# 1   Primero Comfort: the concept

1.1 The name

Primero is a simulation programme for buildings. It was developed to be used by architects from the early stages of the design process. Its name is the short form for „Primaerenergie-Optimierungs-Programm" (Primary Energy Optimising Programme). It is aimed at users that are keen to develop energy-effecent buildings by providing them with the tool to analyse and optimise the designs from the very early stages of the design process. The Primero set of programmes includes different modules to allow this (Energy, Light, Summer and Comfort).

Primero Energy   Primero Light   Primero Summer   Primero Comfort

This manual is for the module 'Comfort'.

1.2 Aim of the programme
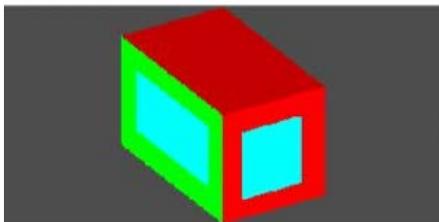
This programme simulates the summer temperatures expected in a particularly exposed room, on the basis of a three-dimensional object. The creation of complex three-dimensional objects is possible (refer to IV.5.7).

This programme enables the architect right from the start of the design phase to analyse rooms with a high risk of overheating and to optimise the design through exploring variations (eg rooms with glass facades or rooms particularly exposed through their orientation).

1.3 Concept of geometric data input

The concept of data input relies on creating three-dimensional objects that can be stacked. Through stacking several objects vertically or horizontally, complex geometric shapes can be created. One room of simple geometry (eg. a rectangular prism) is therefore one single three-dimensional object consisting of horizonal floor and ceiling plus straight walls or tilted walls. A three-dimensional object is created by defining the height of the object (height of the room as well as height above ground level), by filling in the relevant fields and by defining the footprint of the room by drawing a polyline in the relevant field. By drawing a polygon, more complex shapes (of the footprint of the room) can be created. Further, it is possible to tilt the sides of the three-dimensional object in order to simulate tilting facades or sloping roof planes.
At the end, several three-dimensional objects can be combined to form one object which can then be used for the simulation. This is how the complex shapes are created.

1.4 Setting parameters and carrying out the simulation

The next step is to assign parameters for calculation to the building elements of the three-dimensional object. The programme requests the follwing data:

*   construction characteristics (walls, floors, ceilings)
*   windows and doors
*   shading in combination with the windows (eg. Blinds) and parameters for its use
        fixed shading elements, attached to the building (eg. Protruding building elements
        such as a fixed canopy)
*   exterior objects, outside of the building envelope (eg. adjacent buildings or trees)
*   building elements within the room (eg. stairs, landings)
*   technical systems (eg. Ventilation)

To check the data that was entered, documents can be printed which show the data. Once all data has been entered, the simulation can be run. The display of the results of the calculations can be called up. In cases where data for variants to the original design were entered, the results of these can be viewed here as well and conveniently compared.

1.5 Display of results

The temperature fluctuations within the analysed room during a year are shown in a graph. It is possible to extract 'two-week-periods' in order to consider the results in more detail. In addition to this graph, the results page displays the energy balance as well as three analyses of the levels of comfort to be expected in line with DIN 4108, EN 15251 and ISSO 74.

Should overheating of the room become evident, or should there simply be the wish to change planning parameters, the characteristics of the room can be changed by creating a variant. By doing this, the effects of incorporating eg. a different type of shading system or glazing can be analysed in terms of comfort within the room, with a view to increasing comfort. The size and location of windows can also be changed. However, what cannot be changed as part of creating variants is the shape of the room!

The variants are displayed in the results display and can easily be compared, analysed and used to optimise the design of the building. If this analysis is carried out early in the design process, in most cases the overheating of rooms during the summer can be avoided.

2 Service/ System requirements/ Installation

2.1 Service

Information regarding the programme can be found on the following website:
www.primerosoftware.de

The current version of the programme can be downloaded from this website. Further, access codes can be obtained.

