Sustainable Architecture
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Lecture - 53
Whole Building Performance – III

Good morning. Welcome back to this third lecture for this week where we are learning the software called Design Builder. Now, before I go ahead with the talking about how to input more parameters into the software I just want to reiterate that Design Builder is just one software which can be used to perform this kind of an analysis. There are many other softwares of equal capability which are available in the market you could use any one of them, but the input parameters would remain the same. You would require activity templates, you would require the construction materials, and you would require the zones to be created and their performances to be put in into the software.

So, all that would definitely be needed. So, whether you are working with software A or software B the input parameters are going to remain the same and also the mandatory requirement is for compliance you have to use the same software for base case as well as the proposed building. So, what we are essentially doing when we are doing this energy simulation and analysis is that we are comparing the base case with the proposed case.

It is an Apple to Apple comparison at all times. Same software, same input parameters except the ones which are permitted to be changed. And, then we compare how better the proposed building is as compared to the base case that we have taken. And the base case we are taking directly from the values which has prescribed in the codes.

So, if we are working in India we have already seen that ECBC is the code which we normally use and the prescriptive values are already given. So, for creating the base case we would only be considering the ECBC while if they are doing the same exercise for say US and other parts of the world we may be using different codes, in America we may be going ahead with ASHRAE 90.1. For LEAD compliance even in India we may still be going ahead with ASHRAE 90.1 and like that.

So, we have to be very sure that the same software is used and it could be any software which has the same capabilities. So, today what we are going to do is we are going to

input the parameters related to the building envelope. We are going to add in the values the U values and other prescriptive values as given in ECBC for opaque walls for the roofs and also for the fenestration.

So, if you remember ECBC we have U value to be put in for the walls, we have U value to be put in for the roof, we have U value, SHGC and VLT to be put in for the fenestration. Along with that we also have window to wall ratios to be put in for the fenestration. In base case, all these values will be the prescriptive values as given in ECBC. So, let us go ahead and get started with the software and let us see how can we input the prescriptive values. So, let us switch to the screen of the software now.

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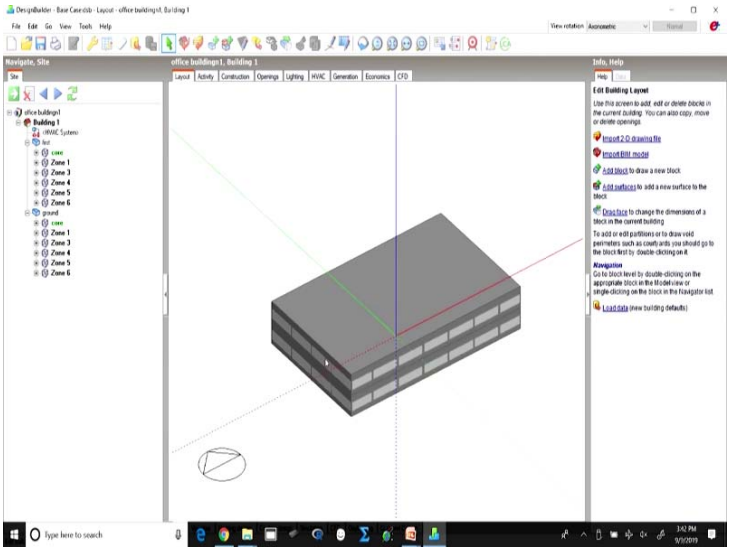

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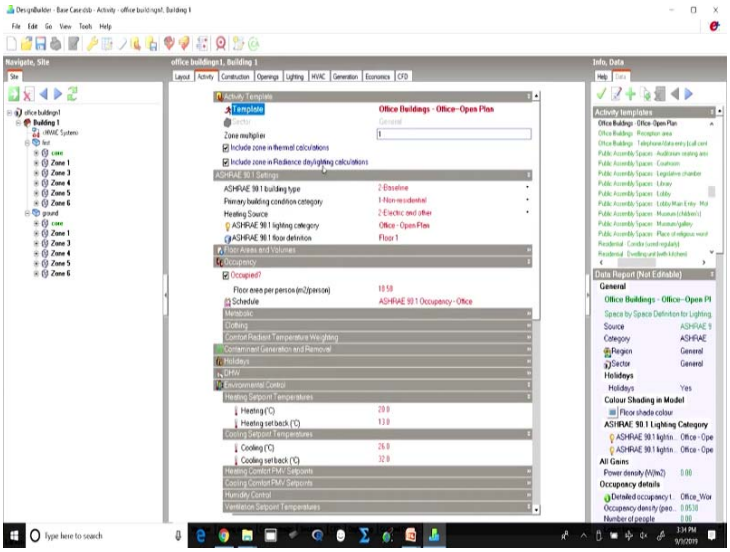

So, in the previous two lectures we have already created the geometry of the building and we have assigned the activity to the building and which has been inherited by all the different zones and wherever we wanted to change we have changed the templates for the activity.

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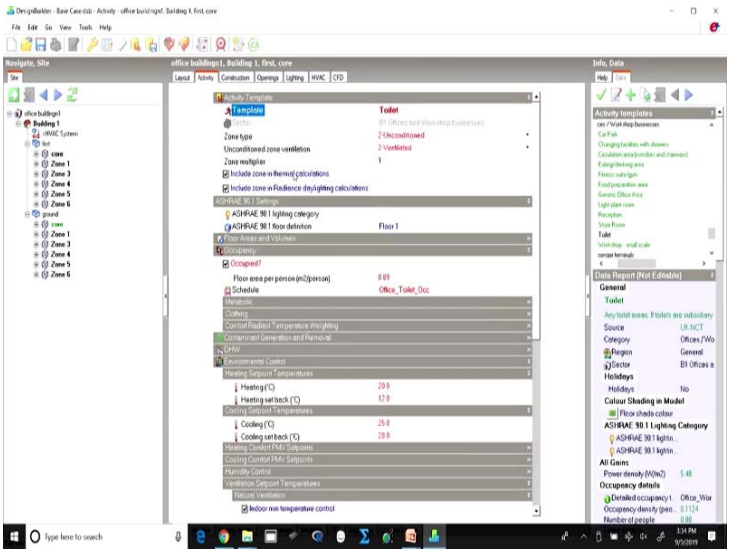

So, now we have a building along with its activity.

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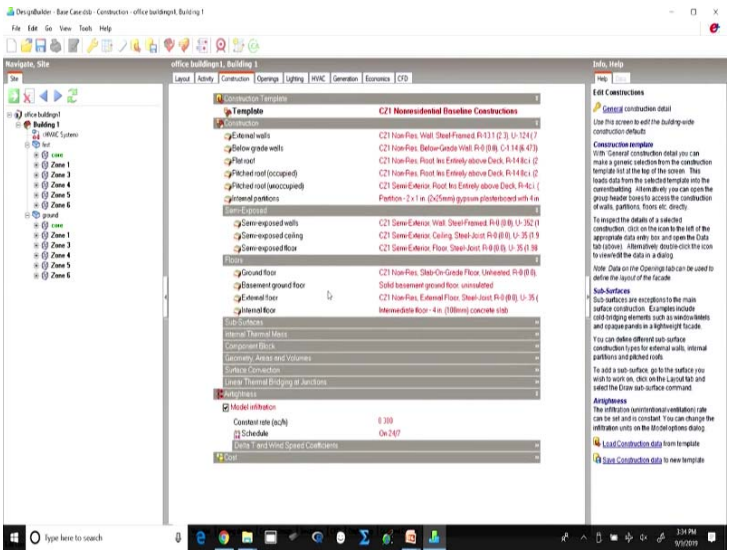

So, we will move on to construction now. So, just to remind you we are still creating a base case building a baseline building and we are not doing the proposed case as yet. So, in the base case building, the template which it automatically takes is CZ 1 non-residential baseline constructions which is what is taken as default here.

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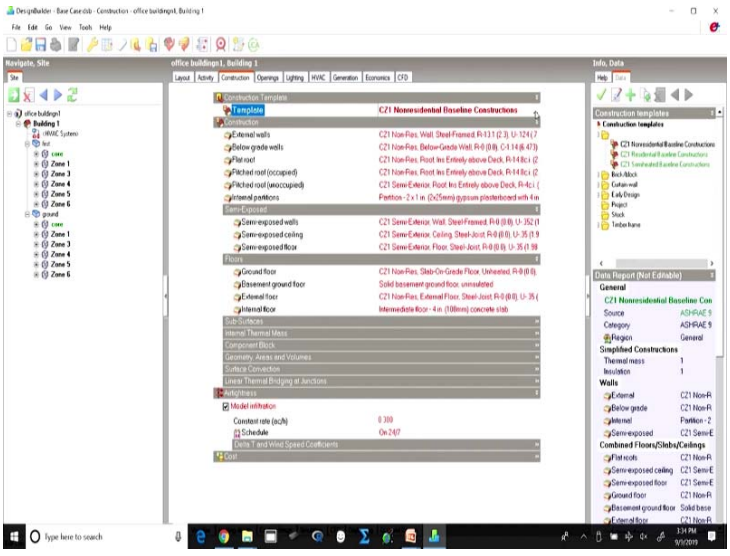

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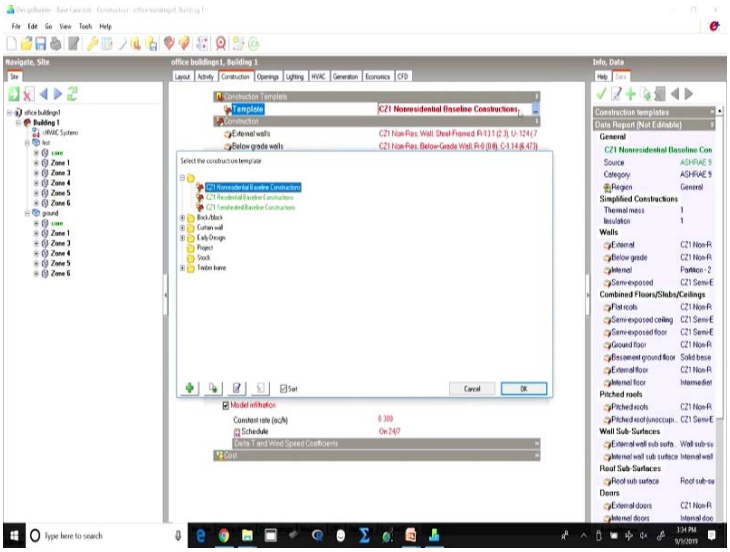

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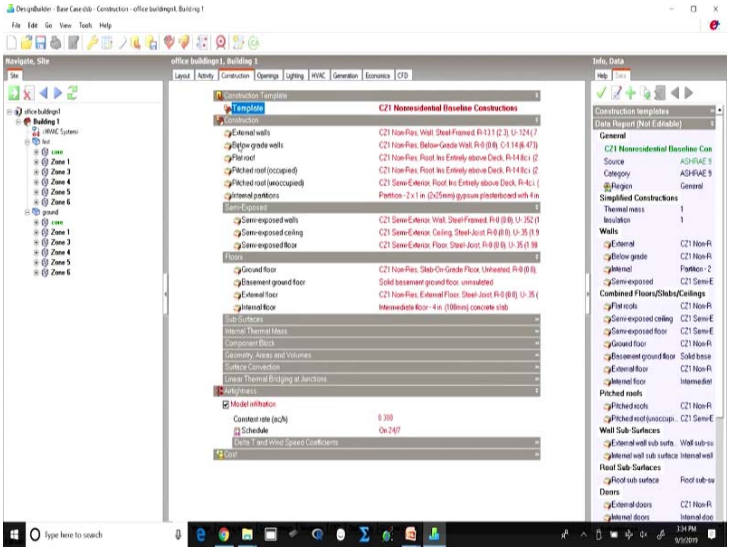

However, we can change the definitions, we can change the constructions for each one of these components. Now, as we have already discussed you know what these external walls or below grade walls or semi-exposed walls are, in this particular building we only have 4 different types of constructions. First one is external wall.

