Sustainable Architecture
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Lecture – 56
Whole Building Performance - VI

Good morning. Welcome to the last week of this course on Sustainable Architecture, where we are now discussing about the Whole Building Performance tool. And, in the previous lecture, we have seen how to create the geometry of a building a proposed building using design builder. So, here for whole building performance we are using 'Design Builder' with an 'Energy Plus' simulation engine.

So, we saw how to create the geometry, we took up a case of a very simple office building, a two floor office building, a rectangular building and we created the base case. So, before we come to this whole building performance simulation, we have to know what goes into the building.

So, we have to know the prescriptions as per ECBC or whatever relevant code, needs to be followed in the context of your building, it might be a building coming up in some other country. So, the code which, which is relevant there will need to be followed to create the base case. So, besides the geometry what is going to be the value of or the parameters for construction, what is going to be the parameter for opening setting and HVAC lighting all of that, has to be known through the relevant code.

So, we have already seen how to arrive at those prescriptive values. And, then in the introduction lecture to the building performance simulation, we have also discussed about the difference between the base case and proposed case. So, we very clearly saw that, what are the parameters which will remain same from base case to proposed case and what are the parameters which will be changed from base case to proposed case.

So, from today for this week we will be designing, we will be creating a proposed case. And we will be changing the values of those of that proposed case and the parameters, the relevant parameters.

So, let us start with the building simulation for the proposed case and go ahead with that. Let us shift to the designer builders screen now.

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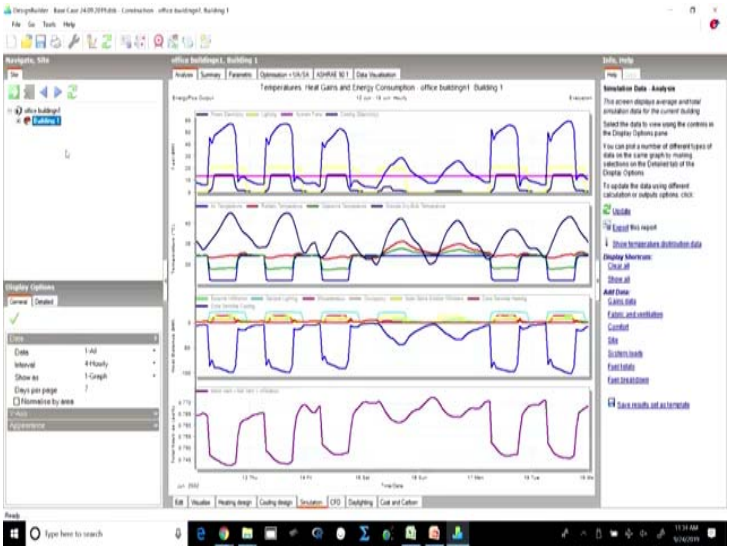

So, hopefully in the last week you would have already created a base case building for any building of your choice. So, just to quickly take a recap, we had created an entire building and then we simulated the building, the base case building, to achieve at the simulation results.

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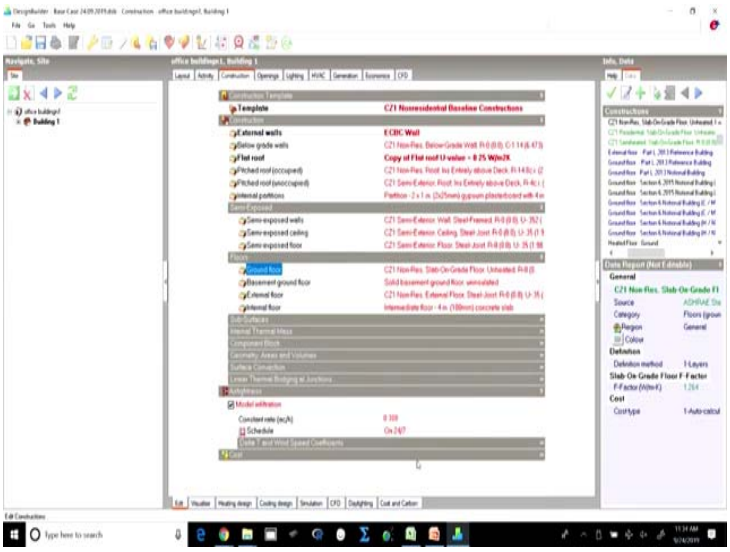

So, quickly giving you a recap of what all we modeled in the building.

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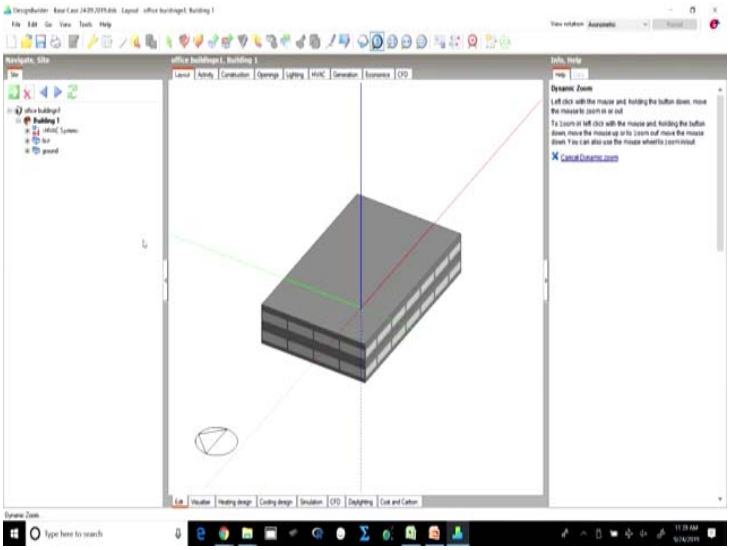

So, starting with a very simple rectangular commercial building an office building of two floors, ground plus first. We had modeled how the building is going to be depending upon it is core.