2.2 System requirements

Windows XP or newer is required to run the programme, at 32 or 64 bit.

2.3 Installing, starting and exiting the programme

This programme requires Java in order to run: Java jre 1.7 or a higher version is required. If not installed already, Primero will prompt you with a link to a Java download. The installation process of primerosetup.exe will cease automatically.

If already installed/ once Java is installed primerosetup.exe will commence. Additionally, Java 3D is required to enable Primero to run correctly (Version 1.5.2 upwards).

Java 3D must be installed **after** the standard Java is installed. Primero will otherwise not run correctly. This must be paid attention to also when updating or upgrading Java.

Installation
Select and run SetupPrimero.exe from the website (Downloads) and follow the instruction.
You will be asked to select locations for two directories.
The first is the place where the programme with all its modules should be installed. You may select any of your choice.
The second is for a temporary directory in which the programme's simulations actually run. The path name must not contain any symbols or spaces and must not be long. It is strongly suggested to use the following: C:/Primero.
You may choose to use different hard drives, including external ones.
The temporary directory must NOT be installed under e.g. C:/programme as in reality this is C:/program files and it contains a space.
When Primero is started for the first time, a window will open which requests a code to be entered in the third field. The code can be obtained via the website. The first two fields must be completed with names/data/titles of your own choice. Symbols, spaces etc cannot be used here either.

Starting the programme
Once the programme has been installed, the icon for the programme will appear on your desktop.
The programme can be started via this icon, the windows menu, or directly via the Primero directory.

2.4 Information regarding the windows
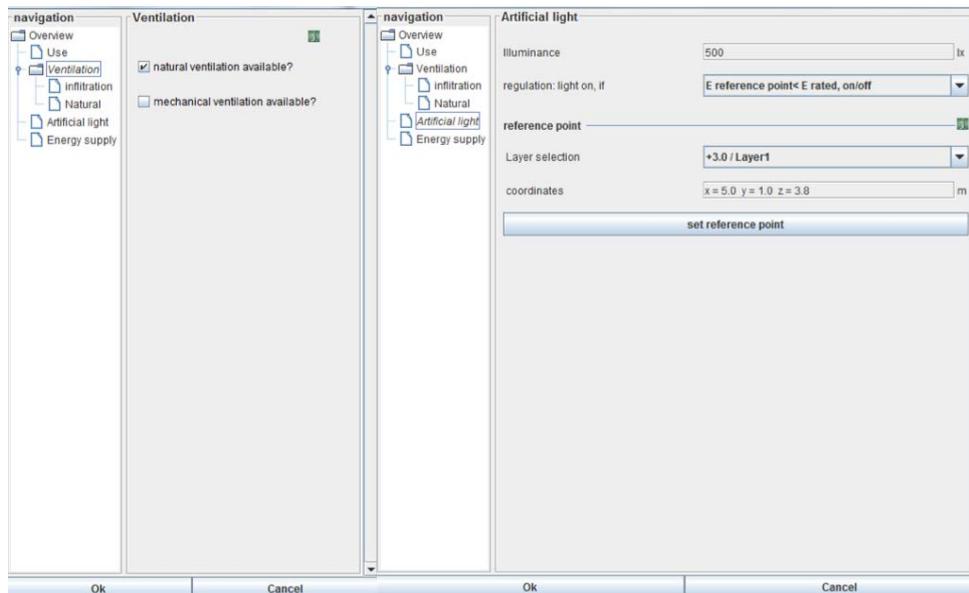
Assistance and information regarding data entry, contents and steps to follow can be called up in numerous places throughout the programme by clicking the green 'i' buttons. A window will pop up, which can be closed again by a further click. If not done, the programme will automatically close the information window after four minutes.

At least all fields marked in red must be completed before the [OK] button will become active. Upon selecting it, you can proceed to the next window.

