Sustainable Architecture
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Lecture – 57
Whole Building Performance - VII

Good morning. Welcome to this lecture where we are creating the proposed case as part of the Whole Building Performance method for this ongoing online course on Sustainable Architecture. And, in yesterday's lecture, we modified the parameters related to construction and openings for the proposed case. In the openings we looked at how to change the template for the fenestration the kind of glass which is going to be used.

We saw how to change the template for the wall type, for the roof type, if there are partitions or ground floors which need to be changed. So, how to change the templates for all these different constructions? We also change the design of the windows the openings, which is the window wall ratio. 1 thing which we have not attempted here is what if the proposed case has some designer windows.

So, it is not like you just say 60 percent and it is like uniformly divided. In case we have to change those windows, then specifically the windows will have to be created on the walls, which we will come to later in the upcoming lectures.

But, for today we will only change the window wall ratio from 40 percent to the 60 percent and then move on to change the parameters for lighting and HVAC. With the changes in these parameters the proposed case at least the first of the proposed case would be fairly ready. And, then we will be ready to compare the proposed case with the performance of the base case and derive conclusions out of that. Whatever changes whether changes have to be made in that we will then subsequently do in the upcoming lectures?

I am hoping that while you are watching these lectures, you are simultaneously working on 1 of the buildings at your own end and you are practicing with the software, because the lectures alone would not help as much as you would practice and you would come up with your doubts, we would be able to clear them and you would be able to grasp understand the process better. So, let us shift to the design builder screen and let us go ahead with changing for the parameters as I have just introduced. So, we shifting the screen now.

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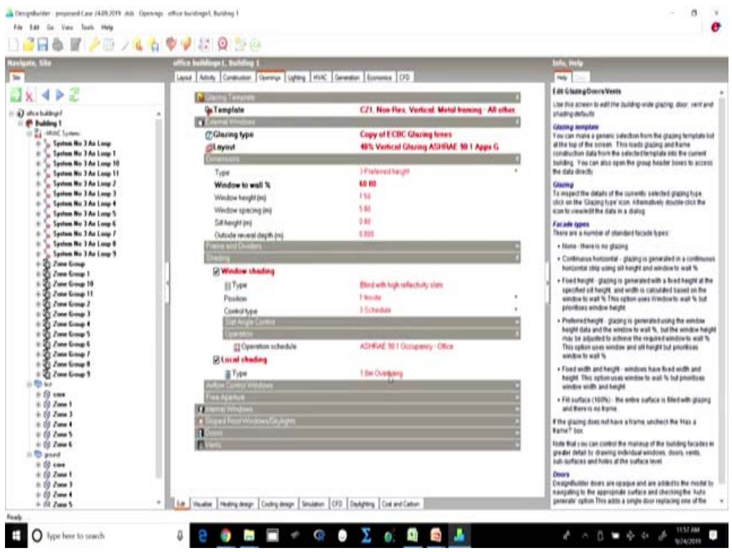

So, in yesterday's class we were working on the proposed case making changes to various parameters, which are different between the base case and the proposed case. So, what we had done yesterday was we changed the fenestration.

So, we changed the glass and made it a better glass performance wise and we also changed the window wall ratio to 60 percent, we checked in the layout that that change has automatically been reflected in the model. Rest of the parameters they remain the same the window height the spacing and the sill height. So, rest of them remaining the same the 60 percent WWR has been chosen.

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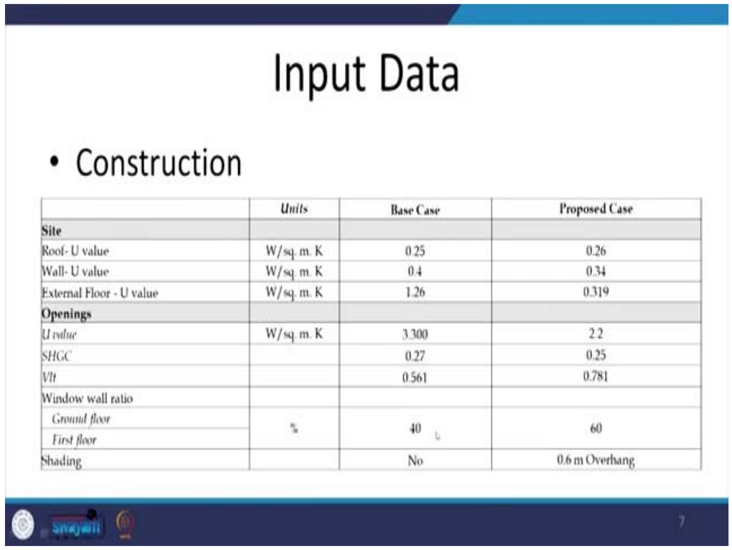

	Units	Base Case	Proposed Case
Site			
Roof- U value	W/sq. m. K	0.25	0.26
Wall- U value	W/sq. m. K	0.4	0.34
External Floor - U value	W/sq. m. K	1.26	0.319
Openings			
U value	W/sq. m. K	3.300	2.2
SHGC		0.27	0.25
Vlt		0.561	0.781
Window wall ratio			
Ground floor	%	40	60
First floor			
Shading		No	0.6 m Overhang

If, we look at the input data, we would also see that in the base case the shading was not provided. However, in the . So, if you look at this tab, which is within the openings tab, which is called shading.

So, there are two types of shadings there is 1 which is window shading. Now, when we are talking about window shading, it is about the internal shading, while if you look at the local shading, local shading is the overhangs or vertical fins which are going to be provided. So, for now in this case we are not looking at the window shading, which may include the blinds the curtains and all those internal shadings, while for local shading we now have to create a an overhang of 0.6 meter.

