Estia

USER GUIDE

DIAL

Version 2.5

Using Radiance

This product includes Radiance software (http://radsite.lbl.gov/)

developed by the Lawrence Berkeley National Laboratory (http://www.lbl.gov/).

The meteo files for simulation are generated with METEONORM 7 (www.meteonorm.com)

Subject to changes and corrections

Disclaimer:

Despite the care taken in preparing and traducing this manual, we can not guarantee the absence of errors or be held accountable, regardless of the reason.

This document is subject to regular controls: corrections and suggestions for improvement will be considered in future editions.

INDEX

Introduction

DIAL+ software has been realized in partnership with the Swiss Federal Institute for Technology (Laboratoire LAURE, laure.epfl.ch).

The project has been granted by the CTI (Swiss agency for the promotion of innovation, Federal office for training and technology), under the project name: "Advanced Fenestration Design Tool".

DIAL+ is a continuation of the **DIAL-Europe** Project financed by the European commission and realised in 2002 with the following partners:

- ESTIA SA,
- EPFL: Laboratoire d'Energie Solaire et de Physique du Bâtiment,
- University of Cambridge: The Martin Centre for Architecture and Urban Studies,
- FhG IBP Fraunhofer Institute für Bauphysik Stuttgart,
- TNO Eindhoven.

DIAL+ is a software suite including the 2 following modules:

1. **DIAL+*Lighting (daylighting + Electric lighting)***
2. **DIAL+*Cooling (thermal + natural ventilation)***

This document guides you through the different steps of the description of a given room and allows you to successively evaluate daylighting performance, electric lighting, natural ventilation potential and thermal behaviour of this room.

Starting / Registration

On the first launch, the software is in « Demo » mode.

1. Use the « Project » menu items to create, open or save your work.
2. Select the language (you will have to restart the program to apply the language change).
3. To register, use the menu bar located in the upper part of your computer screen (System/Register…).

CAUTION: You should have first received a registration key corresponding to the total number of licences you ordered.

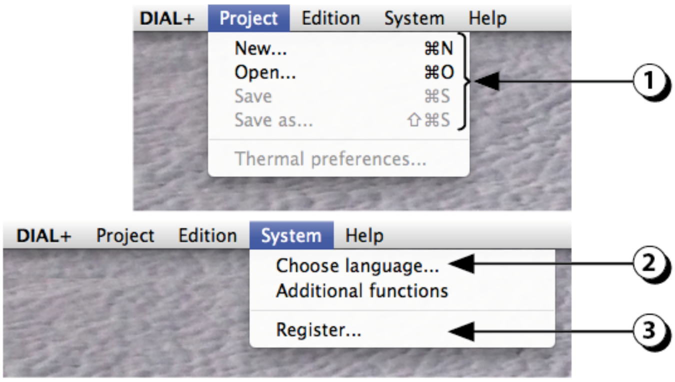


Figure 1: General Menu bar.

4. Click one of these 2 buttons to either start a new study or open an existing project.

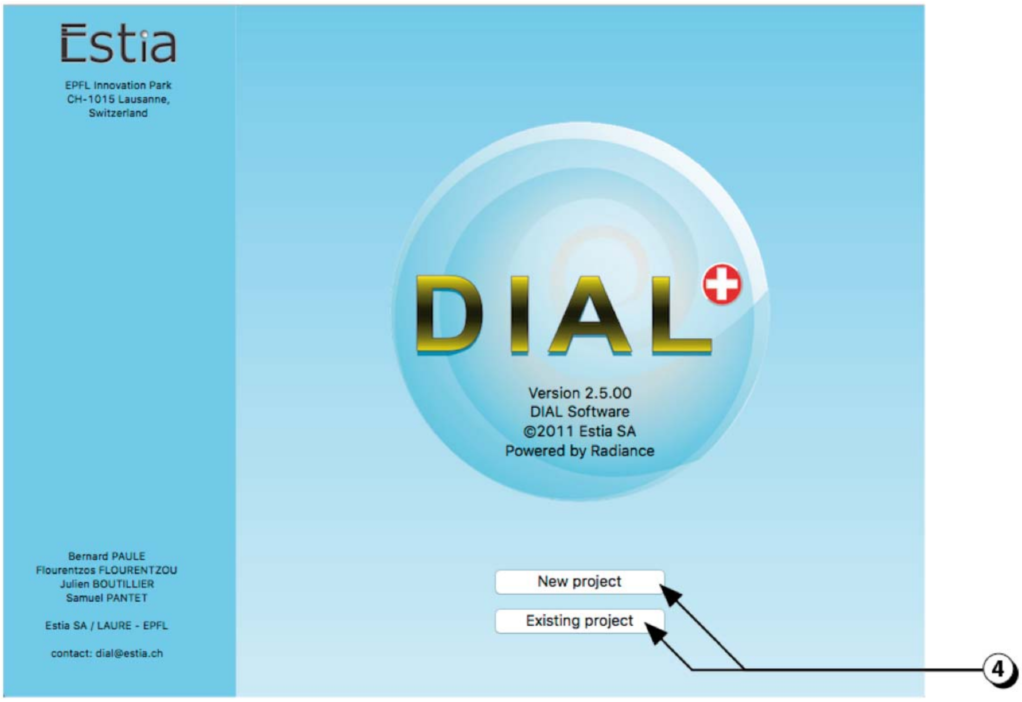
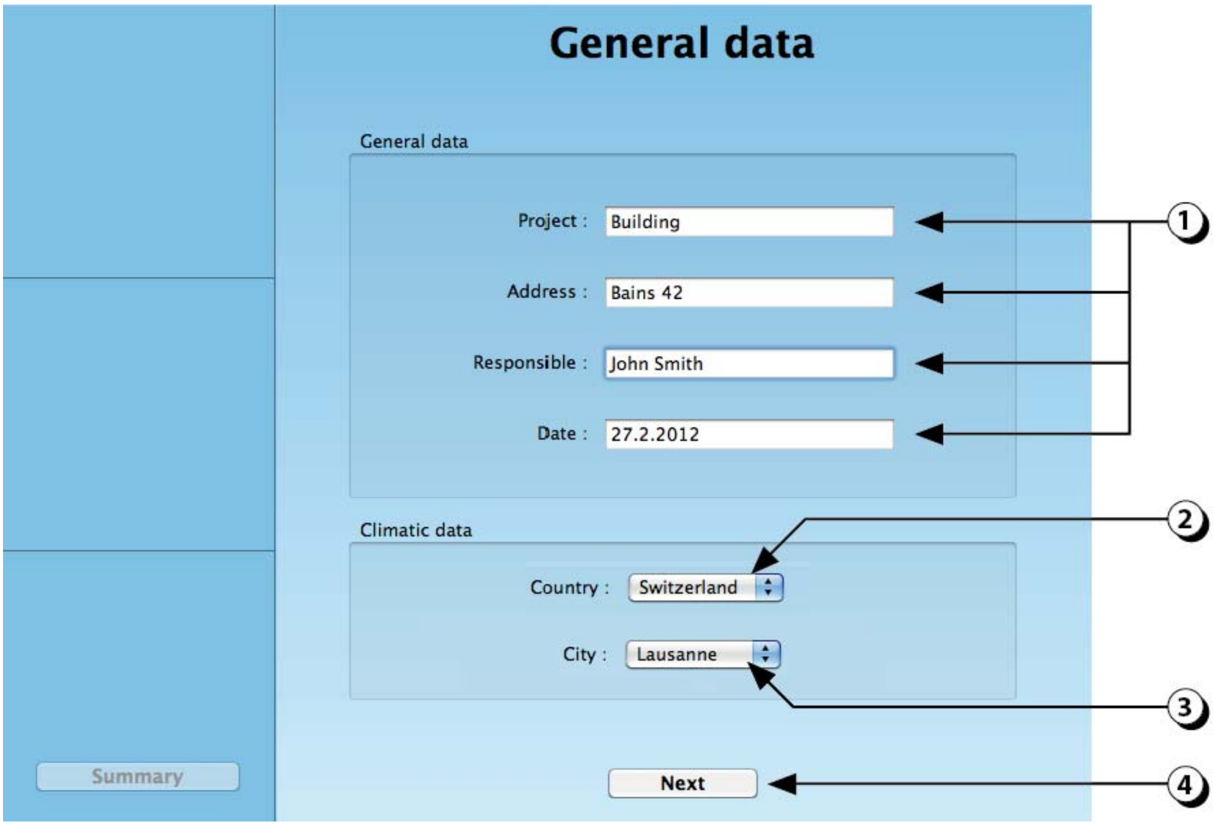


Figure 2: Initial screen of DIAL+.

General data

1. These parameters are useful to qualify the project you are working on.
2. When you save your work, the name of your project will be proposed for the folder (please do not use special characters).
3. Use this button to choose the country where your project is located.
4. Use this button to select a city close to your project location.
5. The thermal data (hourly step) are based on the Direct beam (W/m^2); Horizontal diffuse beam (W/m^2) and Air temperature (°C) and Relative Humidity (%) (data from Meteonorm; www.meteonorm.com).
6. If you want to add data for new locations, follow the process described in page 10.
7. Click on the « Next » button to validate and proceed to the next step.



General data

General data

Project : Building

Address : Bains 42

Responsible : John Smith

Date : 27.2.2012

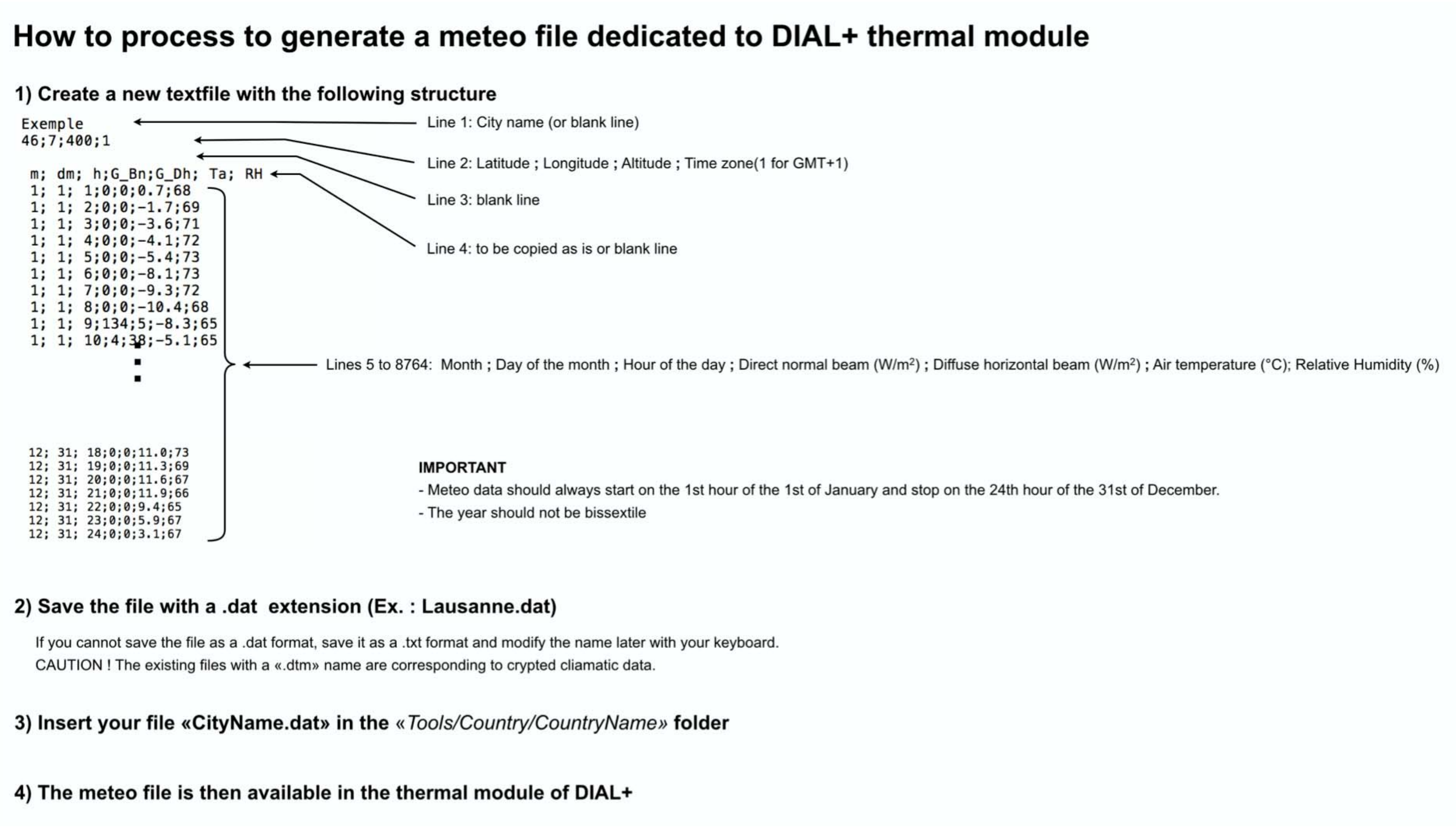
Climatic data

Country : Switzerland

City : Lausanne

Figure 3: Screen copy of the project general data.

Format of the meteorological data



How to process to generate a meteo file dedicated to DIAL+ thermal module

1) Create a new textfile with the following structure

```
Exemple
46;7;400;1

m; dm; h;G_Bn;G_Dh; Ta; RH
1; 1; 1;0;0;0.7;68
1; 1; 2;0;0;-1.7;69
1; 1; 3;0;0;-3.6;71
1; 1; 4;0;0;-4.1;72
1; 1; 5;0;0;-5.4;73
1; 1; 6;0;0;-8.1;73
1; 1; 7;0;0;-9.3;72
1; 1; 8;0;0;-10.4;68
1; 1; 9;134;5;-8.3;65
1; 1; 10;4;38;-5.1;65
       .
       .
       .

12; 31; 18;0;0;11.0;73
12; 31; 19;0;0;11.3;69
12; 31; 20;0;0;11.6;67
12; 31; 21;0;0;11.9;66
12; 31; 22;0;0;9.4;65
12; 31; 23;0;0;5.9;67
12; 31; 24;0;0;3.1;67
```

Line 1: City name (or blank line)

Line 2: Latitude ; Longitude ; Altitude ; Time zone(1 for GMT+1)

Line 3: blank line

Line 4: to be copied as is or blank line

Lines 5 to 8764: Month ; Day of the month ; Hour of the day ; Direct normal beam (W/m²) ; Diffuse horizontal beam (W/m²) ; Air temperature (°C); Relative Humidity (%)

IMPORTANT

- Meteo data should always start on the 1st hour of the 1st of January and stop on the 24th hour of the 31st of December.
- The year should not be bissextile

2) Save the file with a .dat extension (Ex. : Lausanne.dat)

If you cannot save the file as a .dat format, save it as a .txt format and modify the name later with your keyboard.
CAUTION ! The existing files with a «.dtm» name are corresponding to crypted cliamatic data.

3) Insert your file «CityName.dat» in the «*Tools/Country/CountryName*» folder

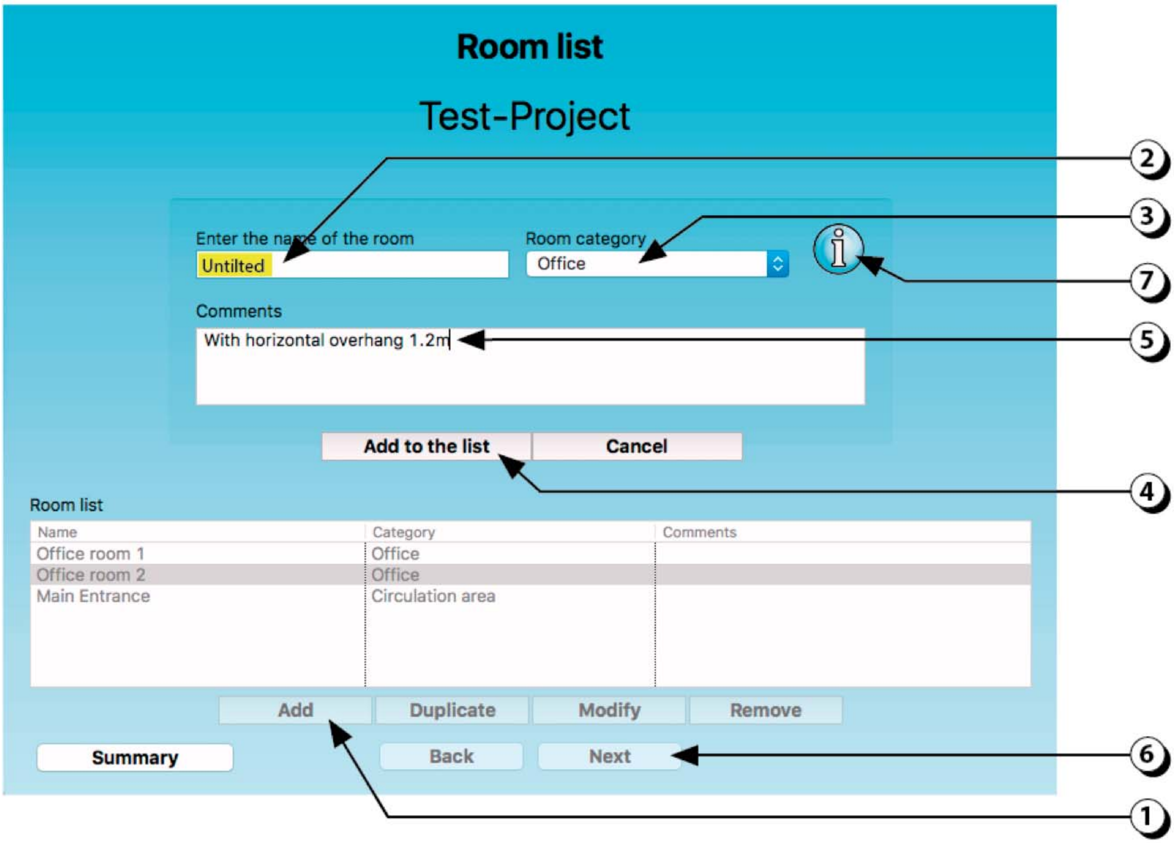
4) The meteo file is then available in the thermal module of DIAL+

Figure 4: Procedure to generate meteorological data for the thermal and lighting simulations.

Room list: Create a new room

DIAL+ allows you to manage a set of rooms belonging to the same project.

1. To create a new room, click on « Add ».
2. Enter the name of the room in the corresponding field.
3. Select the room function.
4. Click on « Add to the list ».
5. You can add a comment in this field.
6. Click on « Next » button.
7. Click on the information button to display the default parameters associated to the selected room function (see screen-copy below).



Enter the name of the room: Untilted

Room category: Office

Comments: With horizontal overhang 1.2m

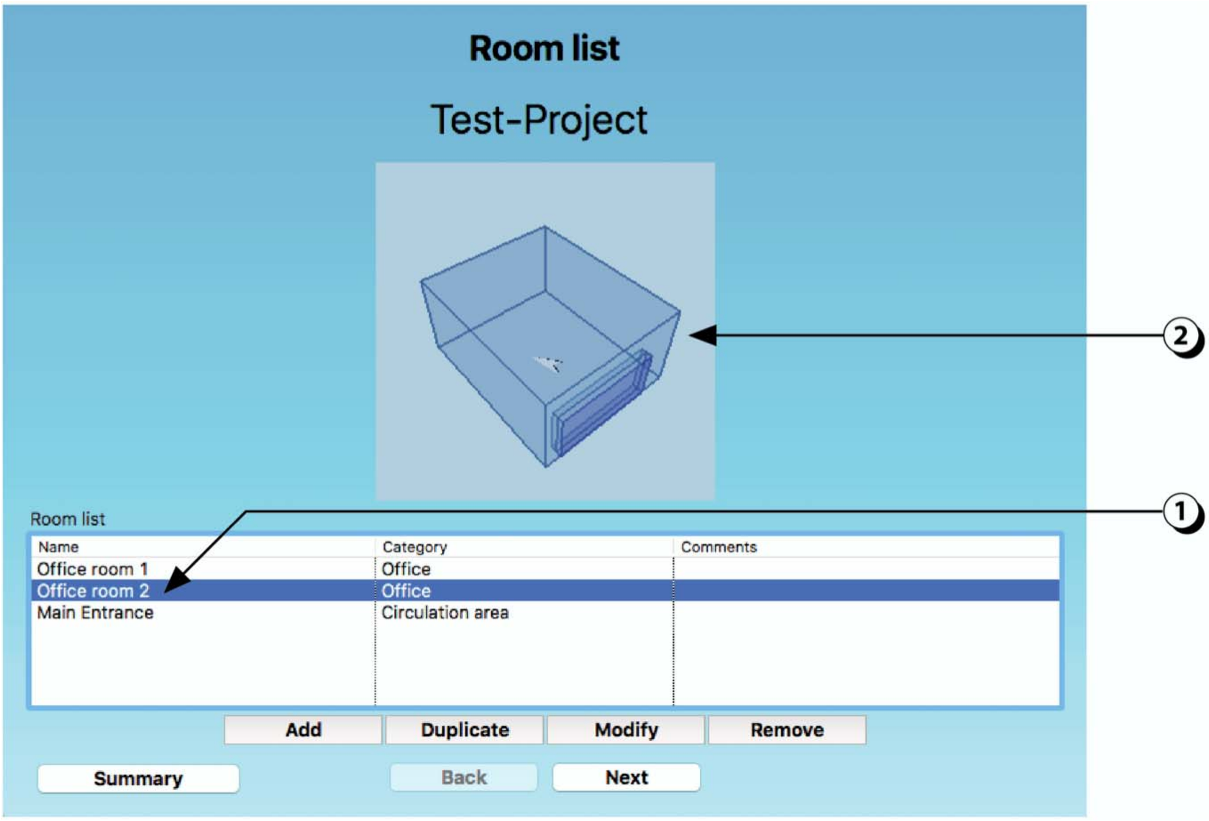
Room list

Name	Category	Comments
Office room 1	Office	
Office room 2	Office	
Main Entrance	Circulation area	

Figure 5: Room list: create a new room.

Room list: Visualization of an existing room

1. To visualize an existing room, select it in the list of the rooms that have already been described.
2. A schematic 3D view of the room is displayed in this window.

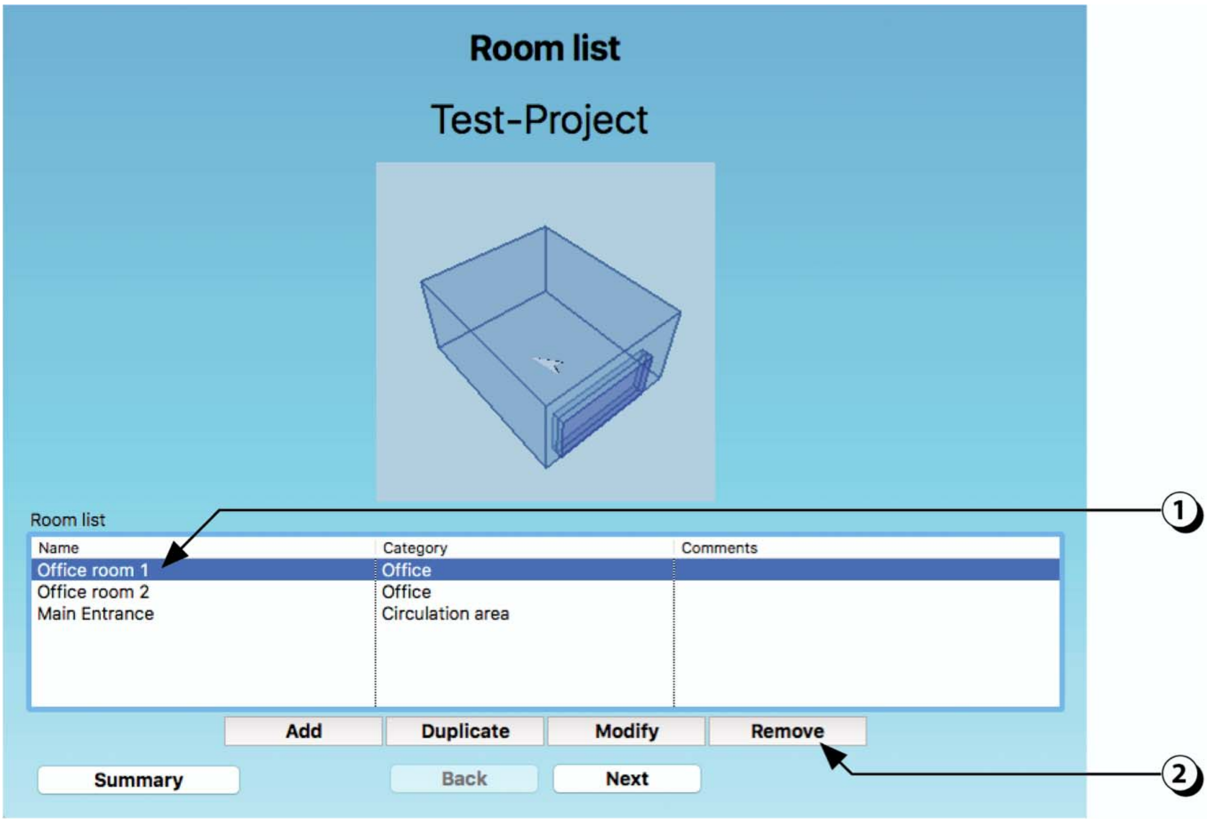


Name	Category	Comments
Office room 1	Office	
Office room 2	Office	
Main Entrance	Circulation area	

Figure 6: Room list: Visualization of an existing room.

Room list: Delete an existing room

1. Select the room in the list.
2. Click on « Remove » to delete the selected room.



Room list

Test-Project

Room list

Name	Category	Comments
Office room 1	Office	
Office room 2	Office	
Main Entrance	Circulation area	

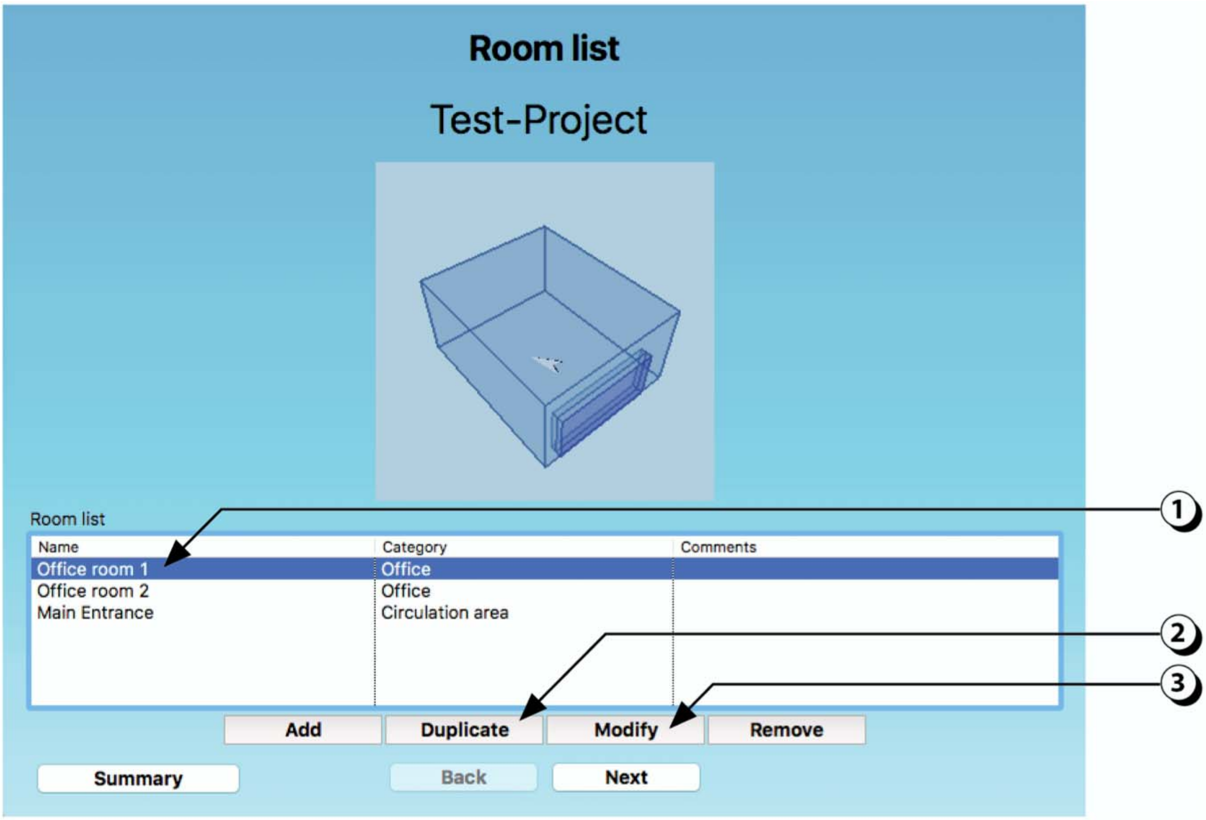
Figure 7: Deletion of an existing room.

Room list: Modify / Duplicate an existing room

1. Select the room in the list.
2. Click on "Duplicate" to create an identical premises.

   (The default name of the duplicate room will be the same as the original one, followed by a number (1, 2, …, etc).

   (To change the name of the duplicated room click again on “Modify” then use your keyboard to adapt the name in the corresponding field).
3. Click on “Modify” to change the name of the room.



Name	Category	Comments
Office room 1	Office	
Office room 2	Office	
Main Entrance	Circulation area	

Figure 8: Modification / Duplication of an existing room.

Selection of the plan geometry

1. Select the type of plan among the proposed selection (rectangular », « trapeze » or « L-shape ».
2. The selected type is highlighted in yellow.

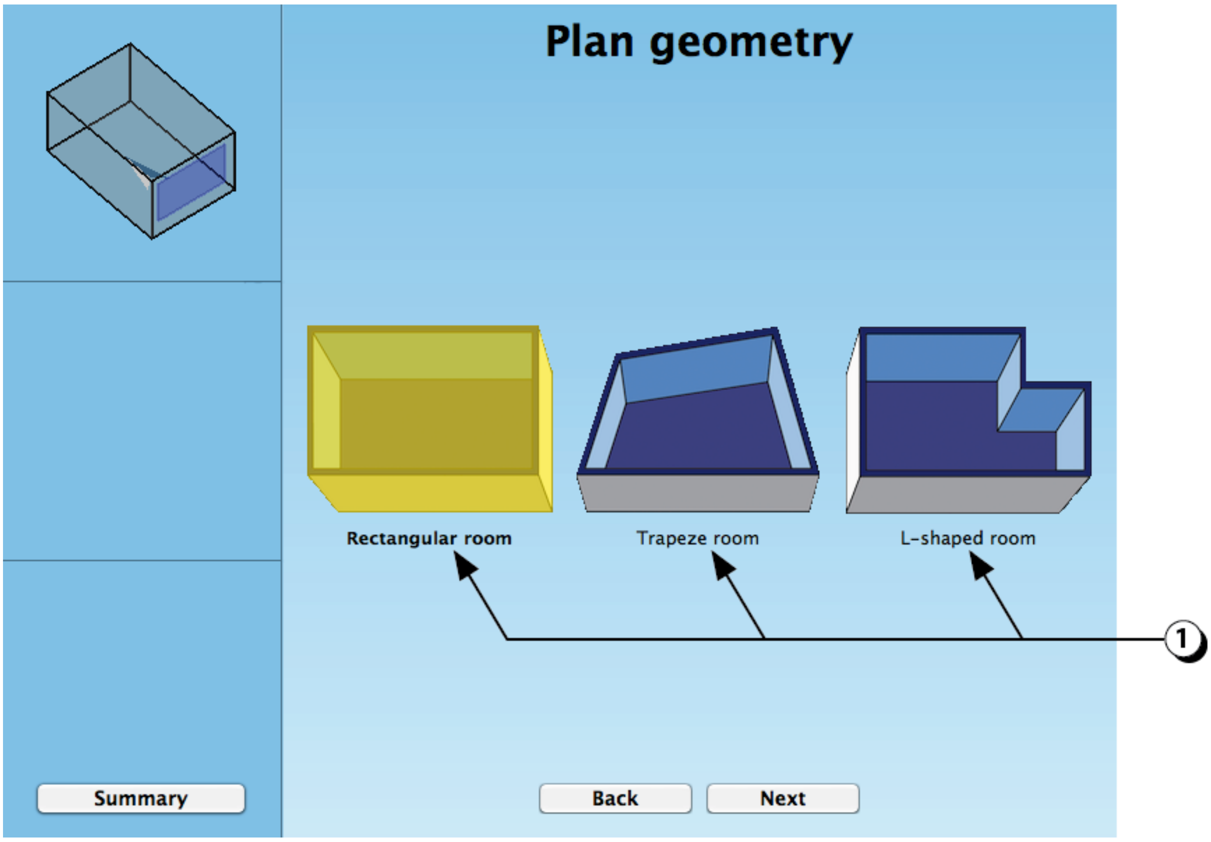
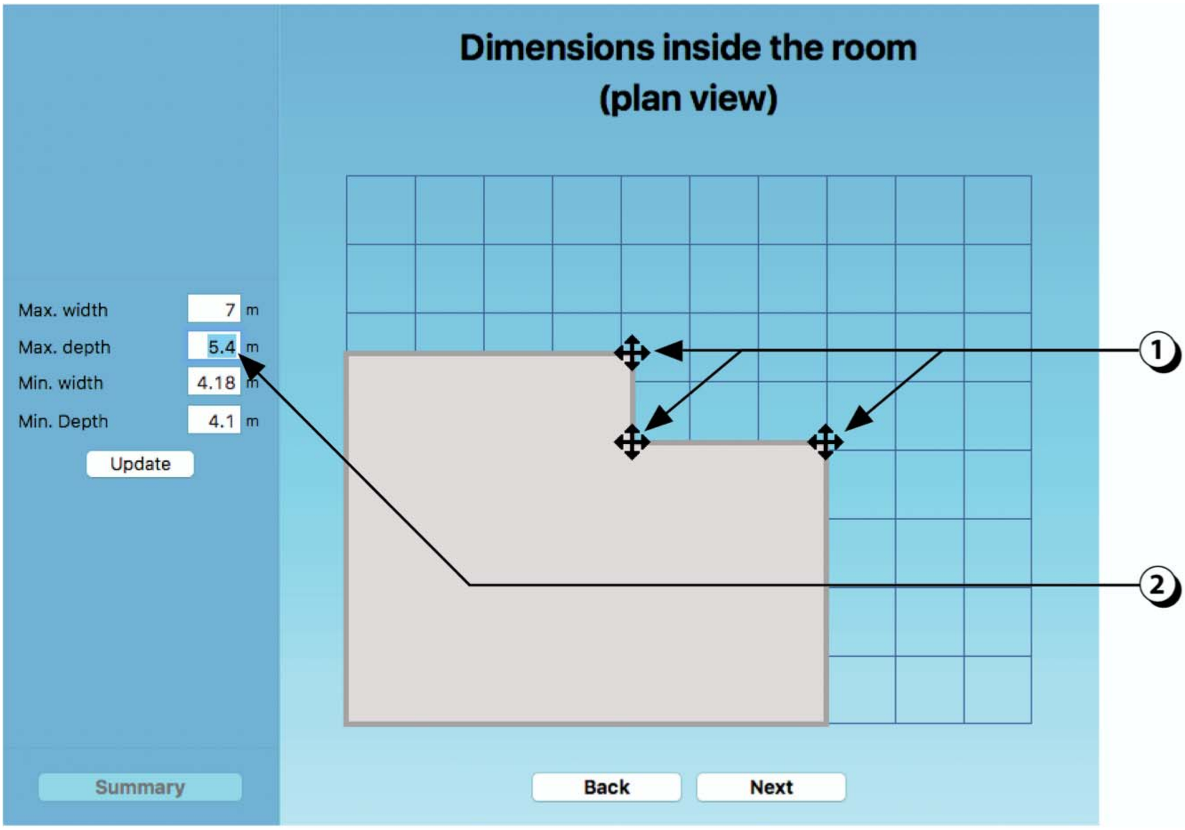


Figure 9: Selection of the plan geometry.

Room dimensions (Plan view)

1. Use the selection arrows to modify the dimensions of the room.
2. The dimensions are displayed in the corresponding fields.

You can also use your keyboard to enter numerical values (don't forget to validate with the "Update" button before leaving the page).



Dimensions inside the room (plan view)

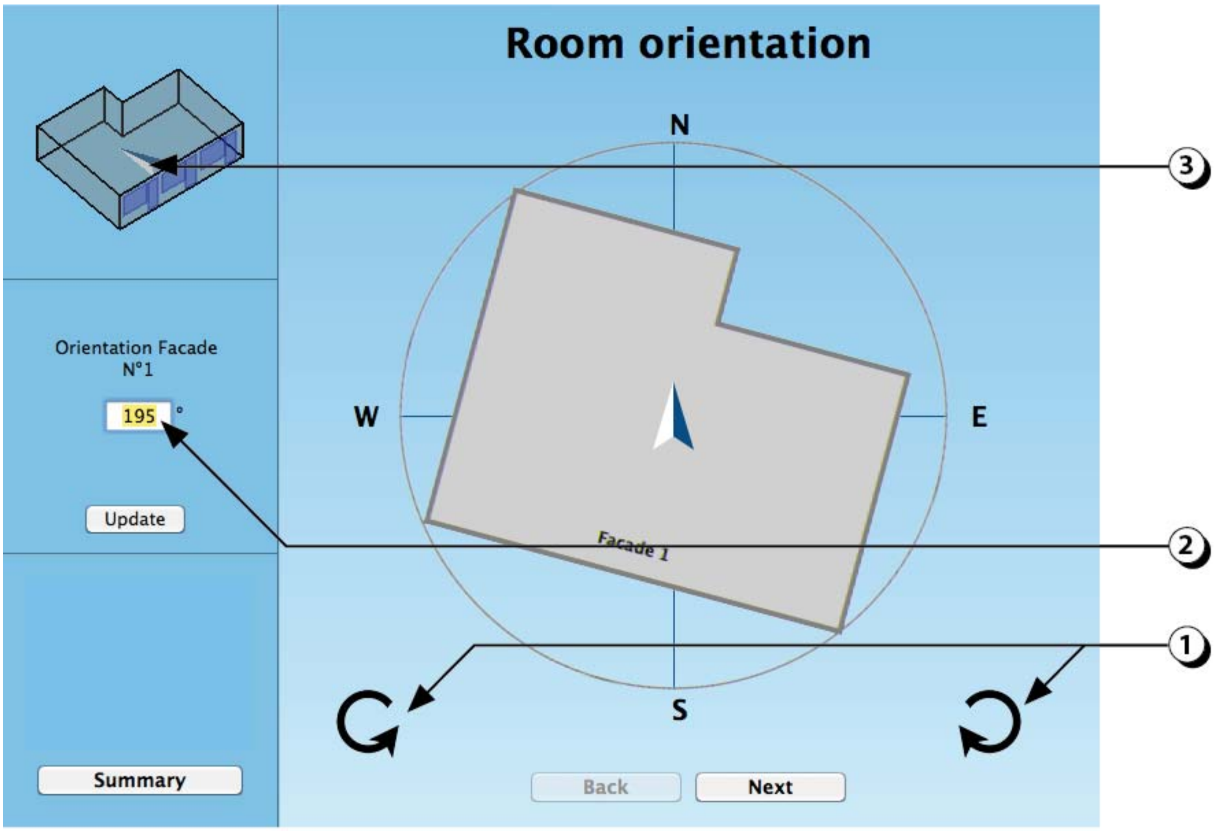
Max. width 7 m
Max. depth 5.4 m
Min. width 4.18 m
Min. Depth 4.1 m

Figure 10: Room dimensions (plan view).

Room orientation

1. Click on the arrows to rotate the room in the appropriate direction. Each click corresponds to a 15° rotation angle.
2. Facade 1 Orientation (°) is displayed in this field.

   (North = 0°, East = 90°, South = 180°, West = 270°).
3. You can also use your keyboard to enter a precise value (don't forget to validate with the "Update" button before leaving the page).
4. The North direction is displayed on the floor of the schematic 3D display of the room.

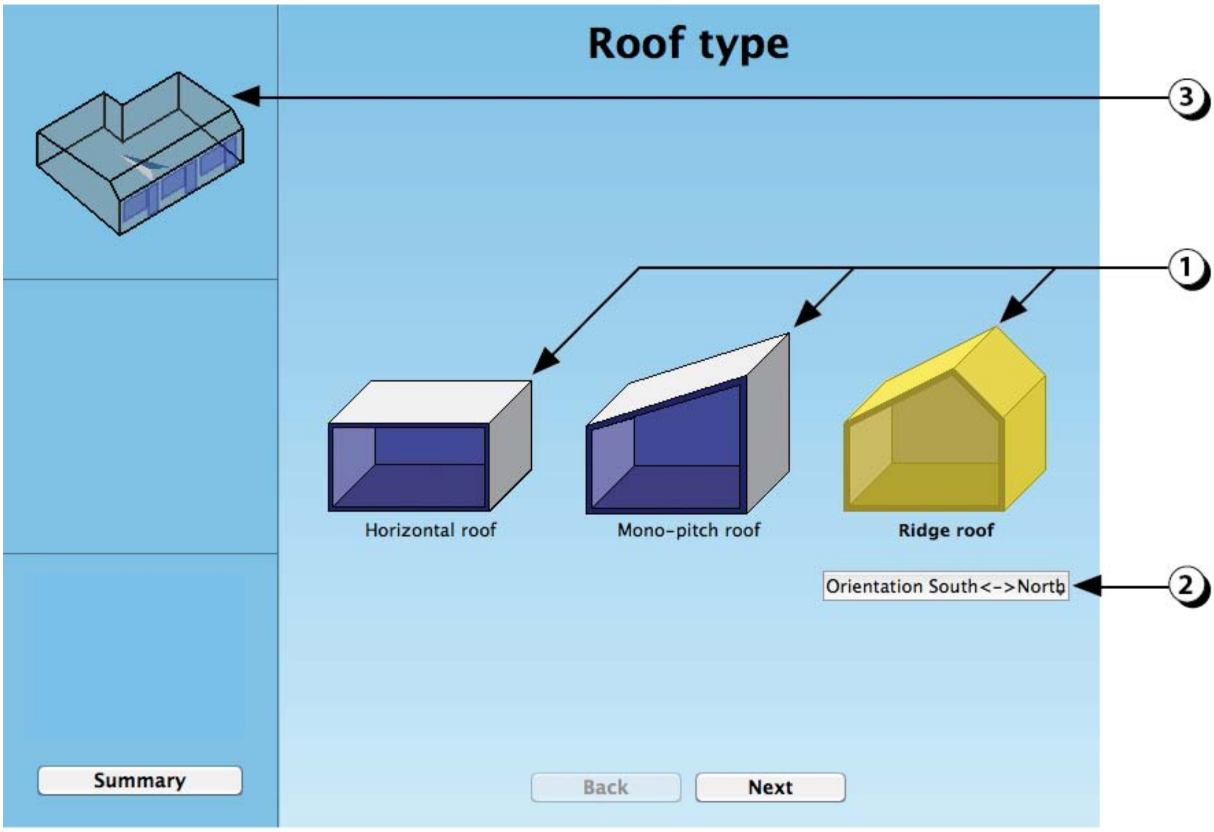


Orientation Facade N°1: 195 °

Figure 11: Selection of the room's orientation.

Roof Type

1. Select the appropriate type of roof (your selection is highlighted in yellow).
2. For Mono-pitch or Ridge roofs, select the appropriate orientation with the combo-box.
3. You can check the ridgepole orientation on the schematic 3D display of the room.

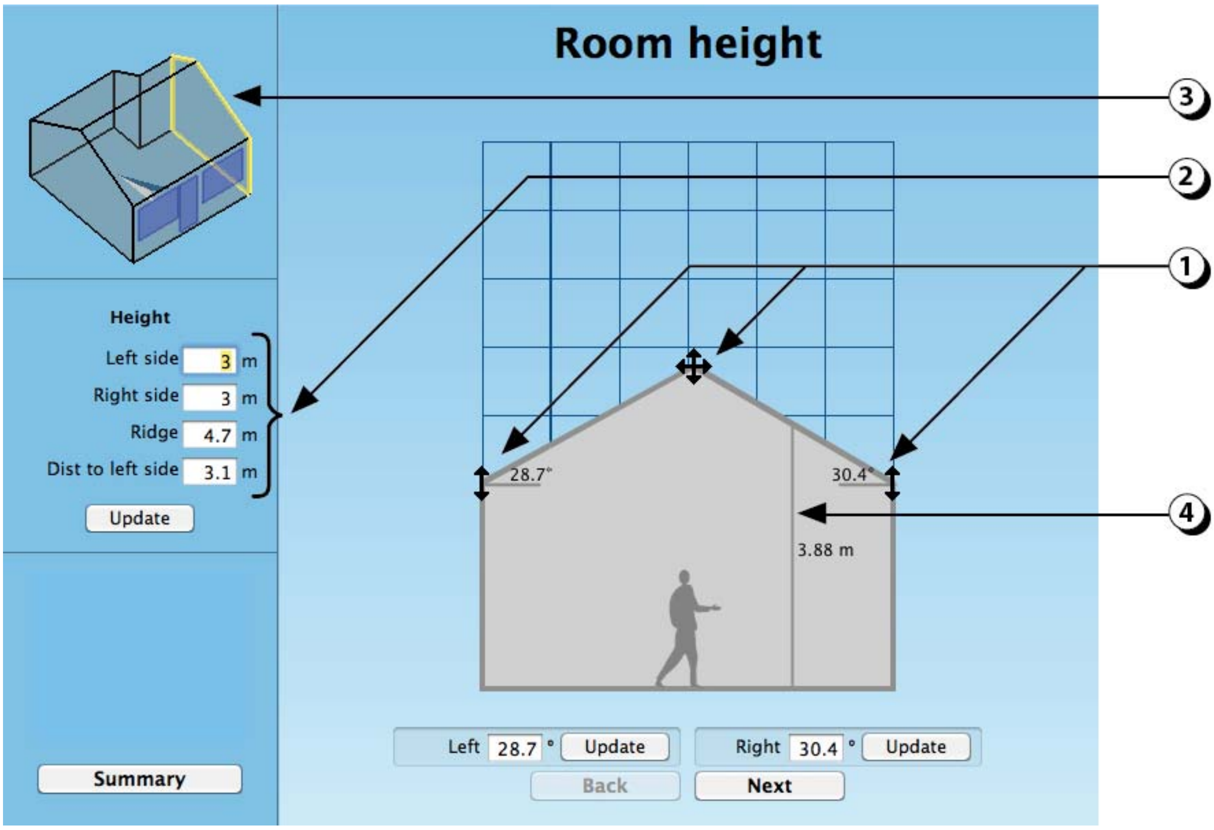


Orientation South<->North

Figure 12: Selection of the roof type.

Room height: Adjust the dimensions

1. Use the multi-directional arrows to adjust the different summits of the roof.
2. The different values are displayed in the corresponding fields.
3. You can also use your keyboard to enter a precise value (don’t forget to validate with the “Update” button before leaving the page).
4. You can check the room configuration on the schematic 3D display of the room.
5. This line is visible for “L-shape” rooms. The value on the right side of the line corresponds to the roof height at the junction of the 2 branches of the “L”.



Height

Left side 3 m

Right side 3 m

Ridge 4.7 m

Dist to left side 3.1 m

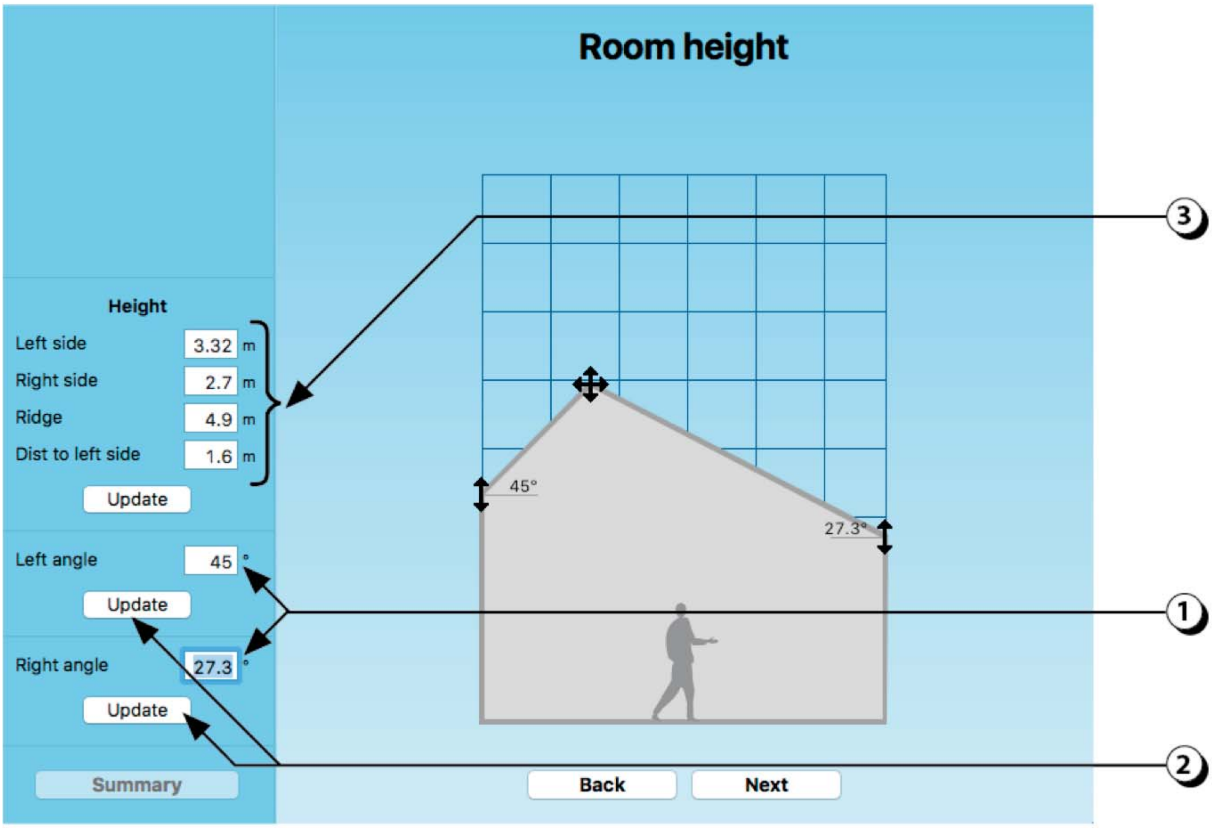
Left 28.7 °

Right 30.4 °

Figure 13: How to adjust the room height.

Room height: Adjust the slopes of the roof

1. For tilted roofs, it is possible to adjust the roof slope(s).
2. Once slope angle defined, click the corresponding “Update” button to update the display.
3. You can check the room configuration on the schematic 3D display of the room.



Height

Left side 3.32 m

Right side 2.7 m

Ridge 4.9 m

Dist to left side 1.6 m

Left angle 45 °

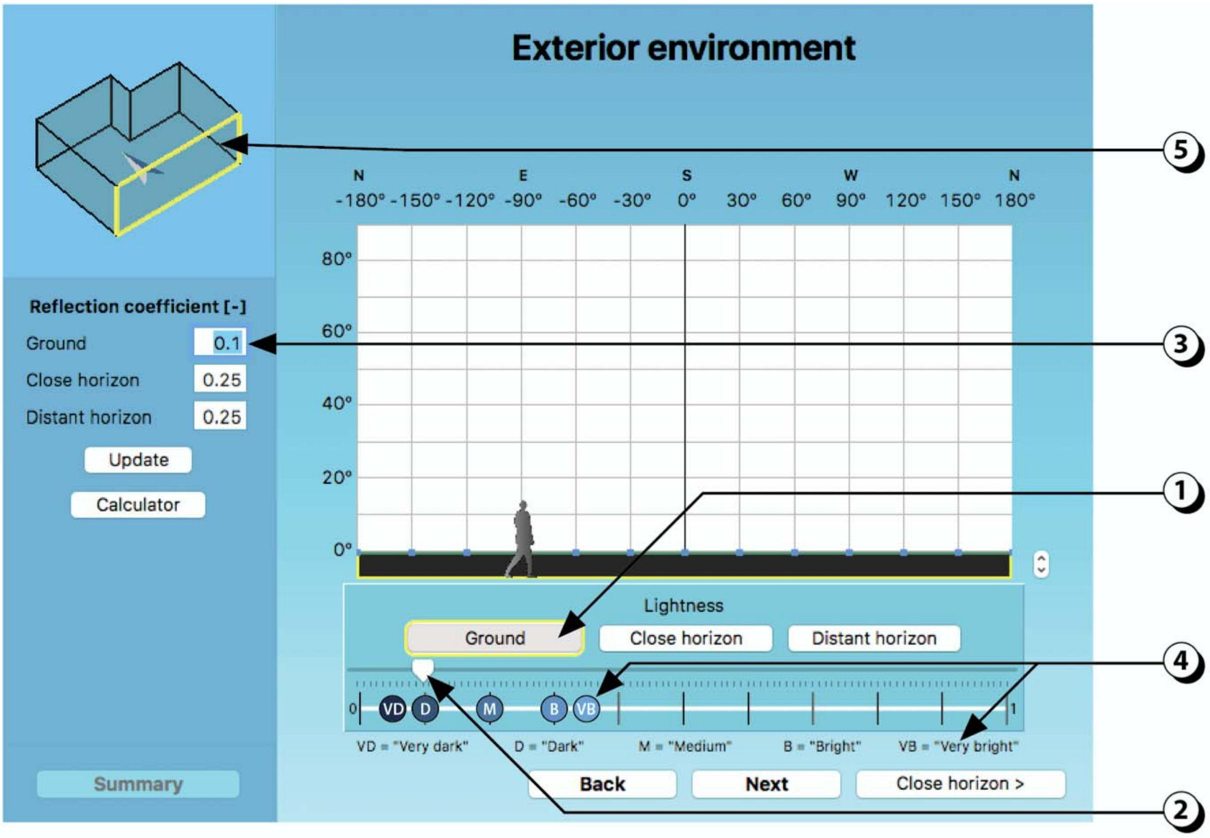
Right angle 27.3 °

Figure 14: Adjustment of the roof slope(s).

Outdoor environment: Ground lightness adjustment

The outdoor ground reflection coefficient (albedo) has a great influence on the indoor daylight availability.

1. Click on the “Ground” button.
2. Adjust the floor brightness with the slider (**CAUTION:** The brightness of your computer screen is only indicative).
3. You also can enter a value with your keyboard.
4. “VD”, “D”, “M”, B” and “VB” (respectively “Very Dark”, “Dark”, “Medium”, “Bright” and “Very Bright”) give a linguistic indication about current values for outdoor ground brightness values. (For example, a 0.30 ground lightness corresponds to a “Bright” ground).
5. Click the magnifier to enlarge the 3D view of the room.



Reflection coefficient [-]

Ground 0.1

Close horizon 0.25

Distant horizon 0.25

Figure 15: Adjustment of the outdoor ground brightness.

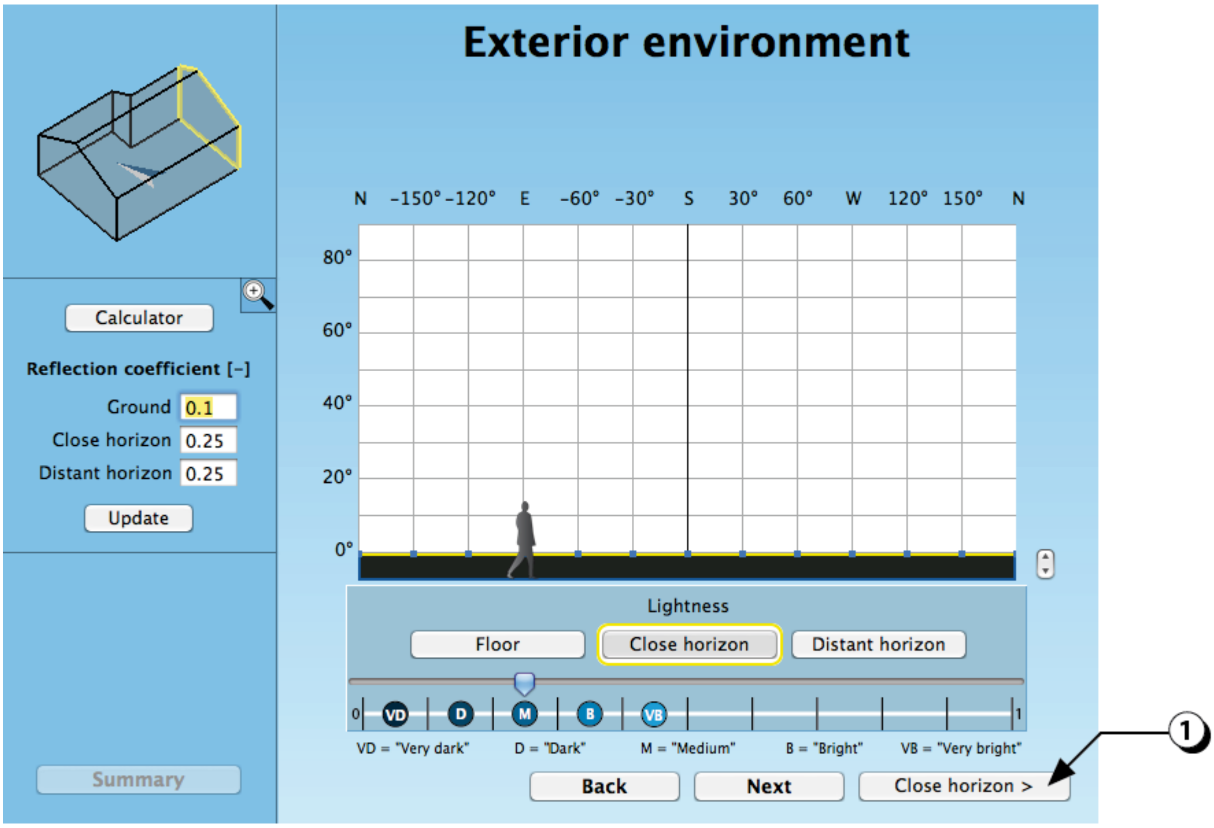
Outdoor environment: Close surroundings (step 1)

Start of the close surroundings description

Outdoor obstacles (buildings, vegetation, hills or mountains) do influence the indoor daylight availability). DIAL+ allows you to describe close or far surroundings.

To describe the buildings located in the close surroundings:

1. Click on the “Close horizon” button.



Ground 0.1
Close horizon 0.25
Distant horizon 0.25

VD = "Very dark" D = "Dark" M = "Medium" B = "Bright" VB = "Very bright"

Figure 16: Selection of the close surroundings.

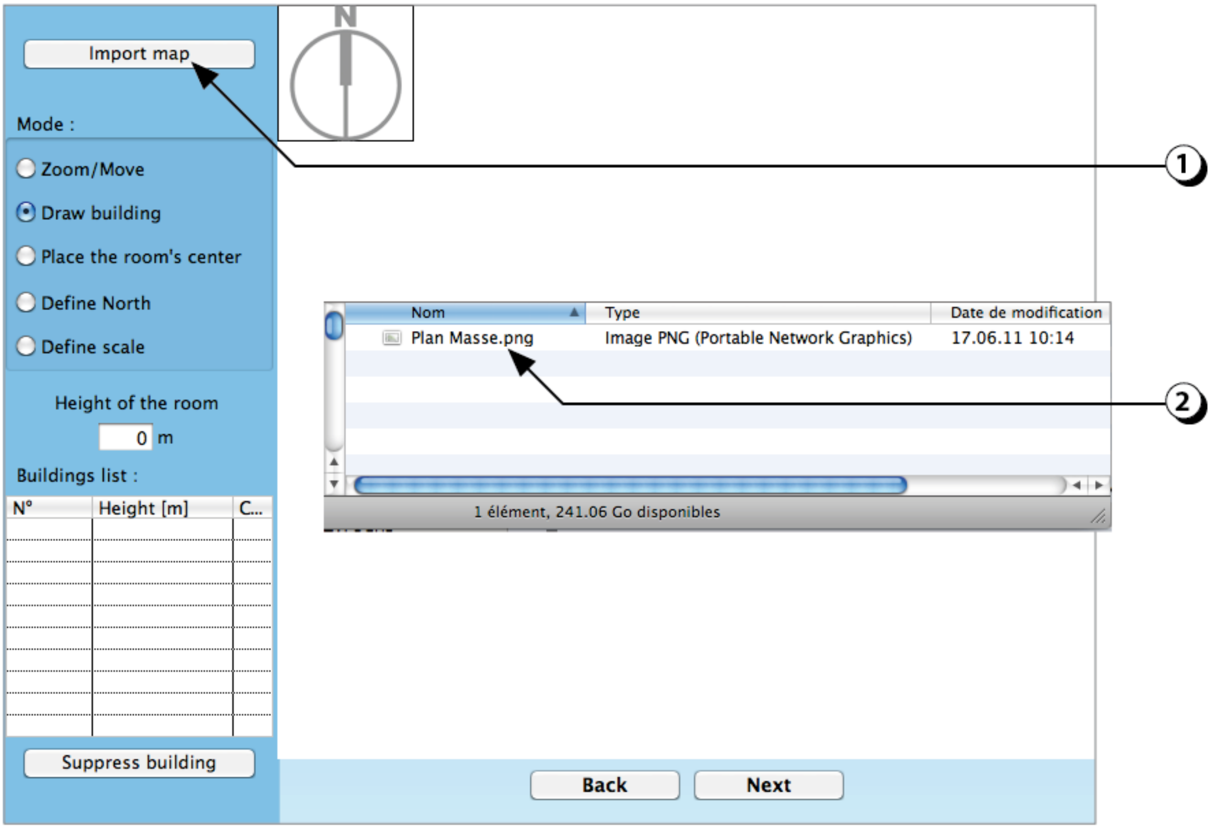
Outdoor environment: Close surroundings (Step 2)

Import a mass plan

A new window opens in which you can import a mass plan of your project.

CAUTION: The file format should be either .jpg or .png (screenshot).

1. Click on the « Import map » button.
2. Select the corresponding map with your browser.



Mode :
○ Zoom/Move
● Draw building
○ Place the room's center
○ Define North
○ Define scale

Height of the room
0 m

Nom	Type	Date de modification
Plan Masse.png	Image PNG (Portable Network Graphics)	17.06.11 10:14

1 élément, 241.06 Go disponibles

Figure 17: Importation of a mass plan of your project.

