Sustainable Architecture
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Lecture - 51
Whole Building Performance-I

Good morning, welcome to the second last week for this ongoing online course on Sustainable Architecture and in this week, we will be starting with the whole building simulation software for assessing the Whole Building Performance. So, the tool that we are going to use and learn is called Design Builder and the simulation engine which goes at the back of it is called 'Energy Plus'.

So, in the next two weeks this week and the last week in 10 lectures we would be covering in detail, how to create a building model using this design builder software, how to input various input parameters and how to take up take the output out of the simulation software. And out of that output that we have received from the simulation software, how to make an assessment and how to prove the compliance is going to be our aim in these next two weeks.

So, here we start with the first lecture of this whole building simulation software where we will be learning about creating new file and new models in design builder.

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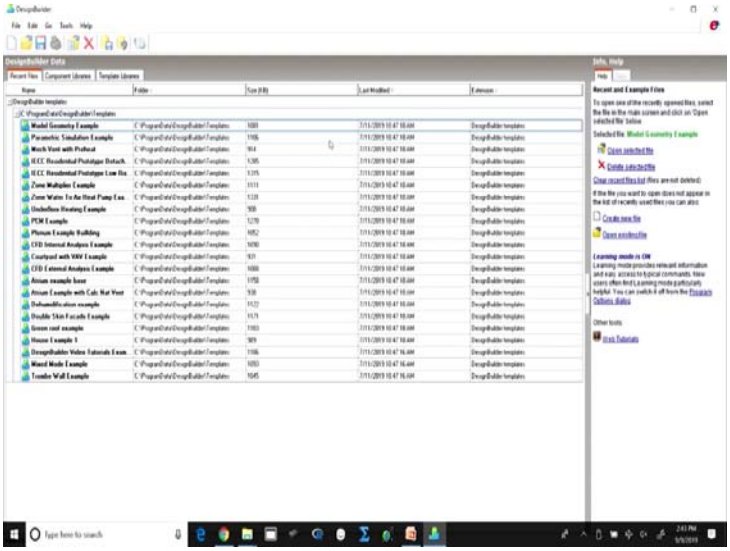

So, let us switch to the screen of the software and let us go ahead. So, the software that we are going to learn as part of this ongoing course is called Design Builder. And, I hope that all of you have already downloaded and installed Design Builder's latest version on your computers.

So, it is freely available for a trial version for a period of 1 month and you can very well practice during this period and you can master the software and there are ample tutorials also available. But, the upcoming lectures will help you learn building simulation whole building simulation using design builder.

So, when you open design builder this is the first screen that you see and it already has some of the pre-designed templates which are available for easy use. So, you can go to each of these templates and see what it contains. So, it has the HVAC templates, it has the building templates. So, if you want to pick up from some of these templates you can always do that.

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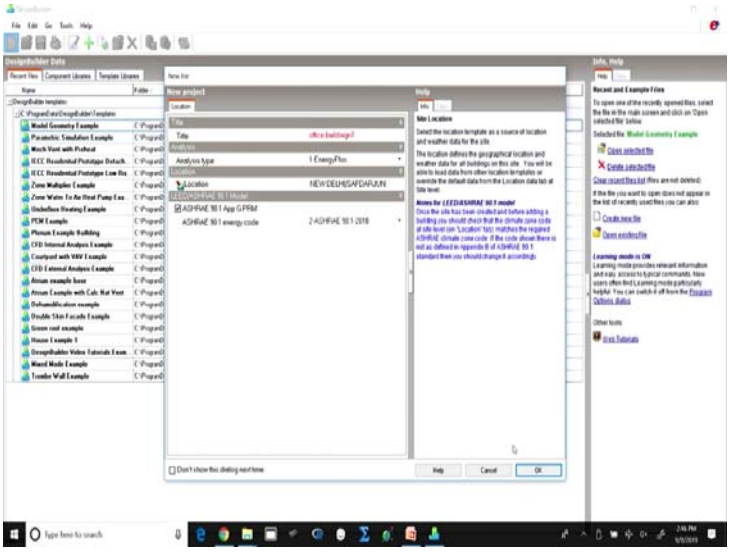

But here, we will start with creating a new file and this is where we will go and start creating a new file. So, you name your file whatever your project Title is; so suppose this is an office building say 1. And the Analysis type the engine that goes at the back of it we will use Energy Plus which is also the default engine in design builder, the Location we have taken it to be NEW DELHI SAFDARJUNG, but if you wish you could choose any other Location which is available.

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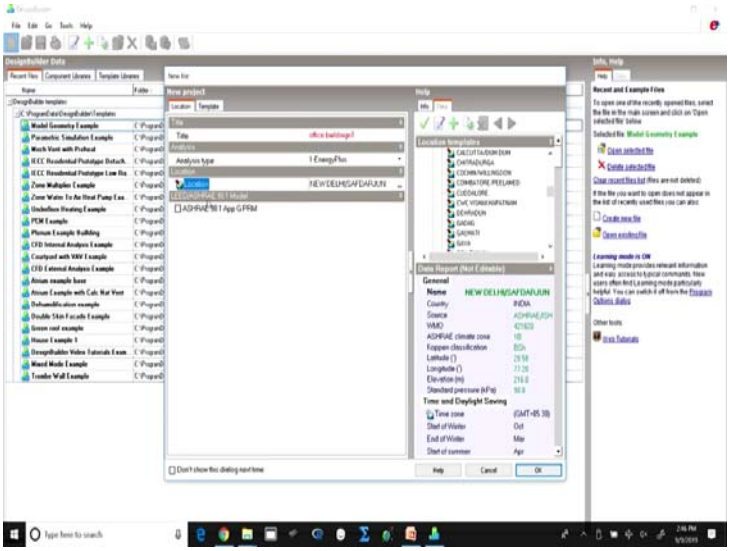

So, if you go to India as a country there are all these locations which are available and these locations come along with the weather data file, which has been generated for these different cities of India. So, here we have taken NEW DELHI the SAFDARJUNG weather data for this current program. And here because we are going to take the base case first, we can check this box which takes ASHRAE 90.1 appendix G.

We have already discussed about ASHRAE 90.1 and appendix G as precursor lecture to this software learning. So, we will just check this and it automatically brings in all the prescriptions which are given in ASHRAE 90.1 appendix G.

