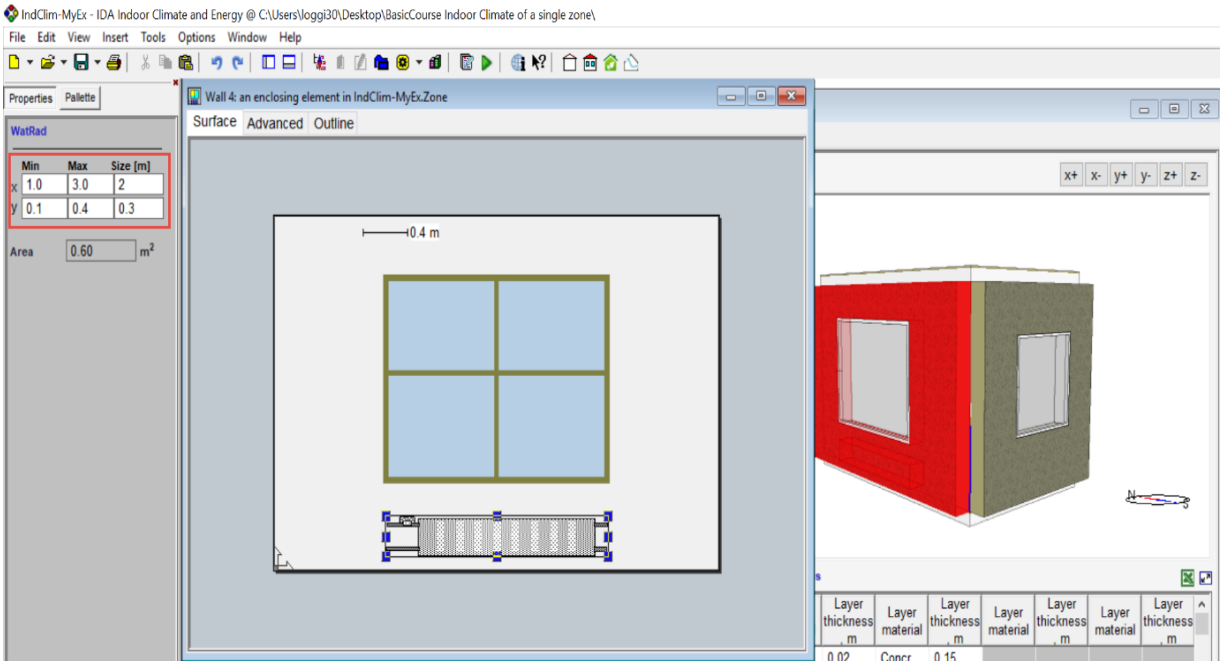
EQUA
SIMULATION TECHNOLOGY GROUP

IDA Indoor Climate and Energy

Basic Course

INDOOR CLIMATE OF A SINGLE ZONE

Guide



February 2018

Purpose

This is the first part of the IDA ICE basic course 1, where you get started with the IDA ICE standard level. You learn how to perform an indoor climate (or comfort) analysis of a room. During this guided exercise, we go through the following tasks:

- Start a new project
- Definiton of the comfort relevant objects in a zone: Windows, ventilation, heaters, coolers, internal loads and controller setpoints.
- Using the suitable zone model (called ”Climate” or ”Energy”)
- Setting up and running a heat load calculation
- Setting up and running a cooling load calculation
- Reading the result tables
- Looking at important zone result diagrams

To get more support, also use the getting started guide, accessible over the ”Help” menue within the IDA ICE software.

Background

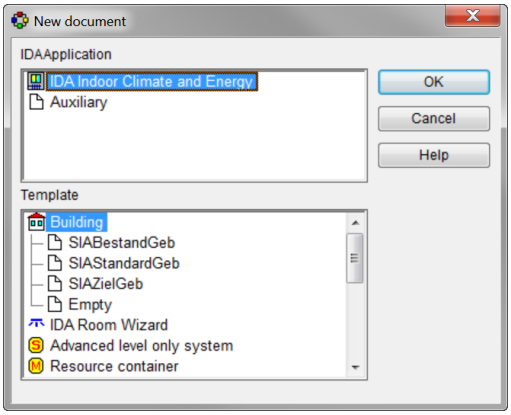
To evaluate the thermal room comfort is an important element of many certification systems as Miljöbyggnad in Sweden, DGNB in Germany or Minergie in Switzerland.

Instructions

Step 1

There are different ways of starting a new simulation project. In the menu bar you can find the three buttons , and . The first button opens a new IDA ICE model without any default input. The second one opens a new IDA ICE model with all default values that are required for being able to run a simulation (including one single zone). The third button opens a new IDA ESBO model. Depending on the localization of IDA ICE, there might be more buttons to start a new IDA ICE model from local building templates.

Not all available building templates are represented in a button on the menu bar. To get the complete selection of building templates, use the command ”File” > ”New” to open the ”New document” dialog as shown below. With deeper knowledge of the IDA ICE software, it is possible to create your own customized building templates.

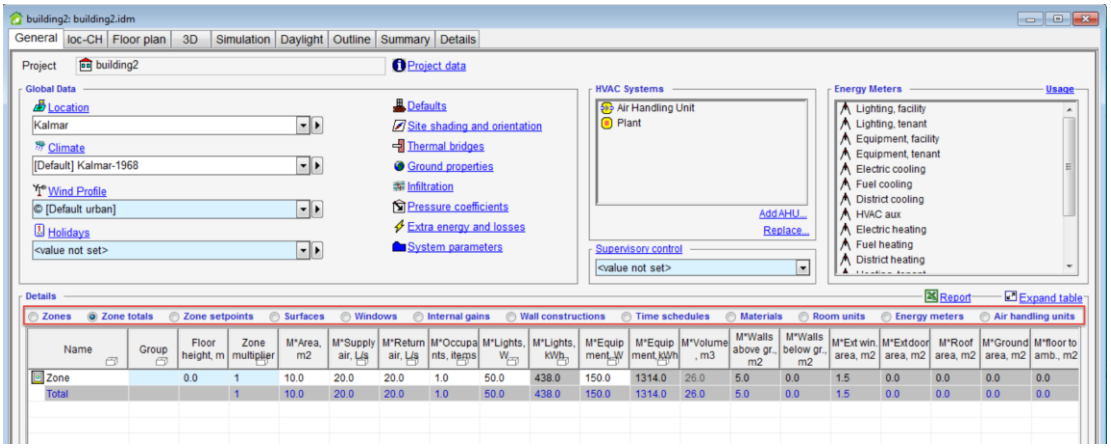


a. Select ”Building” from the ”New document” dialog and click ”OK”. This has the same effect as clicking on in the menu bar. From the table in the lower half of the ***General*** tab, you find that one zone representing a single room (called ”Zone”) is inserted to your new simulation model (the table has one row per zone). From the same table, you can also find the most important predefined properties of the zone. By selecting other tables than ”Zones”, you can choose what model properties you want to look at.

b. Save your model by selecting ”File” > ”Save as...” and rename the model to ”IndClim-MyEx” or any other suitable name and save it in a suitable place.