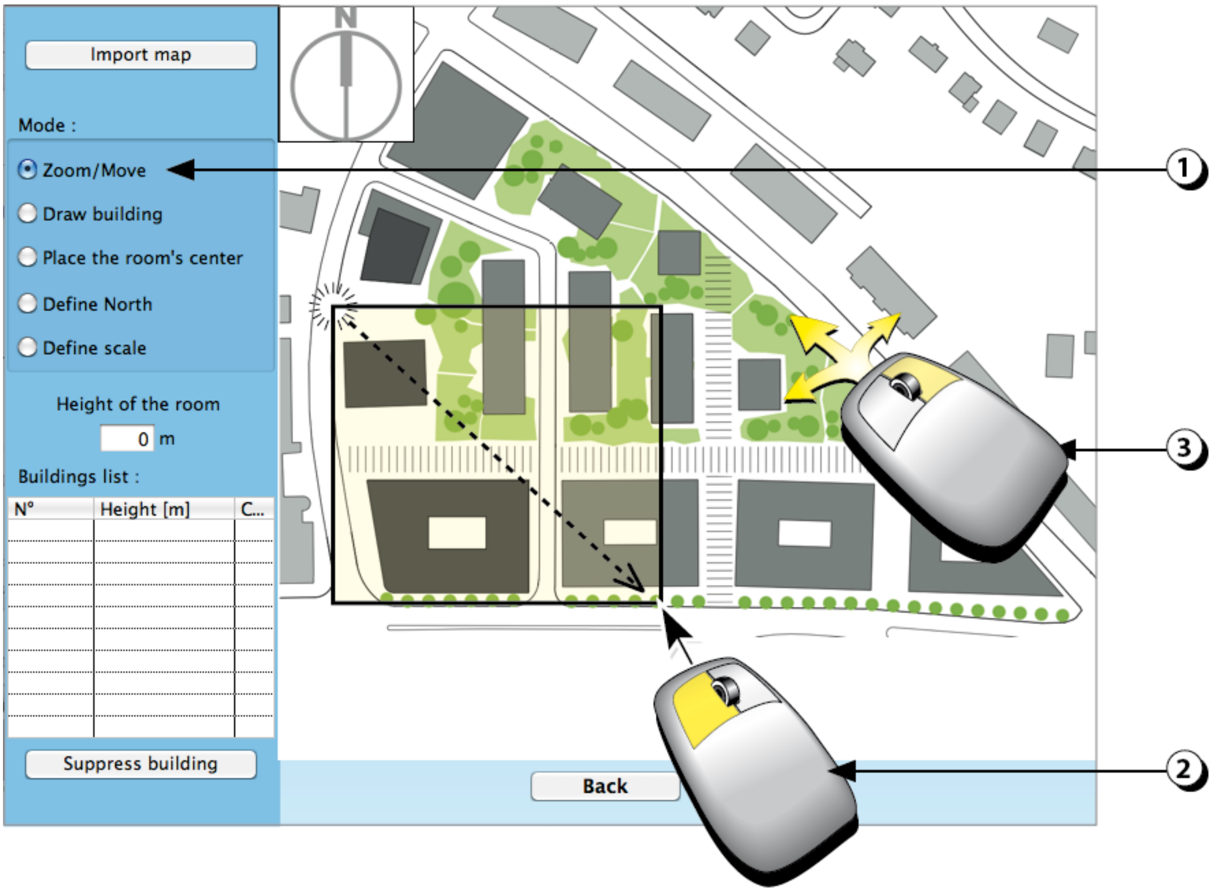
Outdoor environment: Close surroundings (Step 3)

Zoom / Move

Once the mass plan imported, you can:

1. Select the “Zoom/Move” button.
2. Use the left-click button of your mouse to zoom-in (move from up-left to down-right).

   To zoom-out, use the left click without moving the mouse.
3. Use the right-click of your mouse to move on the mass plan.



Mode :

● Zoom/Move

○ Draw building

○ Place the room's center

○ Define North

○ Define scale

Height of the room 0 m

Figure 18: Zoom in / Move on the mass plan of your project.

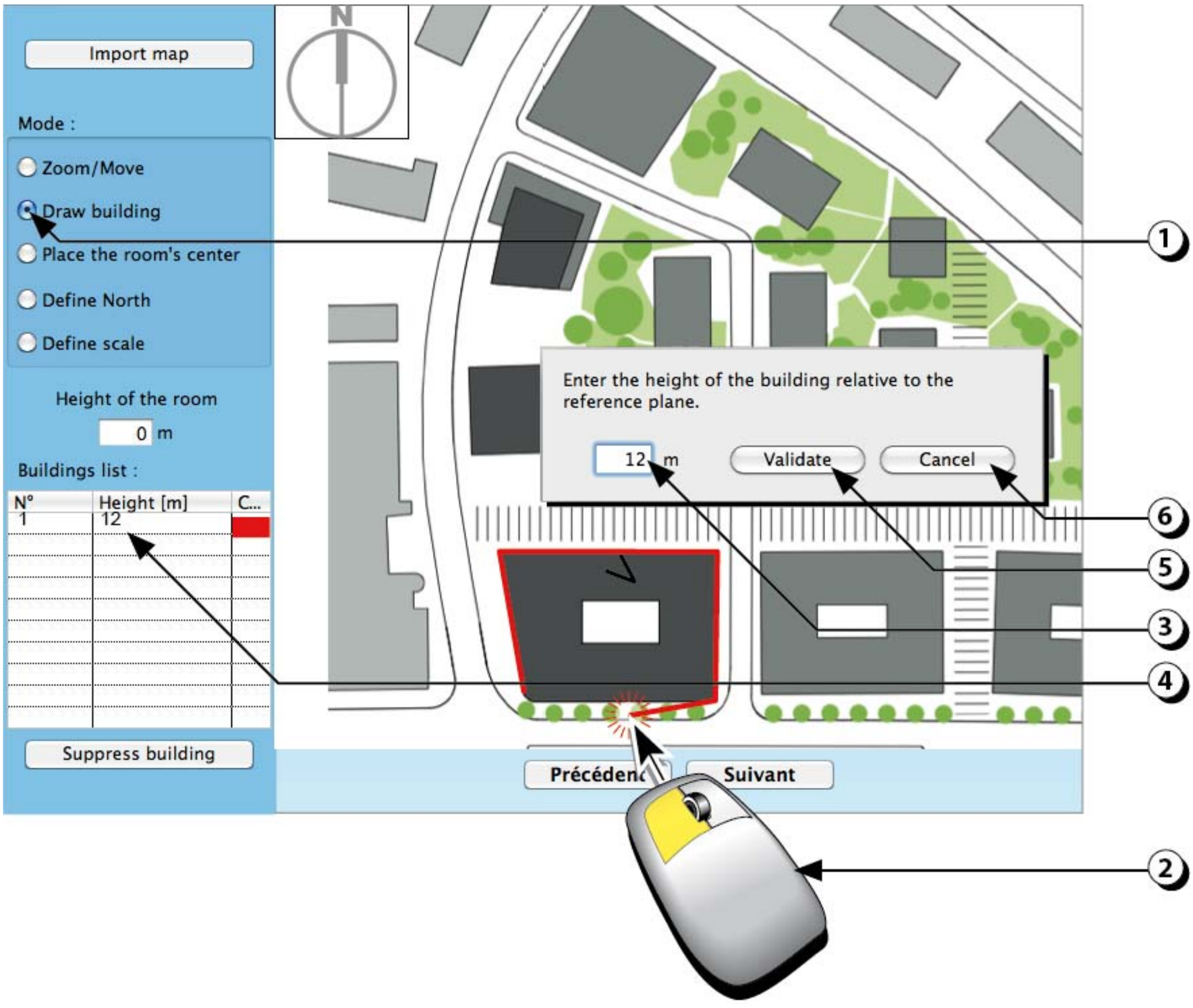
Outdoor environment: Close surroundings (Step 4)

Draw surrounding buildings

You can now describe the surrounding buildings:

1. Select the “Draw building” button.
2. Use the left-click of your mouse to draw the outline of the first building (left click to each summit of the polygon).
3. Once the polygon is “closed”, a new window appears in which you can enter the height of the corresponding building.
4. The number, the height of the building and its colour are displayed in the table (you can modify the height later).
5. Validate to proceed.
6. Click to cancel and remove the building.

Repeat these operations until you have described all the surrounding buildings or obstacles.



Height of the room: 0 m

Buildings list :

N°	Height [m]	C...
1	12	🟥

Enter the height of the building relative to the reference plane.

12 m

Figure 19: Description of a building in the close surroundings.

Outdoor environment: Close surroundings (Step 5)

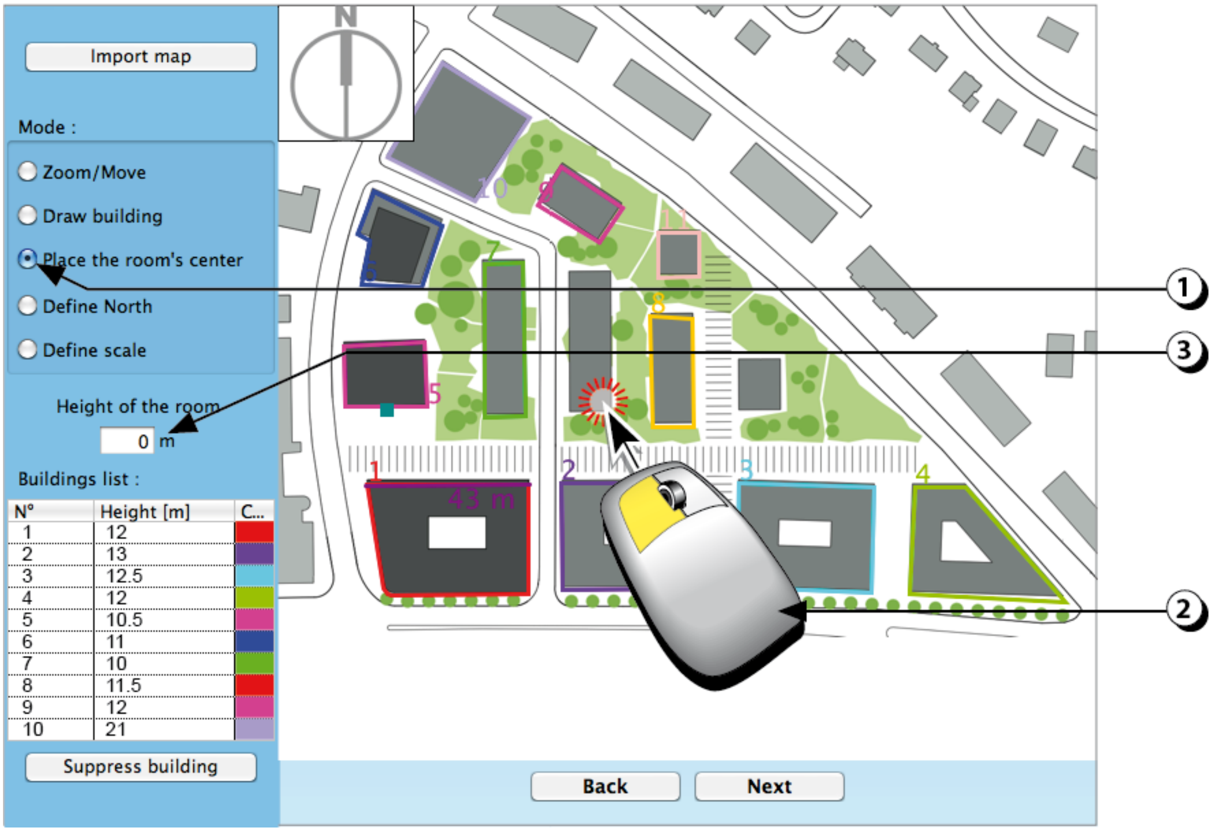
Place the observer (centre of the room)

Once all the surrounding buildings have been described,

1. Select the “Place the observer” button.
2. Use the Left-click to indicate the position of the observer (centre of the room).
3. Enter the relative altitude of the observer, then click on “Validate” to proceed.

Note

The observer’s position should be representative of the centre of the opening (if there is more than one opening choose the barycentre of the different windows).



Mode :

○ Zoom/Move
○ Draw building
● Place the room's center
○ Define North
○ Define scale

Height of the room 0 m

Buildings list :

N°	Height [m]	C...
1	12	🟥
2	13	🟪
3	12.5	🟦
4	12	🟩
5	10.5	🟪
6	11	🟦
7	10	🟩
8	11.5	🟥
9	12	🟪
10	21	🟪

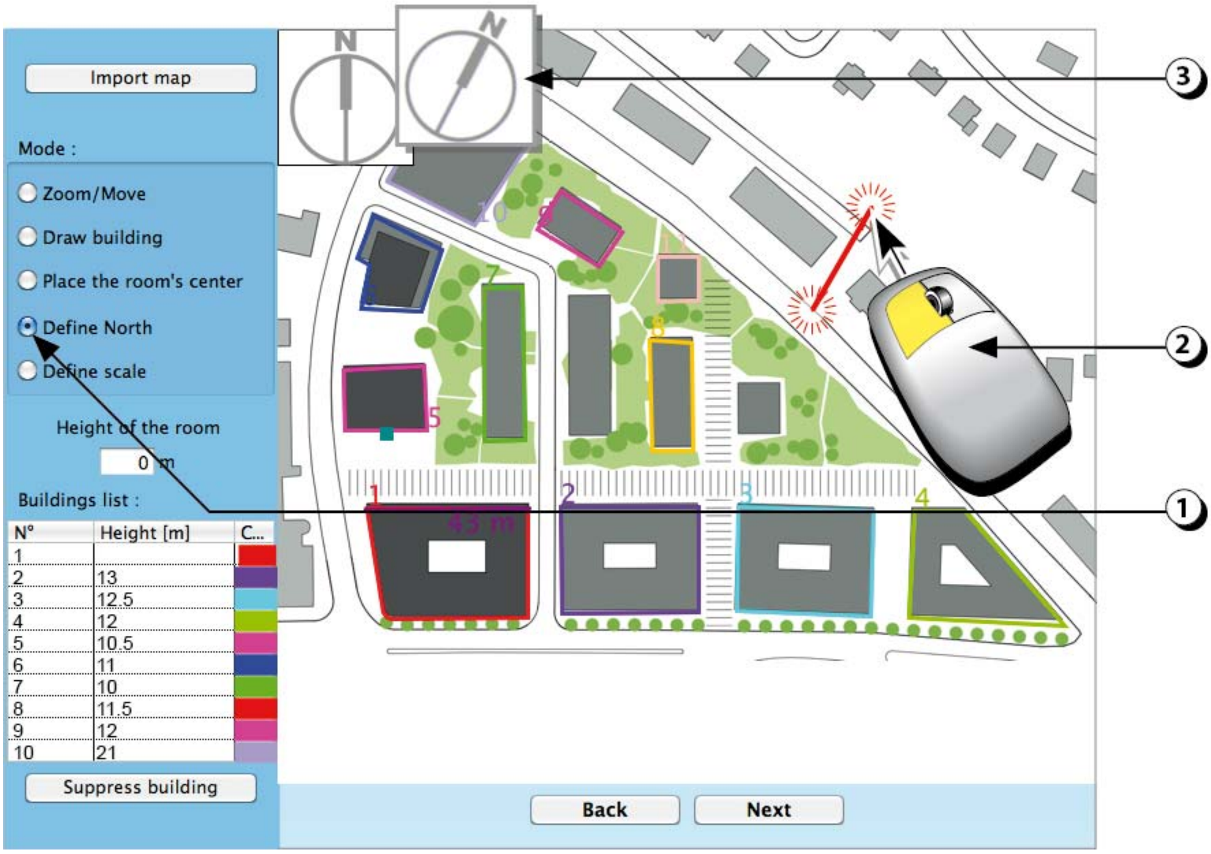
Figure 20: Indication of the position and the reference height of the room.

Outdoor environment: Close surroundings (Step 6)

Choose the orientation

To modify the orientation of the plan,

1. Select the “Define North” button.
2. Use your mouse to draw a segment whose main axis indicates the North direction.
3. The compass is updated and shows the new direction of the North.



Mode :

○ Zoom/Move
○ Draw building
○ Place the room's center
● Define North
○ Define scale

Height of the room 0 m

Buildings list :

N°	Height [m]	C...
1		🟥
2	13	🟪
3	12.5	🟦
4	12	🟩
5	10.5	🟪
6	11	🟦
7	10	🟩
8	11.5	🟥
9	12	🟪
10	21	🟪

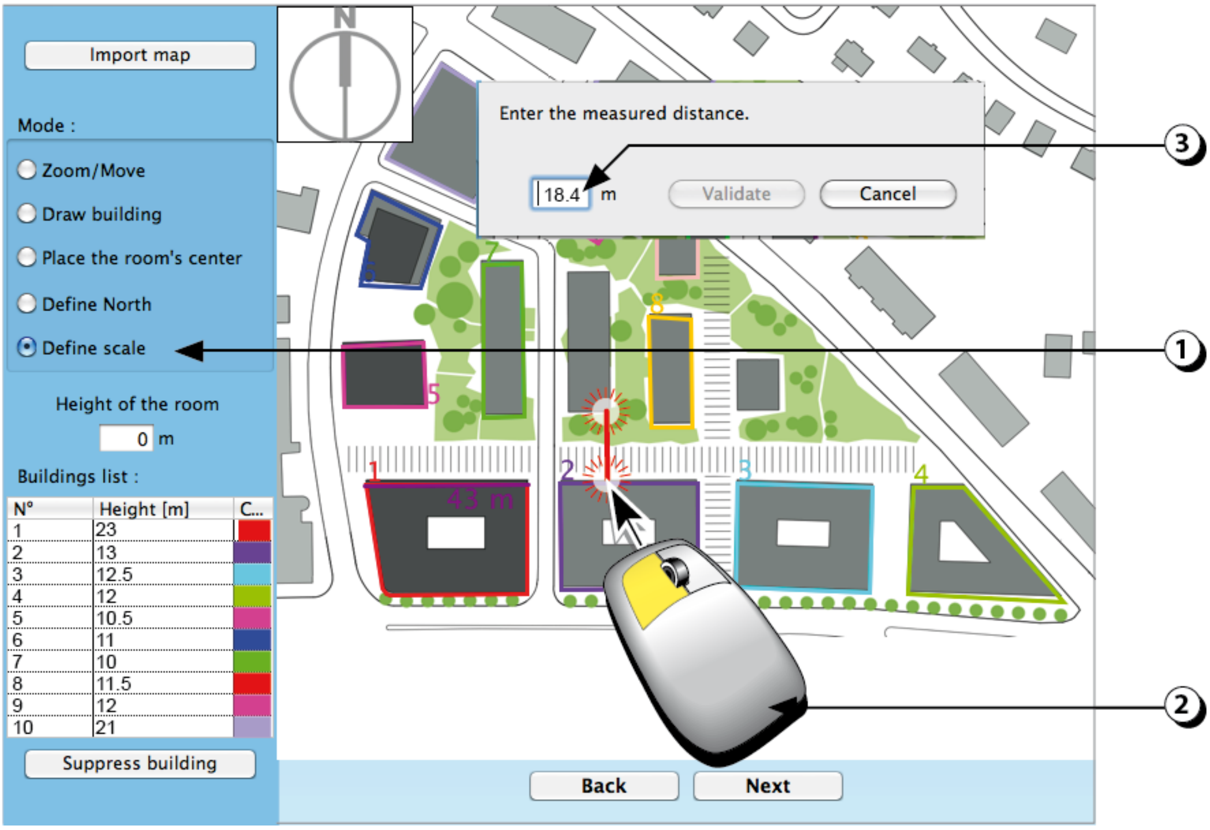
Figure 21: Modification of the plan orientation.

Outdoor environment: Close surroundings (Step 7)

Define the scale of the plan

To define the scale of the mass plan :

1. Select the “Define Scale” button.
2. Use your mouse to draw on the plan a segment of known size.
3. Enter the corresponding distance (m) in this field, then click on “Validate” to proceed.



Mode :

○ Zoom/Move
○ Draw building
○ Place the room's center
○ Define North
● Define scale

Height of the room 0 m

Buildings list :

N°	Height [m]	C...
1	23	🟥
2	13	🟪
3	12.5	🟦
4	12	🟩
5	10.5	🟪
6	11	🟦
7	10	🟩
8	11.5	🟥
9	12	🟪
10	21	🟪

Enter the measured distance.

18.4 m

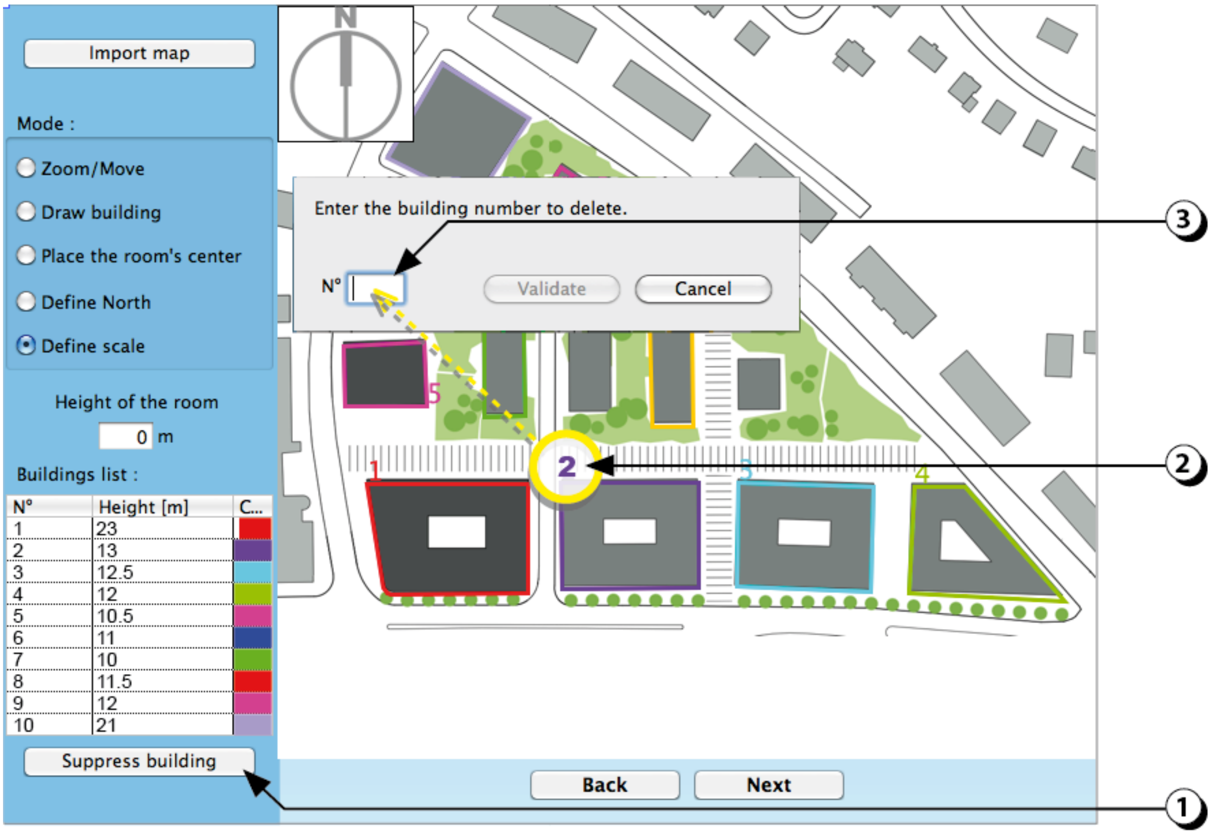
Figure 22: Modification of the mass plan scale.

Outdoor environment: Close surroundings (Step 8)

Delete a building

To delete a building you already described on the plan :

1. Click on the “Suppress Building” button.
2. Search for the number of the building you want to delete (the numbers are located on the top left corner of the buildings outlines).
3. Enter the corresponding number and then click on “Validate” to proceed.



Mode :

○ Zoom/Move
○ Draw building
○ Place the room's center
○ Define North
● Define scale

Height of the room 0 m

Buildings list :

N°	Height [m]	C...
1	23	🟥
2	13	🟪
3	12.5	🟦
4	12	🟩
5	10.5	🟪
6	11	🟦
7	10	🟩
8	11.5	🟥
9	12	🟪
10	21	🟪

Enter the building number to delete.

N°

Figure 23: Process to delete a building.

Outdoor environment: Close surroundings (Step 9)

Visualize the close environment

Clicking on the “Next” button on the previous screen leads to display the angular heights of the surroundings.

The default view is a cylindrical projection of the horizon including the buildings you have described. On the graph are reported the sun paths corresponding to the latitude of your project (21st of each month).

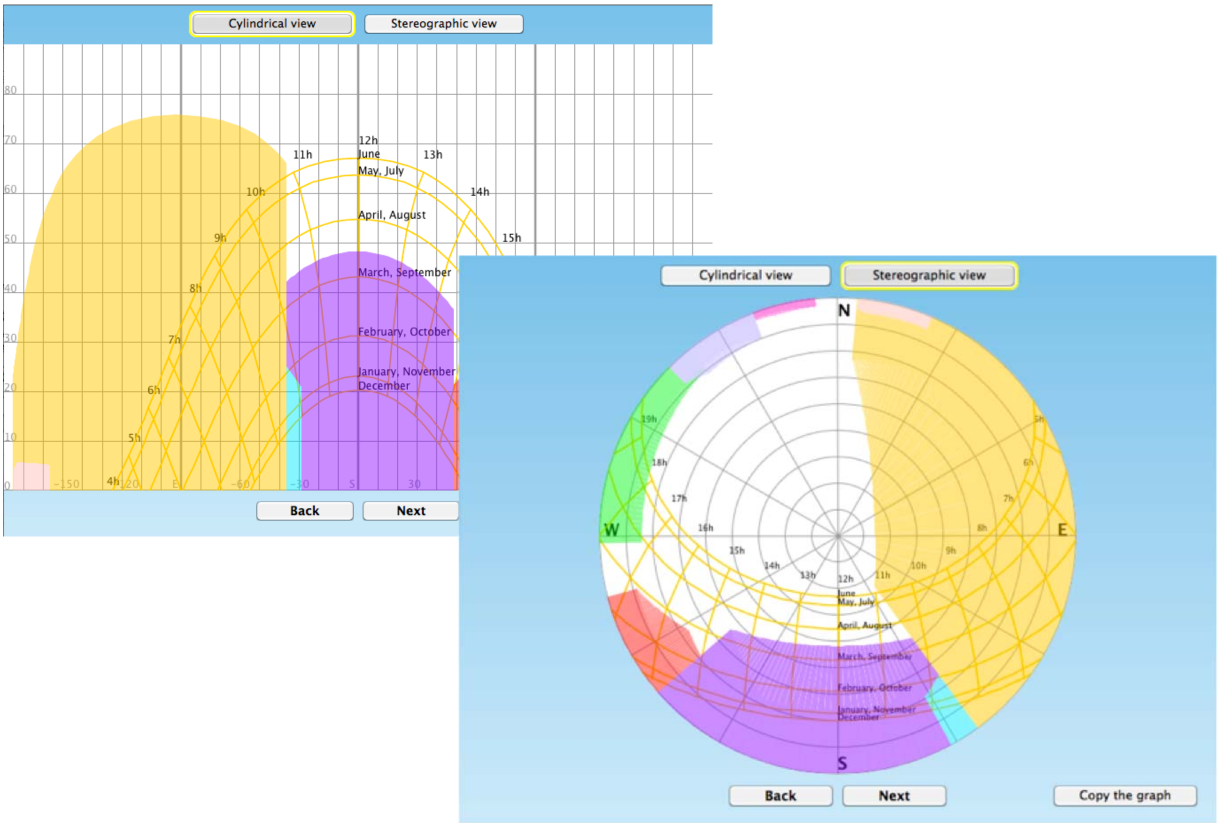


Figure 24.: Visualization of the surrounding buildings (cylindrical and stereographic projections).

Clicking on the “Stereographic View” button leads to display another representation of the close surroundings (stereographic projection).

In this version of DIAL+, the luminance of the obstructed portions of the horizon is as follow: $L_{Obst} = L_{Sky} * \rho_{Obst}$

Where:

- L_{Obst} = Luminance of the obstruction [cd/m^2]
- L_{Sky} = Luminance of the sky [cd/m^2]
- ρ_{Obst} = Reflection coefficient of the obstruction [-]

Outdoor environment: Close surroundings (Step 10)

Select the lightness of the close surroundings

1. Click on the “Close Horizon” button.
2. Change the brightness of the close surroundings by moving the slider along the brightness scale.
3. You can also enter a value in the corresponding field.

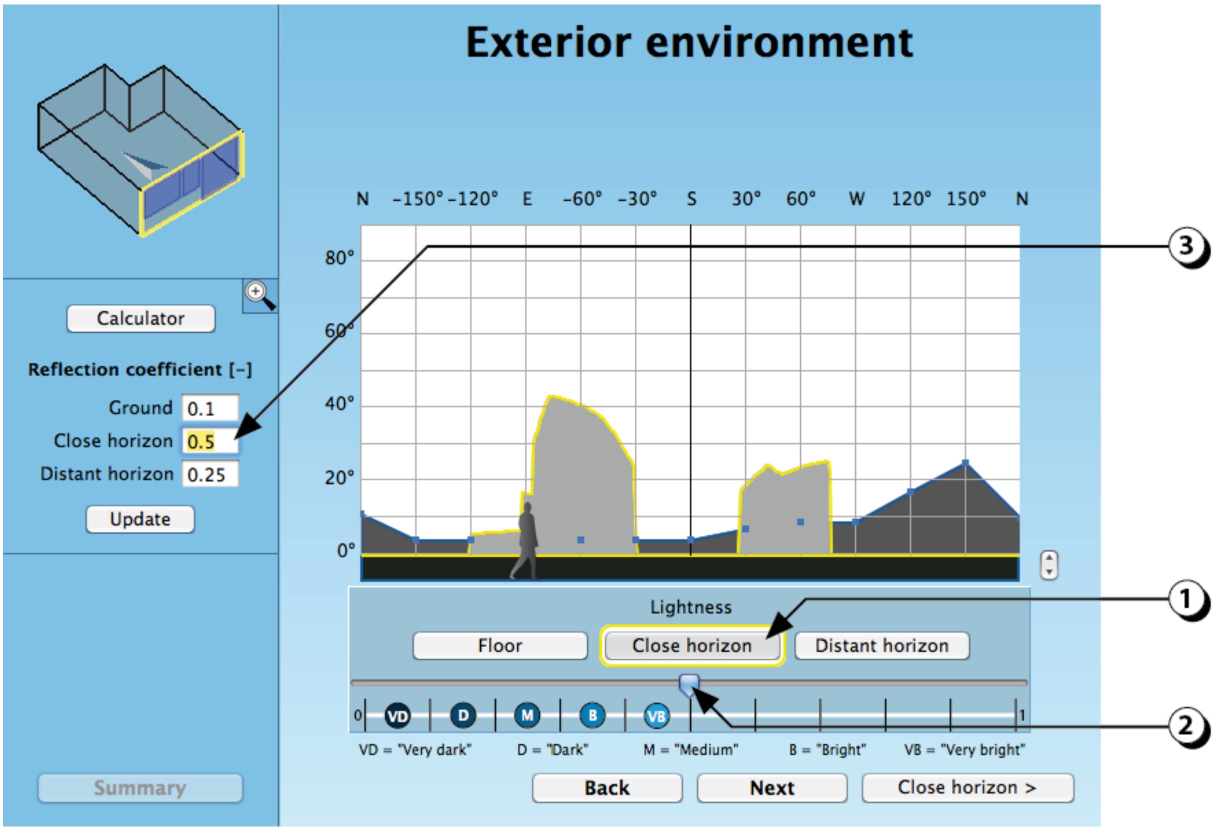


Figure 25: Adjustment of the close surroundings brightness.

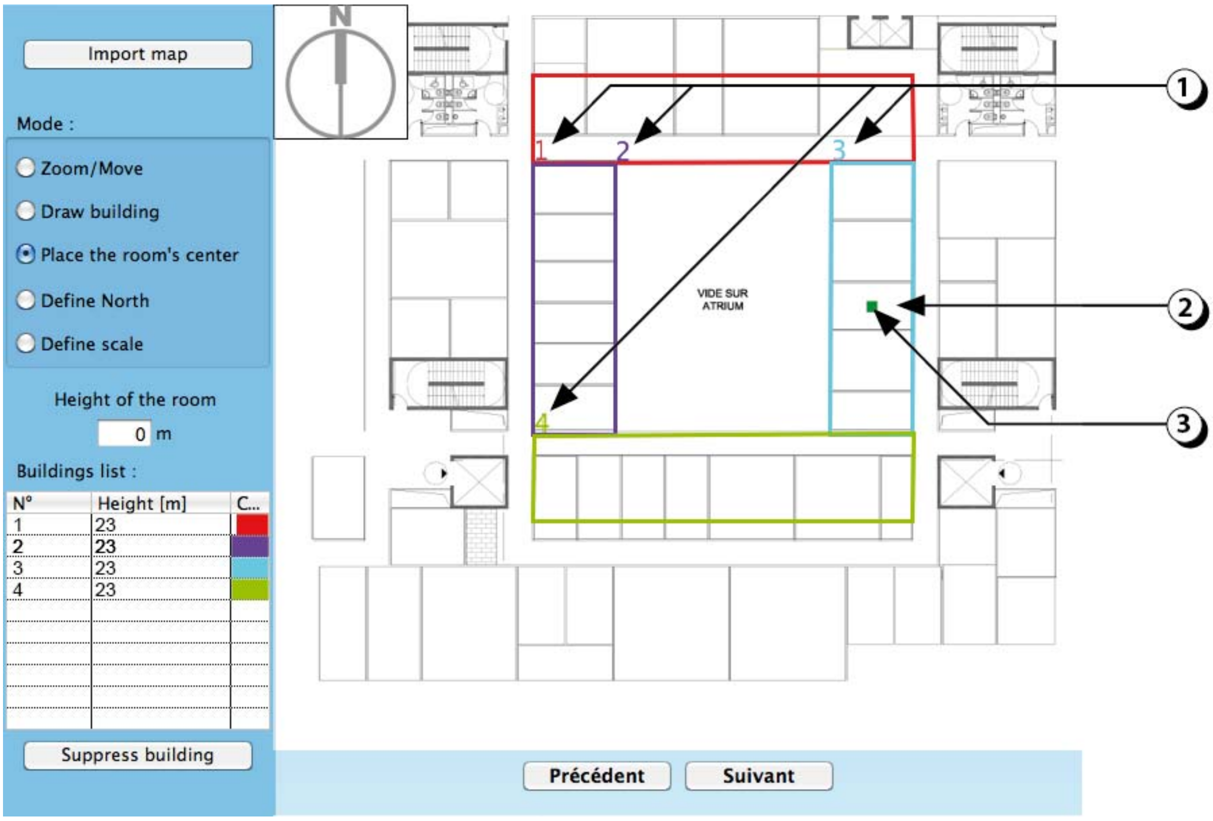
How to use the close surroundings to describe an ATRIUM

When the room you are working on is located inside an atrium or a patio, it is possible to describe this one as a « close horizon » outdoor environment.

1. Build each of the atrium façades as a “close horizon” object as describe in the previous pages.
2. Locate the room you would like to analyse.
3. Place the observer in the centre of the glazing of this room.

CAUTION: If you are working on a glazed atrium, you have to take into account the specific light absorption of the atrium glass and frames. (Multiply the room glazing transmission by the global atrium window transmission).

Another way to describe atria is shown in page 76.



Mode :

○ Zoom/Move
○ Draw building
● Place the room's center
○ Define North
○ Define scale

Height of the room 0 m

Buildings list :

N°	Height [m]	C...
1	23	🟥
2	23	🟪
3	23	🟦
4	23	🟩

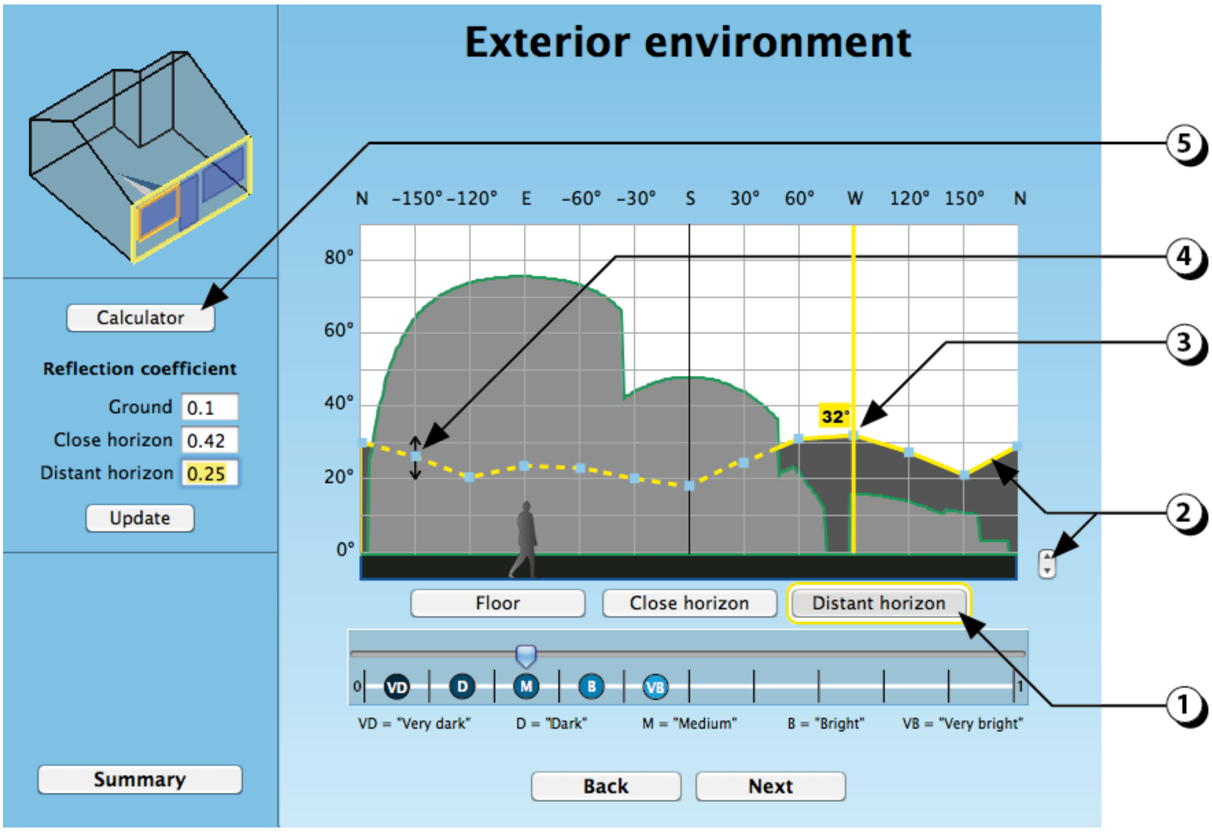
Figure 26: How to use the “close horizon” to describe an atrium.

Outdoor environment: Distant horizon (Step 1)

Define the line of the distant horizon

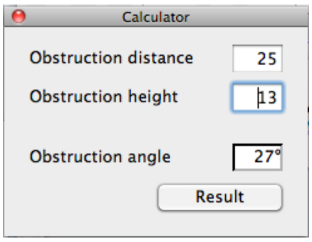
The distant horizon corresponds to the natural skyline (mountains, hills, etc).

1. Click on the “Distant horizon” button to modify the skyline.
2. This button allows you to modify the height of the whole skyline with a 1° increment.
3. Click in any point of the graph to create a new point.(the new point will be created on one of the vertical lines).
4. You can adjust the height of each point by moving it along the vertical axis.
5. The calculator is a tool that allows you to calculate the angular height of a point as a function of its vertical distance to the ground and the horizontal distance from the observer (see details at the bottom of the page).



Ground 0.1
Close horizon 0.42
Distant horizon 0.25

Figure 27: Description of the distant horizon.



Obstruction distance 25
Obstruction height 13
Obstruction angle 27°

Outdoor environment: Distant horizon (Step 2)

Define the average brightness of the distant horizon

1. Modify the distant horizon average brightness by moving the slider along the brightness scale.
2. You can also enter a value in the corresponding field.

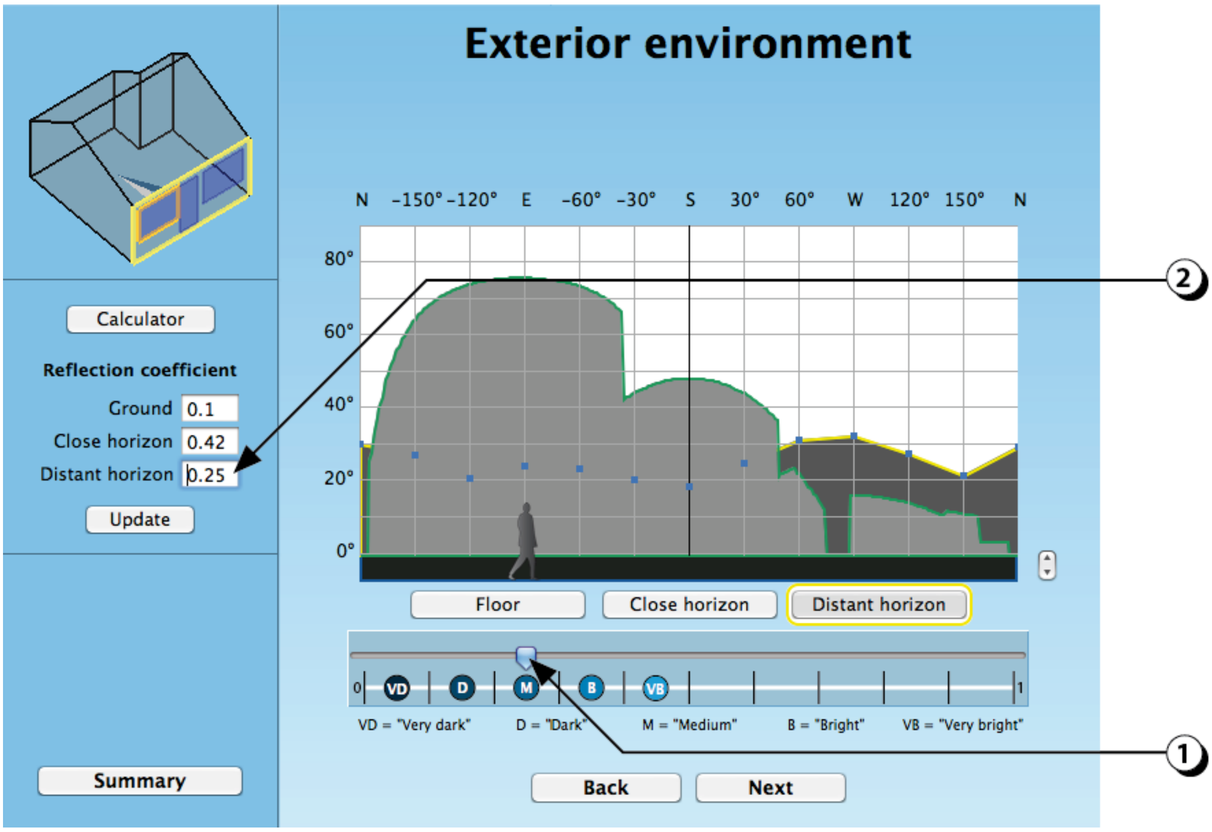


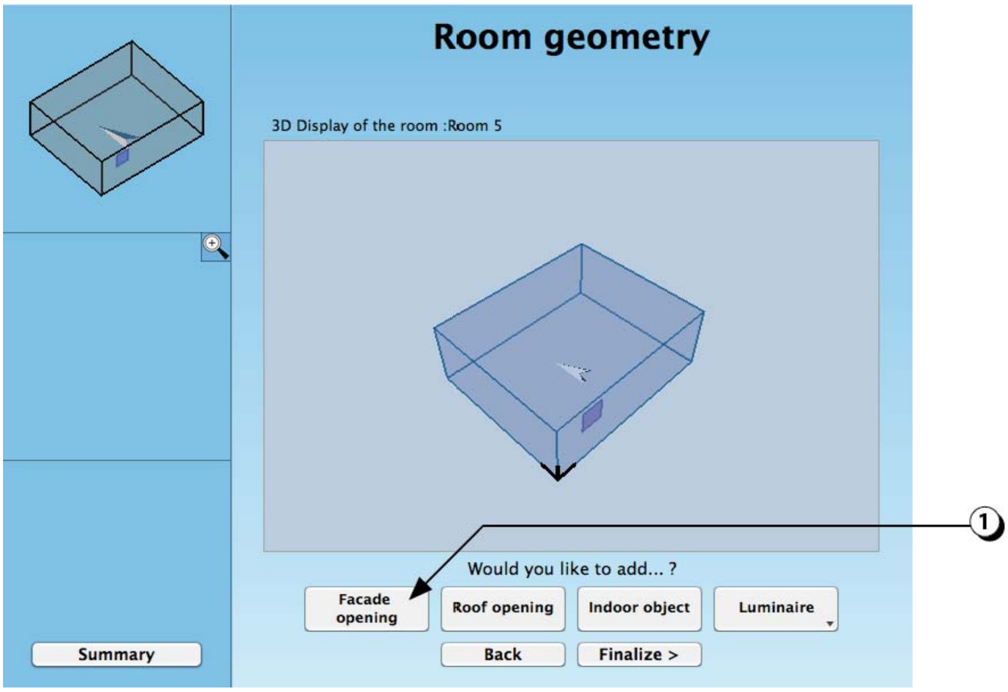
Figure 28: Adjustment of the distant horizon brightness.

FACADE OPENINGS

Add a facade opening

1. Click here to add an opening on one of the facades.
2. It is possible to zoom-in or zoom-out by scrolling.
3. It is possible to modify the view-point by clicking on the mouse left-button.

   It is possible to use the keyboard arrows to modify the view point.



Room geometry

3D Display of the room :Room 5

Would you like to add... ?

Figure 29: Add 1 Opening.

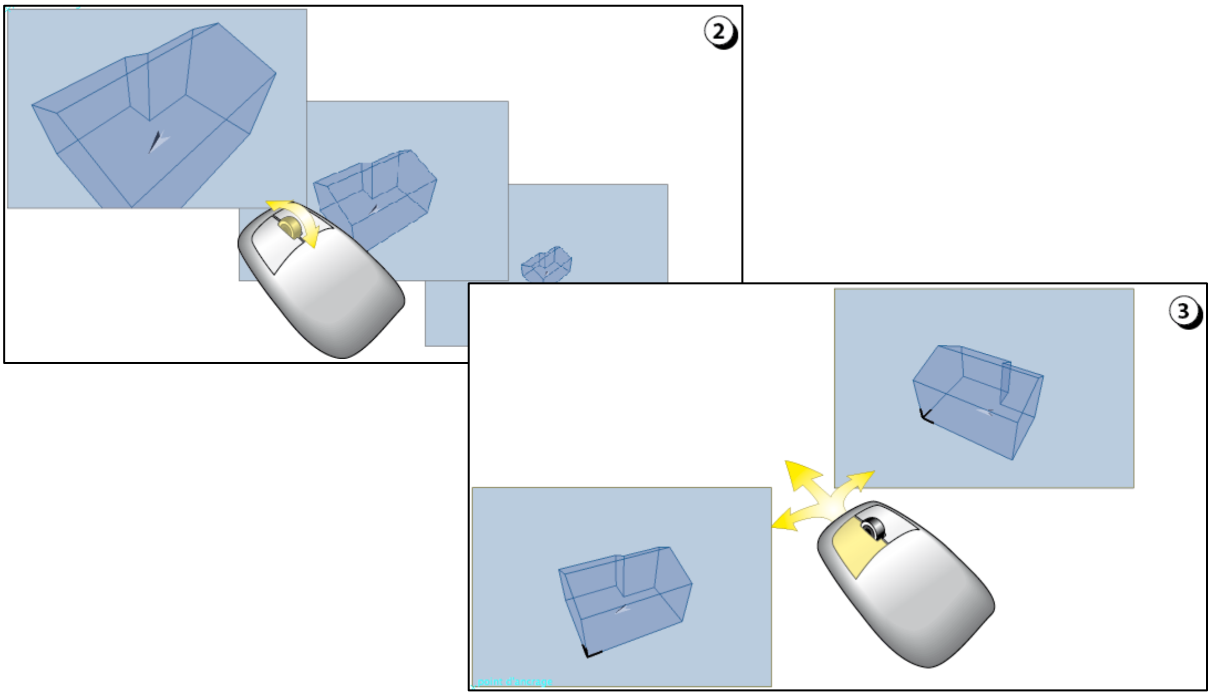
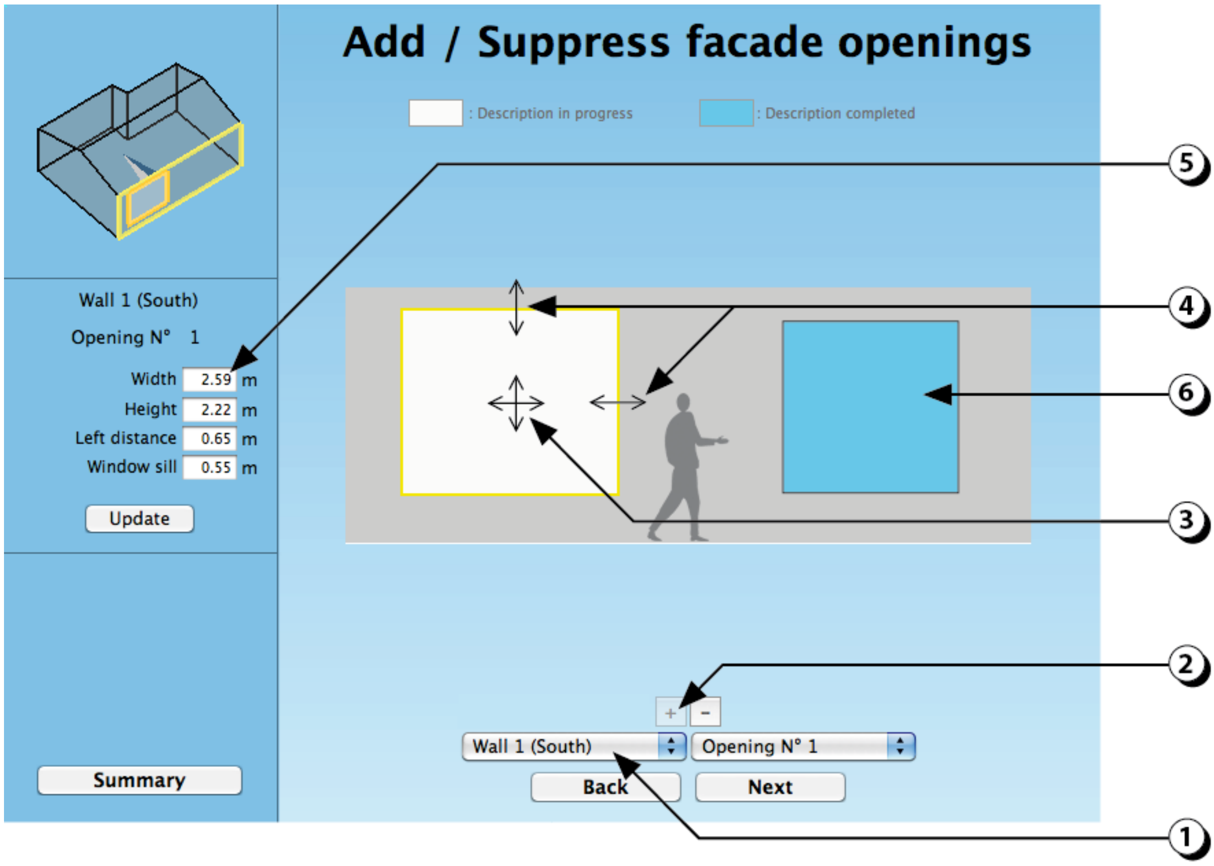


Figure 30: How to use the mouse to modify the 3D display of the room.

Add an opening / Adjust the dimensions

1. Select the façade in which you would like to create a new opening.
1. (the corresponding façade is outlined in yellow in the 3D display located on the upper-left corner of the screen).
2. Click on the "+" button to add 1 opening.
3. Use the mouse to move the opening (distance from the bottom and from the left side of the wall). To move the opening along horizontal or vertical path, press "Shift" (or use the keyboard).
4. Use the mouse to change the dimensions of the opening (height & width).
5. You might also enter a value in the corresponding field.
6. When all the parameters of an opening have been defined (see next pages), the filling colour of this opening is blue.


Add / Suppress facade openings

Wall 1 (South)

Opening N° 1

Width 2.59 m

Height 2.22 m

Left distance 0.65 m

Window sill 0.55 m

Figure 31: Description of the opening geometry (dimension & position).

CAUTION:

- The opening is viewed from outside of the room !
- By default, the dimensions of the window include the frames area.
- The number of openings is not limited, but this parameters influences the simulation time.

Duplicate / Suppress an existing opening

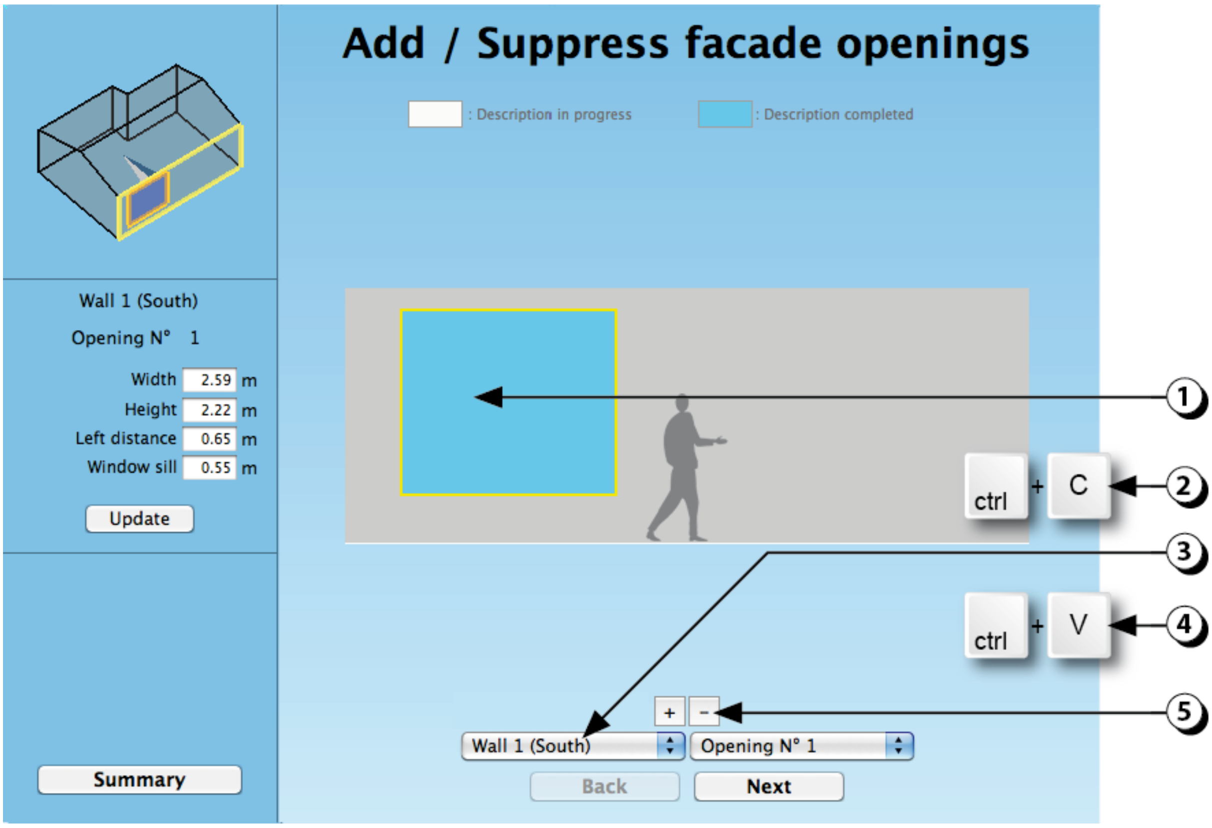
Once the opening has been completely described, it is possible to duplicate it.

1. Select the opening you would like to duplicate (mouse click).
2. Type ctrl+c (cmd+c for Mac users) to copy the opening.
3. **TIPS & TRICKS**: if you want to paste the opening on another façade, use this button to change the destination facade before pasting.
4. Type ctrl+v (cmd+v for Mac users) to paste the opening.

   A second opening is created with the same dimensions (if the 2 openings overlap, they are displayed in red colour).

   You can modify the position of the duplicated opening with your mouse.

   By default, all the characteristics of the new opening are similar to the ones of the initial opening (dimensions, reveal, wall thickness, frame area, glazing type, opening mode, shading devices).
5. Click here to delete an existing opening (you must have first selected it).



Add / Suppress facade openings

Wall 1 (South)

Opening N° 1

Width 2.59 m

Height 2.22 m

Left distance 0.65 m

Window sill 0.55 m

Figure 32: Duplicate / Suppress an existing opening.

Walls thickness

The thickness of the walls and the relative position of the window have a sensible influence on the luminous and energetic flows crossing the opening.

Walls thickness

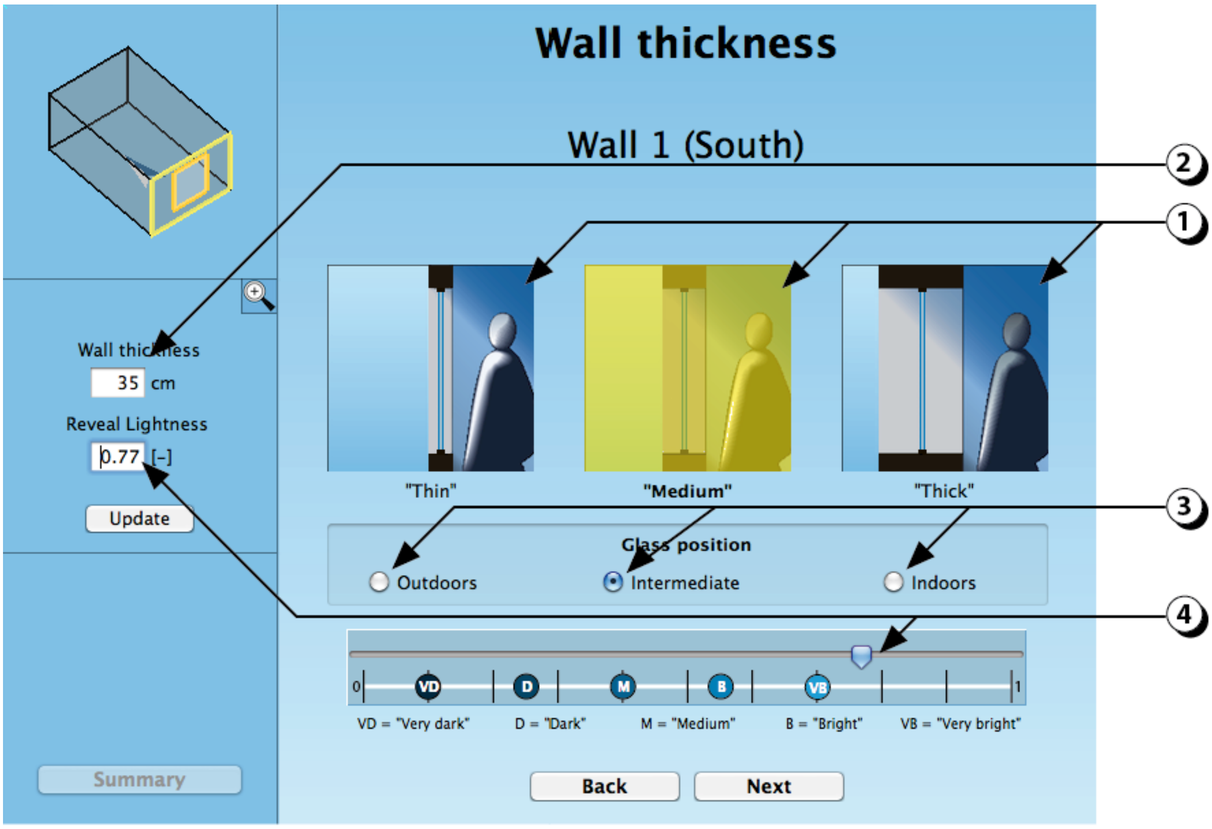
Regarding daylighting, the 4 faces of the reveal are absorbing a portion of the incident light as a function of their thickness and their colour. The same window will transmit less light if it is inserted in a thick wall than if it is inserted in a thin wall.

Glazing position

The influence of the glazing position (outdoor, centre, indoor) is not really relevant regarding the transmitted light flow.

However, regarding thermal issues, the position of the window has a great influence on the direct solar gains. If the glazing is located on the inside plan of the wall, it will be partly protected from the sun, thanks to the wall thickness.

1. Select the wall thickness (your selection is highlighted in yellow).
2. You can also enter a precise value in the corresponding field (Don't forget to validate by clicking on the "Update" button).
3. Select the opening position within the wall.
4. Adjust the reveal lightness.