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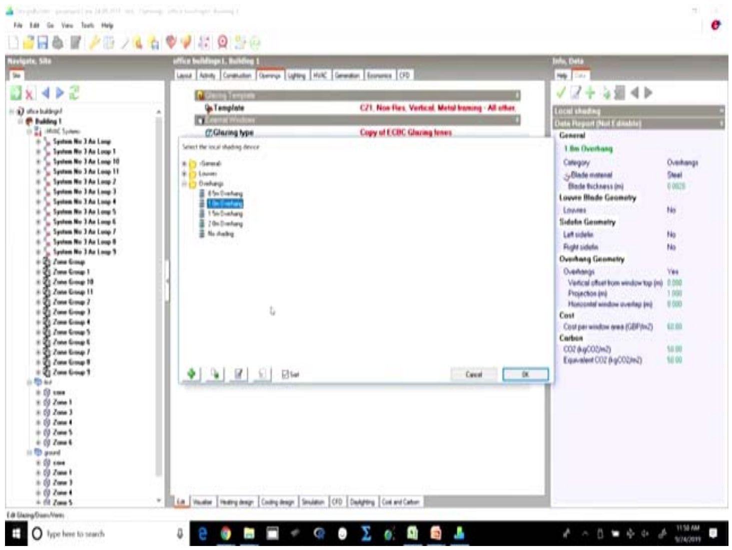

So, if you look at this there are already some templates 0.5 meter overhang, 1.1.52. So, let us select 0.5 meter overhang. And, let us create a copy of this 0.45 meter overhang and edit it to suit our purpose.

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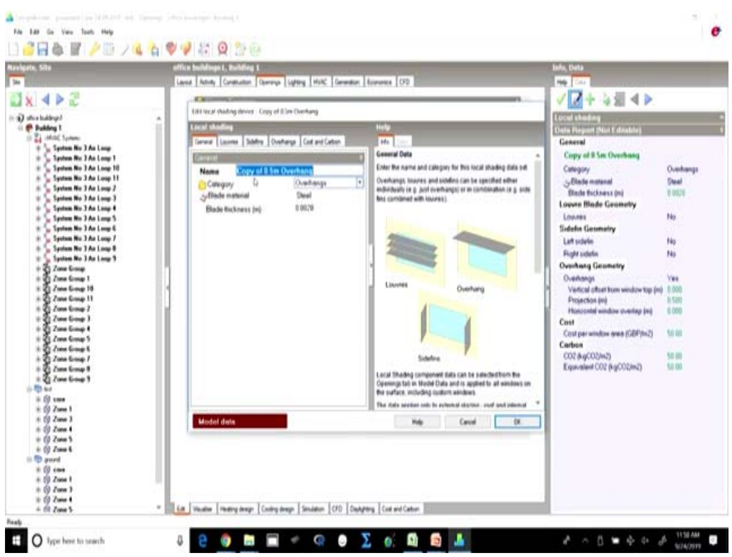

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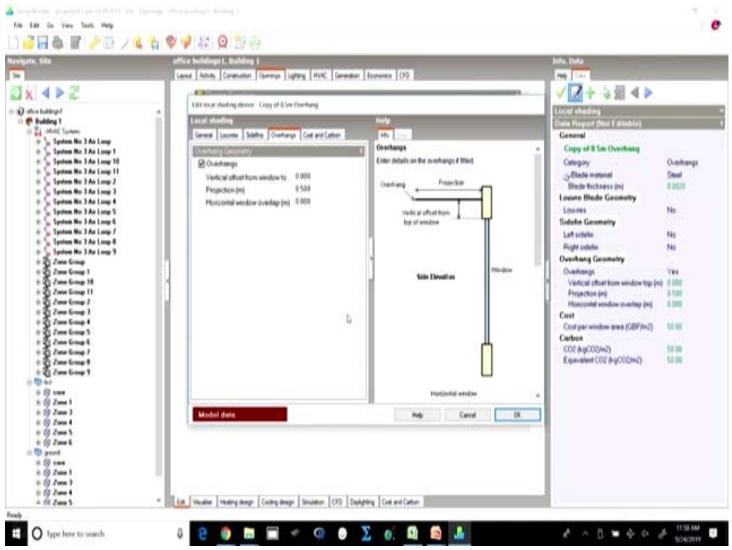

So, the overhang depth is 0.6 in our case. So, we create a copy of 0.5 meter overhang, where the projection is actually 0.6 meters. So, this 0.6 meter overhang has been created here. So, a copy of 0.5 meter overhang has been chosen and let us quickly look at the change it has brought in the model.

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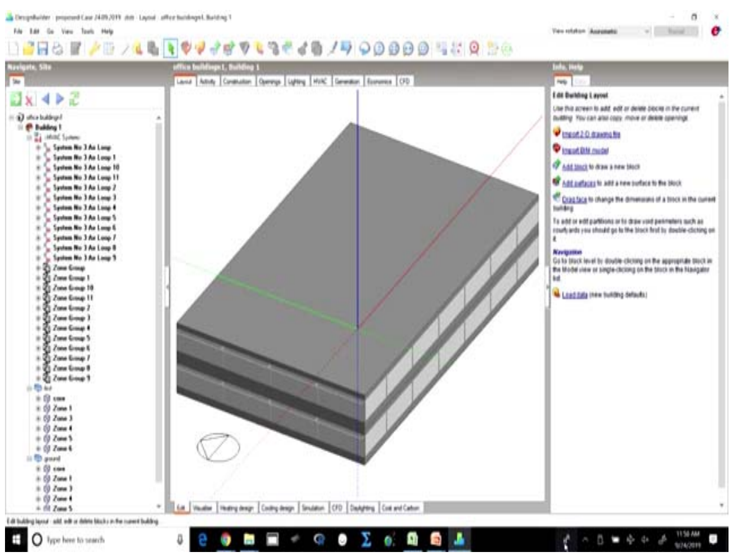

So, if you remember earlier the model did not have these overhangs, if you rotate it you can see that these overhangs have been added on all the sides.

If, sometimes we are not able to clearly see that what all changes have been made, we can also render it. So, if you want to visualize it suppose some material has been changed.

