Sustainable Architecture
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Lecture – 59
Whole Building Performance-IX

Good morning. Welcome to the second last lecture of this ongoing online course on Sustainable Architecture, where we have been discussing about Whole Building Performance Tool Design Builder. Till yesterday's lecture, we have discussed all related to how to simulate buildings using the tool, how to create building, how to modify them, how to modify the materials, how to modify the geometry, how to modify the different performance parameters which are going to go inside the modelling of the building.

One thing, if you remember which we had left while we were discussing about the daylight in building which is criteria for evaluation in different green building rating programs is the day lighting and building, so how much of the floor area is being day lit adequately. So, one is how much and the other one is adequately. So, we also did manual calculations if you remember. So, we had all the tables, we had the rules, we had the equations which helped us calculate how much of the floor area will be assumed or will be considered as day lit if we calculate it manually.

We also showed in that particular lecture two comparative pictures where one was the manual calculation and the other one was the digital calculation which was using the whole building simulation tool. Now, these tools are also equipped to help us with the day lighting calculations digitally, instead of doing the manually we can do it here. Whole building simulation tools take some other tools for example, design builder takes help of 'Radiance' as a simulation tools for tool for calculating daylight which is what we will show how do we go about it in today's lecture.

So, in today's lecture we are going to discuss about the day lighting calculations using whole building performance tool design builder. Let us switch to the design builder screen now.

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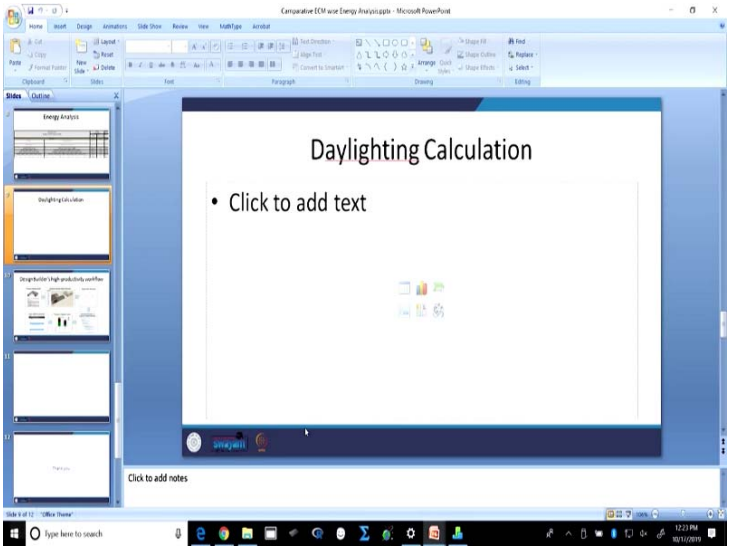

So, today we are going to look at the digital method of day lighting calculation for compliance to green building rating systems. So, as we have already seen that almost all the green building rating programs across the world they place emphasis on allowing daylight to enter the building and in different rating programs different criteria are there.

So, for example, the LEED requires at least 75 percent of the habitated area to be day lit. And day lit also has a range of values, so if we again look at the example from LEED, so we have the day lighting defined using daylight factor, sometimes it is also defined using the luminance, sometimes it is also defined using other terminology which we have seen as part of our lecture on daylight. Most commonly used one is the daylight factor. So, what we have to really do is calculate what is the daylight factor in a room which has windows all around.

So, if you remember we already did the manual calculation using the rules where we calculated how much from the side of the window the light will be available, for how much depth does it penetrate inside the room, if there is a partition then what happens and all of that. Today we are going to look at the digital way of calculating daylight availability in a building. So, we take the same example of as that of the building which we have been considering for calculations.

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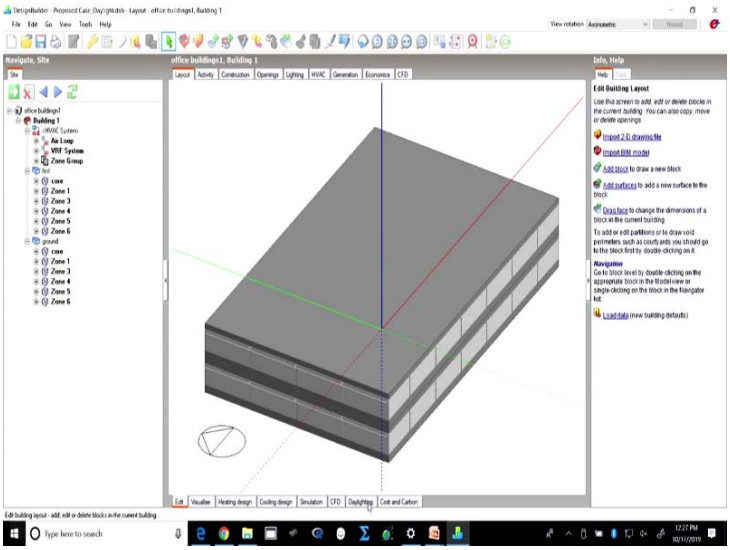

Now, the changes that you have to make to the model or not to the model, but to the settings is first of all we go to the activity and in this we say include zone in radians day lighting calculations.

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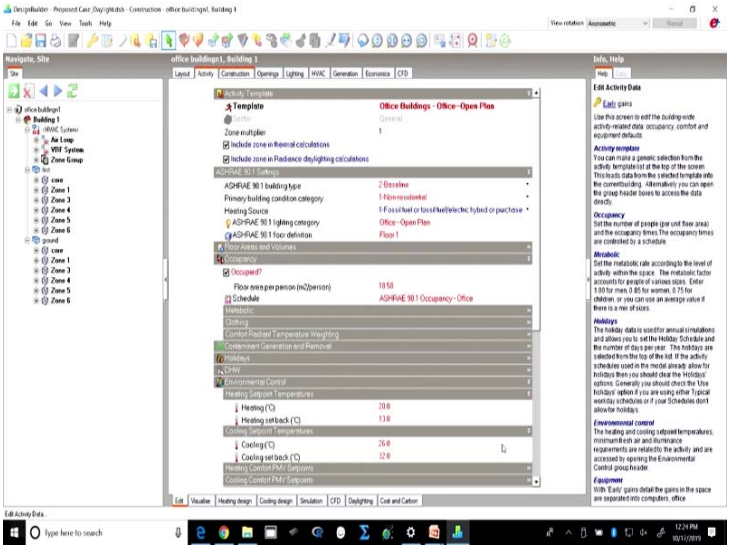

The moment we do that, the model will be used for calculating day lighting using radians as the engine. So, that is what we need to do in the activity tab and when we go to the construction tab and we select whatever wall we have selected. So, we have already selected this particular template.