Wall thickness

Wall 1 (South)

Wall thickness 35 cm

Reveal Lightness 0.77 [-]

Glass position: ○ Outdoors ● Intermediate ○ Indoors

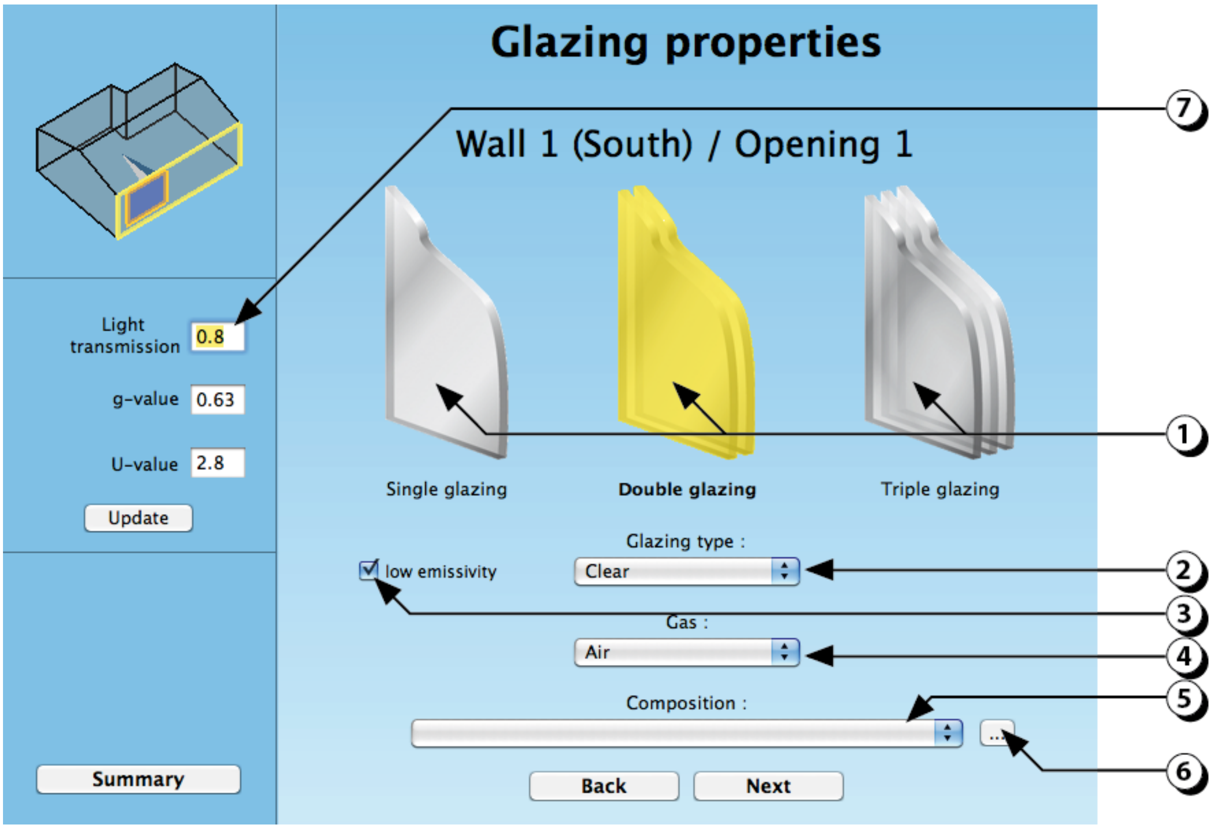
Figure 33: Selection of the wall thickness and the position of the opening.

Glazing selection

1. Select the number of glazings.
2. Select the glazing type (“Reflecting”, “Tinted”, “Clear” or “Diffusing” or “Electrochromic”).

   For Electrochromic glazings (electronically tintable glazings) please see details on next page.
3. If you have chosen double or triple glazing, indicate if it is low emissivity coated.
4. If you have chosen a double or triple glazing, indicate the filling gaz.
5. Click on this button to display a selection of existing products.
6. Click here to display the glazing database (you can also add new glazing in the database).
7. You can also enter a precise value in the corresponding field.

CAUTION: Don’t forget to validate by clicking on the “Update” button.



Glazing properties

Wall 1 (South) / Opening 1

Light transmission 0.8

g-value 0.63

U-value 2.8

☑ low emissivity

Glazing type : Clear

Gas : Air

Composition :

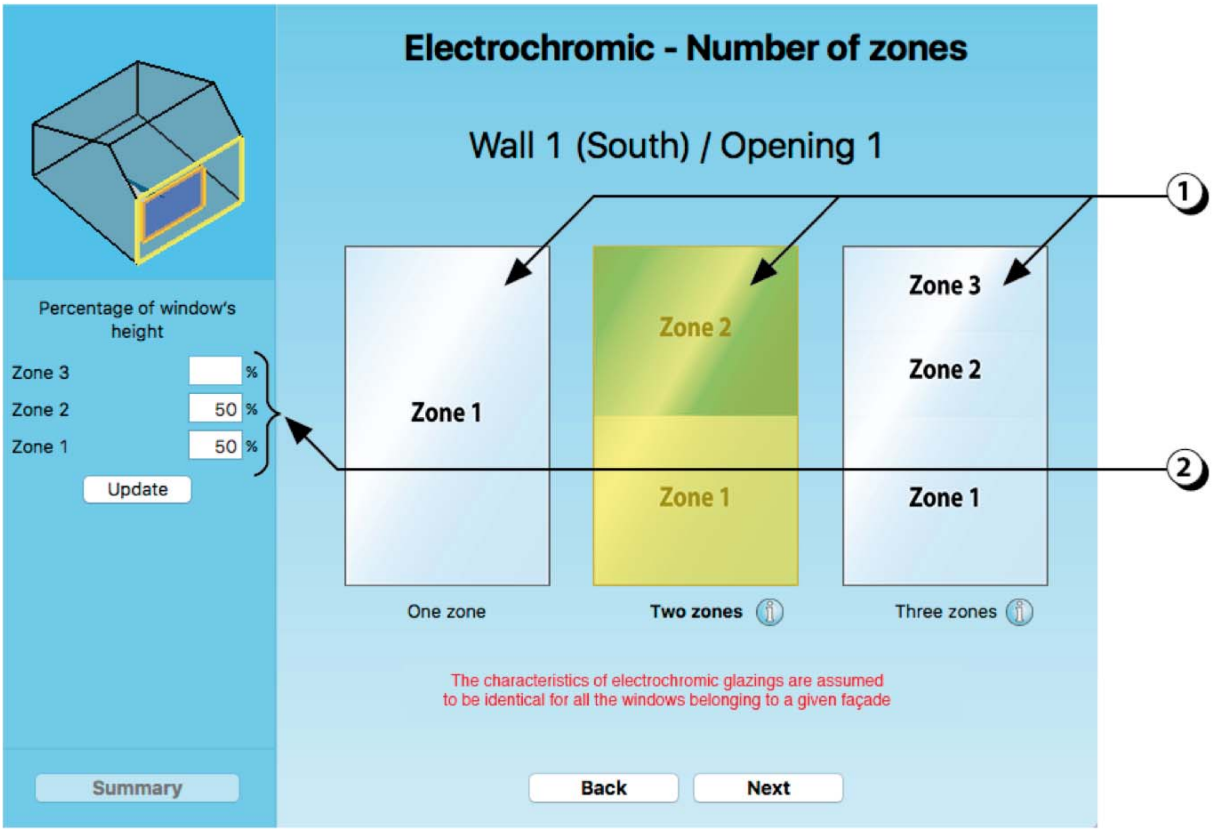
Figure 34: Glazing selection.

Electrochromic glazings (EC)
In-pane zoning characteristics

Electronically tintable glazings also known as electrochromic (EC) glazings are part of the options to be considered in the design of dynamic shading device. Some of the products avalibale on the market may have up to 3 zones of control within the same glass pane. This means that the different parts of a given window can darken or lighten independently .

1. Selecte the number of control zones.
2. Indicate (in percentage) the proportion of each control zone (make sure that the sum of the values is equal to 100%).

CAUTION: The characteristics of electrochromic glazings are assumed to be identical for all the windows belonging to a given façade.



Electrochromic - Number of zones

Wall 1 (South) / Opening 1

Percentage of window's height

Zone 3 %

Zone 2 50 %

Zone 1 50 %

The characteristics of electrochromic glazings are assumed to be identical for all the windows belonging to a given façade

Figure 35: Electronically tintable glazings: selection of the number of control zones.

Electrochromic glazings (EC)
Characteristics of the different status of the glass

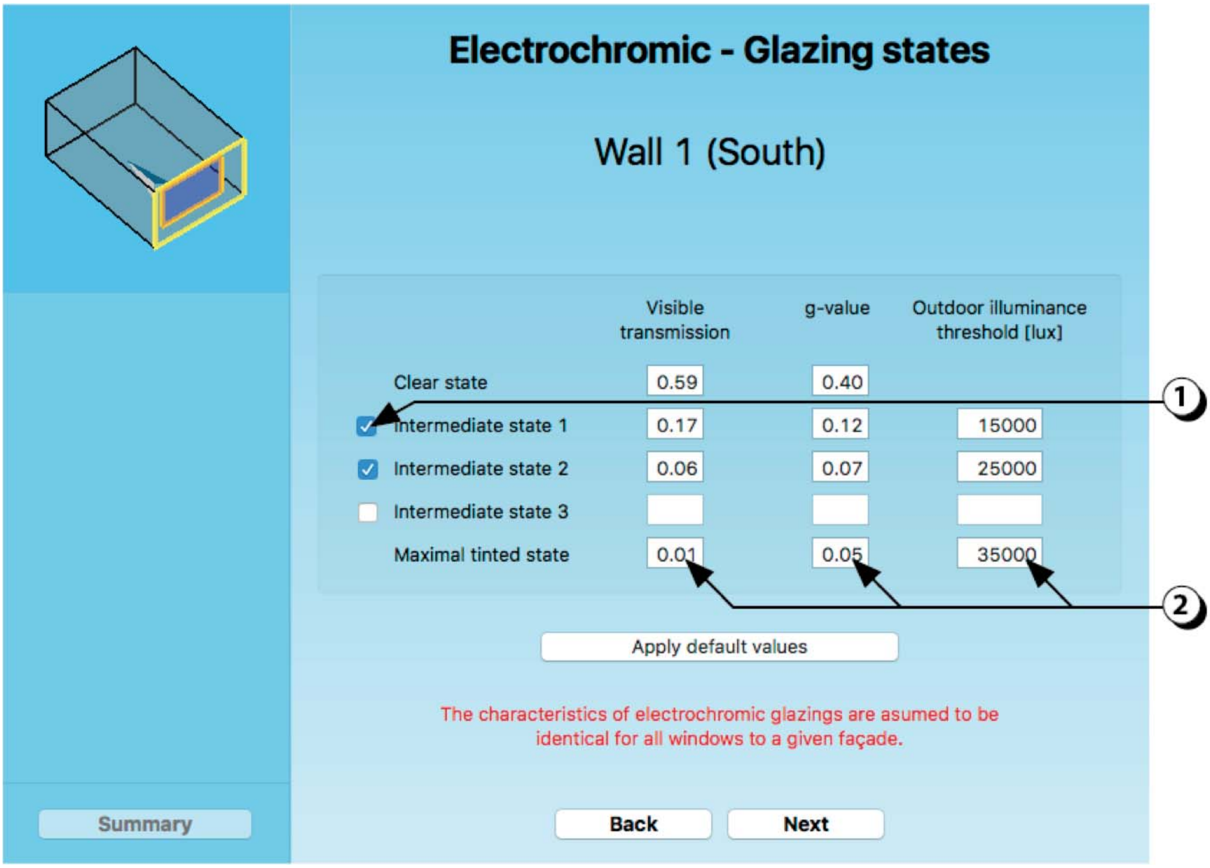
The status of the electronically tintable glazings (visible and transmission and solar factor) can be controlled as a function of the incident radiation (or illuminance) on the façade (external sensor). Manufacturers offer up to 5 different hue levels.

1. Click on the tick to activate or desactivate an intermediate status.
2. Use your keyboard if you want to enter sepcific values.

   For each of the status, please indicate :

   - The visible transmission,
   - The solar coefficient (gvalue),
   - The outdoor illuminance threshold (the illumination value which determines the transition from one status to another).

CAUTION: If you modify the glazing parameters, please make sure that visible transmission and g values are consistent.



Electrochromic - Glazing states

Wall 1 (South)

	Visible transmission	g-value	Outdoor illuminance threshold [lux]
Clear state	0.59	0.40	
☑ Intermediate state 1	0.17	0.12	15000
☑ Intermediate state 2	0.06	0.07	25000
☐ Intermediate state 3			
Maximal tinted state	0.01	0.05	35000

The characteristics of electrochromic glazings are asumed to be identical for all windows to a given façade.

Figure 36: Electronically tintable glazing: description of the different states of the glass and the threshold linked to the transition between one state to the other.

Frame properties

1. Select the appropriate frame area. Your selection is highlighted in yellow and the percentage of the frame area is adjusted in **field (a)**.

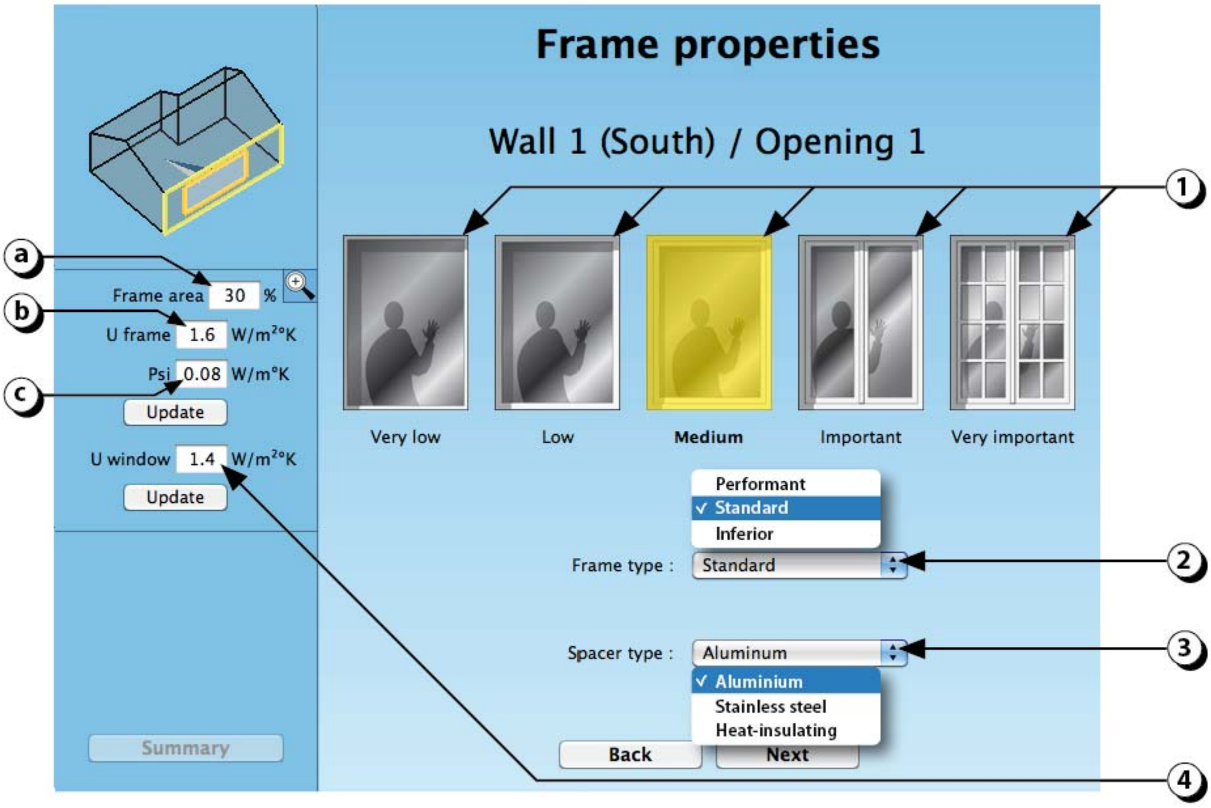
   CAUTION: The frame area is linked to the window dimensions (see Figure 44 for more information).

2. Select the type of frame (the frame U-value is adjusted in **field (b)**).
3. Select the spacer type (the psi value is adjusted in **field (c)**).
4. All these parameters, in combination with the glazing U-value (see **page 40**) give a global U-value of the window.

You can also enter precise values in fields **(a)**, **(b)**, **(c)** and **(4).**

CAUTION: Don’t forget to validate by clicking on the “Update” button.

If you use your keyboard to enter a numerical value in field (4), values of fields **(b)**, **(c)** will no more be considered.



Frame properties

Wall 1 (South) / Opening 1

Frame area 30 %

U frame 1.6 W/m²°K

Psi 0.08 W/m°K

U window 1.4 W/m²°K

Frame type : Standard

Spacer type : Aluminum

Figure 37: Selection of the frame properties.

Frame area: examples

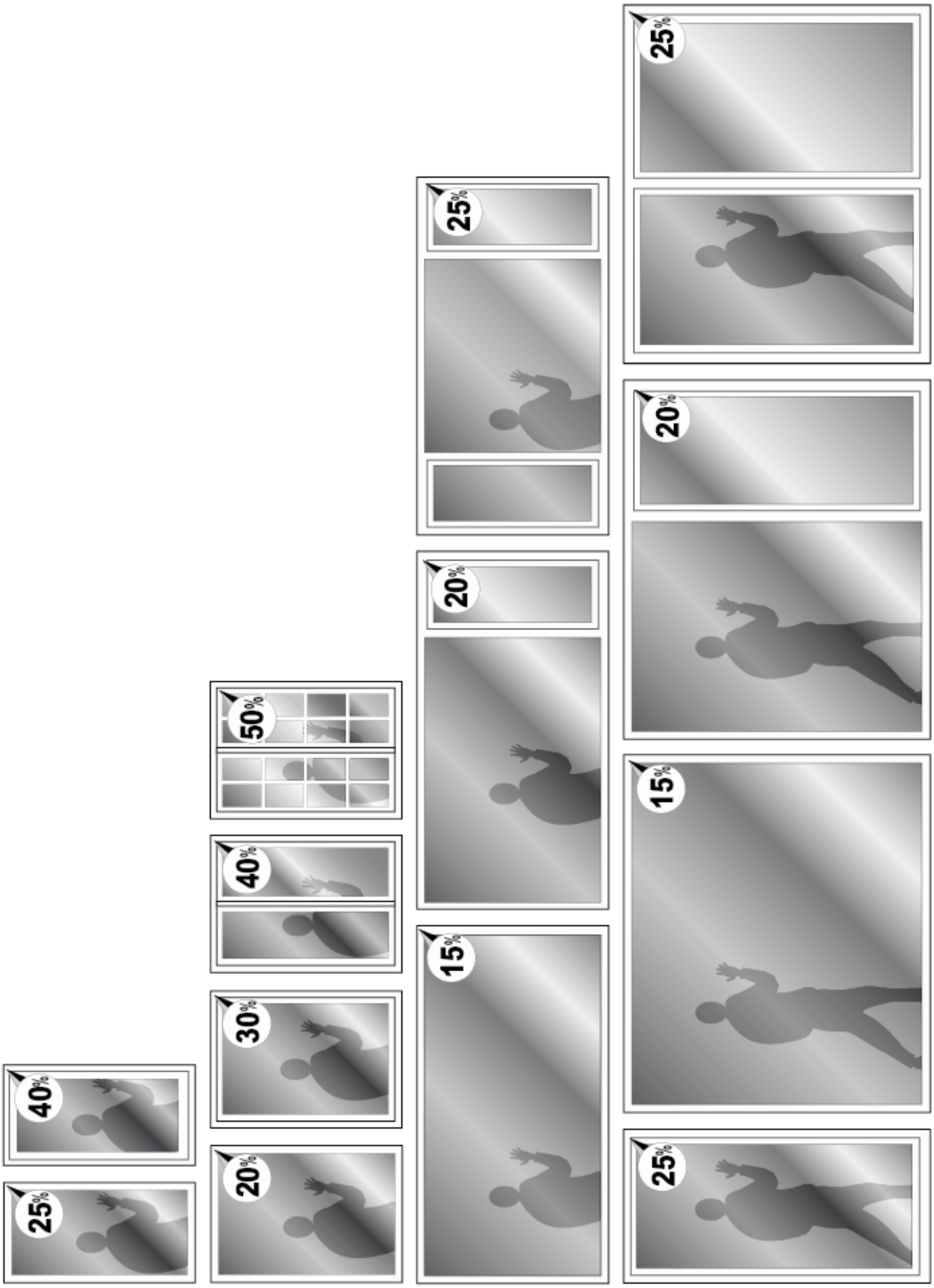


Figure 38: Frame area (%) as a function of the opening type and dimensions.

Opening mode

The potential for natural ventilation (air change and passive cooling) is directly linked to the **percentage of the window(s)** (surface) that can be opened.

1. Select the opening mode of the window you are describing (« Fixed », « Fan light », « Swinging », « Sliding» or «Slide hung» (Your selection is highlighted in yellow).
2. This value corresponds to the percentage of the window surface that can be used for natural ventilation (you may also enter a value with your keyboard).
   - 100% means that the whole surface of the window can be used for air transfer (“Slide hung windows”).
   - 50% means that half of the window surface can be used for air transfer (“Sliding windows”).
   - For swinging windows or fanlight, please see page 113 to determine the percentage of opening.

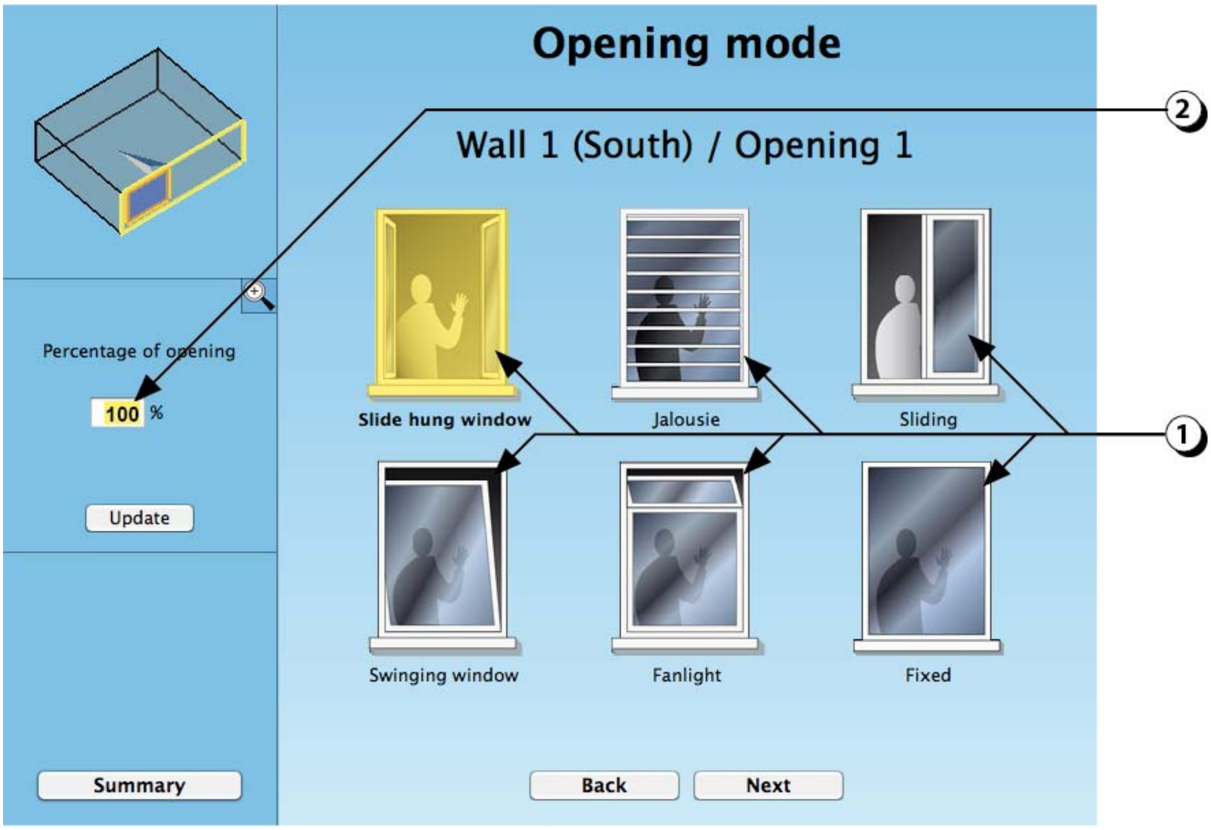


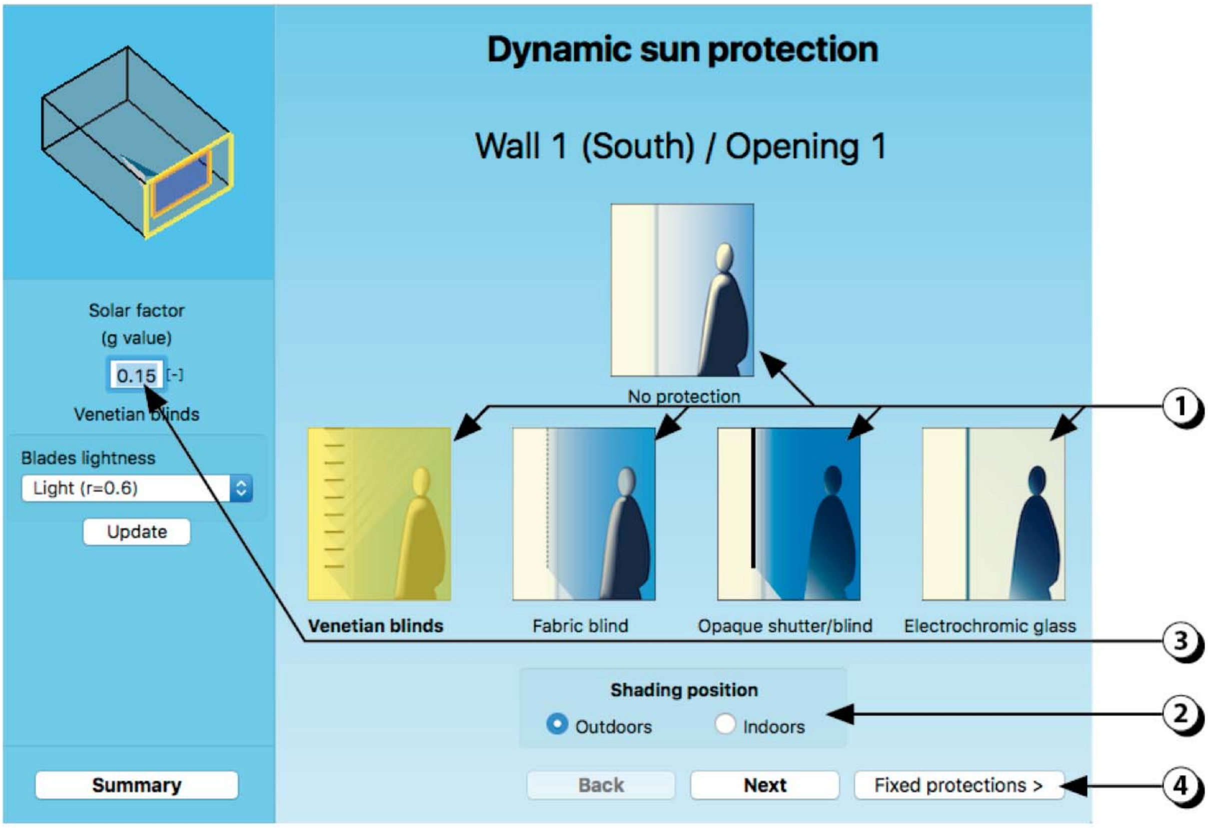
Figure 39: Selection of the opening mode of the window (for natural ventilation purposes).

Dynamic solar protection

Movable blinds are not taken into account for the daylighting calculation as far as daylight factor values correspond to overcast sky conditions (thus the movable blinds are supposed to be removed from the window).

1. Select the type of movable blinds.
2. Select the blinds position (outdoor or indoor).
3. If you know precisely the g-value of the blinds, use your keyboard to enter it in this field.

   PRECISION: For thermal analysis, the incident flux transmitted through the window takes into account both g-values of glazing and shading devices.
4. If the opening is also equipped with permanent shading devices (overhang, fins, vertical or horizontals slats), click this button to proceed to the description of theses elements.



Dynamic sun protection

Wall 1 (South) / Opening 1

Solar factor (g value) 0.15 [-]

Venetian blinds

Blades lightness: Light (r=0.6)

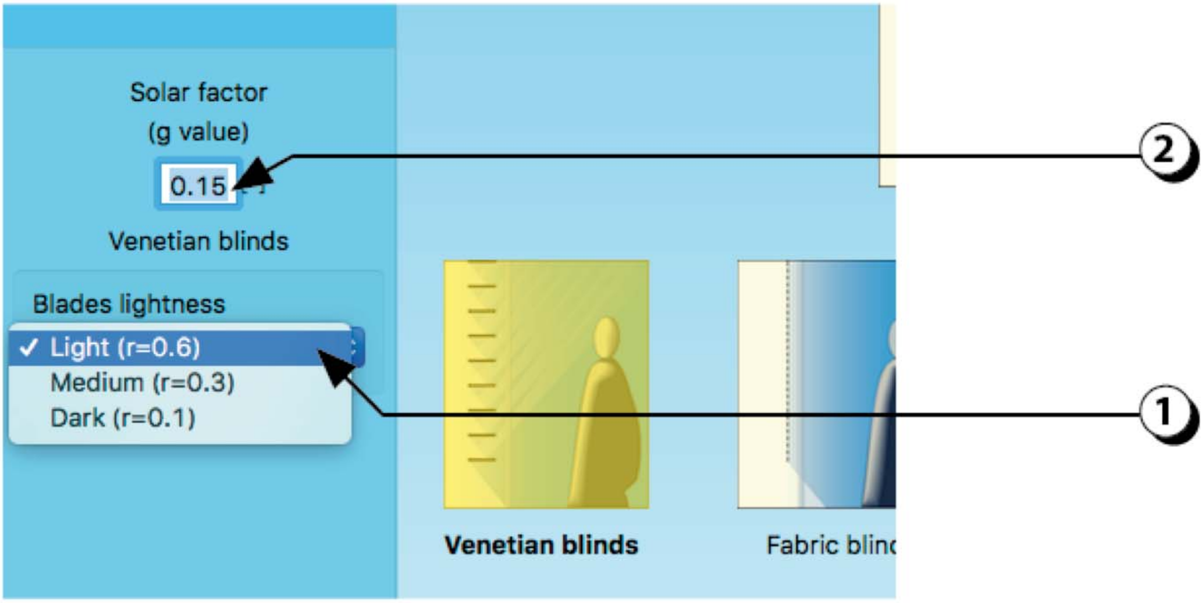
Shading position: ● Outdoors ○ Indoors

Figure 40: Selection of the movable blinds type and position.

Dynamic solar protection: Venetian blinds

If you have selected venetian blinds, you must indicate the brightness of the lamellas as described below.

1. Select the blinds lightness.
2. If neessary, adjust the g value accoring to the manufacturer value.



Solar factor (g value)

0.15

Venetian blinds

Blades lightness

✓ Light (r=0.6)
Medium (r=0.3)
Dark (r=0.1)

Figure 41: Selection of the blinds lightness.

When running a dynamic simulation, for each hour, DIAL+ will select the most appropriate blinds position among the four possibilities described hereafter, in order to block the sun rays.

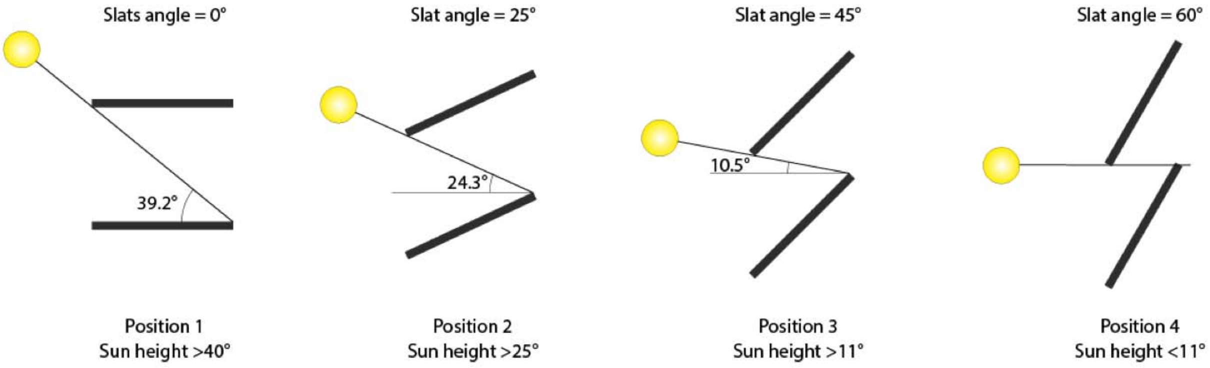
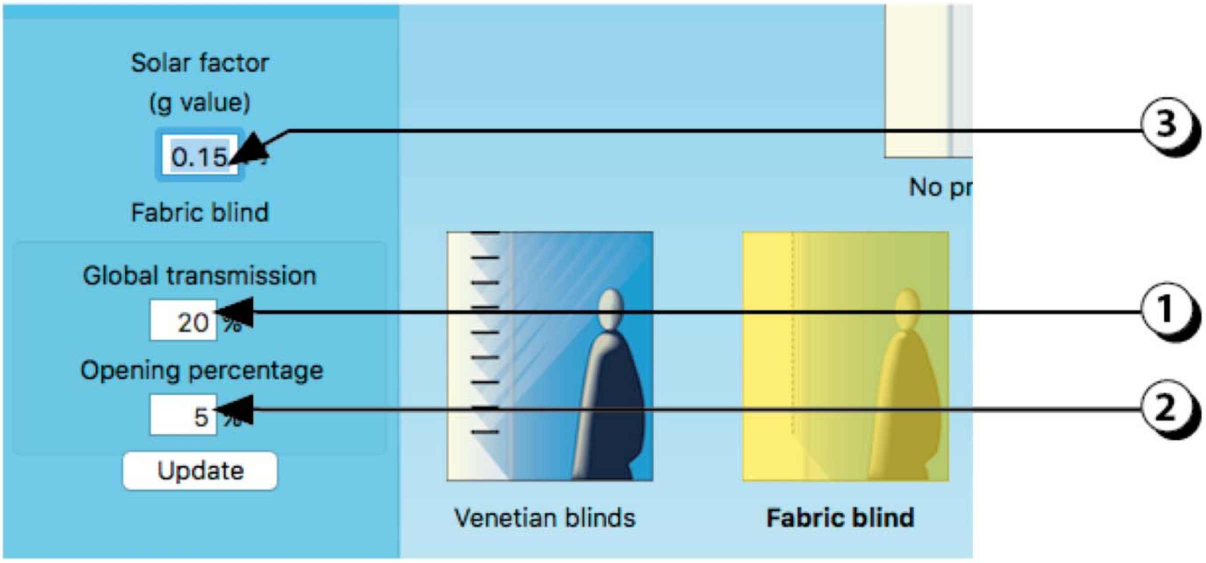


Figure 42: Schematic description of the 4 slat inclination according to the sun altitude.

Dynamic solar protection: Fabric blinds

If you have selected fabric blinds, you must indicate the characteristics of the fabric.

1. Indicate the global transmission coefficient of the fabric
   This value (between 0 and 1) is sometimes noted Tv or Tvnh by the manufacturers. It corresponds to the global percentage of visible radiation (380-780 nm) that goes threw the fabric (global transmission).
2. Indicate the percentage of transparenc of the fabric.
   This value corresponds to the openness factor (OF), i.e. the relative vacuum surface of the woven fabric (holes). The higher this value, the better the visual connection with the outdoor environment (in contrasts, the glare risk is also higher).
3. Adjust the g coefficient of the blinds according to the manufacturers specifications.



Solar factor (g value)

0.15

Fabric blind

Global transmission

20 %

Opening percentage

5 %

Figure 43: Selection of the brightness and the transparency of the fabric blinds.

When running a dynamic simulation (hourly step), these parameters will be used to calculate the daylight contribution and the solar gains according to the sun presence (Sun: blinds down, No sun: blinds up).

Shading device control

The control of shading devices plays a crucial role in the thermal behaviour of the room.

To describe the shading device of each opening, please see pages 46-56.

1. When the occupants control shading device position (e.g. “Manual” with or without motorized blinds), the control is very uncertain and quite difficult to estimate.

   - If you choose “**100% opened**”, the simulation will show the maximum indoor temperature that could be reached in summer (worst case).

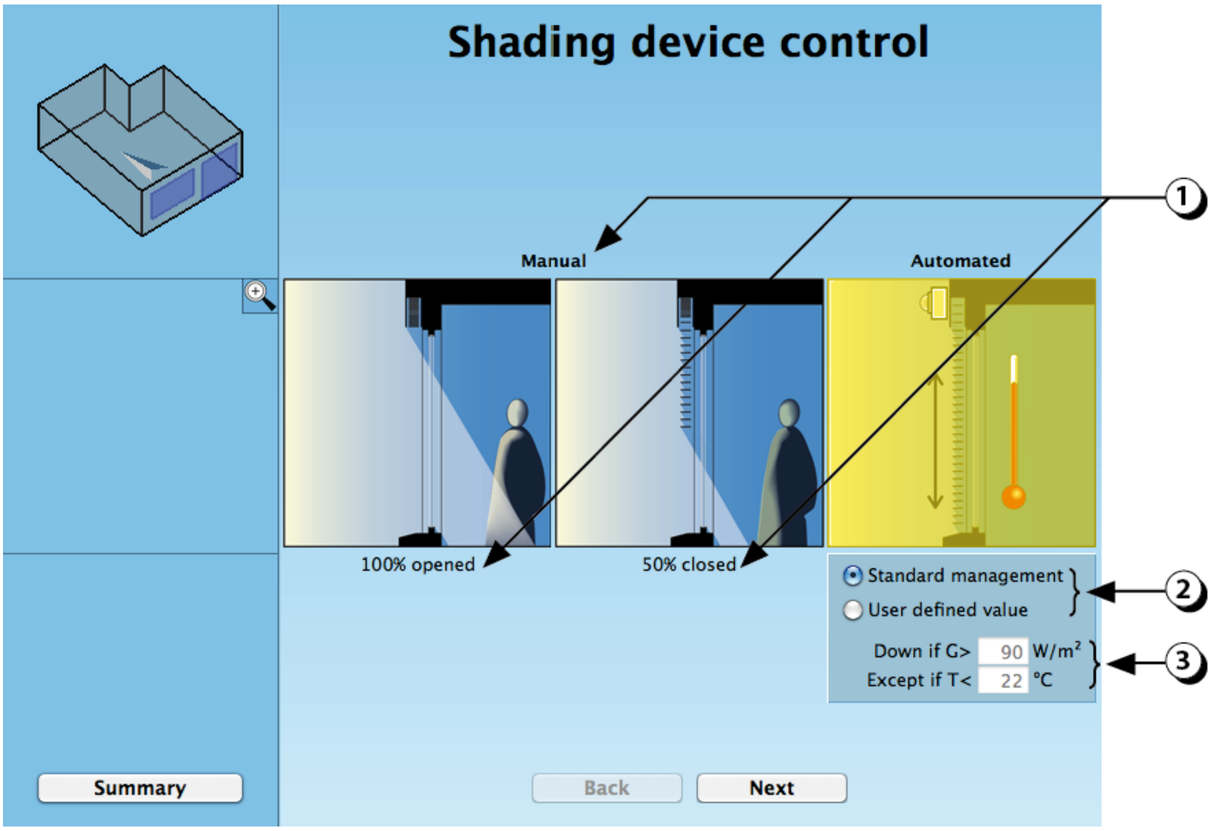
   - If you choose “**50% opened**”, the simulation will represent an intermediate situation taking into account 50% of the potential solar gains (summer and winter).

2. An **automated** control system leads to optimize solar gains in winter, to reduce overheating risk in summer and to minimize the needs of artificial lighting.

3. With the “Standard” mode, shading devices are assumed to be down as soon as the transmitted irradiance is over 90 W/m^2 (and indoor temperature > 22°C).

   - If you choose “User defined values”, you can define the limit values for irradiance and indoor temperature.

CAUTION: The shading device control will be applied to all the openings.



● Standard management
○ User defined value
Down if G> 90 W/m^2
Except if T< 22 °C

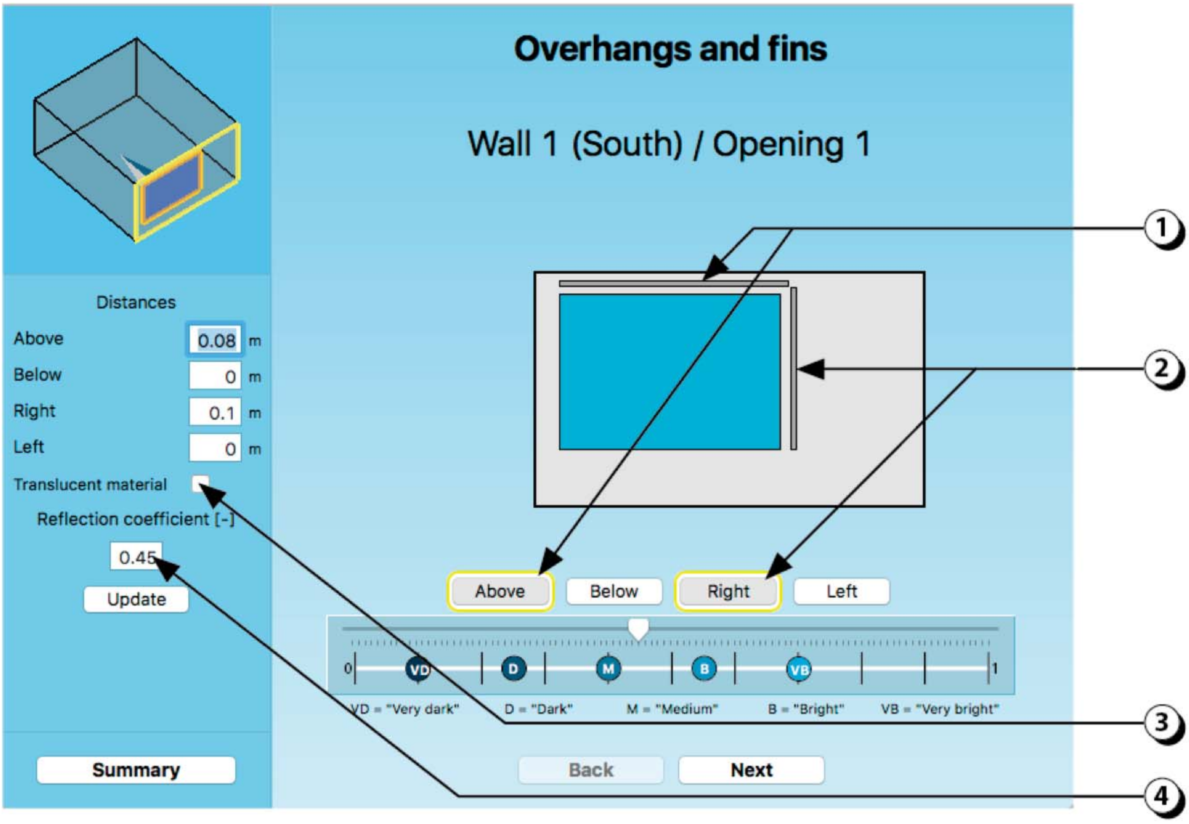
Figure 44: Selection of the shading device control strategy.

Overhangs and Fins: Creation

This screen allows you to indicate whether your room is fitted with outdoor fixed elements located above, below or aside the opening.

CAUTION: This screen deals with elements that are linked to the vertical facade (vertical or horizontal slats that are located apart from the vertical façade can be described later in the In the “Fixed slat(s)” section).

1. Select the overhang(s) and/or fin(s) with the corresponding buttons.
2. You can create overhangs on each side of the opening.
3. If you would like to use translucent material for the fins, click this checkmark. And follow the instructions on next page (description of the detailed photometry).
4. If the fins material is opaque, then adjust the reflexion coeficient (one unique value is applied for all the fins/overhang).



Overhangs and fins

Wall 1 (South) / Opening 1

Distances

Above 0.08 m

Below 0 m

Right 0.1 m

Left 0 m

Translucent material ☐

Reflection coefficient [-] 0.45

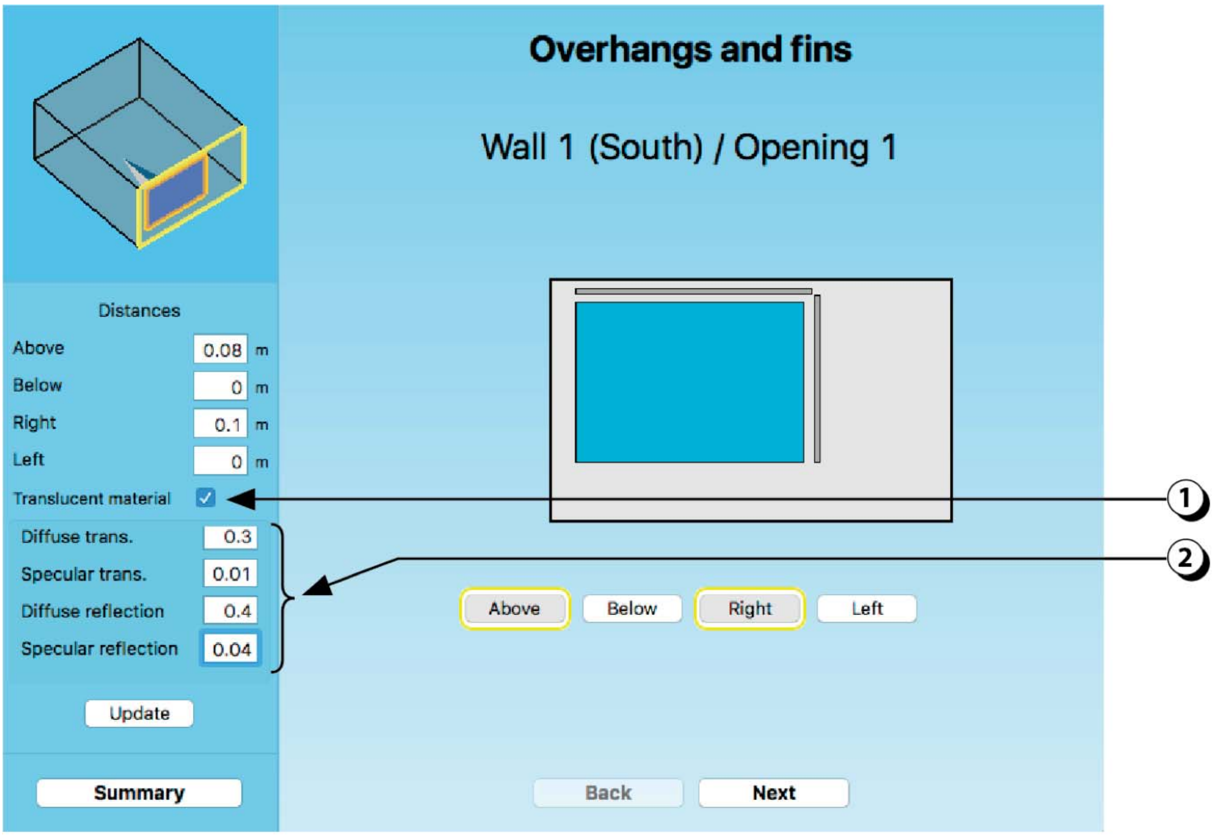
Figure 45: Selection of the overhang(s) and/or fin(s).

Overhangs and Fins: Translucent material

1. Tick the “Translucent material” checkmark.
2. Enter the transmission and reflection coefficient of the overhang / fin material (values somewehre between 0 and 1).
    - Diffuse trans.: Percentage of light which is transmitted in a scatter way (diffusion).
    - Specular trans.: Percentage of light which is transmittted without deviation (transparency).
    - Diffuse reflection: Percentage of light which is reflected in a difuse way (mat surface).
    - Specular reflection: Percentage of light which is reflected following the rule of Descartes (mirror).

CAUTION: The addition of the four values should not exceed 1.

The percentage of light that is absorbed by the overhang/fins corresponds to the gap between 1 and the addition of the 4 values (in the example presented here, the addition of the values is 0.75 (0.3 + 0.01 + 0.4 + 0.04), which means that 25% of the incident light is absorbed).



Overhangs and fins

Wall 1 (South) / Opening 1

Distances

Above	0.08	m
Below	0	m
Right	0.1	m
Left	0	m

Translucent material ☑

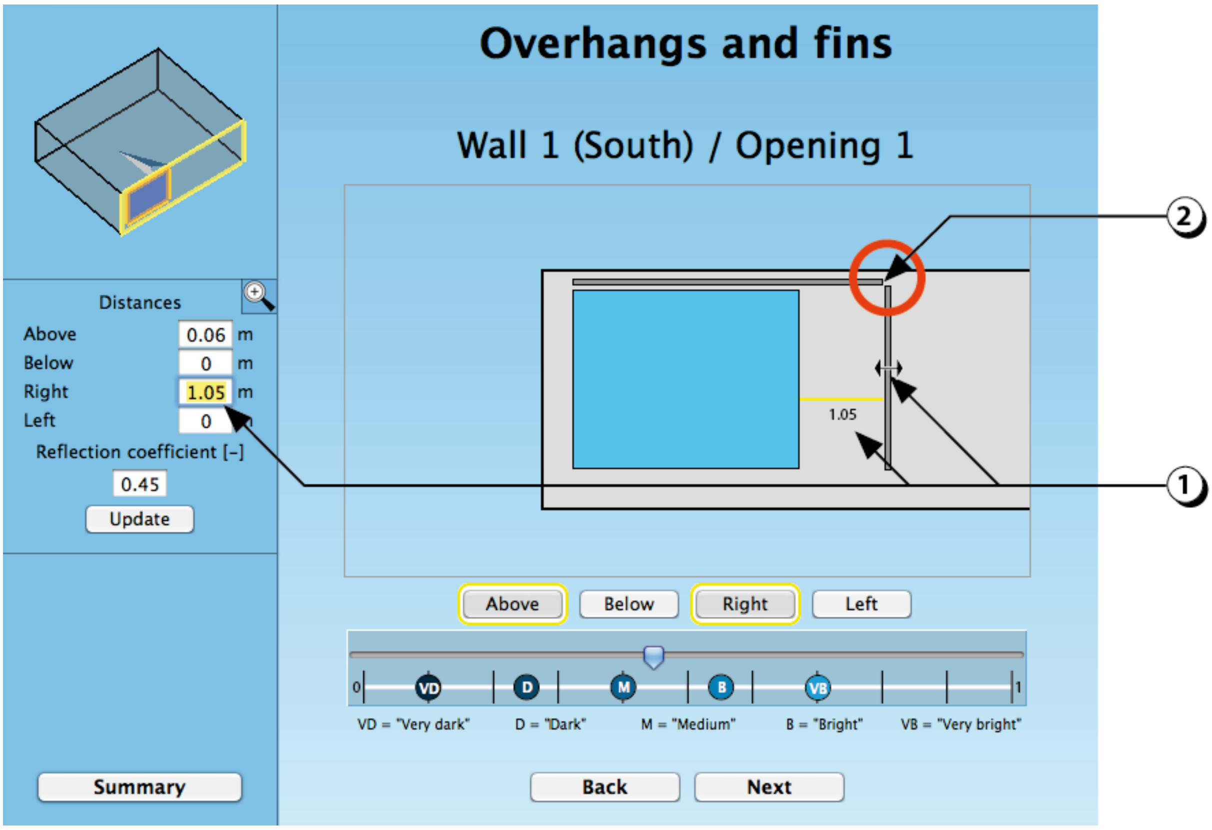
Diffuse trans.	0.3
Specular trans.	0.01
Diffuse reflection	0.4
Specular reflection	0.04

Figure 46: Description of photometric parameters of translucent overhang of fins.

Overhangs and Fins: Positioning

You can define precisely the dimensions of overhangs and fins.

1. An arrow appears when you click on one of the elements you have created. The distance between the element and the opening adapts itself when you move the element.
2. If you create to elements that are adjacent, they will be necessarily contiguous and joined.



Overhangs and fins

Wall 1 (South) / Opening 1

Distances

Above 0.06 m

Below 0 m

Right 1.05 m

Left 0 m

Reflection coefficient [–] 0.45

Figure 47: Selection of the overhang(s) and/or fin(s).

CAUTION: For thermal calculations, overhangs and fins have to be described for each opening.

Overhangs dimension and position (in section)

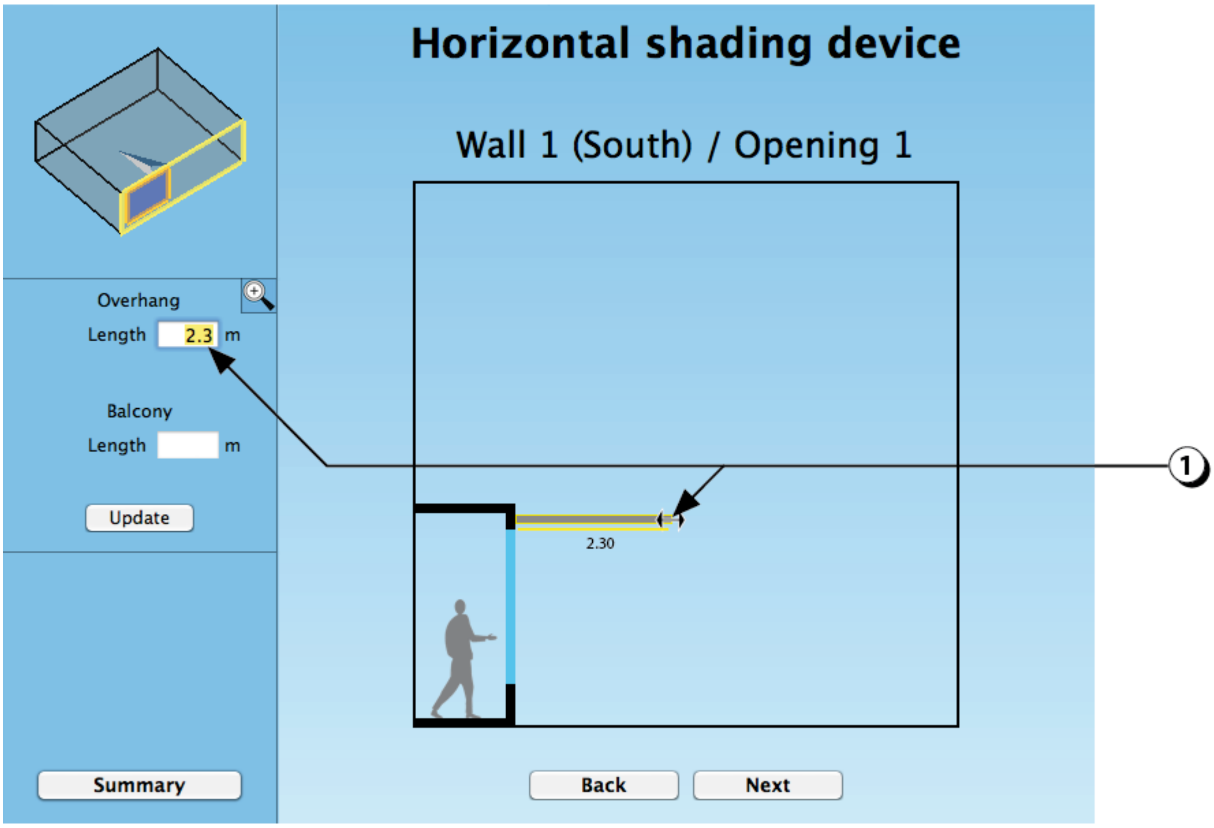
1. If you place the cursor on the extremity of the overhang, a double arrow will appear. Use it you modify the length of the element.

   You can also enter a precise value in the corresponding field.

The “Length” field corresponds to the horizontal distance between the façade and the external point of the overhang.

A similar procedure may be applied for the description of balcony or fin(s).

CAUTION: For Thermal simulations, overhangs and fins have to be described for each opening (even if you chose “applied to the wall width”).



Overhang Length 2.3 m

Balcony Length m

Figure 48: Description of an overhang.

Overhangs dimension and position (in plan)

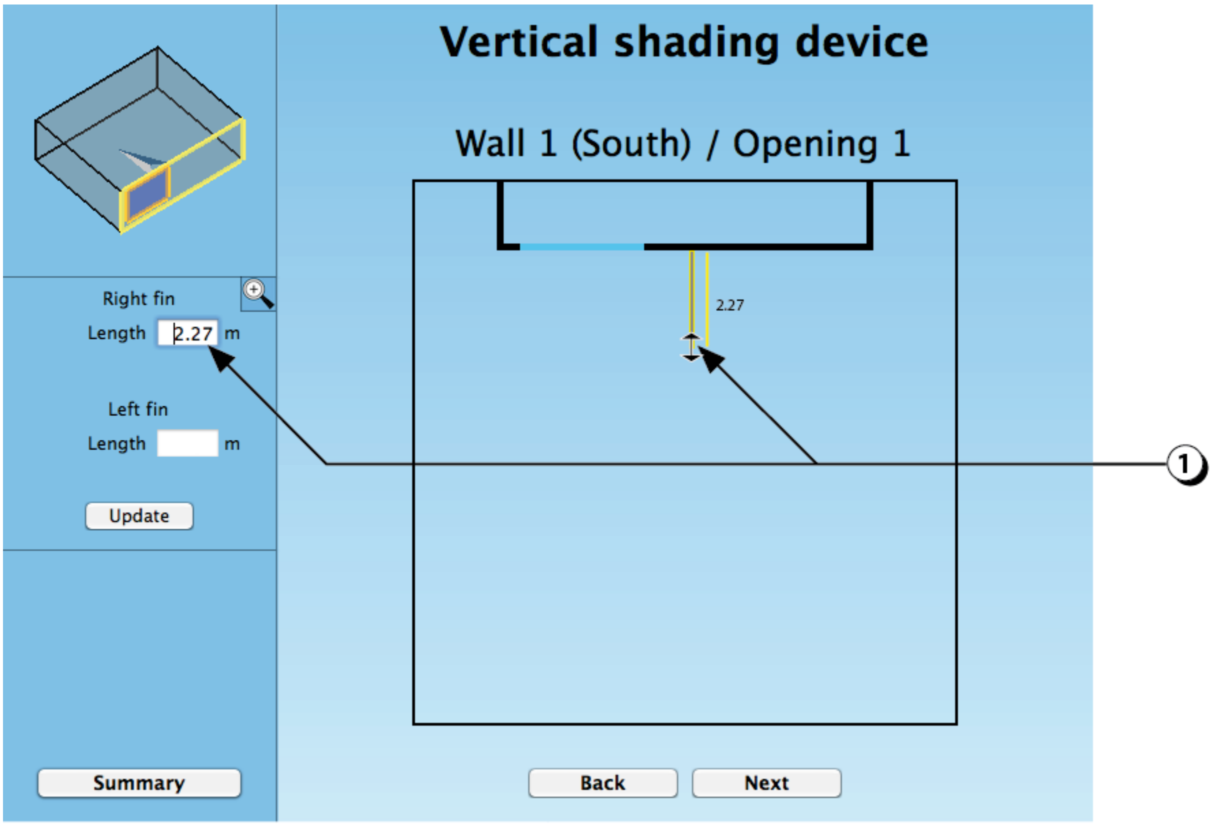
1. If you place the cursor on the extremity of the overhang, a double arrow will appear. Use it you modify the length of the element.

   You can also enter a precise value in the corresponding field.

The “Length” field corresponds to the horizontal distance between the façade and the external point of the fin.

A similar procedure may be applied for the description of overhangs and balconies.

CAUTION: For Thermal simulations, overhangs and fins have to be described for each opening (even if you chose “applied to the wall width”).



Right fin

Length 2.27 m

Left fin

Length m

Figure 49: Description of the overhang width.

Fixed Slat(s)

If the openings are fitted with external blinds (one or several elements).

1. Select the corresponding blinds type.

PRECISION: In this version of the software, beams passing between the wall and the slats (on the edges of the window) are not taken into account in the thermal calculation.