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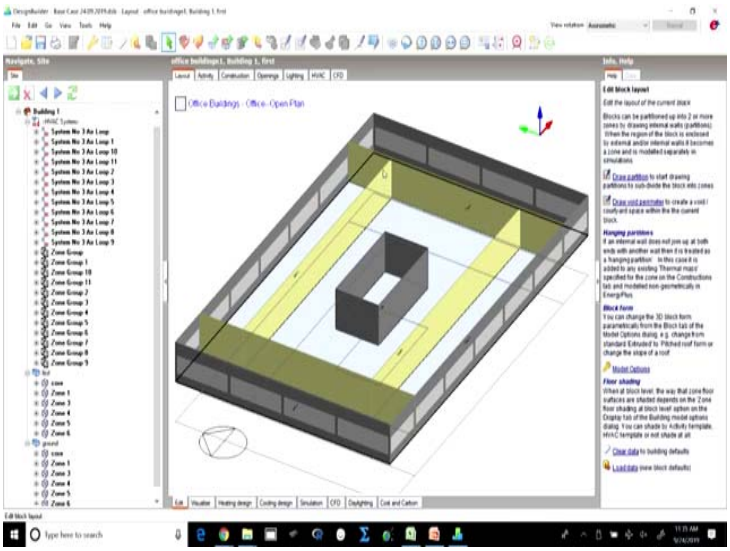

Which was to be used as a toilet cum circulation and then there were perimeter zones. We had created the virtual partitions and then we assigned the activity template.

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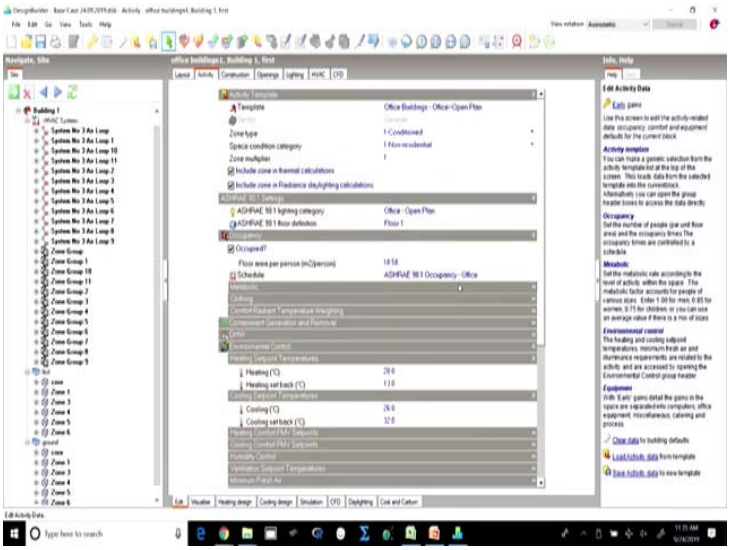

To all the zones which was taken as office buildings.

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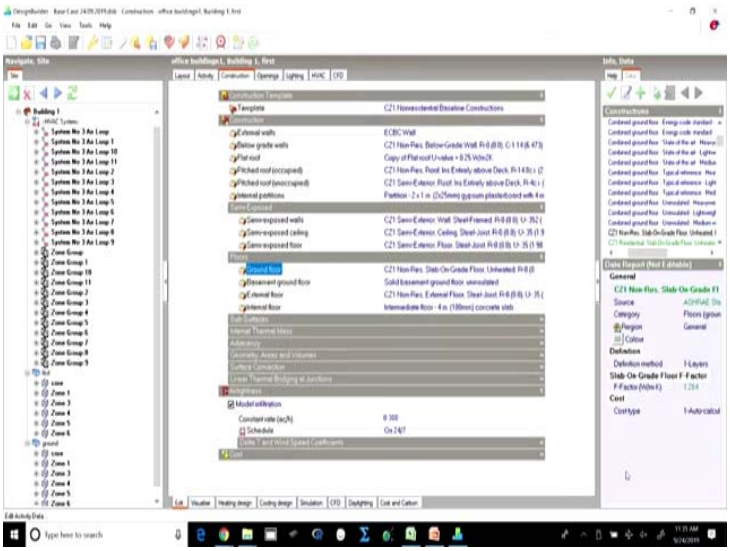

And, then we had defined the construction for this building.

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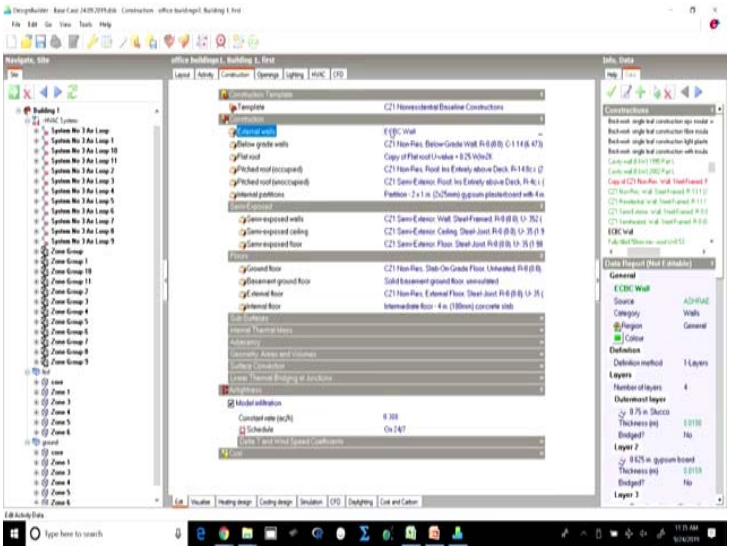

So, we selected the ECBC Wall, where we had specified the U value.

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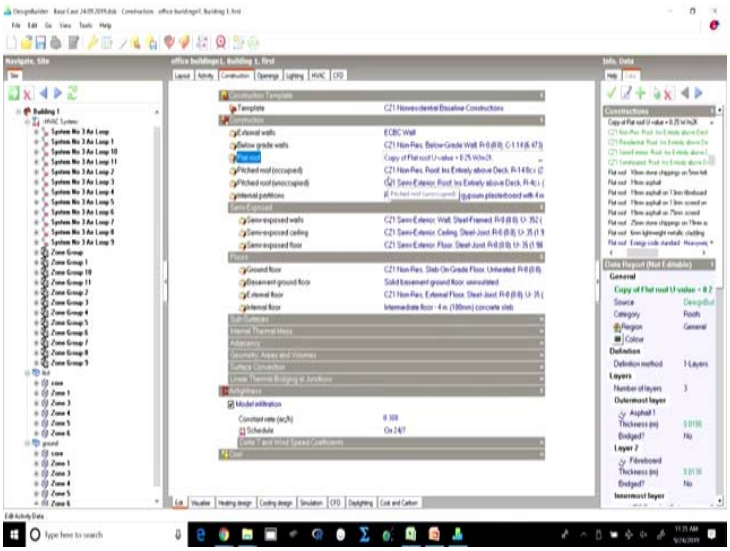

Then we also defined the flat roof, where also we defined the U value. Now, all these were created as per the prescriptive values suggested in ECBC.