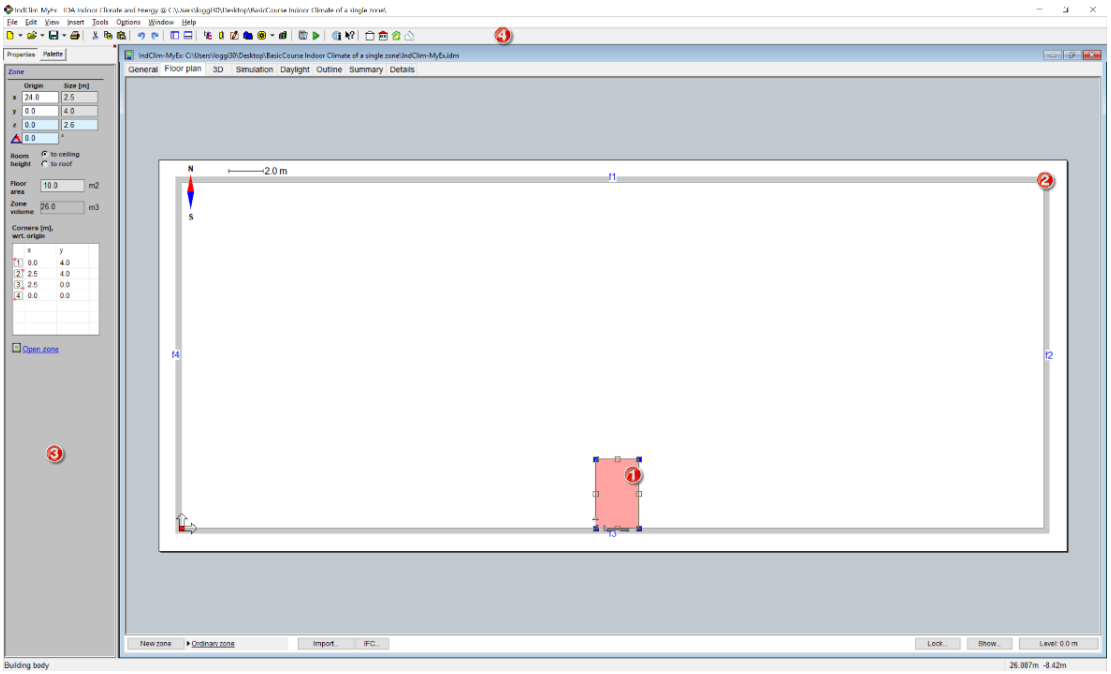
Step 2

a. Select ”Zone totals”, ”Zone setpoints” etc. to study the properties of different objects of your model:



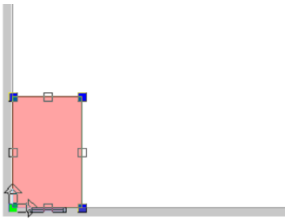
b. Go to the ***Floor plan*** tab and check the zone ❶ (representing a room) and the building body ❷. At the moment, our zone is situated at the southern facade of the building body (see north arrow at top left of the building body).

You can either mark the zone or the building body by clicking on them. The properties of the marked object are shown in the side bar ❸. The side bar can always be opened and closed by clicking on ▯ in the menu bar ❹.



Note: All main geometrical modelling is done in the ***Floor plan*** tab. We will show much more of this in another lesson.

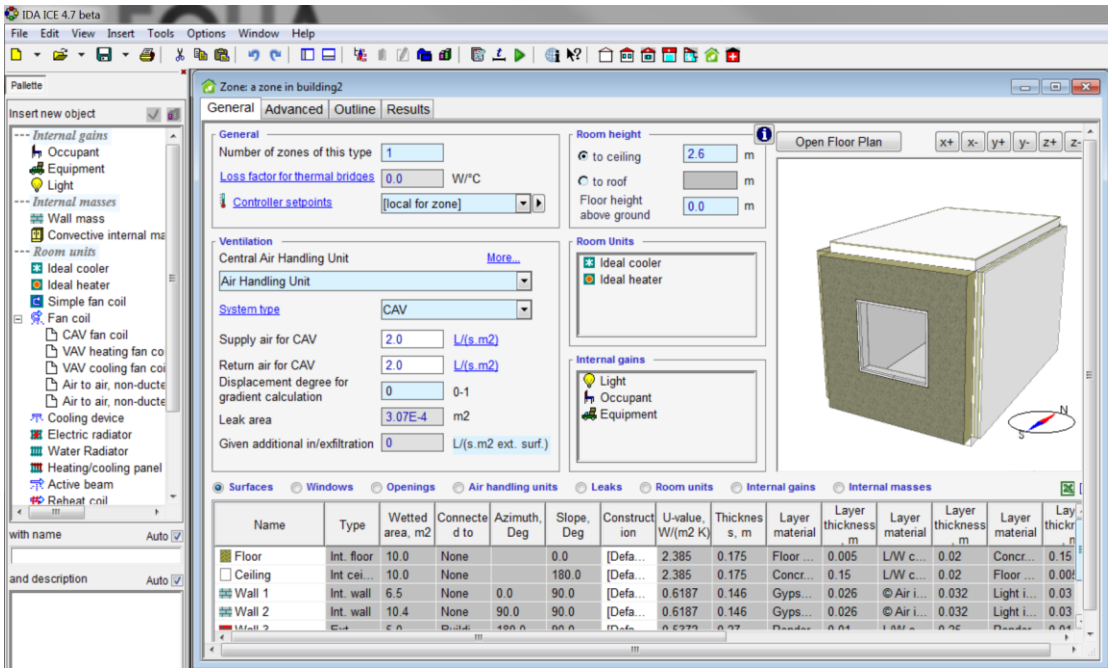
c. Drag and drop the zone till the southwest corner of the building body.



By doing this, use the following features:

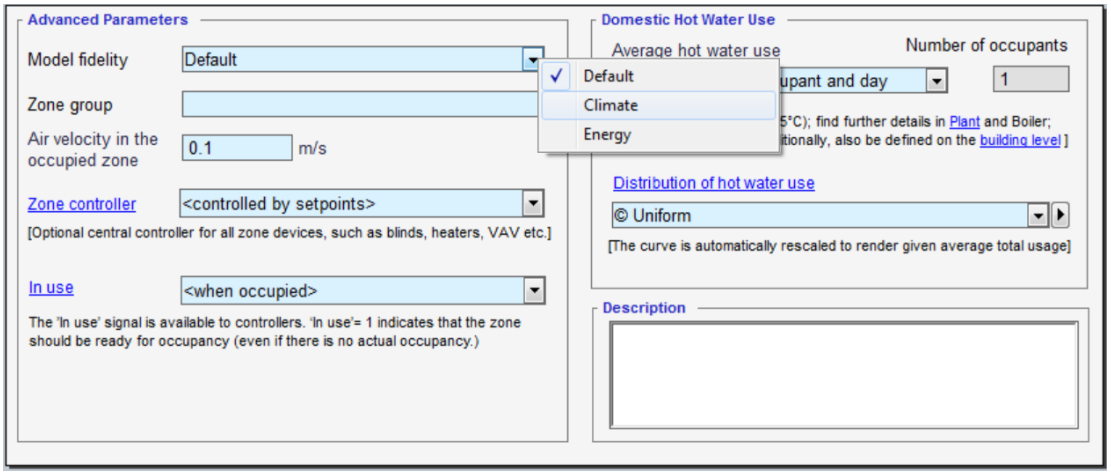
- Snap: When you drag the zone towards the corner of the building body, you can stop near the place you want the zone, but not exactly on it. You will then observe how the dragged object is snapped to other lines/objects. For this, you need to come quite close to the other object. By pressing the Shift-key, you will get help in dragging your object only in x- or y-direction.
- Lock: You find the Lock...-button in the bottom right of the Floor plan view. After clicking here, you can lock the objects you finished working with. Like this you can protect these objects against unintentional moving or resizing.

d. Open the zone form by double clicking on it. In the zone form you find an overview over all properties of the zone. In this lesson, we will concentrate on windows, ventilation, room units, internal heat gains and setpoints.



e. In IDA ICE, you can choose between two different zone models. The little simpler model is called the ”Energy” model. The more detailed model is called the ”Climate” model. The ”Energy” model is a bit faster and suitable for Energy calculations. But to calculate e.g. the Fanger comfort indices and operative temperatures at certain positions in a room, you have to use the Climate model.

To select the zone model, one goes to the ***Advanced*** tab of the zone form:



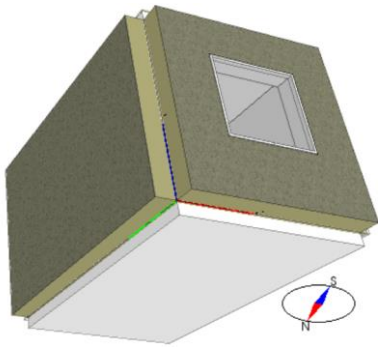
Note: Which of the two models is the “default” model, can be defined in the main ***General*** tab by clicking on Defaults.