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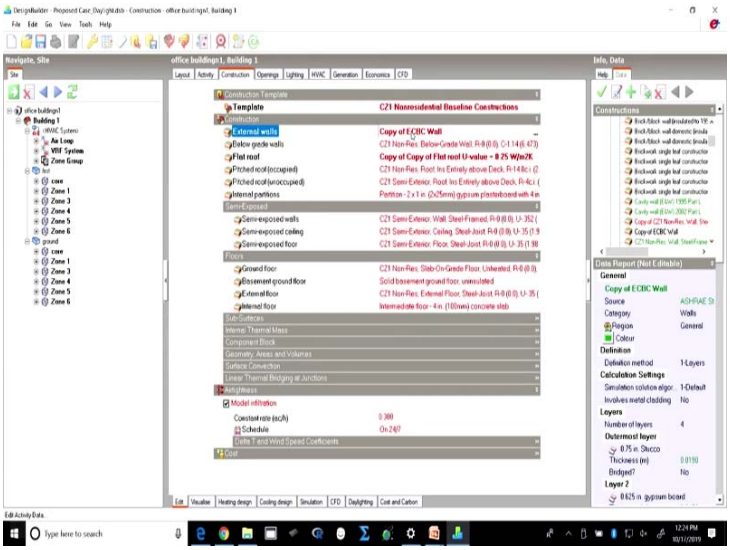

If we go to this template we already have created different layers of this wall. So, this is this was the wall copy of ECBC wall.

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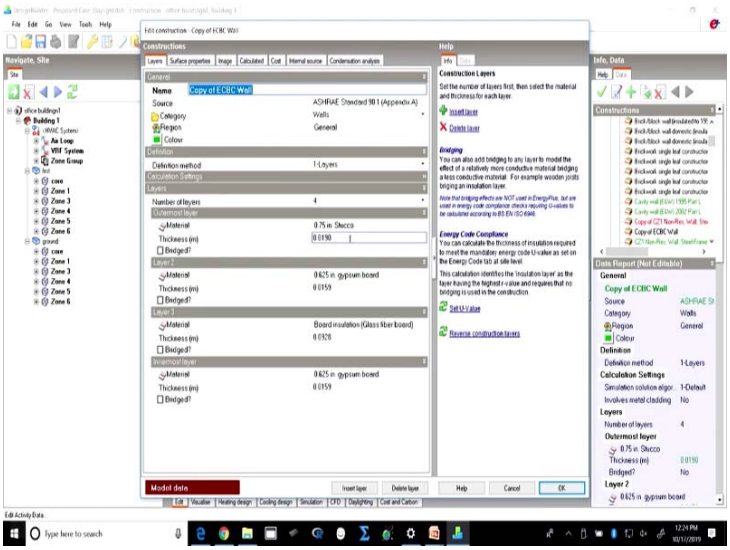

So, what we need to do is we need to change the surface reflectance of all these because when we are talking about day lighting the colour of the internal surfaces, the finish of the internal surfaces, the finish of external surfaces, external ground, roof adjacent building all of that will make a difference.

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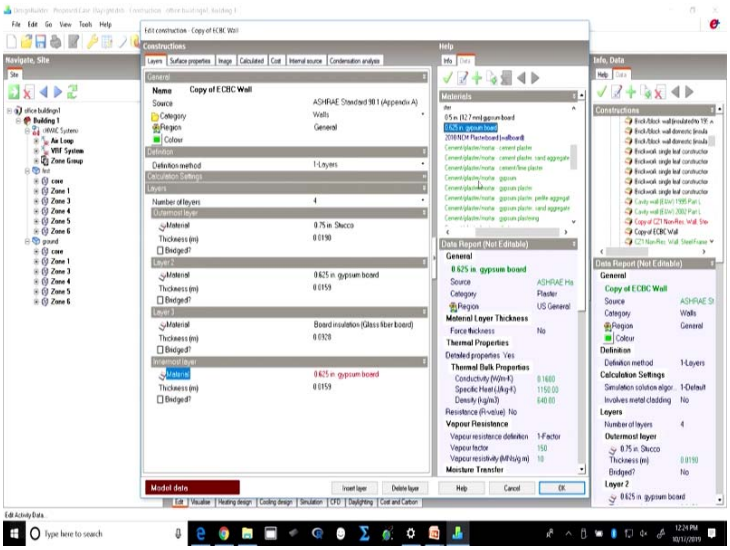

So, what we would do here is we would go to each of these materials.

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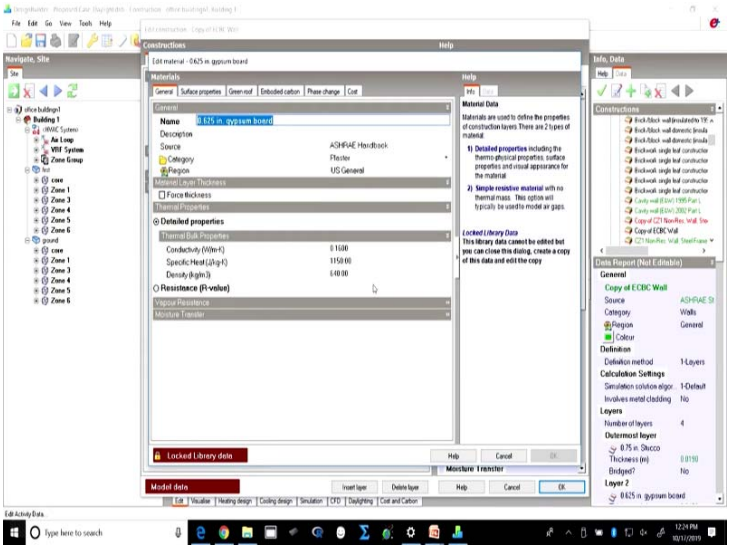

So, suppose we have gypsum board inside, we can go to gypsum board and again edit its properties.

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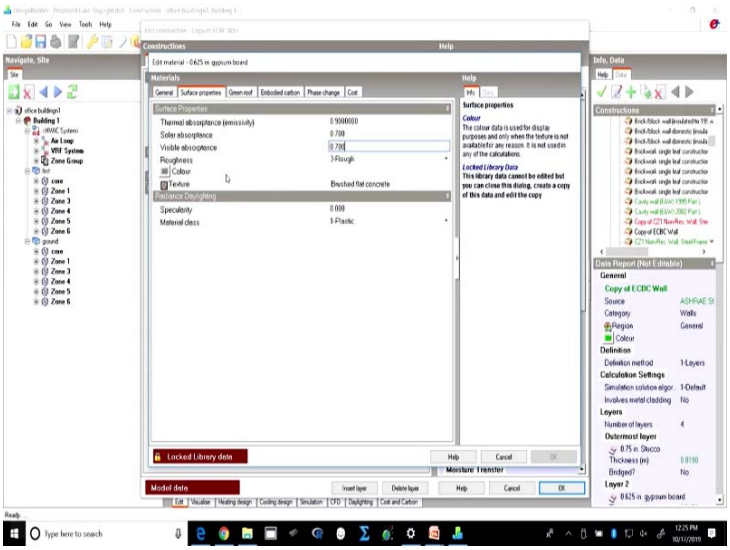

So, for each material we also have the surface properties available and if you look at this is the visible absorptance. So, 1 minus visible absorptance is the reflectance. So, if higher is the absorptance it implies darker is the surface. If we have a lower absorptance which means the reflectance is higher and the surface will be reflecting more of the light. So, depending upon the kind of surface we are going to use and we can also select the roughness, so whether the smoother surface will have higher reflectance which implies that they reflect more light whatever is incident on them.