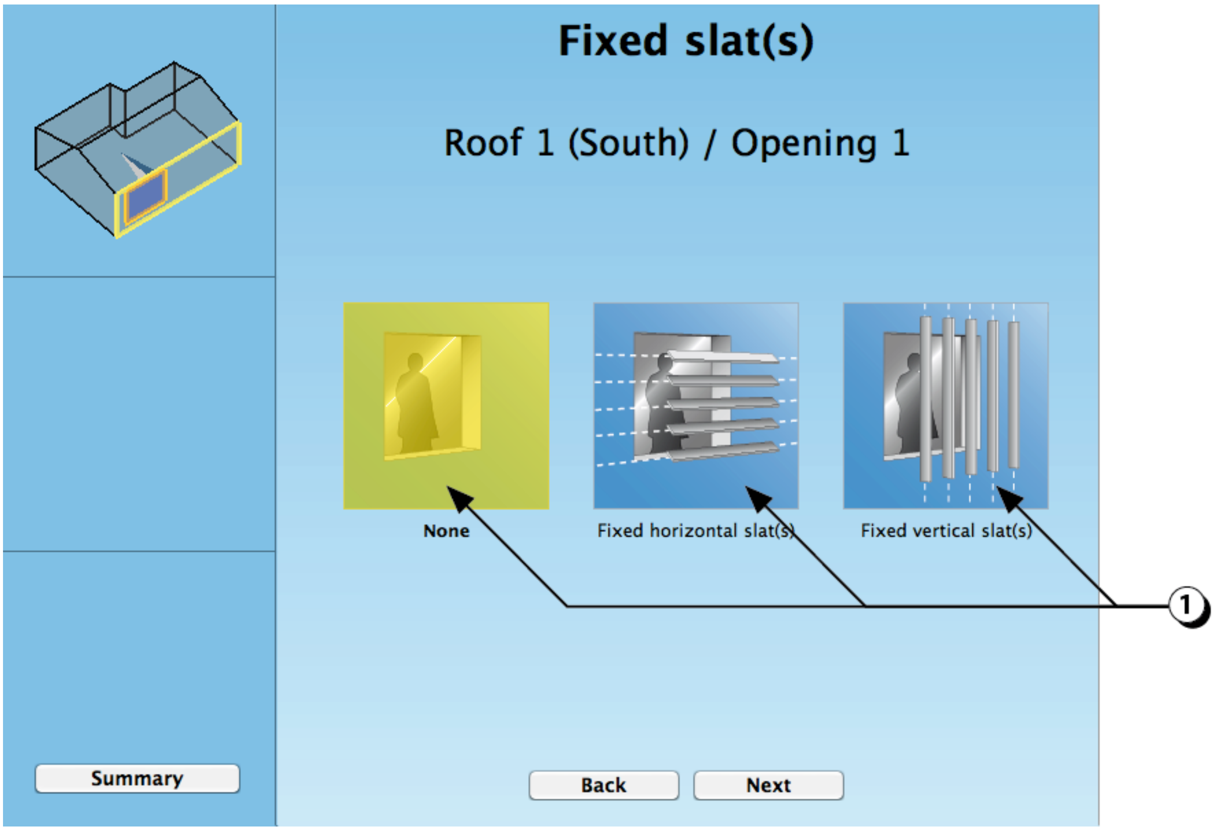
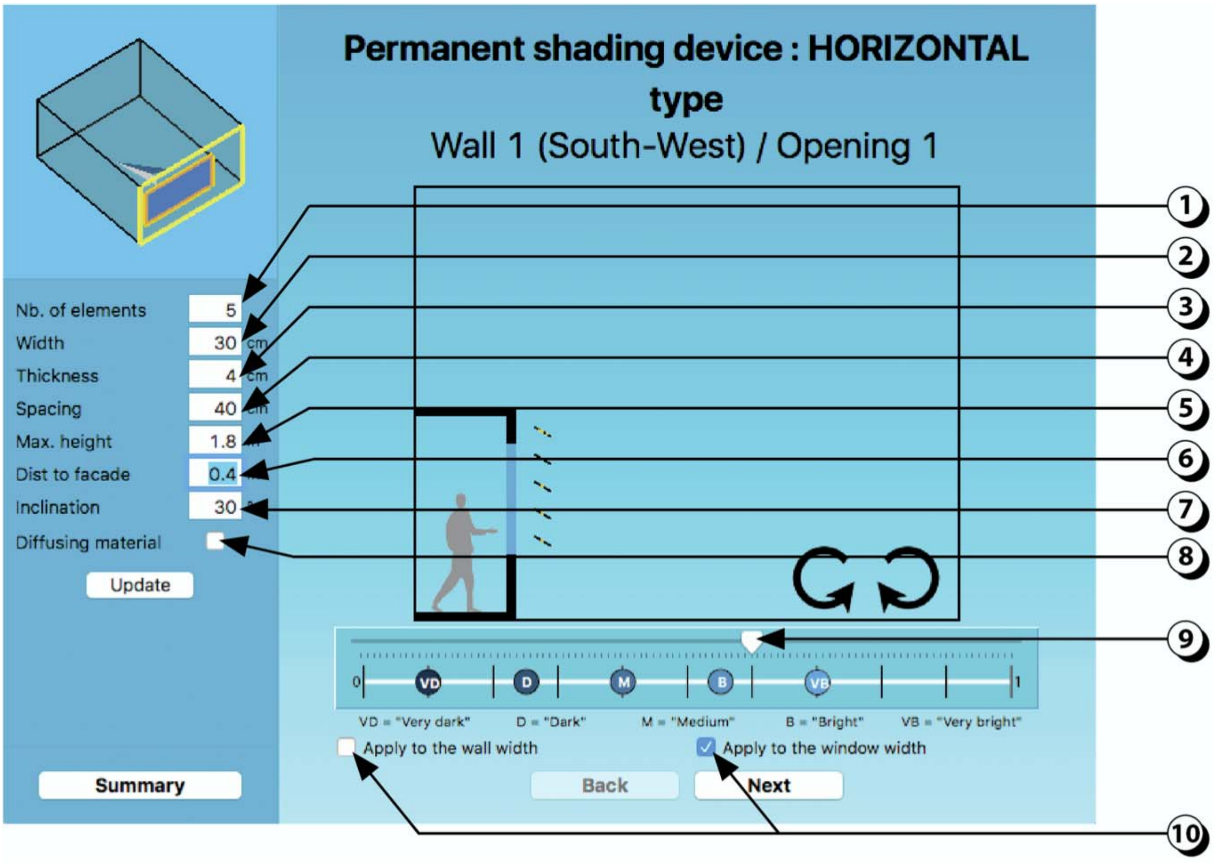


Figure 50: Selection of an external blind system located in front of the window.

CAUTION: For Thermal simulations, fixed slats have to be described for each opening.

Fixes slat(s): Detailed description

1. Indicate the number of slat(s).
2. Indicate the width of the slat(s).
3. Indicate the thickness of the slat(s).
4. Indicate the vertical spacing between the slats.
5. Indicate the height of the axis of the upper slat (= dist. from the window bottom).
6. Indicate the distance between the façade and the slat(s).
7. Indicate the tilt angle of the slat(s).
8. If the slats are translucent click this button (see next page for more details).
9. Indicate the slat(s) lightness.
10. Click on this button if the slat(s) cover the entire wall (otherwise, the slats will only cover the opening you are describing).



Permanent shading device : HORIZONTAL type

Wall 1 (South-West) / Opening 1

Nb. of elements 5
Width 30 cm
Thickness 4 cm
Spacing 40 cm
Max. height 1.8 m
Dist to facade 0.4
Inclination 30 °
Diffusing material ☐

VD = "Very dark" D = "Dark" M = "Medium" B = "Bright" VB = "Very bright"

☐ Apply to the wall width
☑ Apply to the window width

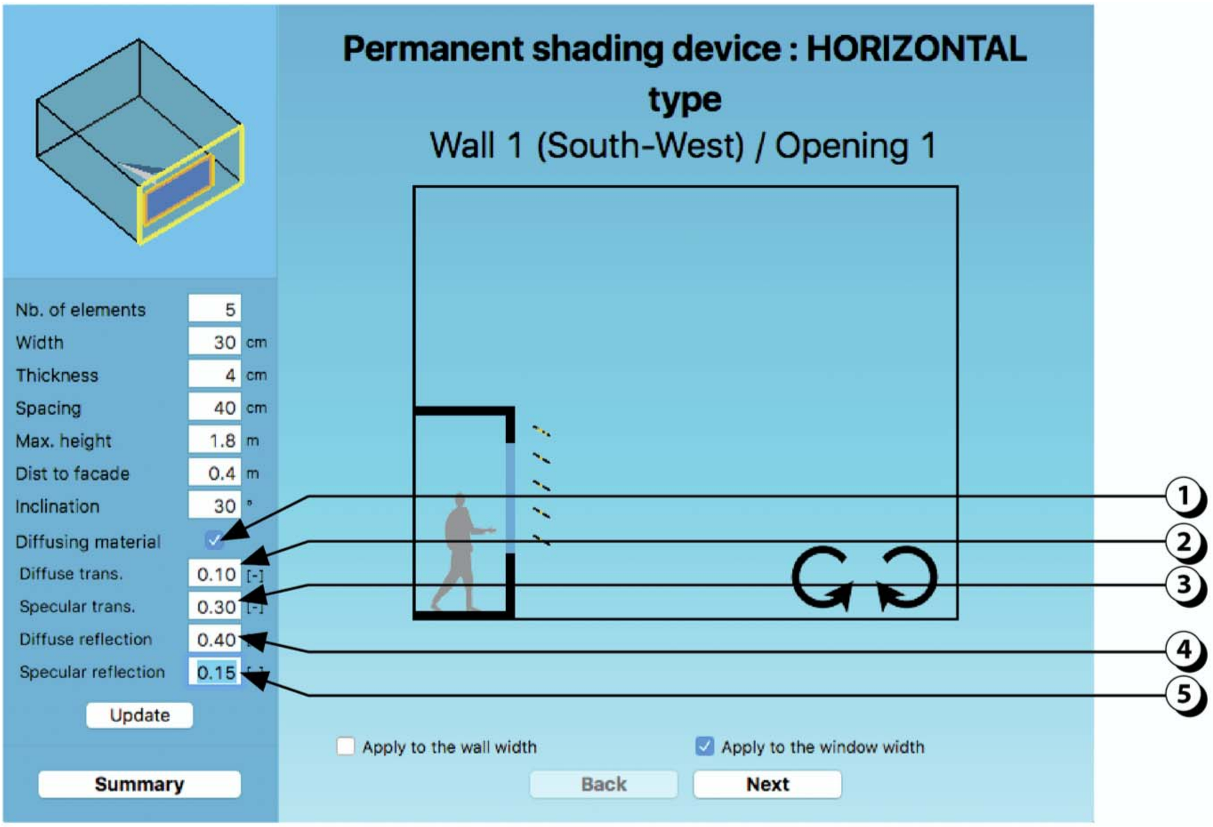
Figure 51: Description of a blind system composed with several slats located in front of the opening.

CAUTION: For Thermal simulations, fixed slats have to be described for each opening.

Fixes slat(s): Translucent material

1. Click this button if you want to describe transparent or translucent slats.
2. Indicate the percentage of light that is transmitted in a diffuse way (scattered).
3. Indicate the percentage of light that is transmitted in a specular way (light beams not deflected).
4. Indicate the percentage of light that is reflected in a diffuse way (scattered).
5. Indicate the percentage of light that is reflected in a specular way (mirror effect).

CAUTION**:** The addition of the four components should be lower than 1 (the difference between the total and 1 represents the share absorbed by the slats).



Permanent shading device : HORIZONTAL type

Wall 1 (South-West) / Opening 1

Nb. of elements 5

Width 30 cm

Thickness 4 cm

Spacing 40 cm

Max. height 1.8 m

Dist to facade 0.4 m

Inclination 30 °

Diffusing material ☑

Diffuse trans. 0.10 [-]

Specular trans. 0.30 [-]

Diffuse reflection 0.40 [-]

Specular reflection 0.15 [-]

☐ Apply to the wall width

☑ Apply to the window width

Figure 52: Description of transparent or translucent slats.

ROOF OPENINGS

Add a roof opening

1. Click this button to add a roof opening.

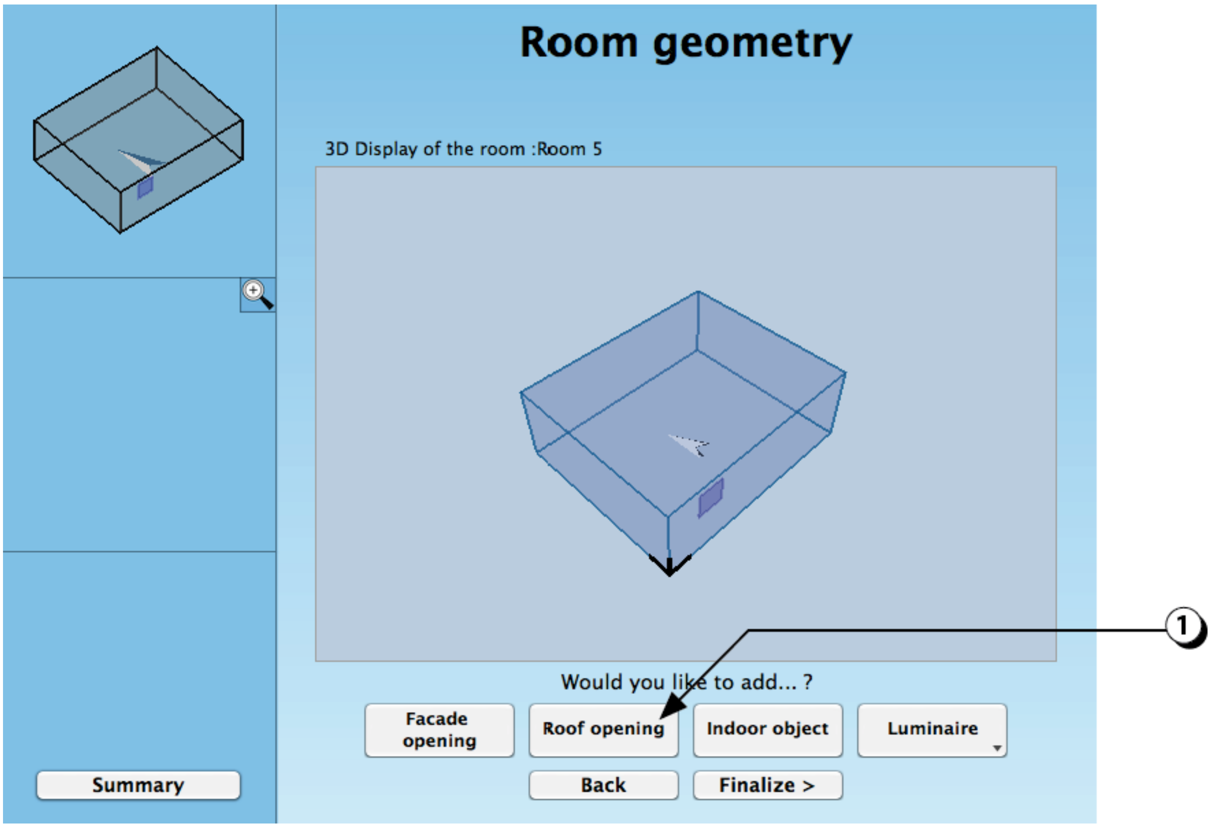


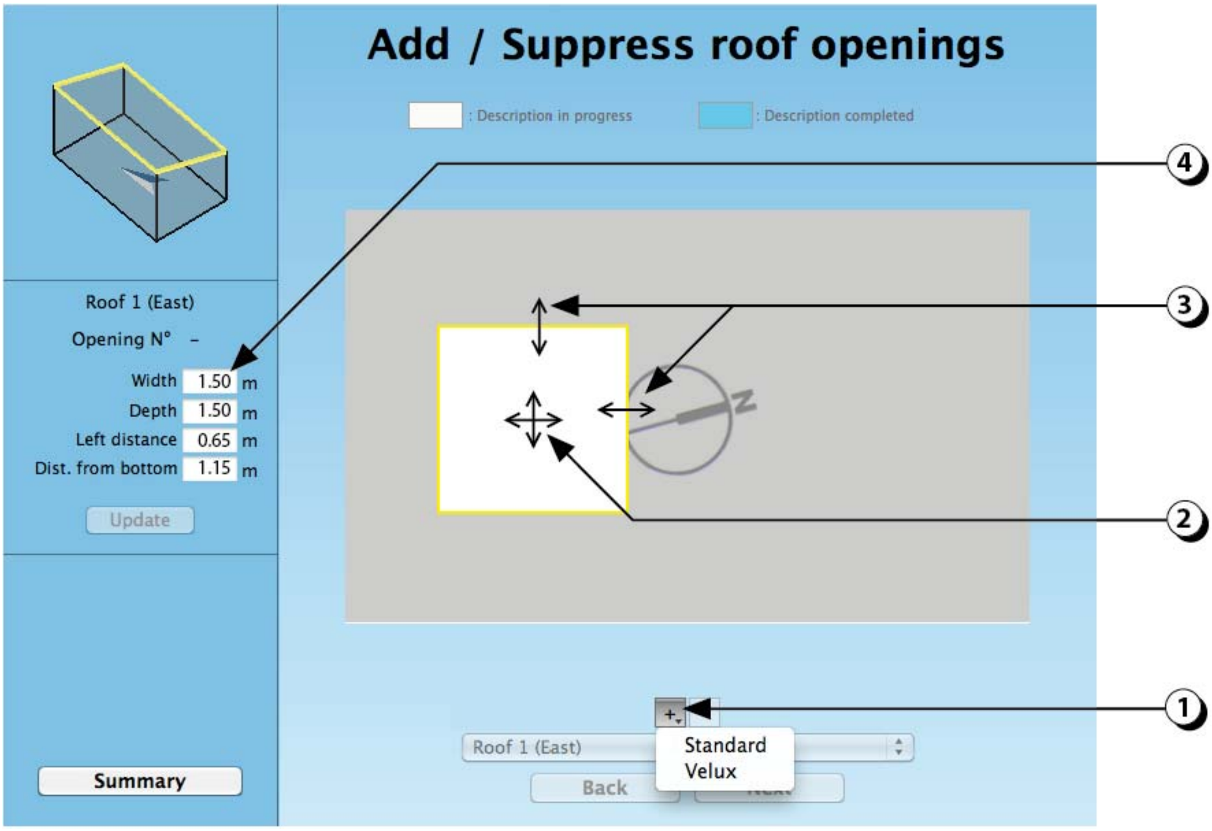
Figure 53: How to add a roof opening.

Dimensions of roof opening(s)

1. Click on the “+” button to create a new opening.

   It is possible to generate either a “standard opening” (e.g. with free dimensions) or to choose one of the “Velux” AS openings.

2. Once you created the opening, you can move it with your mouse.
3. You can change the dimensions by adjusting the edges of the opening.
4. The width and height of the opening are adjusted in the corresponding fields (you can also enter values with your keyboard).



Add / Suppress roof openings

Roof 1 (East)
Opening N° –
Width 1.50 m
Depth 1.50 m
Left distance 0.65 m
Dist. from bottom 1.15 m

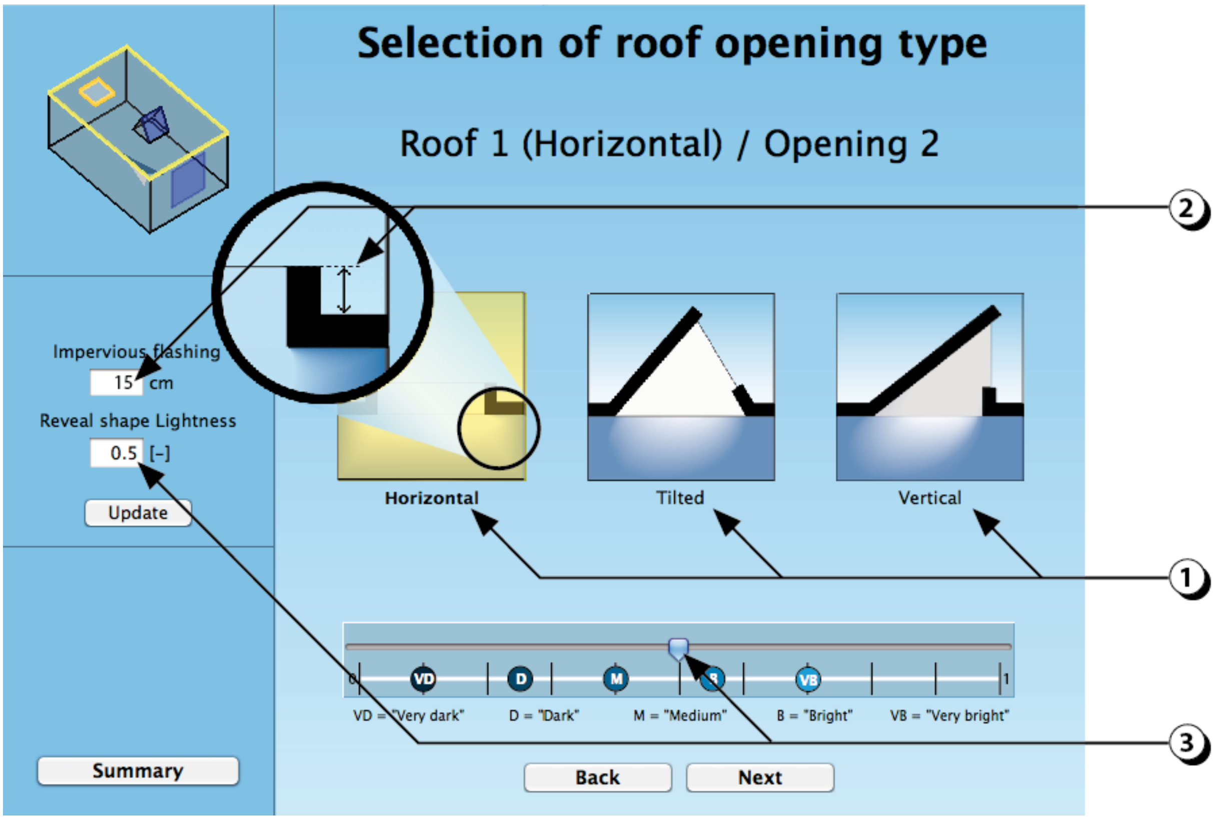
Figure 54: How to add a roof opening and modify its dimensions.

CAUTION:

- In this representation, the opening is seen from outside of the room.
- The surface you are describing corresponds to the hole in the roof.

Type of roof opening

1. Select the appropriate opening type (your selection is highlighted in yellow).
2. Adjust the height of the impervious (vertical distance between the upper layer of the roof and the bottom part of the opening).
3. Adjust the reveal lightness.



Selection of roof opening type

Roof 1 (Horizontal) / Opening 2

Impervious flashing 15 cm

Reveal shape Lightness 0.5 [-]

Figure 55: Selection of the type of roof opening.

Orientation of tilted or vertical openings

1. Indicate the orientation of the glazing by clicking the corresponding button (check if the orientation is correct with the 3D display).

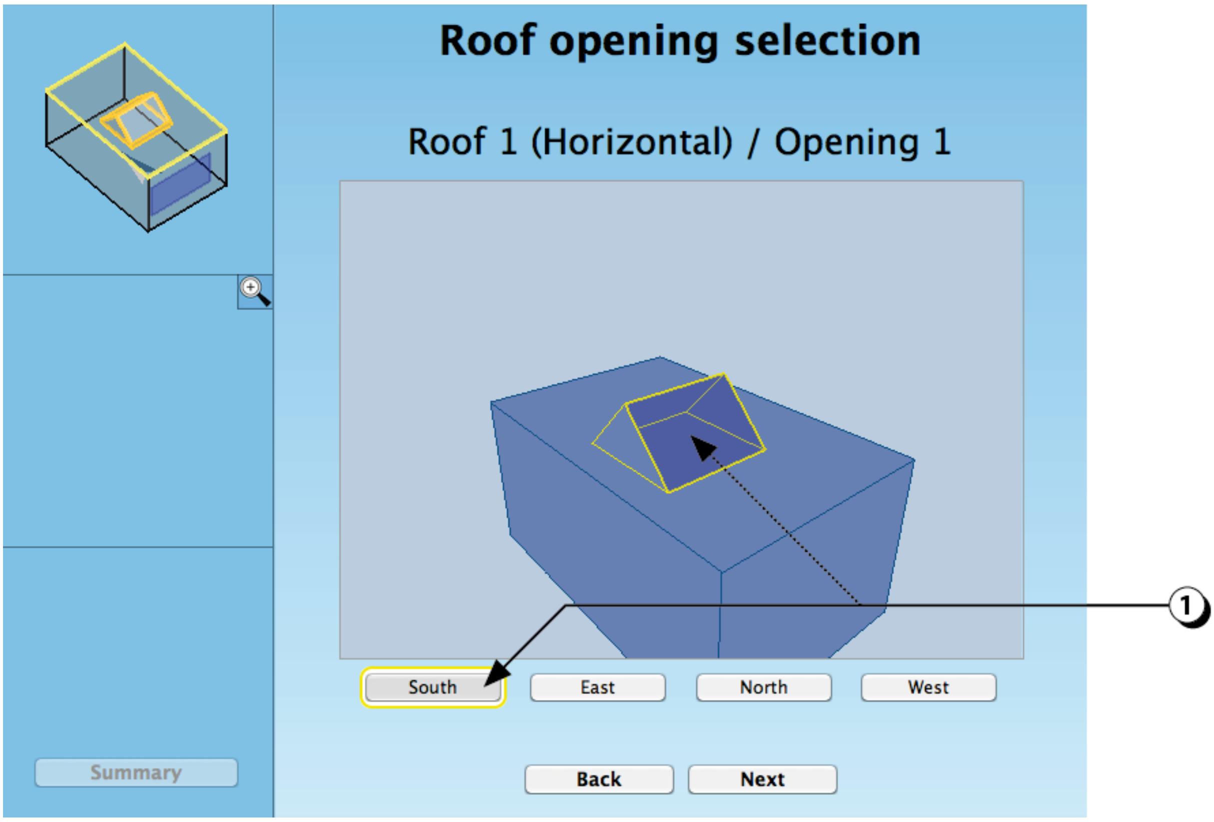
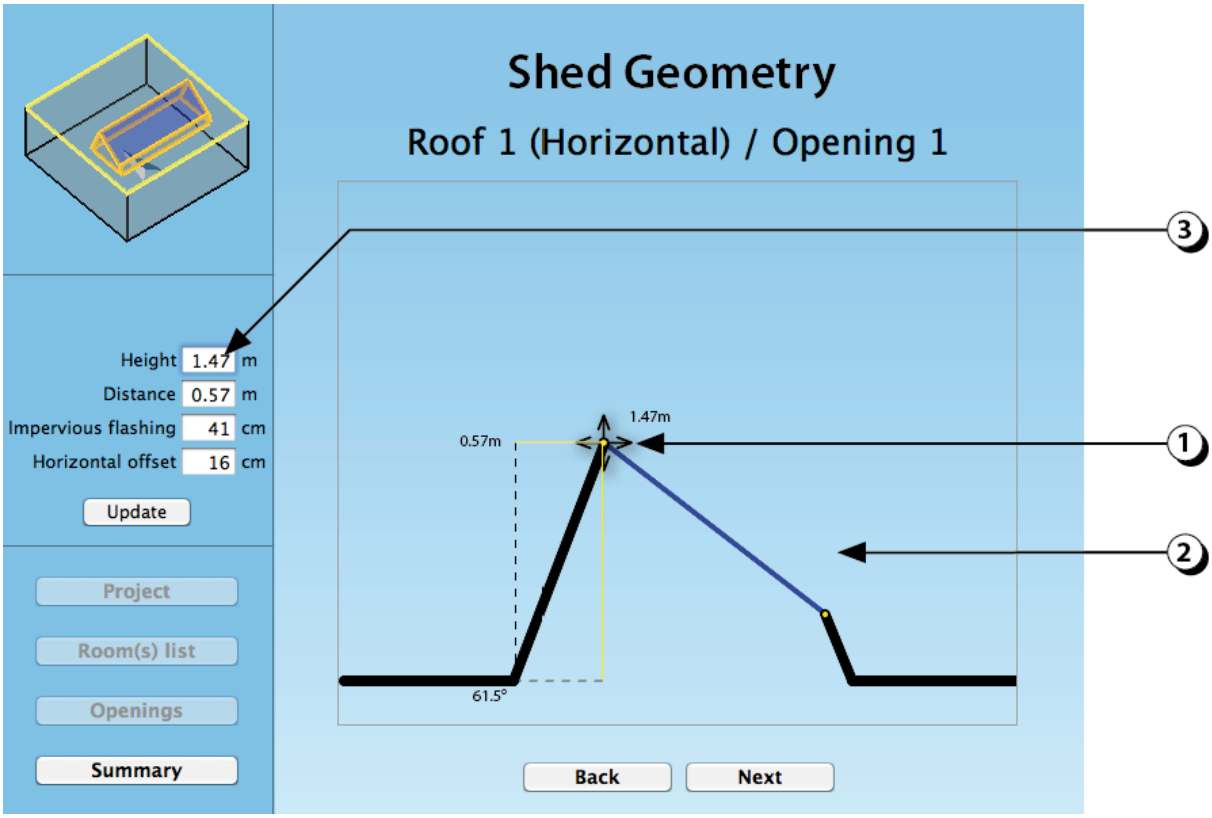


Figure 56: Selection of the orientation of the roof opening (available for vertical or tilted openings).

Geometry of tilted or vertical openings

1. Move the upper point of the glazing to adjust the opening geometry.
2. Move the lower point of the glazing to adjust the opening geometry.

   CAUTION: The angle between the reveal and the roof plan cannot be lower than 45°).
3. The dimensions of the openings are adjusted in the corresponding fields (you can also enter values with your keyboard).



Shed Geometry

Roof 1 (Horizontal) / Opening 1

Height 1.47 m

Distance 0.57 m

Impervious flashing 41 cm

Horizontal offset 16 cm

Figure 57: Description of the opening geometry (section view).

Sidewall shape of horizontal openings

The sidewall shape has a great influence on the indoor daylight distribution. This is particularly important for thick roofs and narrow openings.

1. Select the appropriate sidewall shape (your selection is highlighted in yellow).

   (For angled sidewalls, the 45° angled is applied from the middle of the roof thickness, see Figure 59).

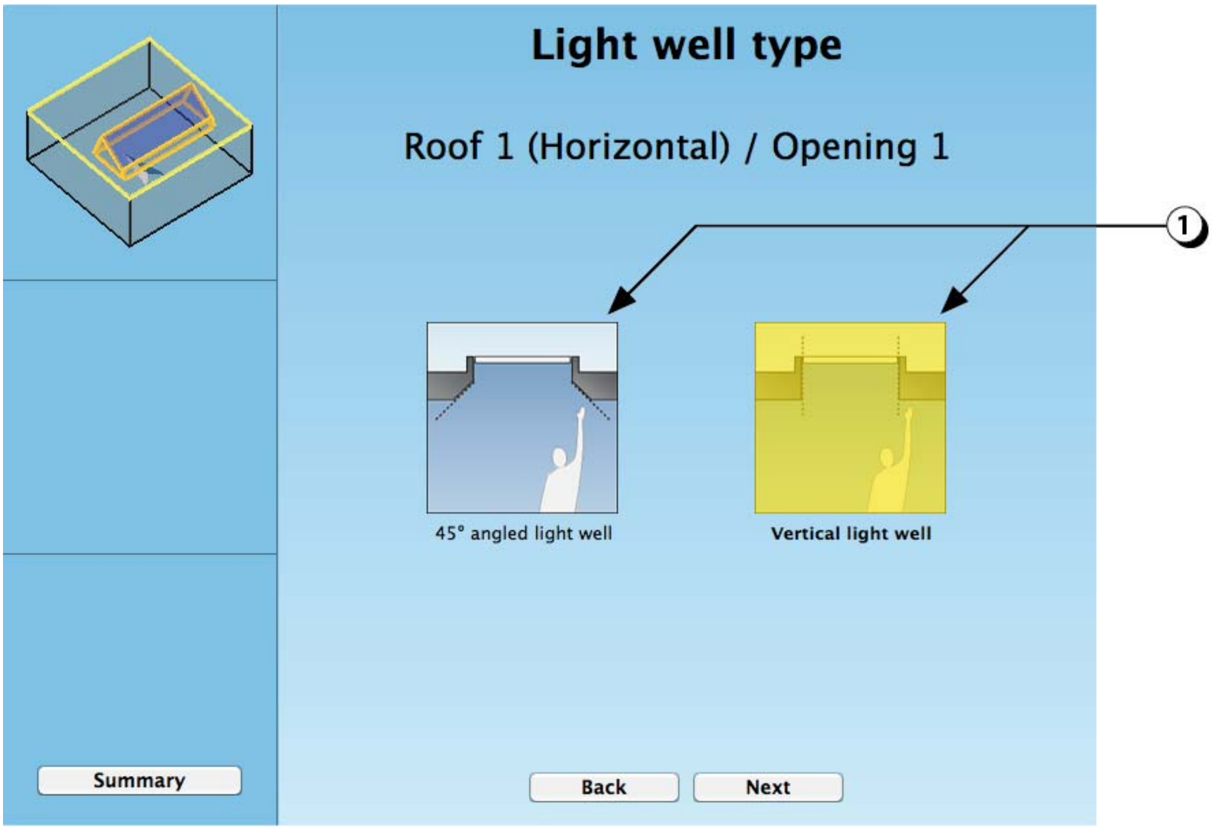


Figure 58: Selection of the sidewall shape.

Roof thickness

1. Select the roof thickness by clicking on one of these proposals (your selection is highlighted in yellow).
2. You can also enter a precise value in this field.

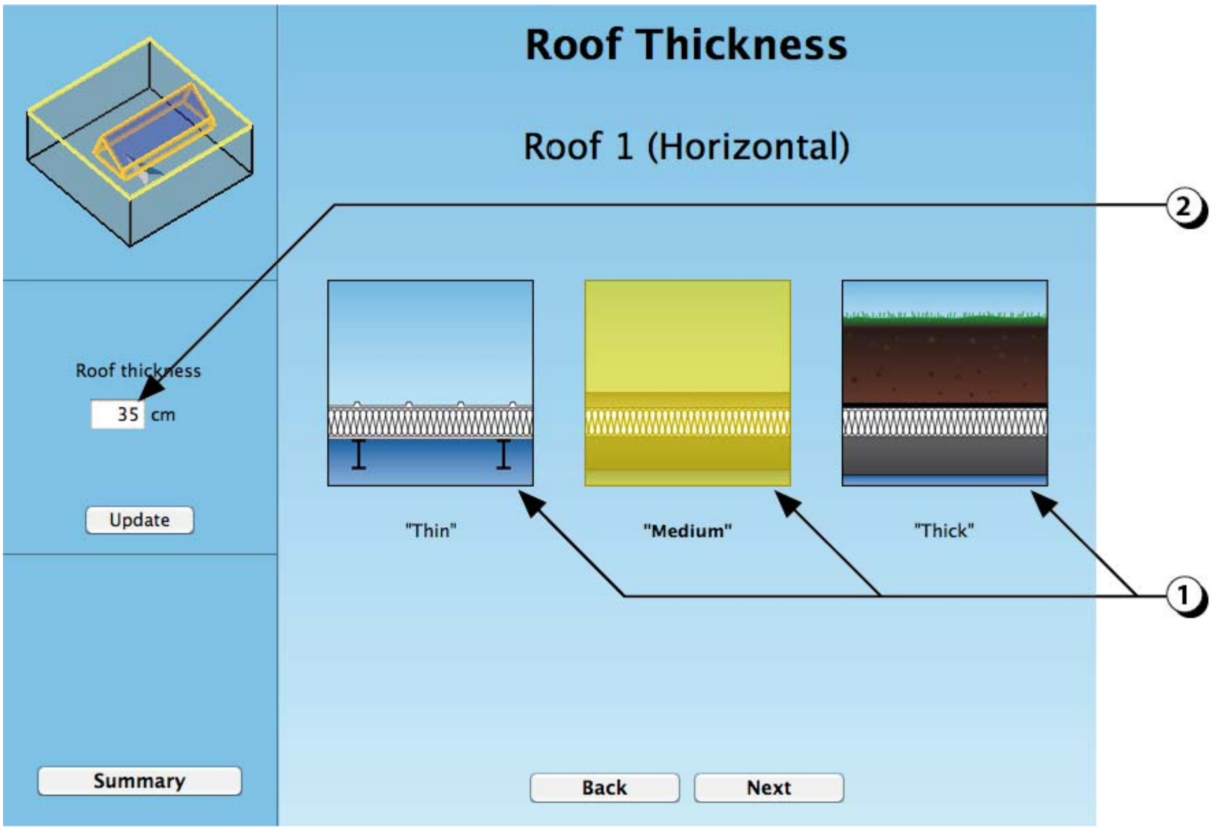


Figure 59: Selection of the roof thickness.

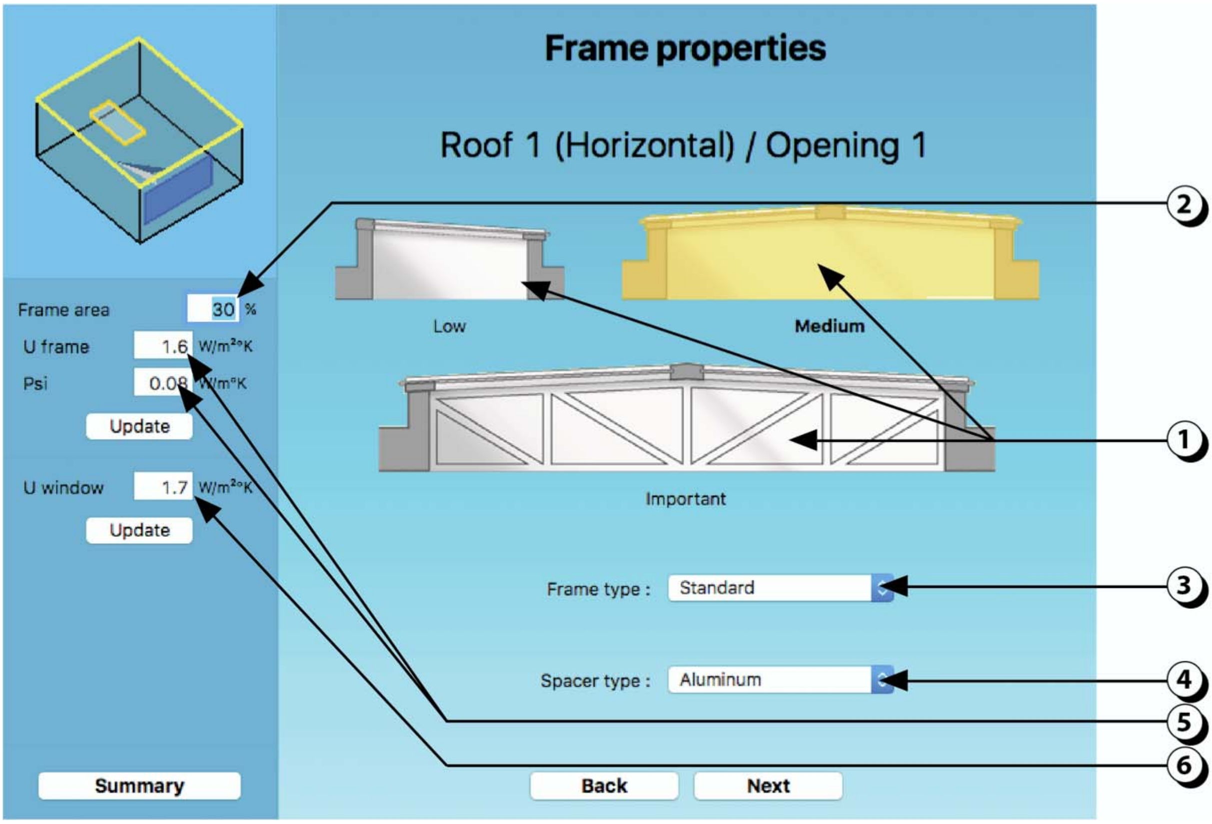
CAUTION: The roof thickness does not include the eventual impervious flashing height (see page 61).

Frame area of roof openings

The frames are reducing the transparent surface and thus diminish the amount of light entering the room.

The frame area (%) represents the portion of the opening(s) that is obstructed by the frames.

1. Indicate the frame area by clicking on one of the proposals.
2. You may also enter a precise value with your keyboard.
3. Select the type of frame (“Performant”, “Standard” or “Inferior”).
4. Select the type of spacer (Aluminium, Stainless steel or Heat insulating).
5. You might also enter précises values.
6. The U value of the window is automatically.



Frame properties

Roof 1 (Horizontal) / Opening 1

Frame area 30 %

U frame 1.6 W/m²°K

Psi 0.08 W/m°K

U window 1.7 W/m²°K

Frame type : Standard

Spacer type : Aluminum

Figure 60: Selection of the frame area of roof openings.

CAUTION: For large openings, you have to take into account the structure beams that reduce the amount of light.

Opening mode of horizontal roof windows

The potential for natural ventilation (air change and passive cooling) is directly linked to the **percentage of the window(s)** (surface) that can be opened.

1. Select the opening mode of the window you are describing (« Fixed », « Top-hung», Your selection is highlighted in yellow).
2. This value corresponds to the percentage of the window surface that can be used for natural ventilation (you can also enter a value with your keyboard).
   - 100% means that the whole surface of the window can be used for air transfer (“Top-hung windows”).
   - Please see page 113 to determine the percentage of opening.

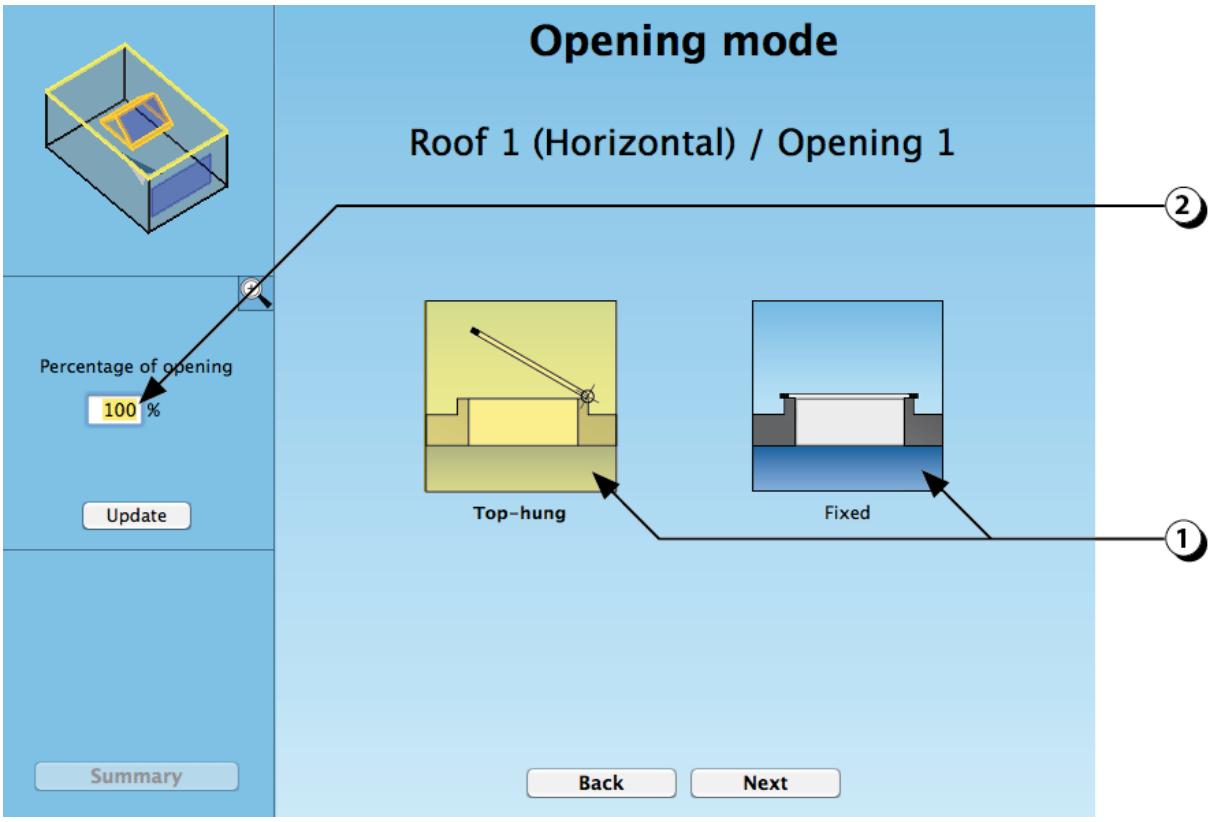


Figure 61: Percentage of the roof window available for natural ventilation.

Sidewall shape for tilted roof openings

The sidewall shape has a great influence on the indoor daylight distribution. This is particularly important for thick roofs and narrow openings.

1. Select the appropriate sidewall shape (your selection is highlighted in yellow).
2. Adjust the sidewall lightness.

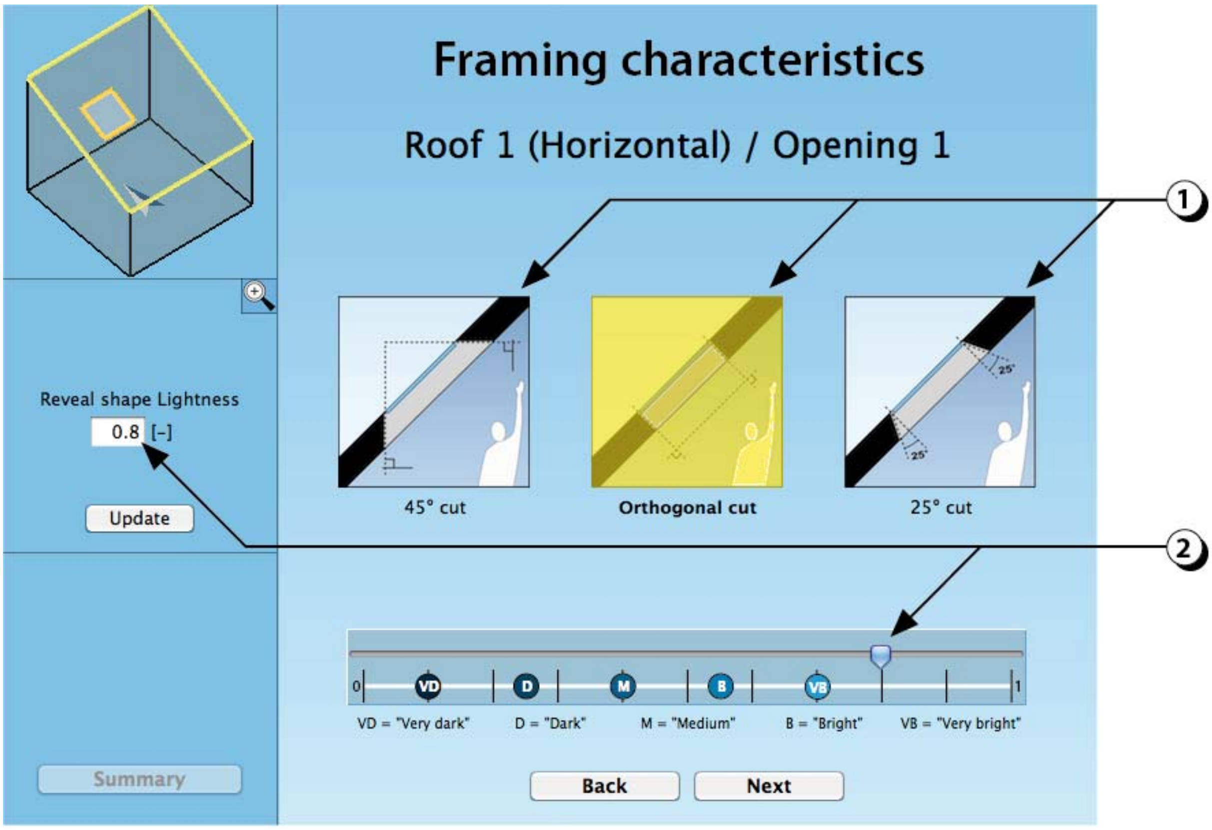


Figure 62: Selection of the sidewall shape for tilted roof openings.

Tilted roof thickness

1. Select the roof thickness by clicking on one of these proposals (your selection is highlighted in yellow).
2. You can also enter a precise value in this field.

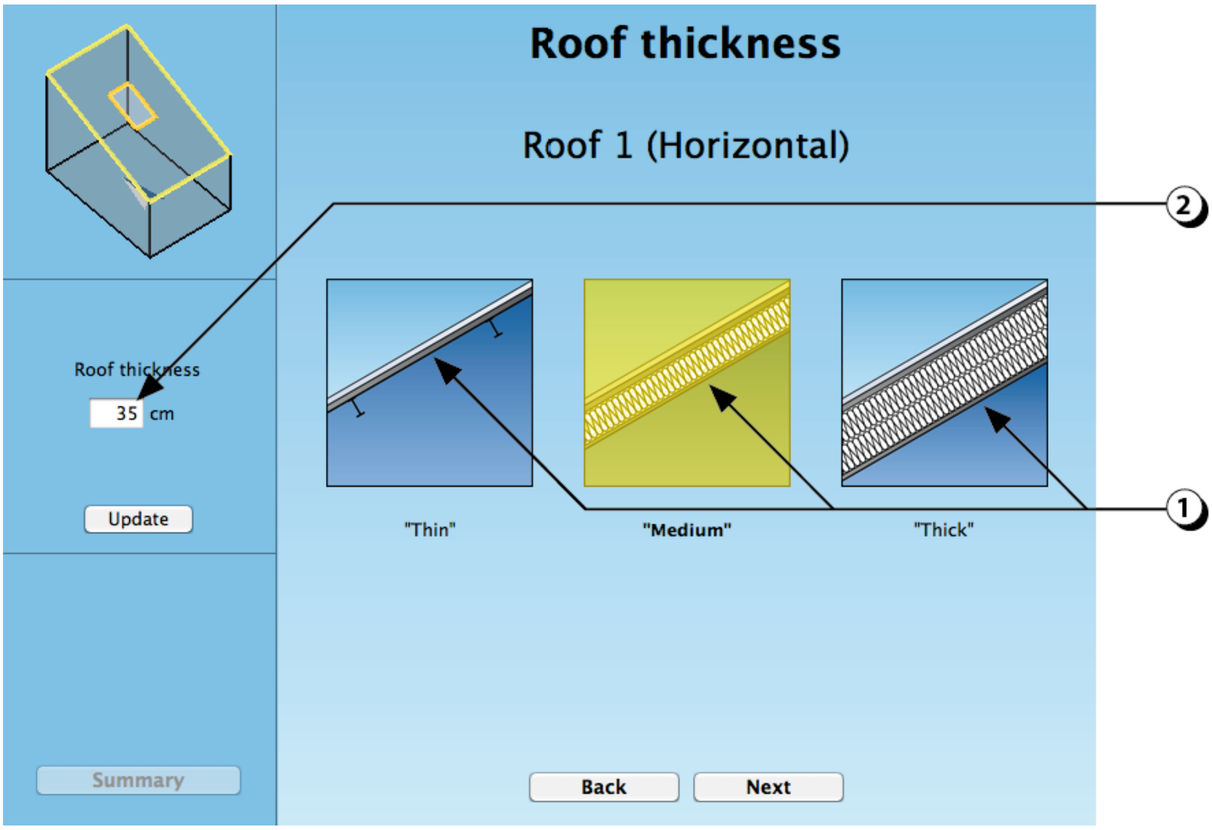


Figure 63 Selection of the roof thickness (Tilted roof).

CAUTION: The roof thickness does not include the eventual impervious flashing height (see page 61).

Opening mode of tilted roof windows

The potential for natural ventilation (air change and passive cooling) is directly linked to the **percentage of the window(s)** (surface) that can be opened.

1. Select the opening mode of the window you are describing (« Top-hung», “Centre-pivot” or “Fixed”. Your selection is highlighted in yellow).
2. This value corresponds to the percentage of the window surface that can be used for natural ventilation (you can also enter a value with your keyboard).
    - 100% means that the whole surface of the window can be used for air transfer (“Top-hung window”).
    - Please see page 113 to determine the percentage of opening.

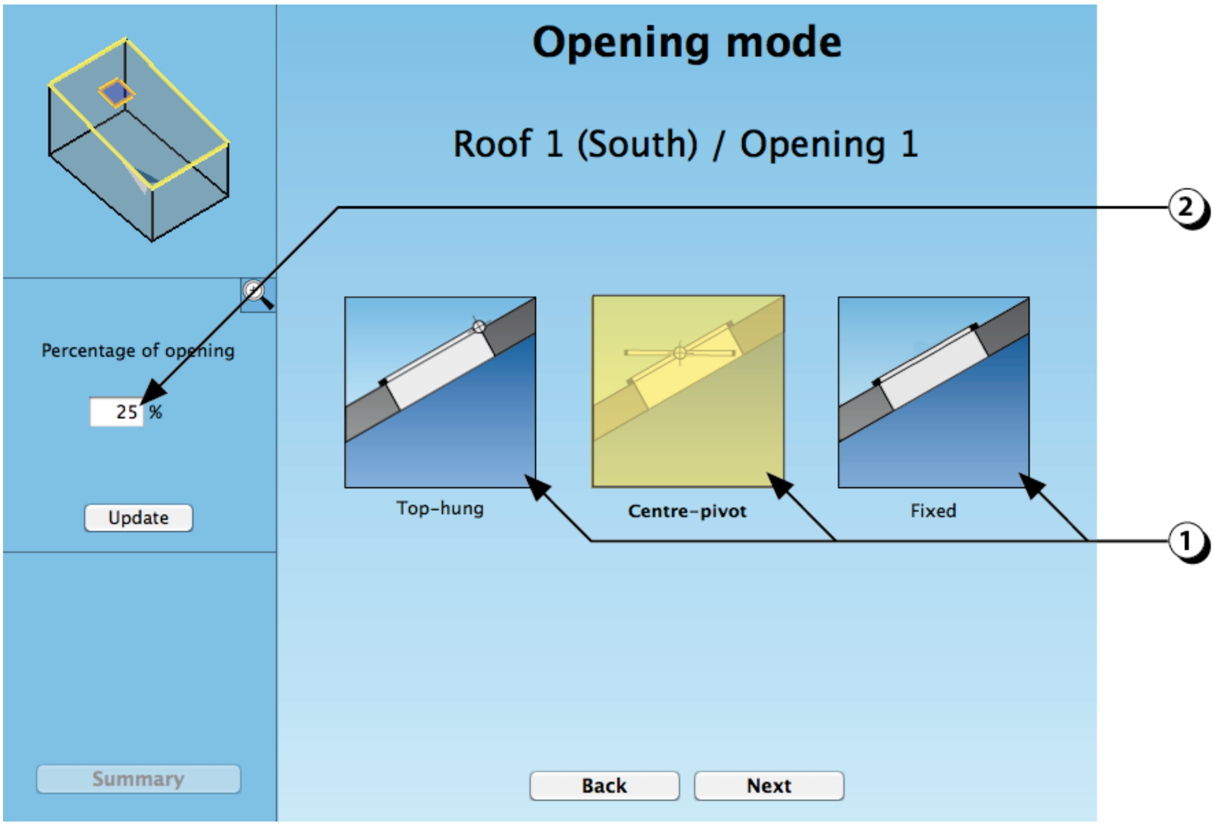


Figure 64: Percentage of the tilted roof window available for natural ventilation.

INDOOR OBJECTS

Indoor objects can be **opaque** or **transparent**. This offers new possibilities to describe glazed partitions or rooms located on glazed atria.

Nota: In this version indoor objects are only taken into account for lighting calculations. They do not have any influence on thermal calculations.

CAUTION: If a given portion of the room has no access to daylight (fully closed by indoor objects), the result of daylighting calculation shall not be consider as valid for this zone.

Indoors objects

1. Click this button to add indoor objects (opaque volumes figuring partitions, furniture beams, etc).

PRECISION: In this version of the software, indoor objects are only taken into account for lighting simulations. They do not have any influence on thermal calculations.

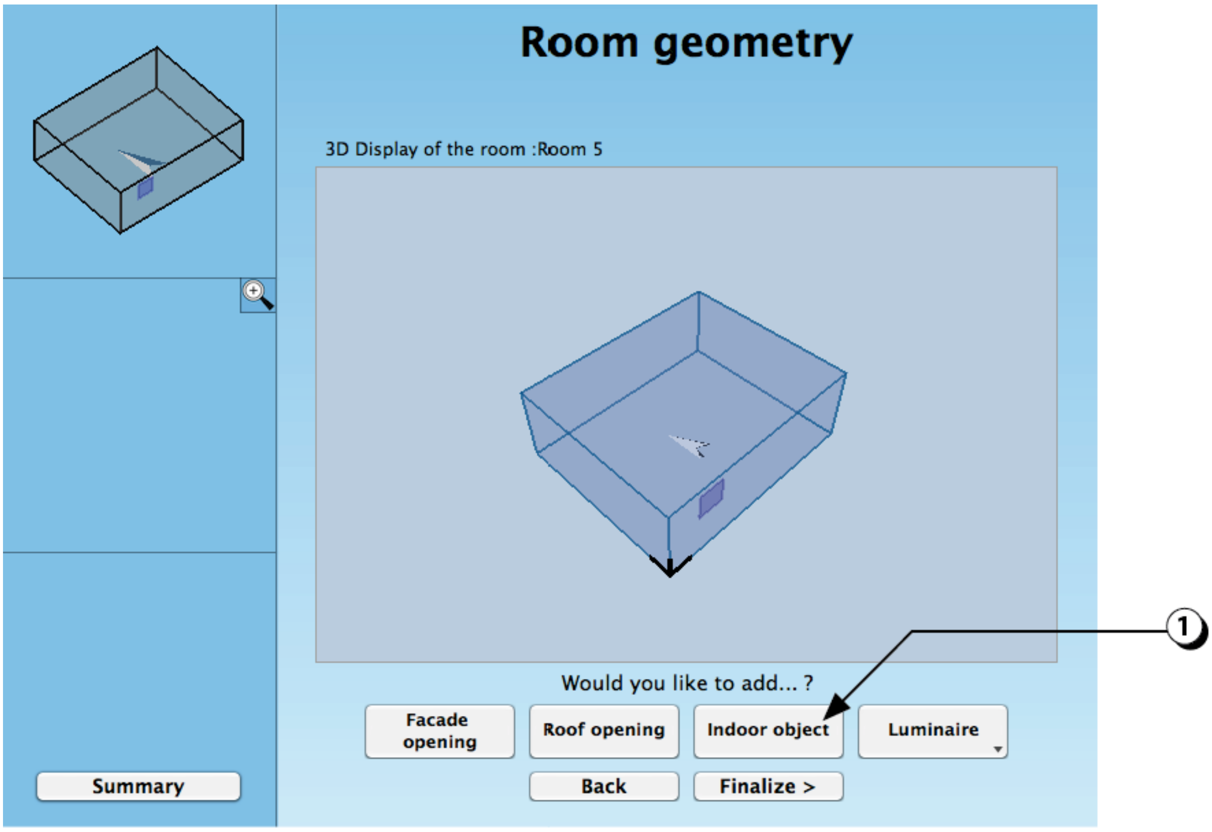


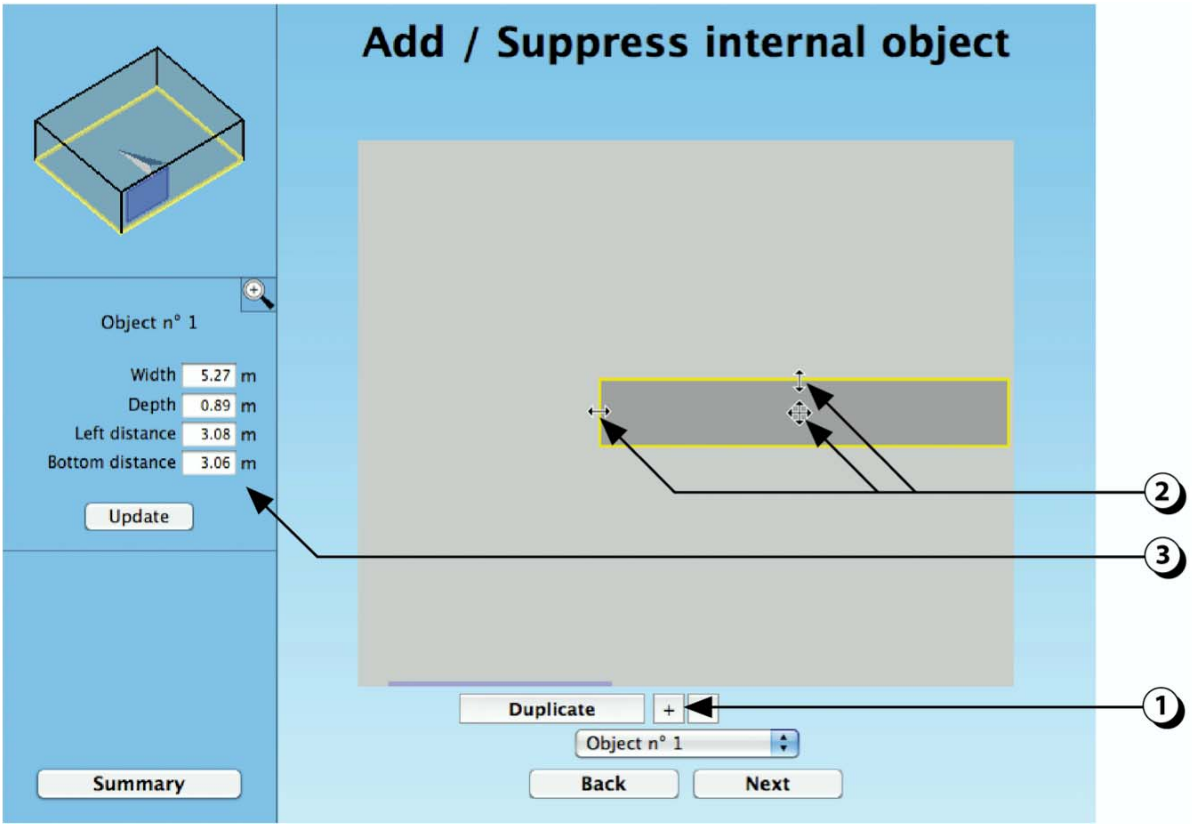
Figure 65: Addition of indoor objects.

Indoor objects type & geometry (plan view)

DIAL+ allows you to describe indoor objects (parallelepipeds) that interact with the daylight distribution and availability.

To add indoor objects, see the corresponding button in the summary page (cf. page 117).

1. Click on the “+” button to add a new object.
2. Use the arrows to modify the dimensions and the position of the object (plan view).
3. You can also enter precise values in the corresponding fields.



Width 5.27 m
Depth 0.89 m
Left distance 3.08 m
Bottom distance 3.06 m

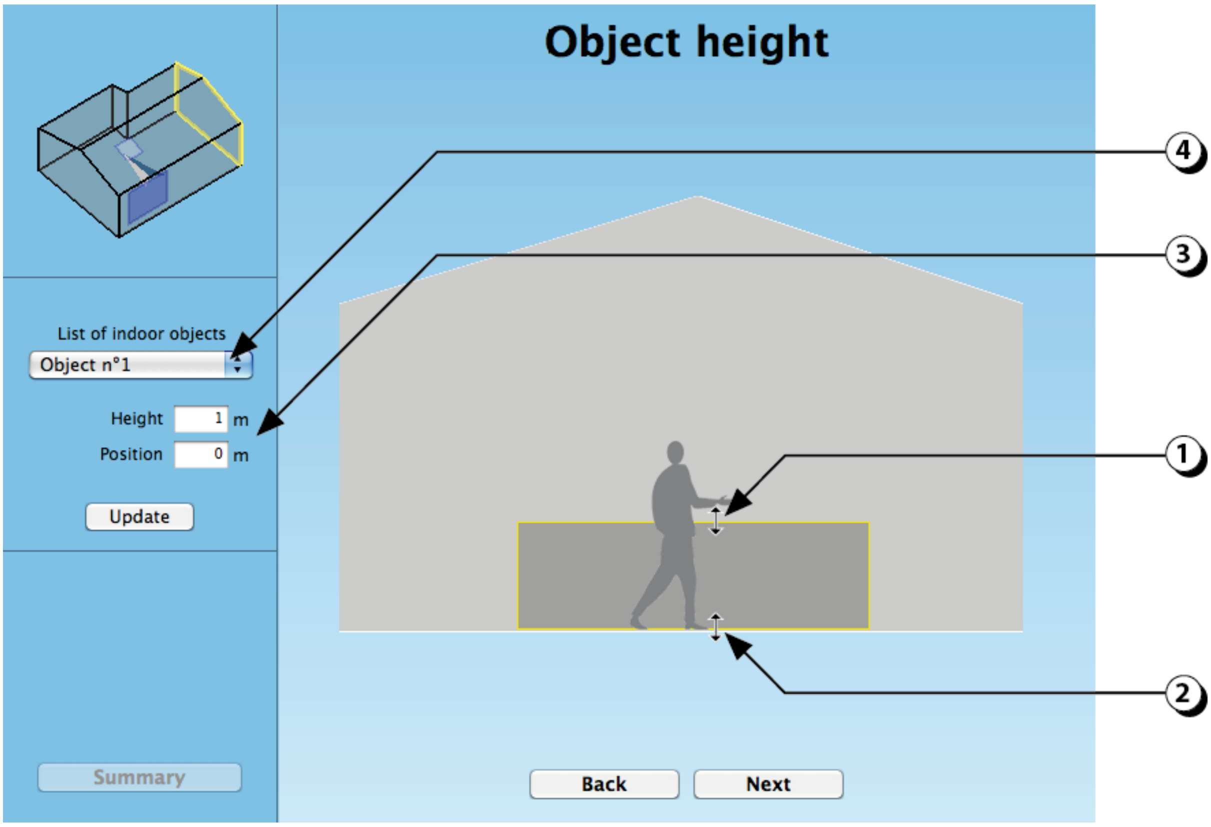
Figure 66: Description of an internal object.