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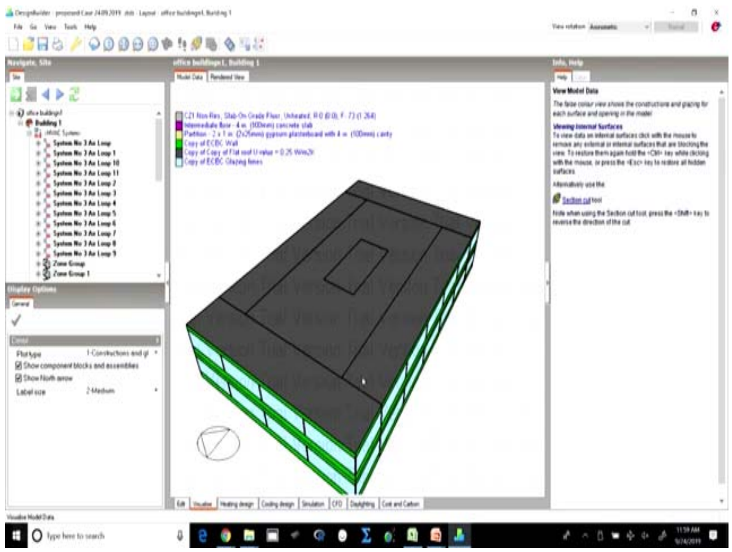

So, we can visualize the model and then it becomes easier for us to visualize the change which have been made. So, we saw clearly that the shading has been added here also while visualizing, suppose we have to visualize, we can change the shading pattern, we can also add the shading into the model incorporate that, so, that the model we can have an estimate, we can have an idea of how the model, how the building is going to cast shadow. Or if suppose there are some buildings in the surroundings of the proposed building, then how these buildings are going to cast shadow on the proposed building all of that can also be identified studied through visualization.

So, for openings we have already made all the desired necessary changes. So, we have added the shading, we have changed the window wall ratio and we have also changed the glazing. So, looking at the input parameters input data from the base case to the proposed case, we have changed the U value of the roof, we have changed the U value of the wall, we have changed the properties for the glazing and we have also changed the window wall ratio and we have changed the shading.

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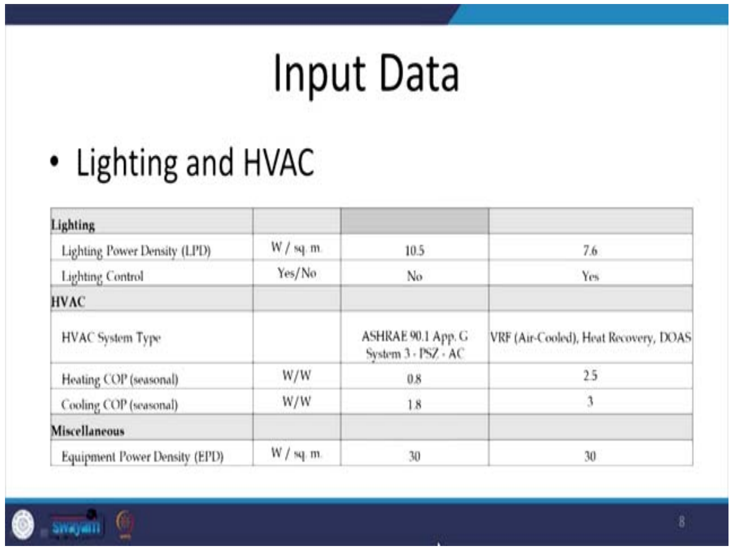

Now, let us move on to the next one. So, for lighting and HVAC we have to change the lighting power density.

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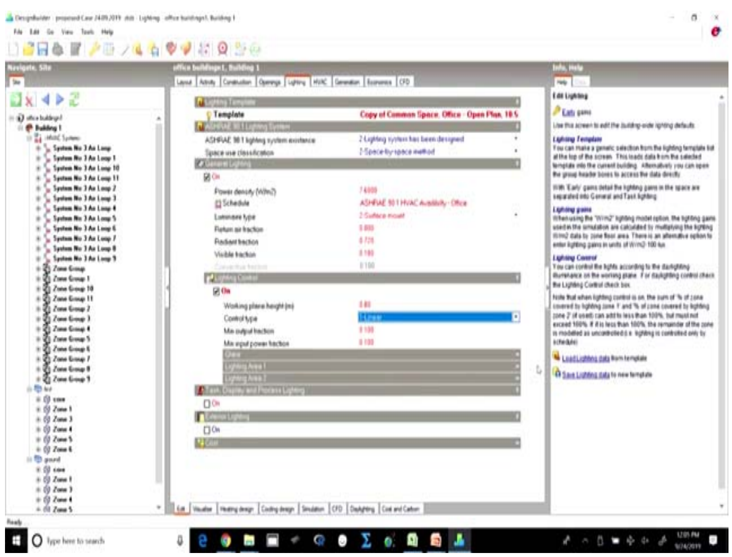

So, we look at the next tab and here instead of a lighting power density of 10.5, we have to propose we have to provide a lighting power density of 7.6.

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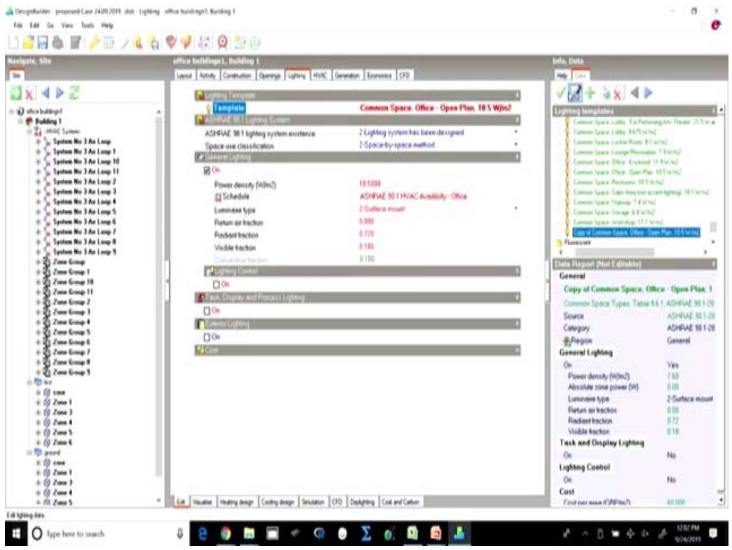