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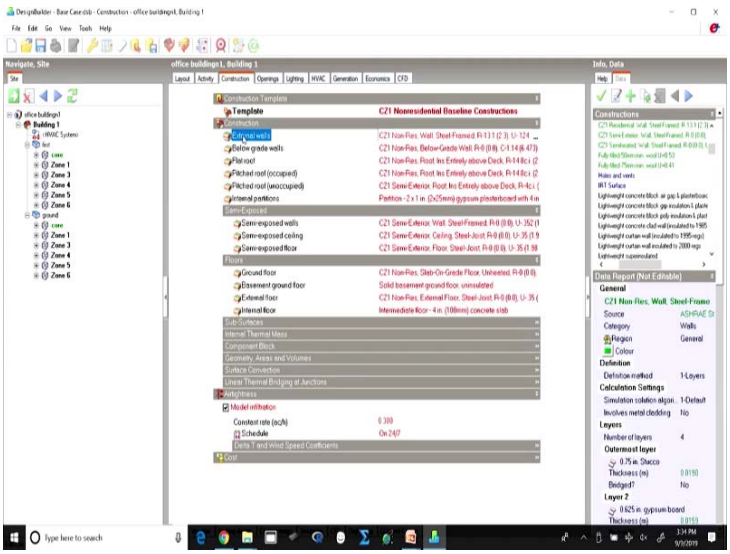

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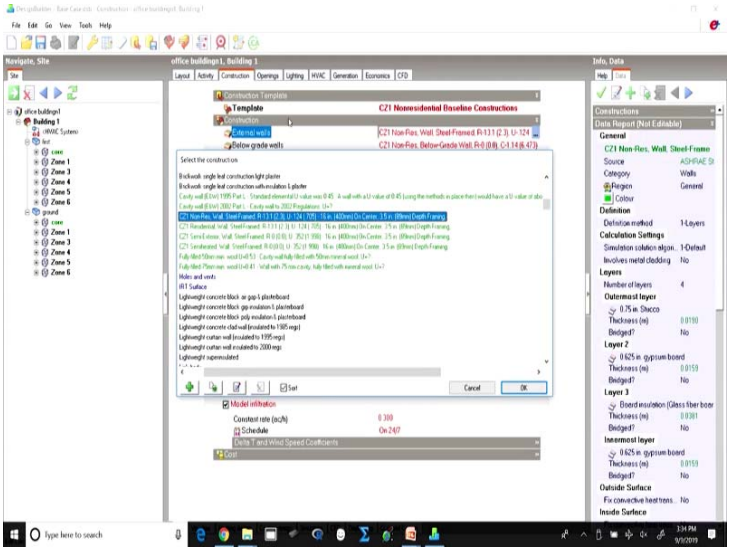

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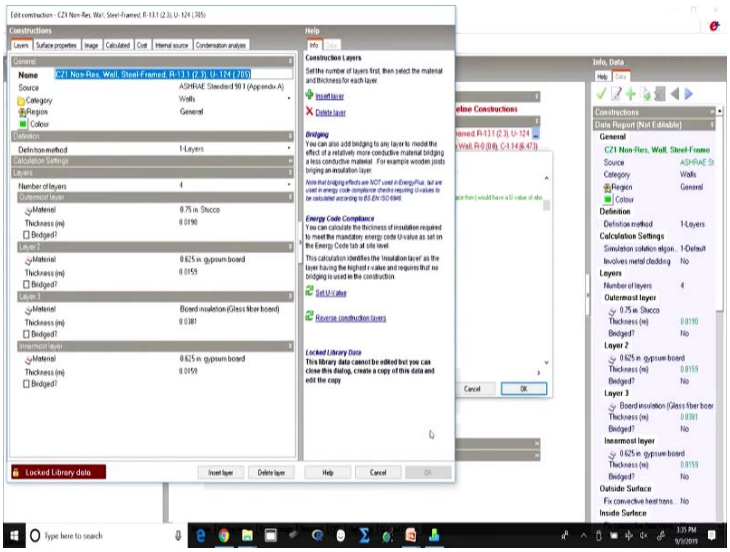

So, here if we go to the external wall and if we see the definitions of whatever is being taken in this wall and we know the 2 overall value.

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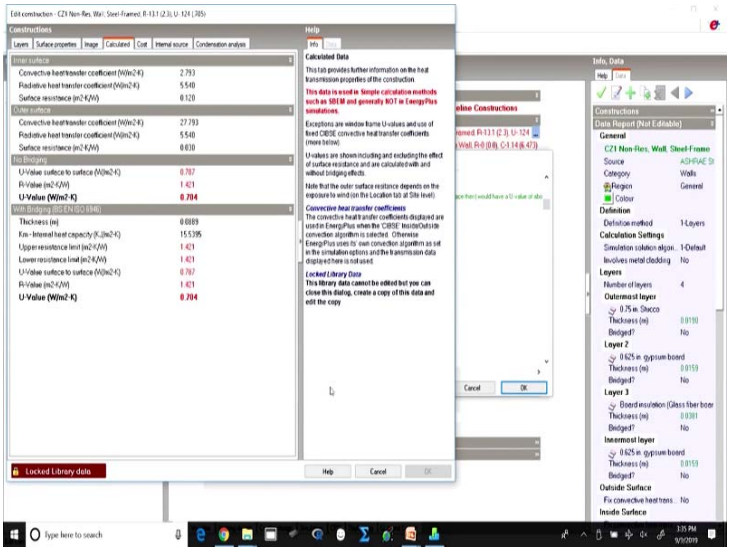

So, here the value has been taken as 0.704 which is the default U value which is coming from the ASHRAE prescriptions. Suppose we are carrying out this whole building simulation process for compliance with ECBC or for any other rating program in India where ECBC has to be followed we will have to define our own U values.

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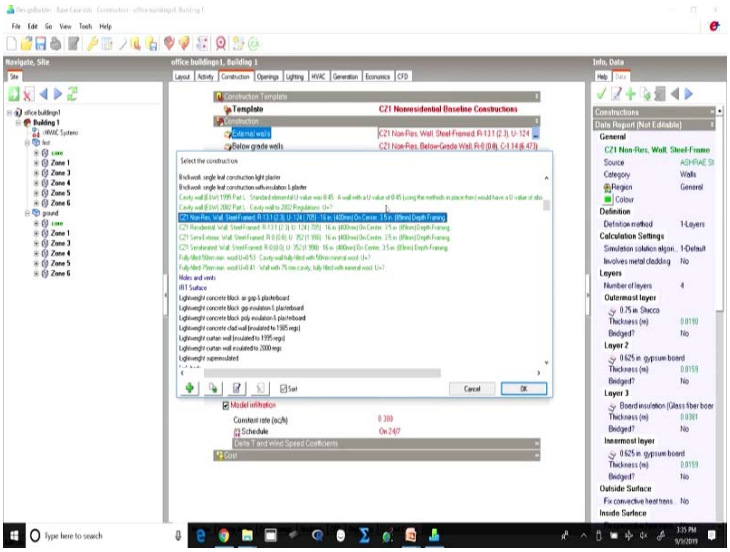

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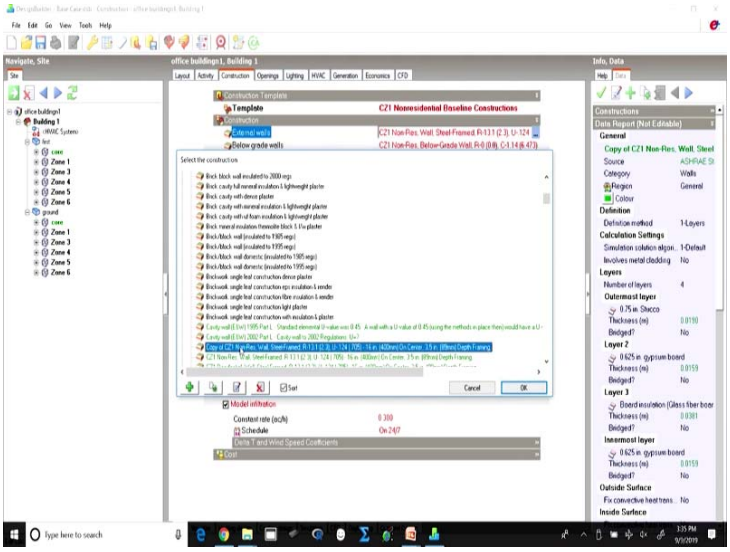

In that case again we will have to create a copy of the external wall.

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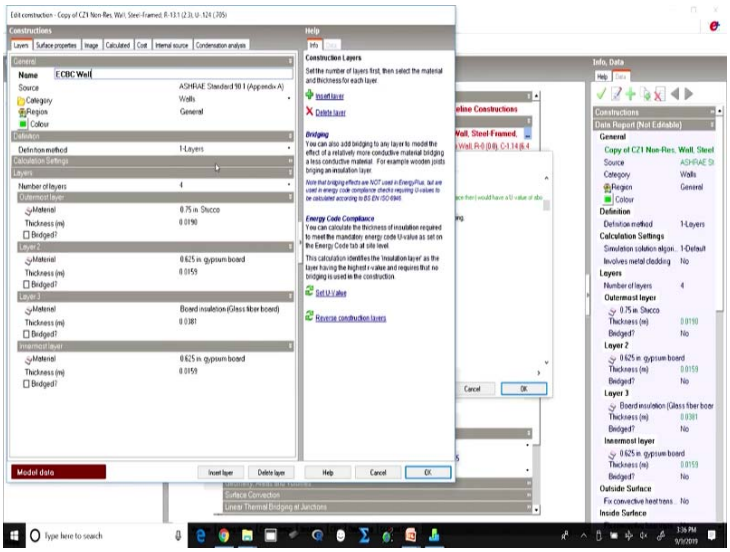

So, this is the copy. Suppose I rename it. I change it to ECBC wall which is what we are going to be taking and we change the construction methods.

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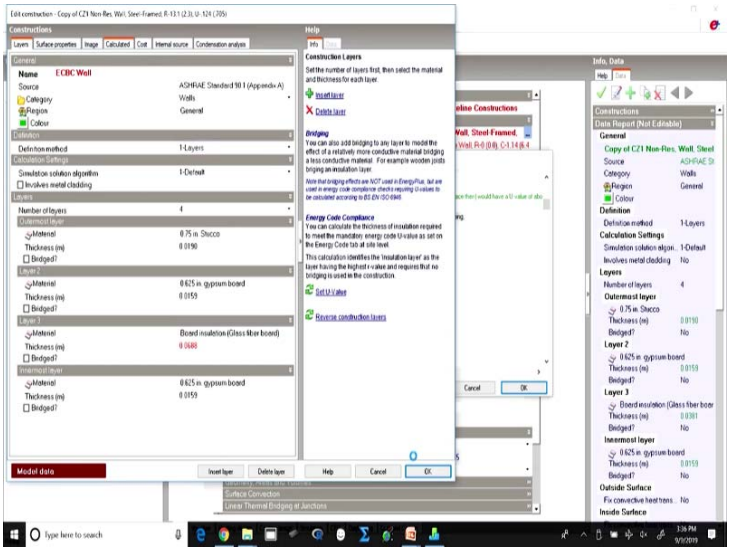

So, we may change the layers individually or we may just change the overall value. So, suppose I want to define the U value. I do not know what the layers are going to be.