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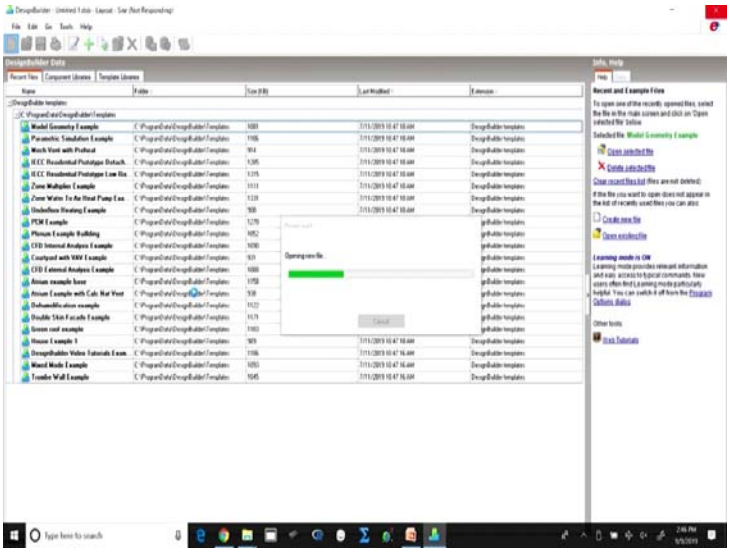

And then when we click OK, we go to the creation of new file where we will be creating the geometry of the building, which we want to create.

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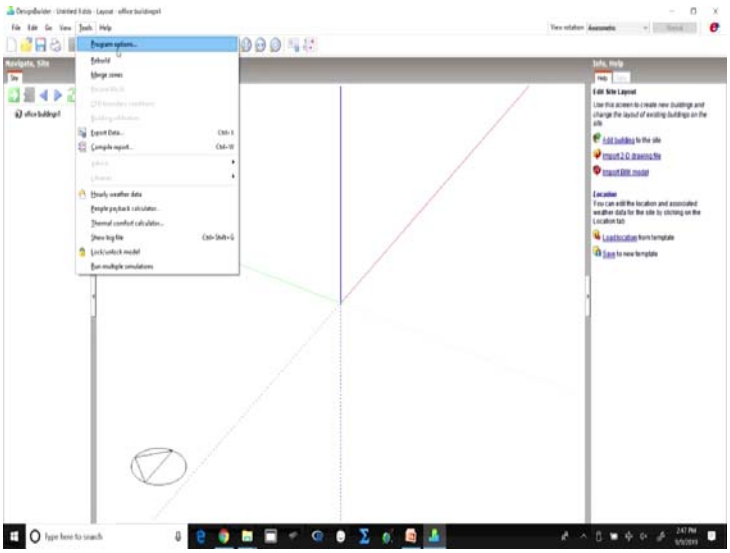

So, we land at this screen which is a blank screen.

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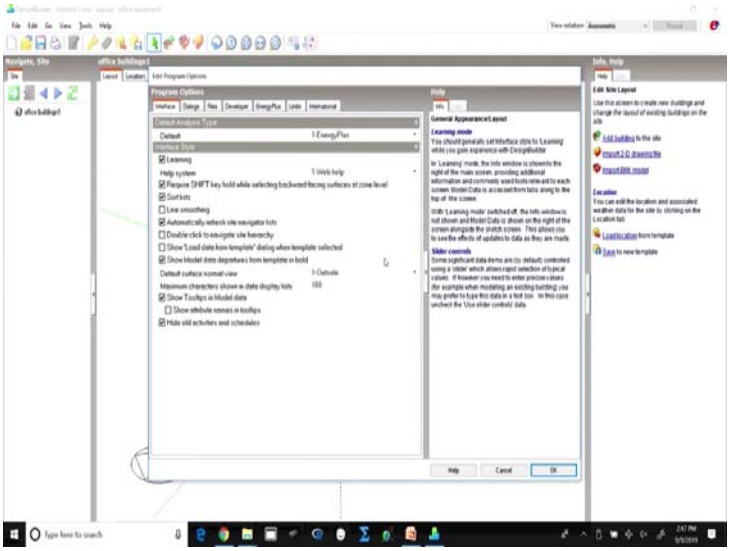

The first thing, that you have to check is checking the units, which is taking.

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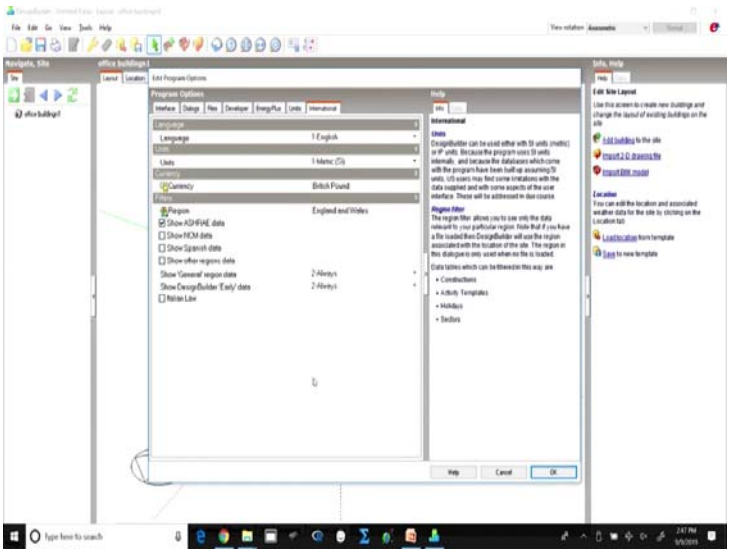

So, here we go to the Tools and we check now it is currently taking the Units in Metric which is what we want.

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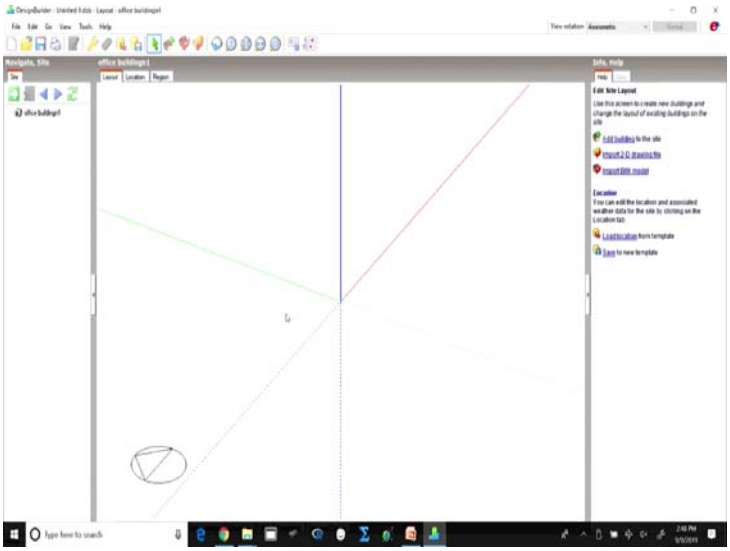

And we will just go ahead with this in case, you want to change it to the feed system so, then we change the units accordingly. Another thing that we have to do now is import a DXF file, a drawing file but in DXF format. So, whenever you draw on AutoCAD you are saving your files as dwg files with dwg extension; however, when we have to bring it to design builder we have to save the same file as a DXF file.