Decimals are entered by using a dot. Data entered that cannot be processed by the programme will be marked in red (eg 2,5 instead of 2.5).

3 Short instructions for geometric data-input: simple shaped rooms

These short instructions are for the most common case of geometric data input: for an exposeded room in the shape of a rectangular prism. The processes of adding of a window, shading and an object outside of the building envelope is also explained in this chapter.

Instructions for creating complex three-dimensional objects and for working with more detailed data parameters are found in chapter IV.

3.1 Project data, use and orientation

First of all, all general project data is entered into the programme. This will assist in managing the project. Further, print-outs for the project generated by the programme will contain this information on each page.
It is necessary to define the climate of the region in which the project is envisaged, the use/s that is/are planned within the building and the orientation of the most exposed room (the room to be analysed).

Regarding the orientation, note that the default angle '0' stands for NORTH. If it is necessary to alter the orientation, do so by entering positive or negative values into the relevant field (eg 50º or -50º). At this step it is possible to define periods of use throughout the year, eg holidays, should the periods of use be a major consideration.

3.2 Input of geometric data

Complex three-dimensional objects can be created by combining several separate three-dimensional objects. The separate three-dimensional objects are created one after another. This chapter explains the creation of a room of a simple geometric shape, a rectangular prism, without tilting walls or sloping roofs or changes in the height of the room.
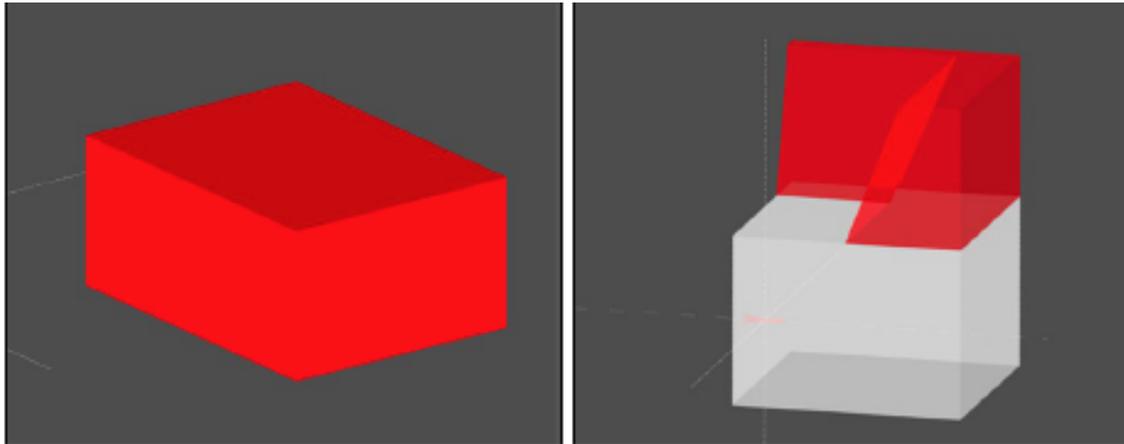
A detailed guide to create complex three-dimensional objects is provided in chapter IV.5.

Positioning of the three-dimensional object
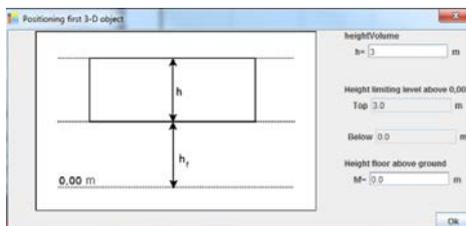
This window requires the data concerning the actual height of the room (h) as well as the height of the room above ground level (hf).

It is necessary to define the positioning of the room in terms of its height above ground in order to enable the programme to calculate the effects of shading through objects outside of the building envelope, should there be any.