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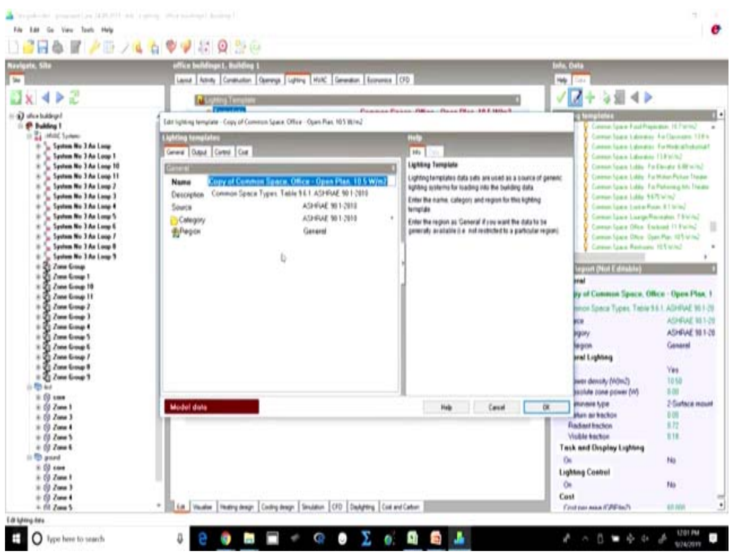

So, again we can use, we can edit the template create a copy and we can change the lighting power density to the desired one.

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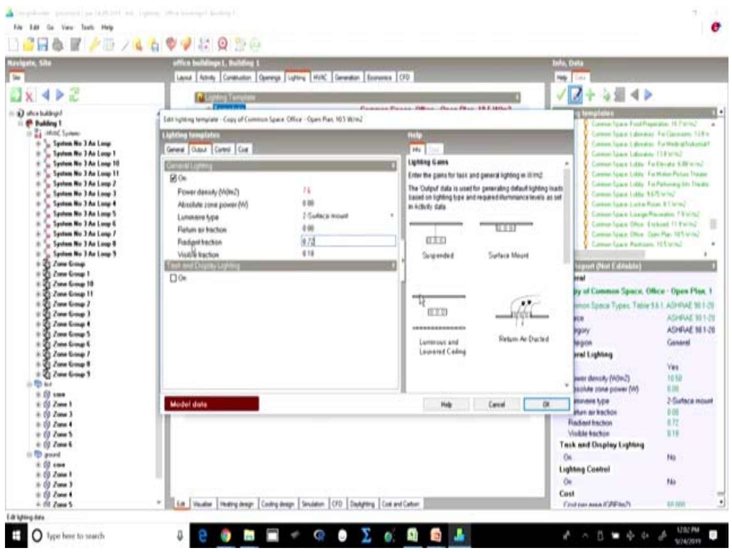

Here, we do not have to specify the type of luminary which is going to be proposed; however, we have an option to do that. We can change the type of luminary here, in case we are going ahead with some luminary, which is not surface mounted, which has to be changed then that change can be made here. We can also change the fraction the radiant fraction. So, how much heat is this particular type of luminary going to create? So, here the radiant fraction is quite high for the basic template of this luminary, the radiant fraction is taken as quite high while the visible fraction is quite low, which implies that a lot of heat will be generated and will be added to the interiors, because of the artificial light.

In case we already have our data, we have already decided on what kind of luminary is going to be used, we can change the radiant and visible fractions for the luminaries. For now we are looking at the lighting power density and we have changed it we apply it.

And, so we can see that the lighting power density has been changed to 7.6. Another, input which was different from base case to proposed case is the lighting control. So, in base case there are no lighting controls to be proposed, while in the proposed case we have to provide for the lighting controls.

Now, before I go on to select the lighting control, we must know what the lighting controls are. So, the lighting controls basically control when the artificial light will be switched on or switched off. Now, it may depend it is largely dependent upon the amount of daylight which is available.

So, sometimes the sensors, the photo sensors will be outside and this photo sensor will sense the amount of light which is available outdoors. So, we were in a couple of previous lectures, while we were discussing about the indoor environment quality. We were talking about the daylight factor DF and there we were talking about the outdoor luminous, the amount of light which is available outside.

So, these photo sensors will have a threshold limit, a cut off limit. Say, if the outdoor light falls below 1000 lux, that is when the artificial light indoors will be lit up, it will be turned on automatically. All other times when the threshold is not met or the value outdoor illuminance value is higher than this threshold; the artificial light will not be turned on.

So, this is what the lighting control is another lighting control is on the basis of occupancy. So, if I turn on the lighting control, here I can see that we have already defined the working plane height, which if you remember our discussion on indoor environment quality the working plane height has been defined as 0.8 only, the same. If, you look at the control type the linear is the best one in the linear as it is not a threshold it continues along with or directly in proportion to the outdoor illuminance.

So, as the outer illuminance continues to go down the artificial lights inside will continue to go up or they will be switched on. However, in real life the linear controls are very costly and difficult to use. So, what we usually have is we have a stepped control in this there are different thresholds stepped thresholds.

So, if the outdoor light falls below a particular threshold. Maybe one row of the artificial lights are turned on. If it further goes down the next layer of the artificial lights or the next row of the artificial lights will be turned on and like that. So, this is how the lighting controls will be controlling the light. And, we will see what difference does it make to the overall consumption of light?

You can make changes as I have already said in the radiant fraction and that is another very significant change. So, if we are using say LED lights; LED lights have a very low radiant fraction they do not get heated up as all other lights. So, this fraction may substantially go down here, for now we will just keep it as the same and introduce the lighting controls.

So, what we have changed in lighting now is we have changed the lighting power density here; we have changed the control type; so, we have added the lighting controls here. In this case we are not adding the task or display lighting or process lighting exterior lighting as these were also not turned on in the base case. So, none of these are is being considered here.