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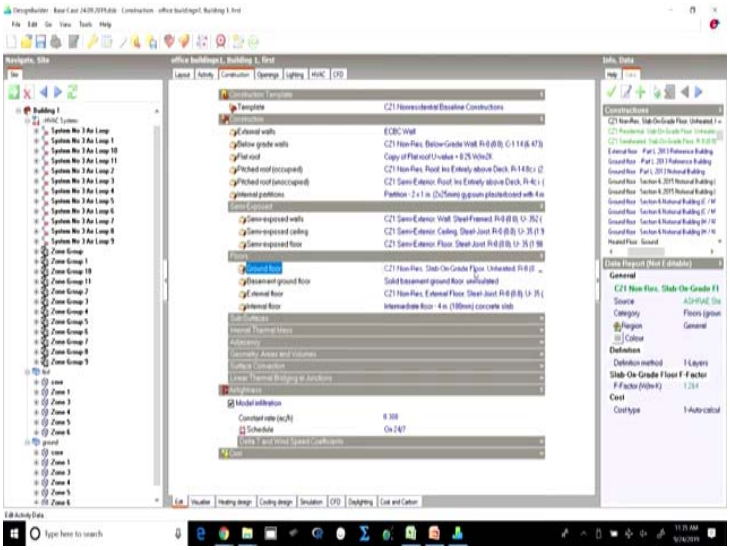

Then we also had internal partitions, which were virtual in this case so they do not matter much and then the ground floor was taken as a default ground floor without insulation. So, the existing template was used here. We also took the constant rate of air changes per hour for modeling the infiltration, which was, which is on the basis of actual ASHRAE 62.2.

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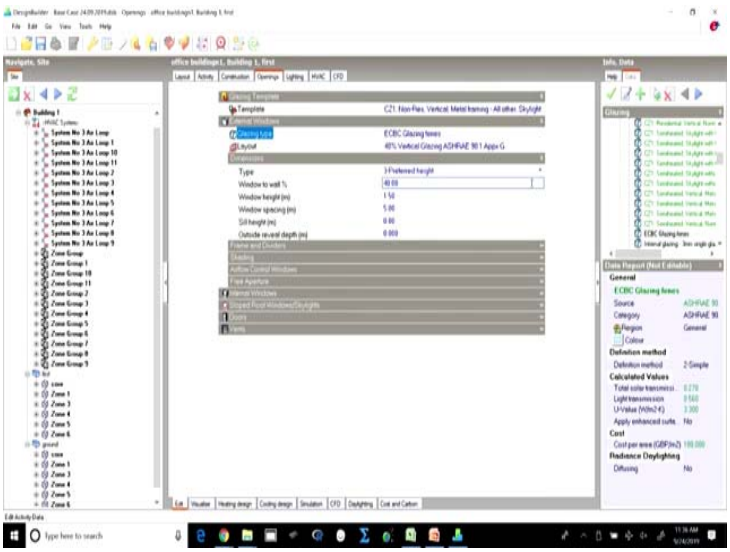

Then, we also modeled the openings as per ECBC it is given that the WWR be maintained as 40 percent.

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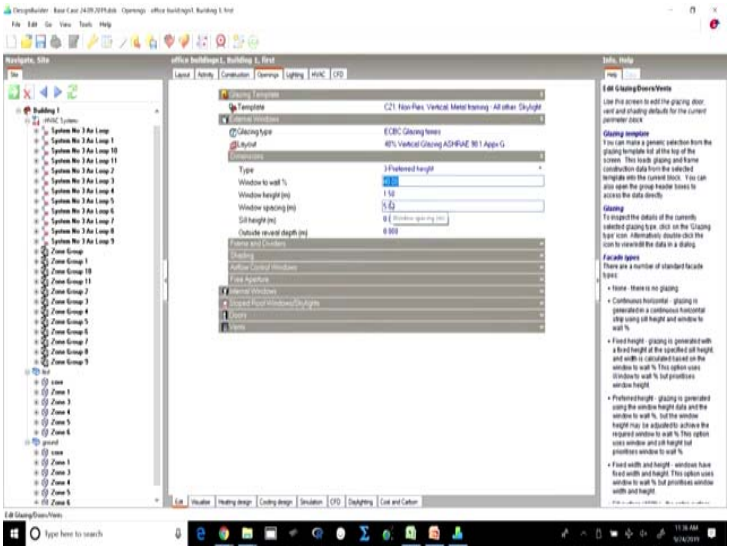

So, we maintained a 40 percent and the windows will be uniformly distributed, which is what happened? Then, we selected, the fenestration, the glazing. And the values that we selected here, were the prescribed values as per ECBC for the composite climate.

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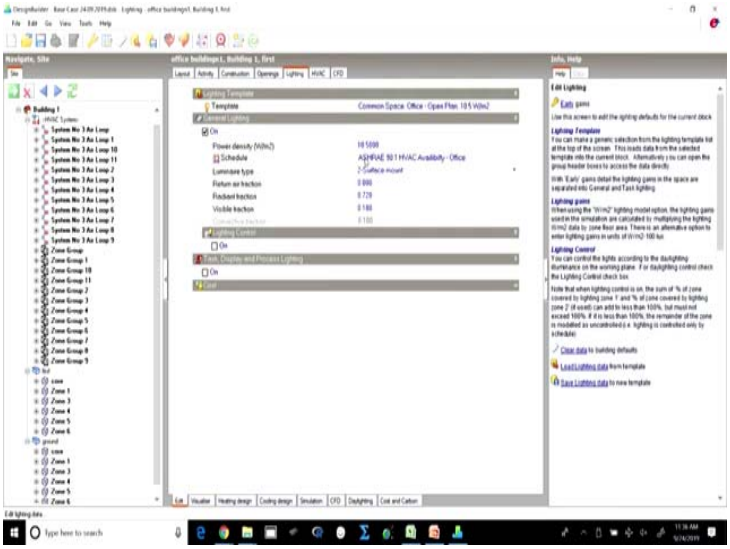

So, and then for lighting we took as 10.5 for the rest of the office, while for core we changed the schedule the power density the LPD was maintained as the same 10.5, which is what was what is prescribed in NBC and also ECBC, but the schedules they have been changed.