Defining the footprint of the room
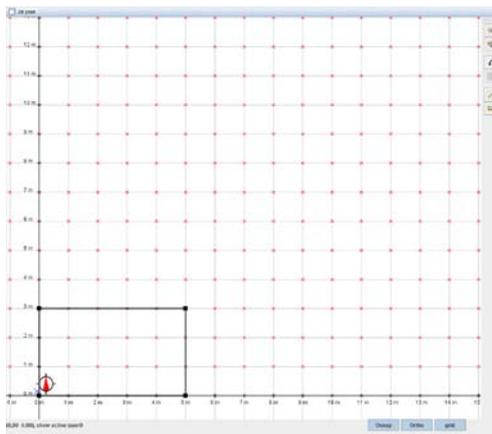
Draw a polyline into the window [2-D-Plan] which defines the outline of the room. To finish the outline of the room, the polyline has to be connected to form a polygon. By pressing ENTER the same is achieved.

The following tools are available which can be found in the top right hand corner of the window:

Zoom

Pan

'undo'/'re-do'

Draw Reference Lines (these will not be affect the floor plan)

Measure distance

You may choose a different way of drawing the outline of the room. At the bottom of the window on the hand side you will find different options:

[Osnap] activates object snap for the points you define.

[Ortho] allows drawing at right angles

[Grid] activates/ deactivates the grid. The characteristics of the grid can be altered.

These options can also be selected via the main menu [Draw].
Refer IV.5.3.
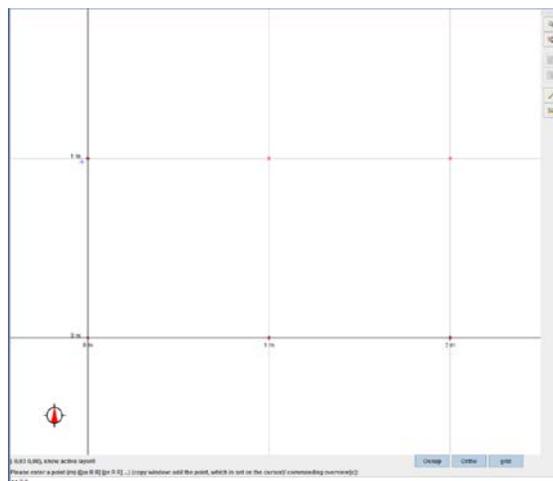
Alternatively, coordinates can be entered in the field below the grid. Data entry is activated by selecting [Input] [Terminal/Console] in the main menu, followed by clicking on the field which appears.

Detailed information regarding this matter can be found in chapter IV.5.3. A table setting setting out the commands can also be found here.

Tilting of building elements
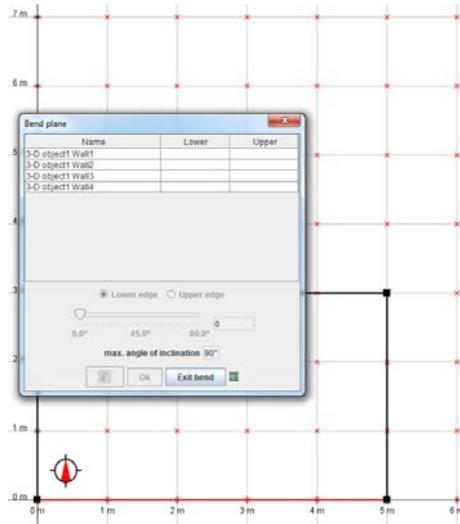
Once the floor plan data has been entered, the walls of the room can be tilted in order represent roof slopes or tilted facades. It is not possible to change the data at a later stage in order to include tilted elements, it must be done at this step of the process.

The example presented in this chapter is a simple geometric shape, therefore no walls will be tilted. Detailed information regarding this matter can be found in chapter IV.5.5.