Note: The “Climate” model is limited to show box zones. Whenever the “Climate” model is selected for more complex zone geometry, IDA ICE will give a warning at simulation start and use the Energy model instead.

f. In IDA ICE, you can navigate through the 3D view (here the zone model) as follows:

- rotate by clicking and holding the left mouse button.
- zoom in and out by clicking and holding the right mouse button and moving up-wand downwards.
- Pane by clicking and holding the middle mouse button or scrolling wheel (alternatively left and right mouse button at the same time)

Try to rotate and zoom to the following view:



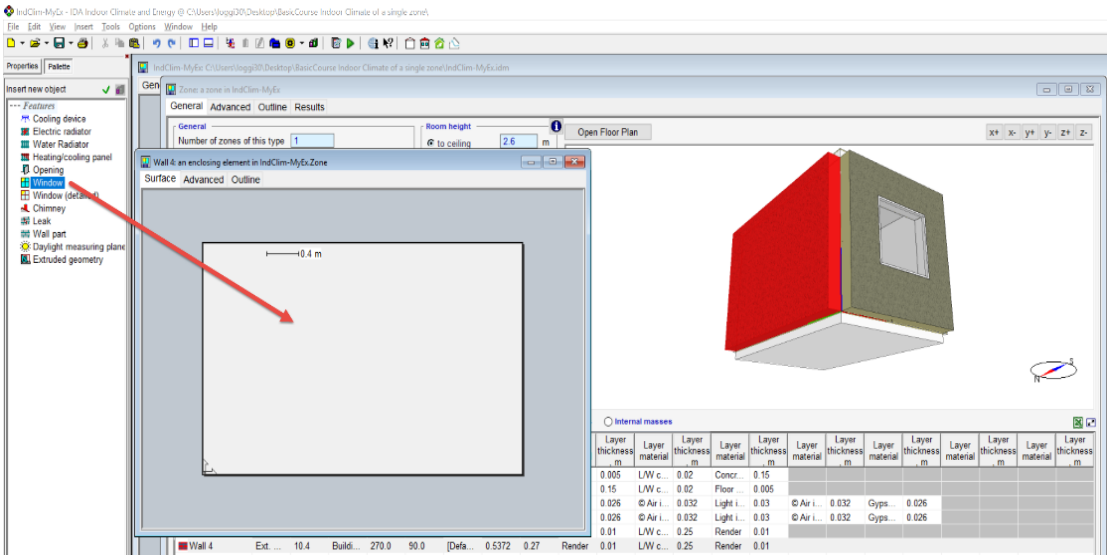
Step 3

a. Open the external wall without window by double-clicking on it in the 3D view. You will then get the form of the zone surface.

Note: The zone surface is always shown from the inner side. The origin point for coordinates always on the bottom left corner of this view.

In the side bar, you can switch from ”Properties” to ”Palette” and back by using the two buttons on the top. The palette gives a list of all objects that can be inserted to the active view. Observe how this palette changes when switching from the zone to the surface form.

b. Drag and drop a window from the palette to the wall surface:



Note: There are two different window objects – “Window” and ”Window (detailed)” – that can be inserted. These two objects are related to two different window models. Here, we use the standard (more simple) window model.

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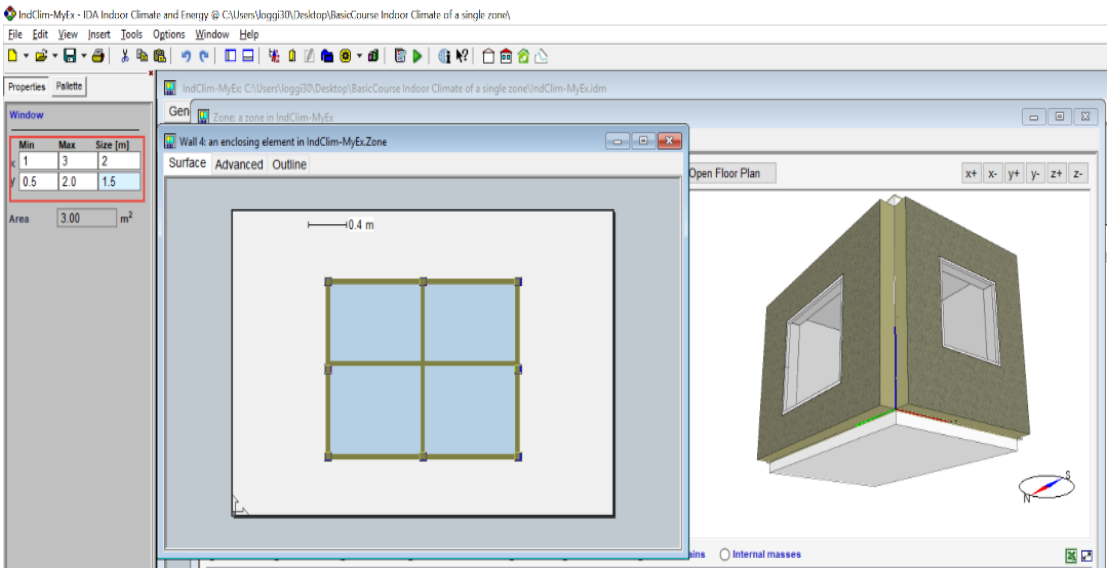
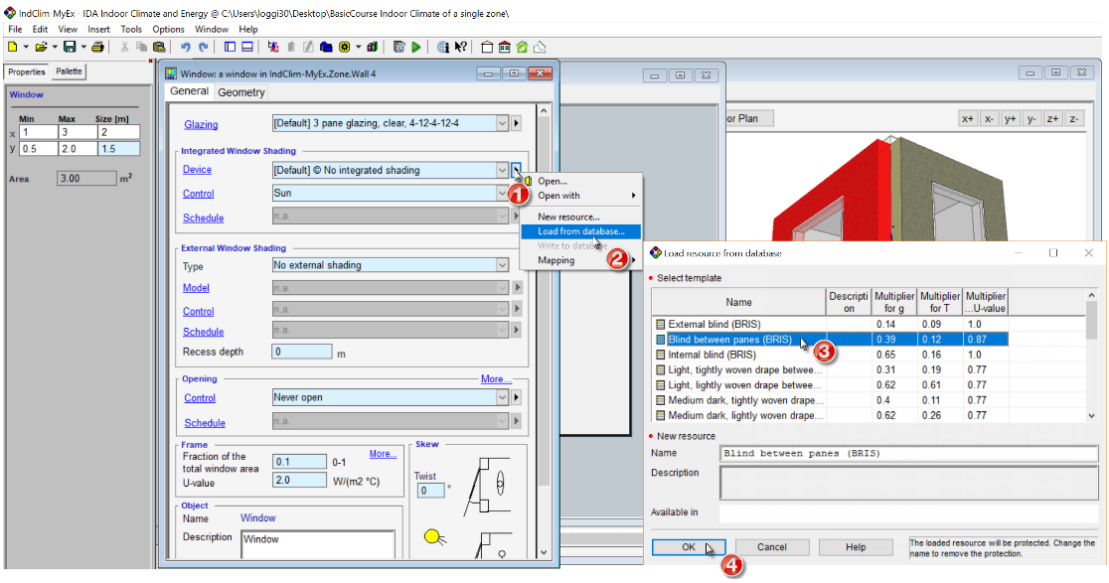
c. You can now change the size and the position of the window by either moving the whole window or its borders/corners, or by editing the geometrical parameters in the ”Properties” view of the side bar.
Model your window to be 1.5 m high and 2 m wide. The sill height should be 0.5 m and the horizontal distance from the external corner to the left border of the window 1 m.



d. Double-click the window (either in the 3D view of the zone form or the 2D view of the surface form) to open the window form. Here you can give all window properties as e.g. the relevant glazing values, how and when the window should be opened, solar protection properties and frame U-value.
Load the ”Blind between panes” from the IDA ICE database by following the clicks in the picture below. You can then close the forms for window and zone surface.