Another important thing that we have to do is clean our dwg files, the drawing files, because, a lot of details which are usually added in drawing files are not required for creating the geometries in a whole building simulation tools. So, here the DXF should only have the basic information as far as its walls and openings are concerned.

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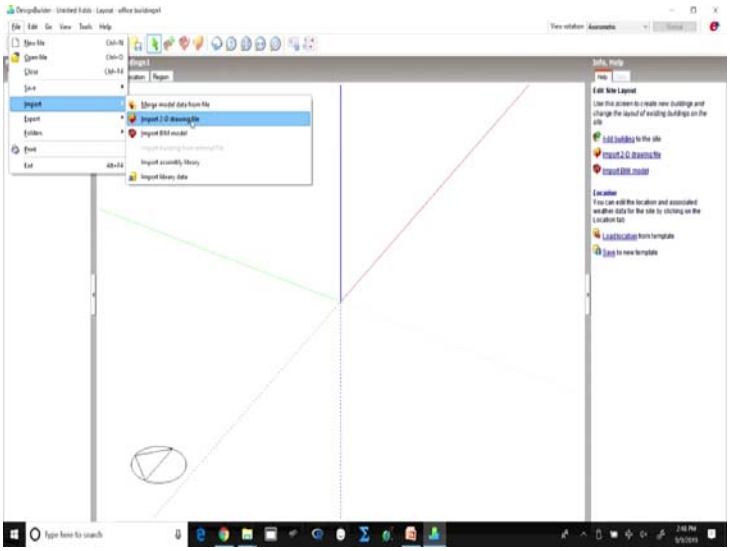

So, we will import a DXF file.

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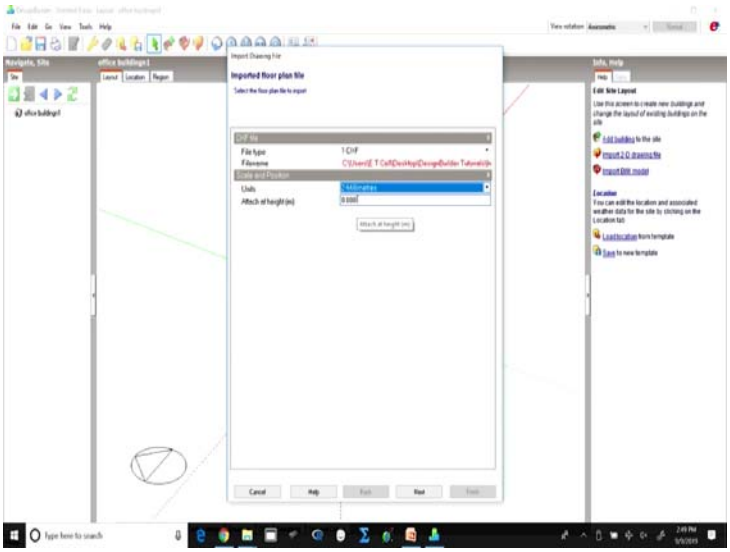

So, we will Import a 2-D drawing file you can already have a DXF ready. Here, we will prefer DXF because it is easier to create your buildings with the help of a DXF file it is easier to pick up points.

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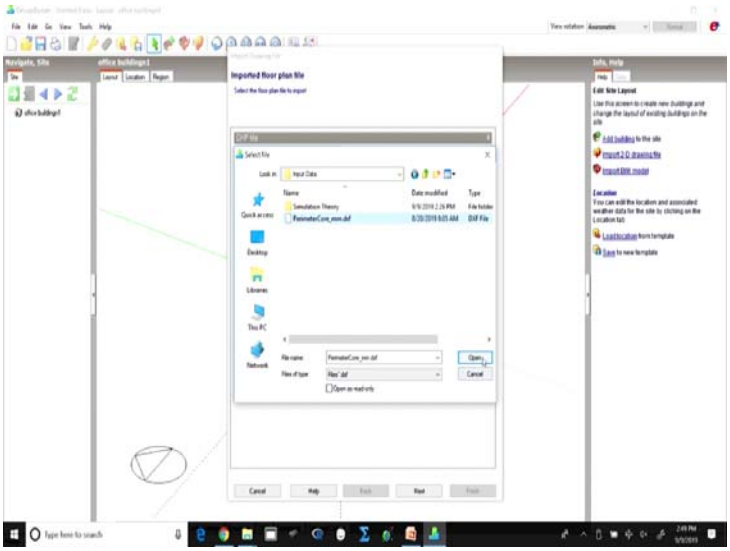

So, we already have created a DXF file, which is for the office building and it has been created in mm. So, here the Units that we will take is millimeters and we attach at height 0, which is we are attaching the drawing at 0 level, which is the ground level and then we create Next.

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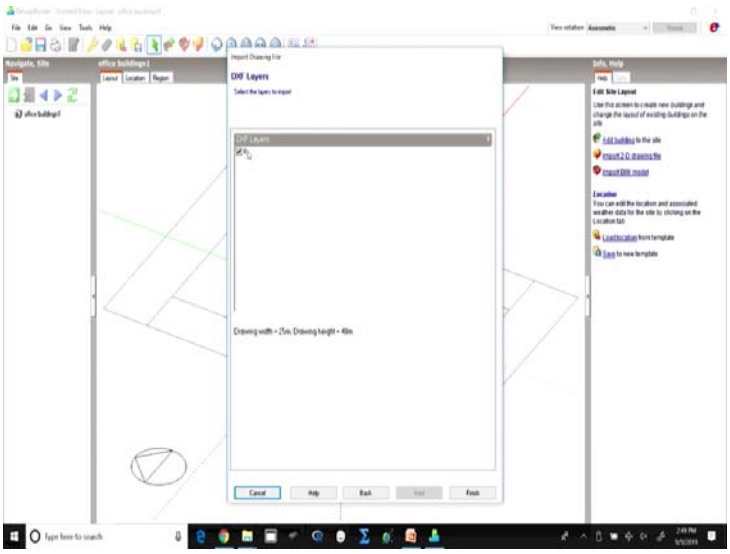

There are, there is only 1 layer in the drawing that we have created and so we Finish.

