the plumbing is the topic that we will be discussing today and when we come to electrical systems we have ELECTRICAL POWER, LIGHTING and AUXILLARY. In building operation system we have TRANSPORTATION, PROCESSING and AUTOMATION. So each of the things will be dealt in each subjects.

Now we are architect so why do we need to know about building services it's a common myth like it is like only the engineers have to do this and architects are not concern about this. But building services are real entities and they demand floor area they demand volume, they demand space so it has to be carefully planned otherwise what happens is when the services are not planned only without planning when you do it there will be a problem in the execution experienced architects they will know and they realize the importance of building services and another important thing is like it adds to the cost of construction of a building because without services as I told you previously the building cannot perform well and it is the responsible for safe and comfortable environment as architects we are giving them a best possible design. So when we give the best possible design the environment should be safe, it should be comfortable and it has to be friendly to theusers. So we have to consider building services, building services are only going to give these features not the shell. So this is unavoidable topicand it has to be architects must have a knowledge and they have to have an appreciation of the subject otherwise the design is not complete.

So basically when we take water we are going to deal with water here so human life and any life does not exists without water we can take away the basic needs the food, shelter and clothing even without that human beings can exists but without water you cannot survive even for a few days so this water is what to the user in a building by the means of plumbing it harnesses the precious resources that is the water and it's a role of plumbing to make it sure

that it is safe, healthy, hygiene and it's also for the well-being of the users. This plumbing only makes possible to bring the clean and convenient water to the users which is often we take it for granted now it also brings comfort and beauty to homes and lives. See kitchens and bathrooms they don't only serves as functional purposes ,they provide comforting needs ,they provide you soothing baths, and they give you the relaxation overall. So all these things are possible only because of water and that water comes into picture only because of plumbing. The next thing is where does these water comes from, the source of water the sources actually we can have it has split into major headings can be like your rain water, your underground water and your surface water. Now rain water is the main source because from the rain water only we have your underground water and surface water have been replenished. But the rain water as it is can be taken as a source of water. Rain and snow in areas where it is going to be snow and underground water nothing but your wells, your springs and your water hidden in the soil.

The water tables are however you tab the water from the underground those are underground water and surface water are your oceans, rivers, lakes, ponds and any other above the surface wherever you can collect the water those become the sources of surface water. Now we have other sources apart from this that is you get the sources from your glaciers water frozen and we have huge amount of water are cabbed into these glaciers. They cannot be a direct source but what happens is when the climate changes and when it is very hot melts and it becomes runs as upstream or rivers and that gives you the source of water cannot the direct source but they replenish the surface water again we have desalination this is the concept that is catching where you can it is a process by which you can convert your salt water or saline water into a fresh water because two-thirds of earth is covered with ocean and we are not even able to use one drop of it. So this is the new process and it is an artificial process it is not a natural source.

Then you have the quality of water, see we cannot use any and every water directly even though it is not for the portable or for drinking use even for irrigation or any other use you cannot use water as such. So you have to take water quality refers to the chemical physical, biological, and radiological characteristics of water. So the water quality should be like for each and every use it varies and it has to be checked and it has to be the quality has to be maintained. What is water quality by definition it is that measure of the condition of water relative to the requirements that's what it will do depending on the use we have to take up the quality. So when you can measure the condition of the water with respect to the use that is what we call has the quality of water and it is often when you whenever says quality you always have a standards to which you reference it with have a bench mark and you have to whatever the quality you are having will be put up with that standards. So the most common standards when you can see is like health of the ecosystem as holds the whole environment. The safety when it comes to the human what is the safety has and the drinking water these are the most common standards that we have for our quality of water.

Now there are many factors which you can measure, the major factor being the concentration of dissolved oxygen, and the water bacteria levels, the amount of salt or salinity and the amount of materials suspended in the water. So all these things has to be to a certain level too much of anything also is not useful it cannot be useful and it will affect the quality of water we need bacteria but too much of bacteria will lead to our diseases like that. So what is a quality of water when it comes to drinking purposes, It has to be free from diseases causing organisms and it is to be harmful chemical substances radioactive mater should not be present , it has to taste good and aesthetically appealing. Aesthetically appealing in the sense it has to be clear and it should be free from objectionable colour or odour. So even though you say the quality of the water is good if the colour is not good we know the water colour is like clear it has to be very clear if the colour changes you cannot be willing to drink it same is the odour. So the taste, odour and colour the physical characteristics we call it has so those things has to be things take for quality of water. It has to be free from disease causing organisms and other chemicals substances. So when all these things fit into a quality of water that can be used for drinking purpose.

So what are the impurities present in water so raw water are whatever water we get from any other source .you can say like that it will definitely have some impurities you cannot say everything is clean. So what are the things impurities we can have these can be organized or categorized as chemical content. Chemical contents is we generates hardness of water so that is like hardness the metals that present in it, the nutrients present in it, chloride, sodium, organic compounds all those things these come under a chemical content then you have the physical content that is your turbidity, colour and odour. Turbidity is like you can see small small particles that is flowing inside the water. So that is the turbidity and colour and odour. Biological content here comes your microorganisms and small organisms like fecal coliform, total coliform, viruses, bacteria etc. so these are the major impurities classification it is like these impurities will come directly from the source or when the water flowing depending on the soil or through which it flows and from external factors like pollution. So impurities are there and we have to be aware of the impurities in that and we have to make sure to remove those impurities. So now we founded what is the impurities are there and how are you going to find out or what are you going to do with it.