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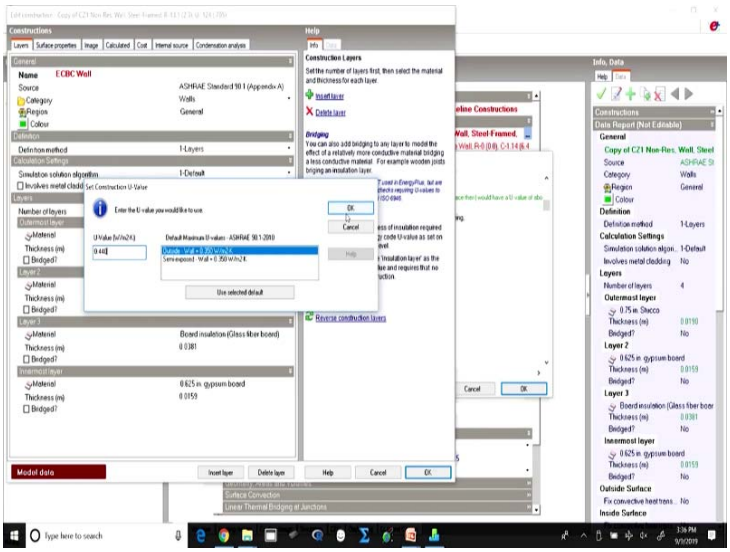

So, we may just define the U value. So, we may just set the U value. So, suppose as per ECBC if the U value is defined as 0.44.

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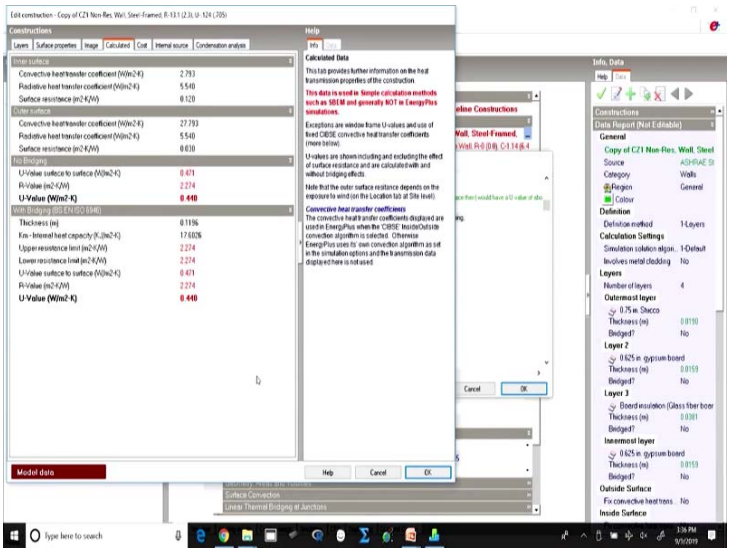

So, I will set the U value here and the calculated value will be brought to 0.44 by defining the layers which are already here or if I want to define the layers I may just define the layers.

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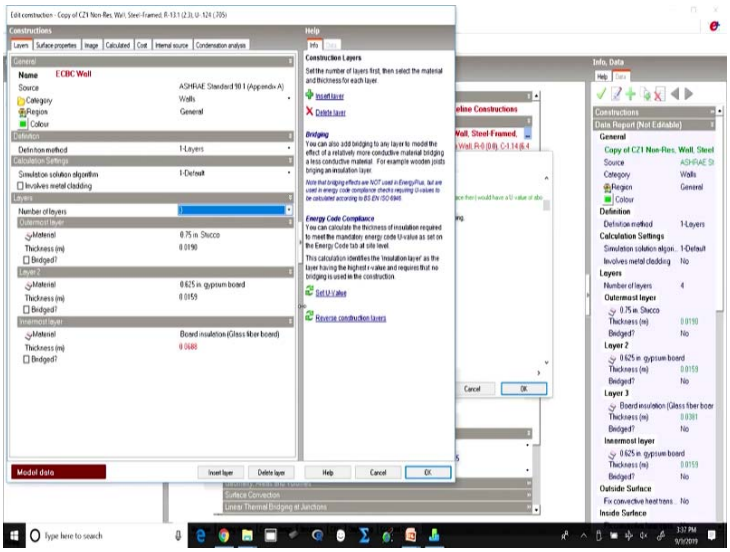

So, suppose I have 3 layers. I may then go on to define these individual 3 layers and along with that I may define the U value.

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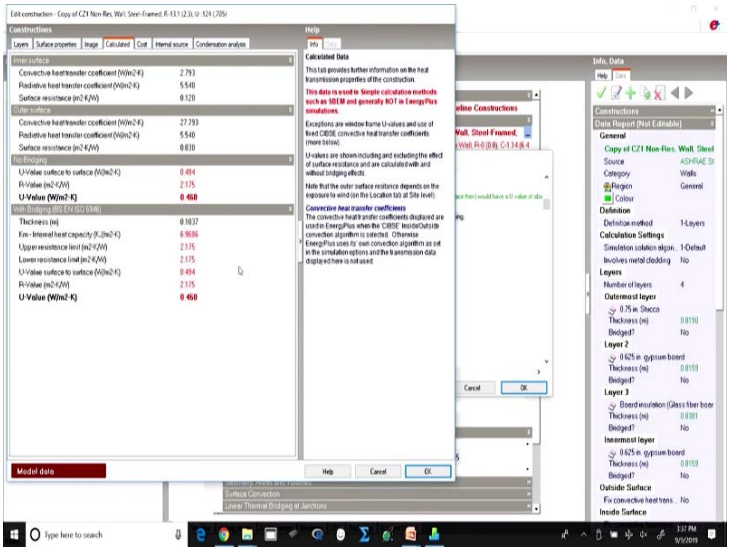

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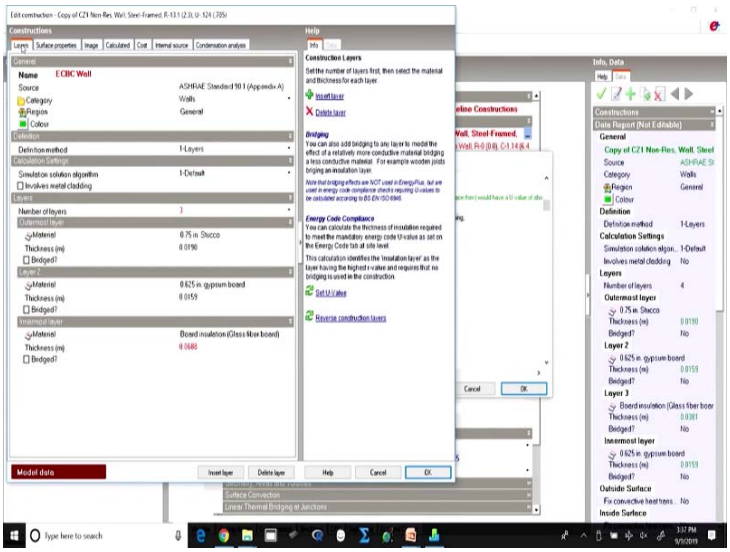

So, if I have to define the U values if I have to define the external walls as per ECBC I will have to check for both.

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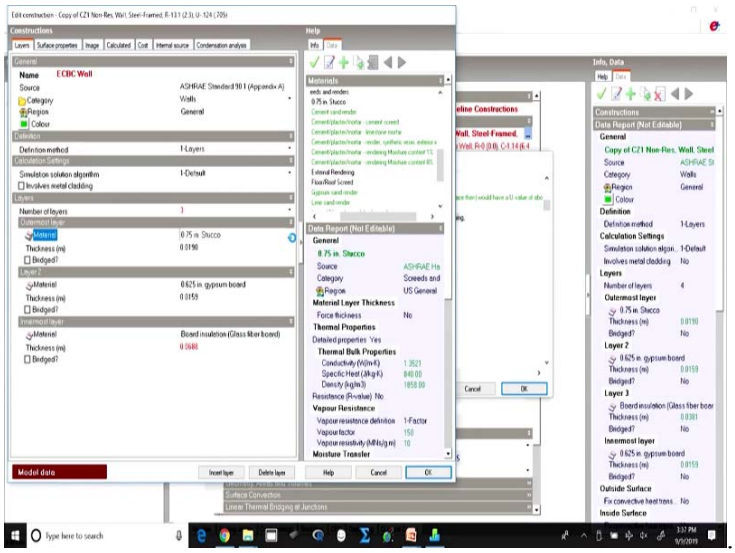

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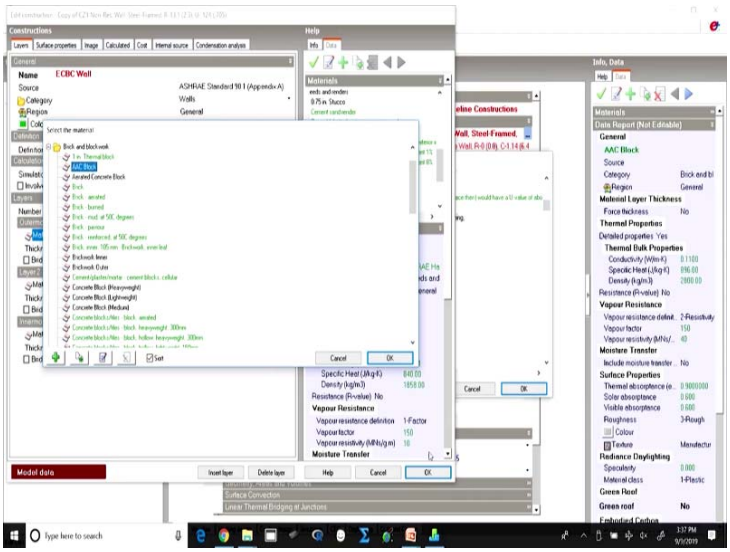

Here you can change the construction materials to bring in whatever layers we want.