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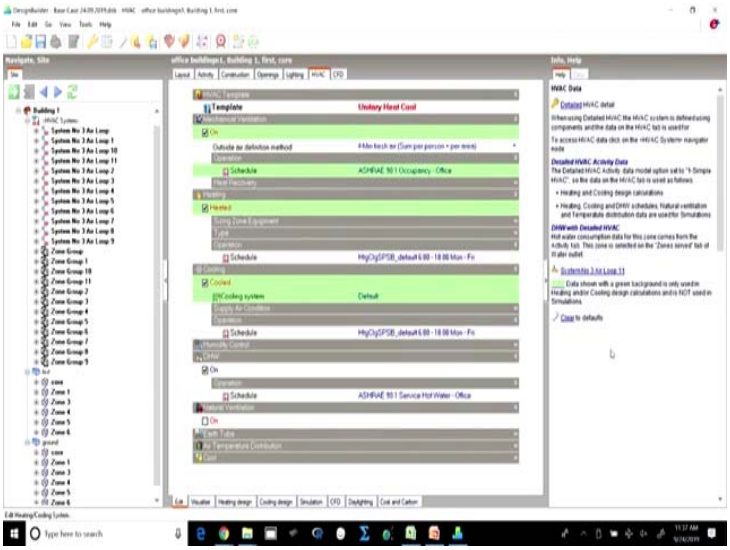

And, then for HVAC we followed the ASHRAE prescription and we used system 3 and this is what we have.

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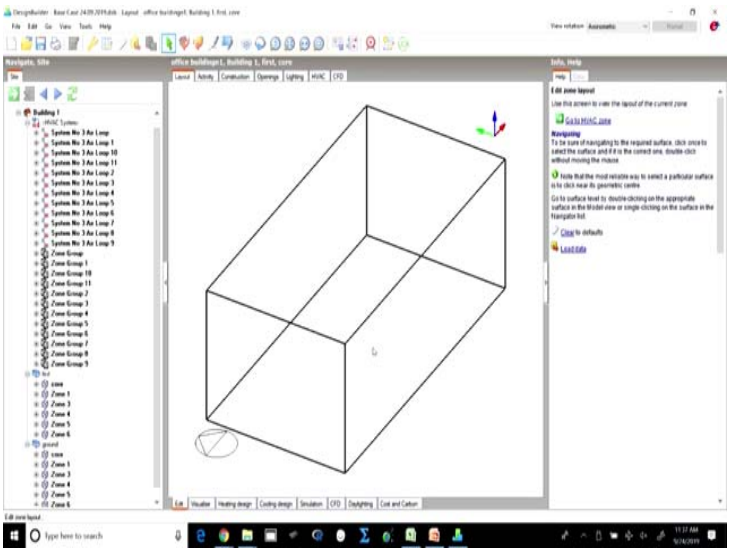

Now, the model was completed in every respect in all regards. And, then we went on to simulate; this case where the building is oriented towards north and we achieved the results.

Now, if we have to then calculate the average performance of the base case, then we rotate the building and create four different cases as I have mentioned earlier also by

rotating the building 90 degree. So, we rotate the building and simulate each of these four cases oriented in four different directions, for annual simulation 365 days hourly basis, 8760 hours specifically.

So, each building will be modeled for the entire duration of an year. And, an average we calculated to calculate the performance of the base case. This is the performance of our base case and we will use it later to compare, whether the proposed case is performing better than the base case or not.

Now, it is time to create the proposed case. So, while we have to create a proposed case we can just create another building in the same file, or we may just save the existing file, and copy it as a new file, and rename it and make all the necessary changes, whatever changes are desired. So, we now have the same file saved as proposed case. Let us quickly have a recap of what all needs to be changed; what is the difference between a base case and a proposed case? This building will look exactly the same, except for some minor changes.

So, let us quickly have a recap.

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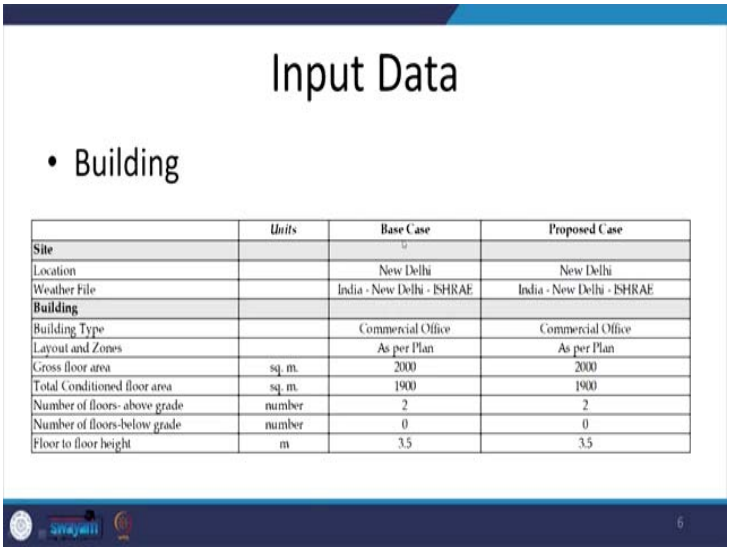

	Units	Base Case	Proposed Case
Site			
Location		New Delhi	New Delhi
Weather File		India - New Delhi - ISHRAE	India - New Delhi - ISHRAE
Building			
Building Type		Commercial Office	Commercial Office
Layout and Zones		As per Plan	As per Plan
Gross floor area	sq. m.	2000	2000
Total Conditioned floor area	sq. m.	1900	1900
Number of floors- above grade	number	2	2
Number of floors-below grade	number	0	0
Floor to floor height	m	3.5	3.5

So, if we look at the input data, the base case and the proposed case will have exactly the same site. So, the location which was taken in base case was New Delhi. And, the weather data file which is chosen is the ‘New Delhi, India’ ISHRAE file.

The same files will be used for the proposed case; they will remain exactly the same. Also the broad geometry of the building will remain the same where the building type, the layout of the building the zones, the gross floor area, the total conditioned area, total number of floors, below and above grade, and also the floor to floor height. So, since all these parameters have to remain the same, we copy it is easier for us to copy the base case as proposed case a new file and then go ahead with the changes.