Position & dimensions of indoors objects (Section view)

The internal objects can be on the floor or “float” in the air. This allows you, for example, to describe a mezzanine or an intermediate floor.

To add indoor objects, see the corresponding button in the summary page (cf. page 117).

1. Use the mouse to indicate the upper limit of the object.
2. Use the mouse to indicate the lower limit of the object.
3. You may also use your keyboard to enter precise values in the corresponding fields.
4. If several objects have been described, use this list-button to select the object you would like to edit or modify.



Object height

List of indoor objects: Object n°1

Height 1 m

Position 0 m

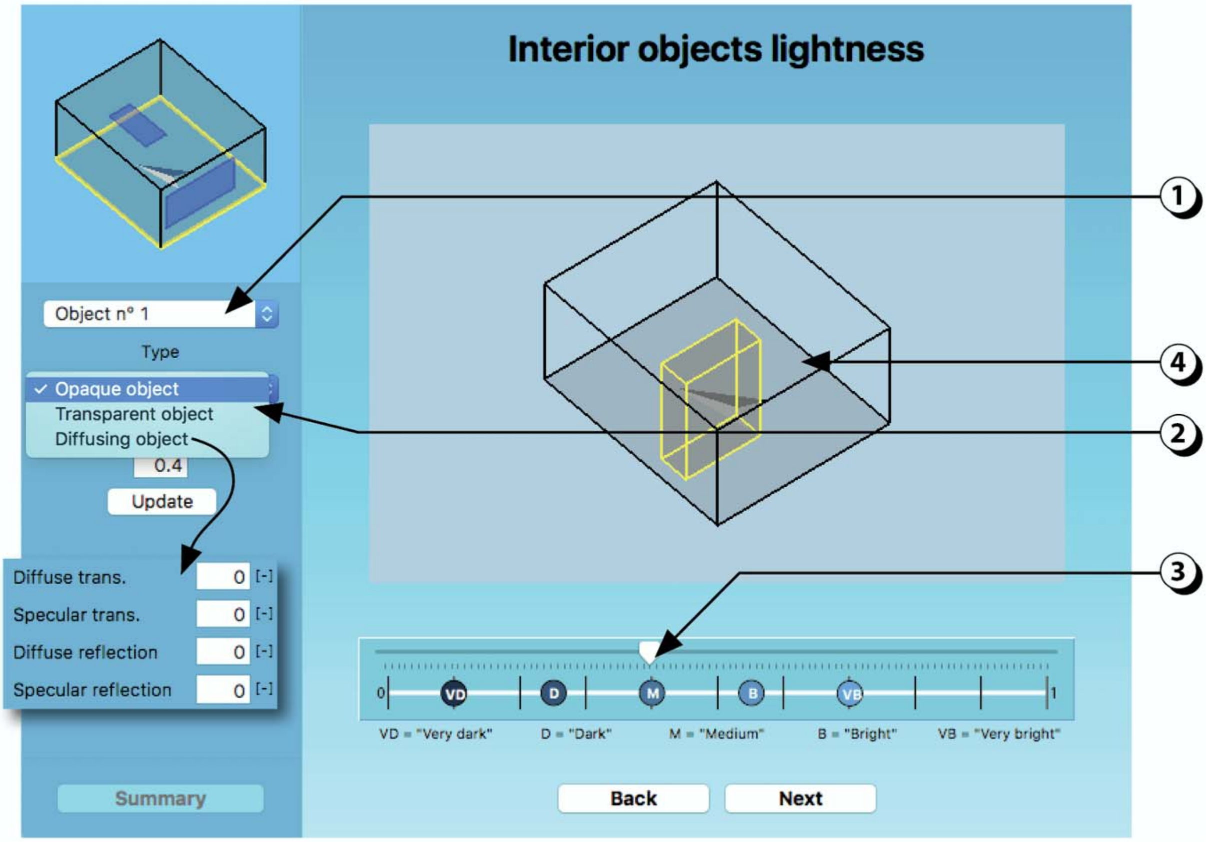
Figure 67: Description of the upper and lower limits of an internal object (section view).

Reflection / Transmission coefficients of indoor objects

Internal objects do interact with light beams, it is thus necessary to give them a brightness. In this version of the software, the same reflection coefficient is applied to all the faces of a given object.

1. Select the object for which you want to modify the photometry.
2. Choose if the object is opaque or transparent or diffusing.
3. Use your mouse to modify the object lightness.
    - If the selected object is opaque, then lightness corresponds to its reflection coefficient.
    - If the selected object is transparent, the lightness corresponds to its transmission factor (specular).
    - For diffusing objects, please enter a value for each parameter (see p. 57).
4. The lightness of the object changes as a function of the reflection coefficient.

   CAUTION: The brightness of your computer screen is only indicative.



Interior objects lightness

Object n° 1

Type

✓ Opaque object

0.4

Diffuse trans. 0 [-]

Specular trans. 0 [-]

Diffuse reflection 0 [-]

Specular reflection 0 [-]

VD = "Very dark" D = "Dark" M = "Medium" B = "Bright" VB = "Very bright"

Figure 68: Selection of the object(s) brightness.

How to describe a patio using indoor objects

Beside the approach described in page 32, it is also possible to consider a set of rooms inside a patio (or an atrium) as a whole system where each space is delimited with indoor objects.

1. Determine the limits of the "system" (a large volume including patio + adjacent rooms).
2. Describe the indoor partitions thanks to indoor objects.
3. Eventually, add transparent and/or opaque objects to describe additional obstacles (balconies, circulations, etc).

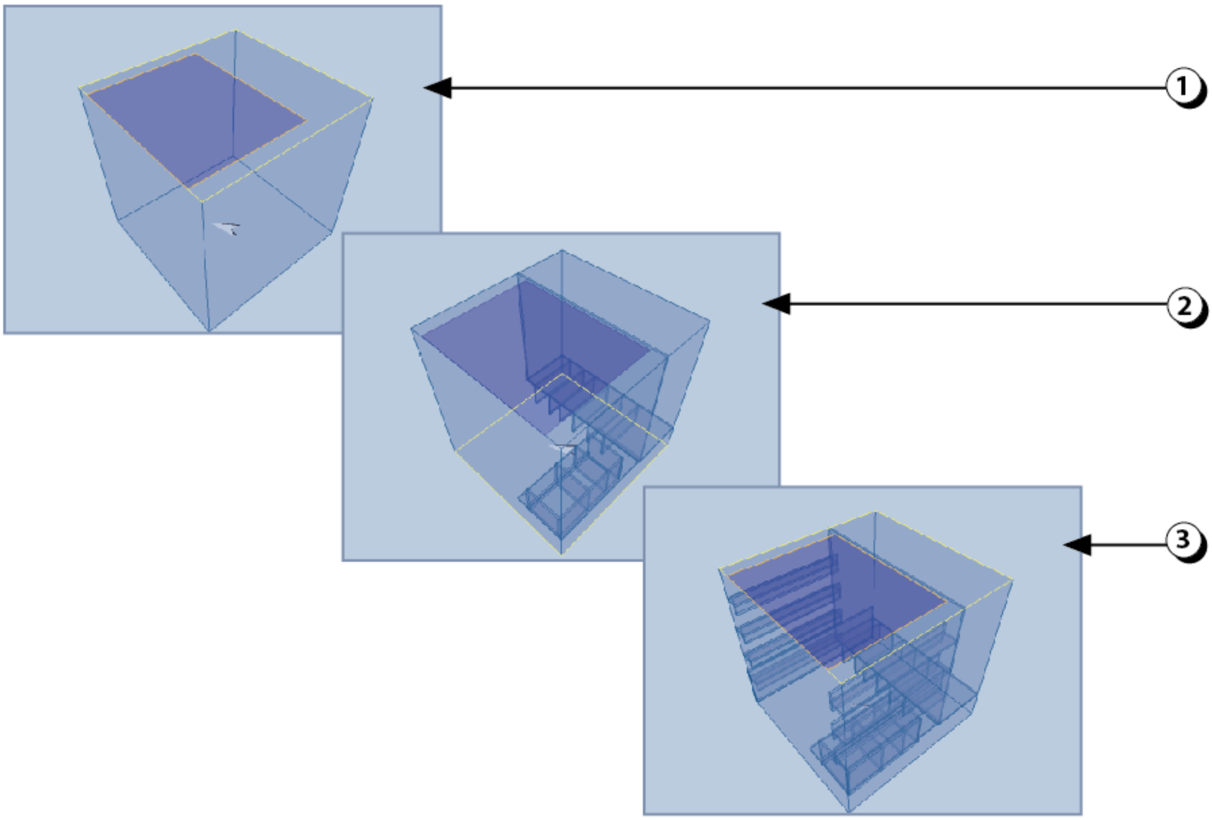


Figure 69: Description of rooms adjacent to an atrium (or a patio) using indoor objects.

MENU: to complete the description

Once you have described all the room openings as well as the indoor objects, you can complete the description by selecting the wanted simulation theme.

1. For daylighting simulation the only parameters that remain to be described are the reflection coefficients of the floor, walls and ceiling.
2. For artificial lighting, the remaining parameters deal with the light sources, the luminaire types and the lighting controls.
3. For thermal simulations the remaining parameters deal with the walls composition, the internal loads, shading device and ventilation strategies, and the heating distribution.
4. When all the parameters corresponding to one of the simulation path are completed, this green symbol is displayed.

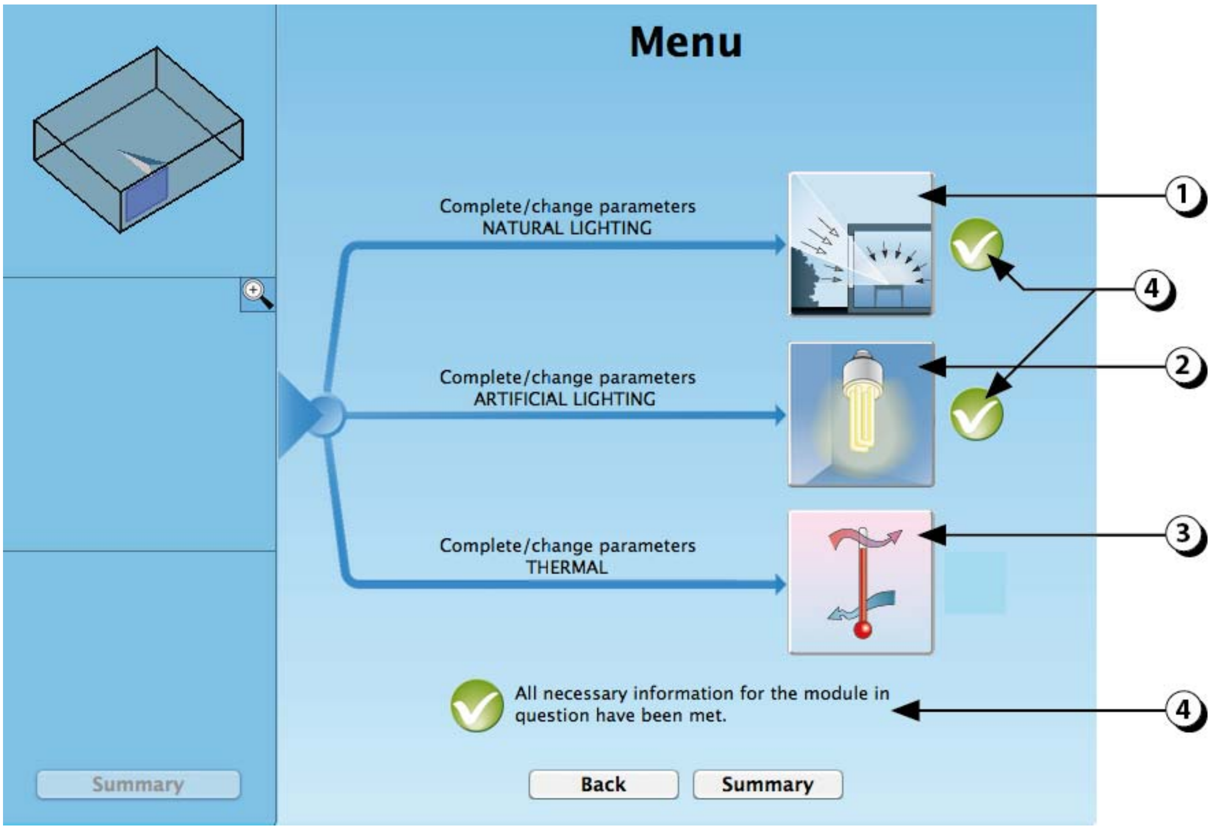


Figure 70: Menu screen allowing you to select the type of analysis you want to perform.

COMPLETING THE DESCRIPTION OF DAYLIGHTING PARAMETERS

The remaining parameters dealing with the daylighting analysis are reflection coefficients.

Floor lightness

The daylight availability is strongly depending on the indoor surfaces lightness, particularly at the back of the room (far from the openings).

Lightness is represented by the reflection coefficient (percentage of light reflected by the material; a 0.25 reflection coefficient means that the material reflects 25% of the incident light).

1. Use the cursor to adjust the floor lightness.

   CAUTION: The lightness scale is bounded between 0 and 1, but reflection coefficients are most of time between 0.05 and 0.85.

2. The icons located below the lightness scale (« VD », « D », « M », « B » and « VB ») are representative of typical values for floor reflection coefficients

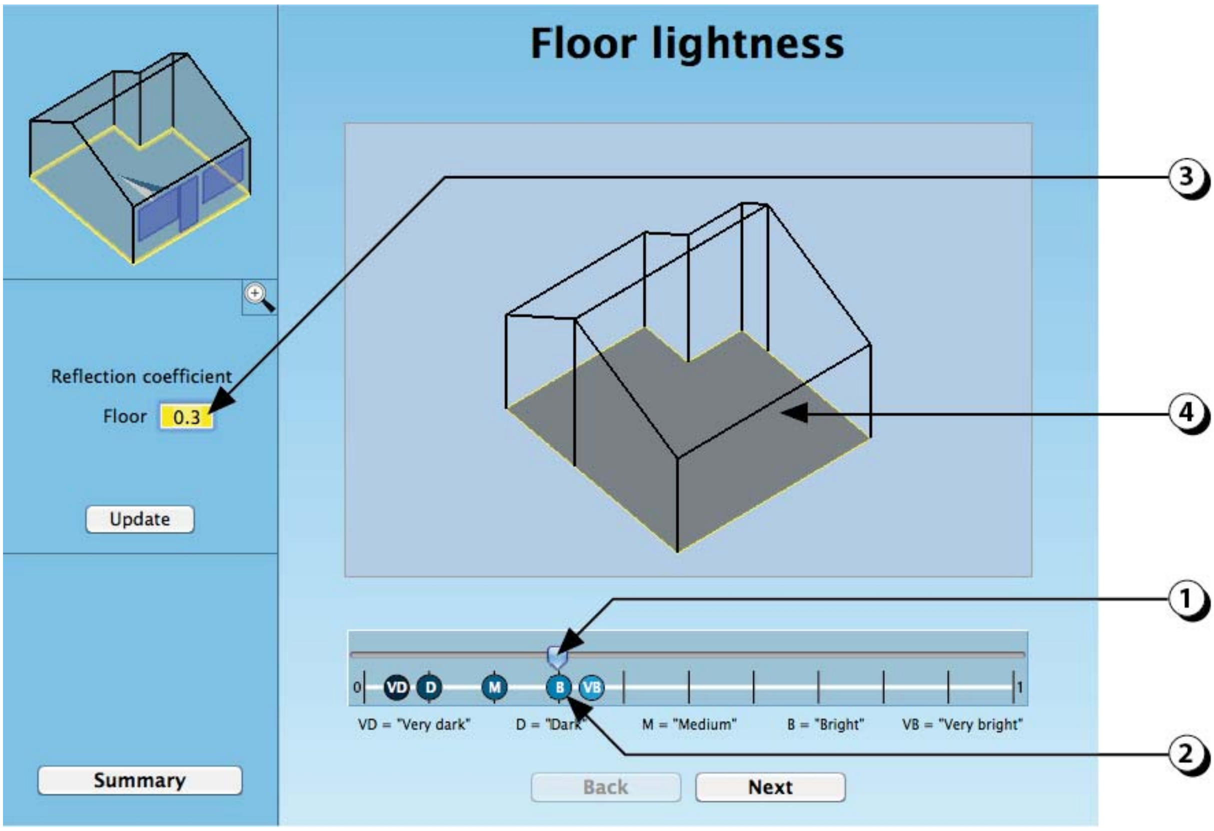
   (VD=«Very Dark», D=«Dark», M=«Medium», B=«Bright», VB=«Very Bright»).

   Example: a 0.30 reflection coefficient corresponds to a “Bright” floor.

3. You can also use your keyboard to enter a precise value.

   (Don’t forget to validate (“Update” button) before leaving the page).

4. Grey levels on the main display window represent the floor brightness.



Reflection coefficient

Floor 0.3

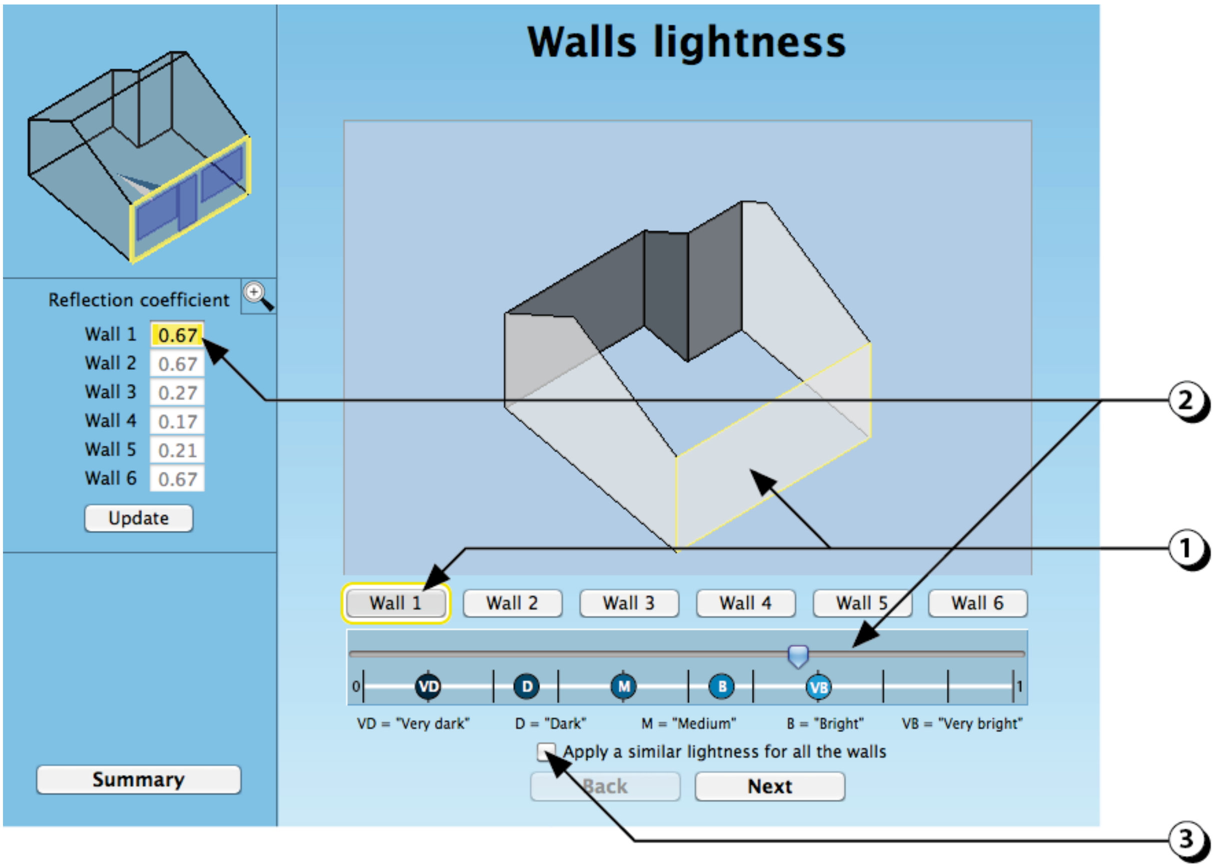
Figure 71: Lightness adjustment of the floor.

CAUTION: It is not possible to display the “real” material lightness on your computer. The grey levels are only indicative.

Walls and ceiling lightness

It is possible to affect a specific lightness for each of the room surfaces.

1. Select the appropriate surface with one of the buttons (the border of the selected surface is displayed in yellow).
2. Move the slider to adjust the lightness of the corresponding surface.
3. Click here if you wish to define the same reflection coefficient to all the surfaces.



Reflection coefficient

Wall 1	0.67
Wall 2	0.67
Wall 3	0.27
Wall 4	0.17
Wall 5	0.21
Wall 6	0.67

☐ Apply a similar lightness for all the walls

Figure 72: Lightness adjustment of the walls.

CAUTION: It is not possible to display the “real” material lightness on your computer. The grey levels are only indicative.

COMPLETING THE DESCRIPTION OF ARTIFICIAL LIGHTING

The artificial lighting parameters deal with the light sources and the luminaires types as well as the lighting control.

Add a luminaire

1. Click here to add a luminaire.
2. If you don't know the exact type of luminaire, click here to describe a generic luminaire.
3. If you know the brand and the specific reference of the luminaire, please first download the corresponding “eulumdat”(.ldt) file from the manufacturer web-site and then click here to go ahead with the study.

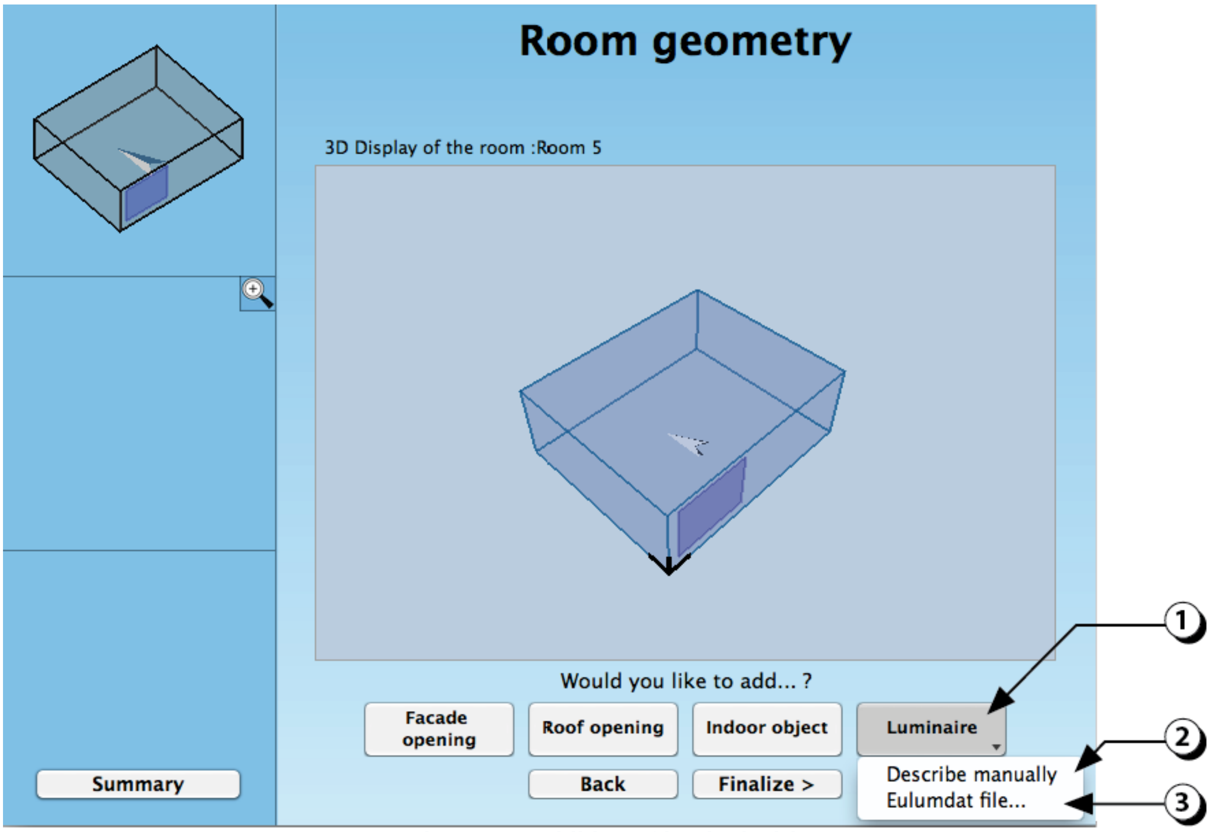


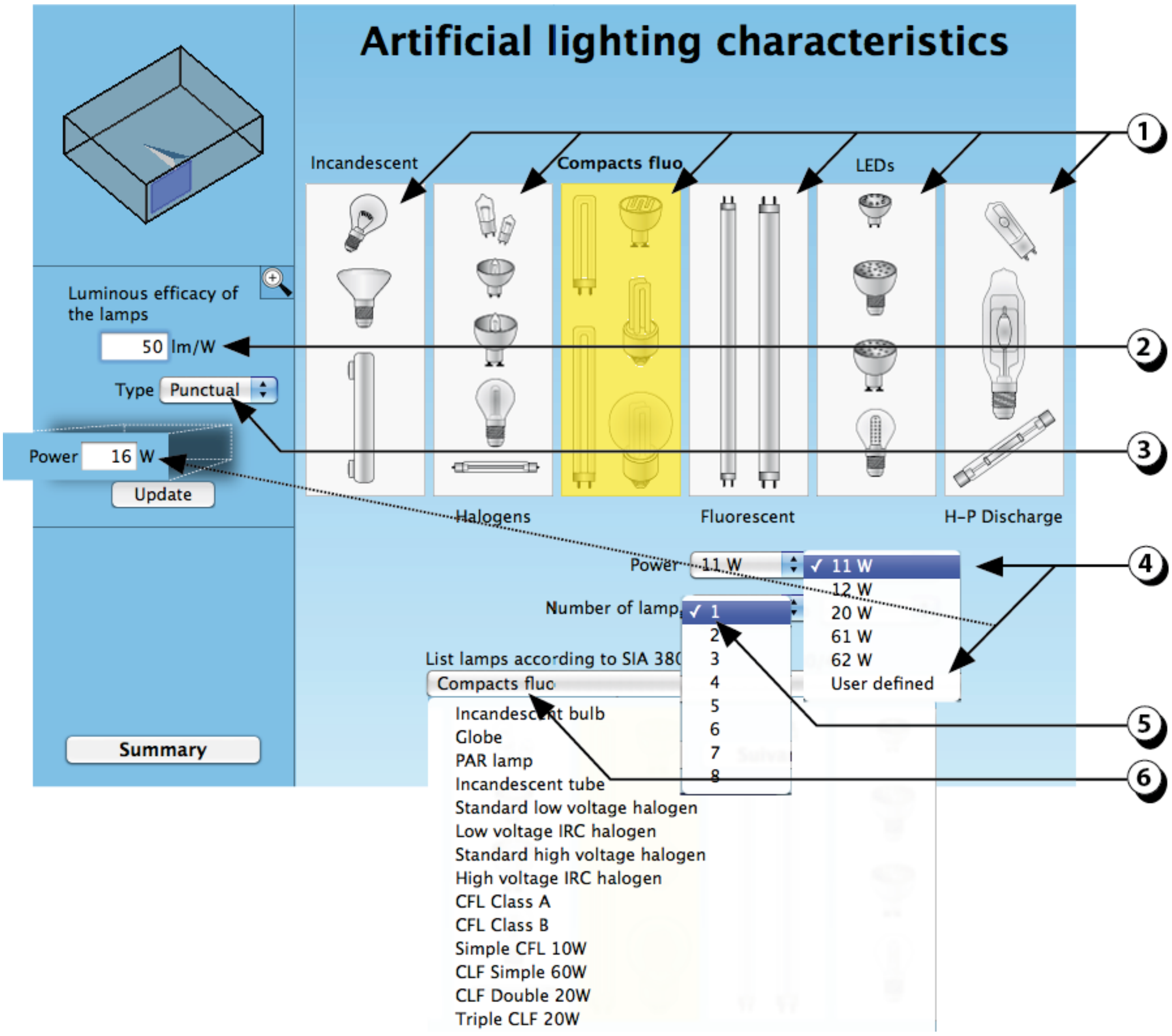
Figure 73: Addition of luminaire(s).

Light sources selection

The light source performance is characterized by the delivered luminous flux [lm] with respect to the power load [W]. High luminous efficacy [lm / W] reflects a good performance.

1. Select the light source type.
2. An average value for luminous efficacy is displayed in this field.
3. Indicate if the light source is punctual or linear.
4. Choose the lamp power within the proposed list.

   if you select “User defined”, you will have to enter the power in the corresponding field (representative values: incandescent 10-15 lm/W, Halogen: 20-30 lm/W, Compact Fluo: 45-60 lm/W, Fluorescent: 75-95 lm/W, LEDs: 80-120 lm/W, HP-discharge: 70-90 lm/W.
5. Indicate the number of lamps per luminaire.
6. You can also select one of the light sources described by SIA 380/4 Swiss norm.



Luminous efficacy of the lamps 50 lm/W

Type Punctual

Power 16 W

Power 11 W

Number of lamp ✓ 1

List lamps according to SIA 380 Compacts fluo

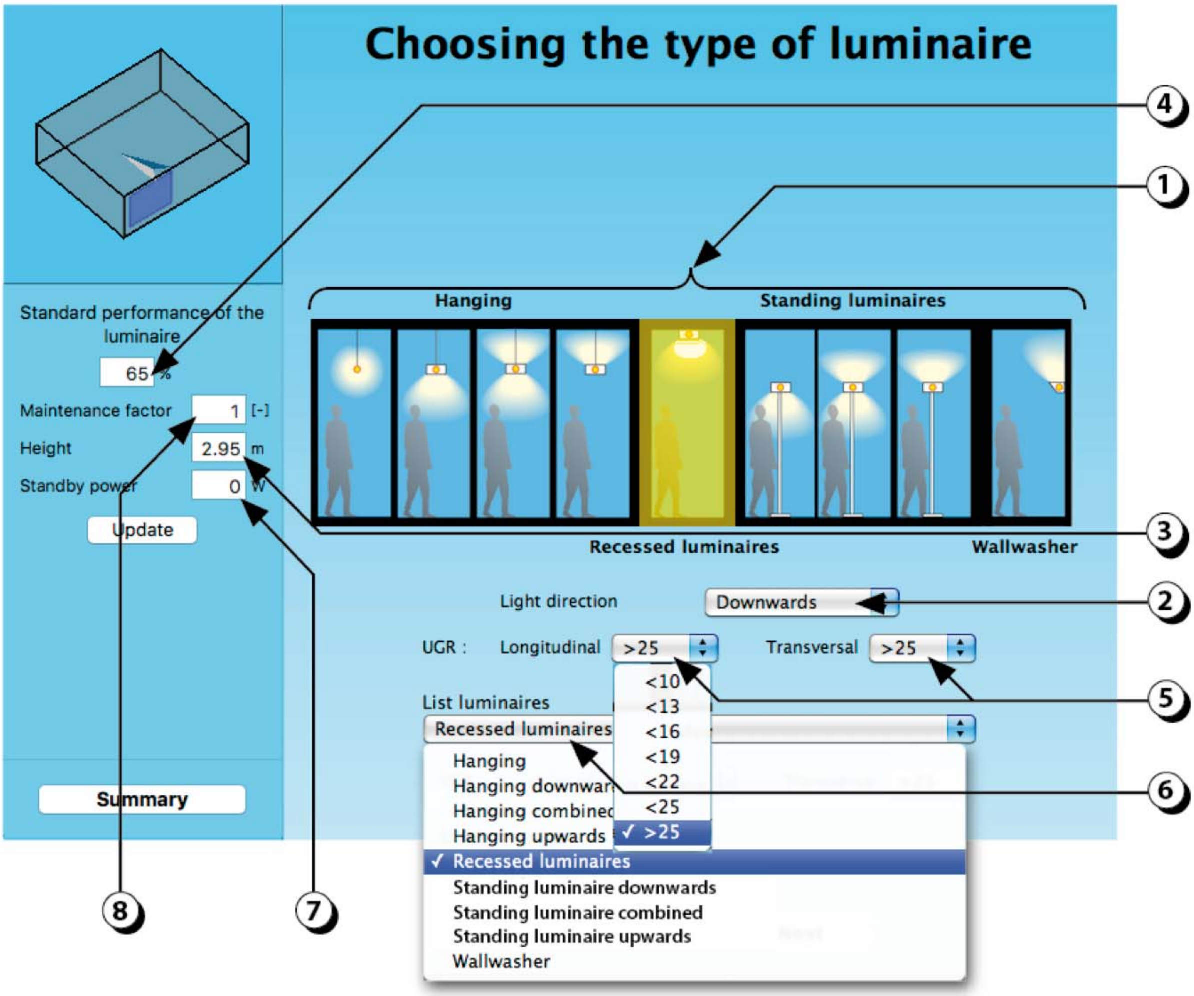
Figure 74: Selection of the light sources.

Luminaires selection

The term "Luminaire" represents the whole system embedding the light source (reflector, grid, diffuser, ballast, etc).

The efficiency of a luminaire is characterised by the percentage of light getting out of the luminaire].

1. Select the type of luminaire.
2. The light direction adapts automatically.
3. Check the luminaire's position (height above the floor).
4. The luminaire efficacy is displayed in this field.
5. Adapt the UGR value (Unified Glare Ratio) of the luminaire.
6. You can also select on of the luminaires described by SIA 380/4 Swiss Norm.
7. If a light sensor or a presence detector controls the luminaires, you should adapt the stand-by power (default value = 0W).
8. If nrecessary, adjust the maintenance factor as a function of the room function (the default value is 1 which corresponds to brand new luminaires).



Choosing the type of luminaire

Standard performance of the luminaire: 65 %

Maintenance factor: 1 [-]

Height: 2.95 m

Standby power: 0 W

Light direction: Downwards

UGR : Longitudinal: >25 Transversal: >25

List luminaires: Recessed luminaires

Figure 75: Selection of the luminaires.

Luminaires filters

Depending of the room function, the luminaires might include filters:

- If there is no filter, the efficacy is high, but as the observer can see the lamps the glare risk is increased.
- If the luminaire is equipped with a diffusing filter (prismatic or opale), the luminance of the lamp is reduced and the glare potential is lowered. On the other side, the global efficacy of the luminaire (lm/W) is also reduced.
- If the luminaire is equipped with a grid, the lamps are hidden and the light beam is more focused. This type of luminaire is recommended for most of workspaces.

1. Select the type of luminaire you would like to implement in the room.

9.

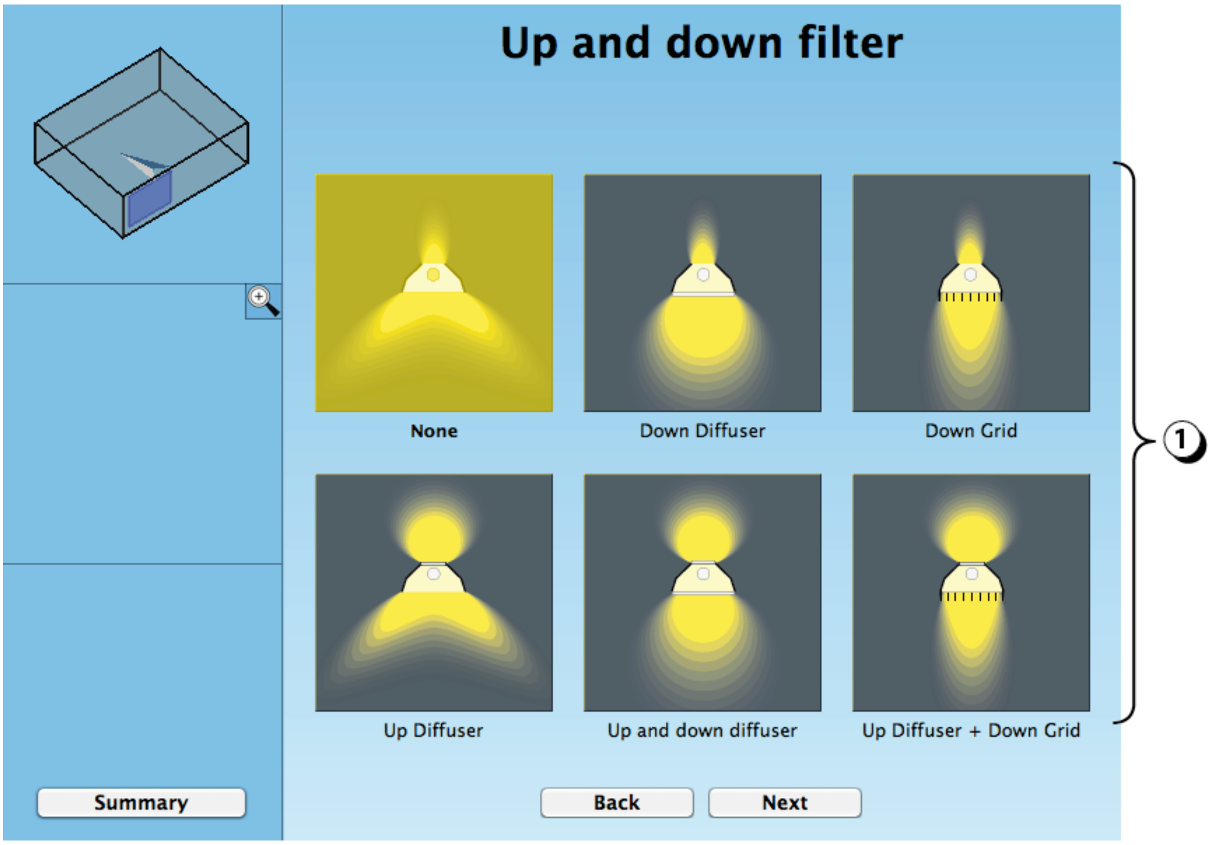


Figure 76: Selection of the luminaire’s filter.

Light distribution

If you have selected a “Direct-Indirect” luminaire, you have to indicate which part of the light is emitted upward and downward.

- A downward dominating light distribution leads to decrease the global power.
- An upward dominating light distribution leads to increase the global power.
- **CAUTION:** Luminaires delivering a portion of their light flow upward should not be to close from the ceiling (min 40 cm). Furthermore, in that case, the reflection coefficient of the ceiling has to be higher than 0.60.

1. Adapt the light distribution.

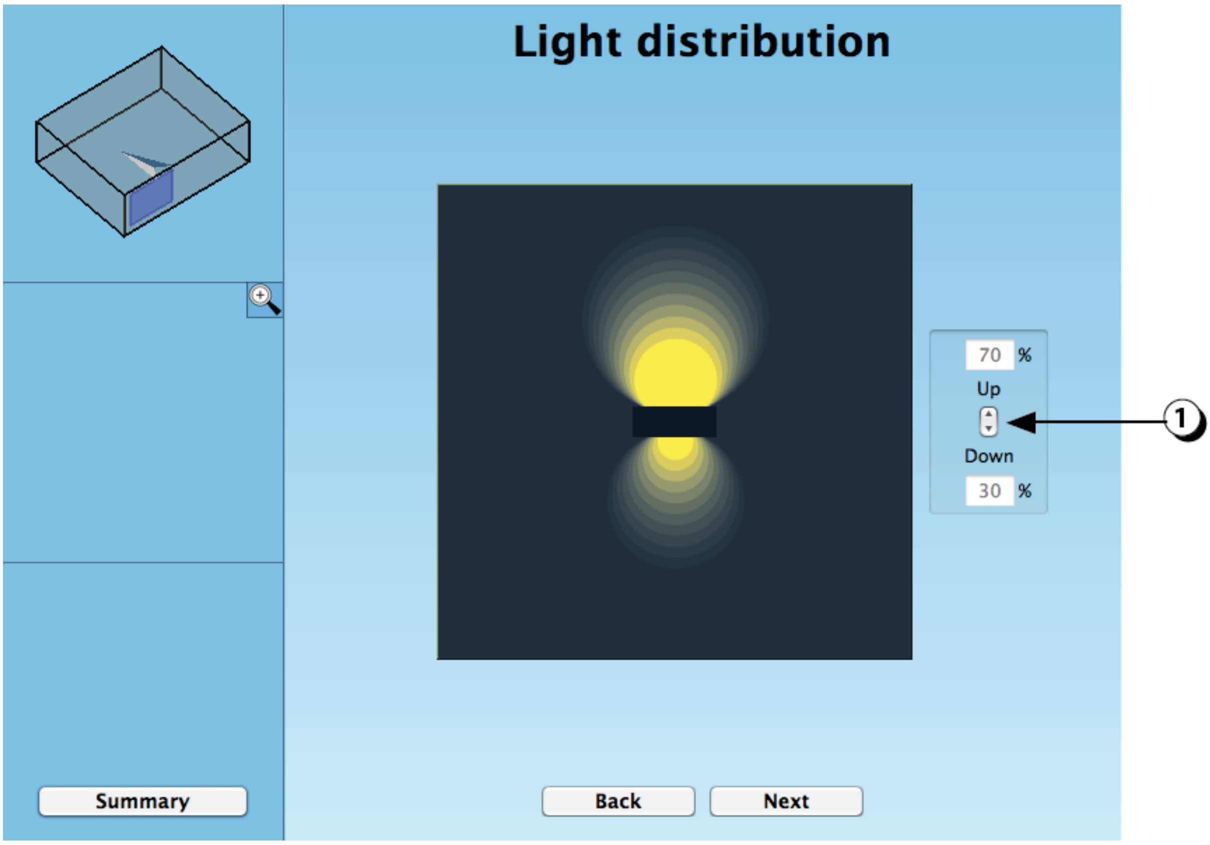
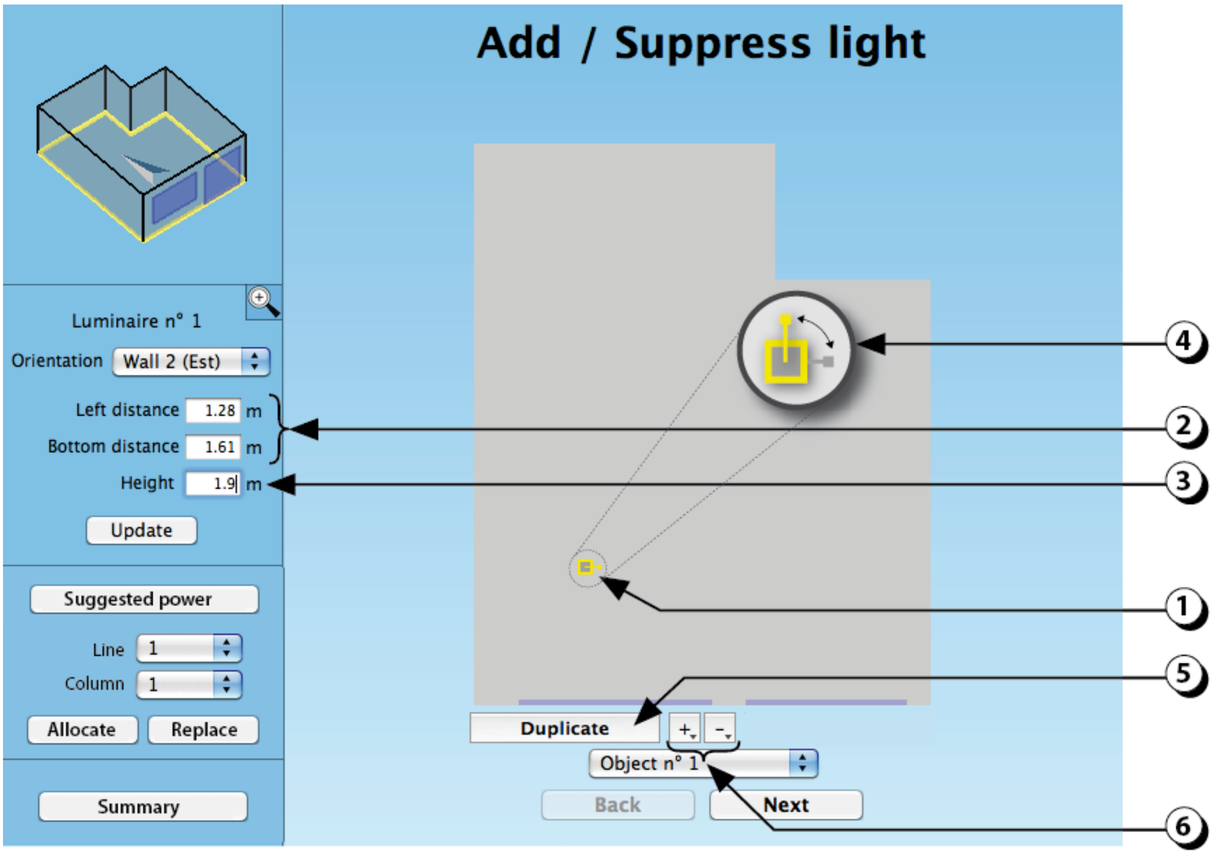


Figure 77: Selection of the light distribution (direct/indirect).

Luminaires positioning

1. You can use your mouse to change the luminaire position.
2. You may also use your keyboard to enter precise coordinates.
3. Do not forget to check the luminaire's height (specially if you have imported an "eulumdat" file).

   CAUTION: Don't forget to click on the "Update" button to validate the changes you have made within the fields.
4. You can change the luminaire orientation (+-90°) with your mouse (this is particularly important for linear and/or asymmetric devices).
5. Use this button to duplicate the selected luminaire (all the characteristics will be reproduced, except the position).
6. Use the "+" button to add a luminaire. (to delete an existing luminaire, please see next page).



Luminaire n° 1

Orientation: Wall 2 (Est)

Left distance: 1.28 m

Bottom distance: 1.61 m

Height: 1.9 m

Line: 1

Column: 1

Object n° 1

Figure 78: Schematic description of the process to create and place a new luminaire.

How to describe rows of luminaires

1. It is possible to describe rows of luminaires by using those scroll menus.
2. Once you have selected the number of lines and columns, click on “Allocate” to create the corresponding luminaires. For “L-shape” rooms, if the central axis of one or several luminaire is located outside the room perimeter, it will be automatically deleted.
3. Click on “Replace” if you want to modify an existing set of luminaires (otherwise another new set will be generated).
4. To remove one or several luminaires, click on the “-“ button (to remove all the luminaires, select the option “Delete all”).

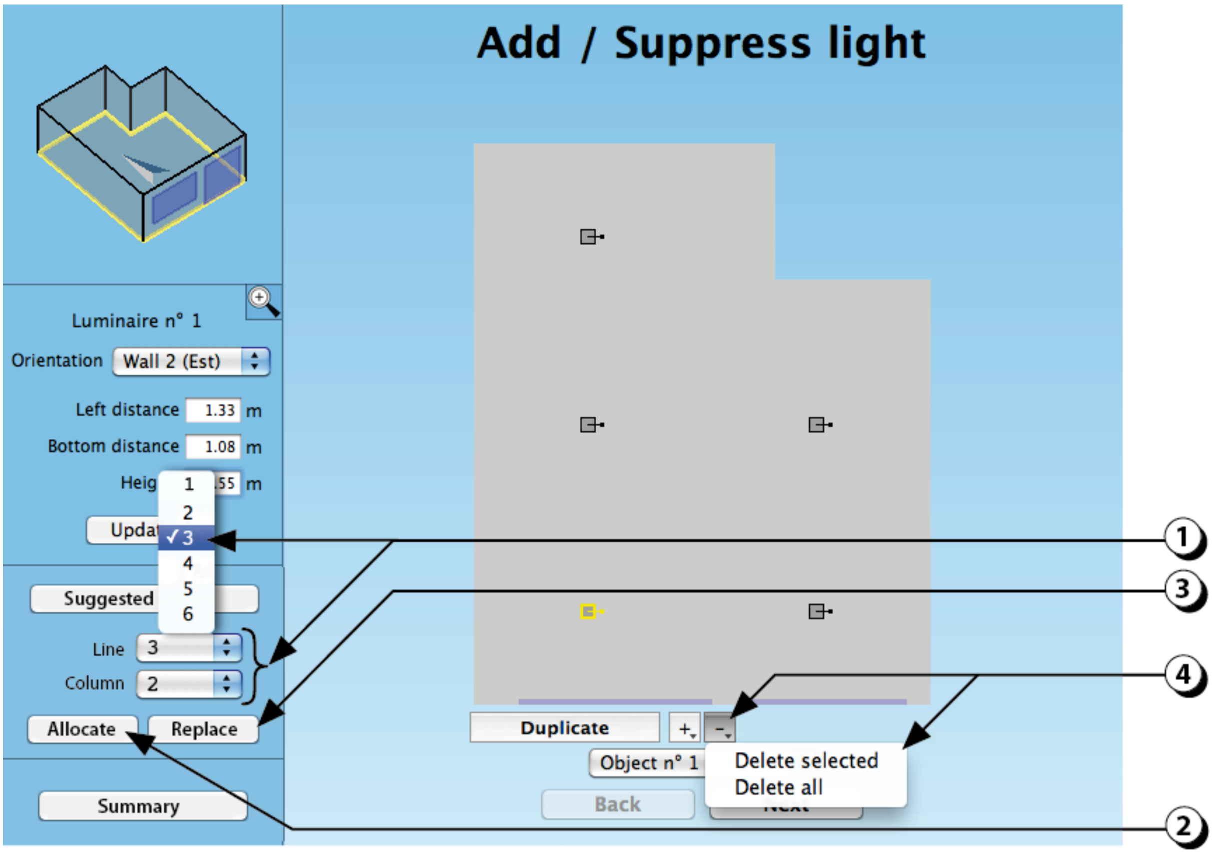
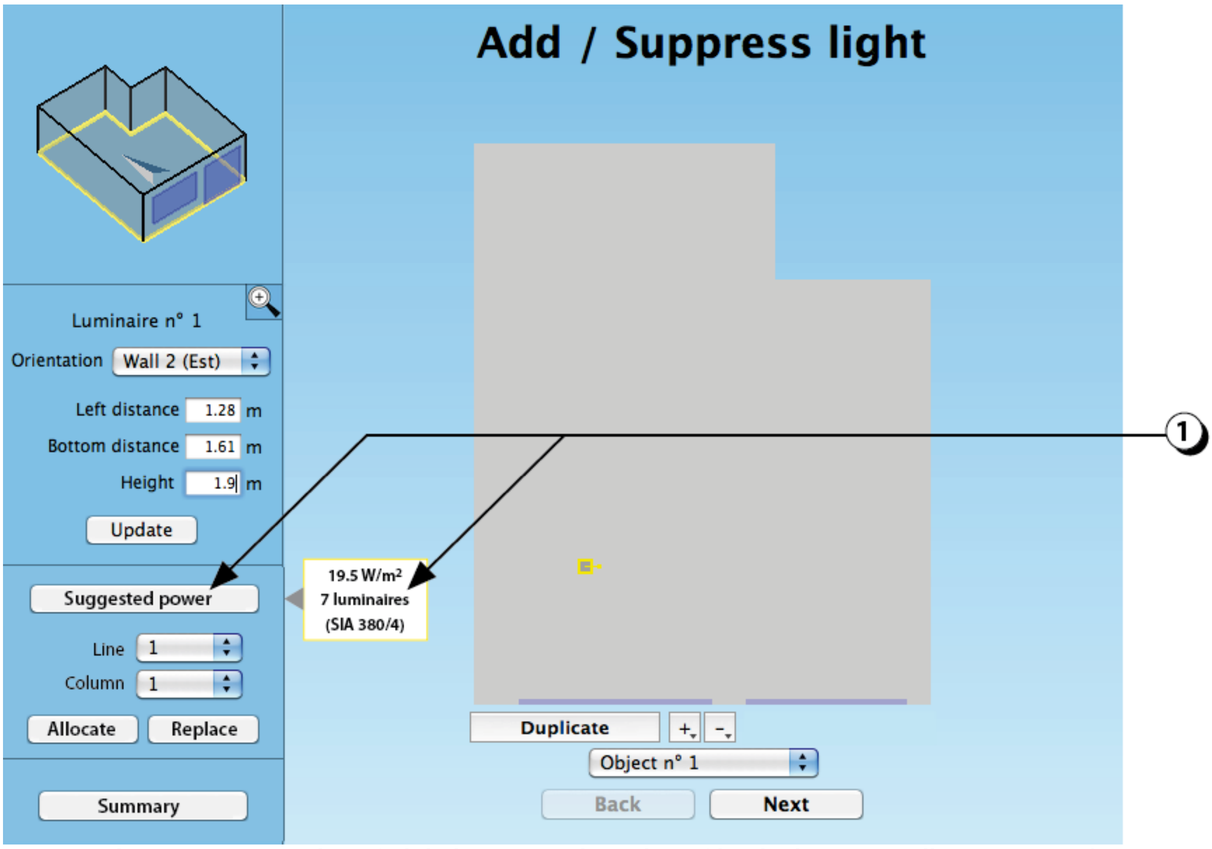


Figure 79: Schematic description of the generation of rows of luminaires.

Suggested power (according to SIA 380/4)

1. If you have no idea how many luminaires should be installed, click on the "Power SIA" button. The software displays a suggestion for total power and number of luminaires (according to Swiss standard: SIA 380/4).

   CAUTION: To the extent that this suggestion is based on providing a uniform level of illumination over the entire surface of the room, it may sometimes lead to overestimate the installation.



Luminaire n° 1

Orientation: Wall 2 (Est)

Left distance: 1.28 m

Bottom distance: 1.61 m

Height: 1.9 m

Line: 1

Column: 1

19.5 W/m²
7 luminaires
(SIA 380/4)

Figure 80: Suggestion of global power and number of luminaires, according to SIA 389/4.

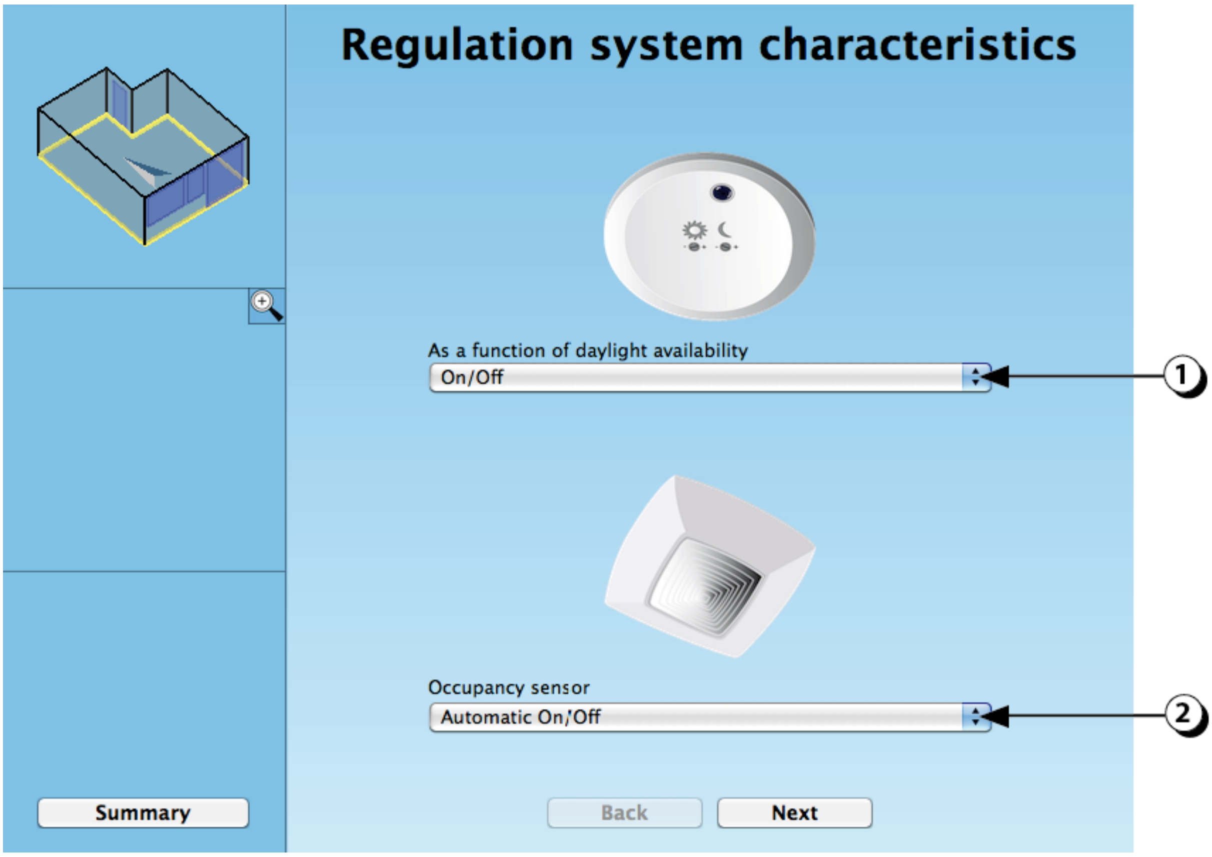
Lighting control

The lighting control and regulation have a great influence on the annual energy consumption due to artificial lighting.

For example:

- Occupancy sensors usually lead to reduce by 20% the annual energy consumption.
- Continuous dimming may lead to divide by 2 the annual energy consumption.

1. Choose with or without occupancy sensor.
2. Select the type of regulation.



Regulation system characteristics

As a function of daylight availability: On/Off

Occupancy sensor: Automatic On/Off

Figure 81: Selection of the artificial lighting control and regulation system.

COMPLETING THE DESCRIPTION OF THERMAL CHARACTERISTICS

Beside the dimensional parameters of the room, thermal simulations require to define the walls composition (thermal mass, insulation, covers, etc). Moreover, the control strategies of shading devices and windows opening (natural ventilation) have to be described.

Floor contact

The first step consists in indicating if the different walls are in contact with external climate or with another indoor room (heated or not).

1. Select the type of contact.
2. The colour of the floor is adapted according to your selection.

- **Indoor** (red): there is not heat transfer threw this element (adiabatic),
- **Outdoor** (blue): the external face is submitted to outdoor weather conditions,
- **Constant temperature** (violet): The adjacent room has a specific constant temperature that can be defined by the user),
- **With reduction factor** (green): The indoor temperature of the adjacent room (T_{adj}) varies depending on the outside Temperature (T_{ext}) and the indoor temperature of the simulated room (T_{Sim}). Thus we have (for example):
    - Reduction Factor = 1 -> $T_{adj} = T_{ext}$,
    - Reduction Factor = 0 -> $T_{adj} = T_{Sim}$,
    - Reduction Factor = 0.5 -> T_{adj} = average (T_{ext} , T_{Sim}),
- **Outdoor ground** (BROWN): The external face is in contact with the ground.

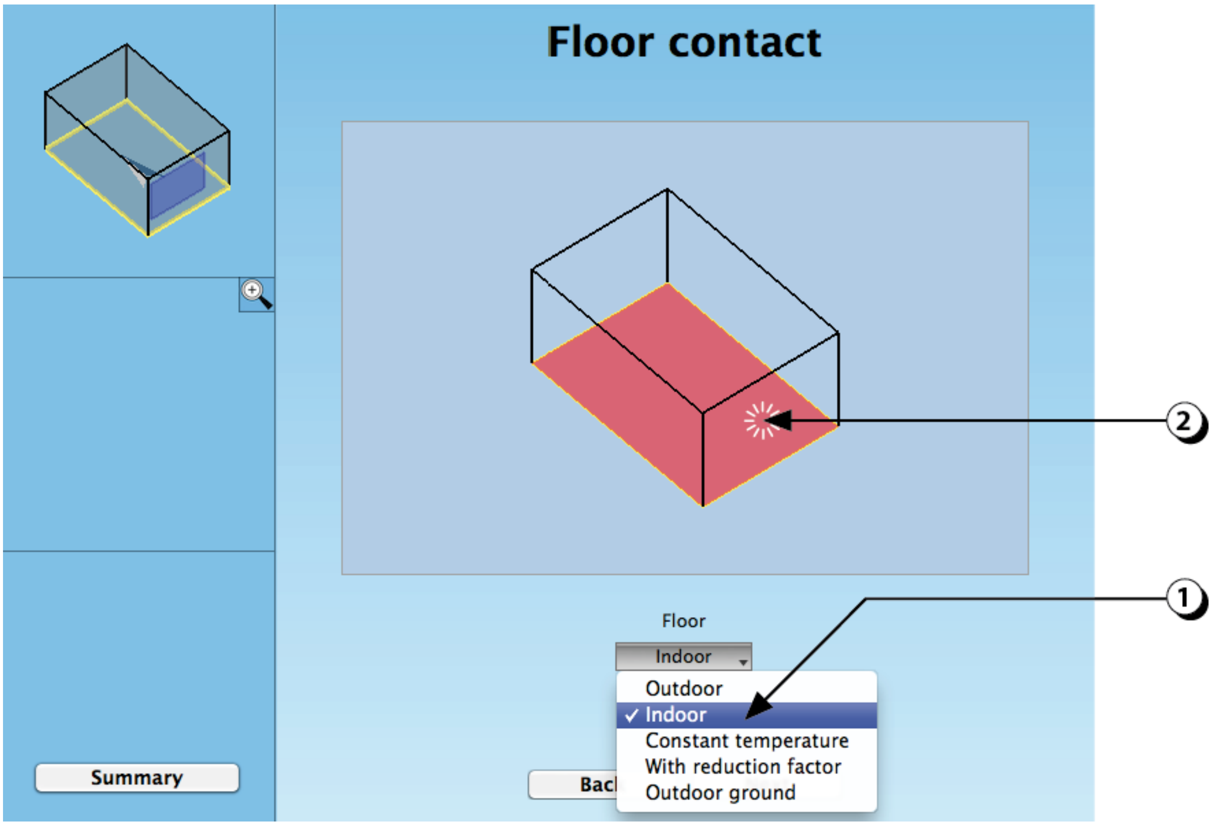


Figure 82: Selection of the floor contact.