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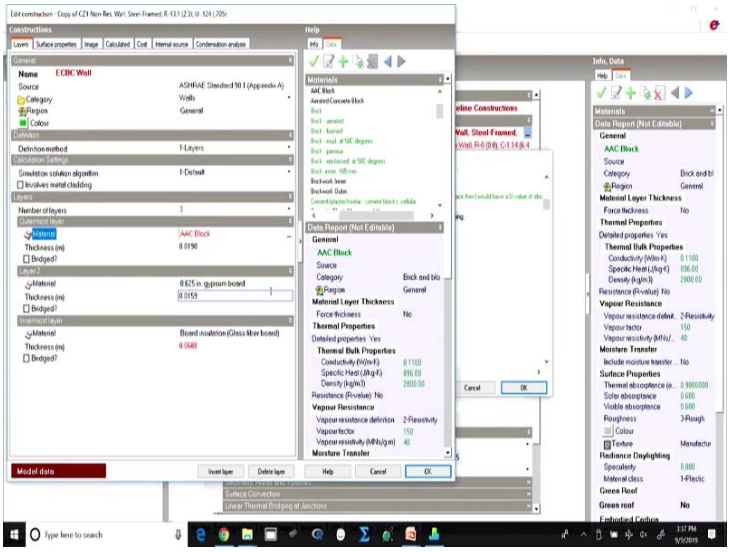

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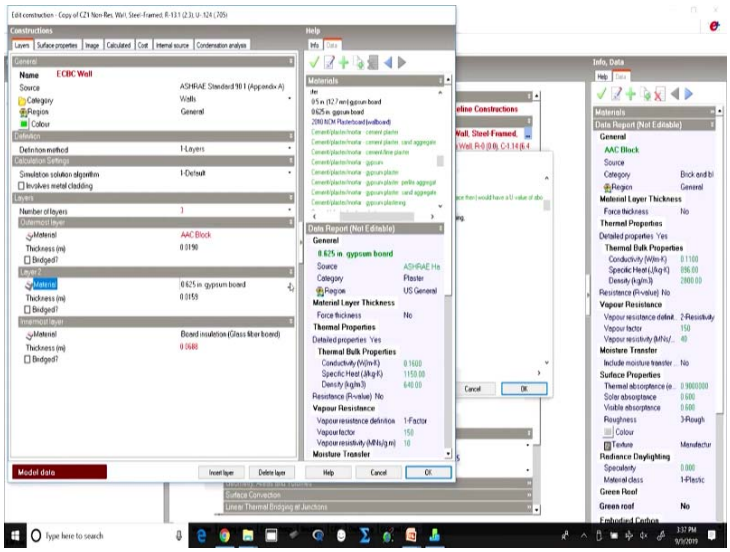

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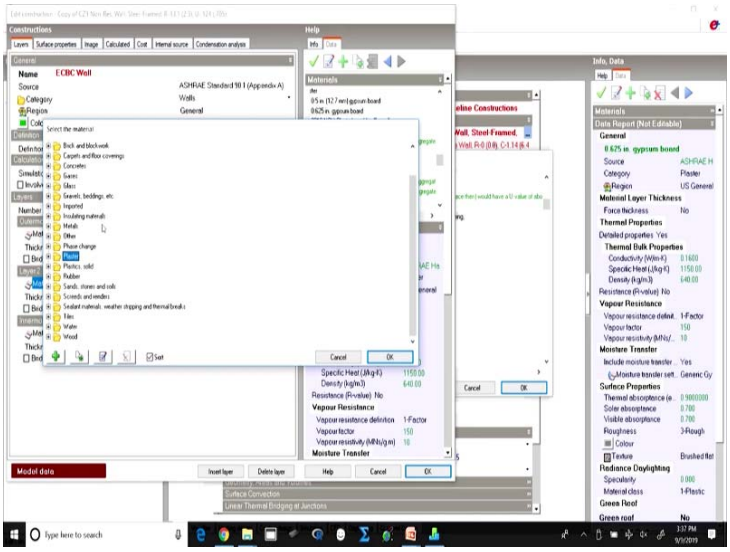

So, suppose I want to use AAC block and then in between I want insulation; so, all these materials and their templates are already available.

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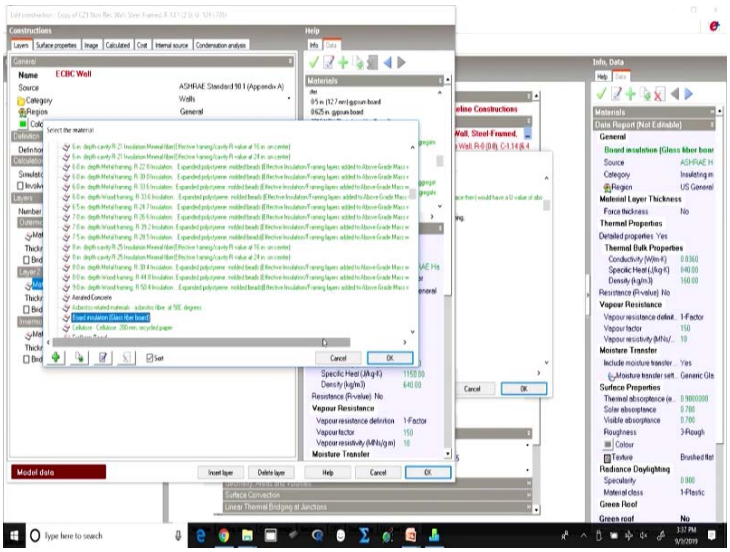

We can choose any construction material in case construction material that you have to use is not available.

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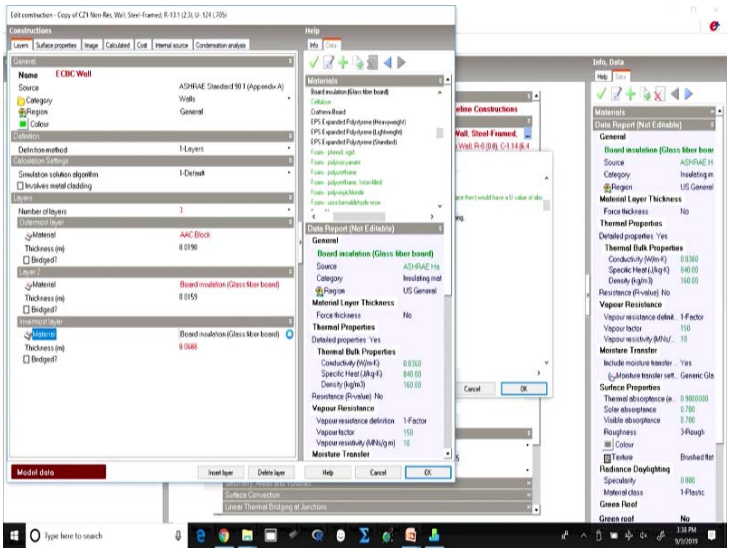

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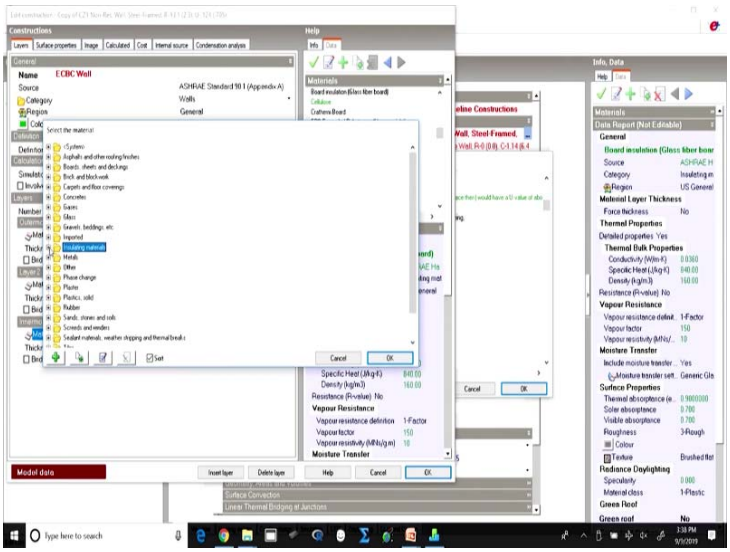

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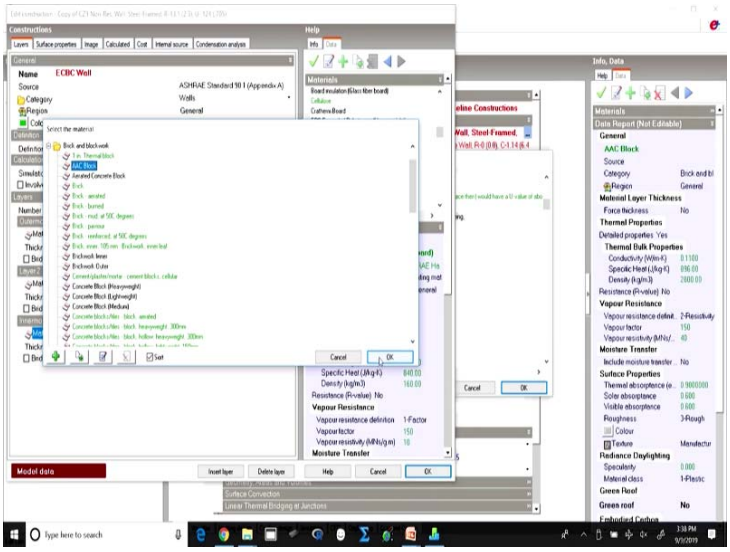

You may define the material and you may change bring in the template for that material as well as we have been doing. So it is possible to create any construction material any template depending upon your requirement.

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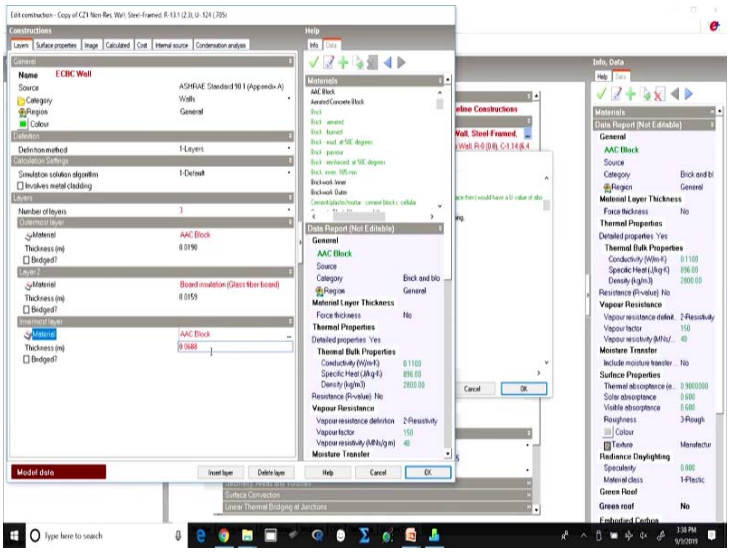

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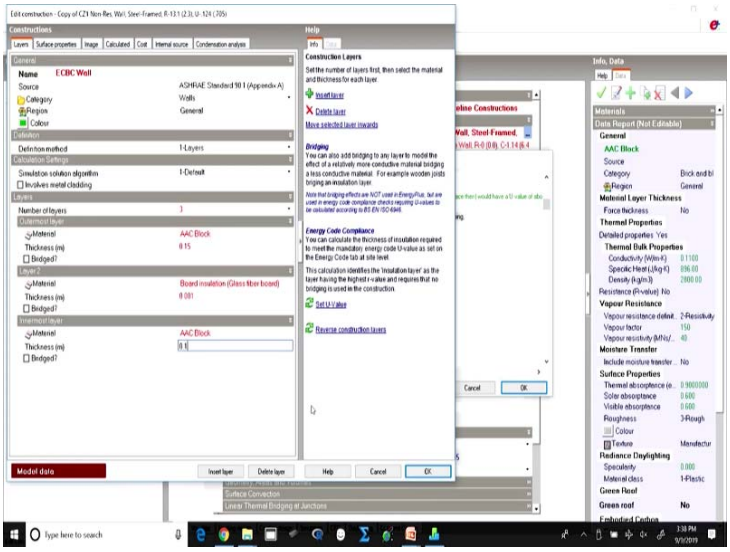

So, AAC block of 0.15 meters an insulation of 0.001 meters and 0.1 again.

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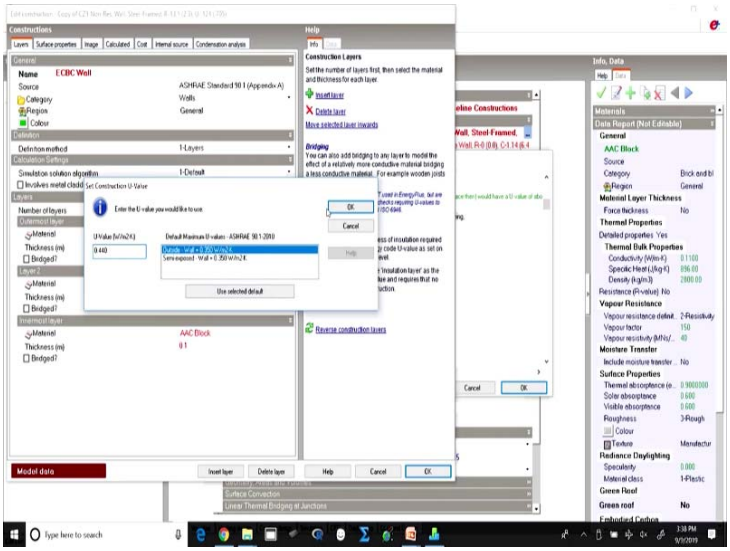

And along with this I set the U values to be 0.440.