So, here we are only talking about the visible properties of the material as far as its reflectance and absorptance are concerned, as far as its texture is concerned and all of that will impart the property, the visible property to the material and these materials will be will automatically be used here and their surface properties will be updated. So, we can make changes in the external surfaces as well as the internal surfaces where the finishes are going to effect the day lighting inside the building.

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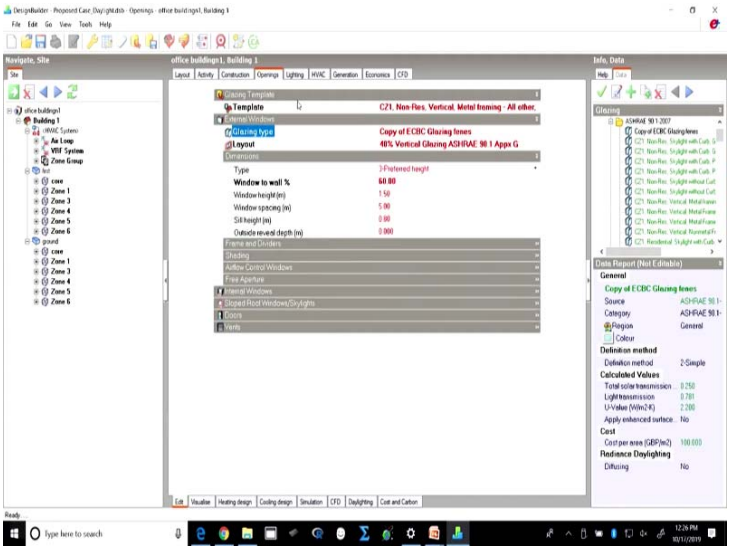

Once we have changed that, we can go to the openings and we can also change the glazing type.

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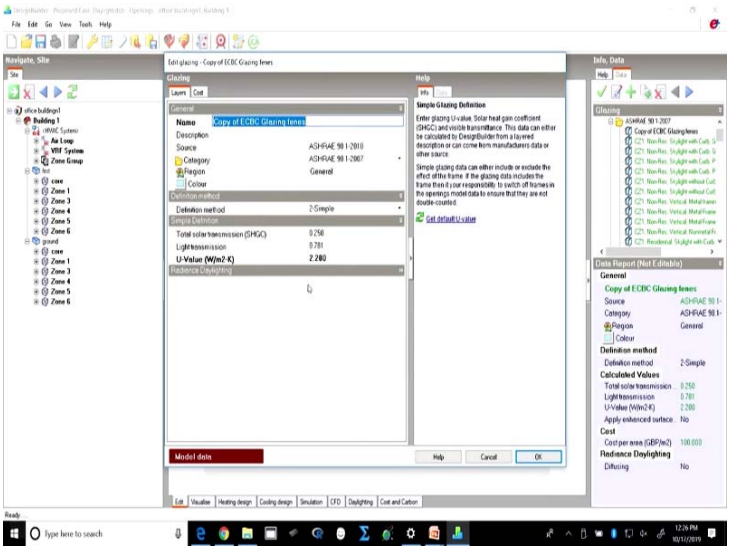

We can check the glazing type here. We have already selected the glazing type when we were changing the type of glass, the glass specifications. Here we can check upon with the light transmission values the VLT values.

Now, if those VLT values would depend upon the type of glass which is being selected for the building for the glass, for the fenestration. Here we can take these values directly

from the specifications which we get from the glass or if we have; if we have a requirement we can keep these keep changing these VLT values and see its impact on the daylight. Once we have done that we are ready for simulating daylight performance of this building and so here is a tab where we click which is called a lighting tab.

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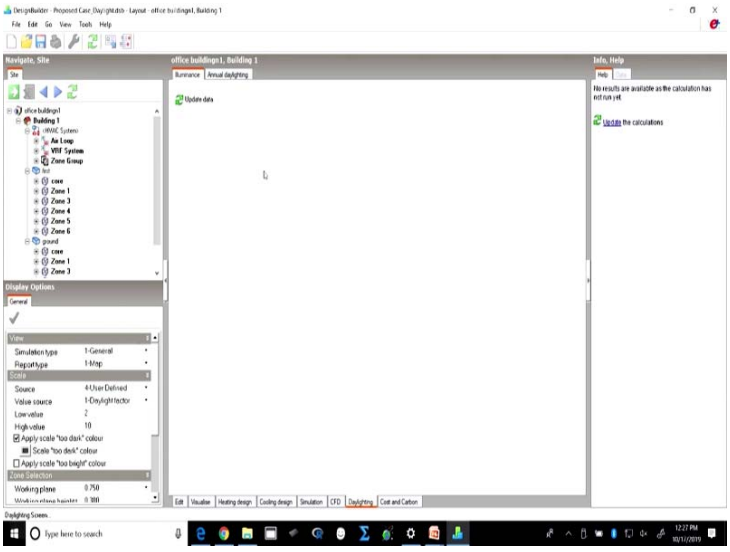

And once we do that it will calculate the illuminance and the daylight factor map for this building.

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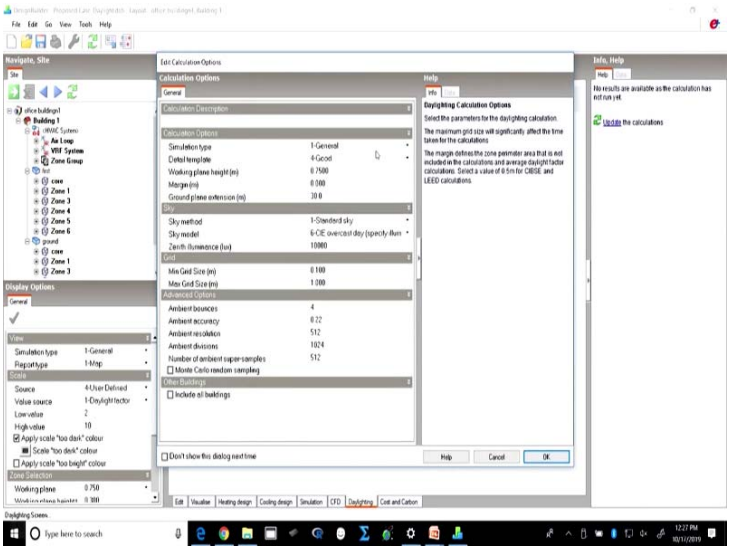

Here while we are simulating before that we also have to check these properties here, these values here.