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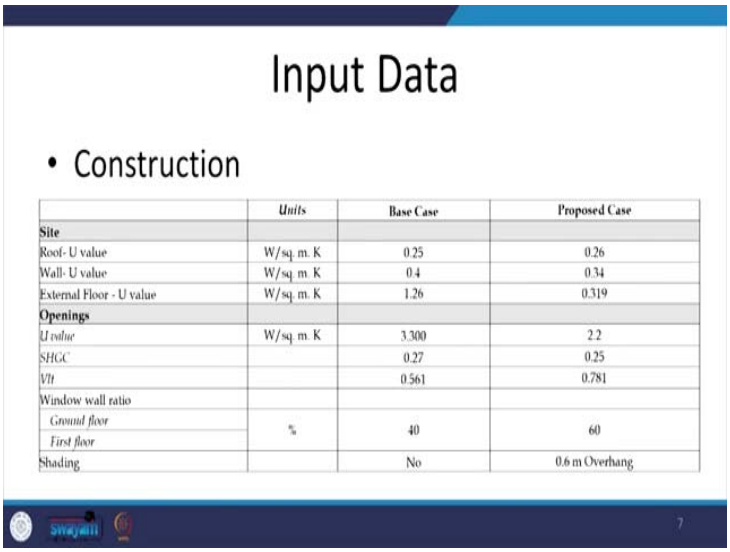

Now, let us quickly look at the changes which we are proposing. So, the base case which we created, if you remember we had created the constructions, the construction typologies for walls, roofs, windows openings, everything as per ECBC prescription.

So, if we are looking at U value here. We created a U value roof with a U value of 0.25, which is as per ECBC; Wall with a U value of 0.4 and external floor with a U value of 1.26. Ground floor we took as default, which is what we will keep the same in proposed case as well. For openings we assumed the U value of 3.3 and SHGC of 0.27 and a window wall ratio of 40 percent, there were no shadings to be considered.

Now, in proposed case the changes that we are going to bring in. The proposed case we are going to assume that roof U value is 0.26, the wall U value is 0.34, and the external floor U value which is not the case here there is no external floor, which is being considered, but 0.319, wherever it is, ground floor remains the same. U value we will take as 2.2, which is improved SHGC as 0.25 and VLT as 0.781.

However, despite using the better glass we or to compensate, for the improvement in the glass, we are taking a new case, a proposal, where the window wall ratio will be increased from 40 percent to 60 percent. So, though this is a negative thing as per ECBC prescriptions for the climate of Delhi, window wall ratio approximately 40 percent is the best proposed one.

However, if we increase 60 percent increase the WWR to 60 percent, but also improve upon the type of glass. Let us see, what kind of differences in performance we see. Also, since base case had no shading, proposed case we will experiment with a shading of 0.6 meter, which is a horizontal overhang.

So, no fancy shading is being proposed here, but impact of shading will now be accounted for.

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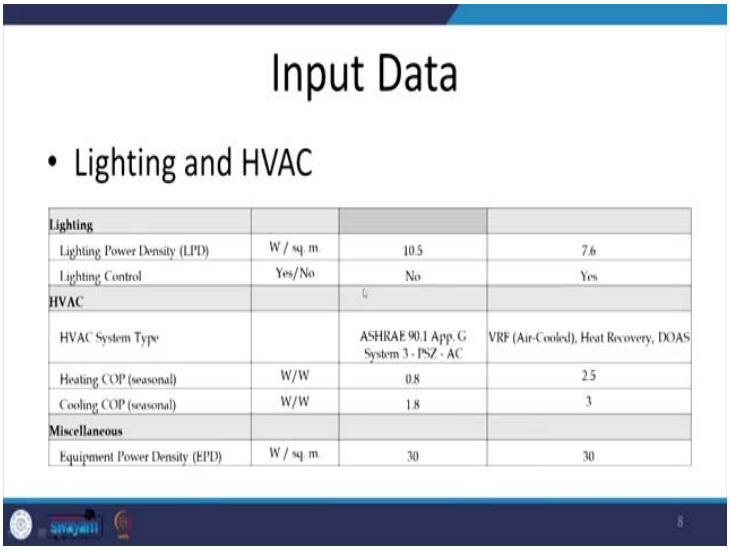

For lighting and HVAC initially we considered lighting power density of 10.5 Watt per square meter. Here, we will reduce it to 7.6 in the base case there were no lighting controls used while in proposed case we will be using the lighting controls.

So, for HVAC we used as per ASHRAE 90.1 appendix G, the system 3 prescription, while in this case proposed case, we are going to use variable refrigerant flow the VRF along with heat recovery. And, instead of the COP for heating and cooling as 0.8 and 1.8

respectively, we will be using a higher coefficient of performance, the equipment power density we are going to keep the same.

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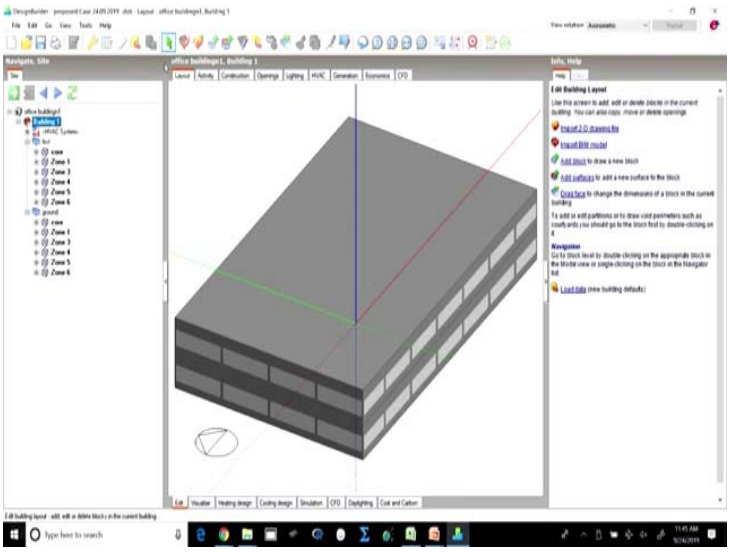

Now, you already know how to change this. Another thing, which is going to be kept as the same here, we are making changes in proposed case.

So, all other things have been brought directly as it is along with the activities.