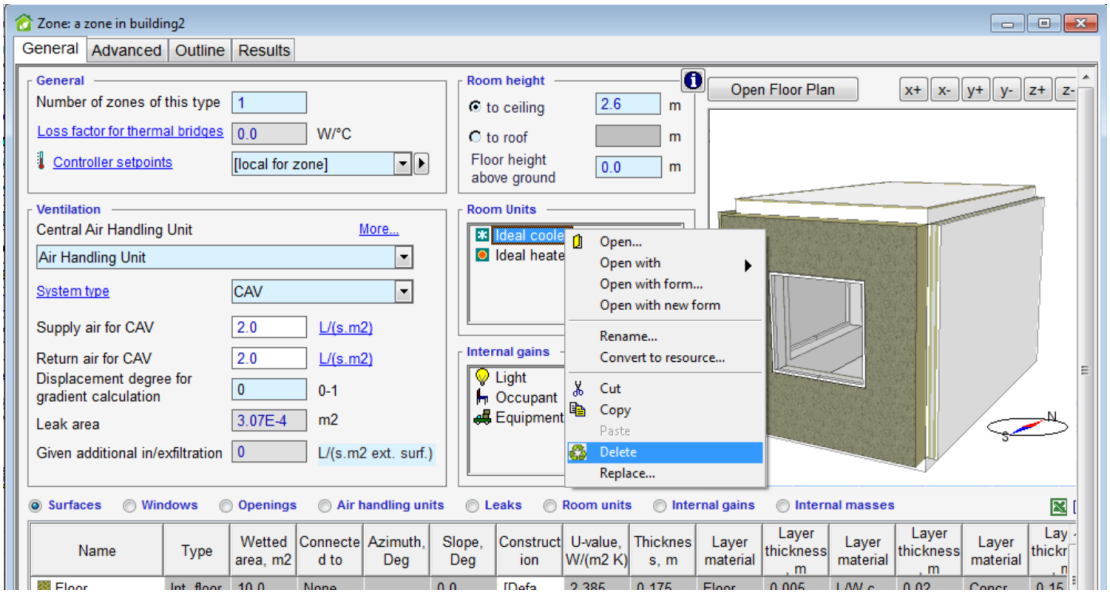


Note: the alternative data input is done from a ***dialog***. A dialog differs from a ***form*** in that way that you need to close it with the “OK” button in order to save your modifications, while in forms changes are always saved automatically and immediately.

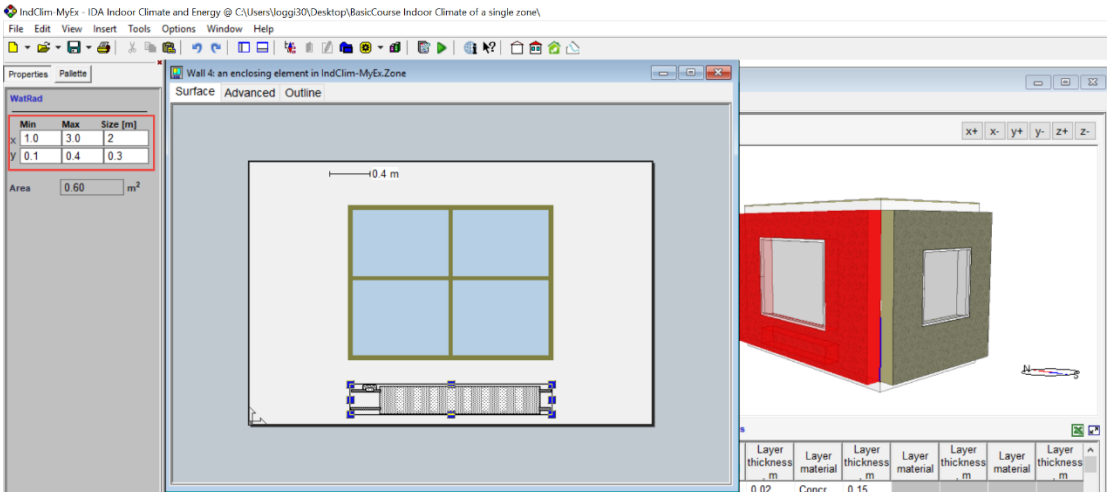
Step 4

As we started our new IDA ICE model with the default building, the inserted zone already has an ”ideal cooler” and an ”ideal heater”. This is to directly be ready for a cooling or heating load calculation without specifying the room unit type that will be installed. But to calculate the thermal comfort of a room, the type of the room units is relevant and the results significantly depend on it.

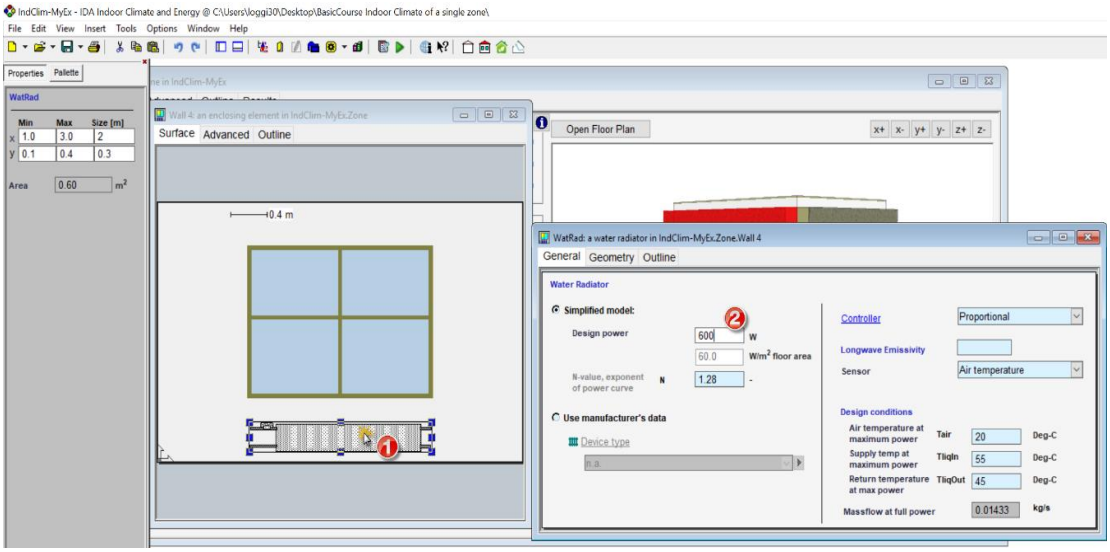
a. We thus delete the existing ideal heater and cooler by marking them one after the other and either click the ”delete” button or selecting ”delete” from the context menu. The context menu of an object is opened by right clicking on the object.



b. We can now insert the specified room units. In this lesson we will use a water radiator for heating and an active beam for cooling, as both is often used in typical Swedish office buildings.
Insert a water radiator below the window of the western facade. You can do this from the zone surface as we did with the window. Position and size of the radiator is shown in the picture below.

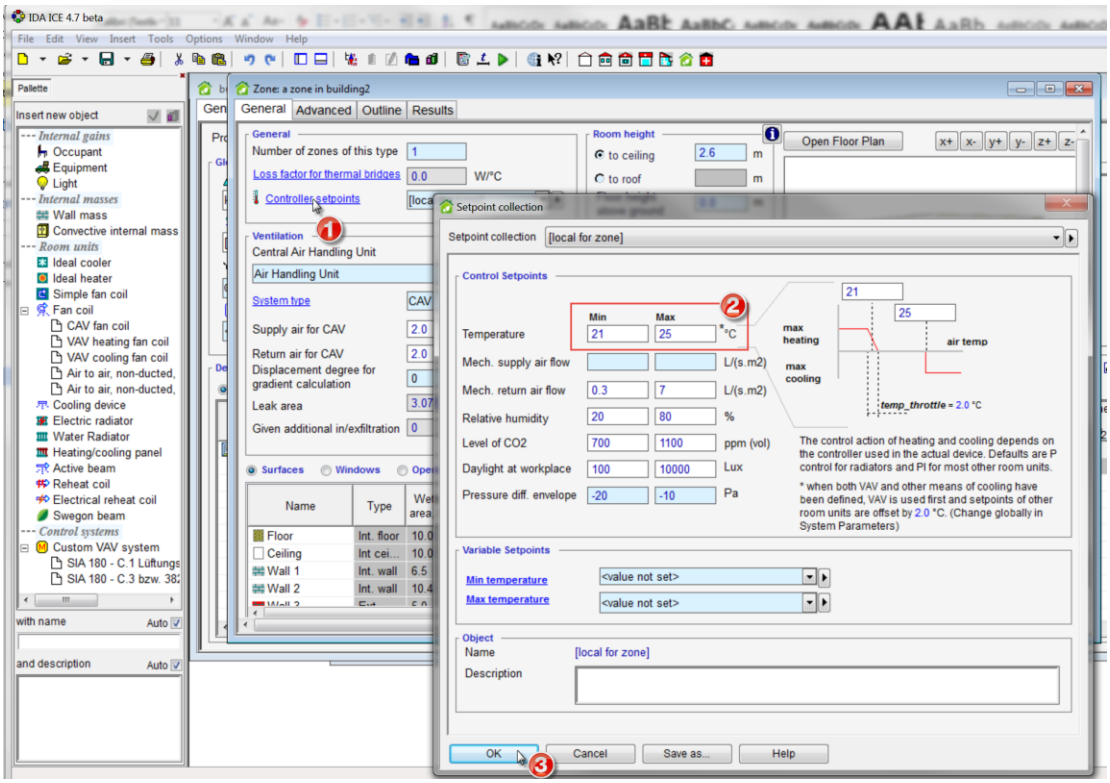


c. Size your water radiator by double-clicking on it to open its form. Click on the button for alternative input data and give 600 W. Normally you should find the design power and design condition of your radiator in the manufacturer´s data sheet.



d. In the water radiator form you can also select the controller type. We leave it at proportional controller. The proportional band is 2 °C by default and can be defined in the system parameters that are accessible from the main ***General*** tab by clicking on.
System parameters.
We can now close the water radiator and the zone surface form.