3D Visualisation
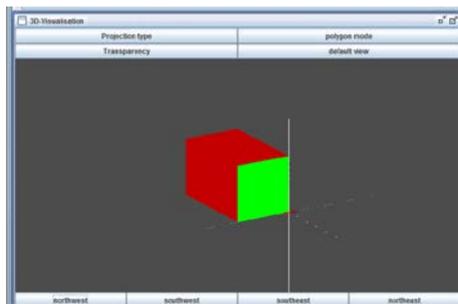
The 3D visualisation is purely a display. It appears once the first three-dimensional object has been created. It can be used for defining the characteristics of the building elements. The building element for which characteristcs are assigned will be highlighted green.

The angle of the object (the point from where it is viewed) as well as the type of display can be changed. The following types of display can be selecetd and adjusted:

[projection type]
[polygon mode]
[transparency]

Further, points from which the object can be viewed are offered for selection, eg
[north-west] and [south-west].

You can zoom in- and out of the picture by using the scroll-wheel of the mouse.

Detailed information regarding this matter can be found in chapter IV.5.3.

Layer overview
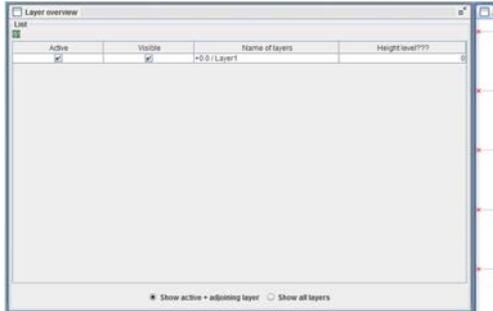
The window 'Layer overwiew' displays the objects that have been created.
When creating complex objects, layers can be turned off (to make the object/ the layer selected invisble) in order to reduce distraction or minimise potential for making mistakes by de/selecting [visible].

The layer you want to work with must be selected [active]. In the 3D visualisation, the adjacent layers will be shown as well. Alternatively, all layers can be shown.

Detailed information regarding this matter can be found in chapter IV.5.3.

Ending data entry/ Safety questions
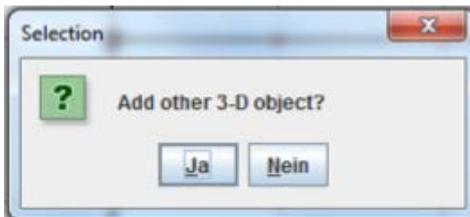
Once a three-dimensional object has been created, you will be asked whether an additional object is to be created. If you do not wish to create an additional object and decline, you will be asked again if the data entry regarding the creation of objects is finalised. It is not possible to add another object at a later stage, it must be done at this stage of the process, hence you are asked twice before you can proceed to the next step.
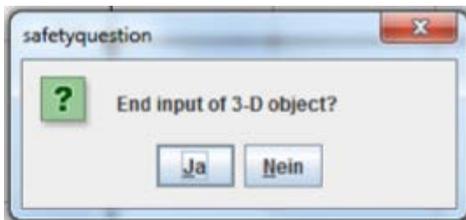
3.3 Detailing the characteristics of the room

Assigning the building elements
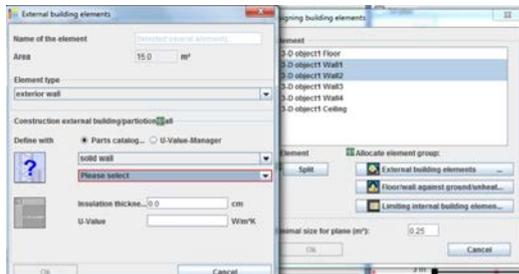
Once the three-dimensional object is created, all building elements that form the envelope of the object (the room) must be assigned to one of the following:
[External building elements]
[Floor/wall against ground/unheated cellar]
[Limiting internal building elements]

It is possible to assign several elements simultaneously (mark using STRG/Control).

The window that pops up following the selection of one type of building element requests further details regarding the type of element as well as construction details (eg external wall, solid wall or skeleton wall, thickness of insulation or U-value).
Options are offered, but it is also possible to define the construction details independently. Detailed information regarding this matter can be found in chapter IV.6.1.
Building elements which are exposed to different external (thermal) influences or building elements whose construction details change (eg different thickness of insulation within the same wall), must be divided into as many parts as necessary and assigned separately.