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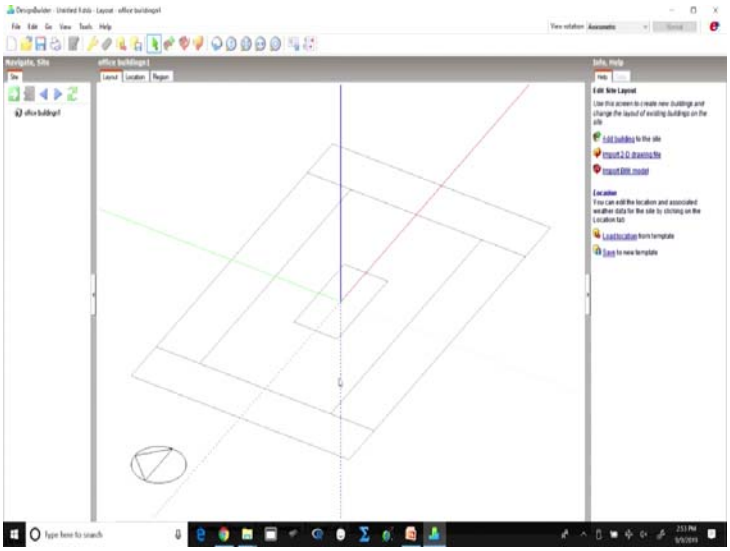

Now, you can see that a very simple single line drawing of this building has been created here, the orientation that it takes is by default. So, in one we are doing the base case as per appendix G, we will have to create the same building and rotate it for 4 different orientations.

So, in one case when the north is up there we will have to create 3 more cases; where the north is rotated to all the 4 sides and then average the performance of this base case building. So, suppose your DXF does not really come in the orientation that we want this is currently the Axonometric view if we look at it in Plan.

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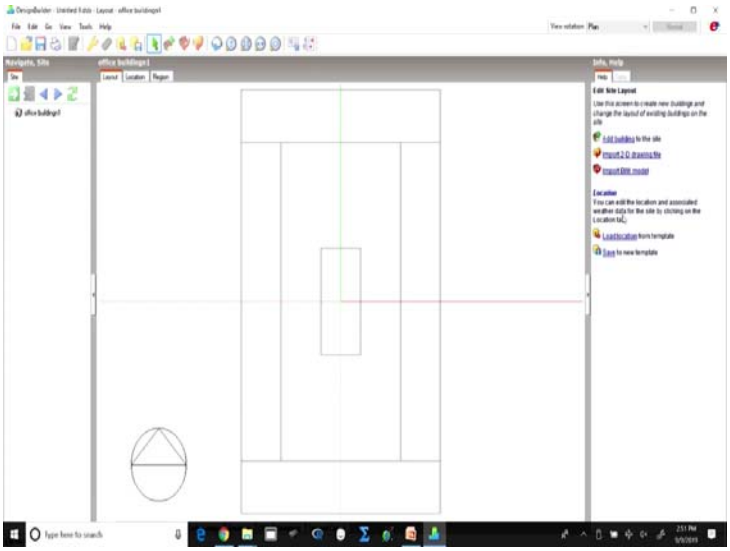

So, suppose we want to organize the DXF in a horizontal manner. So, then in that case we go to Edit the DXF and we can then select 2 points and we can rotate the DXF whichever way we want. So, sometimes the building may not be a very uniform, rectangular, rectilinear building it may have different shapes. So, we may want to orient or rotate the building accordingly.

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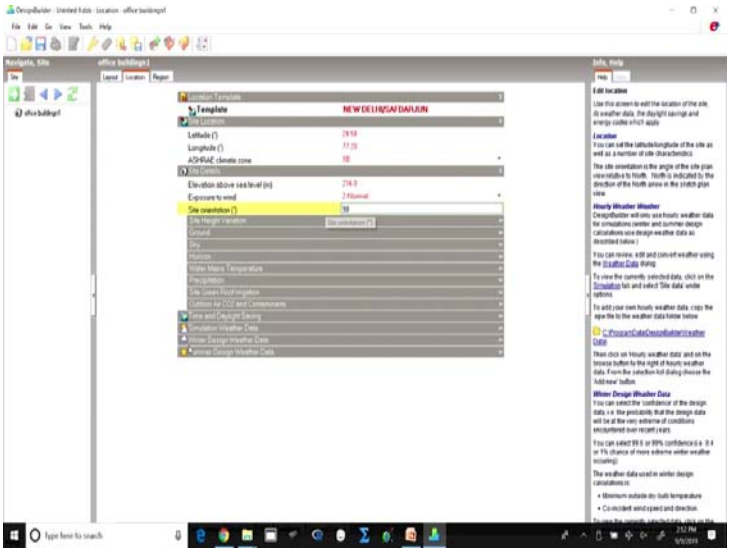

In that case, we will choose this option otherwise to change the orientation of the building and for 4 different cases of base case we will go to the Location, here when we

have already brought in the Template for NEW DELHI the SAFDARJUNG data, it comes along with its geographic details for the site. And, along with that it comes with the Site orientation here we can change the orientation to whatever the orientation is, and then if we go back we can see that the orientation has changed.

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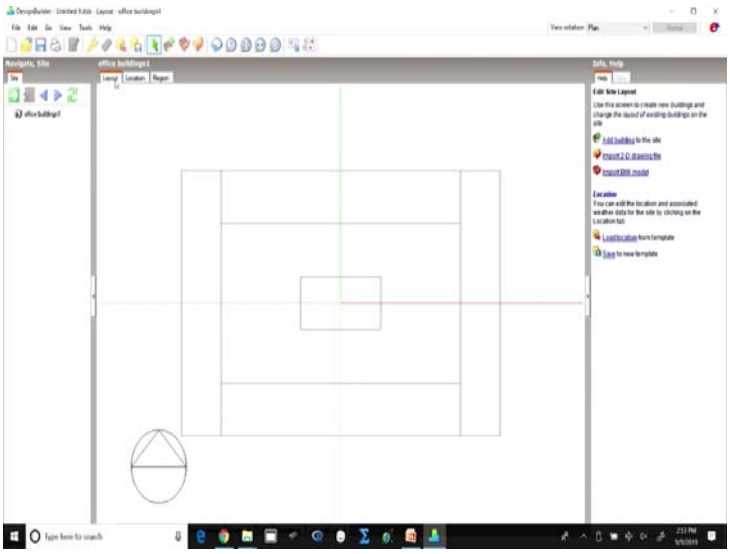

So, the orientation initially was up and now it has changed to this. We can further change, it for every subsequent base case and we can see the difference happening and we can see the orientation changing to this. So, to start with we do not need to change the orientation we can keep the orientation as 00 and start with the default orientation with this. So, once we have this DXF imported here now, I will very quickly explain to you what this drawing particularly meant.