Water Quality Tests

So there are basically nine basic test for water quality and when you do those nine test you can actually give a value to it and the score is taken up. So what are the test is first is the temperature so depending on the temperature is the biological reactions will whatever happens in the aquatic environment is controlled so the temperature should be in control then you have your PH so this is a scale or it is a measurement it measures the acidity in the water so PH level should be within the it should not be within the levels they within the standards then you have dissolved oxygen. Dissolved oxygen test will give you the measure of how much oxygen in that particular water and dissolved oxygen is very important for aquatic plants and

animals then turbidity so this is the measure of how clear the water is. So turbidity is like your undissolved solids will be there so how clear the water is will be reviled by your turbidity test then nitrate. Nitrate is an element which is present in waterit is very important for the aquatic plants and animals so too much of it will lead to like more growth of these plant growth in water then you have phosphates .phosphates is like this is another nutrient in water for similar to your aquatic plants and animals requirements again this also will influence the amount of plant growth so if there is too much you see the algae formation green color soft structures will be forming in the even in pure water it's because of the presence of these nutrients then total solids. Total solids is this is what we called as total dissolved solids actually which is TDS we mention for any water testing so it measures the dissolved substance like your clay ,silt, soil, soil run off now all those very minute particles will be measured by this test then you have the fecal coliform this is a bacteria that it actually propagates in the digestive tracks of humans and animals it causes your pathogenic contamination like water borne diseases are caused by these bacteria so that has to be in control and then you have your biological oxygen demand (BOD). So this actually measures the content of oxygen in the water and it has to be like measure of oxygen when it is removed from an aquatic environment so what are the anaerobic organisms in it and how much you have your BOD.

So these are the basic nine test there are many more test but these are the basic nine test that is required to check the water quality.

So now when you have checked all these water quality there is something called water quality index in these index 100 point scale is there so if you see this first table they given a range like is this going to be from 90-100 it is an excellent quality. Quality level are the quality standards which I told you that quality is will be always referred with standard so this is the standard there if so when the scale is like 90-100 it is very excellent and 70-90 is good and 50-70 it is medium and 25-50 is bad and 0-25 it is very bad now how do you calculate this value it's from this factors so the all the nine factors are like dissolved oxygen, fecal coliform, PH everything based on its importance they given a weightage score so from this weightage score we do a related weighted as score and that score will give you like that will be put in this 100 point scale based on this scale we determine how what is the quality how good the water quality is so quality of water is very important.

Water Treatments

The water quality is not up to the standard what you do what we generally do is we treat the water even the water that is coming from the municipal line or corporation line to your house it is been treated not just like that it is given to you because they do the water quality test and then from there it goes to the treatment plan where the treatment is done and then it comes to the household use.

So basically when you take treatment what is treatment what happens in the water treatment is it is a process actually it is a step by step process it make sure that the water is acceptable for

a specific end use this process depending on the again the usage it will defer so this is particularly it is the process that makes for a specific end use you have to you make the process so what happens here in a water treatment it removes the contaminants or reduce their concentration either it removes the contaminants and if the contaminants cannot be removed it reduces their concentration so that it is fit for the intended use so sketch is given like a when it is a raw water only with treatment can actually have it as your drinking water. Raw water directly cannot be used so when it comes to drinking water you have to remove the contaminants and you have to produce the water pure enough for human consumption because for drinking water the actual quality is completely different it is very highly required so it has to be pure enough for human consumption and there has to be no short term or long term health effect on the health of the human beings so the water which is given for drinking purpose has to be treated with very sensitive tests so now the substances what are the things can be removed during the process for drinking water specially are suspended solids, bacteria, algae, viruses, fungi, all your pathogens and minerals particularly your iron and manganese. So these are the things that can be removed from your drinking water when you do a water treatment.

So when you take up this process is actually you can take it like your physical process, chemical process and biological process like based on your impurities. So in physical process you have settling and filtration. Settling is your sedimentation and filtration in chemical process you have your disinfection and coagulation remove the pathogens and your biological process you have a source and filtration. So majorly you have these processes but when you are take up a typical or a conventional water treatment method basically we have two methods now one is your traditional 7step process and your desalination where you have your conventional process it's like when we have water is like of a standard quality but when the water is when we say a standard it depend that's is salinity where you don't have a normal salinity you can use your traditional thing but when the water is extremely hard or salty you have to go for a desalination process. Now what is a conventional treatment process it has actually basically 7 steps coagulation, flocculation, sedimentation, filtration, disinfection, fluoridation and storage and distribution so these are the 7 basic steps that you water goes through before it is being distributed to the households.