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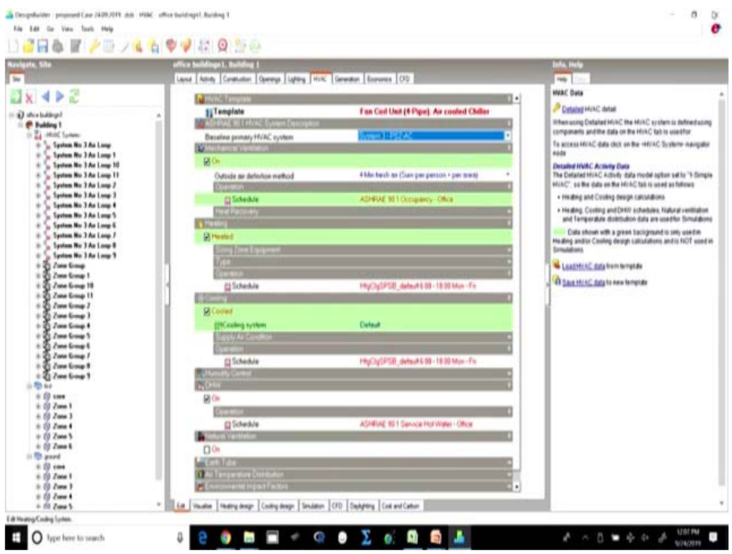

Now, let us move on to HVAC. So, for HVAC instead of using a system 3 we are going to be using a VRF system.

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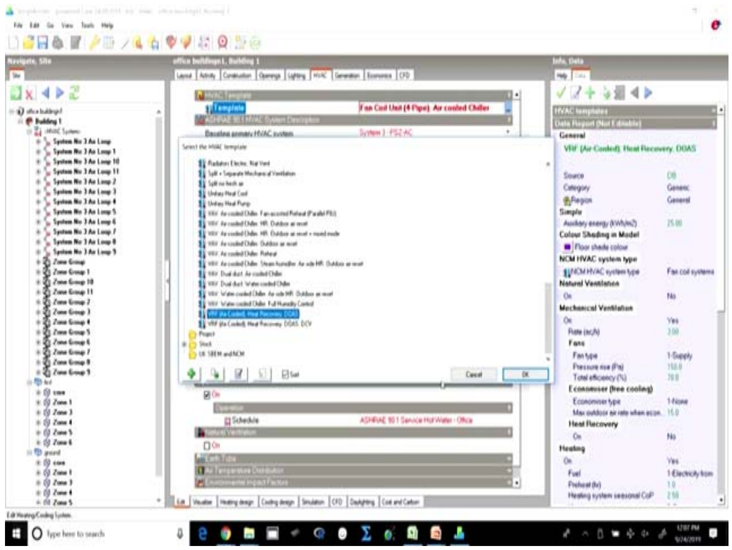

So, we have ready template. So, we just select the ready template and automatically the template will be applied.

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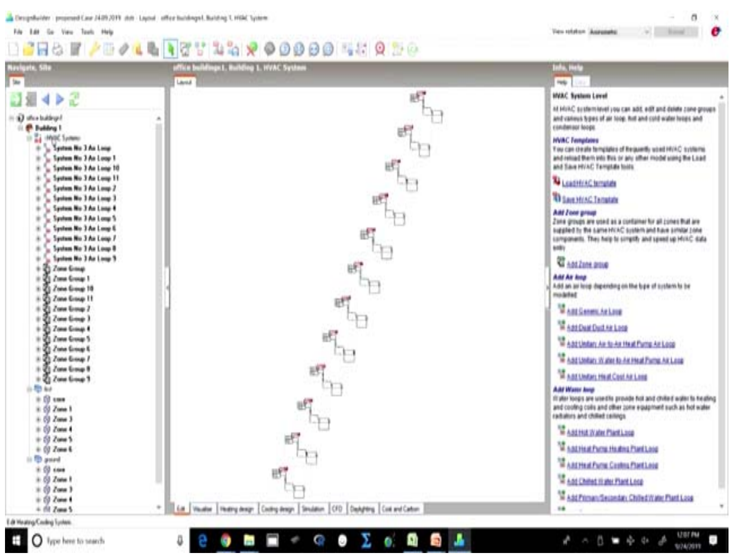

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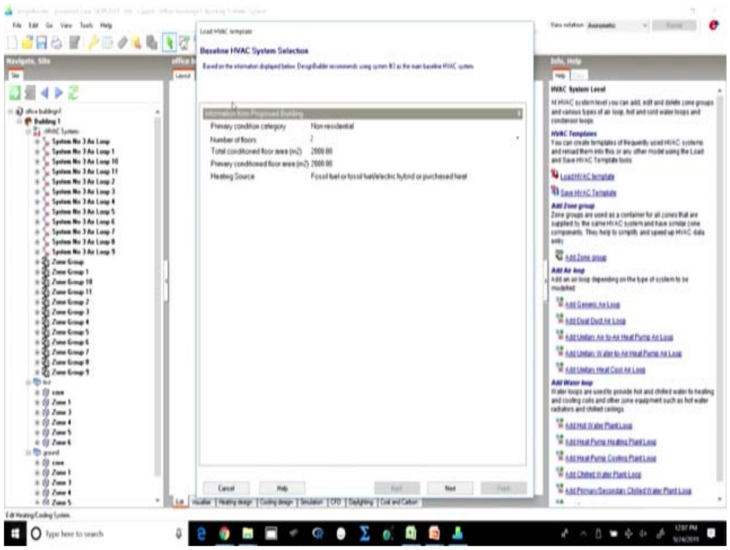