Vertical walls contact

1. Select the type of contact.
2. The colour of the wall(s) is adapted according to your selection.
   - **Indoor** (red): there is not heat transfer threw this element (adiabatic),
   - **Outdoor** (blue): the external face is submitted to outdoor weather conditions,
   - **Constant temperature** (violet): The adjacent room has a specific constant temperature that can be defined by the user),
   - **With reduction factor** (green): The indoor temperature of the adjacent room (T_{adj}) varies depending on the outside Temperature (T_{ext}) and the indoor temperature of the simulated room (T_{Sim}). Thus we have (for example):
     - Reduction Factor = 1 -> $T_{adj} = T_{ext}$,
     - Reduction Factor = 0 -> $T_{adj} = T_{Sim}$,
     - Reduction Factor = 0.5 -> T_{adj} = average (T_{ext} , T_{Sim}),
3. Select this button to apply the same properties to all the walls.

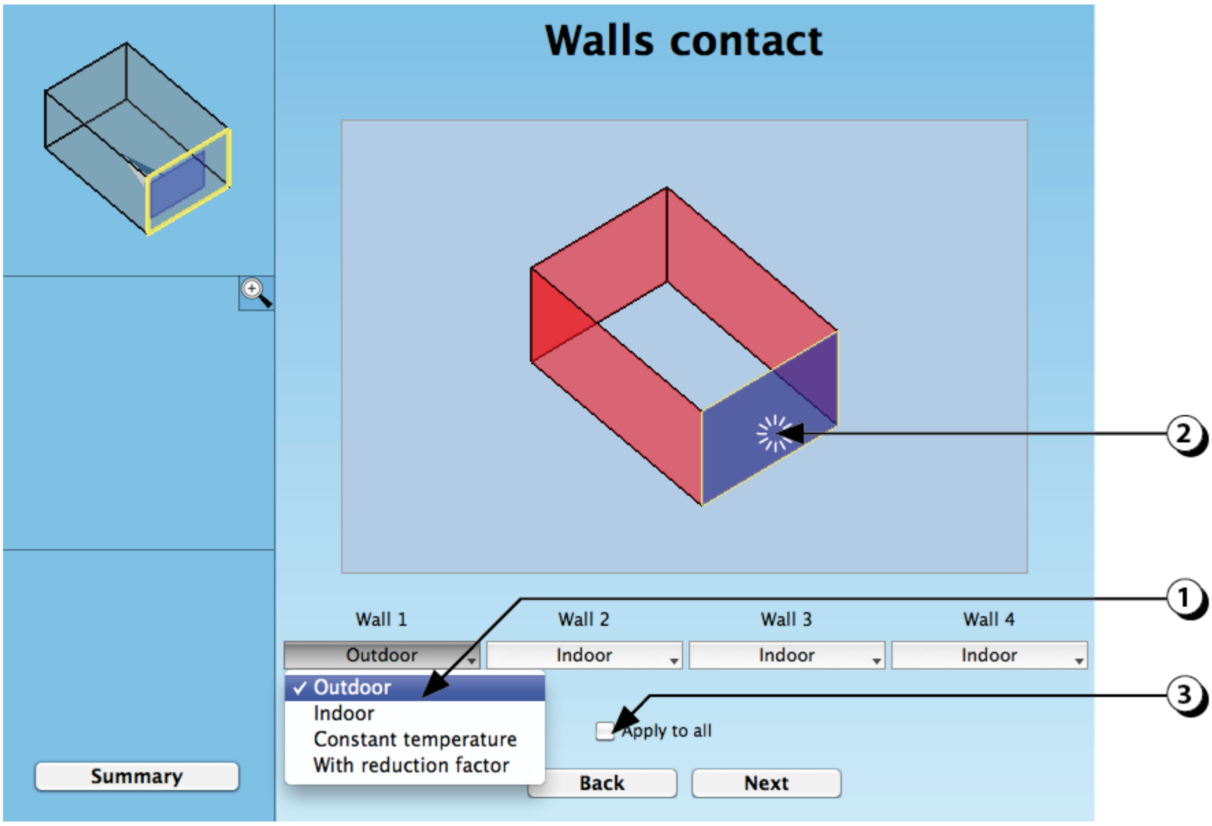


Figure 83: Selection of the walls contact.

Ceiling contact

1. Select the type of contact.
2. The colour of the ceiling(s) is adapted according to your selection.
   - **Indoor** (red): there is not heat transfer threw this element (adiabatic),
   - **Outdoor** (blue): the external face is submitted to outdoor weather conditions,
   - **Constant temperature** (violet): The adjacent room has a specific constant temperature that can be defined by the user),
   - **With reduction factor** (green): The indoor temperature of the adjacent room (T_{adj}) varies depending on the outside Temperature (T_{ext}) and the indoor temperature of the simulated room (T_{Sim}). Thus we have (for example):
     - Reduction Factor = 1 -> $T_{adj} = T_{ext}$,
     - Reduction Factor = 0 -> $T_{adj} = T_{Sim}$,
     - Reduction Factor = 0.5 -> T_{adj} = average (T_{ext} , T_{Sim}),
3. Select this button to apply the same properties to all the ceilings.

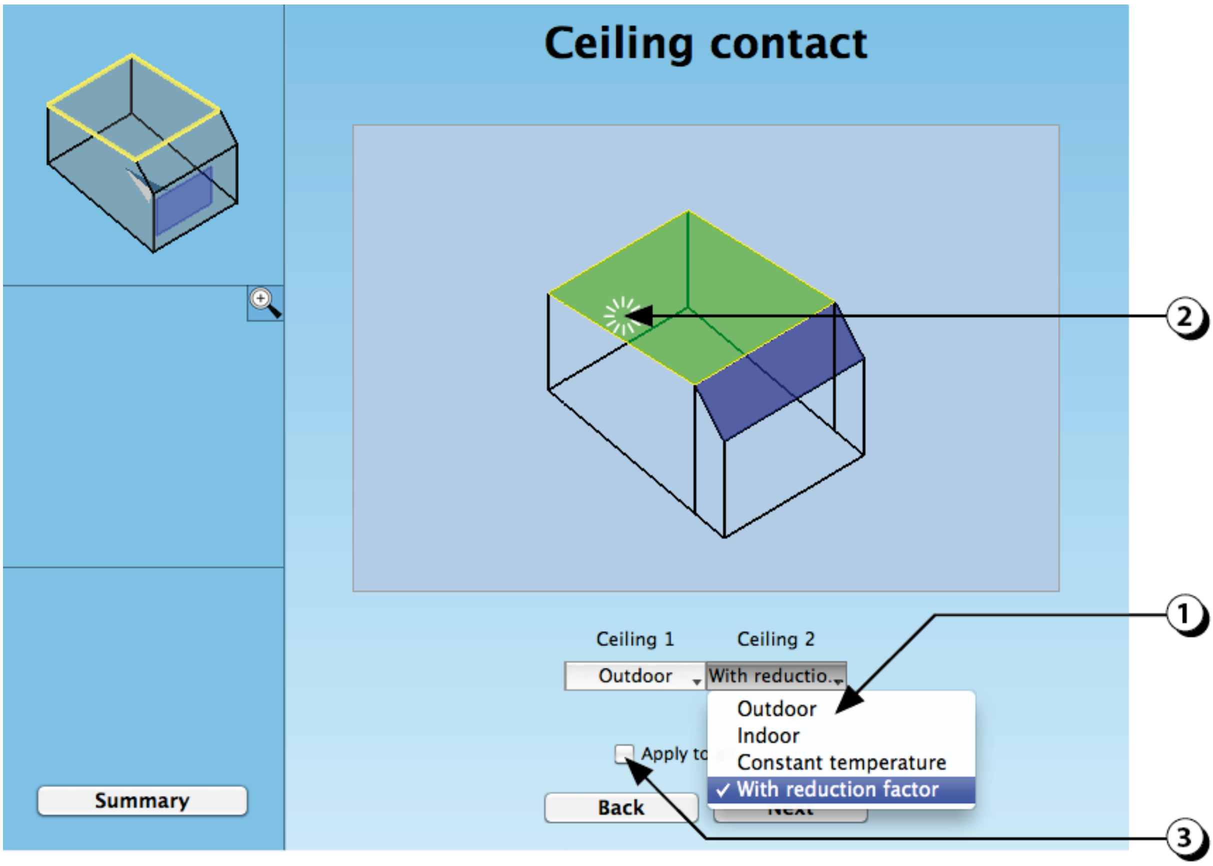


Figure 84: Selection of the ceiling contact(s).

Outdoor wall(s) typology

Depending on their typology, outdoor walls embed a given thermal mass, which will influence the thermal behaviour of the room (thermal inertia).

1. Select the typology corresponding to you case study.

The 3 available possibilities respectively represent a:

- “Low “ thermal mass (Light wall),
- “Average” thermal mass (Masonry)
- “High” thermal mass (Concrete).

2. Click this button to apply the same typology to all the outdoor walls.
3. Use the 3D display to check the wall you are modifying.

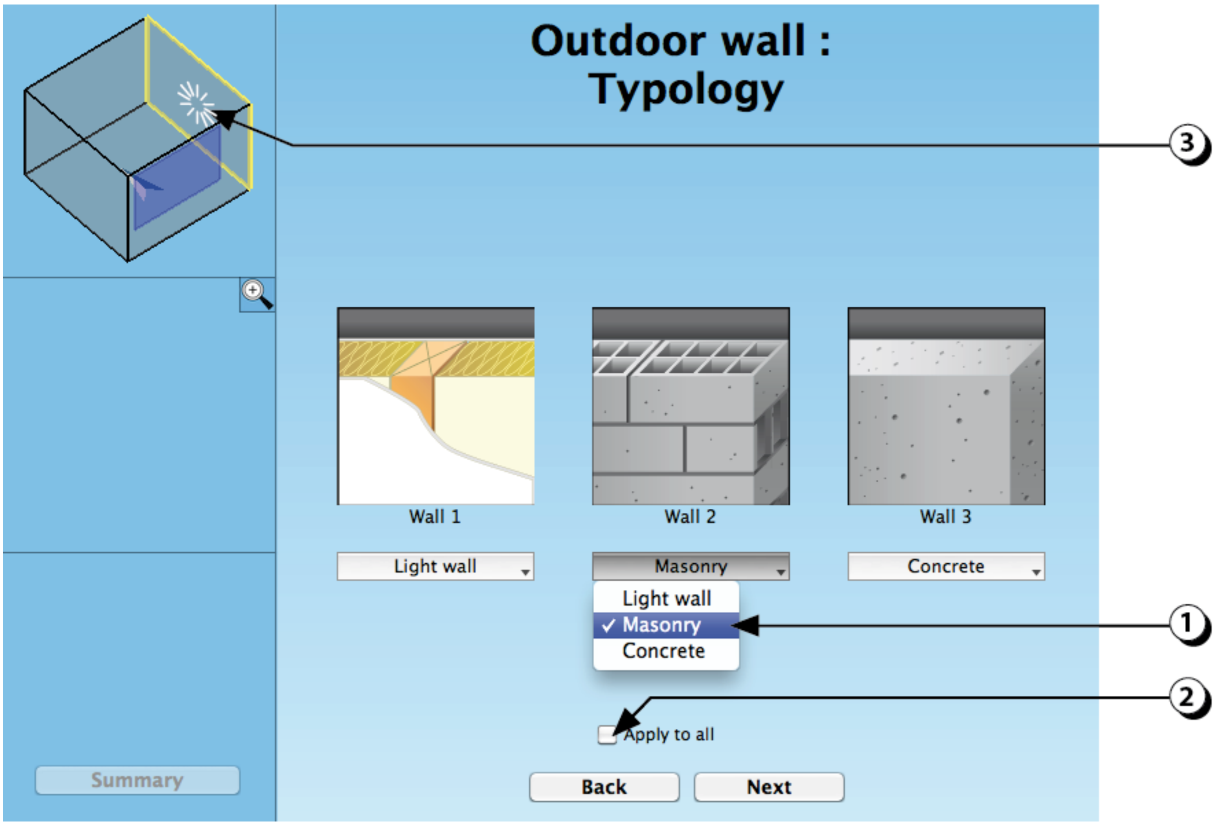


Figure 85: Selection of the outdoor walls typology.

Insulation of outdoor walls

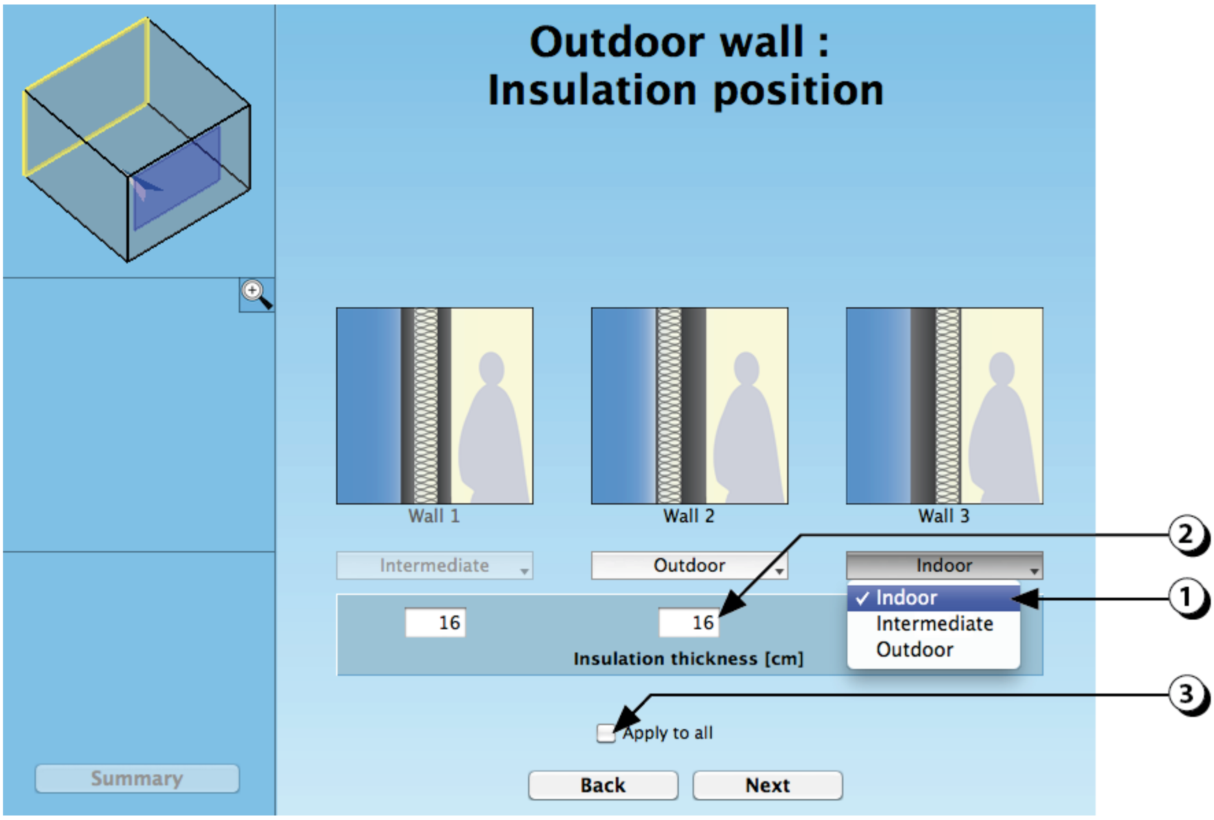
1. Select the insulation position of each outdoor wall, (indoor, intermediate or outdoor).

   NOTA: if the insulation is located on the inside face of the wall, the access to the eventual thermal mass of the corresponding wall will be neglected.

2. Indicate the insulation thickness of each of the outdoor walls.

   CAUTION: The default value for insulation thermal conductivity is 0.04 W/mK. If the real value of the insulation material you would like to use is different, you should consequently adapt the insulation thickness.

3. Click this button to apply the same characteristics to all the outdoor walls.



Outdoor wall :
Insulation position

Wall 1: Intermediate, 16

Wall 2: Outdoor, 16

Wall 3: Indoor

Insulation thickness [cm]

☐ Apply to all

Figure 86: Description of the outdoor wall(s) insulation characteristics.

Indoor wall(s) typology

1. Select the typology of each indoor wall.

   The 5 available possibilities respectively represent a:

   - “Low “ thermal mass (Light wall),
   - “Rather low” thermal mass (Plaster blocks),
   - “Average” thermal mass (Hollow clay blocks),
   - “Rather high” thermal mass (Masonry),
   - “High” thermal mass (Concrete).

2. Click this button to apply the same characteristics to all the outdoor walls.

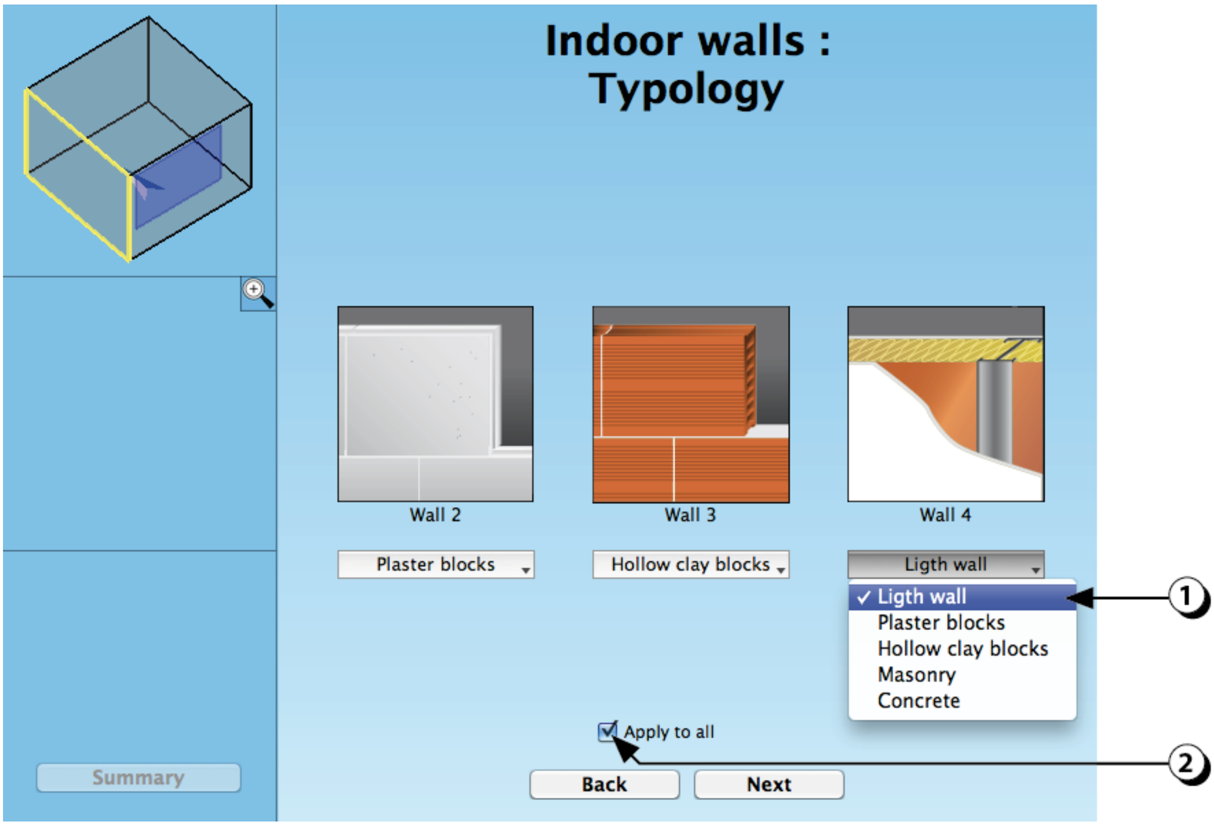


Figure 87: Selection of the indoor wall(s) typology.

Typology of indoor ceiling

1. Select the typology of the indoor ceiling.

The 4 available possibilities respectively represent a:

- “Low “ thermal mass (Wooden structure or Steel),
- “Average” thermal mass (Beams + ribbed floor),
- “High” thermal mass (Concrete).

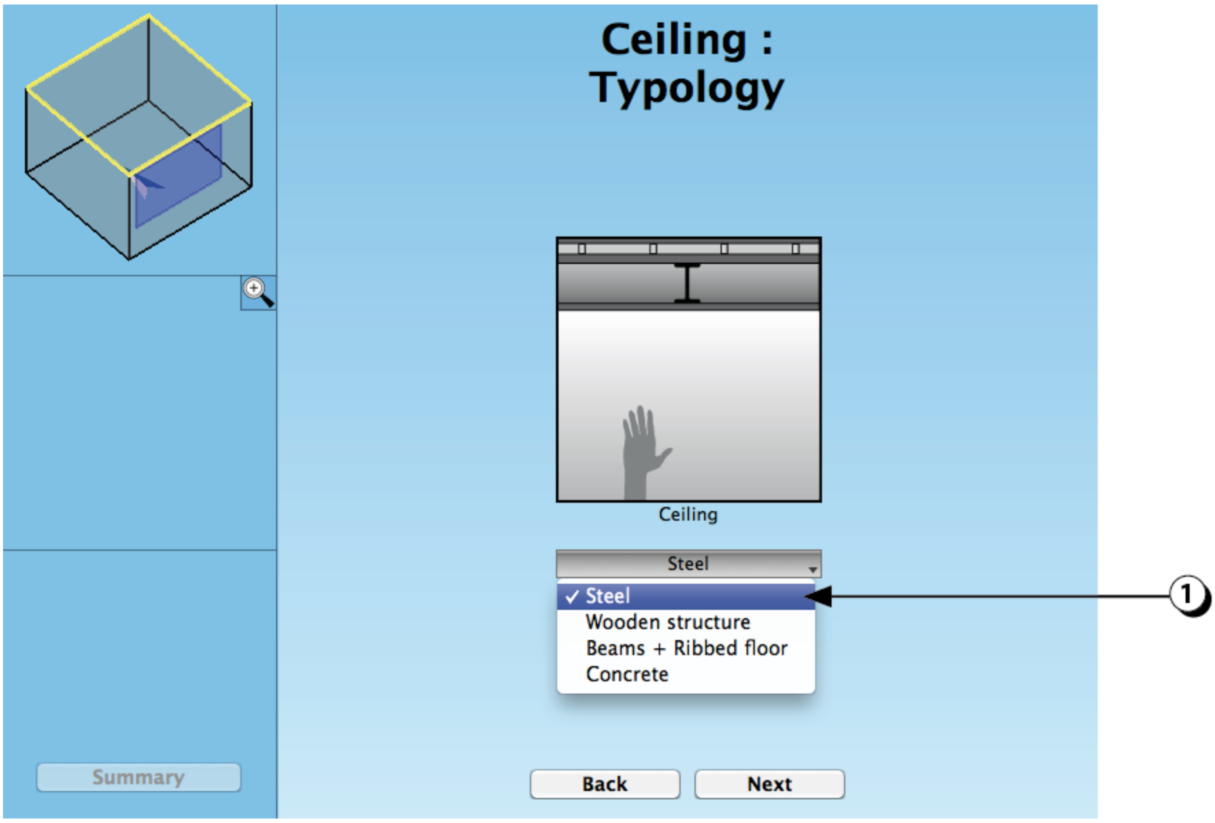


Figure 88: Selection of the ceiling typology.

Floor typology

1. Select the typology of the indoor floor.

   The 4 available possibilities respectively represent a:

   - “Low “ thermal mass (Wooden structure or Steel),
   - “Average” thermal mass (Beams + ribbed floor),
   - “High” thermal mass (Concrete).

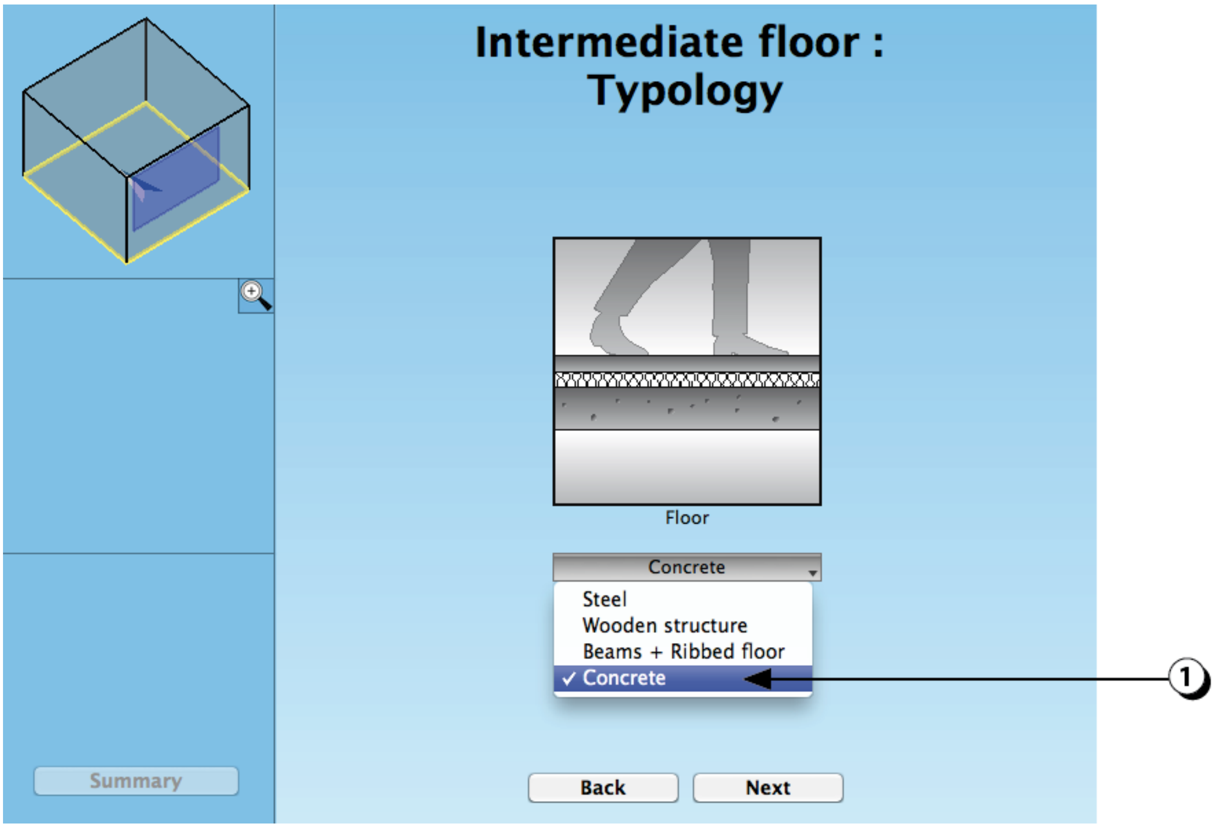


Figure 89: Selection of the floor typology.

Walls indoor coating

1. Select the type of indoor coating of each vertical wall.

   “Wood” and “Acoustic panels” would block the access to the eventual thermal mass of the wall.
2. Click this button to apply the same coating to all the walls.

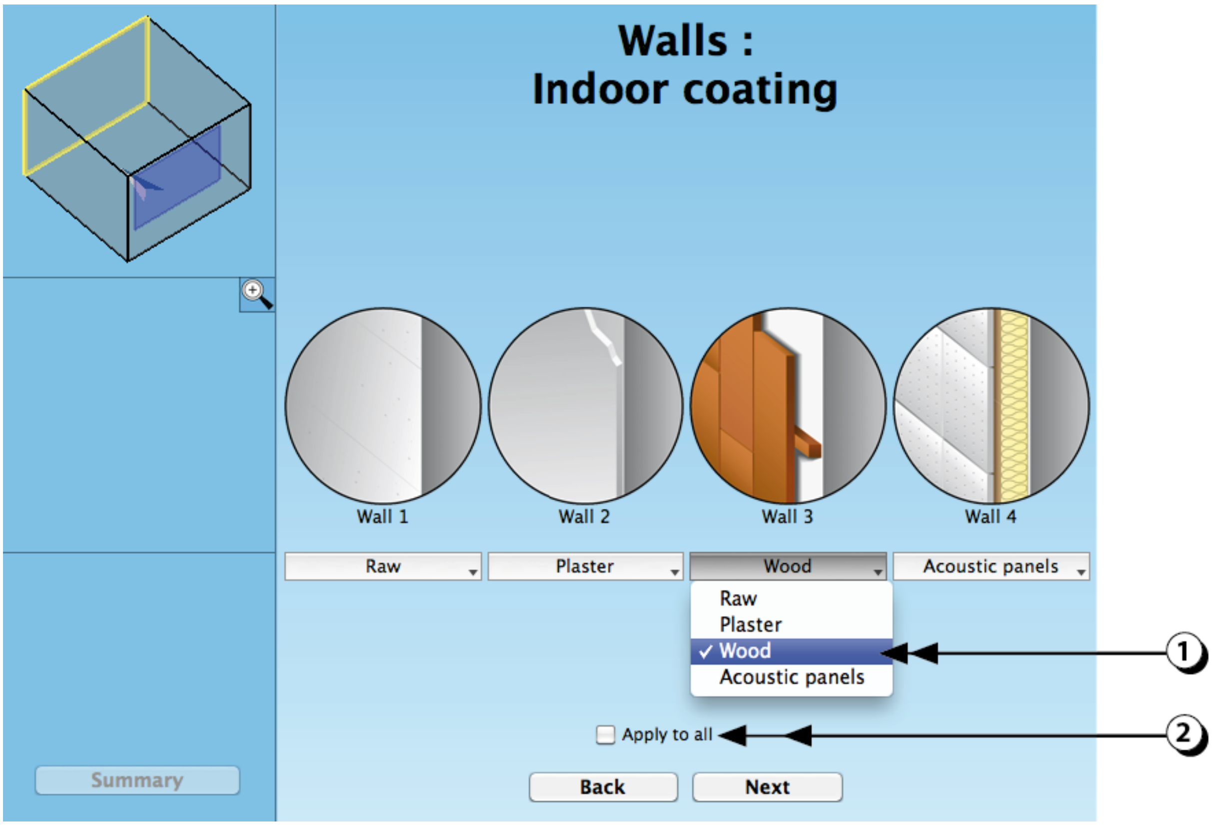


Figure 90: Indoor coating of the vertical walls.

Ceiling indoor coating

1. Select the type of indoor coating for ceiling.

“Wood”, “False ceiling” and “Acoustic panels” would block the access to the eventual thermal mass of the ceiling slab.

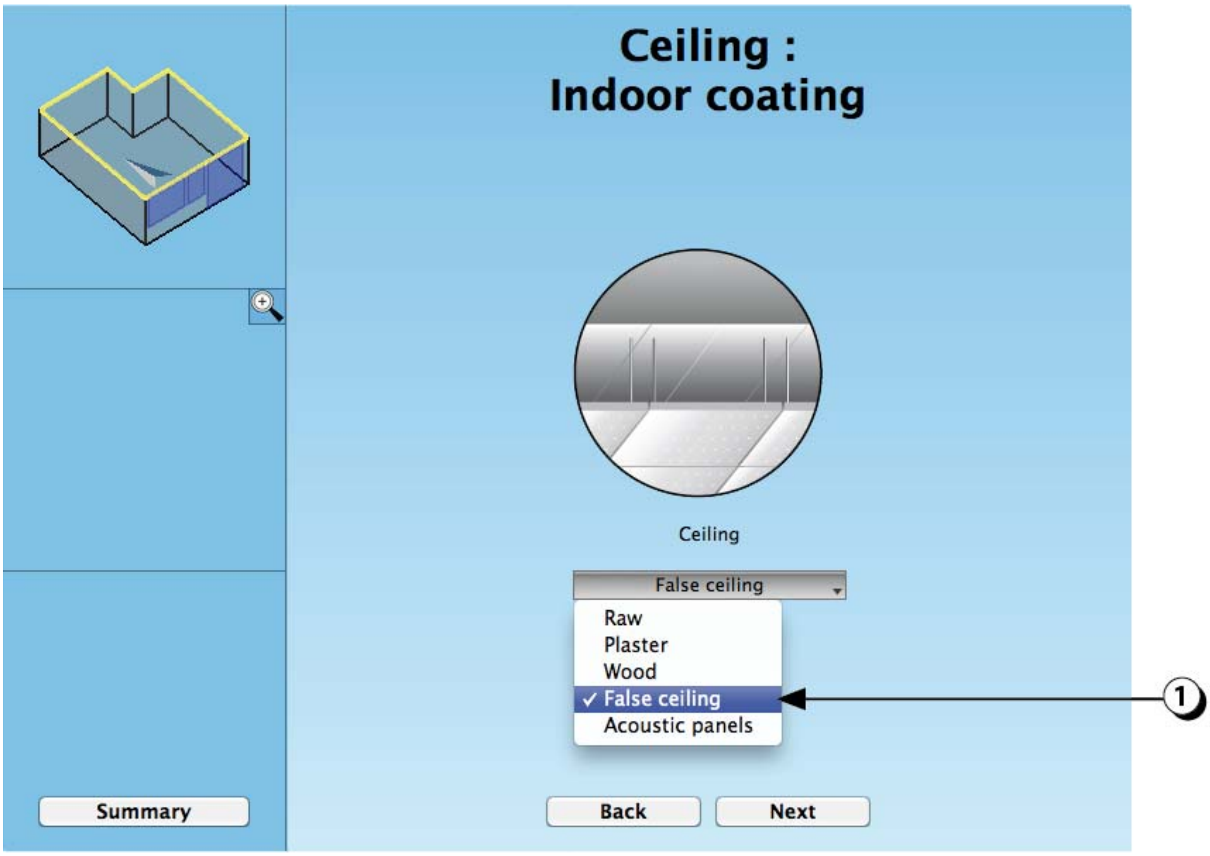


Figure 91: Selection of the ceiling coating.

Floor indoor coating

1. Select the type of indoor coating of the floor.

   “Parquet” and “False floor” would block the access to the eventual thermal mass of the slab.

   “Carpet / Linoleum” would block partially the access to the eventual thermal mass of the slab.

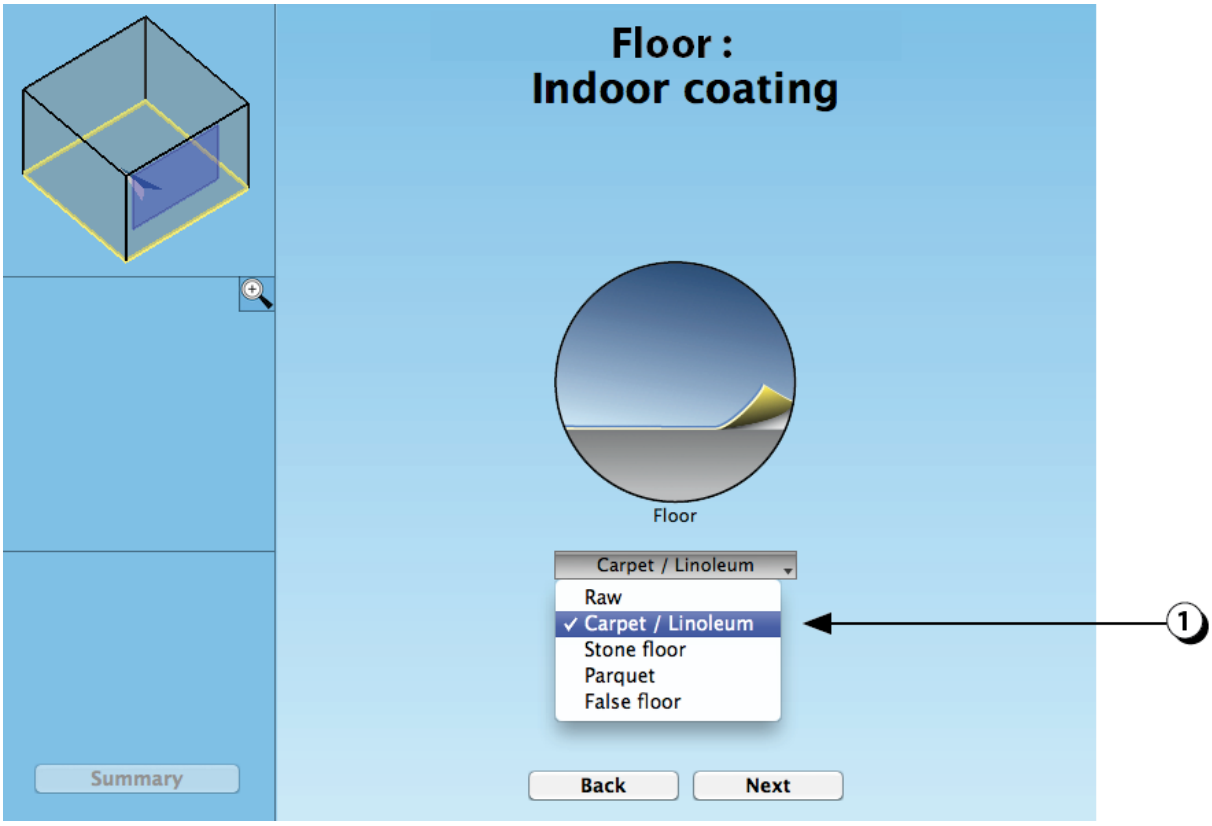


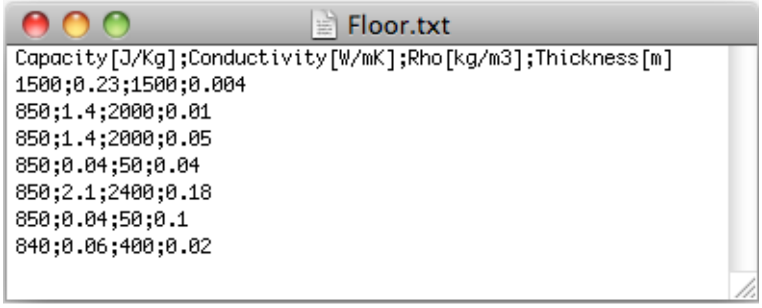
Figure 92: Selection of the floor coating.

How to customize the composition of the walls

(expert users)

It is possible to define precisely the walls composition. To do so, you should:

1. Create a new folder whose name corresponds to the name of the **room** you are working on, followed by «_*Composition*» (for example: « *Room 1_Composition* »).
2. Place this folder in the same folder as your DIAL+ **project**.
3. Within the "_Composition folder", create a set of text-files corresponding to each of the room walls.
    - For a parallelepiped room, the folder should include the following files: « Floor.txt », « Wall1.txt », « Wall2.txt », « Wall3.txt », « Wall4.txt » et « Roof1.txt ».
    - For a L-shape room with a 2 slopes roof, 3 additional files should be created: « Wall5.txt », « Wall6.txt » and « Roof2.txt ».
4. The content of each text-file describes the characteristics (Capacity, Conductivity, Density, Thickness) of each layer (the first layer corresponds to the indoor coating; the last line corresponds to the outdoor layer).



```
Capacity[J/Kg];Conductivity[W/mK];Rho[kg/m3];Thickness[m]
1500;0.23;1500;0.004
850;1.4;2000;0.01
850;1.4;2000;0.05
850;0.04;50;0.04
850;2.1;2400;0.18
850;0.04;50;0.1
840;0.06;400;0.02
```

Figure 93: Example of text-file describing the specific composition of a wall (here a floor).

CAUTION: Each wall should be composed of at least 3 layers to be compatible with the nodal model of the software. The fist layer corresponds to the indoor coating and should be rather thin (idem for outdoor layer).

CAUTION: For each new room you have to create a complete set of composition text-files (including when you duplicate or rename a room).

For your convenience, you can copy the following lines, change the values and possibly add text lines corresponding to additional layers).

```
Capacity[J/Kg];Conductivity[W/mK];Rho[kg/m3];Thickness[m]

1500;0.23;1500;0.004

850;1.4;2000;0.01

850;1.4;2000;0.05

850;0.04;50;0.04

850;2.1;2400;0.18
```

Internal gains due to occupants

PRECISION: For thermal simulations, the “**room occupation**” corresponds to the time slots during which users are assumed to be present in the room (default value = Swiss standard SIA-2024 according to the room allocation).

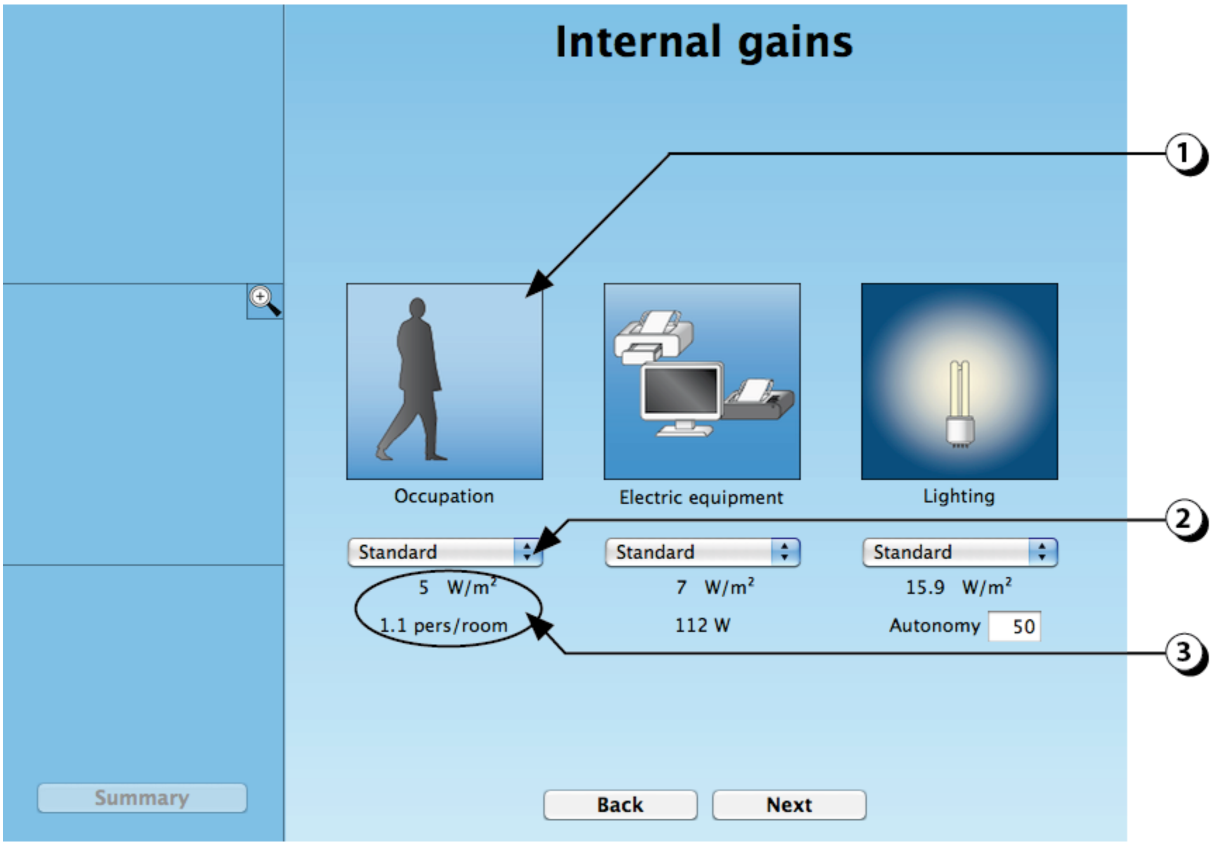
The notion of “**room utilisation”** corresponds to the period during which the devices are switched on (This distinction allows us to take into consideration house buildings where a room can be occupied while devices are switched off (sleeping room during the night).

1. Internal gains due to the occupants are given in W/m^2.

4. They depend on the room function and are linked to the number of person(s), their activity and the occupation schedule.

2. The default value « standard » correspond to the SIA 2024 Swiss Norm. You can modify this value by clicking this button (choose between “Low”, “Standard” and “Important”). It is also possible to enter a “User defined value”.

3. This value is used in combination to the occupation schedule, in accordance with the room function (Hypothesis: 1 person / average activity = 70 W).



Occupation: Standard — 5 W/m^2 — 1.1 pers/room

Electric equipment: Standard — 7 W/m^2 — 112 W

Lighting: Standard — 15.9 W/m^2 — Autonomy 50

Figure 94: Description of the internal gains due to occupation.

Nota: In the calculation, irradiative and convective parts are assumed to both equal to 50%.

How to customize the utilization & occupation profiles

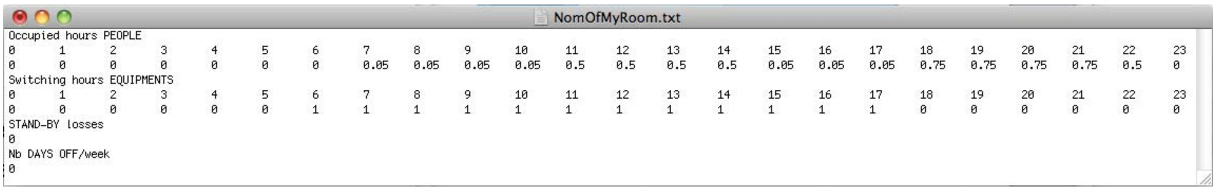
(Expert users)

To customize the occupation and utilization profiles (schedules) please do as follow:

1. Create a text file according to the model presented below. This files describes for each hour:
    - The occupation hours («*Occupied hours PEOPLE*»),
    - The switching hours («Switching hours EQUIPMENTS»).

    As well as:

    - The stand-by losses (if stand-by losses = 12%, then enter 0.12),
    - The number of non-occupied days per week («*Nb DAYS OFF/week*»).
2. Give this file the name of your room (Example: "Room-1.txt »).
3. Place this file inside the folder corresponding to your DIAL+ project.



```
Occupied hours PEOPLE
0     1     2     3     4     5     6     7     8     9     10    11    12    13    14    15    16    17    18    19    20    21    22    23
0     0     0     0     0     0     0     0.05  0.05  0.05  0.05  0.5   0.5   0.5   0.5   0.05  0.05  0.05  0.75  0.75  0.75  0.75  0.5   0
Switching hours EQUIPMENTS
0     1     2     3     4     5     6     7     8     9     10    11    12    13    14    15    16    17    18    19    20    21    22    23
0     0     0     0     0     0     1     1     1     1     1     1     1     1     1     1     1     1     0     0     0     0     0     0
STAND-BY losses
0
Nb DAYS OFF/week
0
```

Figure 95: Example of text-file describing a given utilization profile.

CAUTION:

- In the hour list, the "0" index corresponds to the first hour (from 0:00 to 1:00 AM).
- Occupation and switching values should be somewhere between 0 and 1 (simultaneity factors).
- The specific powers for occupation and utilization are described on page 104.
- If you modify the name of your room (ex. when you duplicate it), the utilization profile will no more linked to the new room.

For your convenience, you may copy these lines:

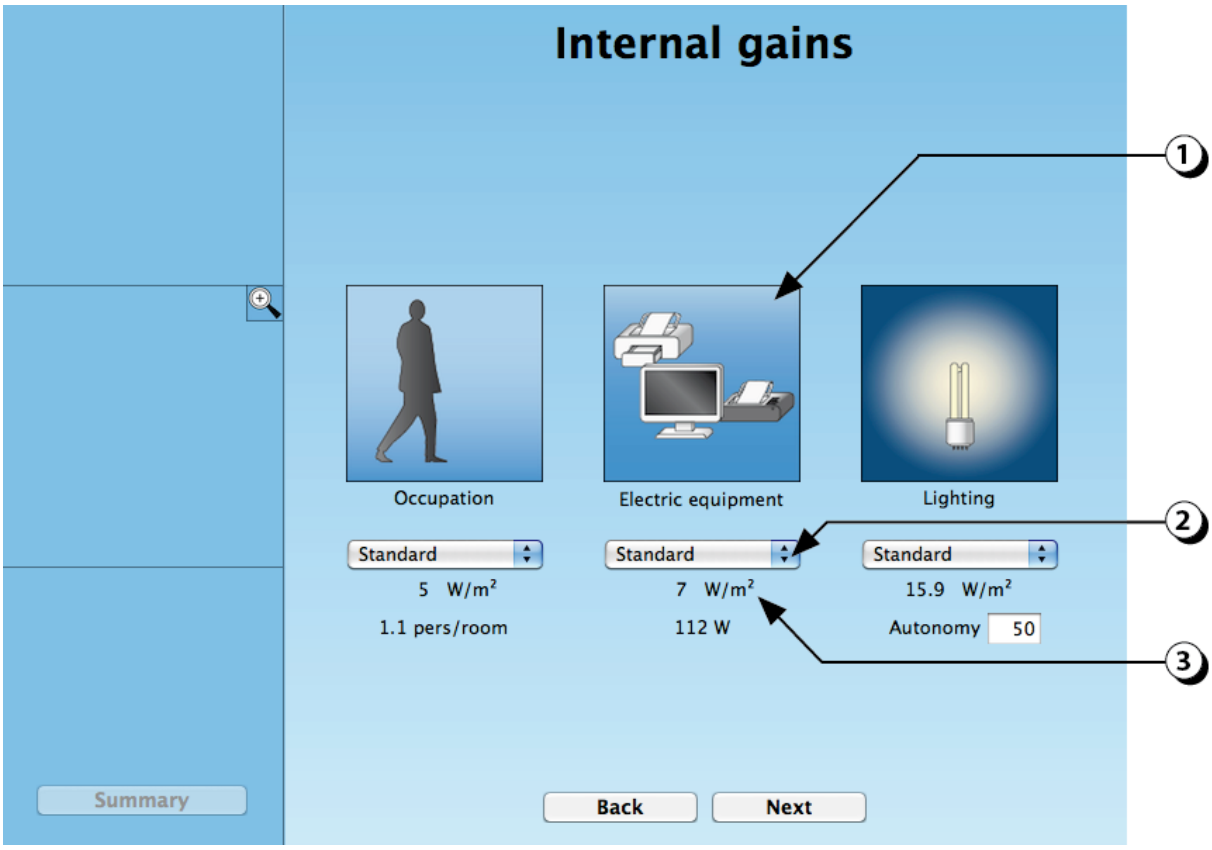
```
Occupied hours PEOPLE
0   1   2   3   4   5   6   7   8   9   10  11  12  13  14  15  16  17  18  19  20  21  22  23
0   0   0   0   0   0   0   0.1 0.1 0.1 0.1 0.5 0.5 0.5 0.5 0.1 0.1 0.1 0.7 0.7 0.7 0.7 0.5 0
Switching hours EQUIPMENT
0   1   2   3   4   5   6   7   8   9   10  11  12  13  14  15  16  17  18  19  20  21  22  23
0   0   0   0   0   0   1   1   1   1   1   1   1   1   1   1   1   1   0   0   0   0   0   0
Stand by losses
0
Nb DAYS OFF/week
0
```

Internal gains due to devices

For thermal simulations, the “**occupancy period**” corresponds to the hours during which the users are in the room (default values are those of the Swiss standard).

On the other hand, the notion of “**utilization period**” corresponds to the hours during which the equipment are in function (for example this allows us to take into consideration the residential buildings where the room may be occupied (room during the night) while the equipment (lighting) are switched off).

1. Internal gains due to equipment [W/m^2] are linked to the room function:
    - Residential: television, household electrical appliances, cooking, etc.
    - Offices: computers, printers, fax, etc.
    - Industry: machines, production process, etc.
2. The default value « standard » correspond to the Swiss Norm SIA 2024. You can modify this value by clicking this button (choose between “Low”, “Standard” and “Important”).
3. It is also possible to enter a “User defined value”.
4. This value is used in combination to the occupation schedule corresponding to the room function (in this version of the software, the occupation schedule cannot be modified).



Occupation	Electric equipment	Lighting
Standard	Standard	Standard
5 W/m^2	7 W/m^2	15.9 W/m^2
1.1 pers/room	112 W	Autonomy 50

Figure 96: Description of the internal gains due to equipments.

Nota: The irradiative part is assumed to be 20% and the convective part 80%.

Internal gains due to artificial lighting

1. Internal gains due to artificial lighting are given in W/m^2. The value depends on the global installed power divided by the room surface.
2. The “Standard” value, that correspond to a typical value related to the room function. If you have already run the “Lighting energy calculation (380/4)” with the “DIAL+Lighting” module, you can report the “specific power” value (User defined value).
3. The default value for daylighting autonomy is 50%. If you have already calculated the daylighting potential of the room with the “DIAL+Lighting” module, you can either report the simplified daylighting autonomy value (SIA-380/4 Swiss norm) or enter the average value of daylighting autonomy calculated with the daylighting module (cf. page149).

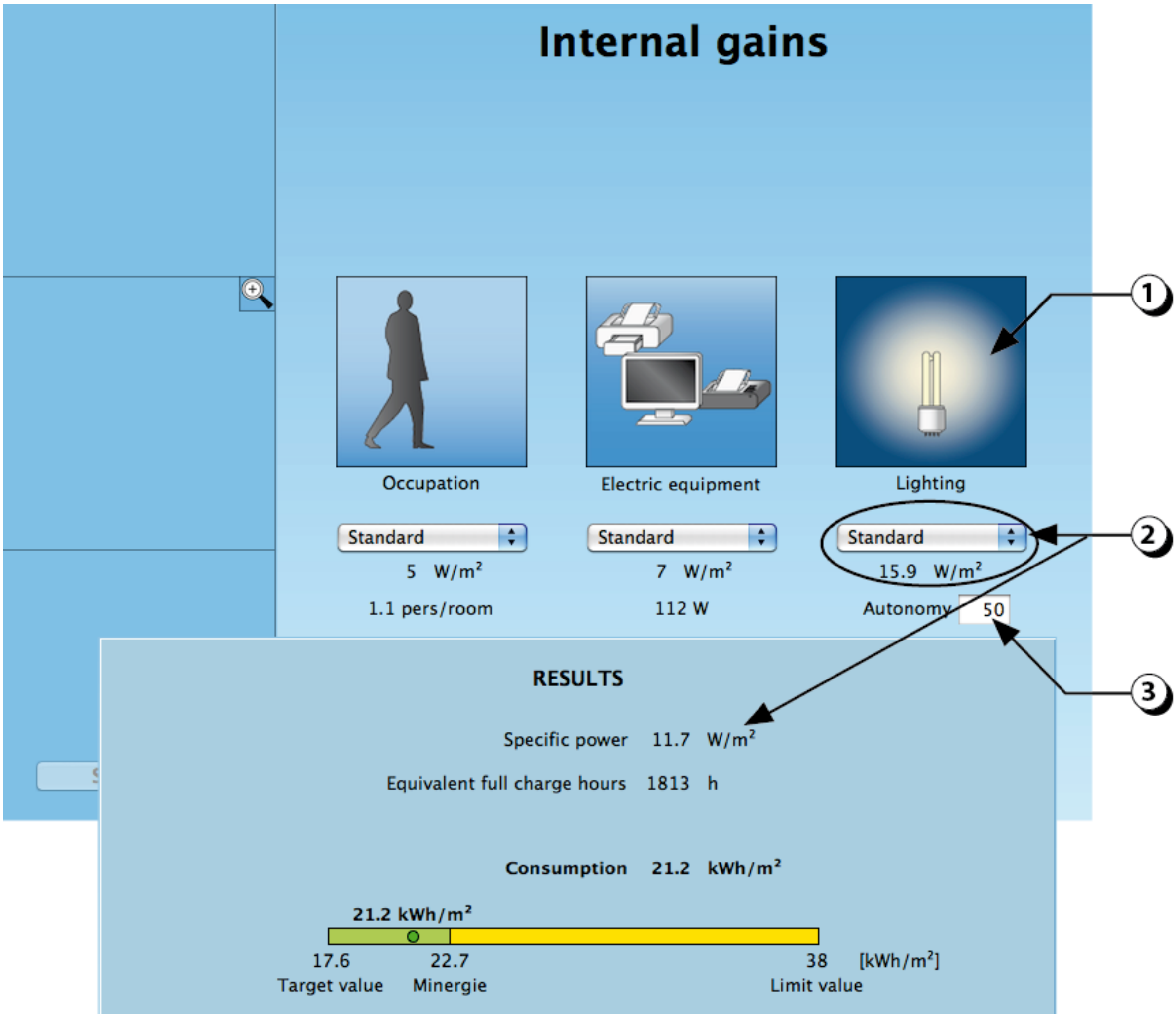


Figure 97: Internal gains due to artificial lighting.

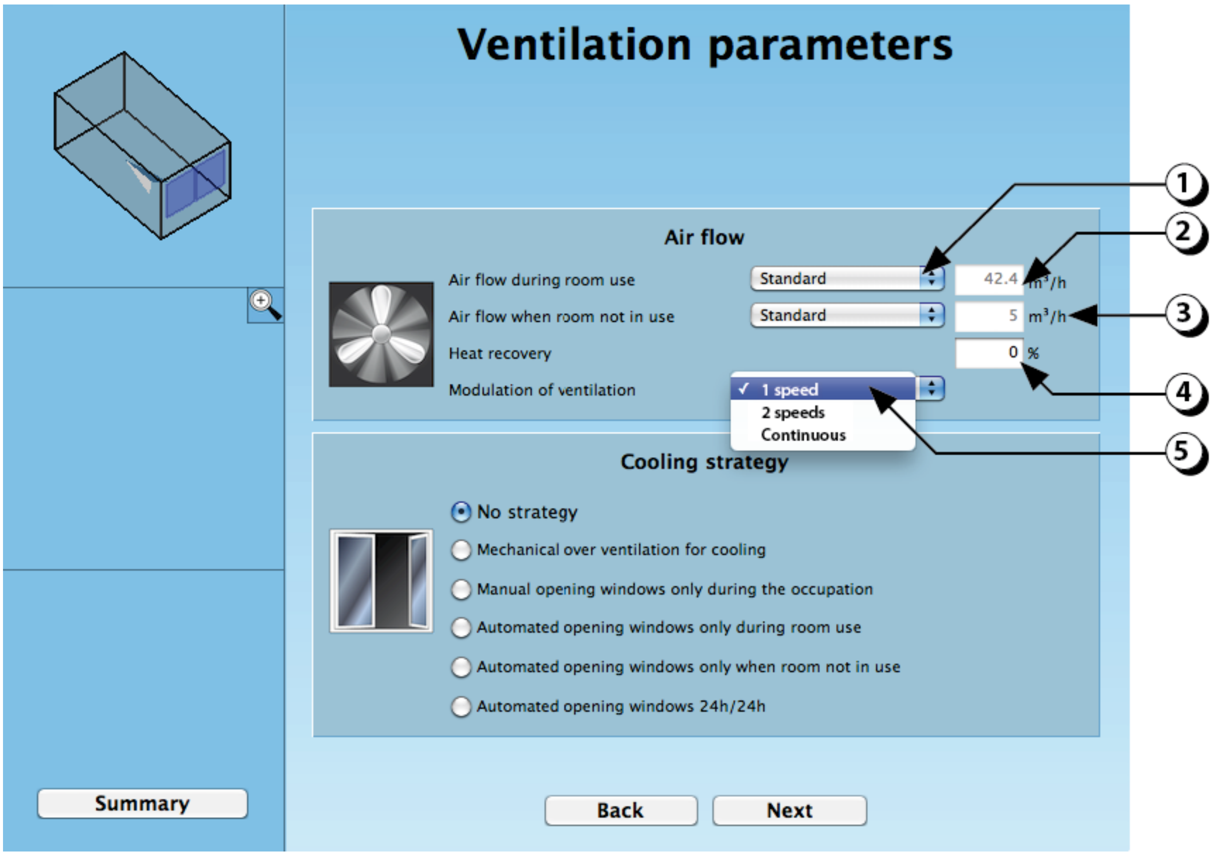
Note: The irradiative part is assumed to be 70% and the convective parts 30%.

Ventilation parameters: Airflow

Ventilation plays a very important role regarding the dynamic thermal behaviour of the room.

1. The airflow during room use corresponds to the extraction of stale air (hygienic air flow). A default value is proposed as function of the room surface and function.
2. If you choose "User defined", you can change the airflow with your keyboard. This rate will be applied during occupied hours.
3. A reduced airflow rate is proposed for the unoccupied hours. You can modify this value by entering a "User value".
4. Heat recovery: you can adjust the percentage of heat recovery (dual-flow).
5. Modulation ventilation during use:

- 1 speed: The applied value for air flow is the one of field 2,
- 2 speeds: - If occupancy rate < 50% then flow rate = 50%,
  - If occupancy rate > 50% Then flow rate = 100%,
- Continuous: The airflow (cf. field 2) is varying according to the occupancy rate.