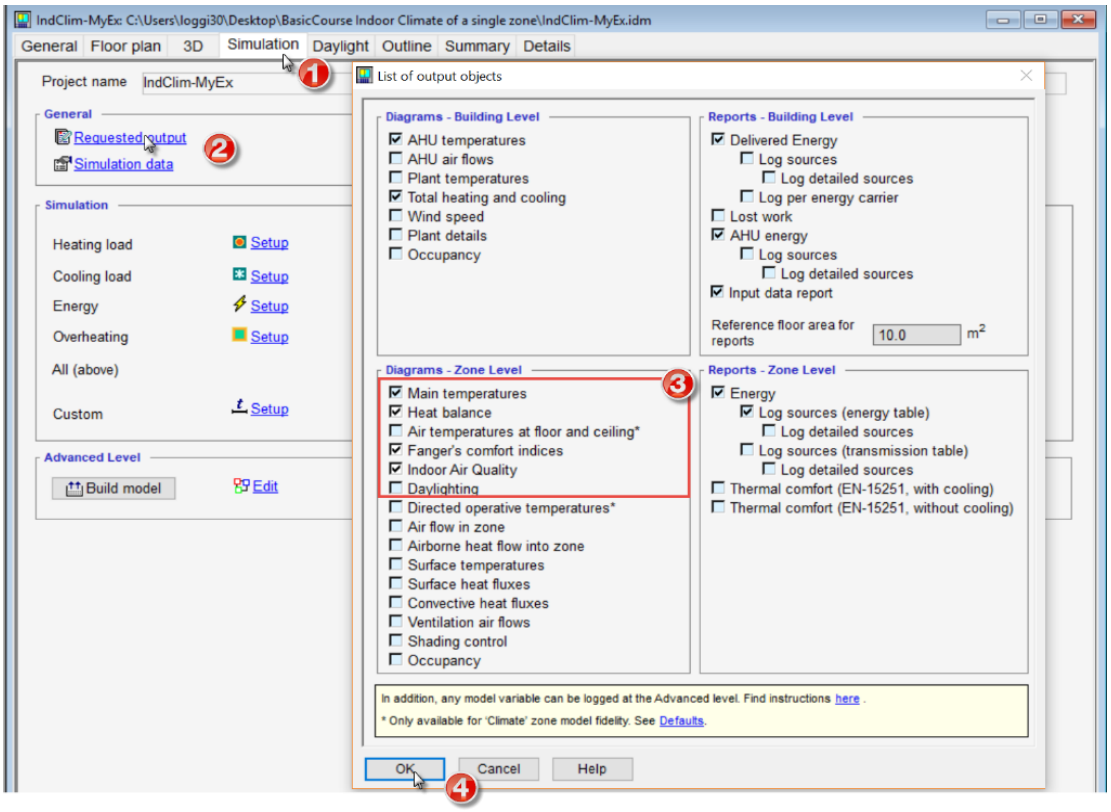
e. The last thing which is relevant for thermal comfort are the zone setpoints. Open the zone setpoint dialog by clicking on Controller setpoints in the zone form. For temperature setpoints, give 21°C and 25°C. Click ”OK” to close the dialog and save your changes.



Step 5

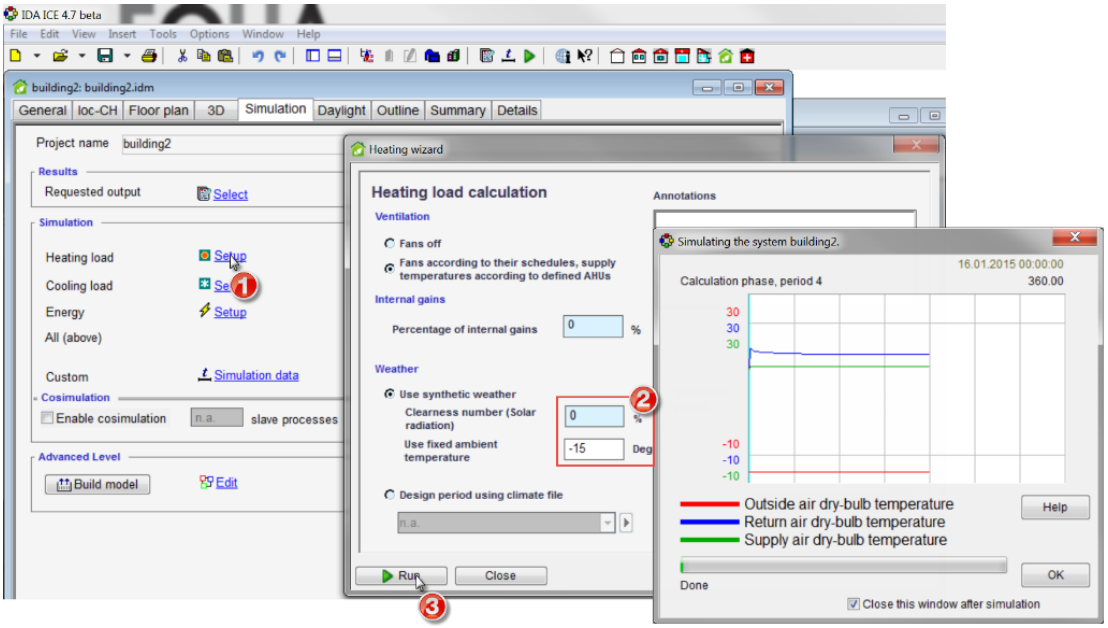
We are now ready to run a heat load calculation in order to verify whether our radiator has the appropriate size.

a. First of all we select the results we want to look at. Go to the ***Simulation*** tab and click on Requested output. Select the zone level diagrams ”Main temperatures”, ”Heat balance”, ”Fanger’s comfort indices” and ”Indoor Air Quality”. Click ”OK” to close the dialog and save your changes.

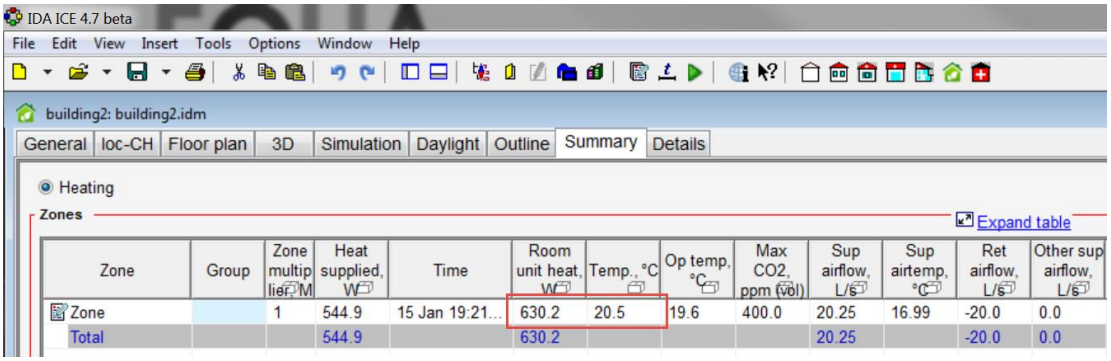


b. Click on Setup for Heating load to select the simulation properties related to heat load calculations. Use a fixed ambient temperature = -15°C and 0 solar radiation. Click ”Run” to start your simulation.

c.