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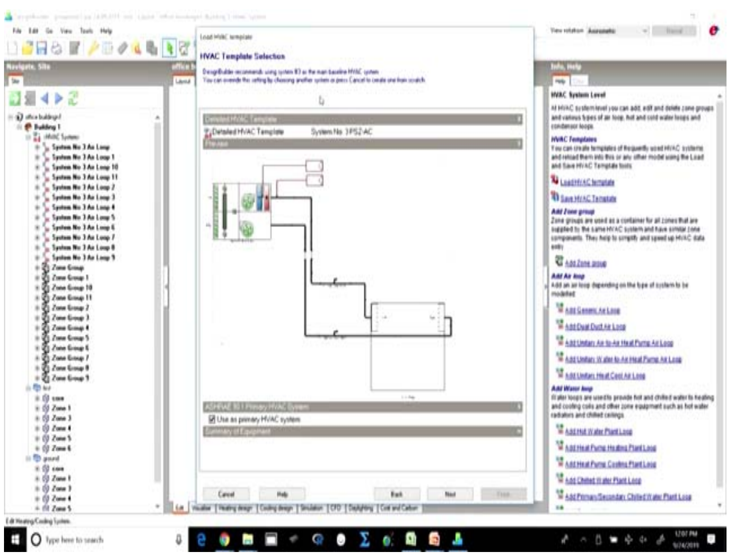

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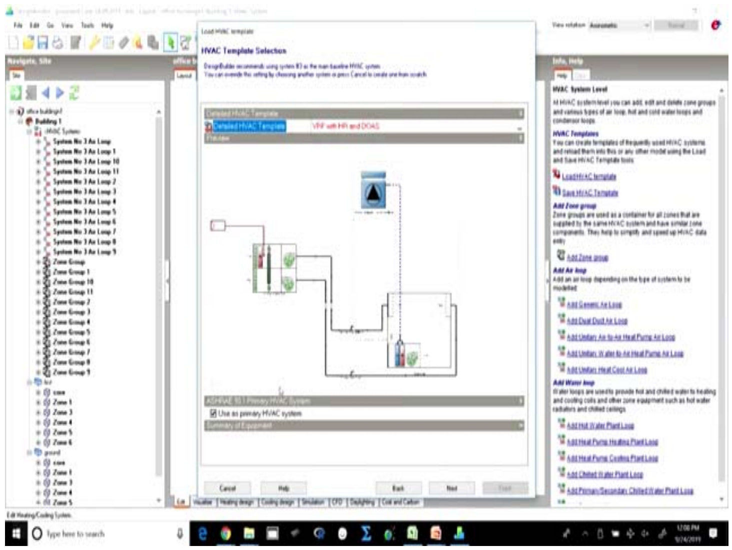

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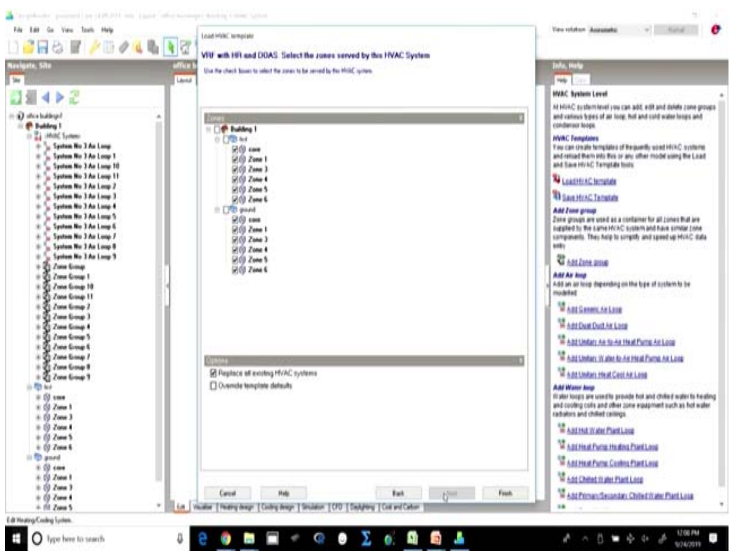

So, we bring in the VRF system and we apply it here.

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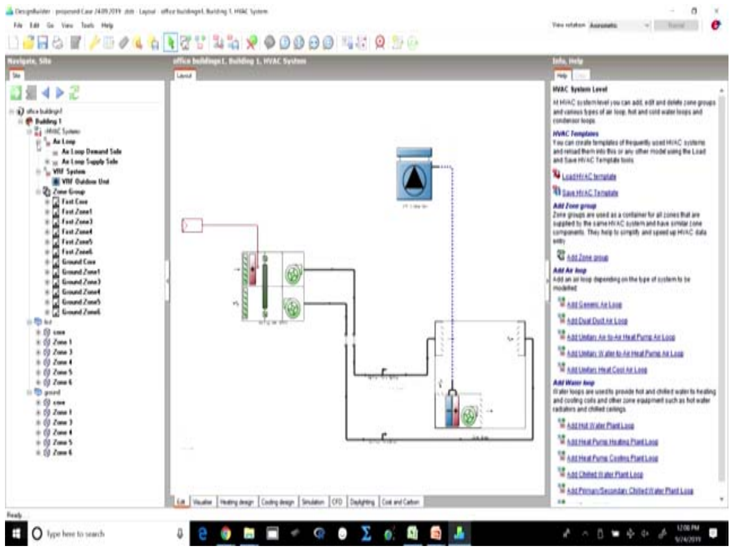

So, instead of system 3, we now have VRF system, which is applied into the building. And, all the zones are now being served all the first floor zones and the ground floor zones are now being served by this HVAC system. So, we have we have made all the changes, which we had to propose in the proposed case.

Now, very clearly some things that we have to keep in mind is when we are talking about the base case and comparing it with the proposed case. The proposed case is actually the building which is going to be constructed; this is the design case what is being designed?

And, the base case, which is going to be used for comparison is the case, which is following all the prescriptive norms all the prescriptions either as per ASHRAE or ECBC or any other relevant code or standard.