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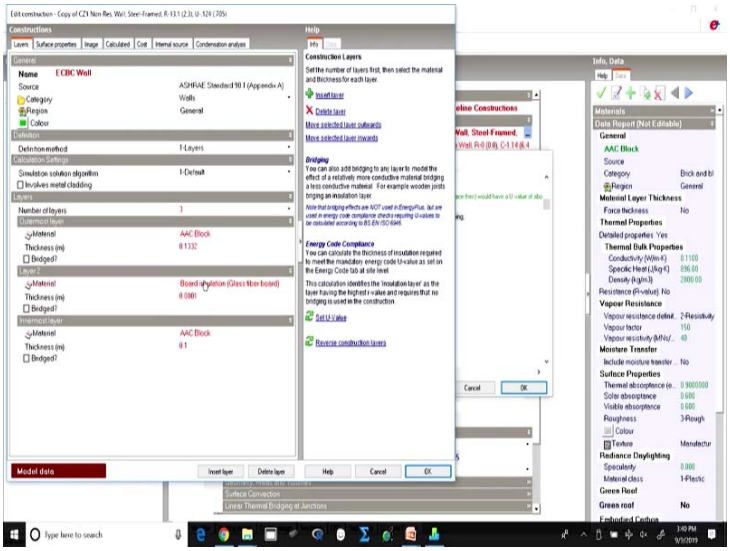

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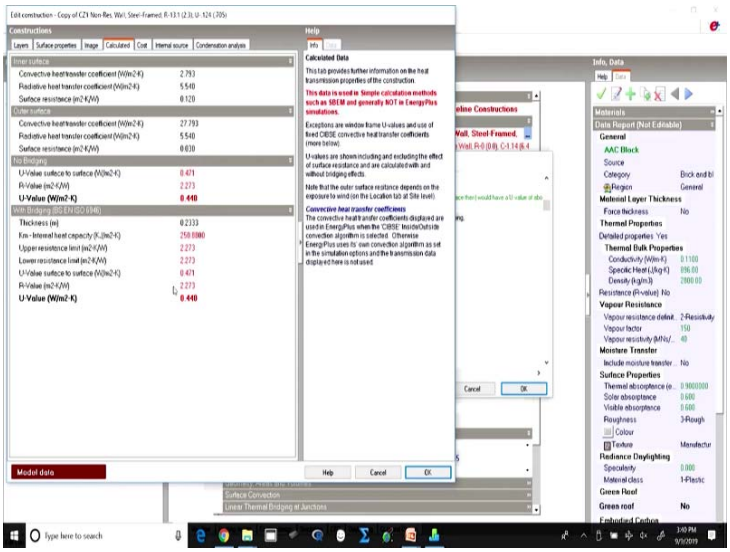

So, now with the given layers the reduction in insulation thickness is now resulting in a U value which is prescribed as per ECBC.

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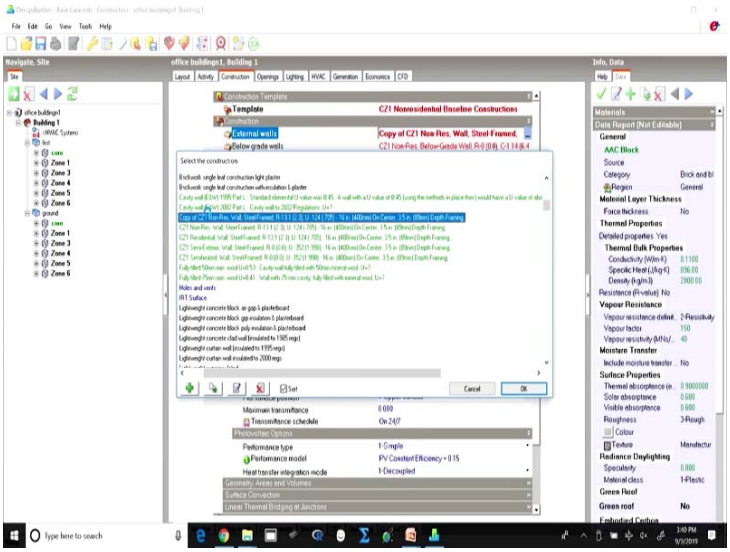

And we just accept it as the ECBC prescribed wall which will now take the U value which is defined in ECBC.

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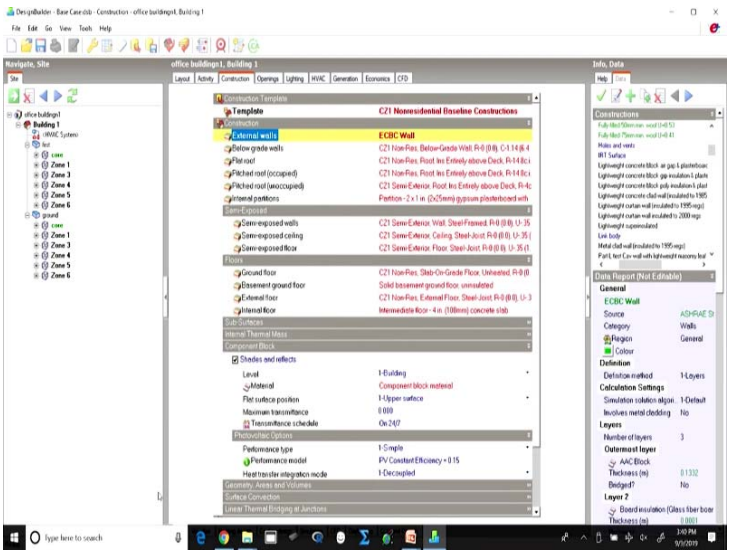

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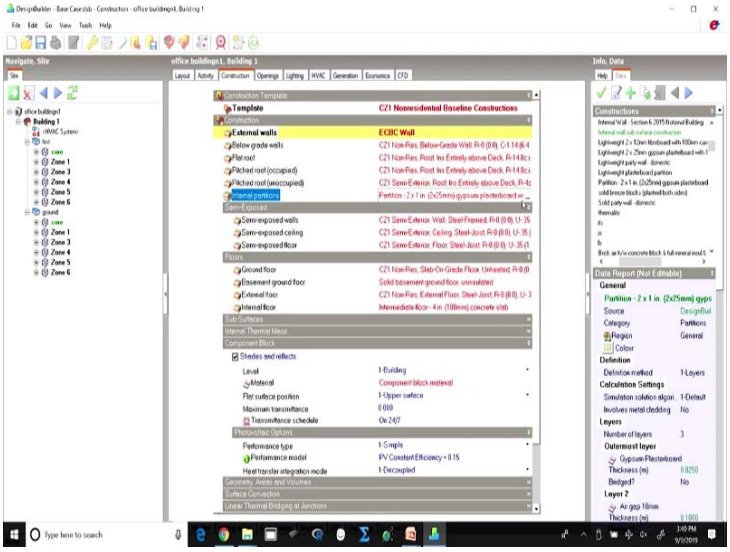

Similarly we change for internal partitions which are not defined. So, we can take it whatever material we want. It is not defined in ECBC.

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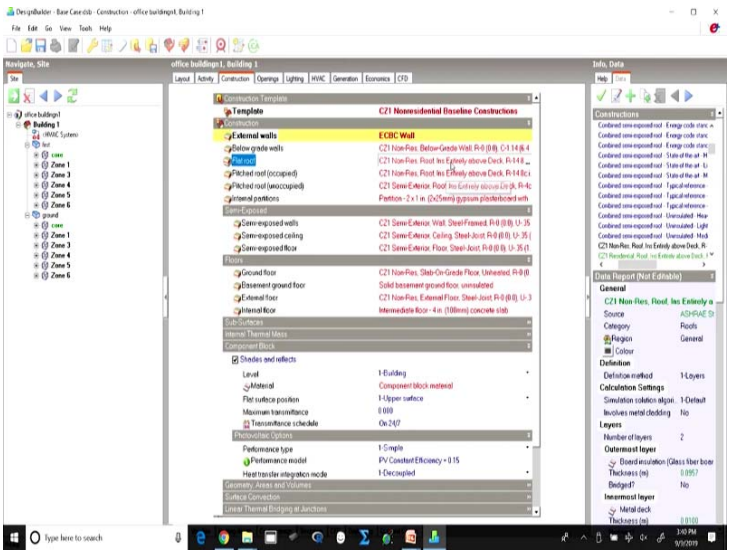

The flat roof again the U value has been defined. So, exactly in the same manner we can create a template for the flat roof. We have to create the template for the fenestration which we will see in openings.

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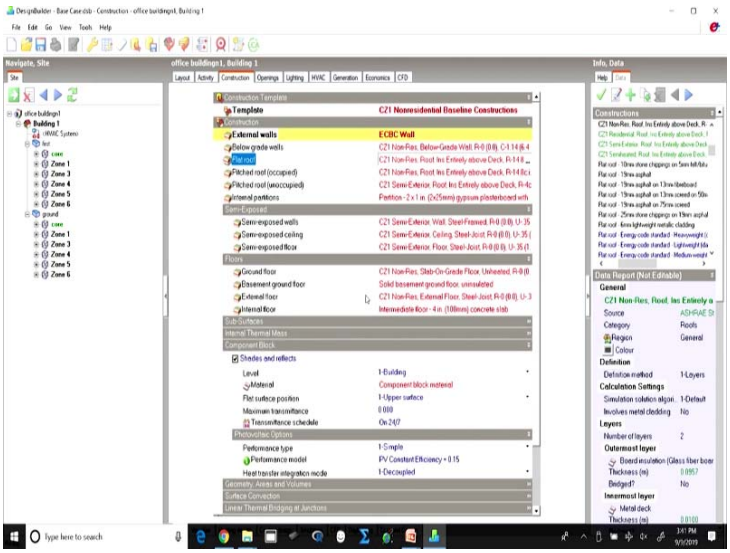

So, here for the construction we are mainly concerned with external walls and the flat roof. Once we have created the templates for these based upon ECBC or any other code that is supposed to be recommended along with that we will take whatever the ground floor slab is going to be.

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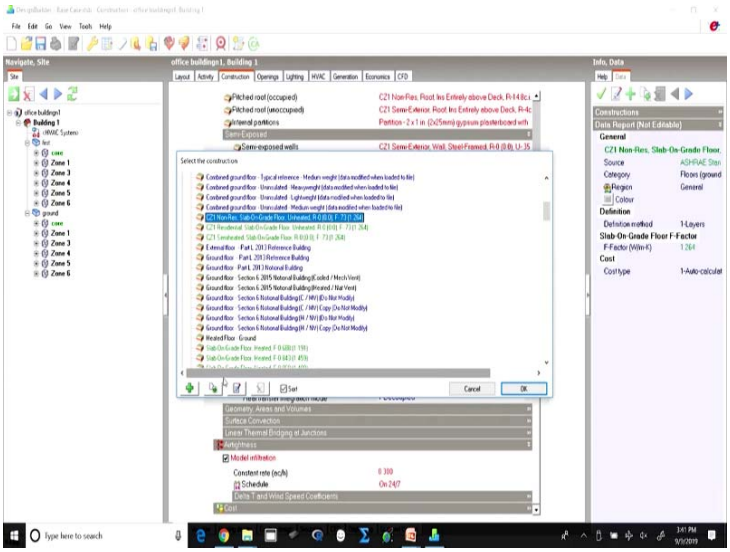

So, we may for greener constructions where we are deliberately selecting materials which are environment friendly or which have a higher thermal mass or which are more absorbing or act as heat sink we may select these different materials for the ground floor and also the internal partitions.