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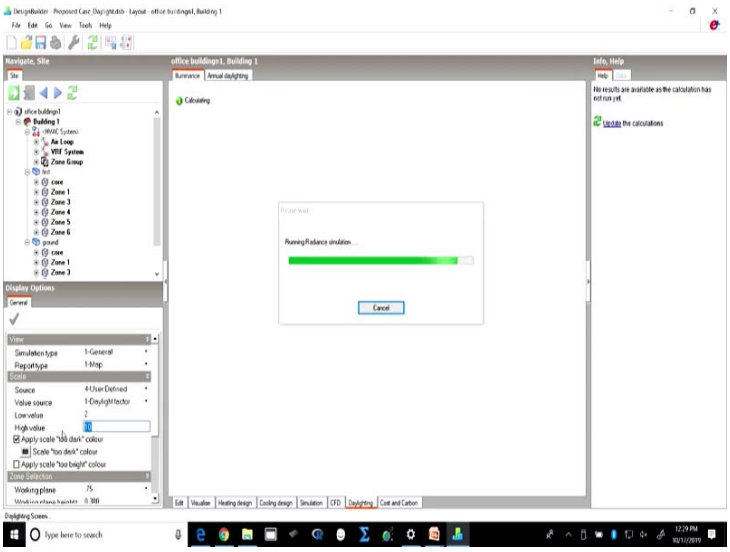

The simulation type could be for compliance with different rating programs, here we are only taking as general. We can report it in a map type or we can also report it in a grid type. The source could be user defined or building block or zone. Here we keep it user defined for now, and the value source could be daylight factor or illuminance. We can look at both of them. Usually when it simulates it will give us the range of values both in daylight factor as well as illuminance, and they are usually synonymous, not synonymous but they have the same ranges. Higher as the illuminance, higher will be the daylight factor.

If you checking with daylight factor we can also set their low values and high values. So, as per the rating programs the minimum values for daylight factor are usually defined. So, as per LEED the daylight factor has been defined to be a minimum of 2. So, we set the lower value of the allowed factor at 2 and we can fix the higher value the upper value of the daylight factor as well.

So, here again different rating programs have different requirements, so sometimes the higher value is also specified because a daylight factor much higher than a certain value may also result in glare. So, we want to control the daylight factor.

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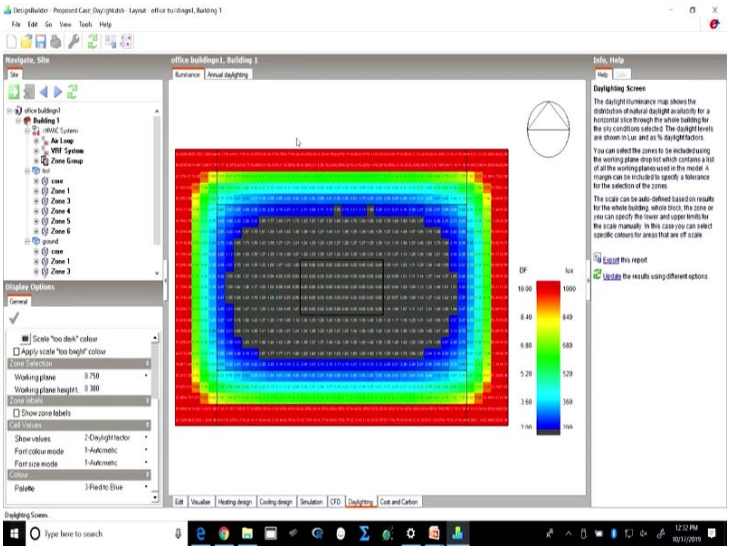

Rest of the areas will be shown as the dark areas. We can also fix the working plane height and we can set the tolerance which we usually keep the same, and here we can also decide to show the values; the values for daylight factor or illuminance on the map itself.

Once we have selected these values and once we have clicked on day lighting we will get a map like this. This is for the entire building taking into account all the zones and if you can see these faint lines here these black lines these are the virtual partitions. So, if you remember while we were creating this building, we had very clearly communicated that virtual partitions are actually non-existent, there are no physical partitions, we are just making these zones to differentiate between the peripheral zones with that of the core zone.

So, if you look at it here we can see that the areas the zones which are shown in red are actually having a daylight factor of close to 10 and as we come down we have some areas on in the corners where we get a daylight factor of 6 to 8, 7 to 8 and then a large area where we have a daylight factor of around 5 to 6 and then 2 to 3 here. And this area which is shown in black has a day light factor of less than 2, which implies that this huge percentage of floor area will not receive sufficient daylight.

So, there is a large percentage of this floor area which is going to remain in adequately lit, it will not have enough light inside. So, we have to, it very clearly tells us that we

have to look at the design look at the plan, and here we can very clearly see that the width of the floor plate is much larger than what is required to allow day light penetrate all the way through.

Also another thing which we can see here is that the peripheral areas the areas which are close to the windows they are too bright, they have a very high daylight factor and which as per some of the green building rating programs is not acceptable. So, what we need to look at is the design of the windows, maybe instead of providing 60 percent WWR, we just have greater WWR towards the north and lesser on the sides or maybe we have ventilators and vision glazing separately. So, the upper glazing which is more for the lighting will have clear glass while the one for the vision glazing.

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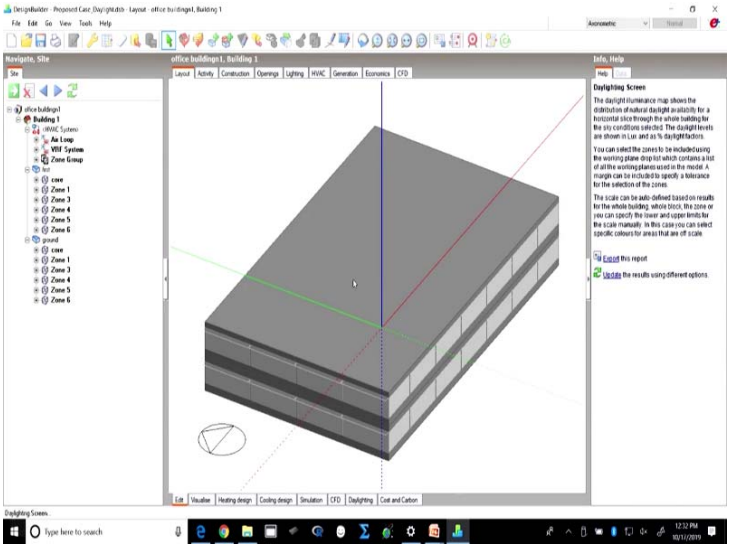

So, instead of having window like this where it is like a single window, we can actually have a different design of the window itself.