So, this is a simple office building which is a rectangular building with the core, service core in the center; now these lines, these 4 lines they define the perimeter zone. So, if you remember our lecture where we were defining the perimeter zones. Now, these perimeter zones are created to differentiate between the zones which are right adjacent to the perimeter because, they have a different day light which is received.

They also have a different heat stress which is received because of the perimeter because of being in proximity with the building envelope and the remaining portion which is inside behaves differently as compared to this perimeter zone. So, these lines will help us in creating virtual partitions. So, the partitions which will be created here are not the real

partitions, but the virtual partitions to just define these perimeter zones and the core zone.

And the center would have toilets and staircase so, which will be confined within the core zone.

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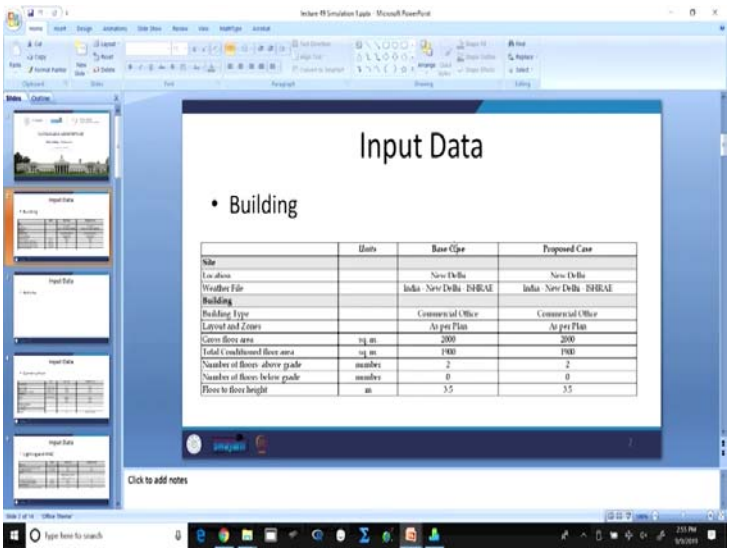

So, for the Base Case we have already selected the Location as New Delhi and the Weather File which automatically comes with selection of this location in design builder is the New Delhi ISHRAE weather data file. In case we want to create a new location for which may be a weather data file is available, but not present in the design builder in that case, a new location can also be created and weather data file can be imported into design builder.

So, the Building Type here is Commercial building and the Layout and Zone is as per the plan as we have just seen. So, the gross total floor area is 2,000 square meter with the conditioned floor area being 1,900 square meters. And total 2 floors are taken here with a Floor to Floor height of 3.5 meters. So, we have to first create a Base Case using this Input Data.

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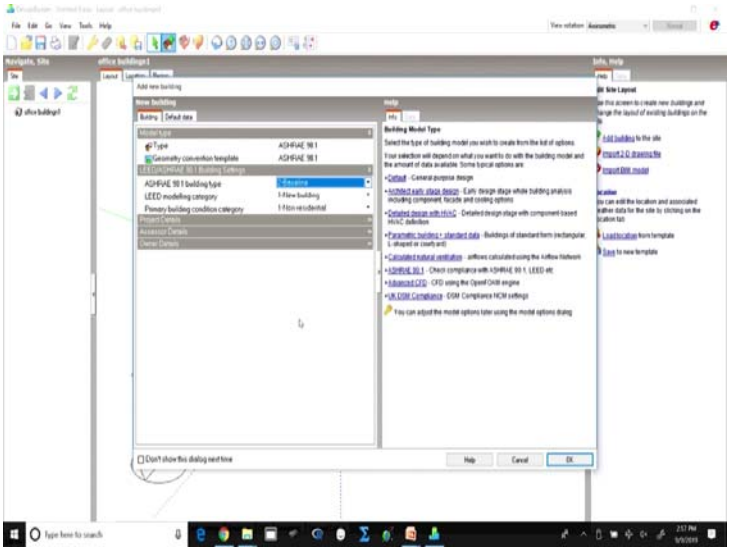

So, once we have already brought the DXF into the design builder we go on to create a New building. And, when we are creating a New building here we are taking the ASHRAE 90.1 base case.

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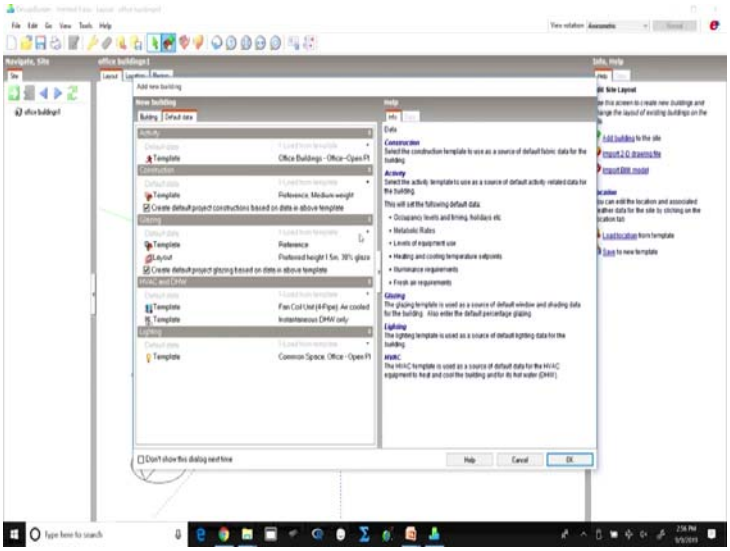

Because the ECBC base case is not available; however, a new Template can always be created which is the ECBC base case and when we take this ECBC base case the default Templates will be loaded like this. Now, all these Templates can be changed we can

bring in different specifications, we can bring in different Templates, but to start with we will just retain the templates as given in the default ASHRAE 90.1 type.

And here we are creating this Baseline. So, we change this building type to the baseline building and we just keep it as it is because, it is a non-residential building and all other details go as the default data and we go on to create a new building. The moment we create a new building, we can see that a new building has been added to this project which was office building 1.