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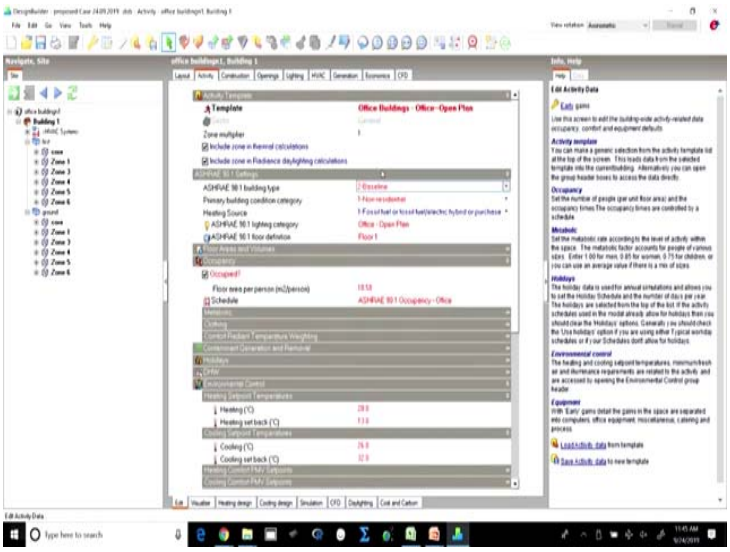

So, the activity is activity as well as the schedule is going to be remain retained as the same. There is no change that is going to be there also the heating set points and the cooling set points are going to remain the same. We cannot show the reduction in energy consumption by changing the set points. Whatever set points have to be taken in the base case will be the same as we will take in the proposed case.

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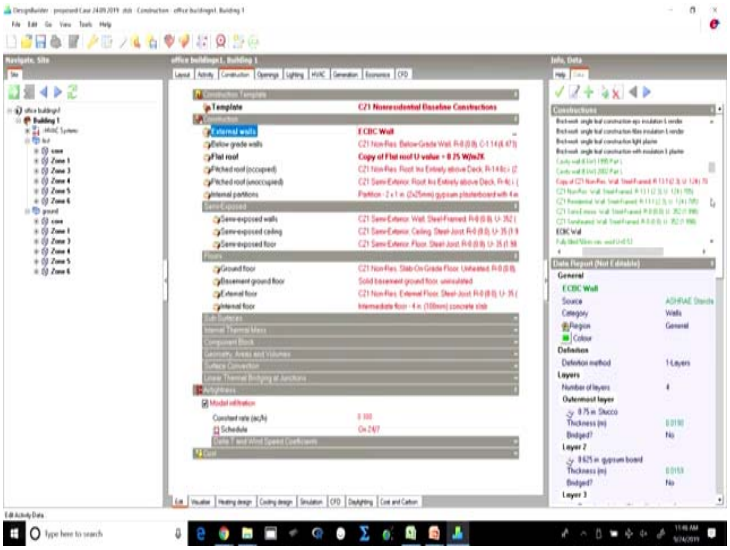

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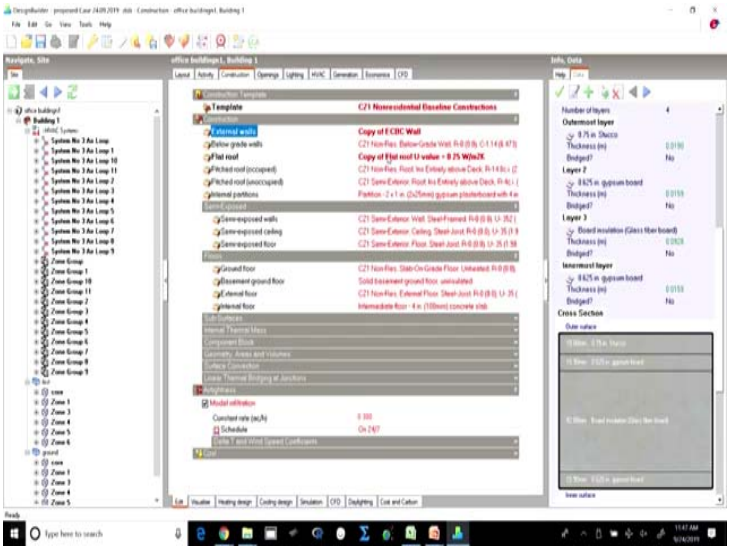

So, let us look at construction. So, currently the wall which is being used is ECBC wall the template and the U value which we used was 0.4.

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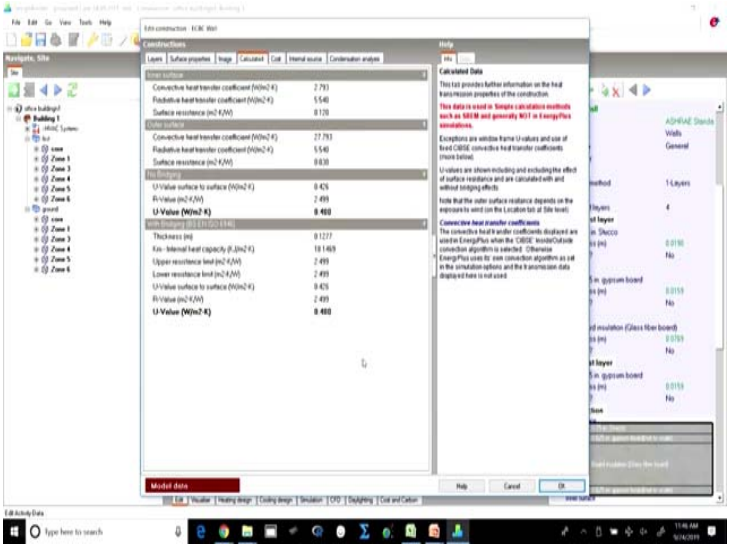

So, if we see the U value, which is being used is 0.4. Now, we have to create a copy of this. So, here we create a copy of ECBC wall, we have already seen it and we edit it.

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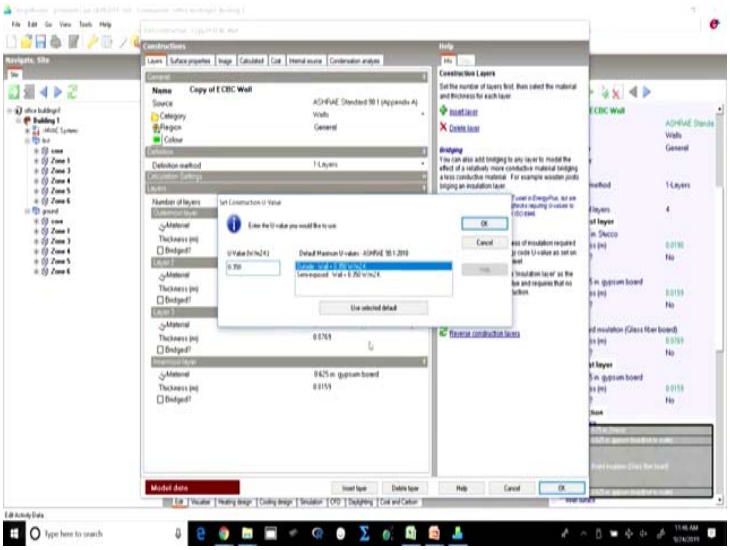

So, we have to set the U value. So, instead of 0.4 as per the input data which we are now using the U value will be changed to 0.34. So, here we change the value to 0.34 for the outside wall. And, we select this copy of ECBC wall, this new template that we have created here. So, if we check the new template, which has been created, which is for the proposed case is 0.34, which is definitely a better wall.