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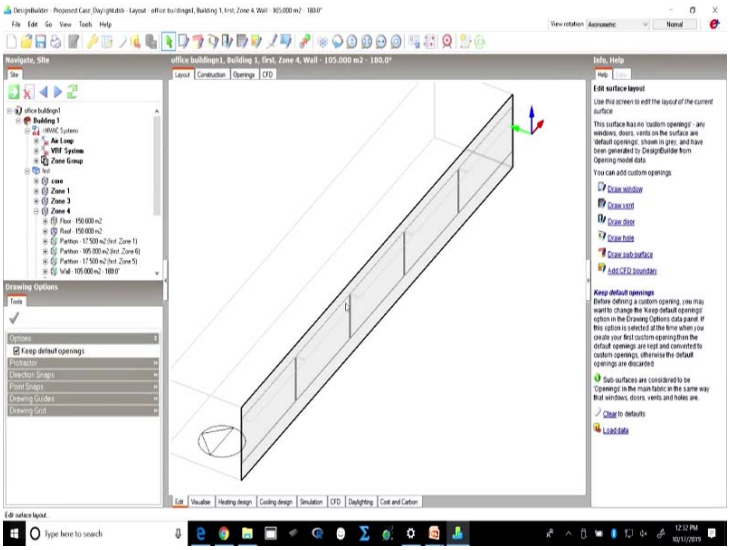

So, we may actually customize the window we can draw on the wall. So, we can totally design the window as per our requirement.

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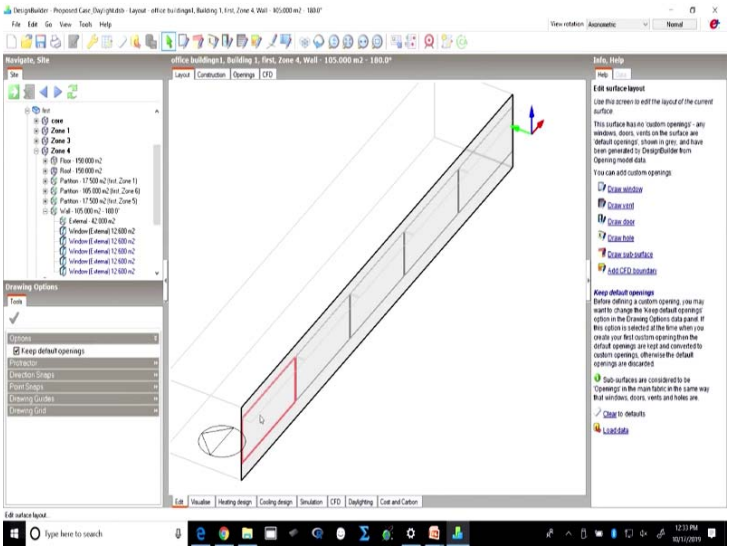

We can remove the windows which are available, customized, we just click on this and we delete. So, we go to the wall and we go to the openings and instead of 60 percent, if we say 0 percent so only on this wall it will change it to 0 percent and here we can now draw the windows.

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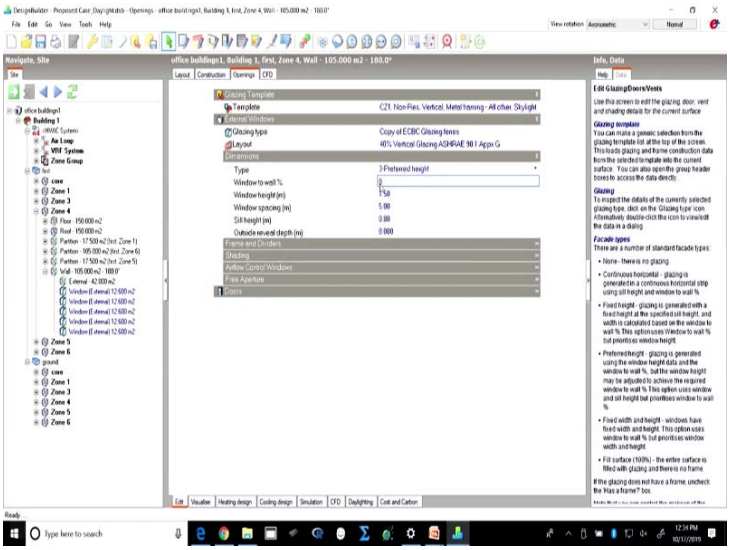

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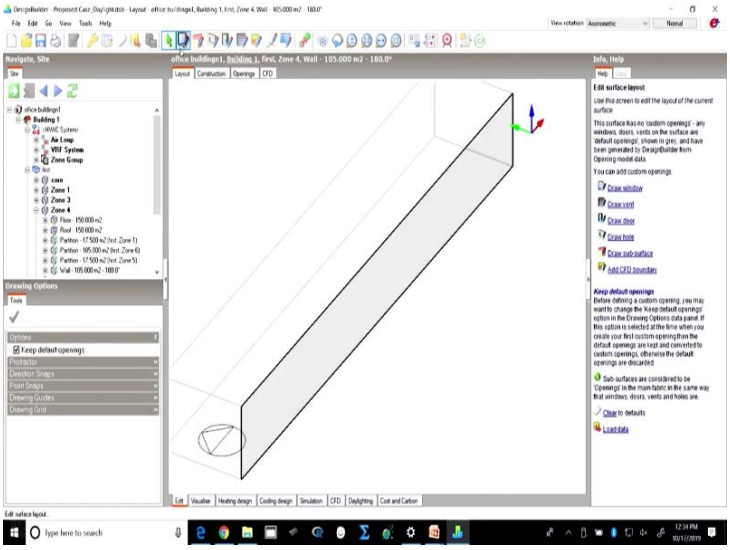

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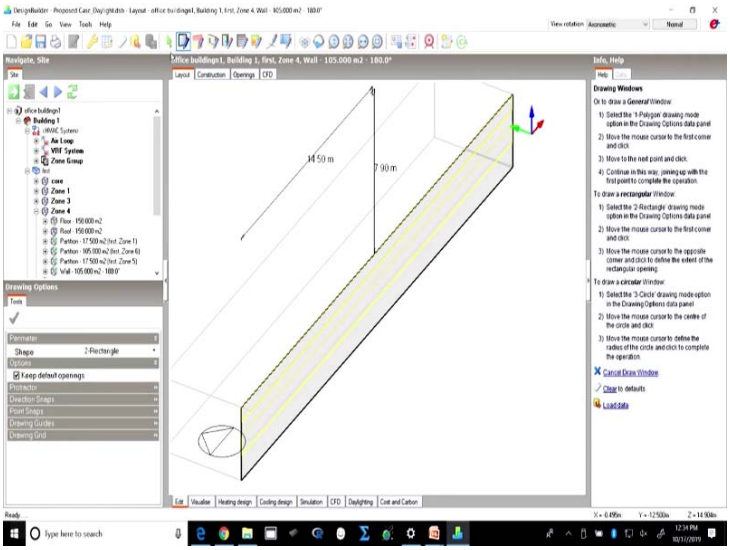

So, suppose I want to have a glazing on top and then I want to have a glazing in between and I can also change the specifications of these windows.