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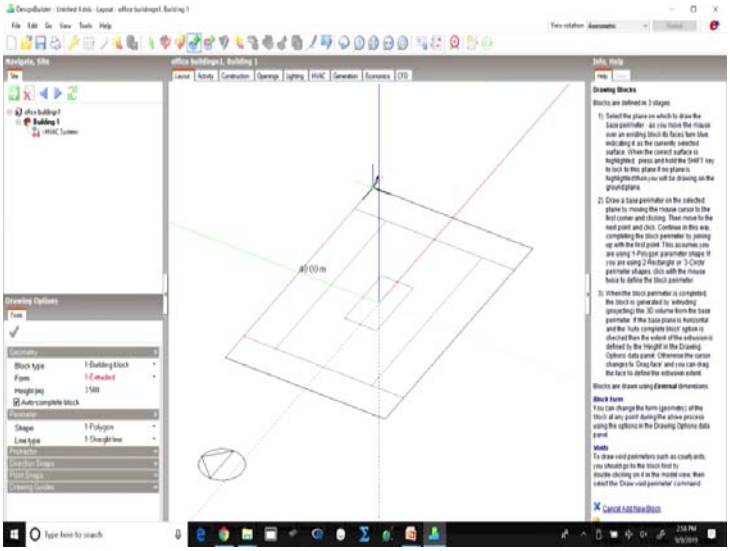

Now, we have to create the Building Block, walls have to be created here we will check the geometry, the Height default height which has been taken as 3.5. In case the building height was more or less suppose you are creating a residential building and you want 3.0 meter height or 2.9 meter height it can be changed from this point.

Suppose we have Sloping walls or we have a Pitched roof or we have a Dome so, that also has to be changed here in Extruded the walls will come as straight walls and the roof will be a flat roof. In case of different options we have to select the option given here accordingly.

Now, we go on to create the block here. So, we are already here on the adding of new block. To add the new block which will be of height 3.5 meters, we simply start drawing on these lines. So, we snap the end points and when we are closing in instead of a green

point, it will start showing us a blue point and the moment we go there it will close it automatically.

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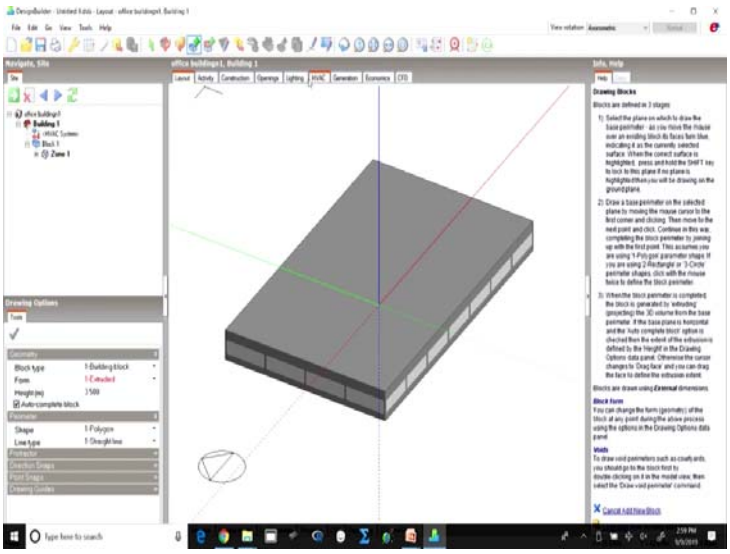

So, the moment it becomes green and we click on it. It creates a building here. Now, this building is coming with default values of all these tabs, activity, construction, opening, lighting, HVAC all that we seeing here is default for the template that we have already picked which is ASHRAE 90.1.

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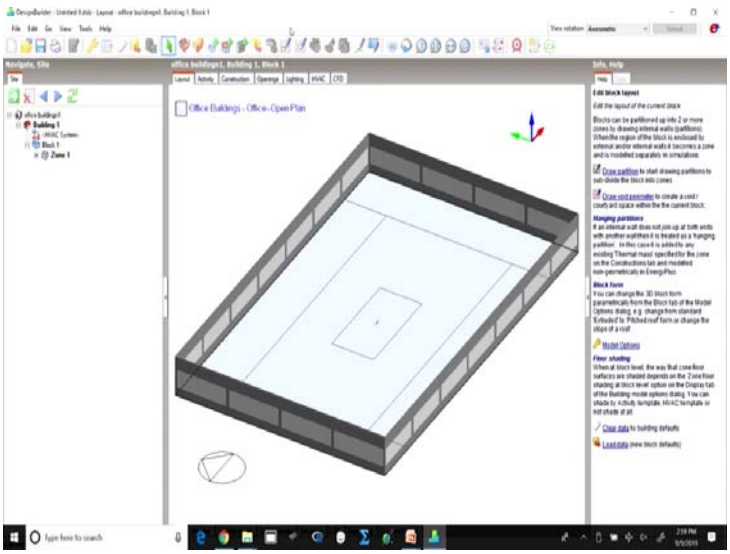

Now, this block is created here if we go into this block we can see that this is currently a complete single zone. So, there is no perimeter zone, there is no core area separated. Now, if we have to create different zones within this we go on to create partitions.

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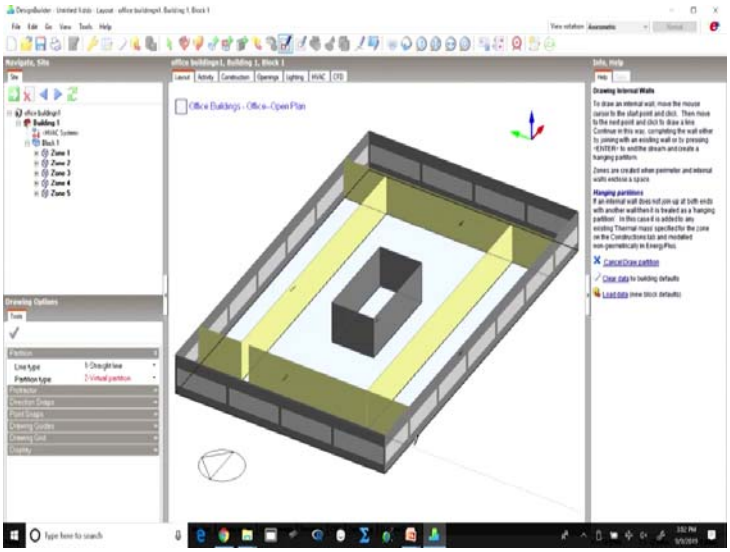

Now, these partitions are Standard partitions or Virtual partitions. So, when I was talking about the Virtual partitions for defining the virtual the perimeter zones this is what we will select; however, right now I want to draw the core zone. So, I will select the Standard partition type and I start to draw the partition just as I have drawn the walls.