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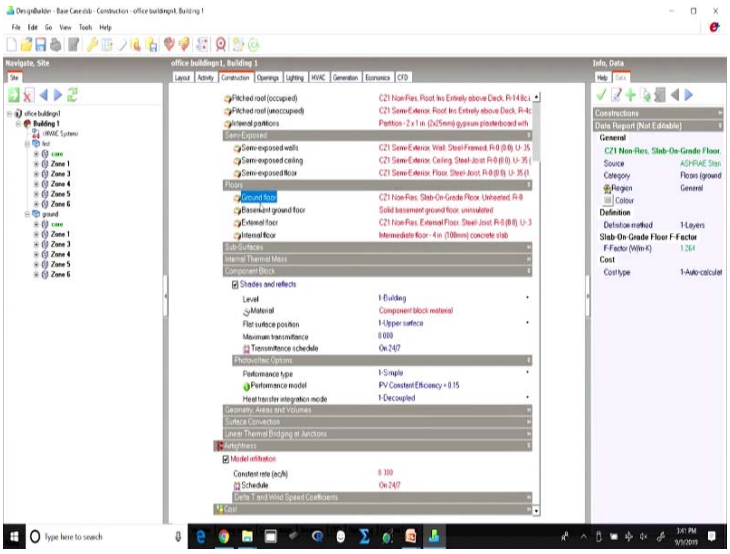

They will add, they will affect the overall thermal perform because of their thermal mass, but since they are not participating in the heat exchange between indoors and outdoors, they will not have as much impact on the overall heat exchange as external walls and flat

roof. So, we change them as per the ECBC. In addition there is another block which is called the component block. So, if I go back to the layout and I go at the building level my building, the building in question, might have another building which is adjacent to it which is not included in the thermal calculations.

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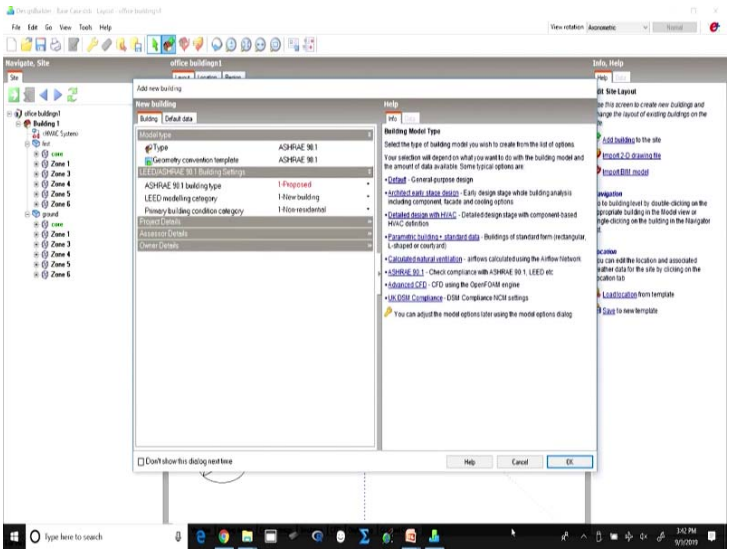

But it is taken into account because of it is shading properties because of the shading that it cast on the building.

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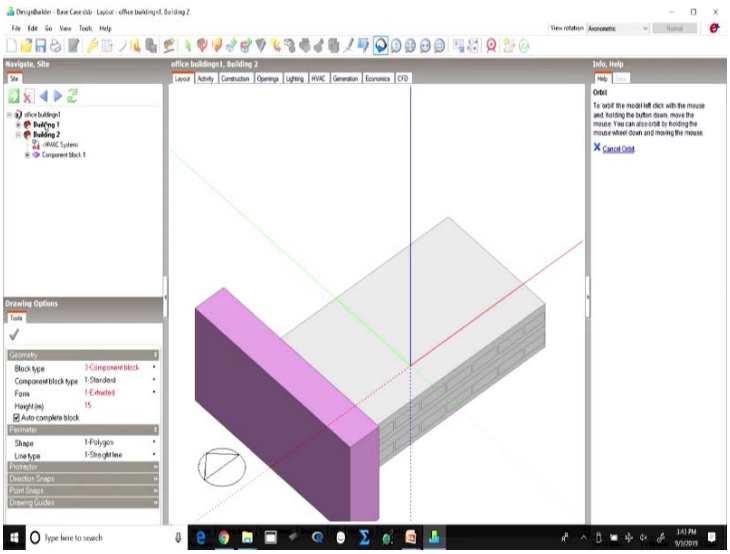

Now, that building will be created as a component block. So, we can create a component block at this site level and this component block. Suppose I make it as a 15 meter high component block. So, this component block will not participate in the thermal calculations, but the shading because of this component block will be accounted for when we are calculating, when we are taking the heat stresses, when we are analyzing the heat stresses in this building.

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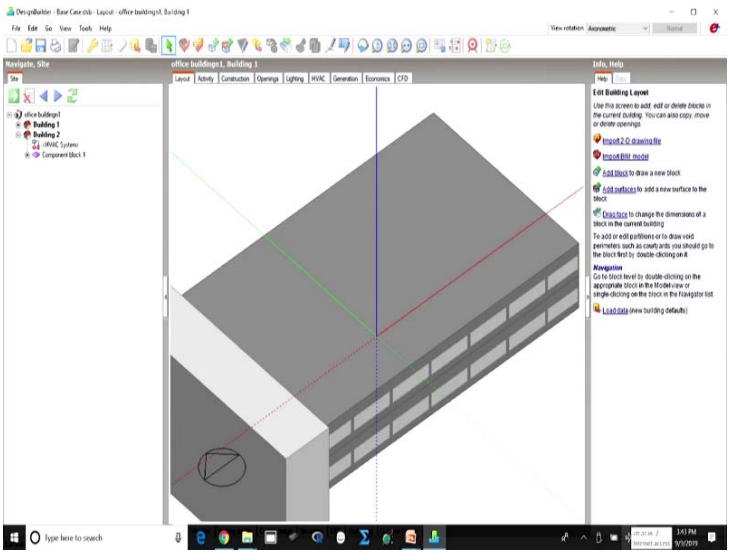

So, this is how a component block is created. Now the properties of this component block.

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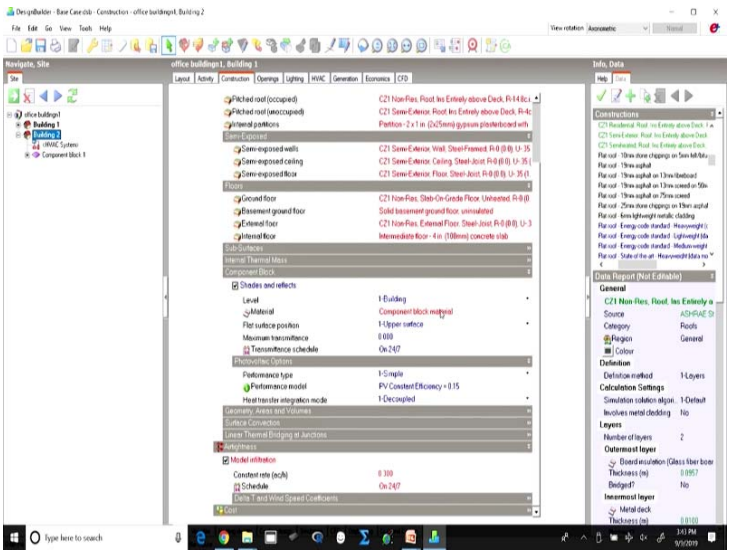

So, suppose I go to building 2. So, the properties which we have for this component block will be defined here. In our case we did not have a building block a component block. So, that is where we did not define what this component block is going to be. The reflective properties the surface properties of this component block will be taken into account, when the building 1 is going to be simulated.

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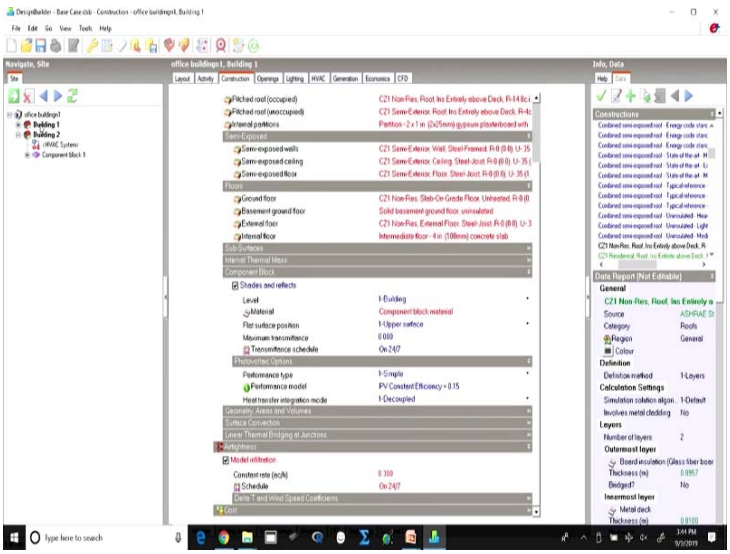

So, in our case there is no component block, but if there was we would talk about these different types of these different properties where they talked about in case there is a photovoltaic we would take the photovoltaic options.

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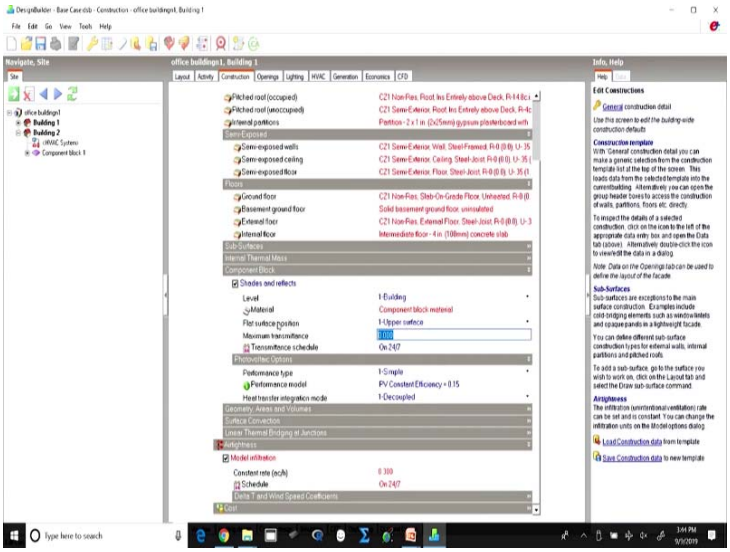

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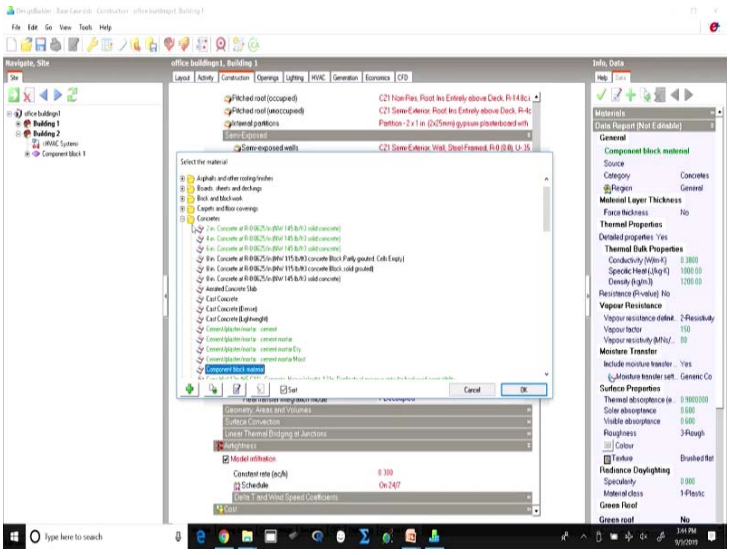

In case it is not we would talk about the transmittance values, we would talk about the surface positions and we would talk about the component block material. Now, this component block material may also be changed we can take it to concrete or brick and automatically the surface properties of these materials will be brought along.