Detailed information regarding this matter can be found in chapter IV.6.1.

Once all building elements have been assigned, this step of the process is completed and the window „Assigning building elements" can be exited..

Detailed information regarding this matter can be found in chapter IV.6.1.

At this stage it may be useful to create variants. It is possible to create up to ten variants with different combinations of building elements/construction details, windows, technical systems and shading systems. Refer chapter IV.9.

Managing characteristics of building elements
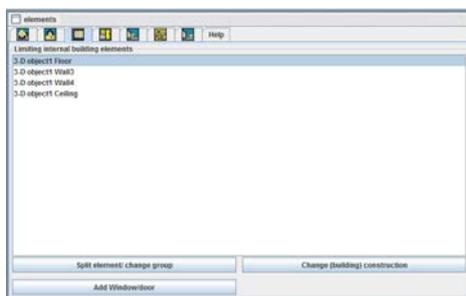
The window „Elements" allows the management and creation of new building elements. You will find the building elements already assigned under the relevant icons. These can be altered here with regards to their task and construction details and they can be equipped with windows, doors and shading systems. Furthermore, internal building elements which do not define the outline of the room as well as objects outside of the building envelope can be created.

The icons allow the management of the following:

External Building elements: Management of the building elements previously assigned   to this category, creating windows and doors as well as shading systems.

Floor/wall against ground/unheated cellar: Management of the building elements previously assigned to this category.

Limiting internal building elements: Management of the building elements previously assigned to this category, creating windows and doors.

Windows and doors: Management of the windows and doors, which have been created via External building elements or limiting internal elements.

Fixed shading elements (part of the building construction, eg canopy): Management of the fixed shading elements that were created via the function External building elements.

Internal obstruction (Internal building elements not defining the outline of the room): creation and management of internal building elements.

Exterior objects (objects outside of the building envelope such as other buildings or trees): creation and management of objects outside of the building envelope.

Detailed information regarding this matter can be found in chapter IV.6.3.

Adding windows and doors
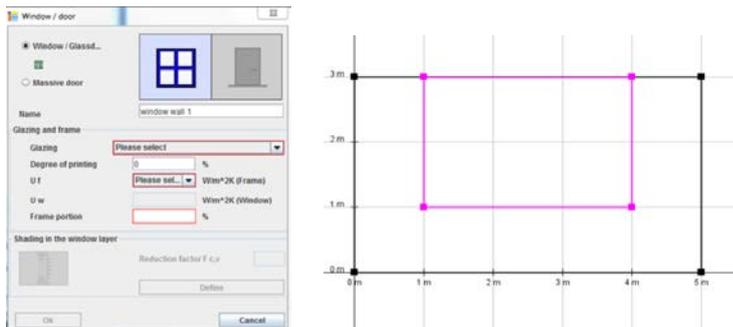
Go to the window 'Elements' and select the building element to which a door or window is to be added. Select [Add window/door].

The drawing grid now does not show the floor plan any more but the elevation of the building element selected. Draw the opening after selecting either [rectangle] or [triangle] as input mode. Other shapes of opening can be created through combining these two shapes in different combinations.

Once an opening is added, you must define whether it is a door or a window, you must assign a name to it and enter the characteristics of its glazing, its frame and shading system/s (this applies to windows; for doors, only the U-value of the door has to be entered). At this stage of the process you only define the type of shading. The parameters for its use are   defined at a later stage. [Refer chapter IV.7.2]

At the end of this process the door or window appears in the 3D visualisation.

Detailed information regarding this matter can be found in chapter IV.6.3.