Now we will be seeing each of the steps in detail now. So this is just to show you a sketch where first to process what happens second process third, fourth, fifth its numbered according to the process and it goes through all these process from 1 like it will be like stored in tanks or basins goes from 1 to the other so to the start first is your coagulation and flocculation so here when the water is moving through the pipes the impurities will clump together ok. So what here what they do is it is taken to a flocculation tank where it is called a flocculation tank second one so here what they do is they add a chemical it is called a coagulant what happens this chemical it will actually bring all the impurities together and make it as clumps ok. That is what they called as our 'flocs'. So it will come together and then that clumps can be removed from that so this your first step.

So second step is your sedimentation so all impurities cannot be removed so this sedimentation is like from the tank around half an hour or so the water is send to this sedimentation tank or sedimentation basin so here what they do is they led the water to settle nothing is done here just the water is kept in the tank and it is left to settle. So here what happens is all the flocs will settle into the bottom and also the very minute like your clay, silt all those particles will be settling down they and they form a sludge and we remove the sludge and that will be treated before disposing so once it settles it is going to settle at the bottom of the basin and the water will be at the top and the water cannot be removed this is the sedimentation process.

So what happens when you go the sedimentation in detail you see basically sedimentation will be a large basin to store water there for a long time so it is a very large tank and the water velocity will be very very slow because we don't want to disturb the ash that is settle down in the bottom so the best location for a sedimentation tank or basin will be like next to your flocculation because water is going to flow from there and the another reason why you need this is because the flocs should not settle there itself in your flocculation so it has to come here and settle down in your sedimentation so this tank can be rectangular or square large area. So the water should be flowing from one end to the other so that is the means why you need a rectangular tank. So it should flow from one end to the other if this is going to be a circular one it should be like from the center towards the outward the flow of water should be designed like that.

Then you have filtration now when you take a filtration here we have basically it filters you have filters here so that will remove the impurities but by now you have all the major impurities removed but what is a filtration is to they are bank of filtrations bank in the sense there are many filters are placed closed together and the filter vessels they like contain either sand or coal and sand like that it will be kept alternatively sand will be placed as the filter so what happens is the water will flow through this and then the impurities will be trapped here so that the water is clear but these filters has to be regularly cleared because the impurities will be stack in the filters has to be regularly cleaned this process is called back washing so the trapped water is there removed so the backwash water is again reprocess and we use it so that you don't waste that water when you come to filtration a specific filter we use one of the thing is your rapid sand filter. So this is where you have your different layers where the water will move vertically through this layers and so you can catch more of your impurities. So here when you see the top layer it removes the organic compounds so these are the things that will affect your odour and taste then you have you're the space between the sand particles will be like more ok. Then the suspended particles will be less that means it will flow through the thing so this filtration is not enough so they go through layers. So when they go through layers it will get trapped in one of the other layer so an effective filtration in this happens only when the depth of the filter the key operation is like the filter so the top layer of the sand is to block all the particles the filter will clog easily so what they do this is the filter is clean by passing quickly through the upward filter.

So if you make it to wait for a long time in the or if it is very slow then it will be like the top layer itself will be clogged so top layer has to pass fast and then the depth of the filter it has to take place so this is your rapid sand filter and there is one more thing before you do this thing compressed air can be blown through this from the bottom of the filter so that it will like remove your impurities so it is similar to your back washing where you remove the impurities like similar to that this is called air scouring. Scouring is like removing the thing then you have your whatever the contaminated wateris disposed of, as I told you earlier along with the sludge even this can be recycled by taking this to the raw water where it is mixed with the raw water and then it comes from the first step then when you take another thing is your pressure filter where you have pressure will be working on it so rapid gravity filters will be there and the pressure with pressure when it is water is forced it is it cleans more so when you take up these pressure filters are more advantages than your rapid sand filters because it is like very smaller particles can be captured here and the pore sizes can be specifically kept the liquids are flow through them rapidly so this is more effective

Then disinfection so how you are going to remove the disinfection. So disinfection is a filtering out the harmful micro-organisms so it is like your to kill any pathogens that is there in the water or you have to make them inactive so the generally we use three common types of chlorine disinfection, ozone disinfection, and your ultraviolet disinfection. So in chlorine disinfection chlorine and its compounds like chloramine and chlorine dioxide will be added and this is a very strong oxidant which will kill all the micro-organisms. There is one drawback to this because it reacts with natural organisms, organic compounds so there is a chemical, harmful by-product for that they add sodium hypochlorite to counter that.

In ozone disinfection it is like unstable molecule which releases one atom providing a powerful oxidizing agent this is very strong and it is very safe it is widely used in Europe basically and the advantages of its like very fewer dangerous by-product are there and the absence of taste and odour problems also is not there. Main advantage is that no residual disinfectant is there in the water when you do an ozone disinfection. Disinfection is also how it is done like passing oxygen through ultraviolet light ok. So that is how the ozone is done.

Now there is an ultraviolet disinfection itself this is directly ultraviolet light is passed through the water this is even more effective as turbidity increases. So then you have fluoridation, fluoride is added into the water as per the standard or the drinking water guidelines so that the appearance, taste and colour is not affected and it is goes to the storage and it is distributed.