Ventilation parameters

Air flow

Air flow during room use: Standard 42.4 m^3/h

Air flow when room not in use: Standard 5 m^3/h

Heat recovery: 0 %

Modulation of ventilation: ✓ 1 speed

Cooling strategy

● No strategy

○ Mechanical over ventilation for cooling

○ Manual opening windows only during the occupation

○ Automated opening windows only during room use

○ Automated opening windows only when room not in use

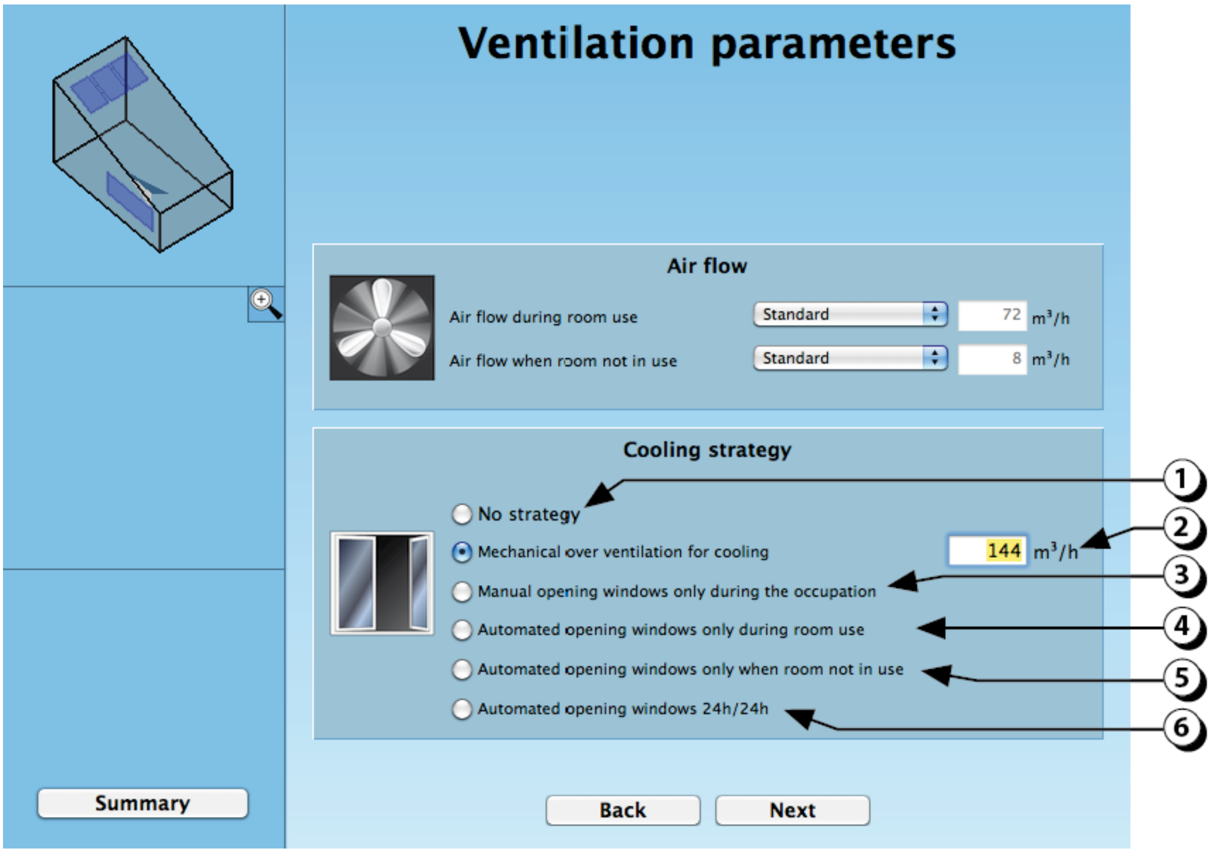
○ Automated opening windows 24h/24h

Figure 98: Ventilation parameters: definition of the airflow.

Ventilation parameters: Cooling strategy

Beyond hygienic purposes, ventilation may be used for free cooling.

1. If you choose “No strategy”, the result of the simulation will be representative of the maximum risk for overheating during summer.
2. The mechanical airflow rate is increased as soon as $T_{ext} < T_{int}$ (and $T_{int} > T_{min}$*). Use your keyboard to enter the corresponding flow (m^3/h) in the adjacent field.
3. This scenario implies that the occupants open the windows when $T_{int} > T_{max}$* (only during the working hours).
4. The openings are automatically opened during working hours as soon as $T_{ext} < T_{int}$ (and $T_{int} > T_{min}$*).
5. The windows are automatically opened during unoccupied hours, as soon as $T_{ext} < T_{int}$ (and $T_{int} > T_{min}$*).
6. The windows are automatically opened 24/24h as soon as $T_{ext} < T_{int}$ (and $T_{int} > T_{min}$*).



Ventilation parameters

Air flow

Air flow during room use: Standard 72 m^3/h

Air flow when room not in use: Standard 8 m^3/h

Cooling strategy

○ No strategy

● Mechanical over ventilation for cooling 144 m^3/h

○ Manual opening windows only during the occupation

○ Automated opening windows only during room use

○ Automated opening windows only when room not in use

○ Automated opening windows 24h/24h

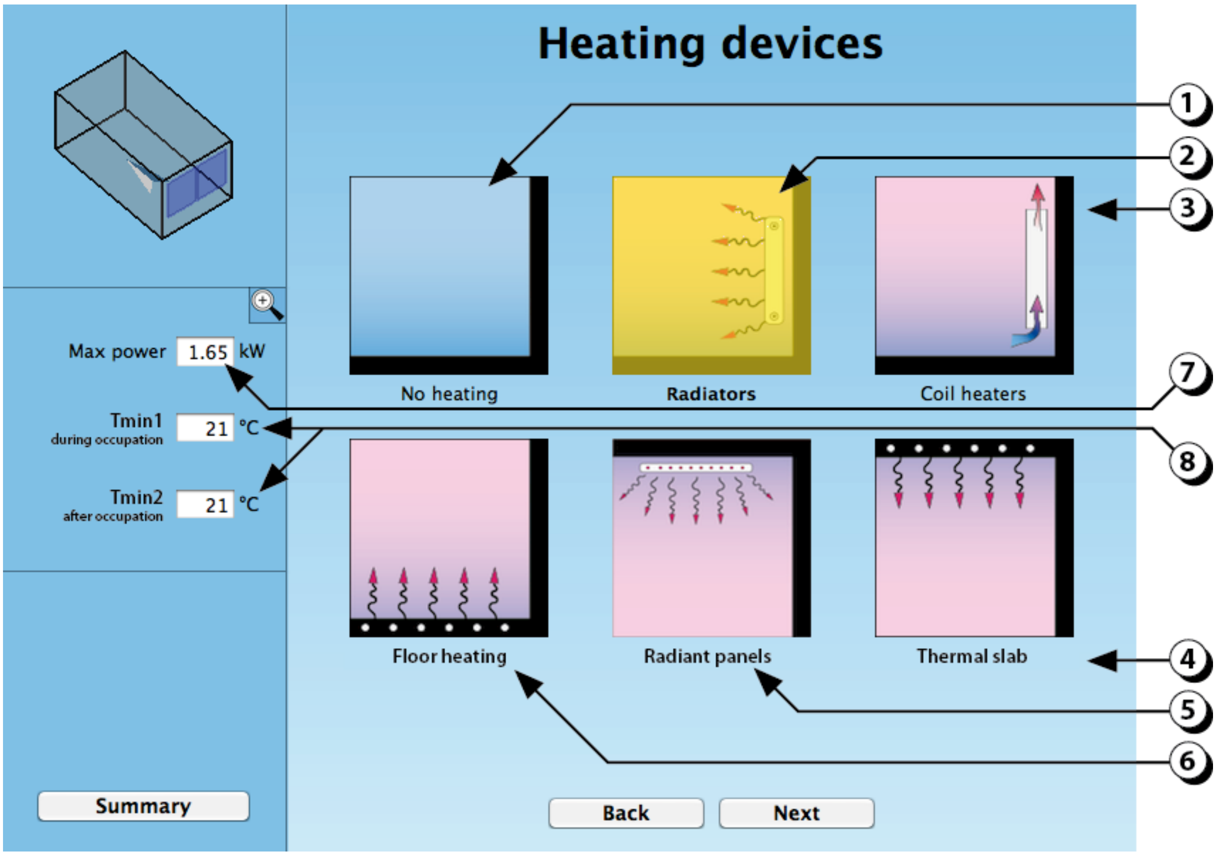
Figure 99: Ventilation: cooling strategy.

*T_{min} and T_{max} = comfort temperatures, see pages 110 & 111.

Heating devices

Select the heating devices:

1. No heating: the simulation will show the indoor temperature evolution along the year, without any heating device.
2. Radiators: Both irradiative and convective parts are equal to 50%.
3. Coil heaters: the convective part represents 100%.
4. Thermal slab: 100% of the heat is distributed via the ceiling slab (available if concrete slab).
5. Radiant panels: 100% of the heat is distributed via a specific element located just under the ceiling.
6. Floor heating: 100% of the heat is distributed via the floor slab (available if concrete slab).
7. Enter the power heating. A default value corresponding to 100W/m^2 is proposed (if the maximum power is too low, the indoor temperature might be lower than the requested value).
8. You can modify the set point temperature (during and outside of the utilisation period).



Max power 1.65 kW

Tmin1 during occupation 21 °C

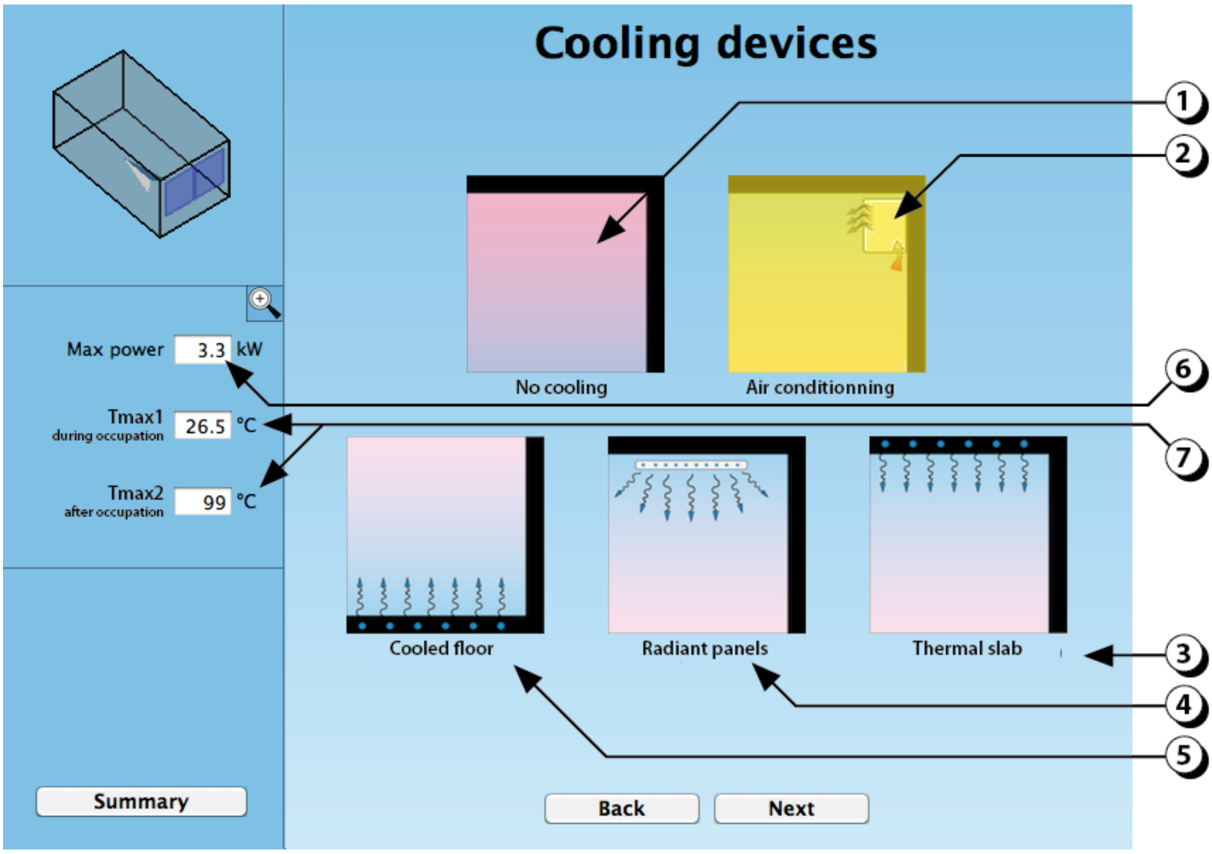
Tmin2 after occupation 21 °C

Figure 100: Selection of the heating devices.

Cooling devices

Select the cooling devices:

1. No cooling: the simulation will show the indoor temperature evolution along the year, without any cooling device.
2. Air conditioning: the convective part represents 100%.
3. Thermal slab: 100% of the heat is distributed via the ceiling slab (available if concrete slab).
4. Radiant panels: 100% of the heat is distributed via a specific devices located just under the ceiling.
5. Cooled floor: 100% of the heat is distributed via the floor slab (available if concrete slab).
6. Enter the cooling power. A default value corresponding to 200W/m^2 is proposed (if the maximum power is too low, the indoor temperature might be higher than the requested value).
7. You can modify the set point temperature (during and outside of the utilisation period). After occupation, the default value for temperature (Tmax2) is 99°C, which means that the indoor temperature is not controlled (no air conditioning or cooling).



Cooling devices

Max power 3.3 kW

Tmax1 during occupation 26.5 °C

Tmax2 after occupation 99 °C

Figure 101: Selection of the cooling devices.

NATURAL VENTILATION PARAMETERS

The two “engines” for natural ventilation are the wind and the chimney effect.

The wind is a random phenomenon (frequency, velocity and orientation) and its effects inside the building are difficult to control and estimate.

The chimney effect leads to air movements as soon as there is a difference between indoor and outdoor temperatures.

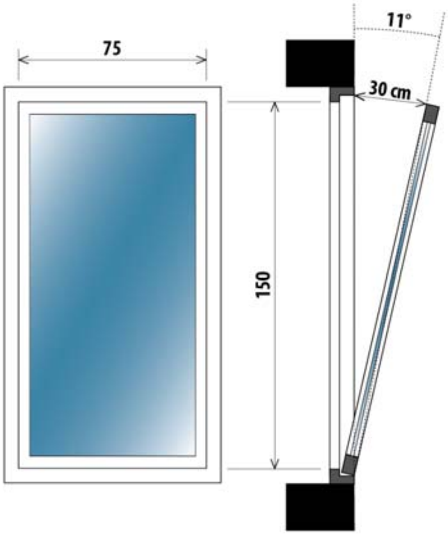
As the wind is not always blowing, a realistic approach consists in dimensioning the openings with the chimney effect and to consider the wind as a complementary help for natural ventilation.

Thus, the ventilation tool of **DIAL+*Cooling*** module estimates the air-change potential due to chimney effect.

It allows you to calculate the airflow crossing the openings as a function of their size and geometry, as well as the difference between indoor and outdoor temperature.

Façade openings: Note on the partial openings

The percentage of opening linked to swinging windows and fanlights is sometimes difficult to estimate. Figure 102 hereafter allows you to find this percentage as a function of the opening angle and the ratio “Window Height”/ “Window Width”.



Let’s take an example: a 150 cm height and 75 cm width window, that leaves a 30 cm space on its upper part when opened.

The opening angle is 11°.

Figure 102 shows that the equivalent opening percentage, is about 21% (orange curve: ratio Height/Width = 2).

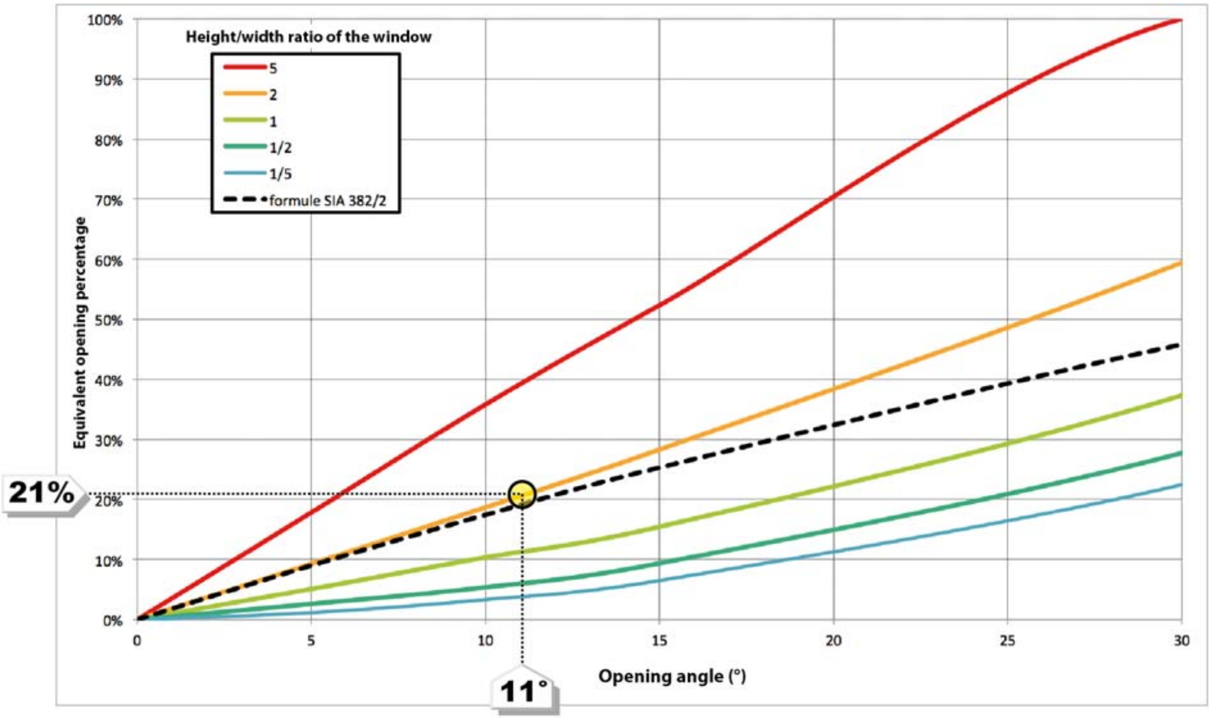


Figure 102: Equivalent percentage of opening as a function of the opening angle and the Height/Width ratio.

Influence of the window's position with respect to the wall's thickness

The window’s position has a significant influence on natural ventilation.

This is particularly relevant for swinging windows and fanlights, as shown below in Figure 103. As a general rule, when the window opens towards indoor, the best ventilation potential is achieved when the plan of the window is situated in the same plan as the inside face of the wall.

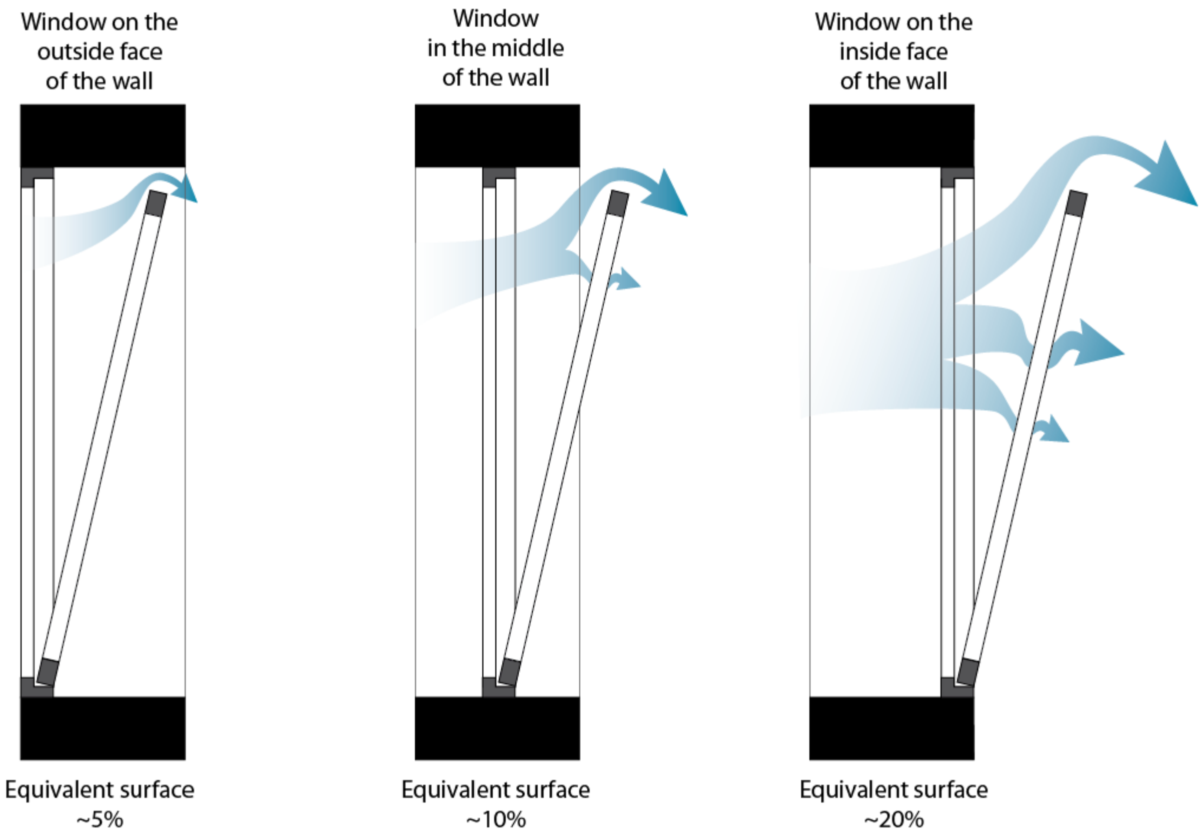


Figure 103: Influence of the window position regarding the potential for natural ventilation.

CAUTION: These figures are indicative and depend on several parameters (frame type, reveal shape, etc).

Influence of opening protections

The user should also take into account the ventilation reduction due to following devices (mosquito net, anti-rain screen, perforated metal, etc).

For example, if the opening is protected with a 20% perforated plate, then the surface of the equivalent opening should be multiplied by 0.20.

SUMMARY

Room Visualization

The summary page allows you to access to all the room description parameters.

A small window, located at the left of the upper side of the main screen, displays the room you are working on.

CAUTION: It is recommended to look carefully at the display before starting the simulation in order to check the room geometry.

On the larger window it is possible to use the mouse-roller and the left click to zoom in or out and to change the viewpoint (cf. page 36).

1. The outline of the window you are working on is highlighted in orange.
2. Use the right-click to display or hide the indoor objects.
3. Click to close the larger window.

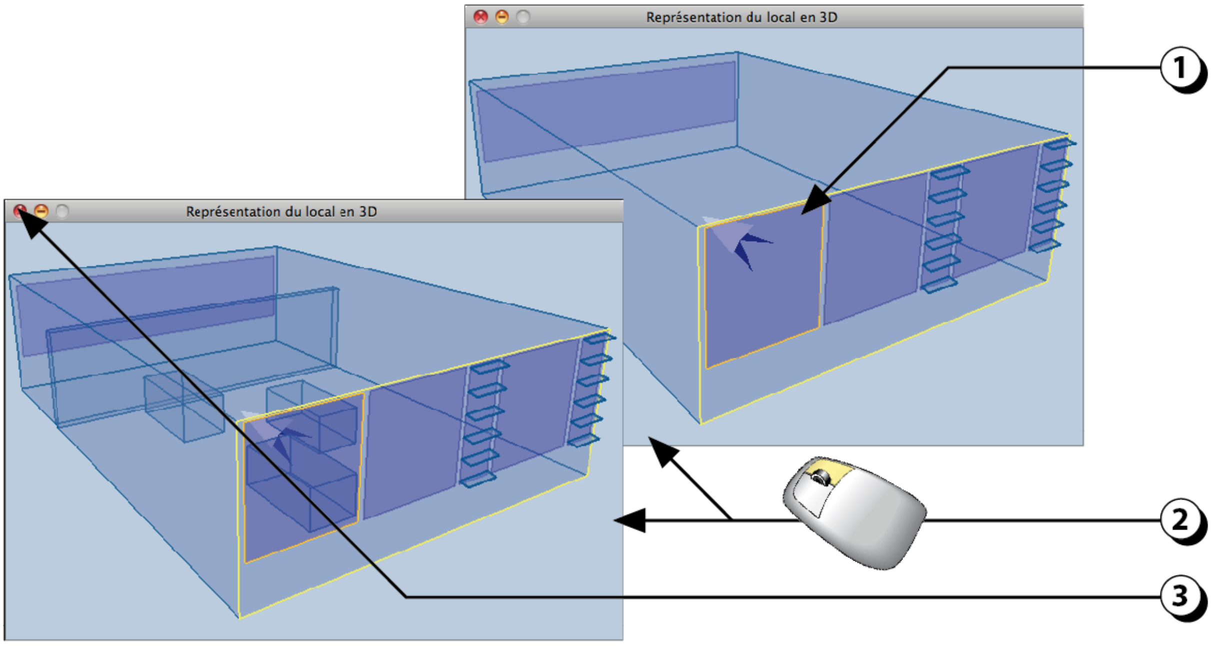
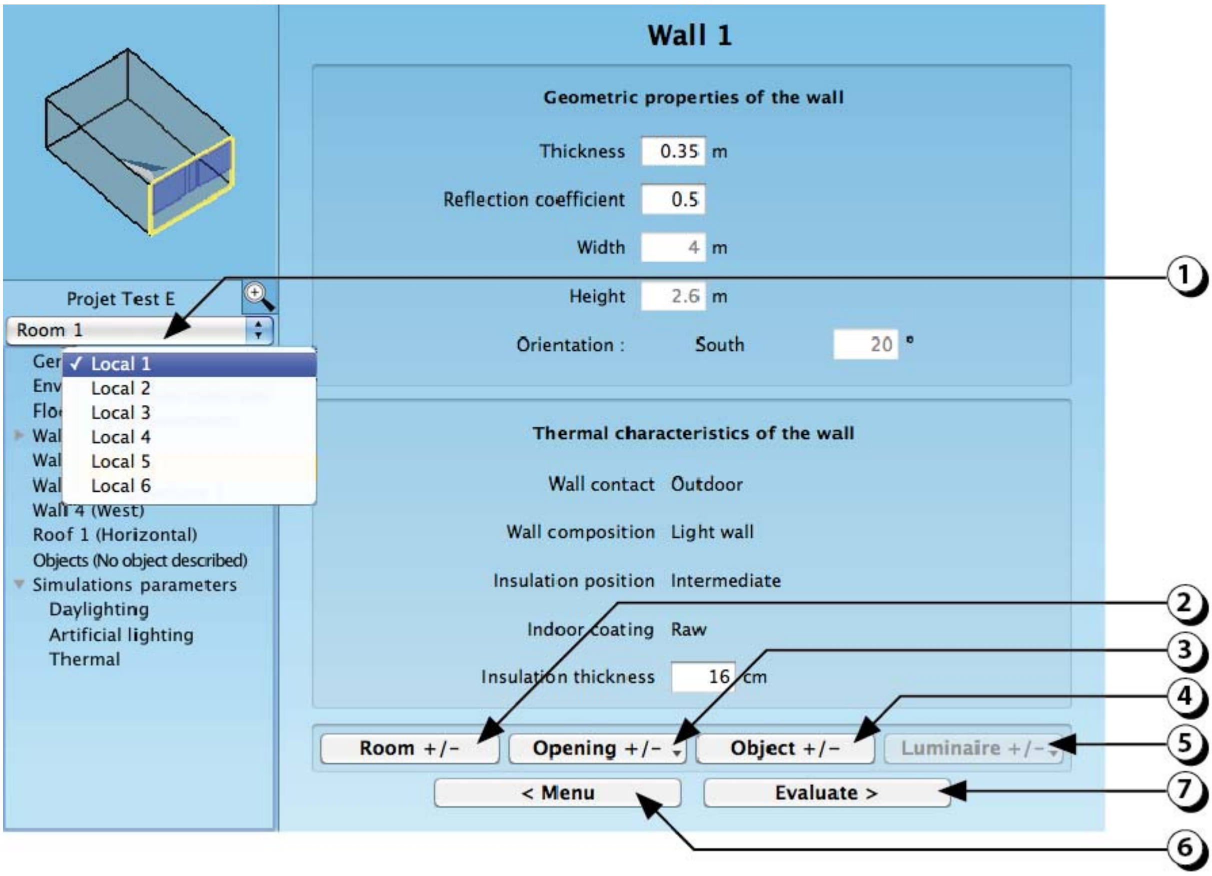


Figure 104: 3D display screen (Large size).

Room selection / Navigation

The summary allows you to access to all the parameters of the different rooms you have described. It is also useful to modify, add or remove some elements (room(s), opening(s), indoor object(s)).

1. Click here to select the room you would like to edit.
2. Click this button to add or remove a room.
3. Click this button to add or remove an opening in an existing room.
4. Click this button to add or remove an indoor object in an existing room.
5. This button will allow you to add luminaires (currently being developed, available in version 2.0).
6. Click this button to proceed to the “Menu” page (cf. p. 77).
7. Click this button to start the evaluation of the selected room.



Wall 1

Geometric properties of the wall

Thickness 0.35 m

Reflection coefficient 0.5

Width 4 m

Height 2.6 m

Orientation : South 20 °

Thermal characteristics of the wall

Wall contact Outdoor

Wall composition Light wall

Insulation position Intermediate

Indoor coating Raw

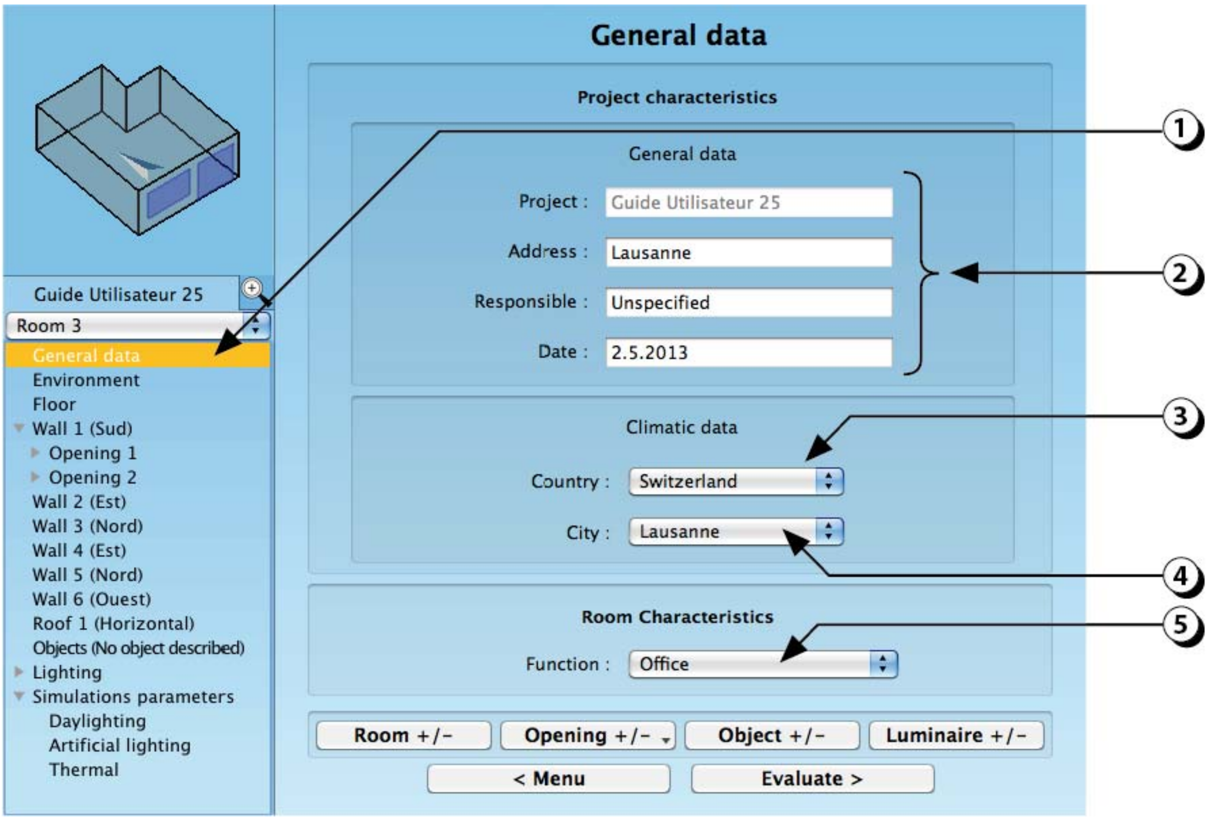
Insulation thickness 16 cm

Figure 105: Summary screen: general characteristics of the room.

General data

Click on the left menu to display the different screen of the summary.

1. Click here to display the general data related to your project.
2. This set of data corresponds to the ones you have described when starting your project.
3. You can change the climatic data by selecting another country.
4. The list of the available climatic data is adjusted as a function of the selected country (to add new climatic data, please refer to page 10 of this manual).
5. Click this button to modify the room function.



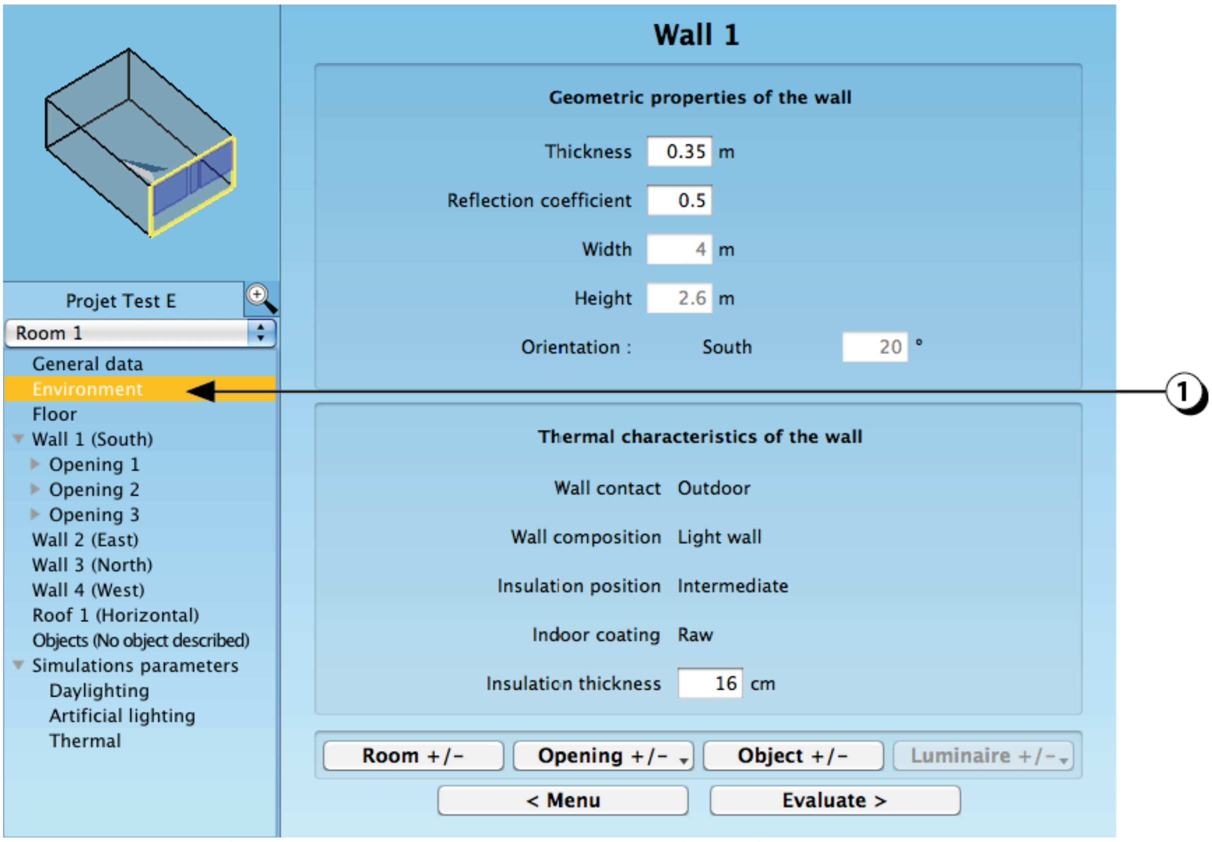
Project : Guide Utilisateur 25
Address : Lausanne
Responsible : Unspecified
Date : 2.5.2013
Country : Switzerland
City : Lausanne
Function : Office

Figure 106: Summary screen: General data.

Characteristics of the outdoor environment

1. Click here to access to characteristics of the environment.

(This will display the screen described in page 21 of this manual).



Wall 1

Geometric properties of the wall

Thickness 0.35 m

Reflection coefficient 0.5

Width 4 m

Height 2.6 m

Orientation : South 20 °

Thermal characteristics of the wall

Wall contact Outdoor

Wall composition Light wall

Insulation position Intermediate

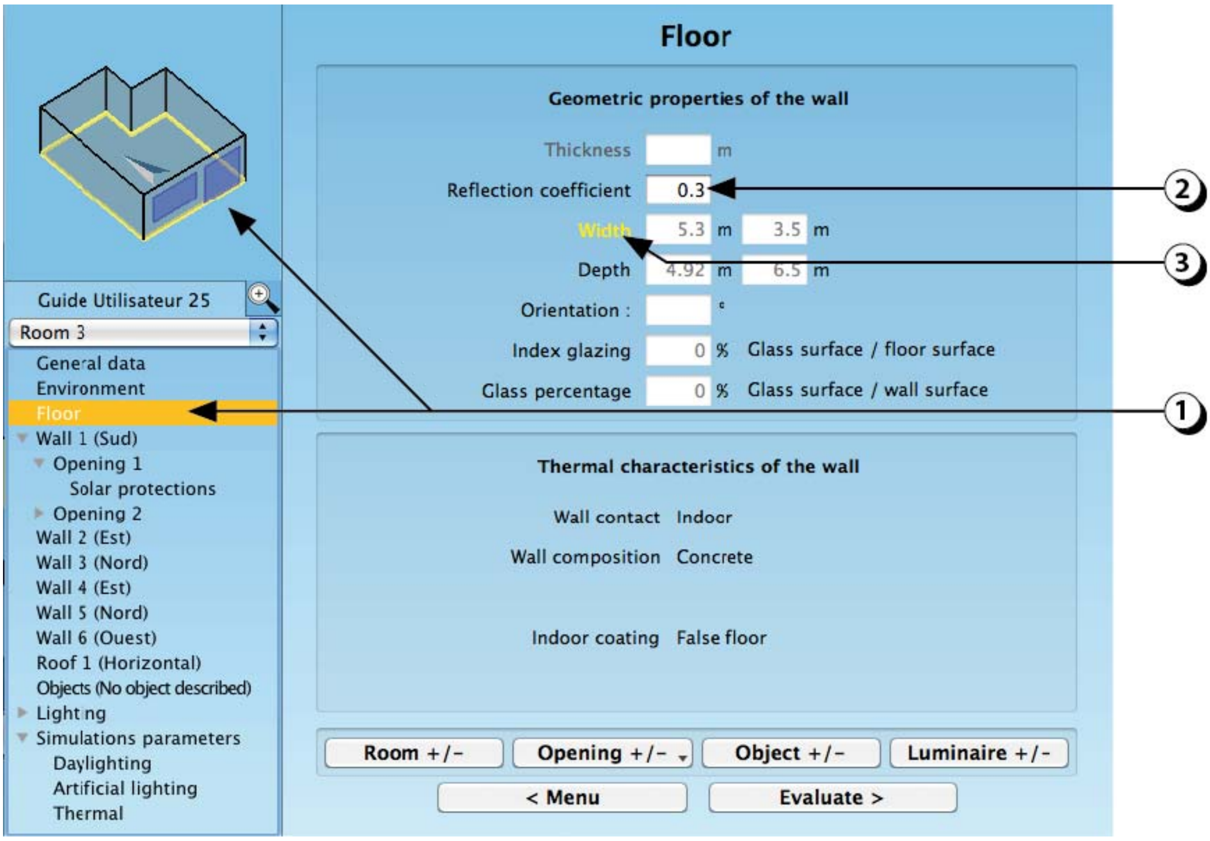
Indoor coating Raw

Insulation thickness 16 cm

Figure 107: Summary screen: access to the environment parameters.

Characteristics of the floor

1. Click here to access to characteristics of the floor (its outline is highlighted in yellow in the 3D display).
2. Some of the parameters can be modified with your keyboard in the corresponding fields.
3. If you place your mouse on one of the “title-words”, its colour becomes yellow. You just have to click on it to proceed to the screen corresponding to the description of this parameter.



Floor

Geometric properties of the wall

Thickness m
Reflection coefficient 0.3
Width 5.3 m 3.5 m
Depth 4.92 m 6.5 m
Orientation : °
Index glazing 0 % Glass surface / floor surface
Glass percentage 0 % Glass surface / wall surface

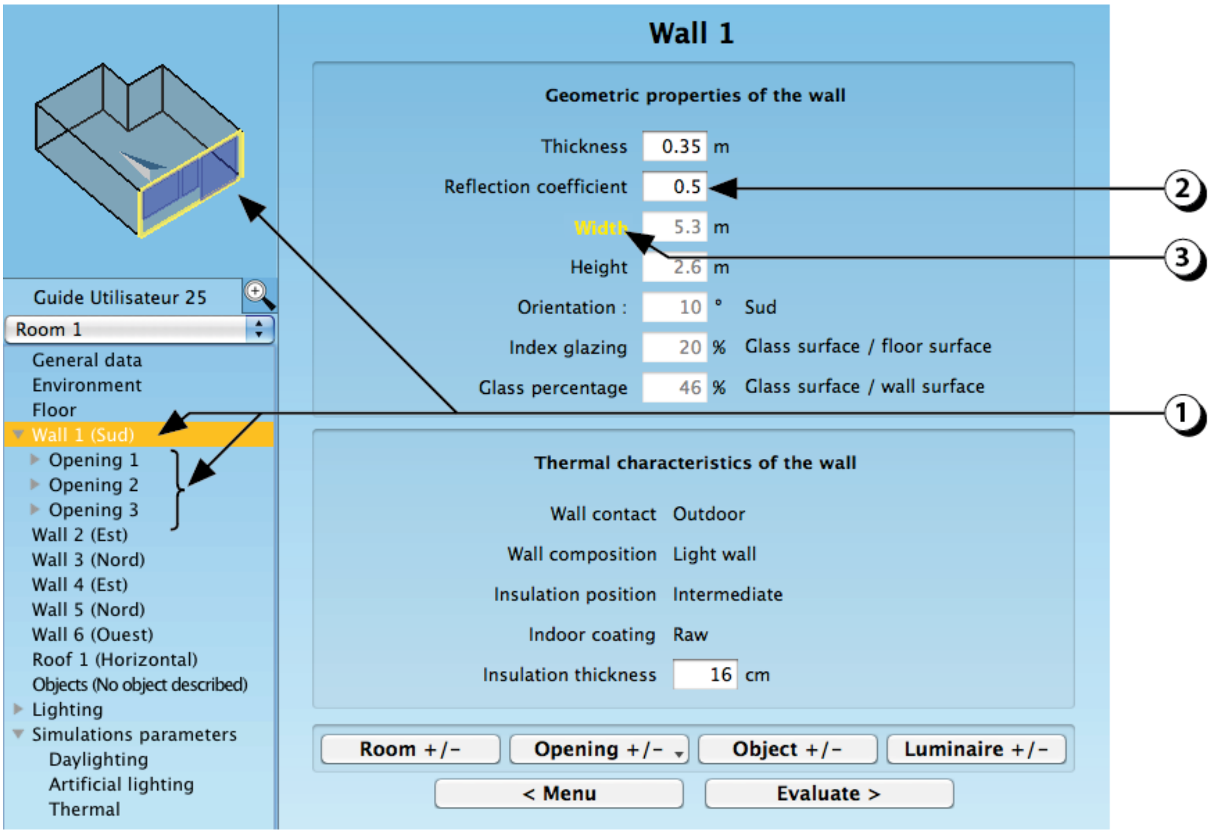
Thermal characteristics of the wall

Wall contact Indoor
Wall composition Concrete
Indoor coating False floor

Figure 108: How to display the characteristics of the floor.

Characteristics of the indoor walls

1. When you click on one of the walls, the list of the embedded openings is displayed below the corresponding wall (the outline of the corresponding wall is highlighted in yellow on the 3D display).
2. Some of the parameters can be modified with your keyboard in the corresponding fields.
3. If you place your mouse on one of the “title-words”, its colour becomes yellow. You just have to click on it to proceed to the screen corresponding to the description of this parameter.



Wall 1

Geometric properties of the wall

Thickness 0.35 m
Reflection coefficient 0.5
Width 5.3 m
Height 2.6 m
Orientation : 10 ° Sud
Index glazing 20 % Glass surface / floor surface
Glass percentage 46 % Glass surface / wall surface

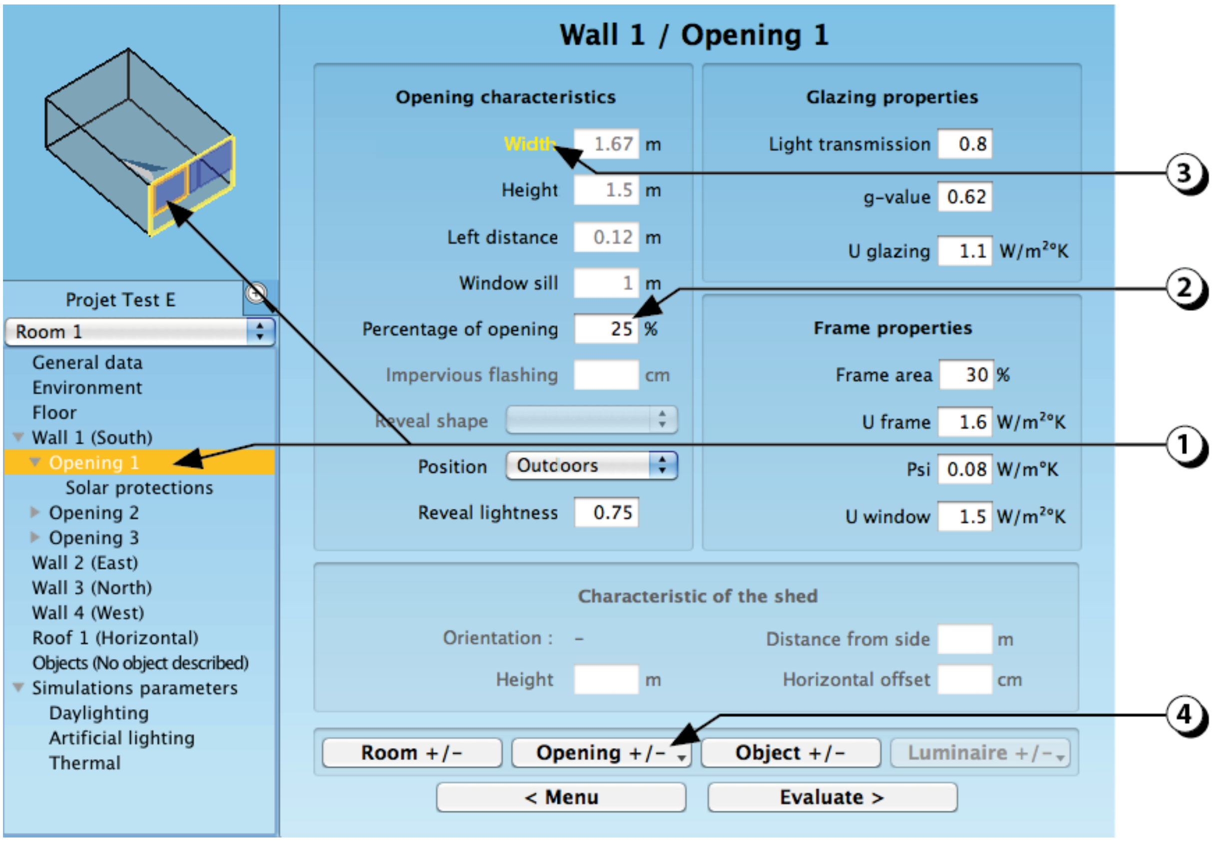
Thermal characteristics of the wall

Wall contact Outdoor
Wall composition Light wall
Insulation position Intermediate
Indoor coating Raw
Insulation thickness 16 cm

Figure 109: How to display the characteristics of one of the walls.

Characteristics of the openings

1. Select the opening you would like to edit (its outline is highlighted in yellow in the 3D display).
2. Some of the parameters can be modified with your keyboard in the corresponding fields.
3. If you place your mouse on one of the “title-words”, its colour becomes yellow. You just have to click on it to proceed to the screen corresponding to the description of this parameter.
4. Click here to add or remove an opening.



Wall 1 / Opening 1

Opening characteristics

Width 1.67 m
Height 1.5 m
Left distance 0.12 m
Window sill 1 m
Percentage of opening 25 %
Impervious flashing cm
Reveal shape
Position Outdoors
Reveal lightness 0.75

Glazing properties

Light transmission 0.8
g-value 0.62
U glazing 1.1 W/m²°K

Frame properties

Frame area 30 %
U frame 1.6 W/m²°K
Psi 0.08 W/m°K
U window 1.5 W/m²°K

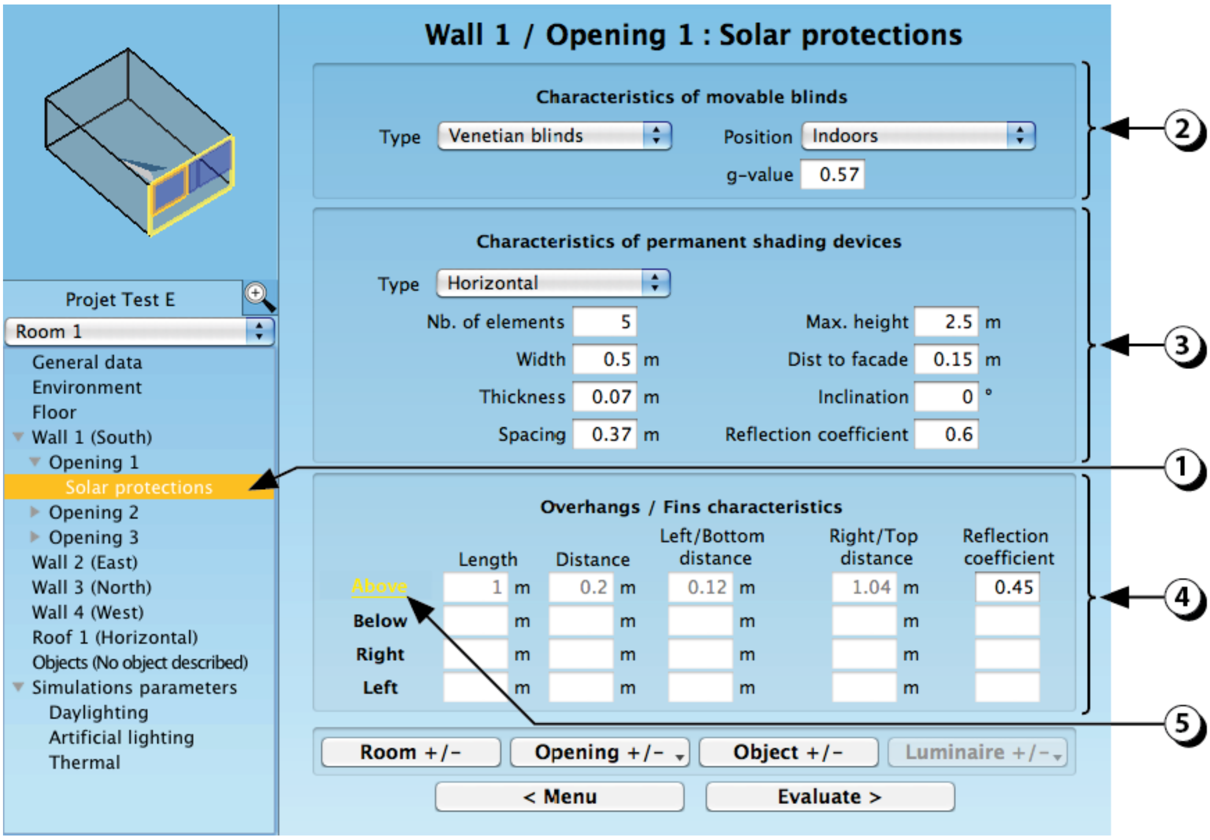
Characteristic of the shed

Orientation : -
Height m
Distance from side m
Horizontal offset cm

Figure 110: Summary screen: Openings characteristics.

Shading devices

1. Once you have selected the appropriate opening, (here “Opening 1” of “Wall 1”) click on “Solar protections.
2. This set of buttons or fields deals with mobile shadings (venetian or fabric blinds, shutters, etc).
3. This group of fields deals with fixed vertical or horizontal blades.
4. This group of fields deals with overhangs, fins and balconies.
5. Clicking on the “Title-words”, allows you to proceed to the user-friendly interface corresponding to this parameter (here the Overhangs characteristics).



Wall 1 / Opening 1 : Solar protections

Characteristics of movable blinds

Type: Venetian blinds
Position: Indoors
g-value: 0.57

Characteristics of permanent shading devices

Type: Horizontal
Nb. of elements: 5
Width: 0.5 m
Thickness: 0.07 m
Spacing: 0.37 m
Max. height: 2.5 m
Dist to facade: 0.15 m
Inclination: 0 °
Reflection coefficient: 0.6

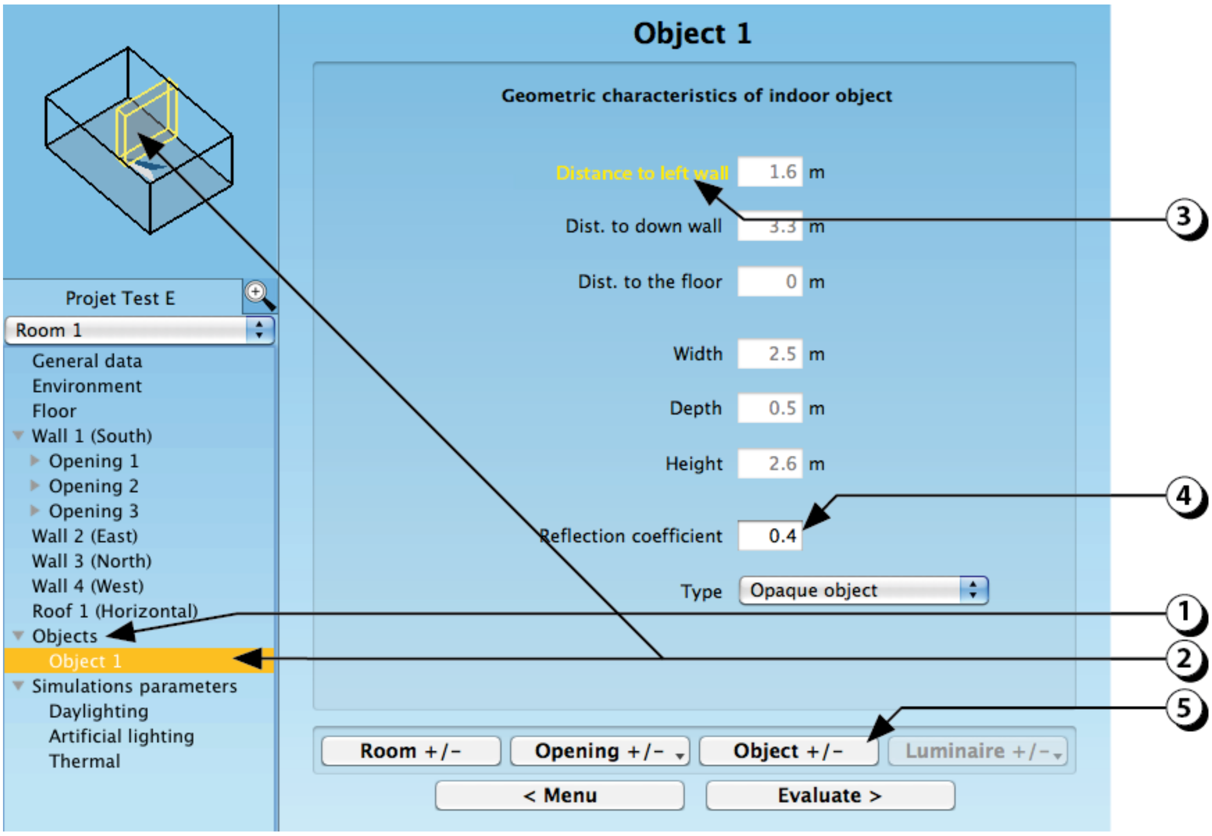
Overhangs / Fins characteristics

	Length	Distance	Left/Bottom distance	Right/Top distance	Reflection coefficient
Above	1 m	0.2 m	0.12 m	1.04 m	0.45
Below	m	m	m	m	
Right	m	m	m	m	
Left	m	m	m	m	

Figure 111: Summary screen: Shading devices characteristics.

Indoors objects

1. Click to open the list of the existing objects.
2. Select the object you want to edit or modify in the list (its outline is highlighted in yellow in the 3D display).
3. Clicking on the “Title-words”, allows you to proceed to the user-friendly interface corresponding to this parameter (here the distance between the selected object and the left wall).
4. Some of the parameters can be modified with your keyboard in the corresponding fields.
5. Click on this button to add or remove an object.



Object 1

Geometric characteristics of indoor object

Distance to left wall 1.6 m

Dist. to down wall 3.3 m

Dist. to the floor 0 m

Width 2.5 m

Depth 0.5 m

Height 2.6 m

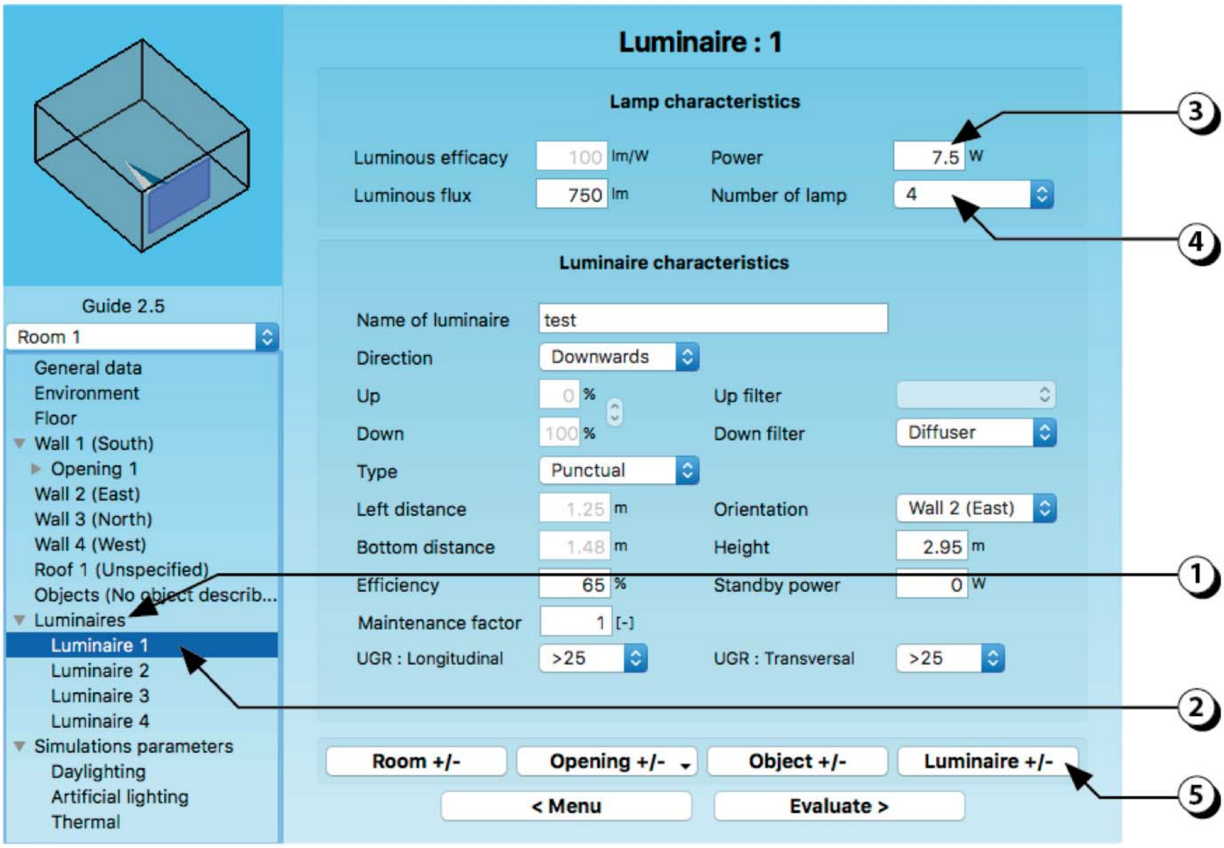
Reflection coefficient 0.4

Type Opaque object

Figure 112: Summary screen: Indoor objects characteristics.

Luminaires

1. Click here to open the list of luminaires that have already been described.
2. Select the luminaire you want to display.
3. Clicking on the “Title-words”, allows you to proceed to the user-friendly interface corresponding to this parameter (here the power of the selected luminaire).
4. Some of the parameters can be modified with your keyboard in the corresponding fields.
5. Click on this button to add or remove a luminaire.



Luminaire : 1

Lamp characteristics

Luminous efficacy 100 lm/W
Power 7.5 W
Luminous flux 750 lm
Number of lamp 4

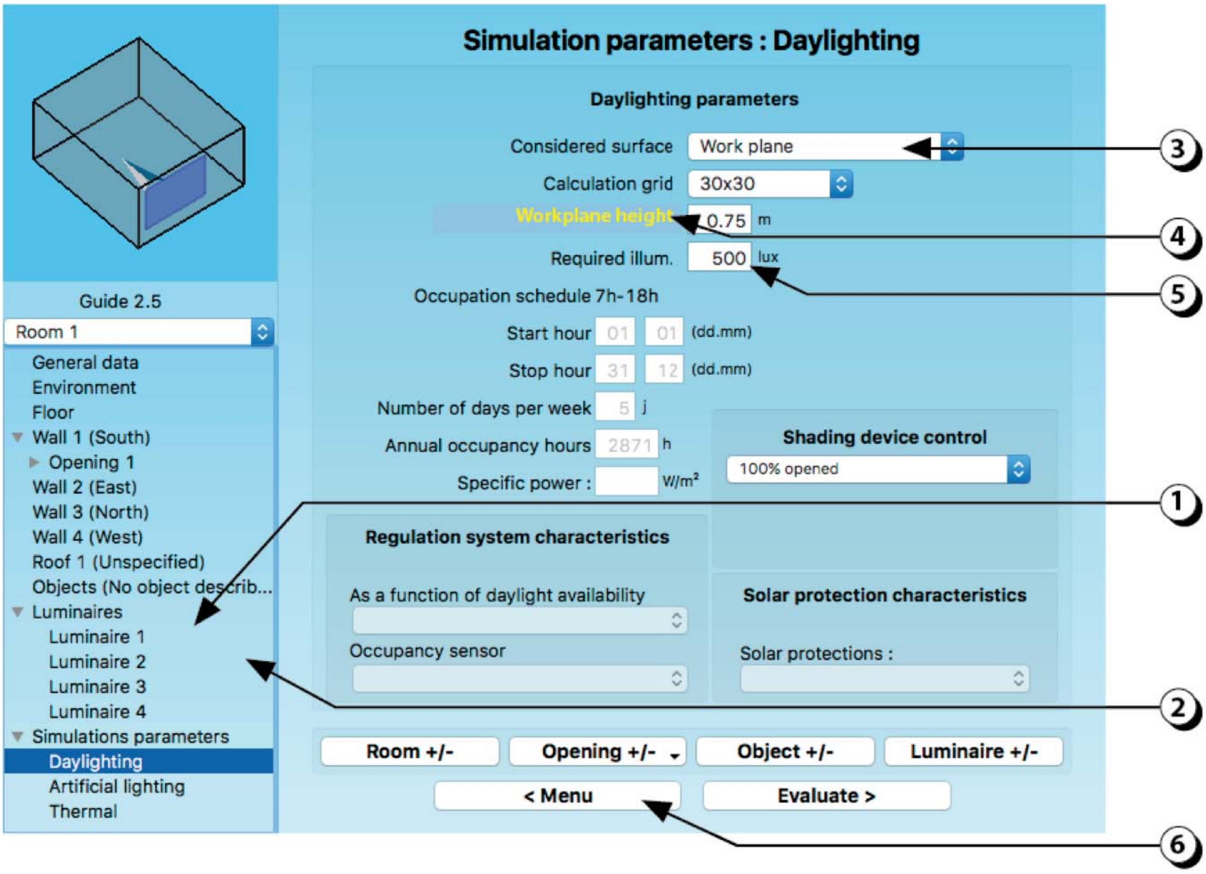
Luminaire characteristics

Name of luminaire test
Direction Downwards
Up 0 %
Up filter
Down 100 %
Down filter Diffuser
Type Punctual
Left distance 1.25 m
Orientation Wall 2 (East)
Bottom distance 1.48 m
Height 2.95 m
Efficiency 65 %
Standby power 0 W
Maintenance factor 1 [-]
UGR : Longitudinal >25
UGR : Transversal >25

Figure 113: Summary screen: luminaires characteristics.

