Building Services I

Lecture 4

Rainwater Harvesting

What is rain water harvesting really it is like harvesting of rainwater is like you just it is a technic basically where you collect water from surfaces where the rain falls and it is stored for later use so why is this important the rainwater harvesting is needed to improve the water supply, the food production and ultimately you get the food security generally it contributes to the income generation also. Water insecure households or individuals in rural areas they will be benefitting the most. Providing a household with high quality drinking water and year round storage. So many benefits are obtained when you harvest rainwater so it is really a very important phenomenon to be followed so there are many methods to do rainwater harvesting broadly we look into two areas first is the surface runoff harvesting and then the roof top rainwater.

In urban areas we have huge surface areas we don't have permeable land concrete surfaces so the rain that falls in that it will runs away as a surface runoff so how you can this water cab be caught and used in aquifers and by adopting appropriate methods and then you can save those water in roof top rainwater harvesting that's what everybody does where you the roof will become the catchment area and the water is collected and then it is taken down to the ground aquifers.

Now this is basically how a rainwater harvesting works so in this picture if you can see you have the roof this is the catchment area where you collect the water and you have a gutter for the water flows from the roof to the gutter and from there it is collected in a pipe this is the downtake pipe here the collected water flows down and here you have a storage where it can be collected directly to the storage and then you have a delivery pipe lines and then it goes to the first flush and then a filter we will be looking about all this components in detail so this is basically how a rainwater harvesting is done for a rooftop so we'll see each one in detail.

So catchment, the surface where it receives the rainfall that area we call it as a catchment. So it can be a terrace, it can be a courtyard, it can be a paved surface or any open ground so the terrace will be generally made of flat RCC or stone roof or sloping roof so this is the area which actually contributes to for harvesting the rainwater then transportation so from the catchment area the water will flow down from the roof top from the rainwater rooftop should be carried to the storage system so it is carried through down take water pipes or drains to the storage system. These water pipes should be UV resistant with required capacity depending on the rain fall in a particular area the water from the sloping roofs could be caught through gutters and down take pipes it is a sloping pipe you need to have gutters to catch the water, at terrace is the mouth of each drain should have a wire mesh so that there is any other floating material foreign object can be captured there itself it will not come to the storage area

Then first flush so it is a device which is to flush of the water received in first shower because the water from the first shower it will be contaminated it will carry all the dirt from the terrace and even the dirt from the air so this needs to be done contaminating storage or rechargeable water it has to cleaning of silt and other materials deposited on the roofs during dry seasons so in dry seasons so many dirt will get collected on the roof so to filter that we use this first flush. The provisions of first rain separator should be made at outlet of each drainpipe. So first shower that coming into it should not be taken into the storage you have to make the separator so that it will be drain it out.

Then is the filter, filters are used for treatment of water to effectively remove turbidity, colour, and microorganisms. So after flushing the thing it should pass through filters so the filters will be like gravel, sand and netlon mesh filter is designed so that is placed on top of the storage tank and the water will pass through it so the water is filtered so the storage tank will be clean always.

And storage tanks, so these tanks can be above the ground or below the ground so the water collected it is diverted to a storage tank or it recharge to the underground aquifers so when you diverted to a storage tank it can be used for secondary purpose like washing, gardening like that you can use the water but when we recharge the ground water also percolation will happen in the ground and the ground water table will improve now when we come to the delivery systems the piping systems that is going to be convey the stored drain water till the end uses for the delivery system in rainwater harvesting so these are the components

So what are the various methods to recharge the ground water aquifers so you can recharge the bore wells, recharge the dug wells, recharge pits can be done, recharge shafts are done, recharge trenches are usually made this is for surface runoff and you have a percolation tank so we'll see each one in detail here so recharging of bore wells the water that we collect is diverted to the bore wells after passing through the settlement or filtration tank so if you see this is the filtration tank you have this is the bore well so water will come inside here you have the filter pass through all the other the sand, the charcoal, the gravel and the pebbles are there so the water will pass all through the filters and come here.