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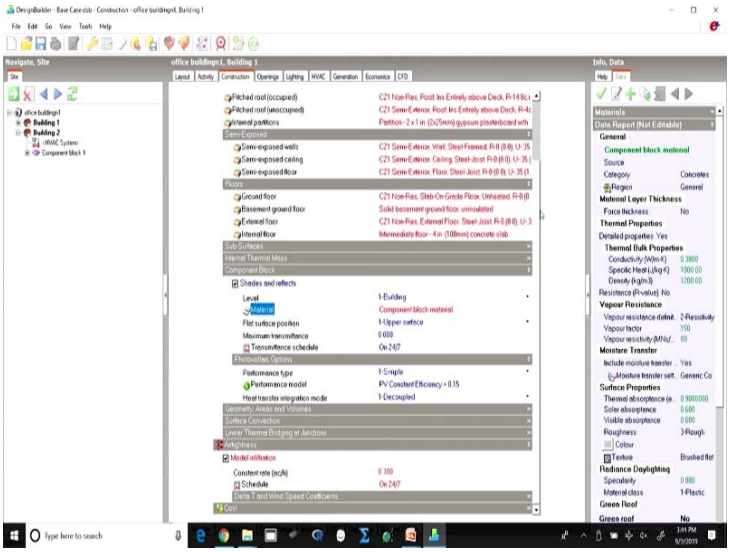

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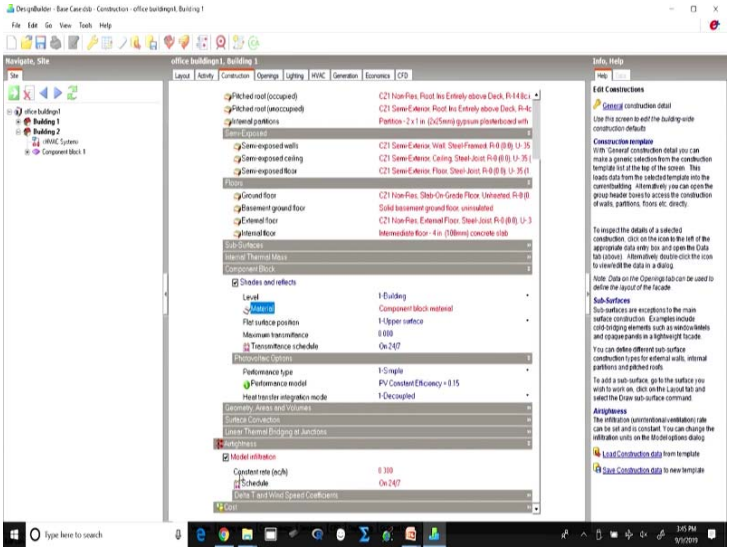

So, that is what the component block would mean. Another thing which is important is the air tightness. So, whenever we are talking about the model and we are calculating the heat gain or loss because of infiltration this is where these values will matter. So, when we are defining these values for infiltration depending upon how tight air tight the model is these values will change and ASHRAE 62 usually defines the rate of exchange in case of infiltration. Here since we are following the ASHRAE templates we would keep it as the default value of 0.3 which is coming directly from the code.

So, we leave it as it is and that is how we have completed defining the construction. So, currently I will delete this building 2 and I have only building 1, but in case you have other objects other components which are present and which will impact only because of shading then we may create all those components using the component block. Another thing that is part of construction is the fenestration the openings.

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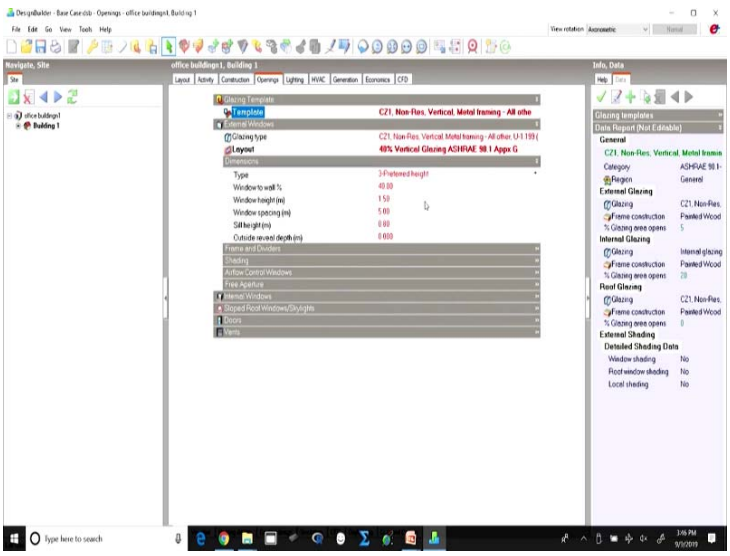

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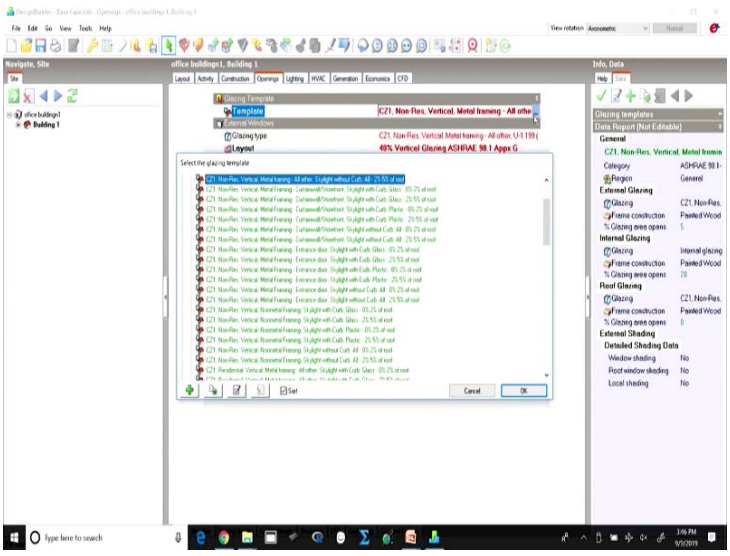

Now, the template here which has been taken is CZ1 for non residential which is for vertical windows which are metal framed. In case we want to change the template we

can change the template and we can change the glass type and all the frame type for matching the corresponding values which are given in ECBC. The first thing which we have to check is this the window to wall ratio which has been by default defined as 40 percent. ECBC also defines it as 40 percent.

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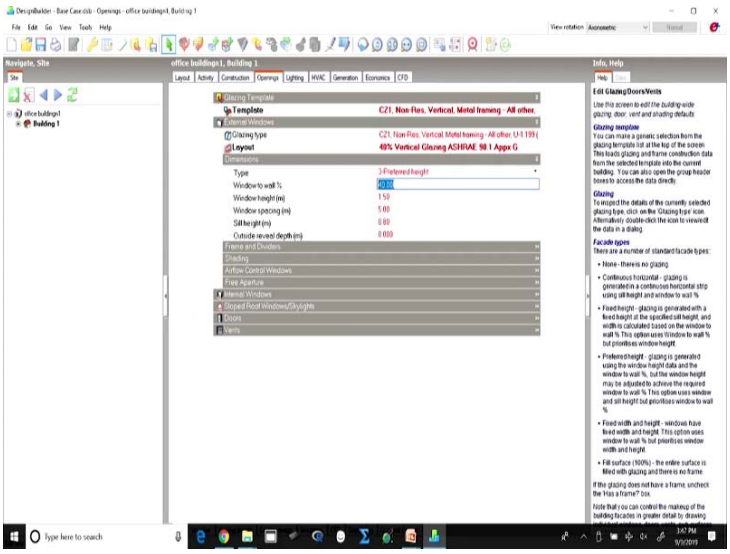

So, here it is as per ECBC in case it was not we would just change the number here and this 40 percent has window height of 1.5 meter the window spacing of 5 meters and the cell height of 0.8 meters. It would result a WWR or 40 percent would result in a geometry like this where all the facades uniformly have 40 percent WWR at each level. This is what this 40 percent WWR implies. For a base case we have to define a uniform WWR and hence a definition or defining of window to wall ratio at this level is required.

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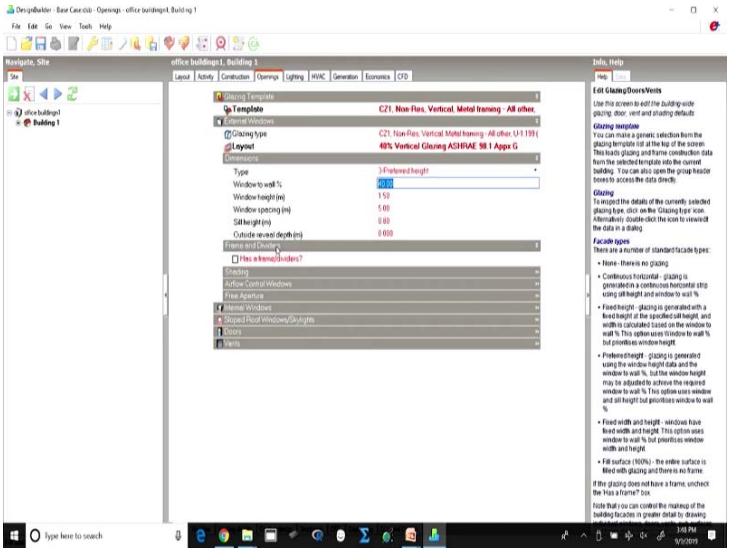

So, we have already defined this. Now we can also define the frames and dividers by changing the template.