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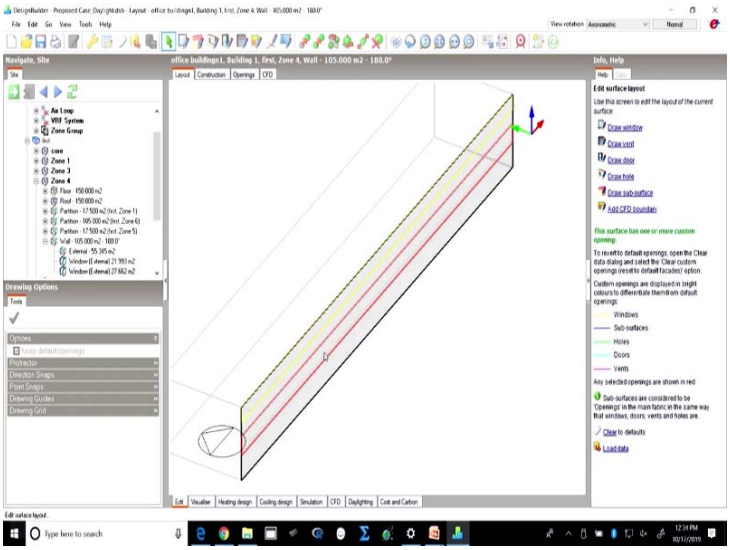

So, if I go to openings, I can also change the fenestration type and we can we can select a glass.

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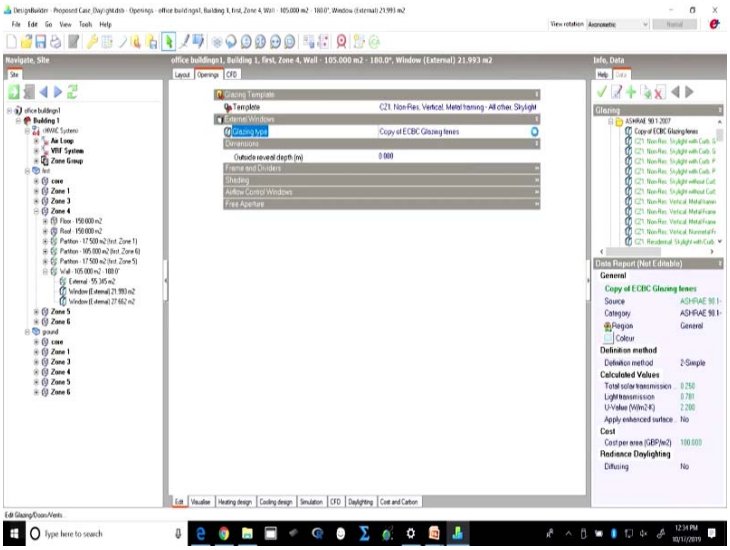

We can, I can select a glass for the topmost window. So, I can select the glass for the top most window as a clear glass.

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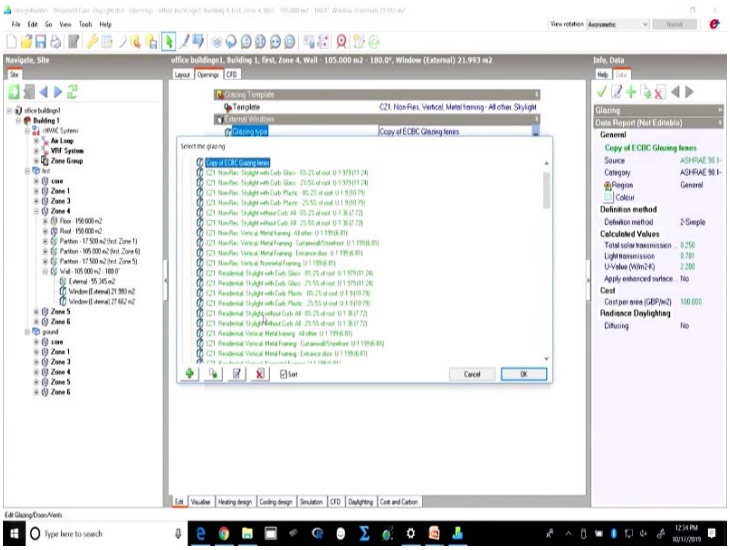

So, instead of ECBC fenestration I can just take it to be a simple clear glass.

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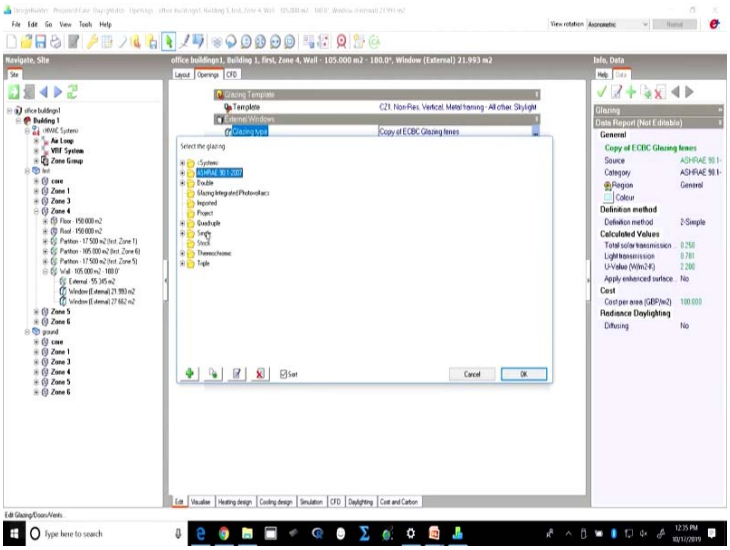

And I take it to be say single clear 6 mm.

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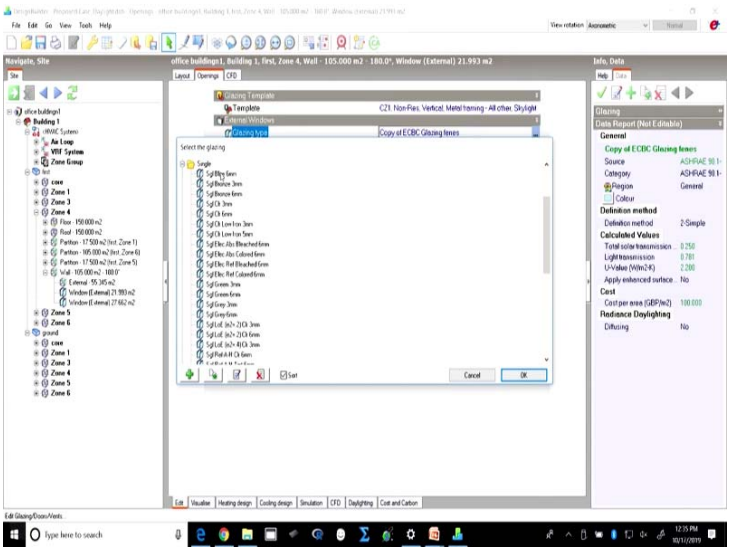

So, this implies that I have if we look at the properties here of the glass, it has a light transmission value of 88 percent and while if I go back and if I look at the other window, this window I might want to have glass which does not have a VLT as high as that.