Now, these walls may appear to be very thin, but the property is that these walls are taking are already defined in the construction templates. Now, I have to define the perimeter zone, so I change the Partition type to Virtual partition and I start drawing the virtual partitions here. Once we have created the partitions the zones will automatically be created.

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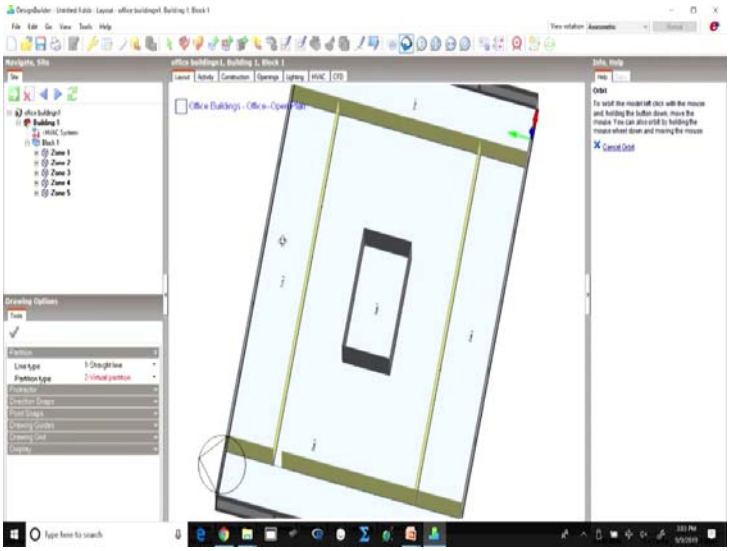

So, we can see that automatically wherever an enclosed zone was created using standard partition or virtual partition the zones have been created. However, because the partitions were not joining, this entire zone is currently behaving as a single zone.

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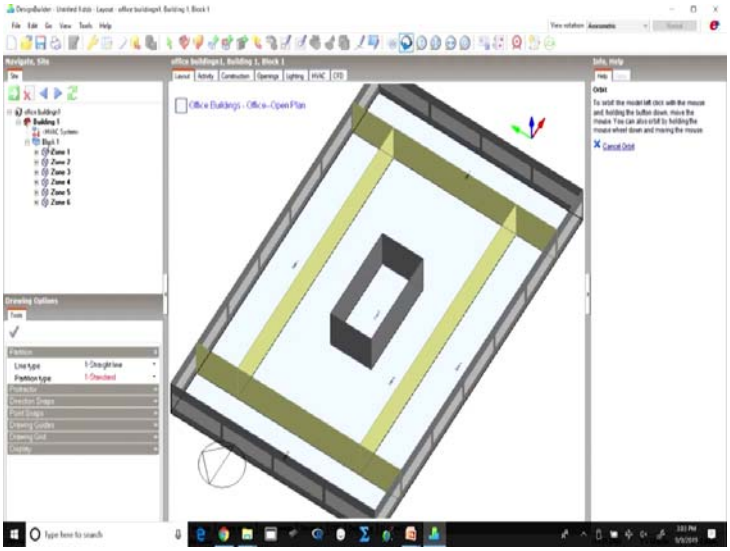

Now, when we have created these virtual partitions, these virtual partitions do not really physically divide the space into different zones. But, it will only account for the heat exchanges, the difference in heat exchanges and the light which is coming by making it a different partition.

We can choose to have the same HVAC system for all these zones and they will continue to remain as 1; however, we can define a separate HVAC system for each of these zones, whether they be divided by virtual partitions or by standard partitions. So, this is how the building has already been defined and we can also name these different Blocks differently.

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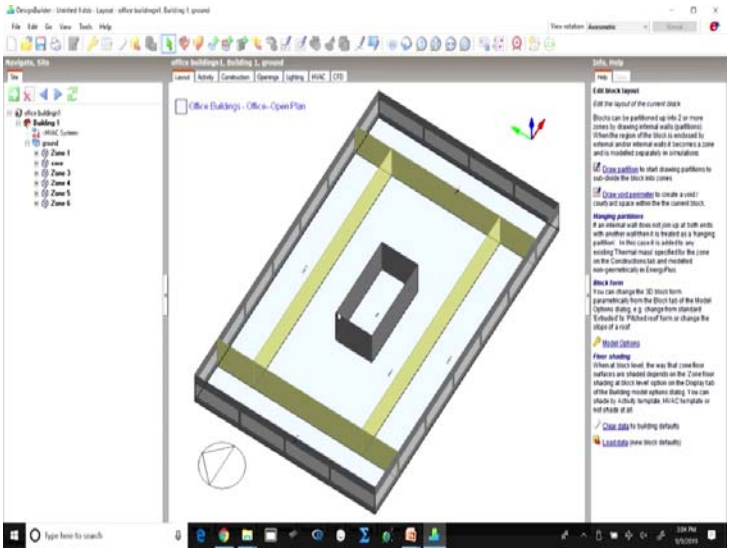

So, suppose this one, you just double click on these names and it will automatically change it is better to name your floors and zones differently. So, that it is easier later to analyze the results because they come along with the Zone names and the block names so, accordingly we can change these Zones also.

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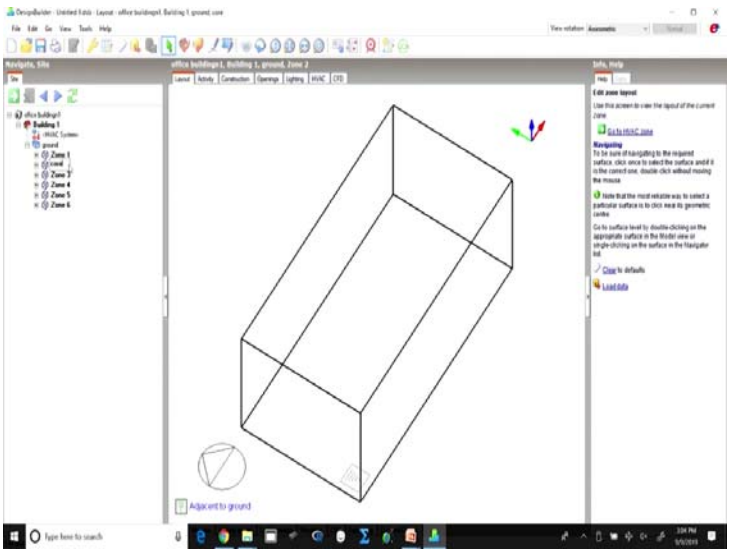

So, this is the core zone. So, we can change this core zone as a core, because this is where our different systems would be. So, this is going to remain an unconditioned space while rest of this area is going to be a conditioned area. So, rest of the zones are basically single zone, but just virtually partitioned. So, this is at the block level.