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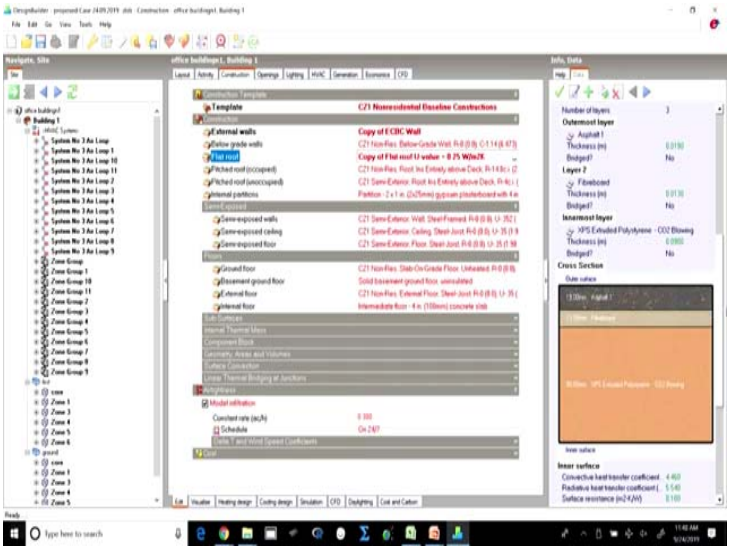

Similarly, we will change the templates for each one of this the flat roof U value here was 0.25, while what we are proposing in the input data is 0.26.

So, we create a copy of the flat roof U value and we edit the values to set whatever values we want or we can also specify the layers. In case the layers are known, then the layers will be specified instead of the specific U values. So, we have already defined the external walls and the flat roof here and the construction has automatically been reflected in the respective blocks. So, if we go to the first floor and we see we have we already have the copy of ECBC wall with a U value of 0.4 and the copy of flat roof with a U value of 0.26.

So, if you look at it here, the U value of roof is the performance of the roof in the proposed case is lower than that of the base case. Marginally, but yes it is lower while the performance of the wall is proposed to be better than that of the base case. So, this is how we will change the construction.

This is automatically reflected in both the floors then we move on to openings. Now, the changes in openings are one we are changing the glass in the proposed building. So, we change it to this new glass which is being shown here, the properties which are being shown here.

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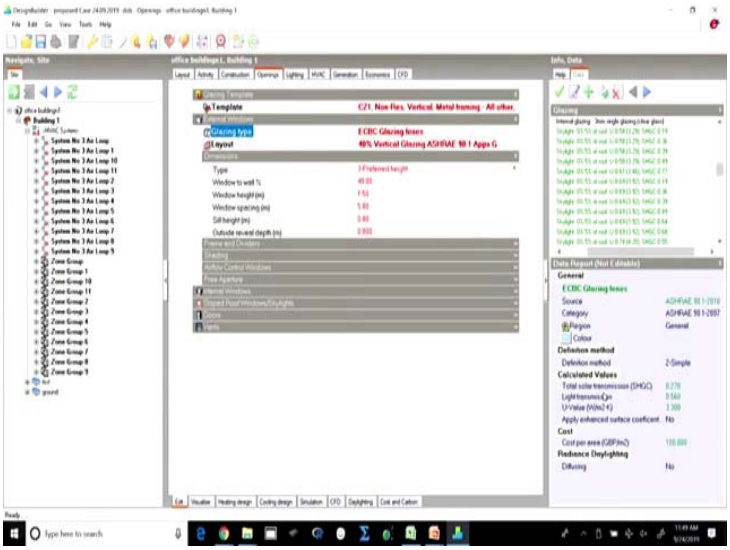

So, instead of using an ECBC glazing fenestration, let us edit the properties; create a copy and edit.

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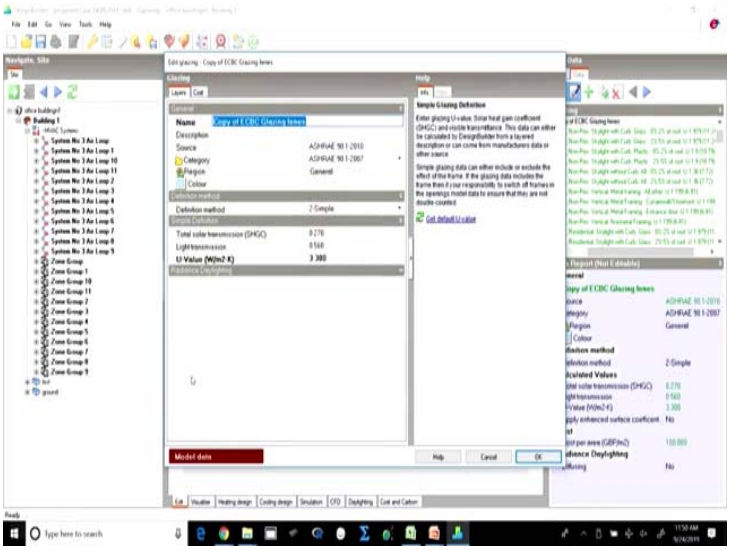

So, instead of 0.27 the solar transmission has been proposed to be 0.25, U value to be 2.2 and VLT to be 0.78. So, the U value goes to be 2.2, which is possible to be created here and the light transmission becomes 0.781 and the SHGC goes to be 0.25. Now, this these values that I have created here might appear to be hypothetical values.

However, when in real scenario when we enter the values for the proposed cases we might actually be selecting a glazing system, which is already available in the market.