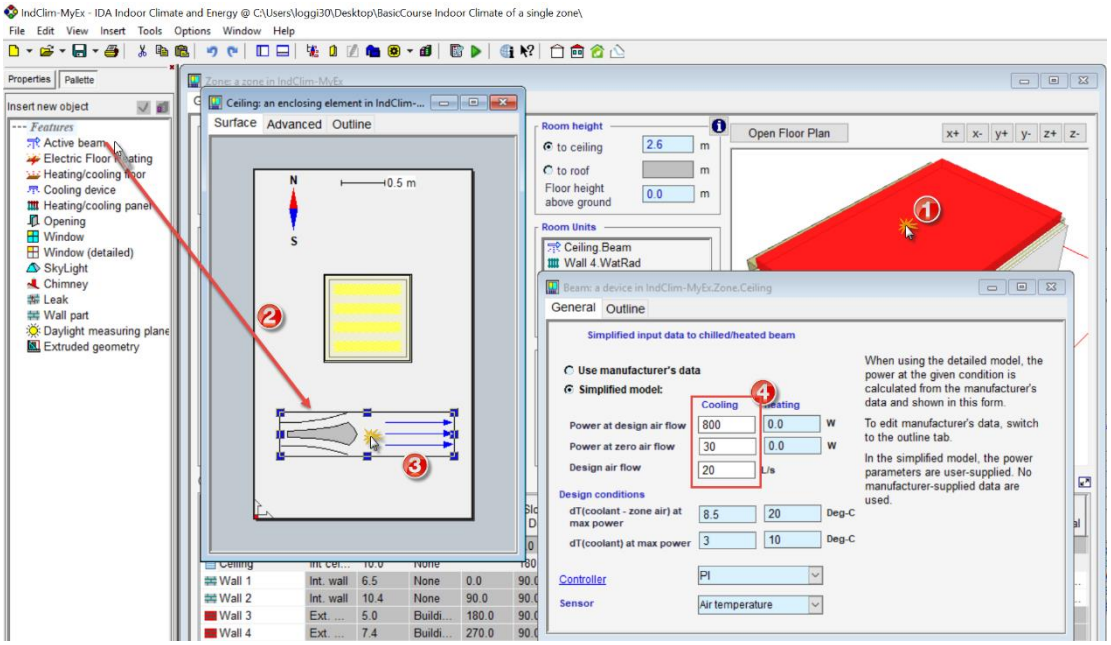
After the simulation, the ***Summary*** tab is opened automatically. This result table (for Heat load calculations) shows maximal power and temperatures at maximal power. As we now did a heat load calculation with static boundary conditions, we can also expect static conditions within the results. Check the room units heating power and room air temperature.



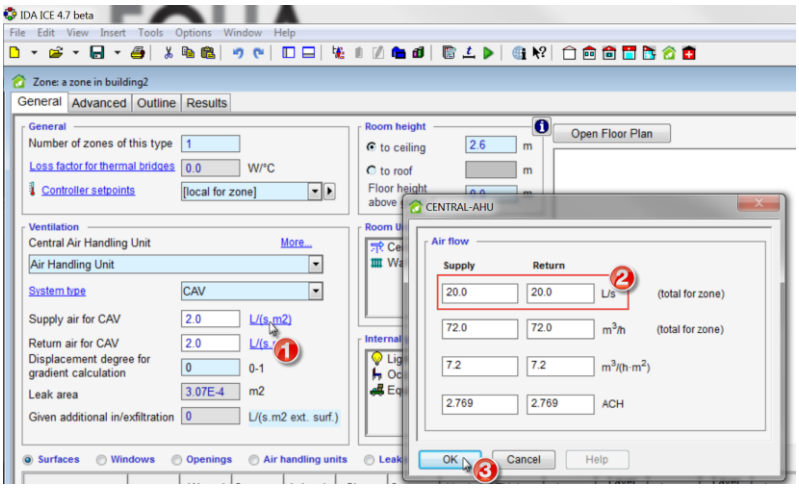
Step 6

We want now continue with a Cooling load calculation. To do so we first insert the cooling room unit.

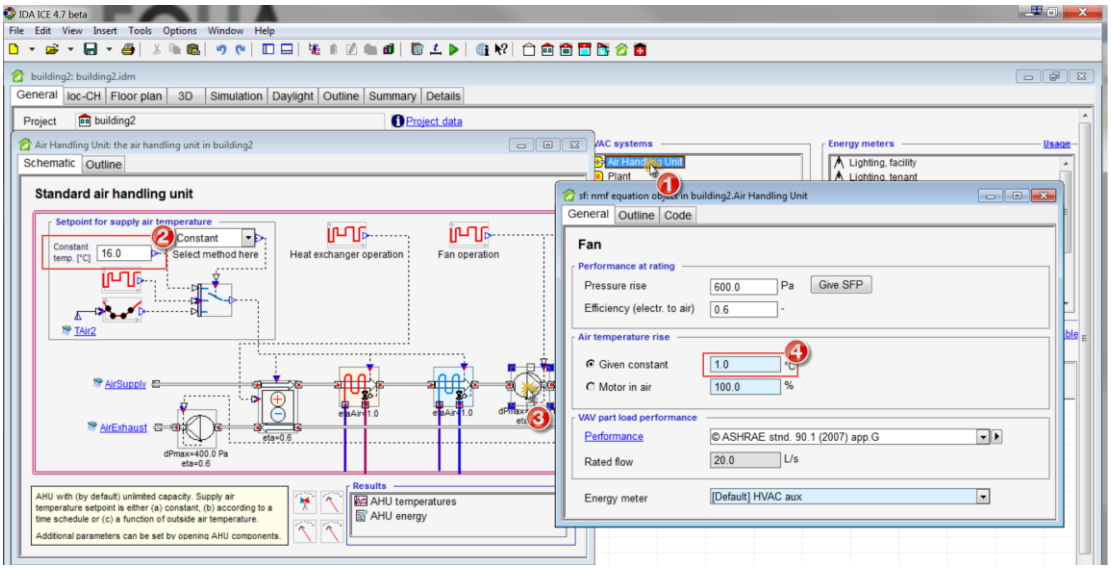
a. Open the zone form and insert an active beam to the ceiling. Double-click the active beam and set design cooling power to 800 W at 20 L/s as well as 30 W at 0 L/s. Leave the controller at PI what effects that the cooling power is adjusted in order to hold at most 25 °C as long as the provided maximal cooling power is sufficient. Leave all other parameters at the default values and close the active beam and the ceiling form.



b. Check the ventilation settings in order that supply air flows should meet the requirements of the active beam.



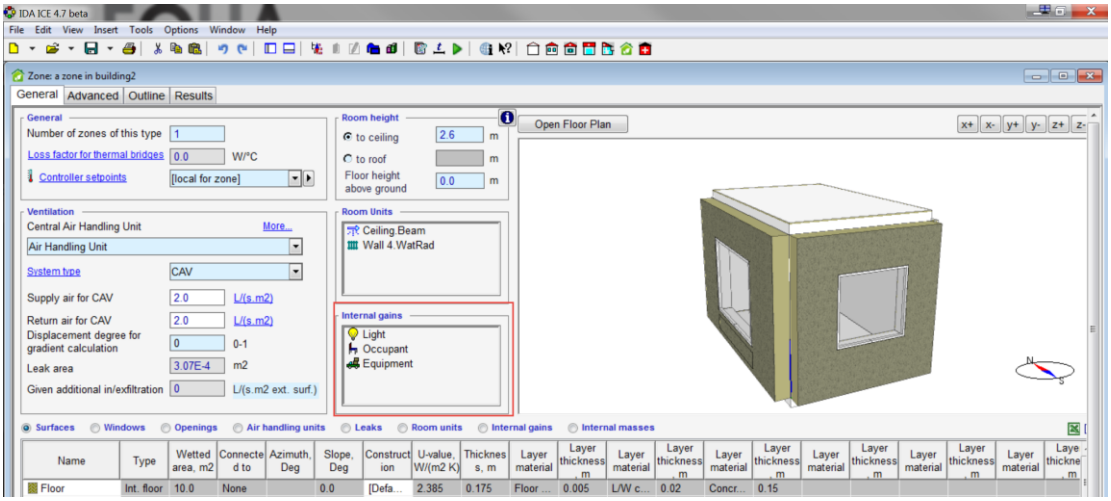
c. The ventilation supply temperature is set in the air handling unit. Open the air handling unit from the ***General*** tab and check the supply temperature that should be set to 16 °C by default. This temperature is by default raised by 1 °C through the radiator resulting in 17 °C.