So here you have the collection tank and this will again is a settlement tank so whatever something comes through this filters it settles here and then it charged through the bore wells. Now recharging of dug wells so when you have dug wells how you have to do it so after passing through the filtration beds we saw here the same thing it is here so passing through the surface filters it comes down and the dug well will be recharged so this is how you recharge a dug well so all around the you have the filtering beds there you have the perforated pipes who collect the water and recharge the dug well the next is the recharge pits so this is what is generally done where you don't have a bore well or a dug well you go for a recharge pit so it is a small pit it will have it is rectangular or square also circular it will be 1 to 2 meters in width and 2 to 3 meters depth so it is constructed brick and stone with a weep hole so this is your RCC slag this is your floor level then you have your perforated brick work here so the water comes in through

this and here you have your filter bed where the things will filtered and the pit will be recharged then the similar thing you have recharge shafts here the size is different the board hole will be there with a 30 m diameter and it is 10 to 15 m deep so you have to go too much depth is needed then go for a shaft where the width will be less and the depth will be more the same filter bed can be seen here so this bore again it has to be lined its slotted or perforated PVC so the board that you see here this will be again it will not be a just a shaft it will be lined means there will be an inner pipe put inside and that will have slotted pipes so the water will go to the water table.

Next you have recharge trenches usually it is made for surface runoff if you see here it is a trench of size 0.5 to 1 m wide and the depth will be 1 to 2 m. So this is your perforated cover so the perforated water will go into perforated is the holes will be there on top of the cover so the holes will go inside this then you have the filter media and this trenches will collect the water so it is excavated on ground and refilled with porous media like pebbles, boulders or brickbats. Then the same thing the trench is when it is a tank is called a percolation tank it is artificially created surface water bodies like lake or bonds water bodies will be created and this will be slight deep to your normal floor area and that will have the percolation will happen there so all the surface runoff will be water will be diverted to the tank and then water is collected there. So these are the various methods you can recharge ground water aquifers.

Waste Water Treatment

Now the other water that we use how you can reuse it or how you can conserve it so that is waste water treatment so water is waste water is water no longer needed there or suitable for its most recent use you cannot use it immediately or you don't need that water any more that water we call it as waste water so how do you do treatment. Treatment means you remove the impurities from the water being the treated so put together is your waste watertreatment when the water which is no longer needed you remove the impurities and so that it can be reused that is waste water treatment so it is a process to convert waste water into effluent which can be reused or returned to the water cycle with minimal environmental issues.

So when it comes to waste water we have to consider this minimal environmental issues so this waste water can be directly reused that is called water reclamation. So avoiding the disposal of the use of treated water effluent can be for various purposes this is used the physical infrastructure used for this kind of treatment is called WWTP that is waste water treatment plant in short we call it as WWTP so why we have to treat waste water what is a real ned for it the used water what we have why we have to treat it why not we use it directly because they have different type of impurities such as human waste, food scraps, oils, soaps, chemicals so much impurities are there in the used water if you don't read the water or we use it directly then the environment and human health can be affected negatively impacted.

So what are the impacts the water when you directly leave in to the water bodies or something it will harm fish and the wild life populations it will deplete the oxygen the chemicals in the

used water it will consume the oxygen in the water and it will deplete the oxygen, beach closures, will happen other restrictions on recreational water use, restrictions on fish and shellfish harvesting and contamination of drinking water. So when you don't read the water waste water and you can use it or through it away directly so there is so many problems coming up.

So the main objective of waste water treatment is to remove as much as the suspended solids as possible before the remaining water which we call it has effluent which is discharged back to the environment. So what are the objectives you have to kill the pathogens first then improve the quality of waste water, you avoid unhygienic conditions, protect the aquatic life from the toxicity wastes as I told you it is harmful for the fish the chemicals in the used water, to make the used water usable for agricultural or aquaculture so that you don't waste the water you actually reuse it.

So what is the process so waste water treatment it is done in three stages like physical, chemical and biological method three ways you do it and three process is there it is classified broadly like primary treatment, secondary treatment and tertiary treatment. What is a primary treatment In primary treatment what we do here is if you look at the picture you will understand it is collected and you have a grid chamber and you have a sedimentation tank it just left to settle here so what happens is large suspended floating solids will be removed from this process so more complex compounds are broken up and it is converted into simpler compounds so that decomposition can happen so here you have a screens, grit chambers and primary sedimentation tanks so this is your screens that is filters screens are nothing but filters so huge undissolved solids will be filtered here then you have the grit chamber where smaller things will be settled here and again you have sedimentation tank for very finer particles to settle at the bottom of the tank.

The next process here secondary treatment here what happens is we add the biological this is the biological treatment where you add certain things so that the remaining organic matter will be removed like it will decompose easily so this is your primary from the primary clarifier that is your primary treatment process from here it is taken to the aeration tank here you have a compressor where air is sent into this water and aeration will take place so more oxygen will be given to the air and then it goes to the secondary clarifier and whatever sedimented here again comes here for aeration so it is a cyclic process so this is like consists of biological treatment units that has secondary settling tanks, secondary clarifier and sludge digester.