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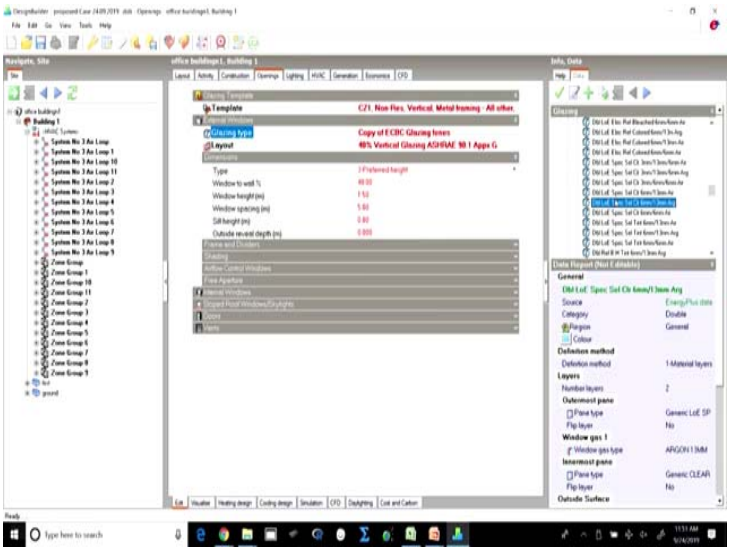

So, suppose we have to select a double glazing system. So, a lot of these different types of double glazings, the templates are already available here. We can select any one of them and we can check for their values.

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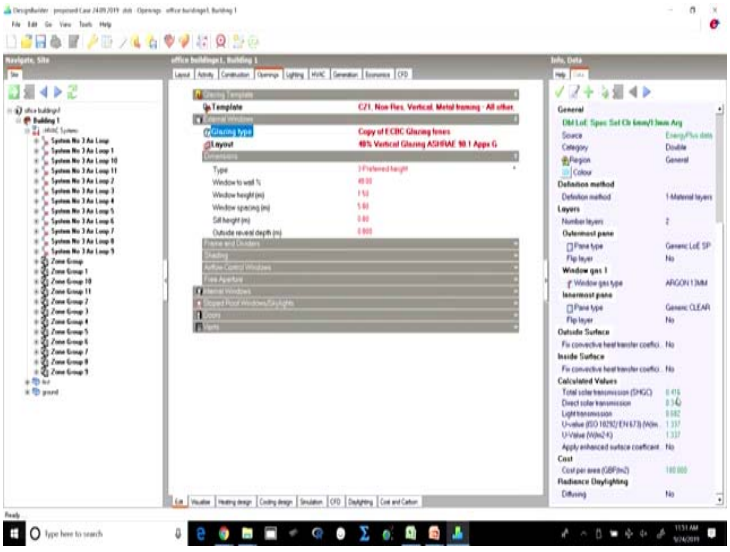

So, in case we have a glass type in mind a type of double glazing which we already have in mind and also their values, we can directly select this glazing type and use it here.

However, in case we are going for a specific configuration where we are selecting two different types of glasses and getting them assembled, specifically for the project for the proposed project, there we might have these values U values SHGC and VLT, which may be entered and a new type of glazing system may be created.

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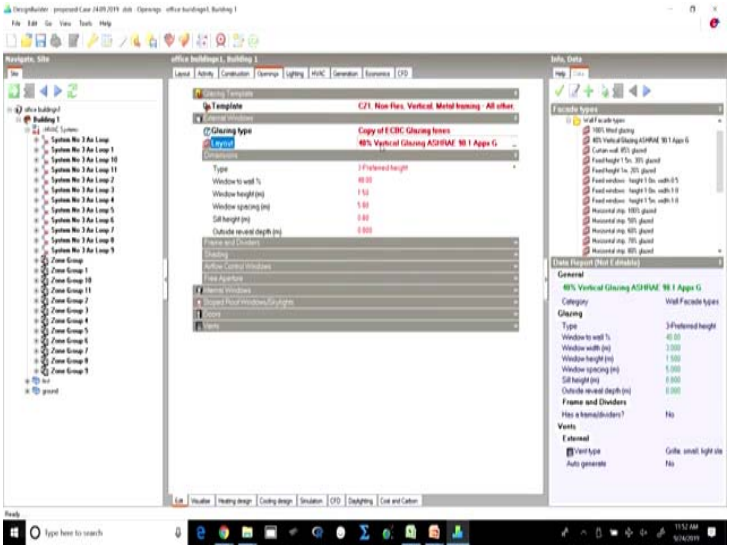

Now, in layout we already have used a 40 percent vertical glazing as per ASHRAE. If, we see here we do not have a different say 60 percent vertical glazing in ASHRAE the template.

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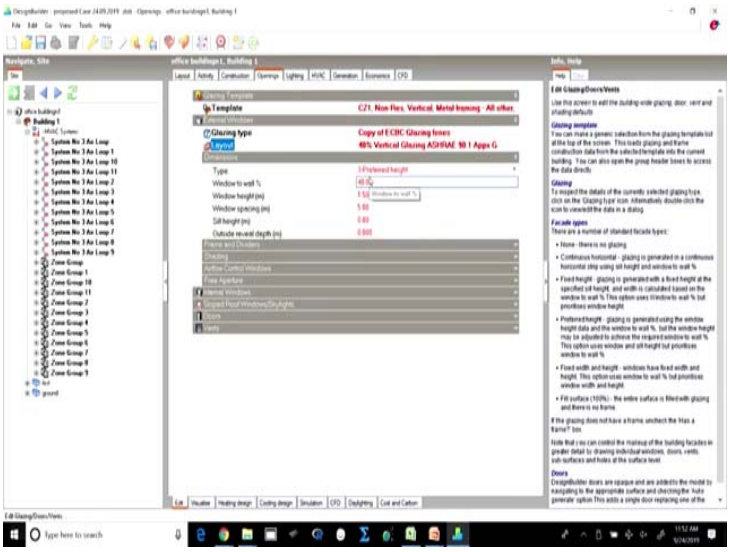

So, we keep the template as the same where it is uniformly distributed on all the sides the preferred heights and spacing's are already given. Instead of 40 percent window to wall ratio, we will just change it to 60 percent window to wall ratio and update it; let us quickly check the difference it brings.

So, we can see that the spacing between the windows has reduced, if you compare it with that of the base case, you can see that the windows have been changed and the overall window to wall ratio the window area has been substantially increased. So, we stop here for today's lecture. And we will continue to create our proposed case and make the changes in the base case as per the proposal and continue with the same lecture in the tomorrow's class.

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