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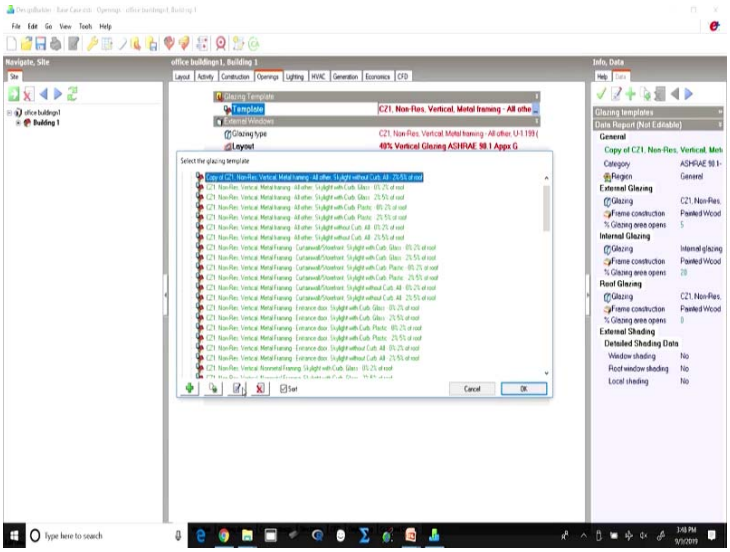

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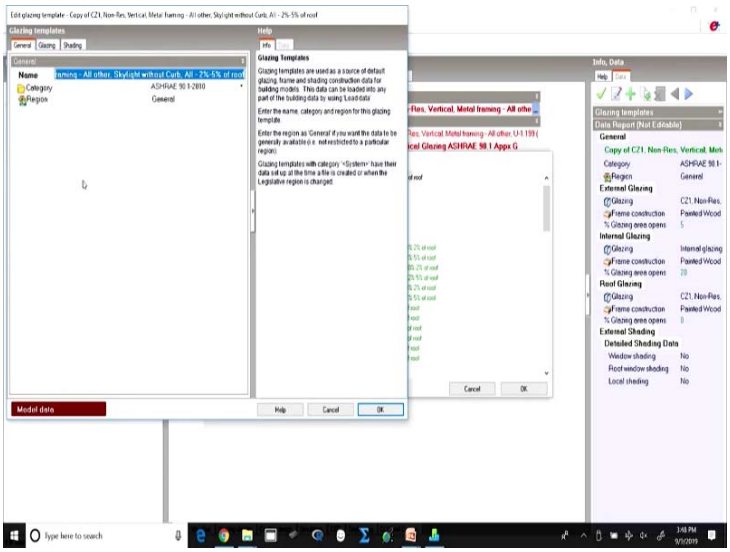

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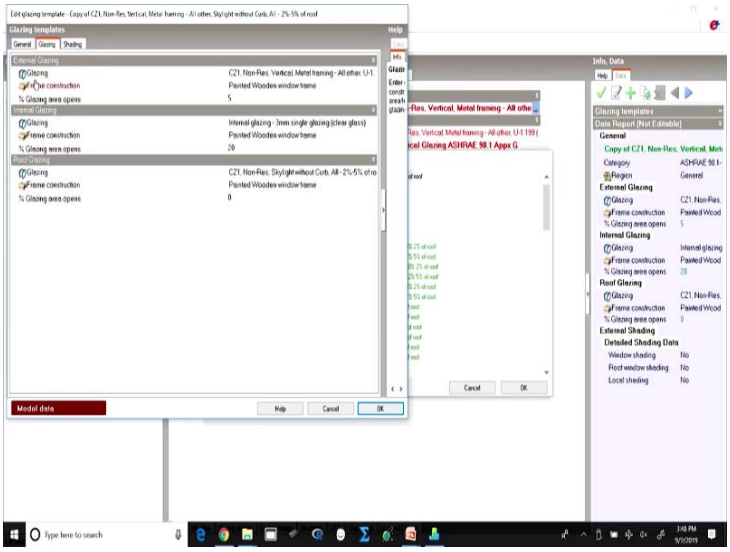

So, suppose I have to change the template and I have to change the different parameters. So, first of all it is the external glazing. So, what kind of glazing is going to be used?

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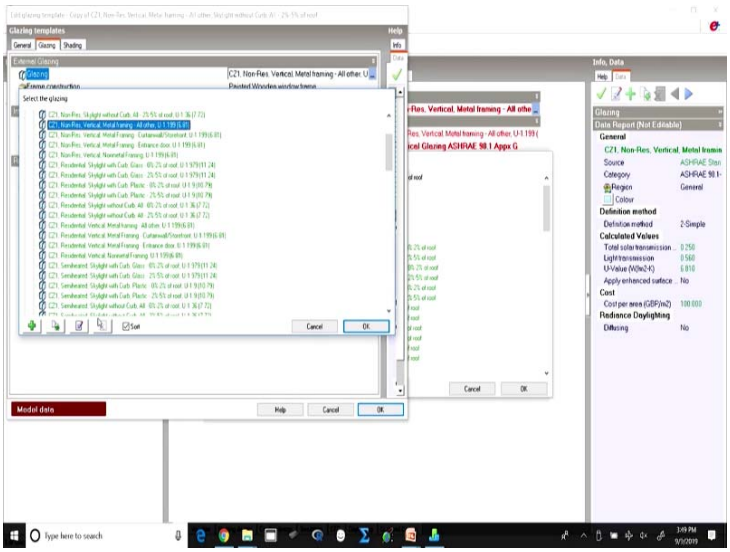

What is the glass type? So, we can select different glass types which come with different U values and SHGC as predefined.

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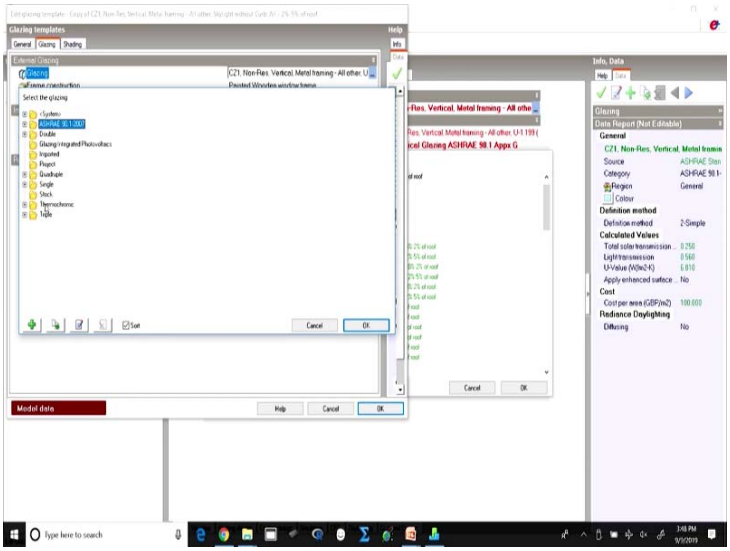

So, the glass which is going to be taken in is taken from the International Glazing Database IGDB. And we can select any glass type that we want. So, here the default glass type has been taken with a U value of 6.8 and a total SHGC of 0.25. However, if you look at the ECBC values they require a glass with a U value of 3.3. So, we can define we can create a template, we can create a new glass type, we can edit it to meet

the requirement for this U value, we can set the U value to 3.3 or as defined by ECBC, we can set the SHGC and also the VLT as defined by ECBC in a similar fashion.

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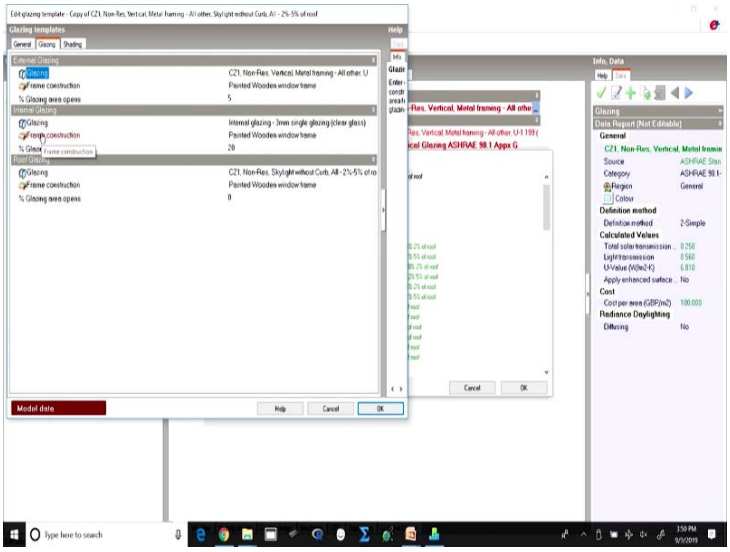

So, overall it will give the U value for the window on the basis of the glazing that has been selected. This is for internal glazing. Suppose we have internal windows which in this case we do not have and also in case we have the skylight the roof glazing. So, as per ECBC even the roof glazing and the values are defined. So, individually we can define the U value SHGC and VLT for each of these window types and also the frame construction. Once we have done that the building geometry is complete.

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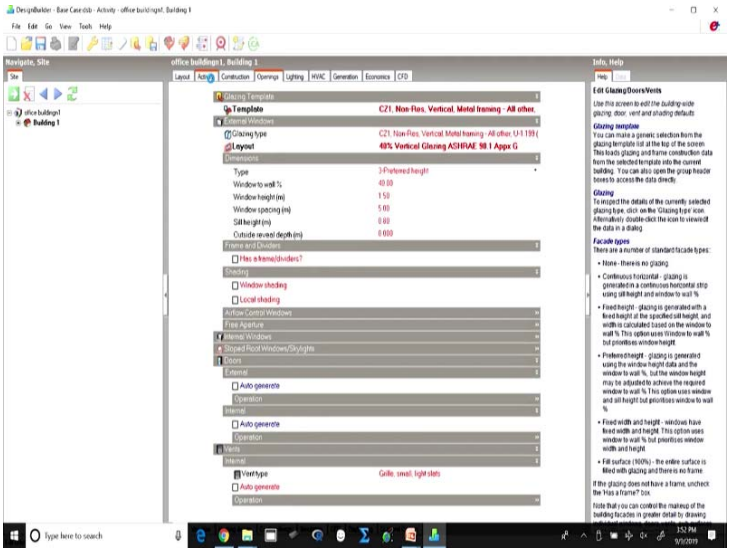

In addition we can add the window shading. So, suppose we want to have window shading or local shading, we may have to provide them here. However, in base case we will not define the shading here. However, for the base case we will not define the shading as we have already seen in the compliance approach the base case will always be simulated without shading and with fenestration equally uniformly divided on all the facades as per the given prescribed WWR.

Also, if you want to add ventilation ventilators and doors we can auto generate them here, but for the base case we would usually not keep the these options on because it would require the natural ventilation to be taken into account while in this case we are not having natural ventilation enabled for this building.

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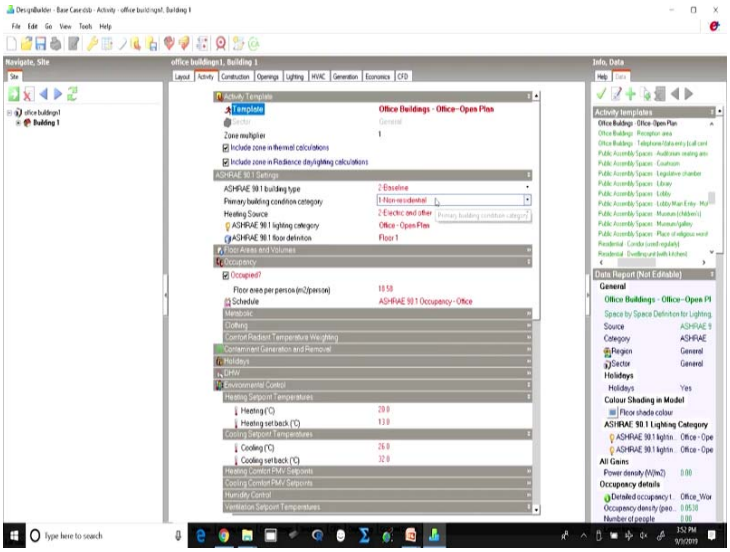

So, with this we have completed the activity construction and openings which, largely for construction and openings, are the passive features and activity remains constant for both the base case and the proposed case. So, in the next lecture I would expect that you would have completed all these details and giving the inputs as far as construction and openings are concerned and activity is concerned and we will move on to the active systems which are Lighting and HVAC.

So, see you again tomorrow and kindly complete the exercise which has been done so far. I hope you are following it along with me. So, see you again tomorrow.

Thank you, bye bye.