Adding a fixed shading element to a building element
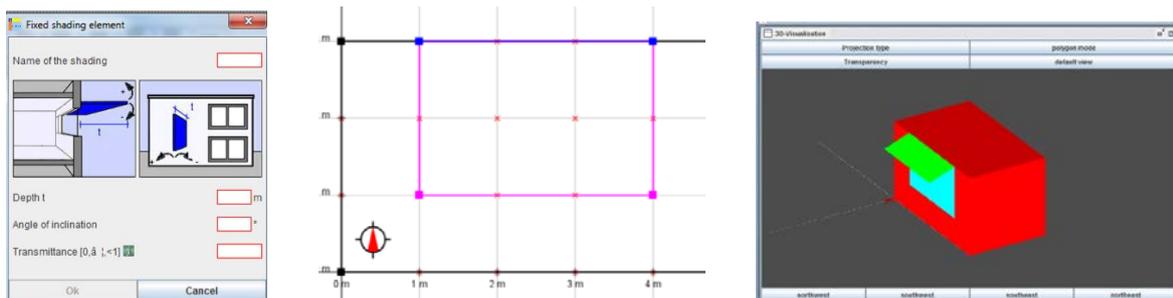
Select the relevant external building element and click [Add shading]. The drawing grid shows the elevation of the building element. Define the location of the fixed shading element in the elevation drawing (the shading element must be fixed to this building element and must not be outside of it, eg the floor above).

After placing the element, a window will appear that requests data regaring the depth of the element, its angle in relation to the bu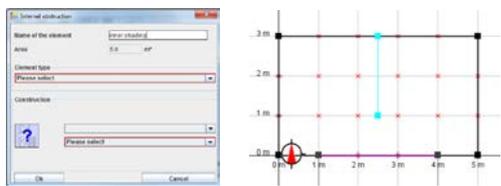ilding element and the transmittance of the shading element. Detailed information regarding this matter can be found in chapter IV.6.3.

## Creating an internal obstruction (internal building element not defining the outline of the room).
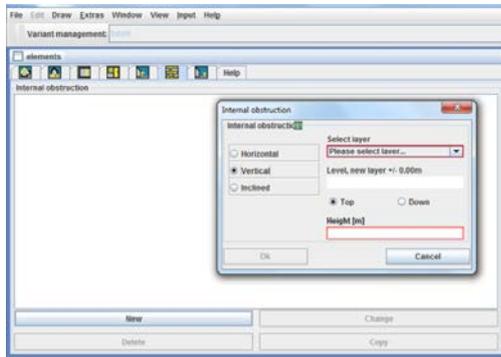
Only internal building elements of solid/ massive construction are relevant with regards to the simulation of temperature fluctuations. Only those internal elements should therefore be added.

Select the icon [internal obstruction] of the window 'building elements' and click [new]. Select one of the options given [horizontal], [vertical] or [inclined] and if relevant enter the height of the element. Select the layer where the element is positioned or create a new layer.

Draw the element into the floor plan. If the internal building element is tilted, its projection must be drawn and afterward, its height must be entered. Following this, you must assign it a name and define the type of building element and construction characteristics.

If you change the settings of the 3D visualisation to transparent, you will be able to see the internal element.
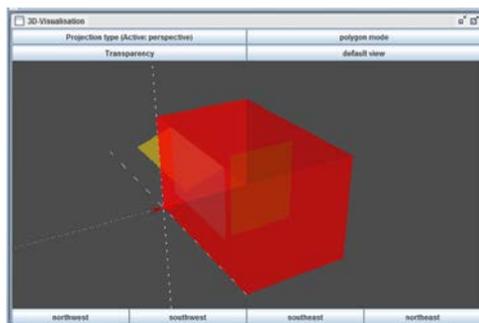
Detailed information regarding this matter can be found in chapter IV.6.3.