Now the tertiary treatment in this tertiary treatment the non-biodegradable so whatever whop cannot decompose in the secondary treatment that will be taken care of by your tertiary treatment by chemical process here non –biodegradable organic pollutant and a significant percentage of nutrients like nitrogen and phosphorous will be removed this nitrogen and phosphorous are very harmful to your aquatic life or wild life so this is an advanced treatment that is used for waste water from industry specifically containing specific pollutions like industry

we have so many chemical waste water coming out so for that particular waste water we use the tertiary treatment so this is about the process treatment process.

So we are going to look into the waste management for water this waste management is made mandatory by governing authorities or the planning authorities, development authorities here we will be looking into Chennai metropolitan development authorities mandatory requirements in residential or predominantly residential developments when you have dwelling units more than 100 dwelling units are there then you should have a waste management infrastructure below that it is not mandatory but the dwelling units exceeds 100 in number you should have a waste management infrastructure this will be applicable for apartments basically where you have large complex of apartments so the dwelling units it goes beyond 100 you will have a waste management infrastructure.

Atleast a closed nonpolluting storage provision should be there for solid waste storage within the premises itself so even if you don't have a huge infrastructure huge treatment plant you should have atleast a closed nonpolluting storage provision should be there so that temporarily you store there the sedimentation atleast the primary treatment atleast happen there and then the waste can be taken out so these infrastructure waste management infrastructure or whatever you are providing there should have direct access from the abutting road so that the local body can remove the stored waste from the storage then that is about waste water.

When comes to sanitation when you take about sewage systems you should have when the local body is not providing any sewage system so what you do is if the dwelling unit exceeds 50 numbers are the area is more than 2500 square meter you should have a sewage treatment plant so it shall be provided and maintained by the people who live there and the disposal of sewage will happen within the site itself so for all these things you should have a proper clearance from the city water supply and pollution control board then the location and design has to happen accordingly.

Now when the dwelling unit is less than 50 and there is no sewage land is provided by the city corporation and the area is less than 2500 square meter then you have a septic tank with up flow filter so this is what a septic tank with up flow filter is that should also be within the premises and then the disposal of the sewage will also happen within the site itself.

Mandatory Regulations

Now coming to rain water harvesting so the mandatory provisions for the special buildings, group developments, multi-storeyed building that is given is there should be a pebble bed of 1 meter wide and 1.5 meter depth. We swathe recharging of aquifers right so the same similar kind of thing has to be done what is the size of this everything is given in this thing there should be a minimum of 1 meter width and 1.5 meter depth all around the building you should have this and then it should be filled with round pebbles the size of the pebbles is 5 centimeters and 7.5 centimeters size.

So you have to provide this kind of an arrangement for special buildings, group buildings and multistoreyed buildings. Special buildings with any building with more than four storyes is consider as a special buildings, group buildings will be this special buildings when you have more than one in number within the complex that is called group development or group buildings and then multistoreyed buildings is floors more than 4 floors that is called multistoreyed buildings so these kind of buildings mandatory to have a rain water harvesting all around the buildings. Concrete paving should be done for this buildings should be done all around this building and the slope should be 1 in 20 and the slope should be toward the pebble bed that is already been done so the rain water from the terrace and the pavements will flow to this pebble bed flows toward the pebble bed all around so that is why we providing this all around the building so which ever direction the rainwater flows it will reach the pebble bed.

Then Dwarf walls in masonry of 7.5 centimeters, dwarf wall is like a speed breaker ok that will be provided at the entrance because you dig this trench all around the building you have entrance and exit. One entrance one exit will be mandatory will be there so there you cannot have this you have the trench above that you will have a dwarf wall you do it in masonry it should be atleast 7.5 centimeters height will be like at the entrance depending on the entrance height and the other thing is this will also stop the rainwater from going into the road from the entrance and exits.

And then there are additional regulations for all buildings that is been given is if you have ground floor the floor level of the closets should be atleast o.9 meters from the road level you cannot have it less than that and centrally air conditioned building should have their own waste water reclamation plant waste water reclamation is the cooling tower is the water that which is coming out that again used for the cooling thing itself so for cooling purposes and use reclaim waste water for cooling purposes and the additional regulation other thing is separate sump should be constructed for portable water by the supply by the city water the volume should not exit 1000 litres per dwelling so this sump will be independent other tanks so that storing water from other sources will be done here other sources in the sense the rainwater harvesting water can be stored here so that should not be less than 1000 litres for a dwelling so a separate sump is also needed so this is about waste water conservation.