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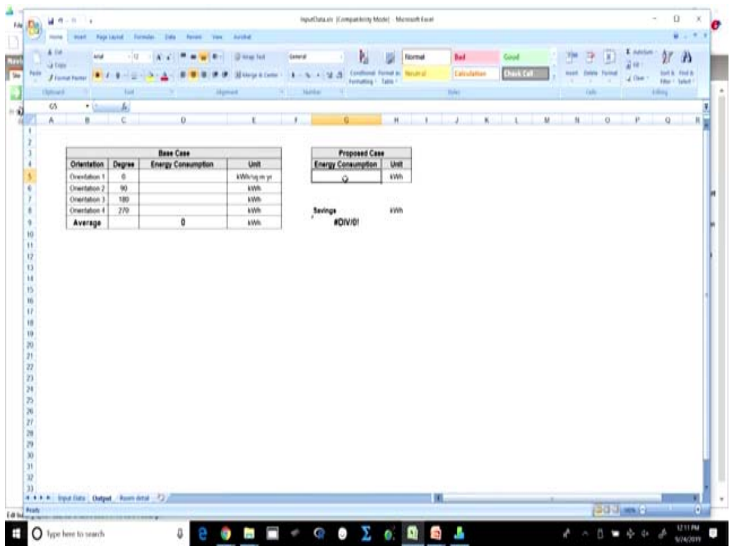

A comparison between the two the base case and the proposed case if we see so, we will find out the normalized energy consumption in units per meter square for proposed case and also for the base case. As, I said that for the base case we will have to simulate it for four different Orientations; Orientation 1 where it is facing north and then subsequently rotating it orienting it to 90 degrees from the north. We will have the energy consumption for each one of this and the average will be the average base case consumption.

We will do the simulations for the proposed case and calculate the energy consumption for the proposed case. In ideal scenario where the proposed case has to perform at least equal to or better than the base case, the energy consumption of proposed case or EPI not energy consumption here, but it is the energy performance index, the unit of electricity consumed per meter square as compared to the base case they have to be lesser or equal to the base case EPI.

So, this is what the intent is? Now, here we will simulate the base case and get these values, we will run the simulation get these values and we will also simulate the proposed case. Proposed case will have only one case or if you are still in the iterative process, where you are still open to making changes improving upon or deciding upon the various parameters.

So, suppose you may be wanting to decide whether just 0.6 meter overhang is good enough or not, whether we need vertical fins or overhangs, several proposed case energy conservation measures. So, ECM 1 where we add the overhang of 0.6 ECM 2 where we add vertical fins, ECM 3 where we apply insulation layer on top of the roof and like that.

So, we will keep making those changes and we will keep saving those proposed case ECMs as separate cases and keep comparing with the base case average. This is what the intent is? So, let us quickly simulate it, simulate the proposed case model for an entire year.

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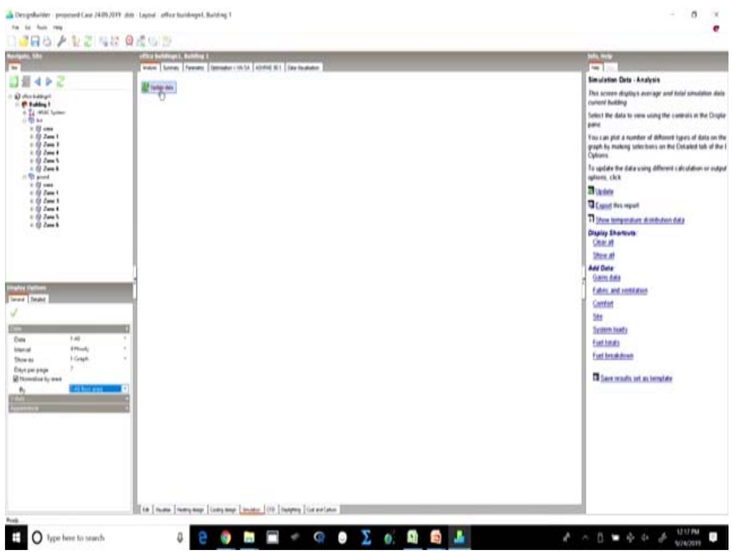

So, we have to do we have to carry out an annual simulation always.

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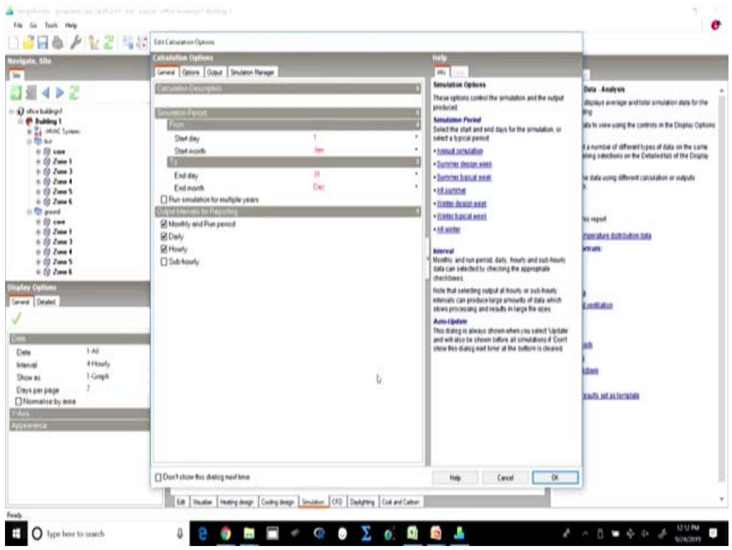

So, that is what it requires and we have to carry out an hourly simulation and that is how it will be compared for all the zones?