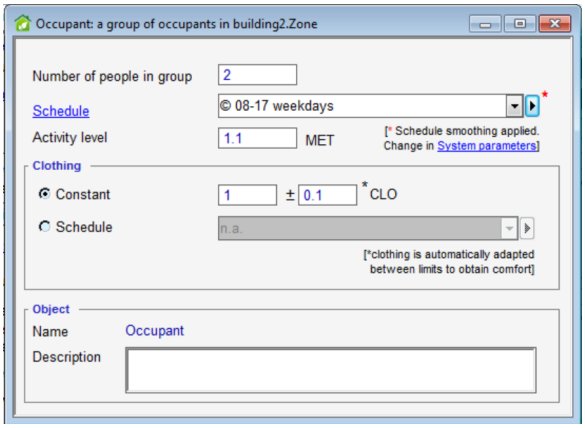
Step 7

Next is to define the internal heat gains that normally are very relevant for the cooling load.

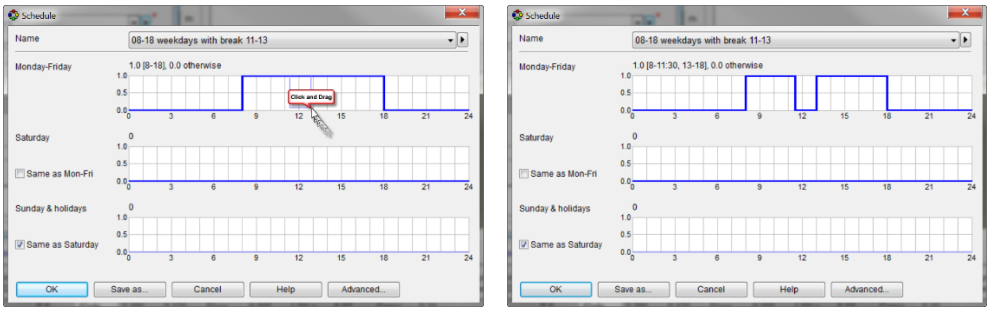
Open the zone form and look at the list of ”Internal gains”. There are 3 different types of internal heat gains: Occupants, equipment and lights. Occupants are positioned on the floor, lights are positioned to the ceiling. Lights do also have a geometrical length and width. Equipment does not have a position in the zone. You can drag in multiple internal gains from each type or delete them separately from the list.



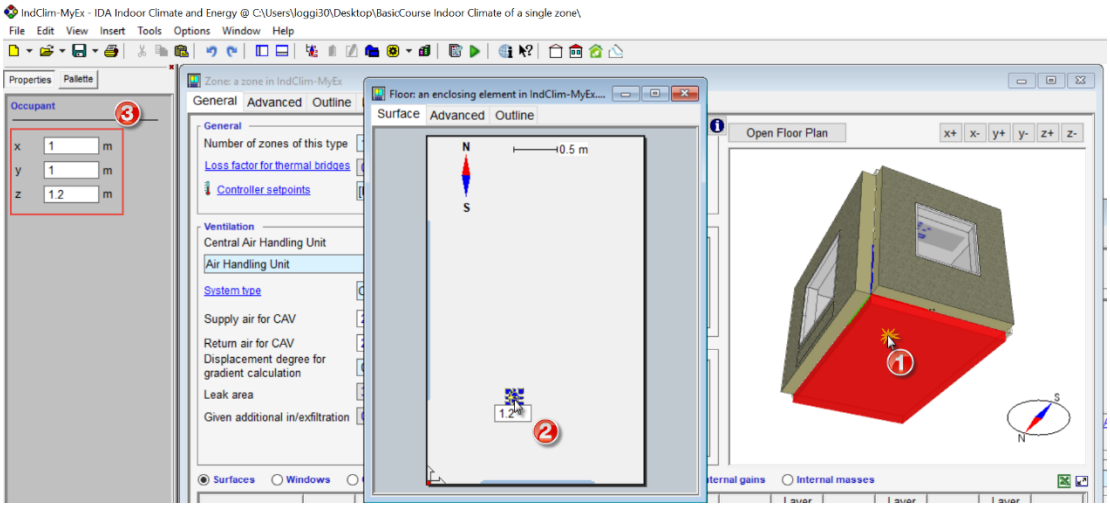
a. Open the occupant load by double-clicking on it. Set the number of people to 2, Activity level to 1.1 met and clothing to 1 ± 0.1 clo. For the occupancy schedule you select ”load from database” and choose ”08-17 weekdays”.



b. We now adapt the occupancy schedule by clicking on Schedule and then clicking the button ”Save as...”. We chose the name ” 08-18 weekdays with break 11.30-13”, adapt the description and click ”OK”. Define your schedule according to the figure below by ”dragging the blue profile lines. Click ”OK” to close the dialog and save the changes.

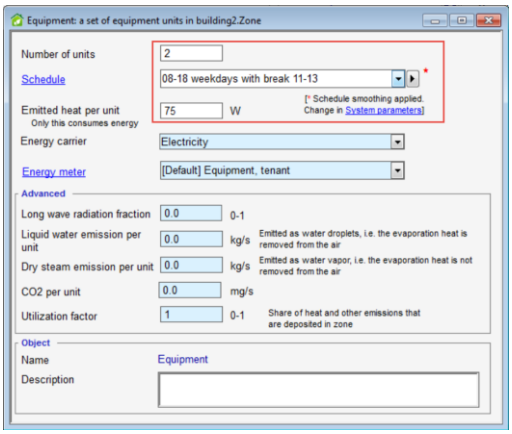


c. Open the floor of the zone and mark the occupant. You can change the position of the occupant object (consisting of 2 persons) by either drag and drop of the occupant icon or by giving the coordinates in the ”Properties” part of the side bar. Position your occupant as in the figure.



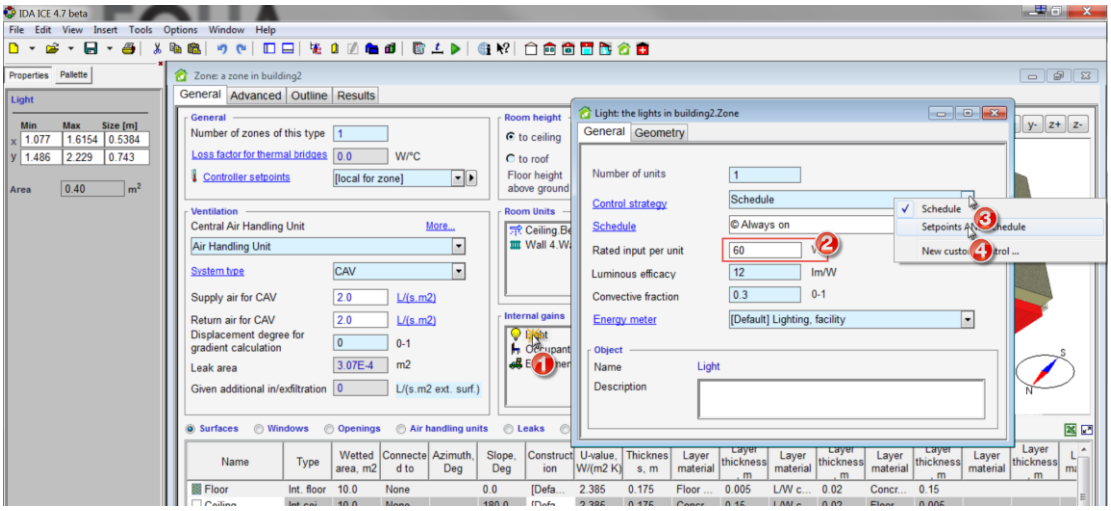
d. Now doubleclick on Equipment in the Internal gains list of the zone form. Give 2 units with 75 W each. And change the schedule to the one defined before. You will refind it in the dropdown-list. Look at all other parameters but leave them on default.

Also test the help function by clicking on  and then onto the equipment form.