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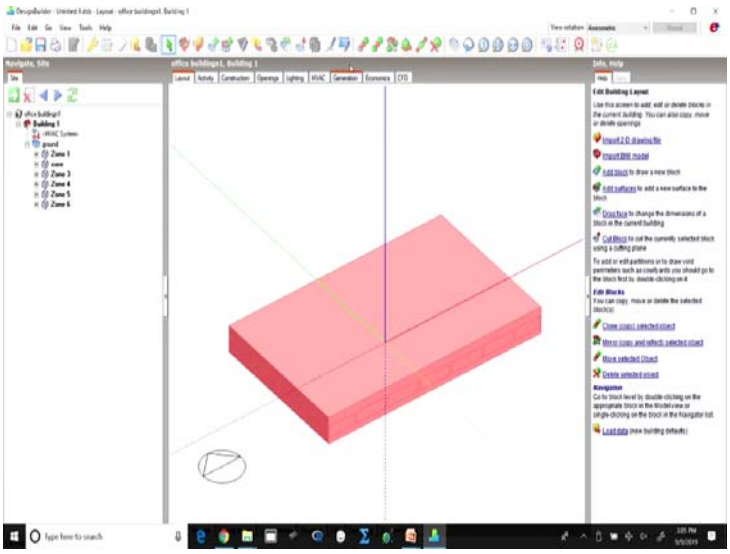

Now, this was ground floor and we saw right in the beginning that the building is going to have 2 floors.

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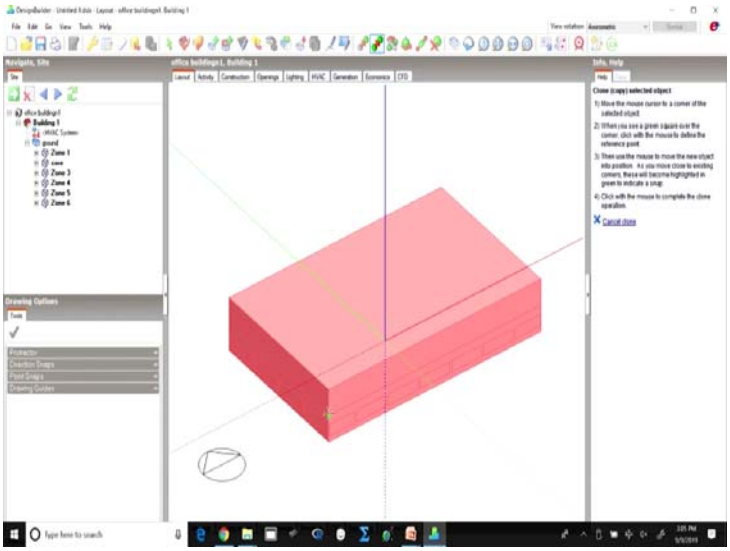

So, we select the entire ground floor and we clone it. So, we can just clone the same object select a base point and copy it.

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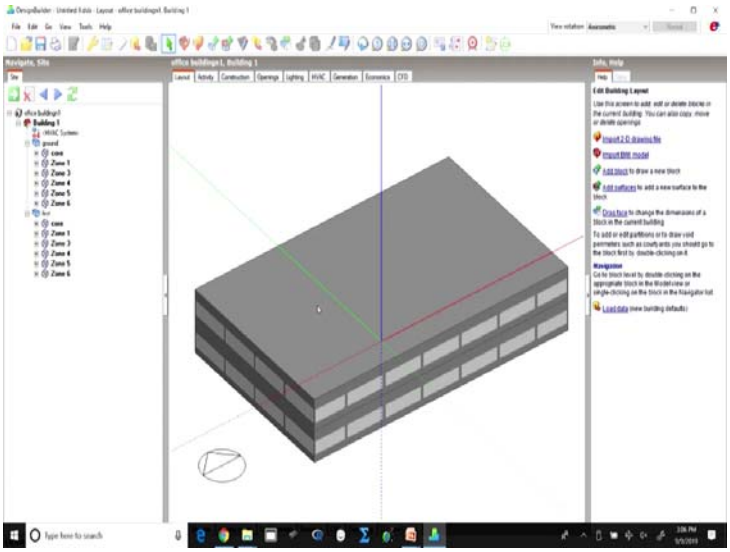

So, all the properties that were there for the ground floor have been copied onto a first floor which is this.

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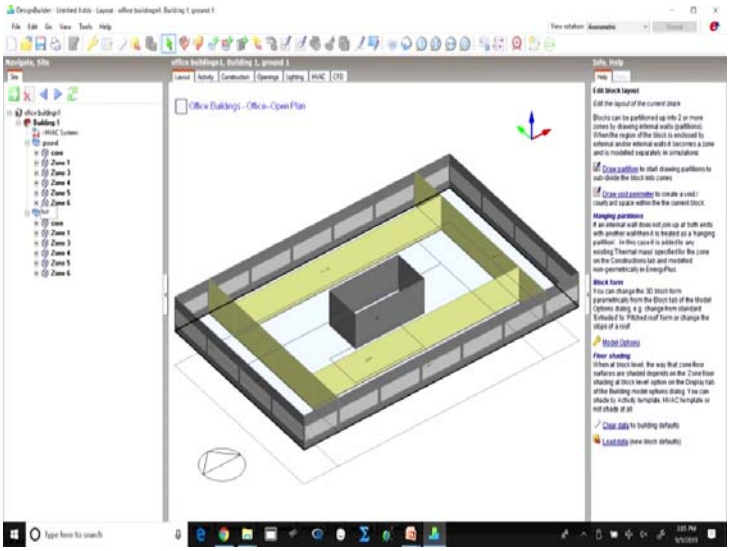

So, we can rename it to be some different block all together and the same Zone if we see here for the first floor automatically, a core zone has been created and the same zones as we saw in the ground floor they have been recreated.

So, we have now completed making the geometry of the building now the windows that have come is default, by default a uniform window wall ratio which is distributed uniformly on all the sides. A roof which has automatically come with the construction which we will see in the upcoming lectures, walls and all other systems lighting HVAC, so, all of these have come as default templates.

So, I will stop here for this lecture today and I hope tomorrow when you come to attend the next lecture you would already have a building plan and you would have created a default baseline building, taking the templates and you would have been able to create geometry for yourself. So, in the next class next lecture we will look at the activity templates and we will see how the activities can be assigned to this building kindly save your projects and come tomorrow with the building geometries.

Thank you and see you again.