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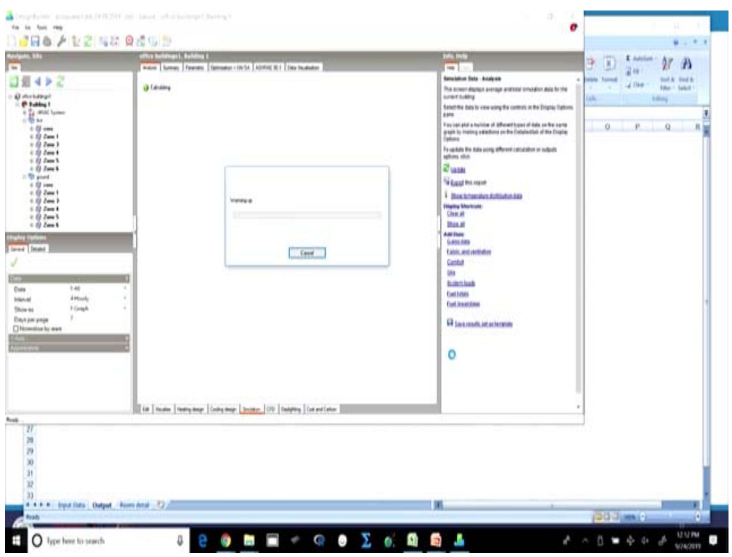

So, you can simulate your data for your model for an year and then calculate the results arrive at the results also. Please keep in mind that whenever you are running the simulation, simulation is being assigned at the build level. So, that all the zones are simulated we are not simulating one single zone separately.

Also we have discussed in a while we were working on the base case, what are the different parameters, what is going to be the warm up period and what are the different values that we would require we would want to get out of the simulation results?

So, all those default values have been maintained as the same in the proposed case. And, we will now be looking at the results. Also another thing while meanwhile when it is simulating we can do is, we can look at the absolute numbers or we can normalize the results by area. So, when we say normalize by area, if you look at total energy consumption normalized by area, it will actually give us the EPI; Energy Performance Index, because energy performance index is nothing, but the energy consumed per unit area per annum.

So, total energy consumption divided by the total area of the building per annum is what is going to give us the energy performance index EPI values for a building. So, let us look and compare the results of the proposed building and quickly see, what changes can be brought in and how the performance of the proposed case can be improved upon the base case.

I hope when you are going through these tutorials where I am working on an actual case, you are simultaneously practicing and preparing your own models. So, as you prepare your own model and whatever difficulties you will arrive at while working on these models, you can continuously post to me and keep watching these tutorials.

Besides these tutorials or the lectures that we have in the class, you can also go to the design builder tutorials you can watch them and you can have a lot of doubts clarified for yourself. And, see whether you are able to create models start with simple models do not take up too complicated building forms or building uses and you should be able to use the tool conveniently.

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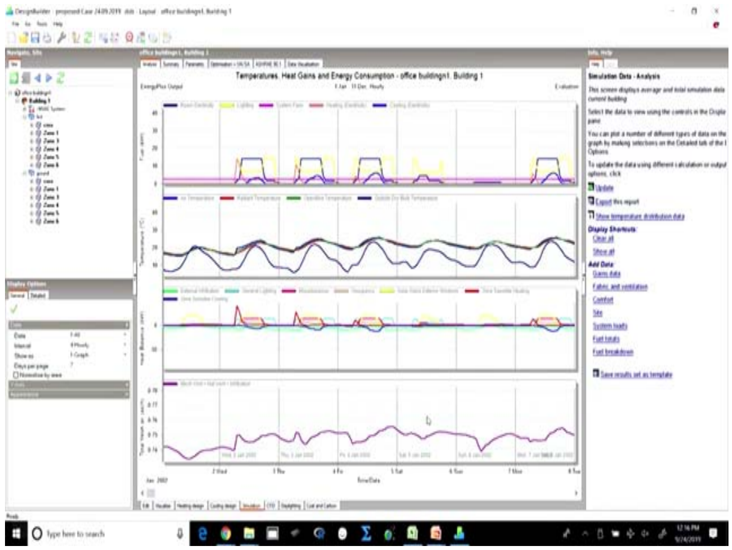

So, here we have the annual simulation completed for this proposed building, which we just now modeled. So, if I normalize this by area. So, it will be dividing all these values by the floor area and we will get the.

So, we are taking we can do it by all floor area or occupied floor area let us do it by all floor area, because that is normally how it will be done and we just calculate the revised values. So, the values which will be achieved here, we will be getting the normalized values by area.

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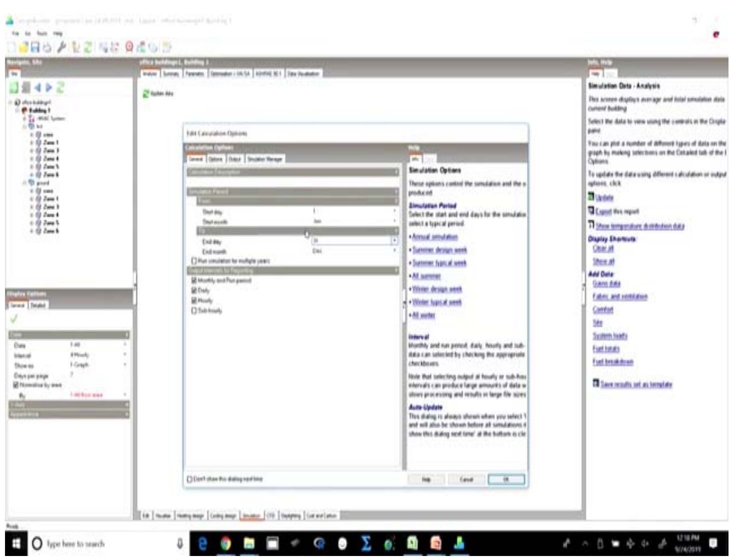

So, we will close our discussion here as the simulation can be carried out continued at your end. And, tomorrow when we come for the next for the lecture, where we will have the data the simulation data both for the proposed case, as well as the base case and we will then see that how we can compare between the two cases and how we can improvise upon the base case model to achieve the desired performance as we want in proposed case. Or where all can we reduce or reduce the stringency of proposed parameters.

For example, the U value of wall can be compromised with, because the U value of the roof has been reduced substantially even beyond the ECBC prescription. So, whether those changes in parameters can be brought in; that is what the whole building simulation facilitates us. So, we will stop with this lecture today and tomorrow we will continue to analyze the results.

Thank you for being with us today, see you again tomorrow bye bye.