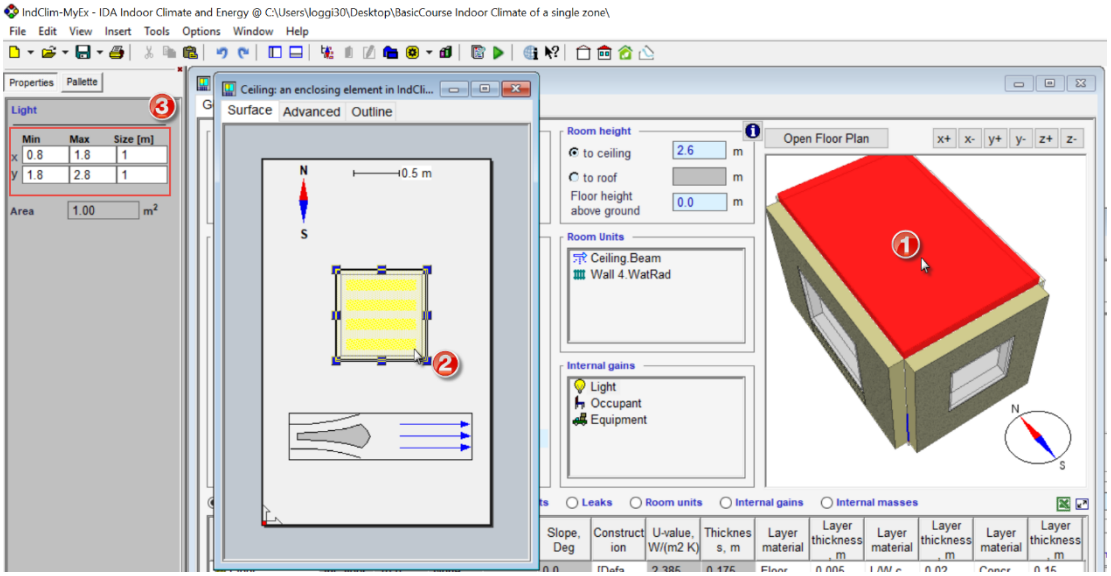


You can now close the equipment form.

e. As you did with the other internal gains, open the light and give 1 unit with 60 W. Also select the control strategy ”Setpoints AND Schedule”. This means that the light will be controlled according to daylights as long as the schedule allows it. As the schedule is ”Always on”, we will have lights during the whole night.



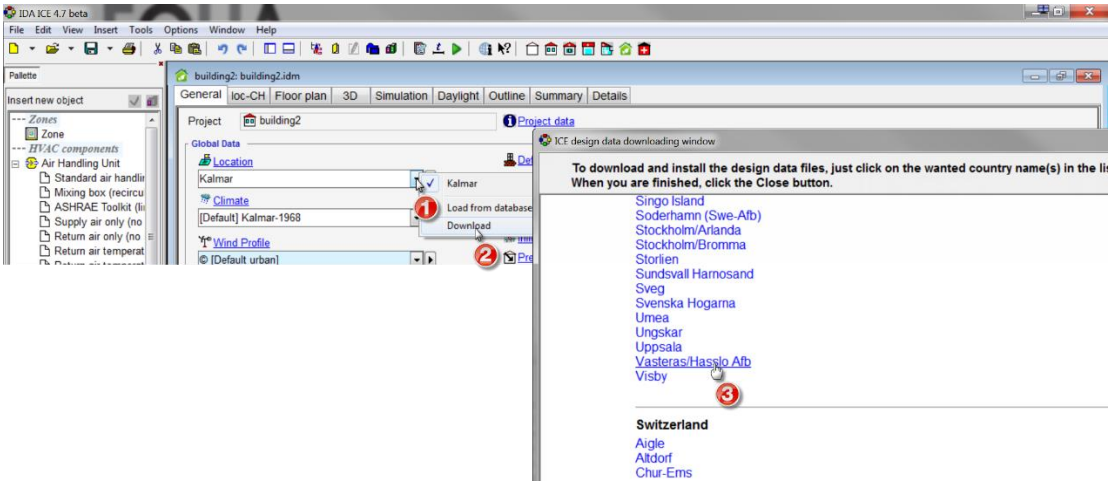
f. Open the ceiling to see where the light object is positioned. Adapt the size to 1x1 m and place it approximately to the center of the room.



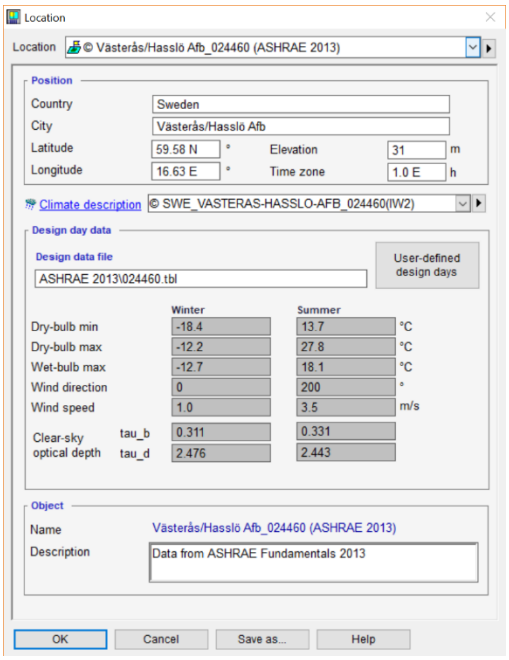
Step 8

We can now run the cooling load calculation to study the summer comfort. The climate is according to the selected location.

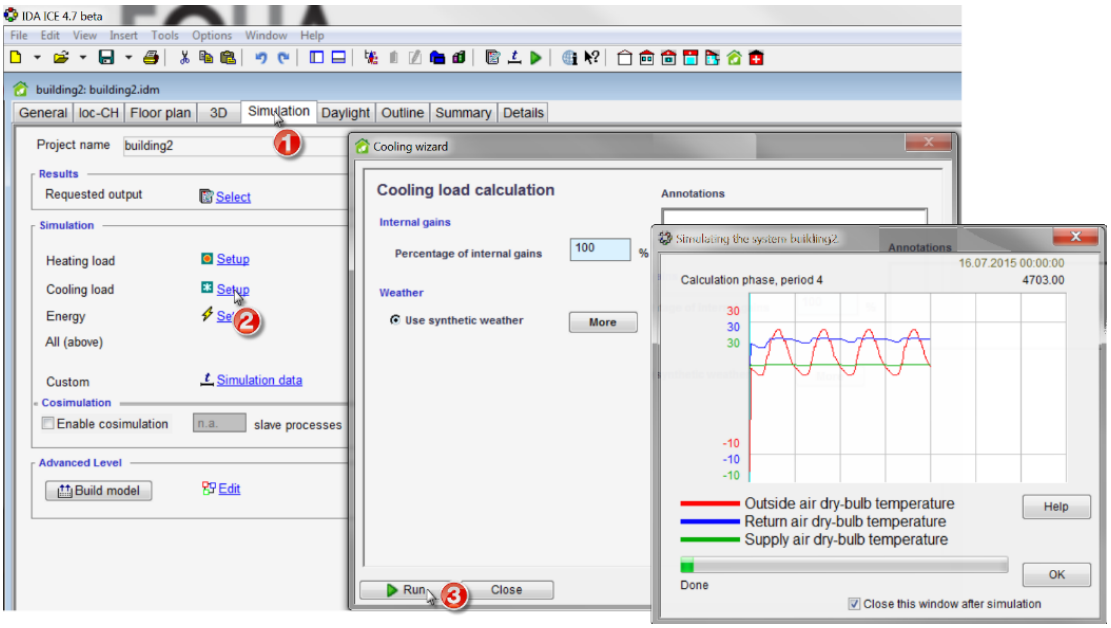
a. Go to the main ***General*** tab and select Västerås by selecting ”Download”, clicking on ”S” for ”Sweden” and scrolling down to the correct station. Then click ”OK” and ”Close”.



Open the location form by clicking on Location and study the data that can be given here. Close this form without modifications.



b. Go to the ***Simulation*** tab and open the Setup for Cooling load calculation. Use all default settings and click ”Run”!



c. Study the results in the ***Summary*** tab and compare the table values with the diagrams in the ***Details*** tab. Unselect the two diagrams ”Total heating and cooling” as well as ”AHU temperatures” and select the zone diagrams ”Main temperatures”, ”Heat balance” and ”Fanger’s comfort indices” instead.

Use the duration diagram type to find

- the number of hours with operative temperature greater than 26 °C
- the number of hours with PPD (percentage of people dissatisfied) greater than 12 %

The figure below guides you to do this.