## Creating exterior objects (objects outside of the building envelope)
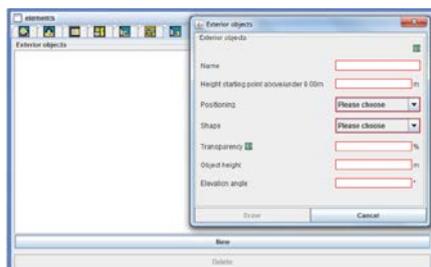
Objects outside of the building envelope may overshadow the room/building that is being analysed and can therefore affect the temperature within a room.

Select the icon [exterior object] of the window 'building elements' and click [new]. Define the height of the starting point, the positioning, the shape, the transparency and the actual height of the object.

If relevant, enter the data for the elevation angle. Once this process is completed, the object can be placed into the drawing grid, which shows the floor plan.

If relevant, enter the data for the elevation angle. Once this process is completed, the object can be placed into the drawing grid, which shows the floor plan.

Detailed information regarding this matter can be found in chapter IV.6.3.
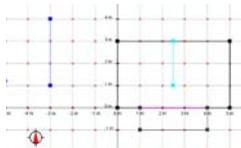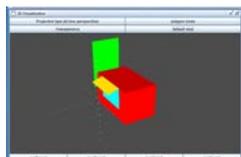
Technical systems
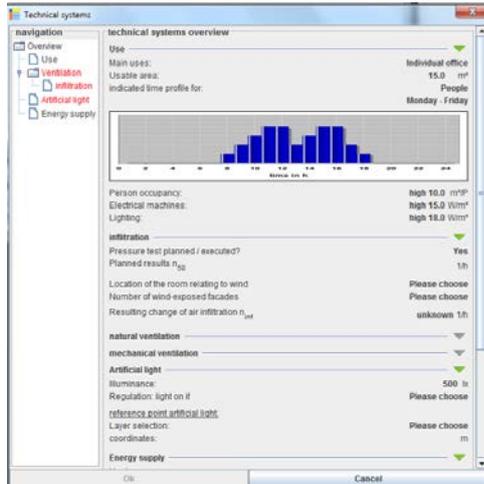
Defining the details of the technical systems is the final step in the process before the simulation can be run. Select [technical systems]. On the left hand side of the window that pops up you will find the display 'navigation'. Here, the various technical parameters are listed. These technical parameters have to be defined on the display on the right hand side of this window. At a minimum, all data marked red is required!
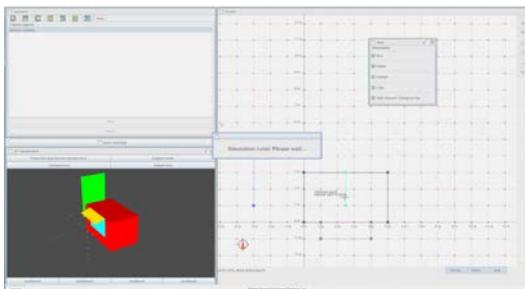Detailed information regarding this matter can be found in chapter IV.7.1.

3.4 Display of results
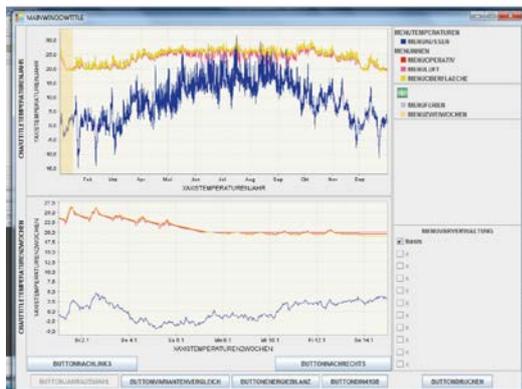
Once all necessary data has been entered, select [calculation] in the menu at the bottom of the page. When the calculations have been carried out, select [results]. A new window will open which displays the results.
You may analyse and evaluate the results by applying parameters such as [year/selection], [comparison of variants], [energy balance], [DIN 4108], [EN 15251] or [ISSO 74].
Detailed information regarding this matter can be found in chapter IV.8.3.