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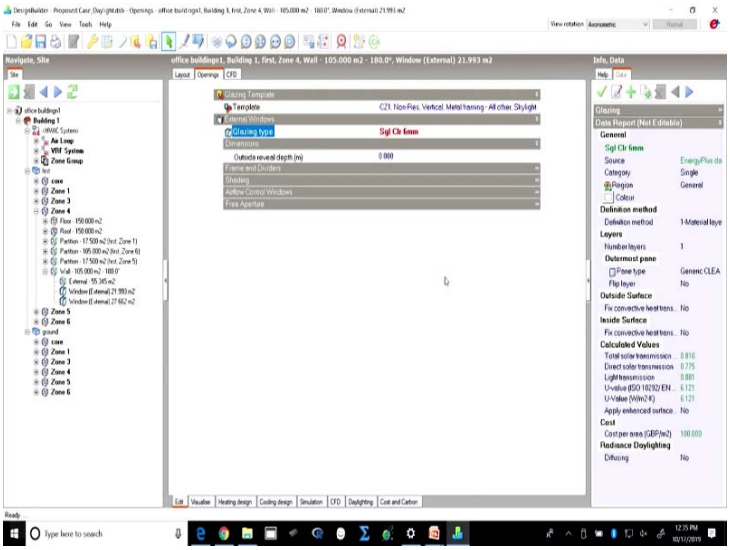

So, suppose I am taking a double glass and I take a double, if I take a double grey and I select the properties 6; 13, 6.

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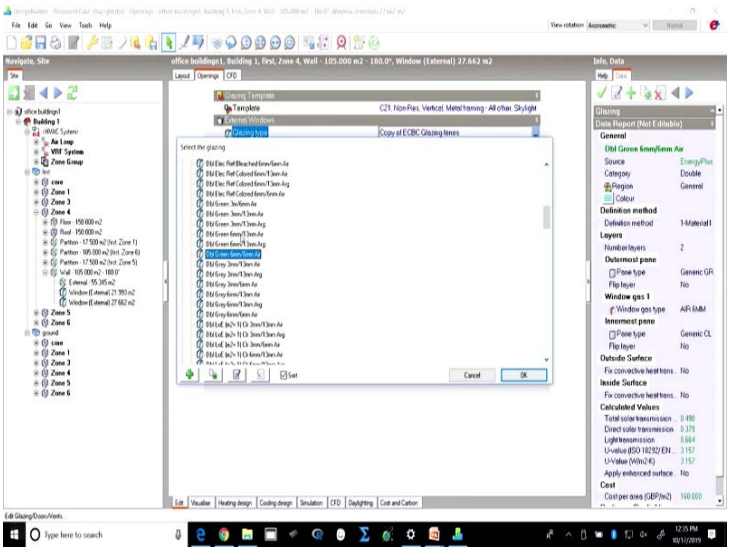

And if I check the light transmission it is around 66 percent and I select it ok.

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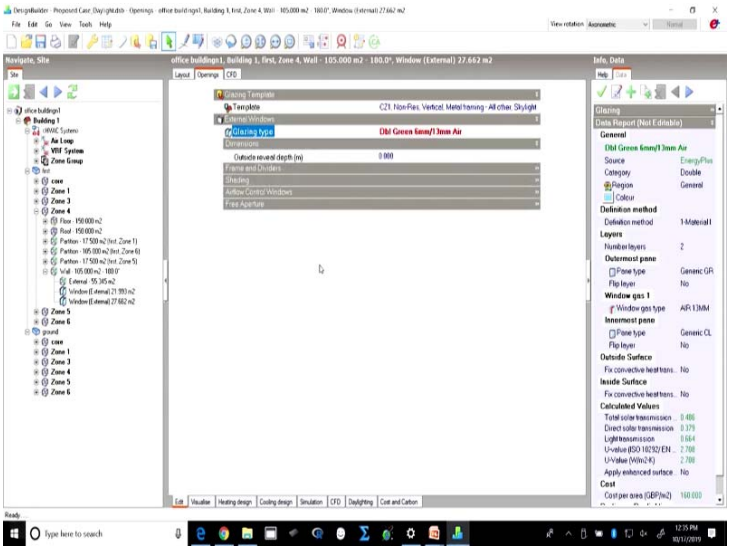

We can go back and we can simulate it again.

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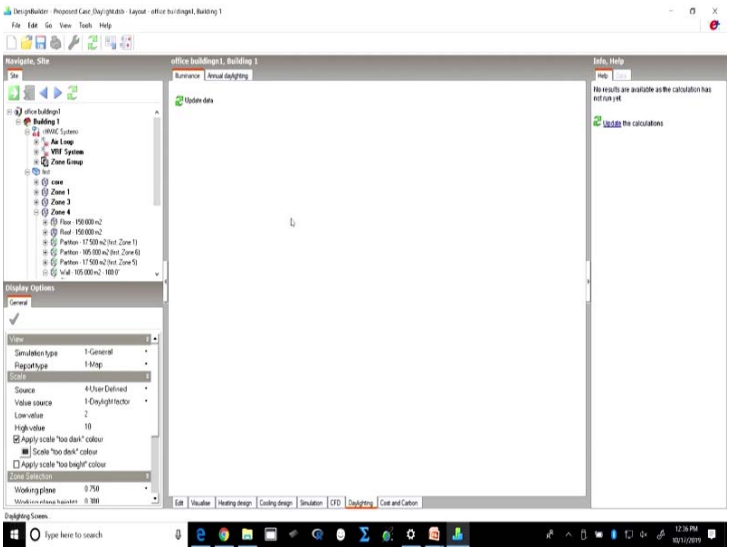

So, we simulate the building again for its day lighting and we can see the changes that it brings along with it.

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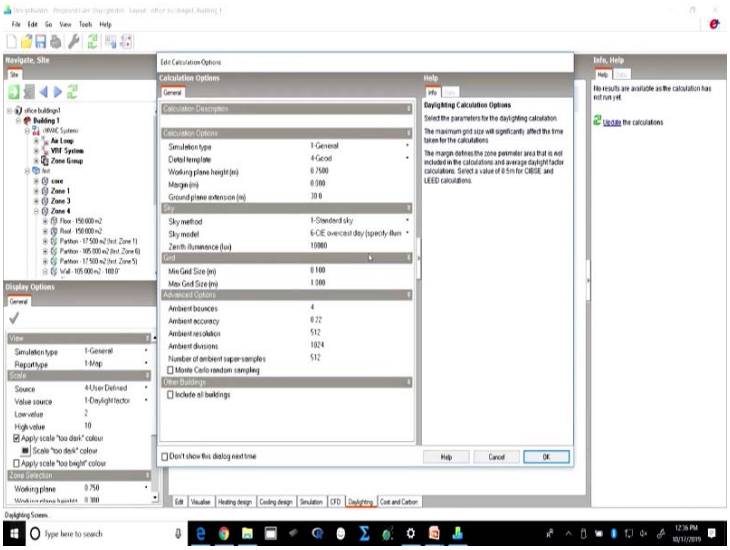

This is what we can do, if you want to check different options for the daylight calculations and every time we can see whether more and more area is being adequately lit, day lit or not.

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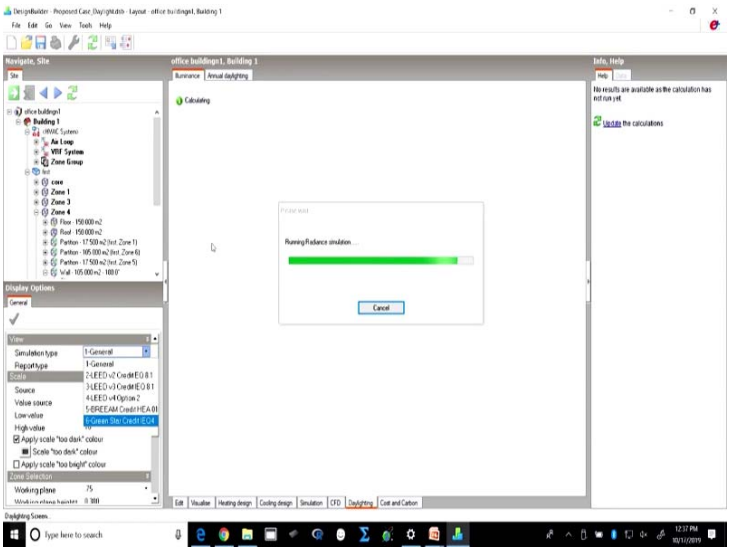

We can also select if you want to go for the compliance we can go with either of these options and it will automatically tell it will generate a report in the format which is desired for LEED or BREEAM or Green Star and tell us whether this particular building plan and the open the fenestration design complies with the criteria, compliance criteria

given in these rating systems or not and we can see the changes. So, we this is very good to be used at a very initial stage of design; at a very initial stage of design where we are still working on the on finalizing the design of fenestration which orientation should I provide fenestration on.

So, if I know clearly the fundamentals that, not as the side where I want to provide with fenestration, but I was not very clear whether I have to provide for a clear glass or I can provide for a tinted glass or I should provide for a low-e glass. This is an interesting way to look at this. So, we will simultaneously be looking at the day lighting calculations and also the energy implications of that.

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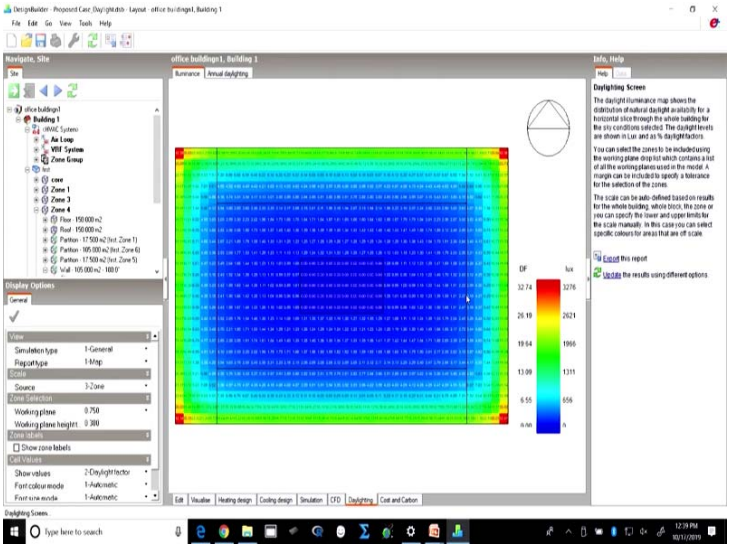

So, if we compare the values which we had earlier we would see that the values for the southern side has they have become more uniform, and similar thing we can do if you want to change the fenestration design and the glazing specifications for all the windows in this particular building. And we can keep experimenting and comparing the different options that we can possibly have through design as well as specifications.

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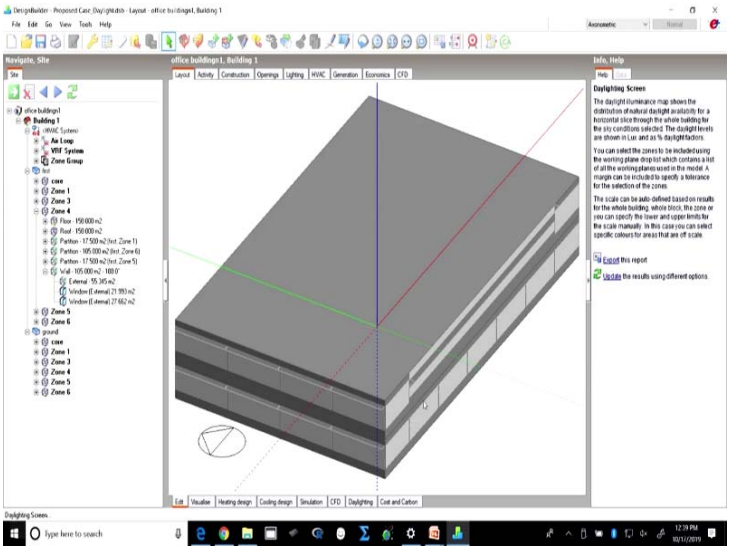

So, this is what we would do while we are doing daylighting simulations. We can work with the design of windows, we can work with the specifications, we can work with the shading devices, we can work with orientation of the windows and literally all the parameters concerning the fenestration.

So, this was all for today's lecture. And with this we have already completed almost everything about the whole building simulation and the various purposes for which whole building simulation is used in green building certification and for green building rating programs compliance.

In the last lecture, on whole building simulation we would be looking at some easy options of generating the base case models and using them for compliance. Here what I have been discussing so far was where you want to improve upon your design. So, besides the compliance, the tool, the whole building simulation tools helps us in designing better buildings. If we have already designed, if we have already completed the design of the building these tools also help us in proving the compliance which is what we will see in the last lecture of this course which is unsustainable architecture in tomorrow's lecture.

Thank you for being with us today. See you again tomorrow. Bye-bye.