Simulation parameters: Daylighting

1. Click to open the list of the simulation parameters.
2. Select the simulation topic (here Daylighting).
3. Select the plane on which the lighting calculation will be done (default is horizontal work plane at 80 cm above the floor).
4. Clicking on the “Title-words”, allows you to proceed to the user-friendly interface corresponding to this parameter (here the work plane height).
5. Some of the parameters can be modified with your keyboard in the corresponding fields.
6. If all the parameters corresponding to the selected topic (here Daylighting) have not yet been described, click on this button (cf. page 77).



Simulation parameters : Daylighting

Daylighting parameters

Considered surface: Work plane
Calculation grid: 30x30
Workplane height: 0.75 m
Required illum.: 500 lux
Occupation schedule 7h-18h
Start hour: 01 01 (dd.mm)
Stop hour: 31 12 (dd.mm)
Number of days per week: 5 j
Annual occupancy hours: 2871 h
Specific power : W/m²

Shading device control: 100% opened

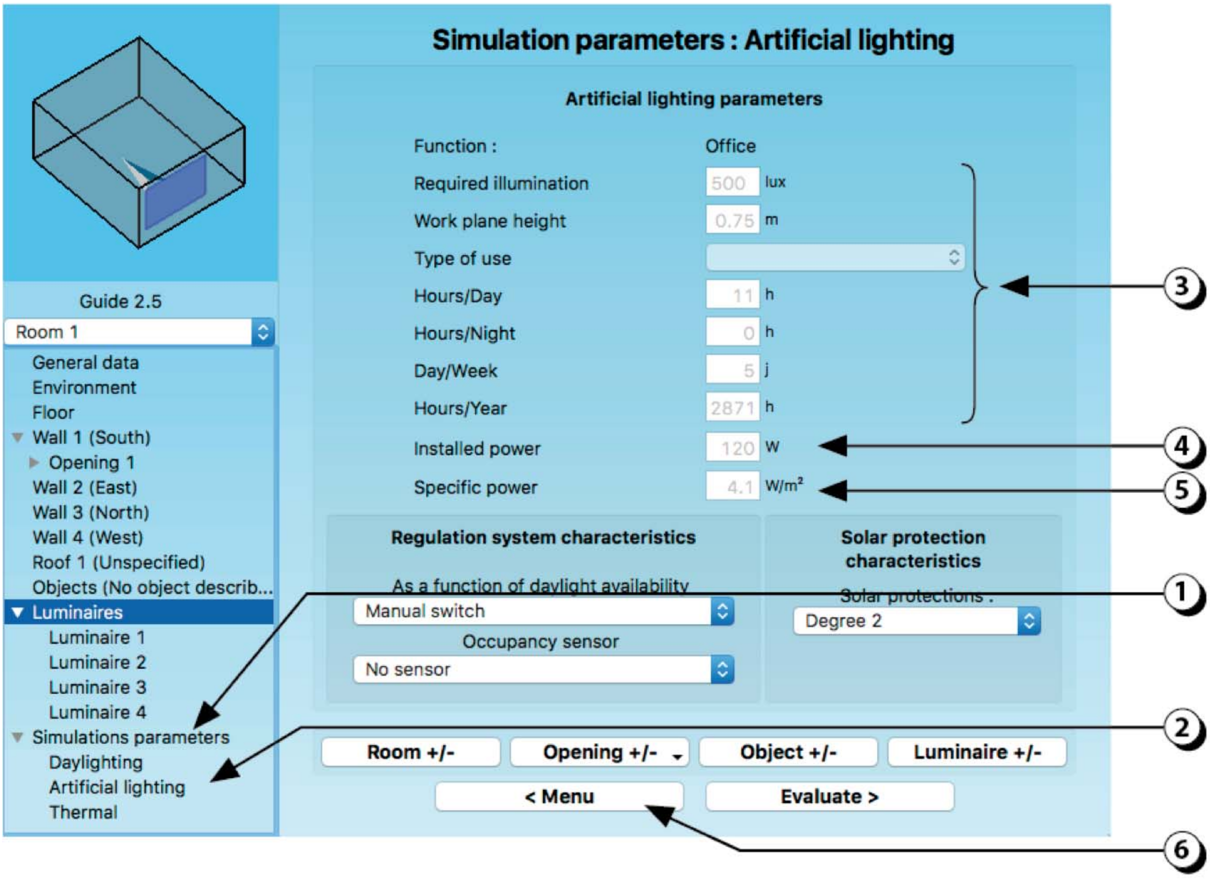
Regulation system characteristics
As a function of daylight availability
Occupancy sensor

Solar protection characteristics
Solar protections :

Figure 114: Summary screen: Daylighting simulation parameters.

Simulation parameters: Artificial lighting

1. Click to open the list of the simulation parameters.
2. Select the simulation topic (here Artificial lighting).
3. Those parameters are linked to the room function (default values from Swiss standard SIA 380/4).
4. The Installed power corresponds to the global electric lighting system you have described.
5. The specific power corresponds to total the power divided by the room surface.
6. If all the parameters corresponding to the selected topic (here Artificial lighting) have not yet been described, click on this button (cf. page 77).



Simulation parameters : Artificial lighting

Artificial lighting parameters

Function : Office
Required illumination 500 lux
Work plane height 0.75 m
Type of use
Hours/Day 11 h
Hours/Night 0 h
Day/Week 5 j
Hours/Year 2871 h
Installed power 120 W
Specific power 4.1 W/m²

Regulation system characteristics

As a function of daylight availability: Manual switch
Occupancy sensor: No sensor

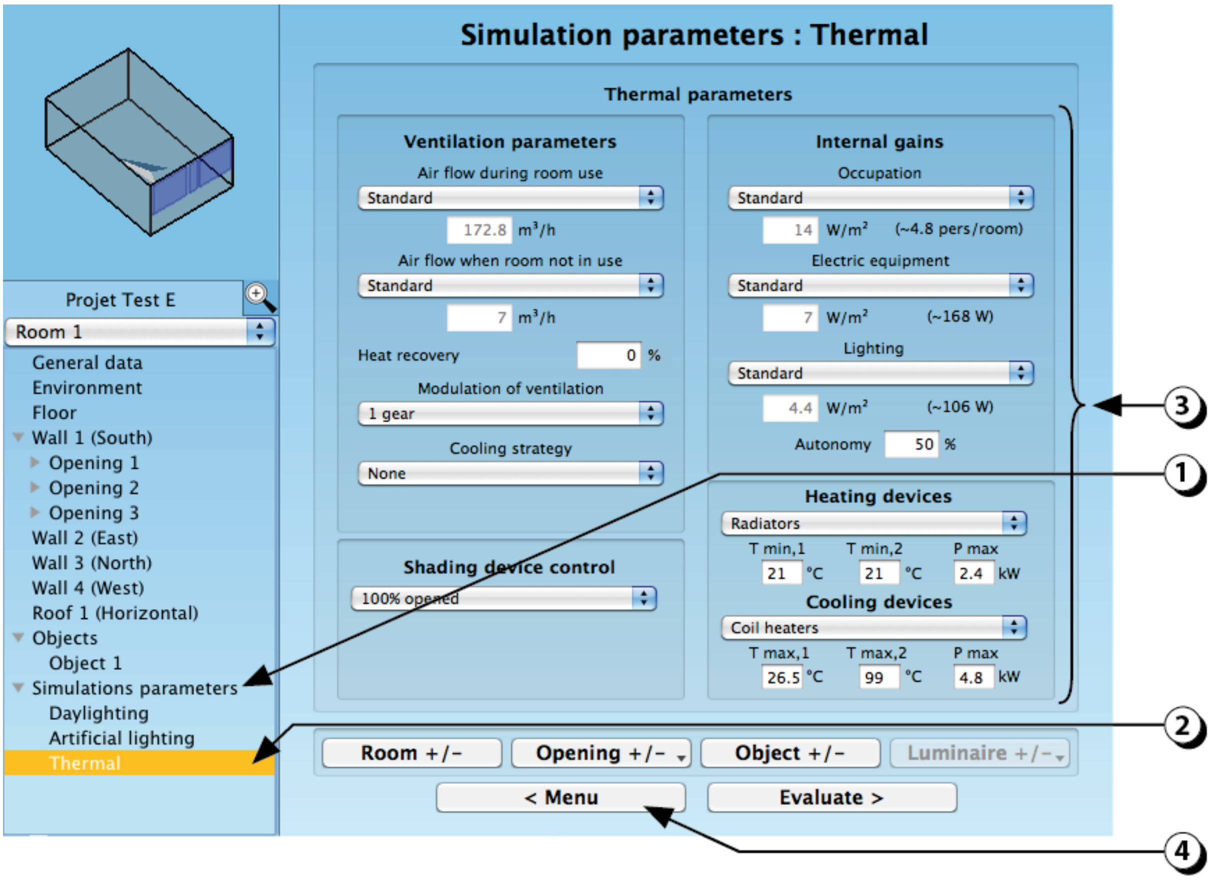
Solar protection characteristics

Solar protections : Degree 2

Figure 115: Summary screen: Artificial lighting simulation parameters.

Simulation parameters: Thermal purposes

1. Click to open the list of the simulation parameters.
2. Select the simulation topic (here Thermal).
3. You can modify the Thermal parameters described previously.
4. If all the parameters corresponding to the selected topic (here Thermal) have not yet been described, click on this button (cf. page 77).



Simulation parameters : Thermal

Thermal parameters

Ventilation parameters

Air flow during room use: Standard, 172.8 m³/h

Air flow when room not in use: Standard, 7 m³/h

Heat recovery: 0 %

Modulation of ventilation: 1 gear

Cooling strategy: None

Shading device control: 100% opened

Internal gains

Occupation: Standard, 14 W/m² (~4.8 pers/room)

Electric equipment: Standard, 7 W/m² (~168 W)

Lighting: Standard, 4.4 W/m² (~106 W)

Autonomy: 50 %

Heating devices: Radiators

T min,1: 21 °C; T min,2: 21 °C; P max: 2.4 kW

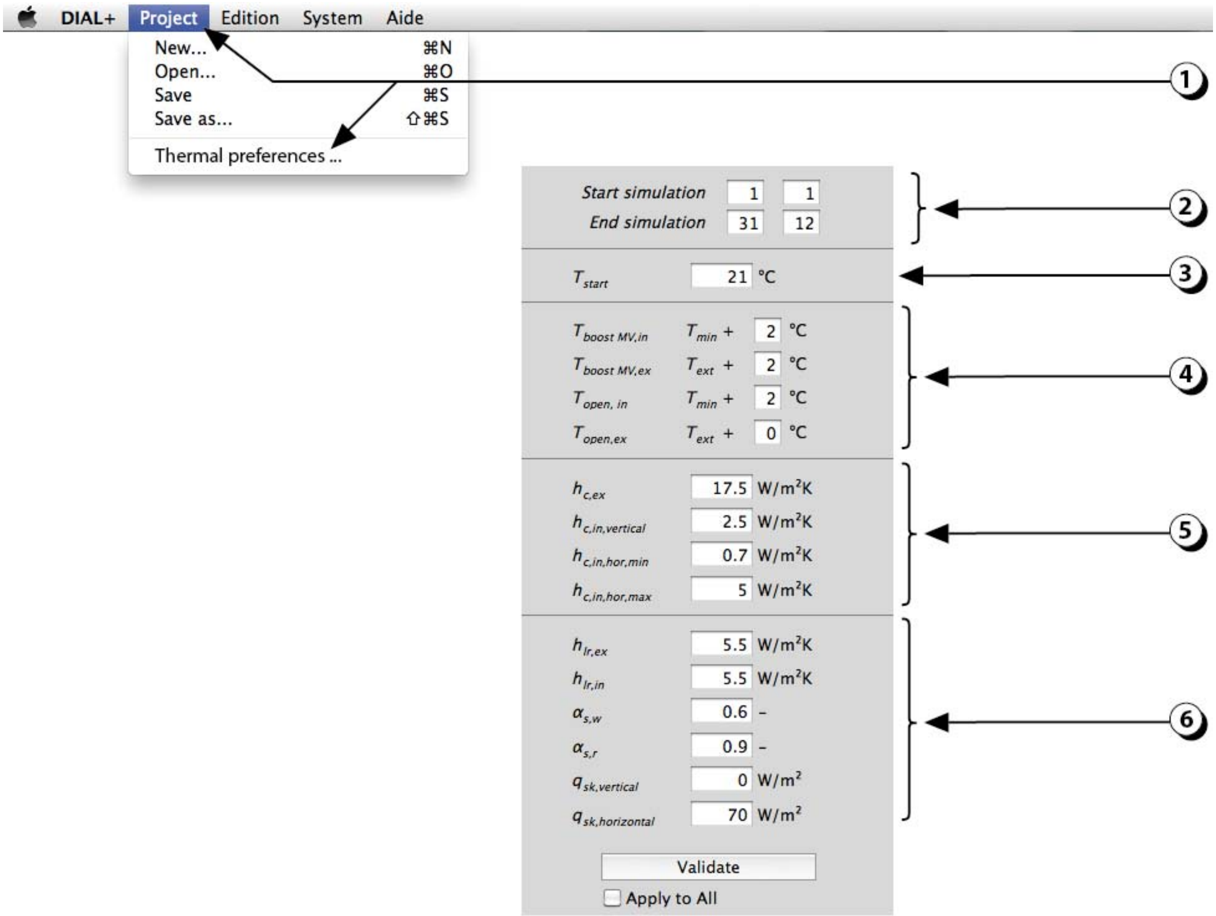
Cooling devices: Coil heaters

T max,1: 26.5 °C; T max,2: 99 °C; P max: 4.8 kW

Figure 116: Summary screen: Thermal simulation parameters.

Thermal Preferences

1. The thermal simulations are relying on a set of parameters, which you can edit and modify by clicking “Project/Thermal preferences” in the main menu bar (top of your screen).
2. Start and end dates of the thermal simulation.
3. This is the room and walls temperature at the beginning of the simulation.



Start simulation 1 1
End simulation 31 12

T_{start} 21 °C

$T_{boost\ MV,in}$ T_{min} + 2 °C
$T_{boost\ MV,ex}$ T_{ext} + 2 °C
$T_{open,\ in}$ T_{min} + 2 °C
$T_{open,ex}$ T_{ext} + 0 °C

$h_{c,ex}$ 17.5 W/m²K
$h_{c,in,vertical}$ 2.5 W/m²K
$h_{c,in,hor,min}$ 0.7 W/m²K
$h_{c,in,hor,max}$ 5 W/m²K

$h_{lr,ex}$ 5.5 W/m²K
$h_{lr,in}$ 5.5 W/m²K
$\alpha_{s,w}$ 0.6 -
$\alpha_{s,r}$ 0.9 -
$q_{sk,vertical}$ 0 W/m²
$q_{sk,horizontal}$ 70 W/m²

Figure 117: List of the thermal preferences.

4. **$T_{boost,MV,in}$**: The mechanical “over-ventilation” will stop below this temperature.

   For example, the value 2° means that the over-ventilation will be switched off as soon as the indoor temperature is lower T_{min} + 2°C (thus 23°C in the example).

   $T_{boost,MV,in}$: This value corresponds to the difference between indoor an outdoor temperatures below which the mechanical “over ventilation” will not start.

   For example; a 2°C value means that the mechanical over-ventilation will not be switched on as far as indoor temp will not exceed (outdoor temp. + 2°C).

   $T_{open,in}$: This value is used to determine the indoor temp. below which the windows could not be opened.

   For example, a value of 2°C means that the windows could not be opened as far as indoor temp. is lower than T_{min} + 2°C (thus 23°C in the example).

   $T_{open,ex}$: This value corresponds to the difference between indoor an outdoor temperatures below which the windows could not be opened.

   For example; a value of 0°C would mean that the windows will be kept closed as far as indoor temp. is lower than outdoor temp.

   A value of 2°C means that the windows will be kept closed as far as the difference between indoor temp. and outdoor temp is lower than 2°C.

   A value of -5° would mean that the windows will be opened when indoor temp. is more than 5° lower than outdoor temp.

5. These values correspond to the convection coefficients of outdoor and indoor surfaces. For more information, please consult EN -15265 & EN 15-255 norms (default values correspond to the recommendation of these norms).

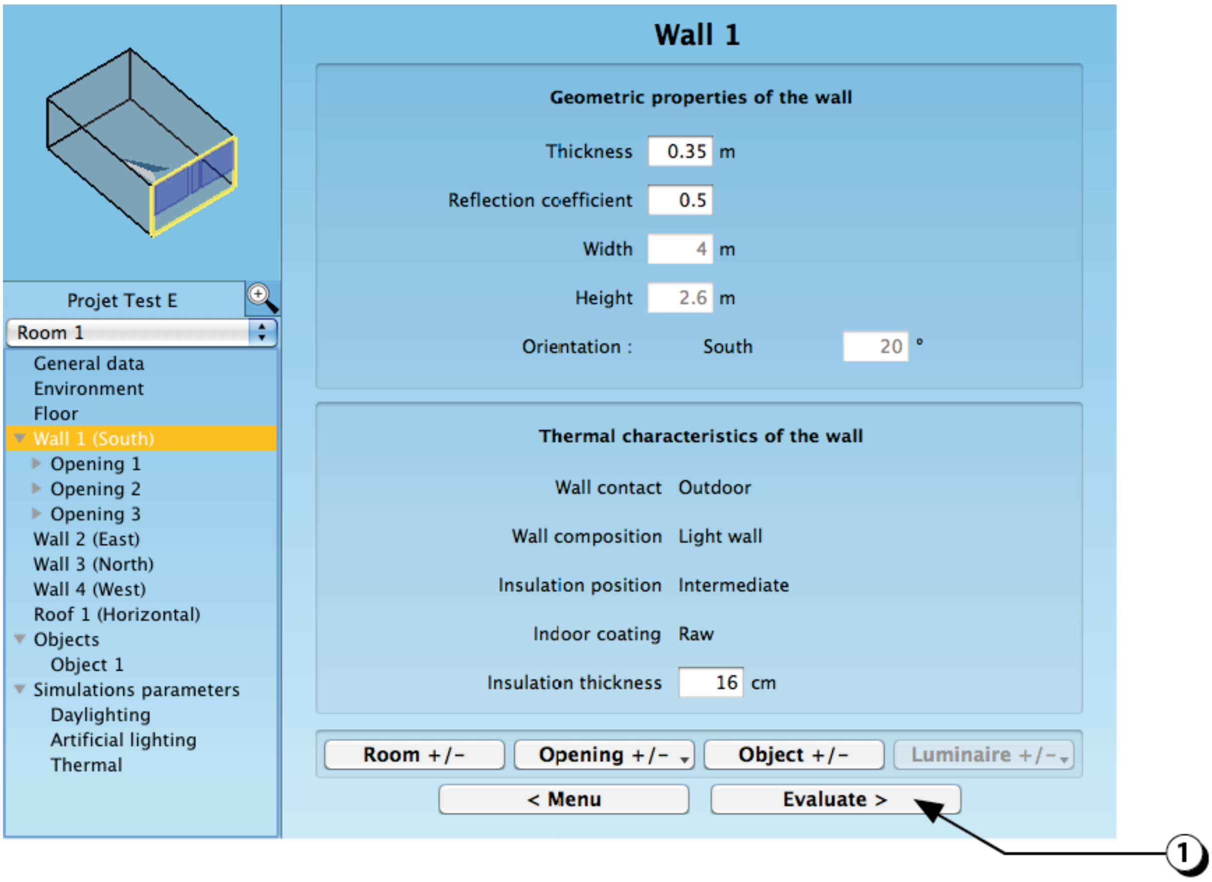
6. These values correspond respectively to:
   - Coefficients of irradiative exchanges (Hlr,ex & Hlr,in),
   - Outdoor coefficients of absorption of walls and roof (as,w & as,r),
   - Correction coefficients of the heat density flux between the outside surfaces and the sky (qsk,vertical & qsk,horizontal).

For more information, please refer to European Norms EN-15265 & EN 15255 (default values correspond to the recommendation of these norms).

EVALUATION

Starting the evaluation

1. Once you have finished the room description, click on the “Evaluate” button to launch the simulations.



Wall 1

Geometric properties of the wall

Thickness 0.35 m

Reflection coefficient 0.5

Width 4 m

Height 2.6 m

Orientation : South 20 °

Thermal characteristics of the wall

Wall contact Outdoor

Wall composition Light wall

Insulation position Intermediate

Indoor coating Raw

Insulation thickness 16 cm

Figure 118: Summary page: start the evaluation.

Selection of the evaluation

DIAL+ is a suite of tools that allows you to optimize the overall energy transfer functions linked to rooms' apertures.

DIAL+*Lighting*

1. Calculation of outdoor shading due to close and distant horizon.
2. Shading studies: hourly calculation of solar factors for each window as a function of the permanent shading devices (slats, overhangs & fins).
3. Daylight factor (Radiance) as well as daylighting autonomy (see pages 141-165).
4. Electric lighting simulations (Radiance) and calculation of the annual energy consumption due to lighting, according to the SIA 380/4 Swiss Standard (see page 172).

DIAL+Cooling

5. Thermal comfort: dynamic thermal simulations (solar gains, indoor temperature, number of overheating hours per year, heating & cooling demand, …, etc) (cf. pages 176-187).
6. Calculation of the air-flow crossing the windows and thus the potential for natural ventilation of your room (time requested to extract used-air and replace it by fresh-air, cf. page 190).

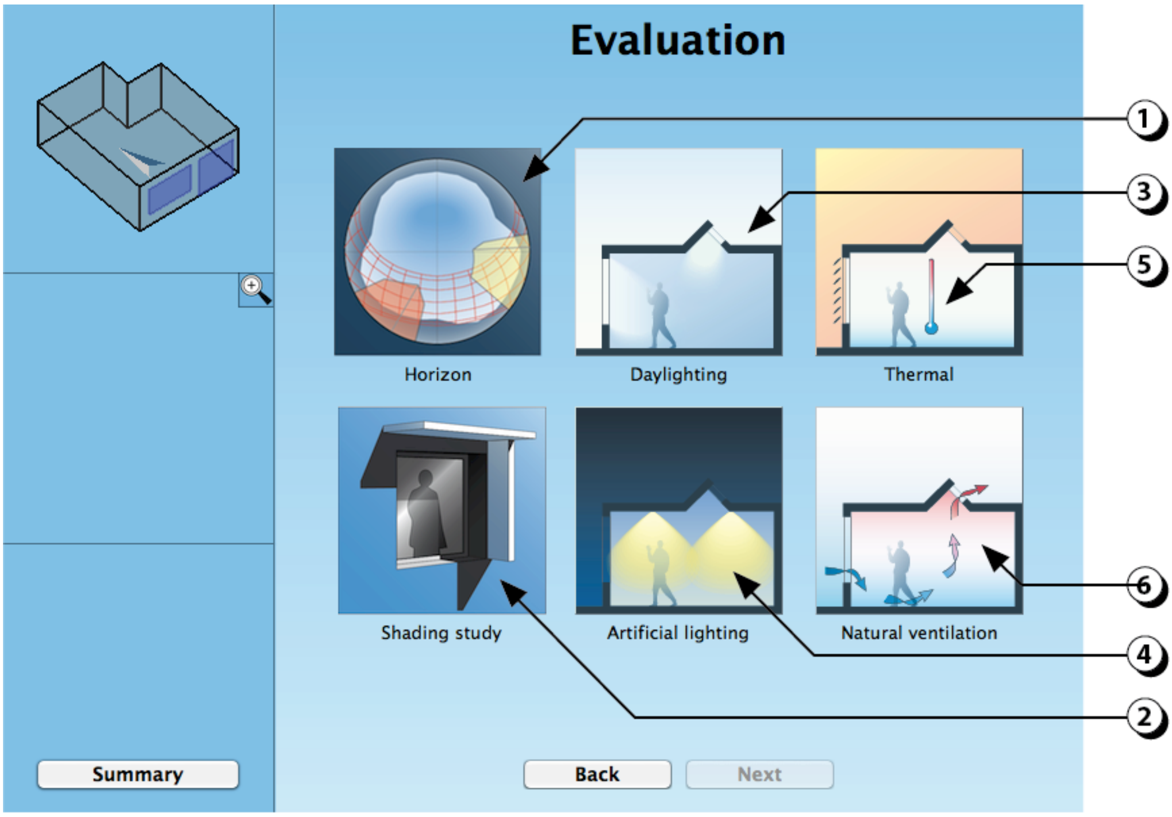


Figure 119: Access to the different calculation modules.

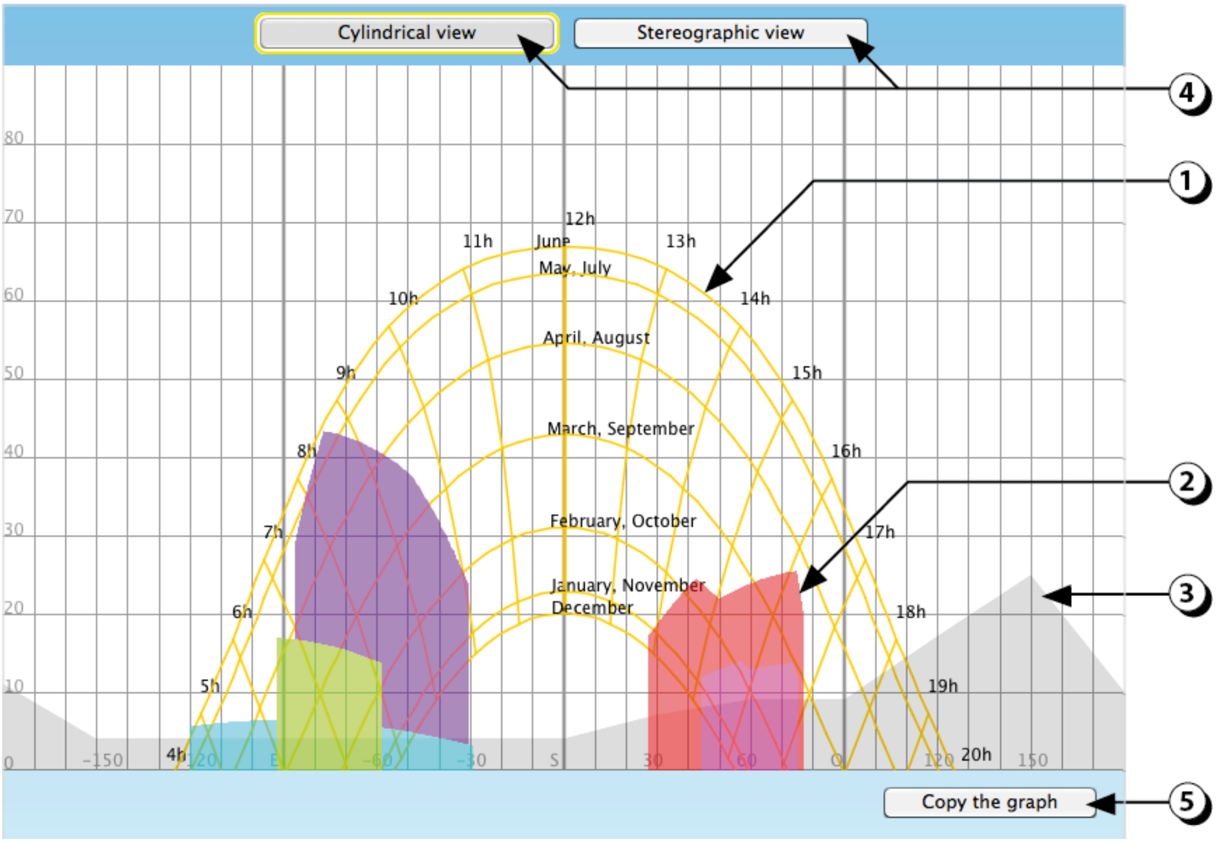
HORIZON MASKS

This module allows you to display on a unique picture, the solar trajectories (sun path) and the outdoor obstructions (close buildings and distant horizon).

It gives the opportunity to predict, for each window, when the sun is visible and when it is hidden.

Horizon masks

1. Sun paths are displayed on the 21st of each month. The hours are solar hours.
2. Obstructions due to close horizon (with specific colour for each building that has been described (cf. pages 22 to 32).
3. Obstructions due to the distant horizon (hills, mountains, etc), cf. page 33.
4. Use these buttons to change the view mode.
5. Use this button to copy the graphic in the buffer (to paste the picture into a document (.doc, .ppt, …, etc) type ctrl+v (or cmd+v for Apple users).



7.

Figure 120: représentation des trajectoires solaires avec les masques d'horizon proches et lointains.

SHADING STUDIES

This module allows you to calculate the solar factors (hourly step) of each window as a function of the permanent shading devices (slats, overhangs & fins).

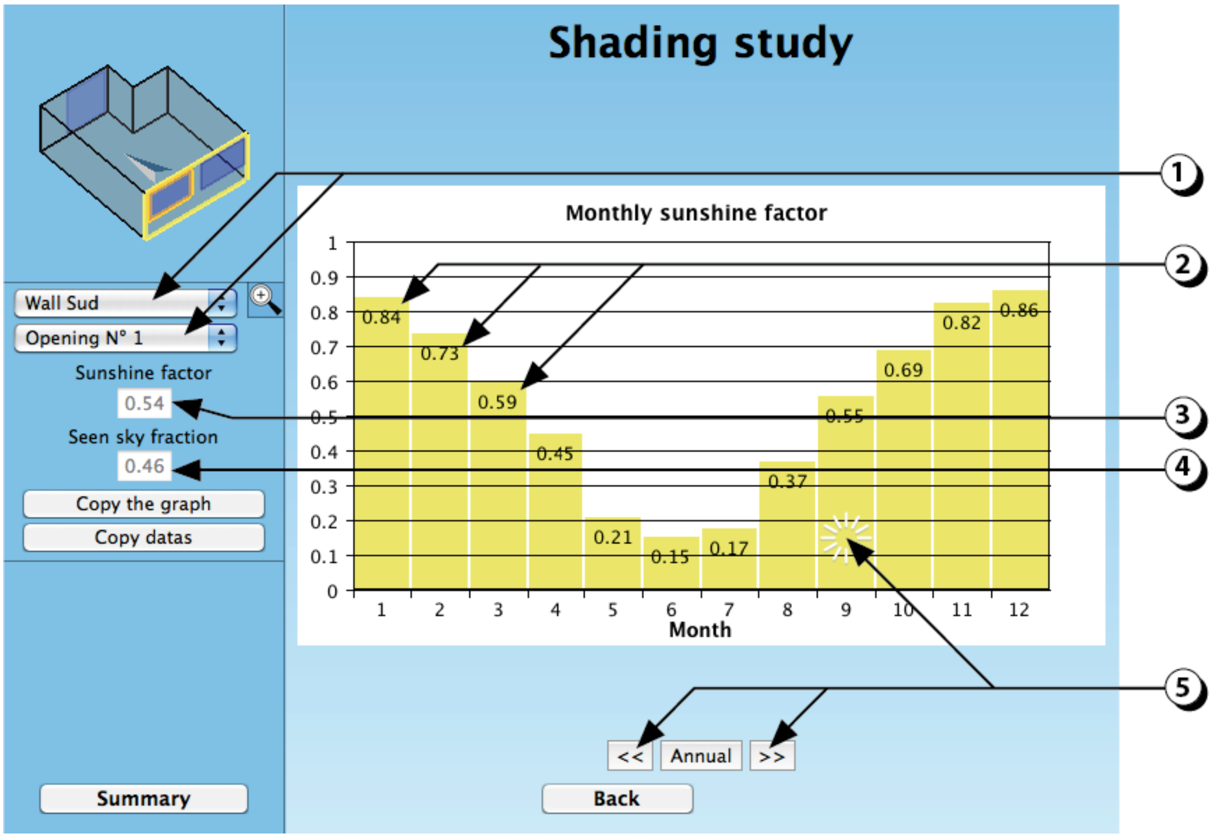
Shading factors / Year

1. Select the wall and the opening you want to analyse.
2. The values displayed on the graph correspond to the solar factors on the 15th of each month. This value is calculated according the PERENE standards [1].

   For a given date, if the solar factor is 0.84, it means that only 16% of the window area is shaded.

3. This value corresponds to the annual average solar factor of the selected window.
4. The “Viewed sky fraction” is calculated from the centre of the glazing. This value is independent from the date.
5. To display the detail of one month (the 15th), click on “<<” or “>>”, or one of the monthly bars of the graphic.

8.



Wall Sud

Opening N° 1

Sunshine factor 0.54

Seen sky fraction 0.46

Figure 121: Solar factors along the year

[1] PERENE Réunion: « PERformances ENErgétiques des bâtiments à La Réunion », Mise à jour 2009. LBPS Imageen.

Shading factors / Month

1. The shading factor of the selected month is displayed in this field (here value for the 15th of March).
2. The colours of the graph have to be interpreted as follow:
   - Blue: night hours,
   - White: day hours during which the sun is not visible from the selected façade,
   - Grey: shaded portion of the window,
   - Yellow: sunny fraction of the window.
3. The selected opening is equipped with an overhang and a vertical fin. For this reason, it is partly shaded during the morning.
4. Click here to scroll through the months.
5. Click here to come back to the annual graphic (cf. previous page).

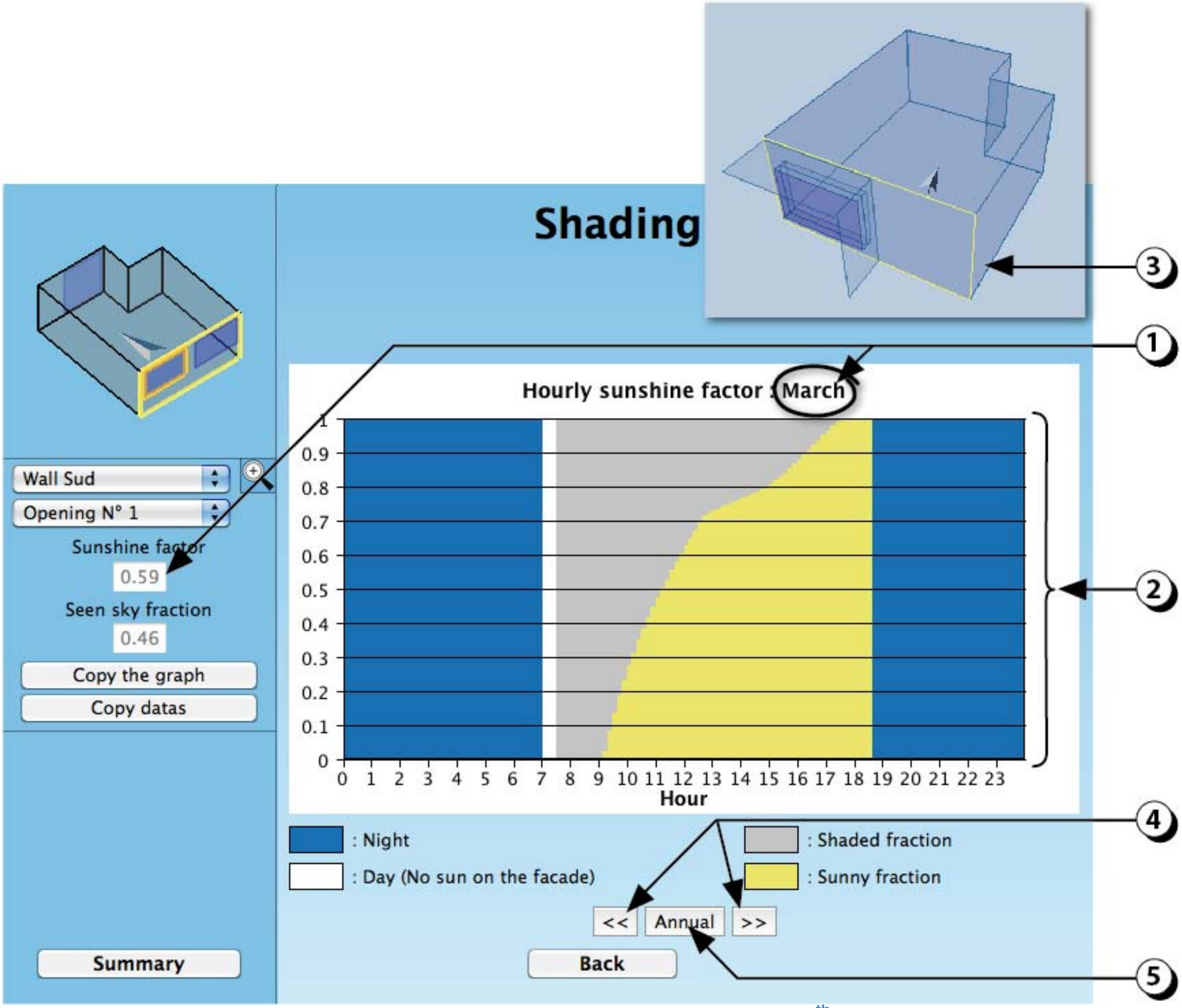
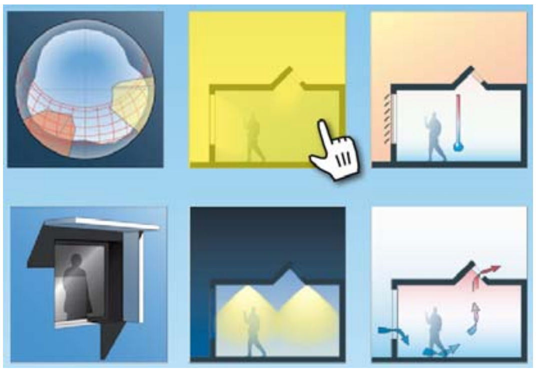


Figure 122: Solar factor for a given date (here the 15th of march).

DAYLIGHTING EVALUATION



This module allows you to estimate the daylighting potential of a given room. The simulations are made with RADIANCE.

The software produces several types of results:

- **Autonomy according to Minergie-ECO®**
  The daylight autonomy is calculated via a simplified formula following to the Swiss label.
- **Daylight factor**
  Simulations are run with Radiance (CIE Overcast sky).
- **Diffuse Daylight Autonomy**

  Climatic data (hourly diffuse illuminance) and DF values are combined to estimate the time during which the indoor required illuminance level is achieve thanks to diffuse daylight (sky vault, no sun).
- **Dynamic Daylight Autonomy**
  Hourly simulations are run with Radiance (Three-phase method). For each step, the global illuminance (direct + diffuse components) is calculated in relationship with the shading device position (automated blinds). Among the main output one can mention **sDA** (Spatial Daylight Autonomy) and **UDI** (Useful Daylight Illuminance).

A connexion with the electric lighting module allows you to calculate (RADIANCE simulation) the illuminance values due to the luminaires you have selected (cf. Figure 123).

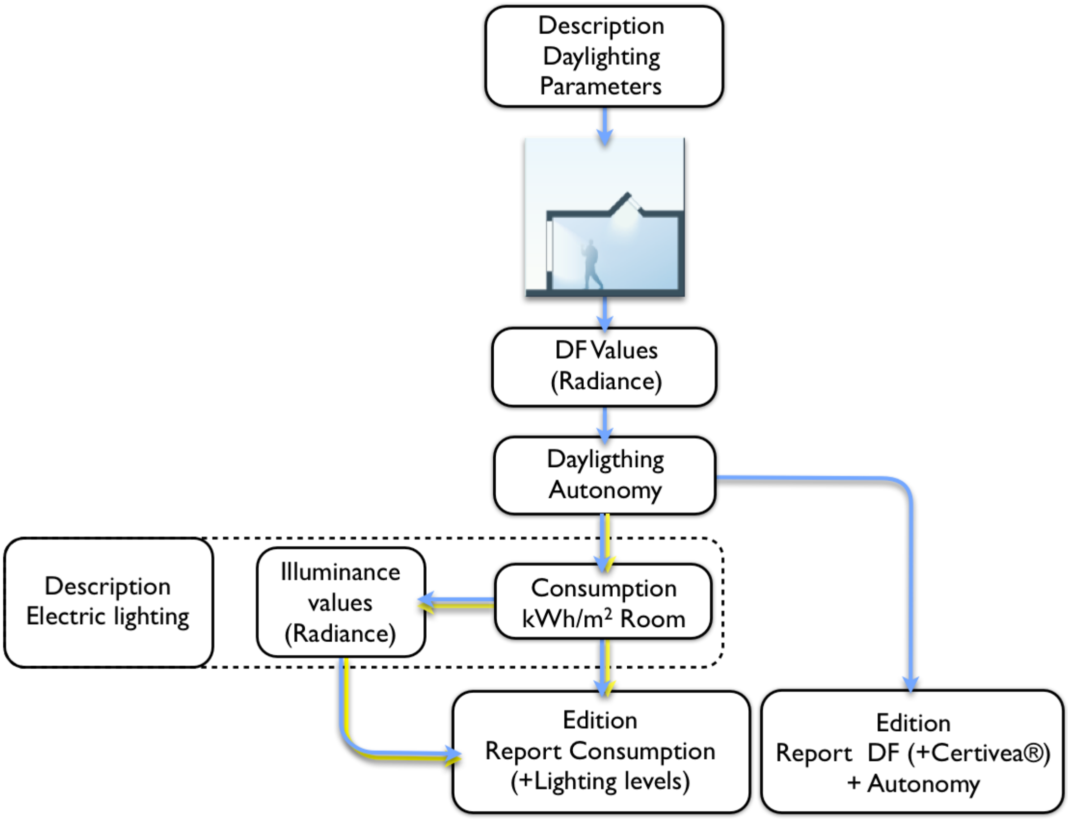


Figure 123: Block diagram describing the potential assessments of the daylighting module.

Daylighting: Selection of the calculation surface

1. Select the surface (floor or walls) you would like to analyse.
2. If you select the “Work plane”, the calculation will be done on a virtual surface whose height is represented by a yellow plane. You can change the plane height with the slider.
3. You can also enter the height of the work plane with your keyboard.

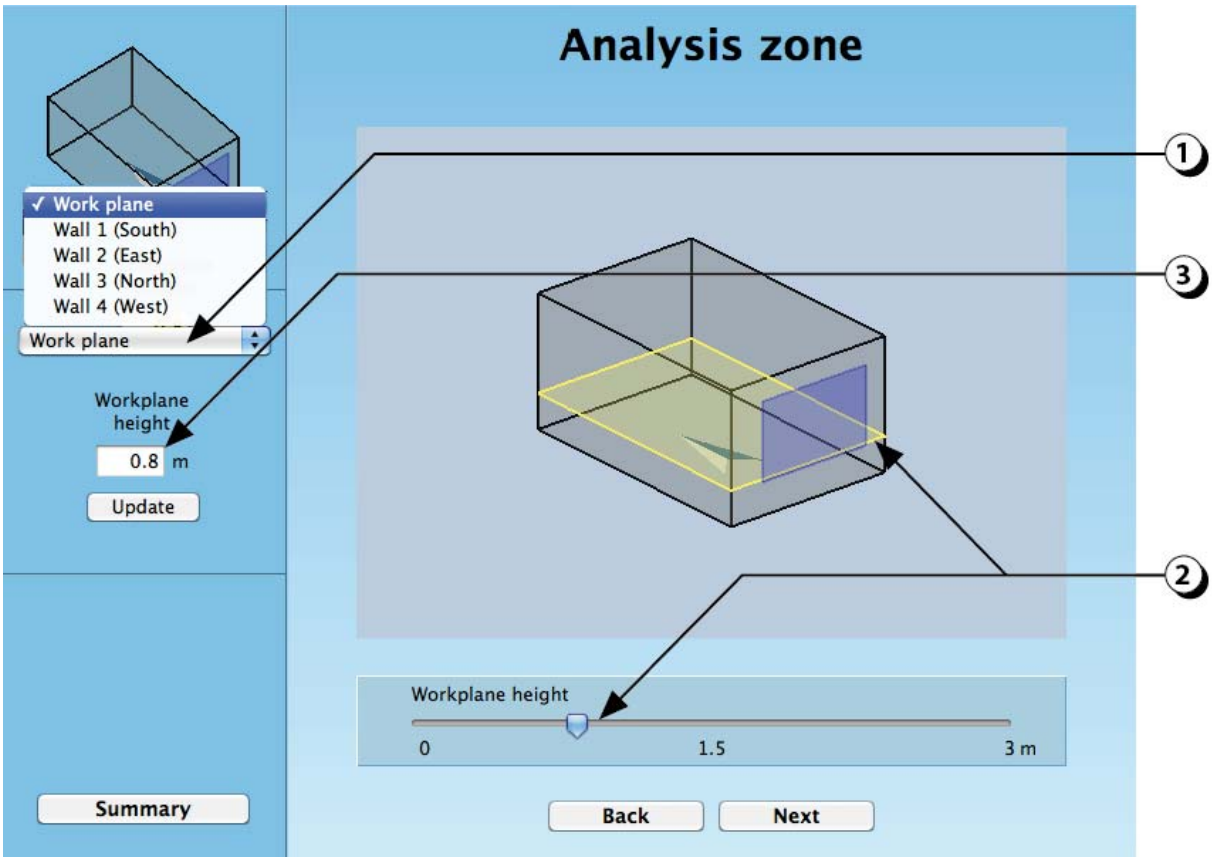
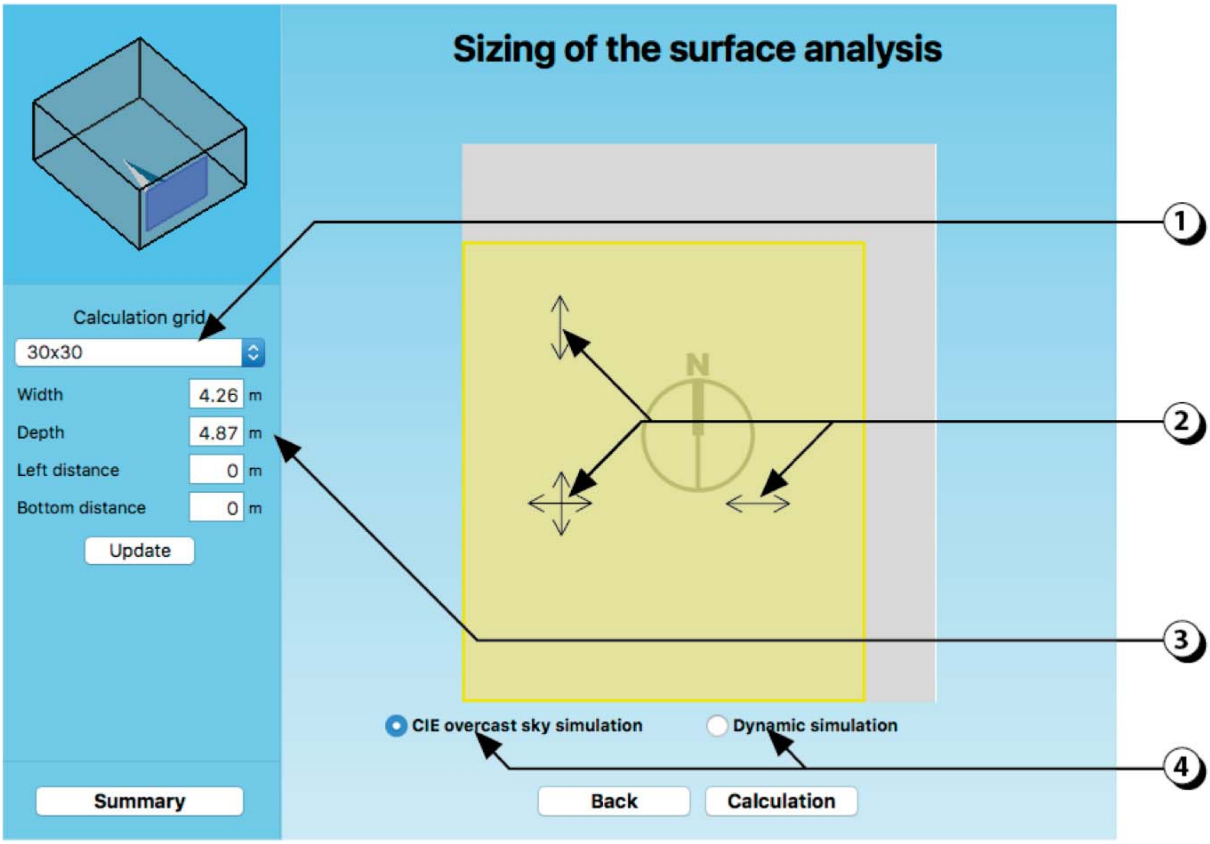


Figure 124: Selection of the surface for the daylighting calculation.

Daylighting: refining of the calculation surface

1. Adjust the calculation grid according to the requested level of precision (max. 100x100; the daylighting calculation will be done at the centre of each mesh of the grid).
2. You can adjust the area calculation (yellow rectangle) with your mouse.
3. You can use your keyboard to adjust the dimensions of the calculation area.
4. Select the type of calculation you would like to perform.
   - CIE Overcas Sky = Daylight Factor and Diffuse Daylight Autonomy,
   - Dynamic simulation: Spatial Daylight Autonomy (sDA) and Useful Daylight Illuminance (UDI).



Sizing of the surface analysis

Calculation grid: 30x30

Width: 4.26 m

Depth: 4.87 m

Left distance: 0 m

Bottom distance: 0 m

● CIE overcast sky simulation ○ Dynamic simulation

Figure 125: Selection of the calculation area, the grid definition and the simulation type.

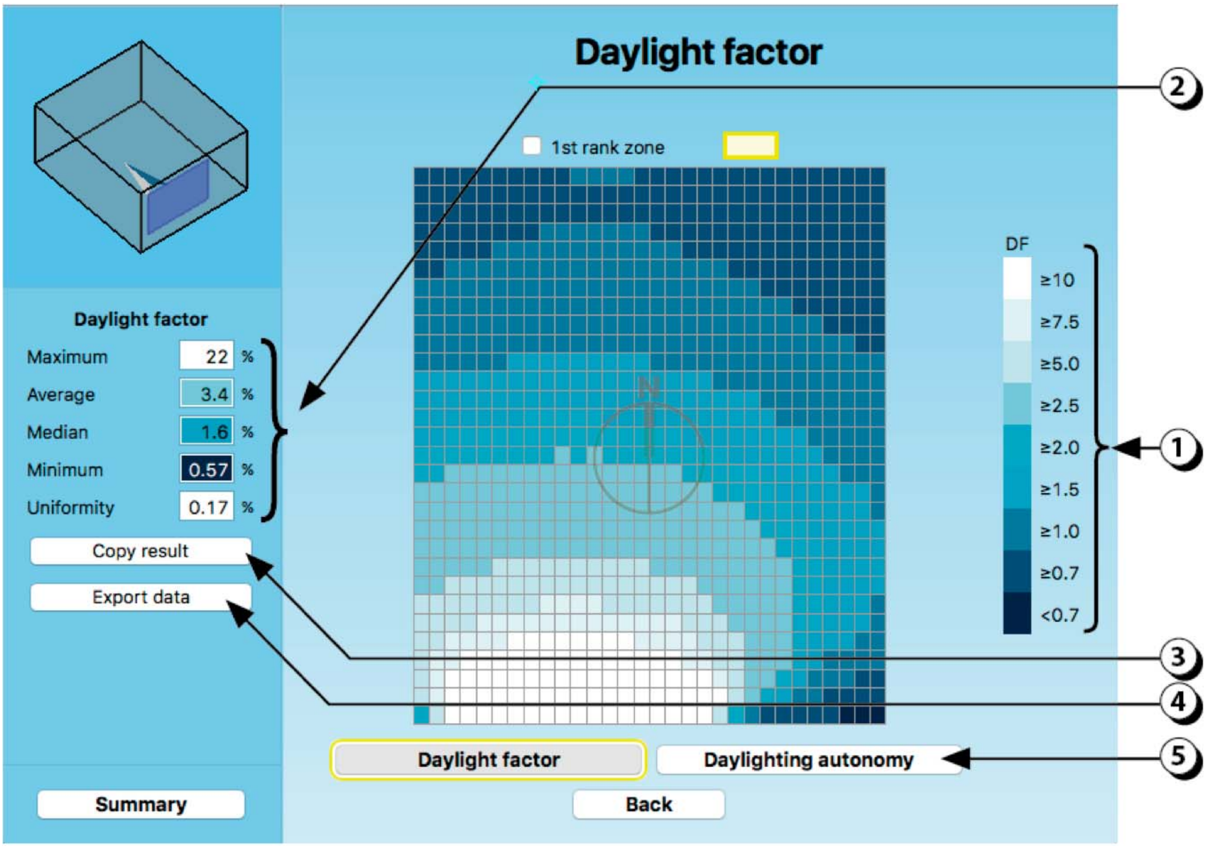
Daylighting: Daylight factor values

Lighting calculations are made with Radiance software[1].

Daylight factor values are calculated with the "CIE overcast sky", thus the sky luminance distribution is governed by the following equation:

$$L(\theta) = Lz . (1+ 2\cos\theta)/3$$

1. The results are displayed with blue colour patches according to this scale.
2. These 5 fields display the Maximum, Average», Median and Minimum values of the daylight factor, as well as the Uniformity (Minimum/Average).
3. Click this button to copy the image of the results, then paste it in any external document (Word, Page, PowerPoint, Keynote, .. etc) with the ctrl+v or cmd+v command.
4. Click this button to export the results into a .csv file (you will be able to open this file with any spread sheet software like Excel).
5. Click this button to calculate the diffuse daylighting autonomy on the selected surface.



Daylight factor

Maximum 22 %

Average 3.4 %

Median 1.6 %

Minimum 0.57 %

Uniformity 0.17 %

Figure 126: Daylight factor values.

---

[1] *The Radiance software (http://radsite.lbl.gov/) is developed by the Lawrence Berkeley National Laboratory (http://www.lbl.gov/).*

Daylighting: Daylight factor values: details

1. If you move the mouse on the colour patches, the daylight factor value corresponding to the position of your mouse is displayed.
2. The distance from left façade is displayed.
3. The distance from bottom façade is displayed.
4. If you click inside the colour patches, a profile of the values (line or column) is displayed (see Figure 128).

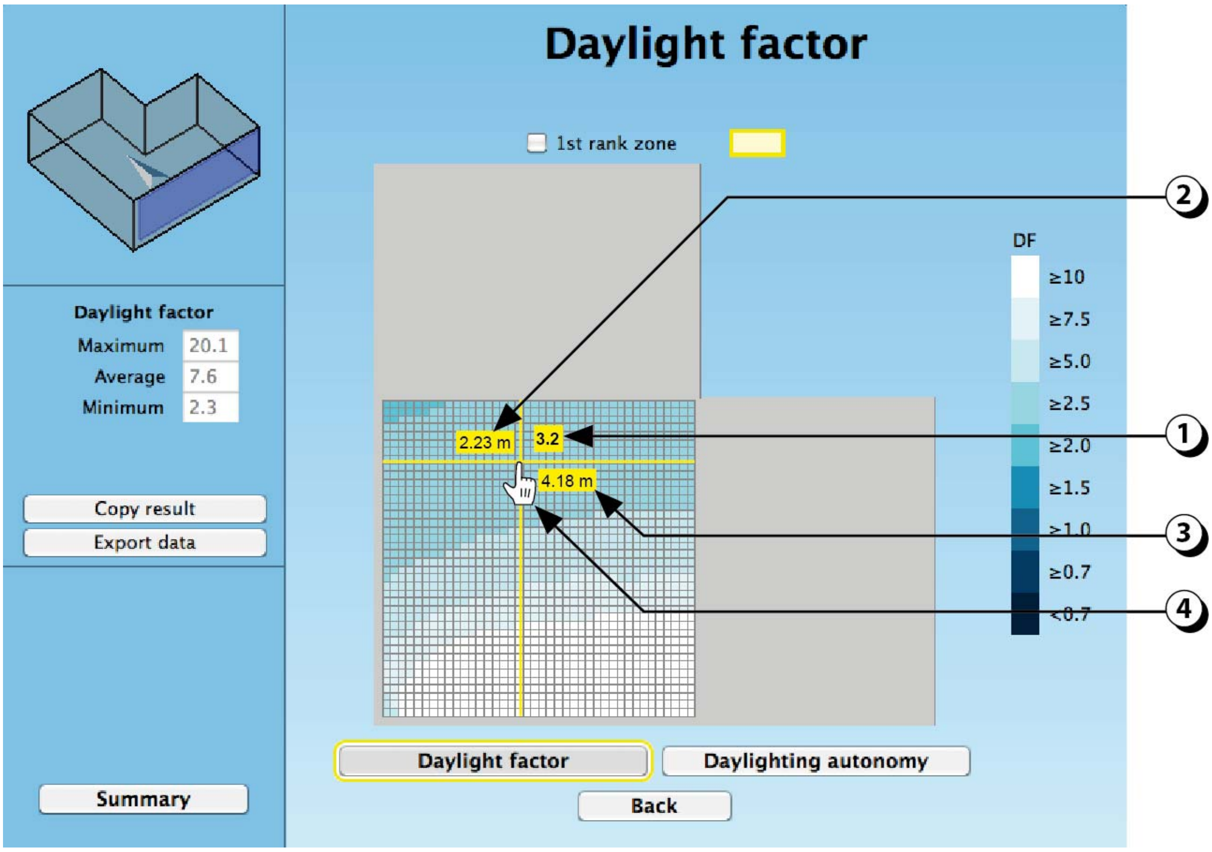


Figure 127: Daylight factor values, display of the results.

Daylighting: Daylight factor profiles

1. If you click on one of the blue coloured meshes this will display a daylight factor profile (vertical or horizontal).
2. Click this button to change the profile (vertical or horizontal).

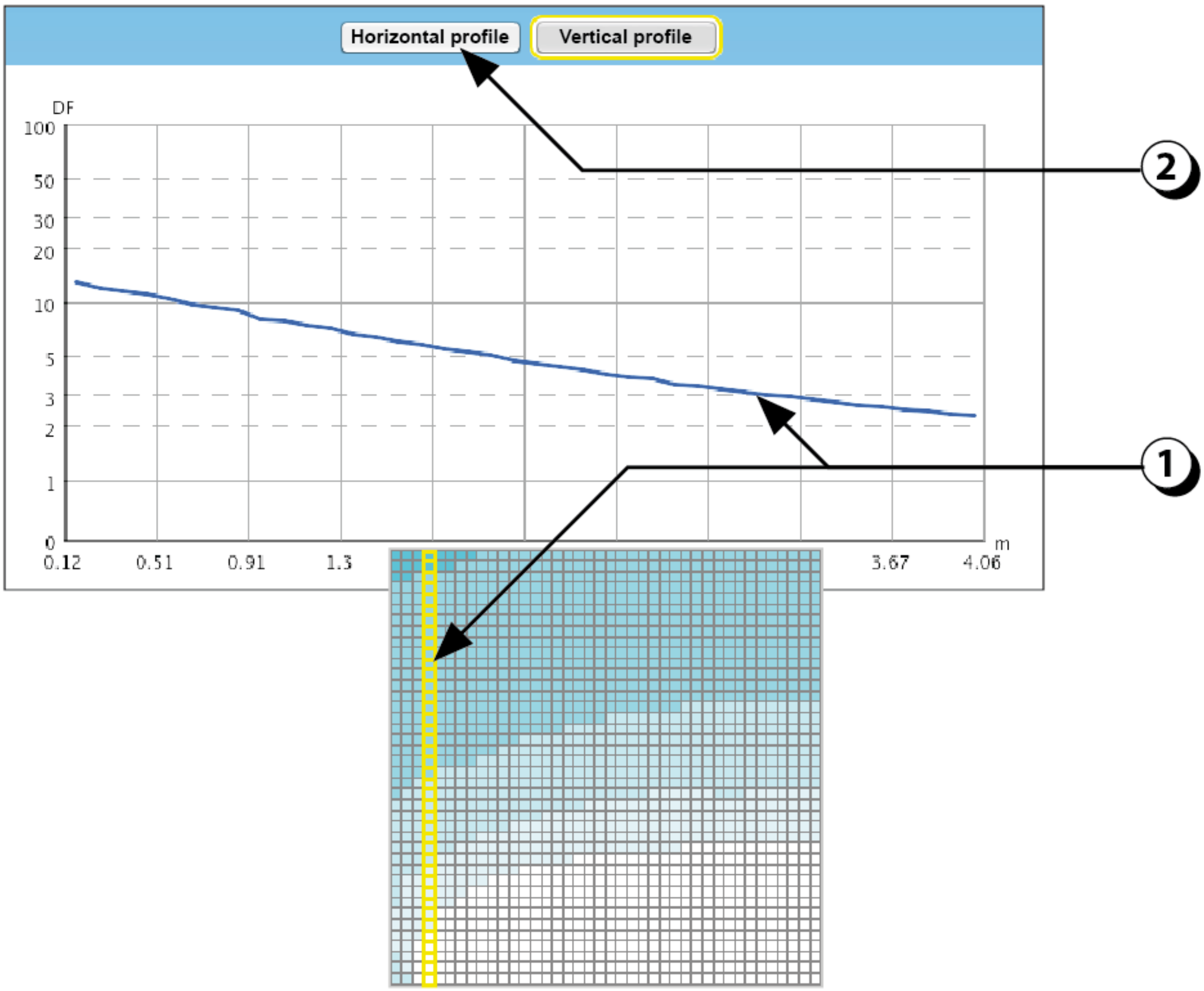
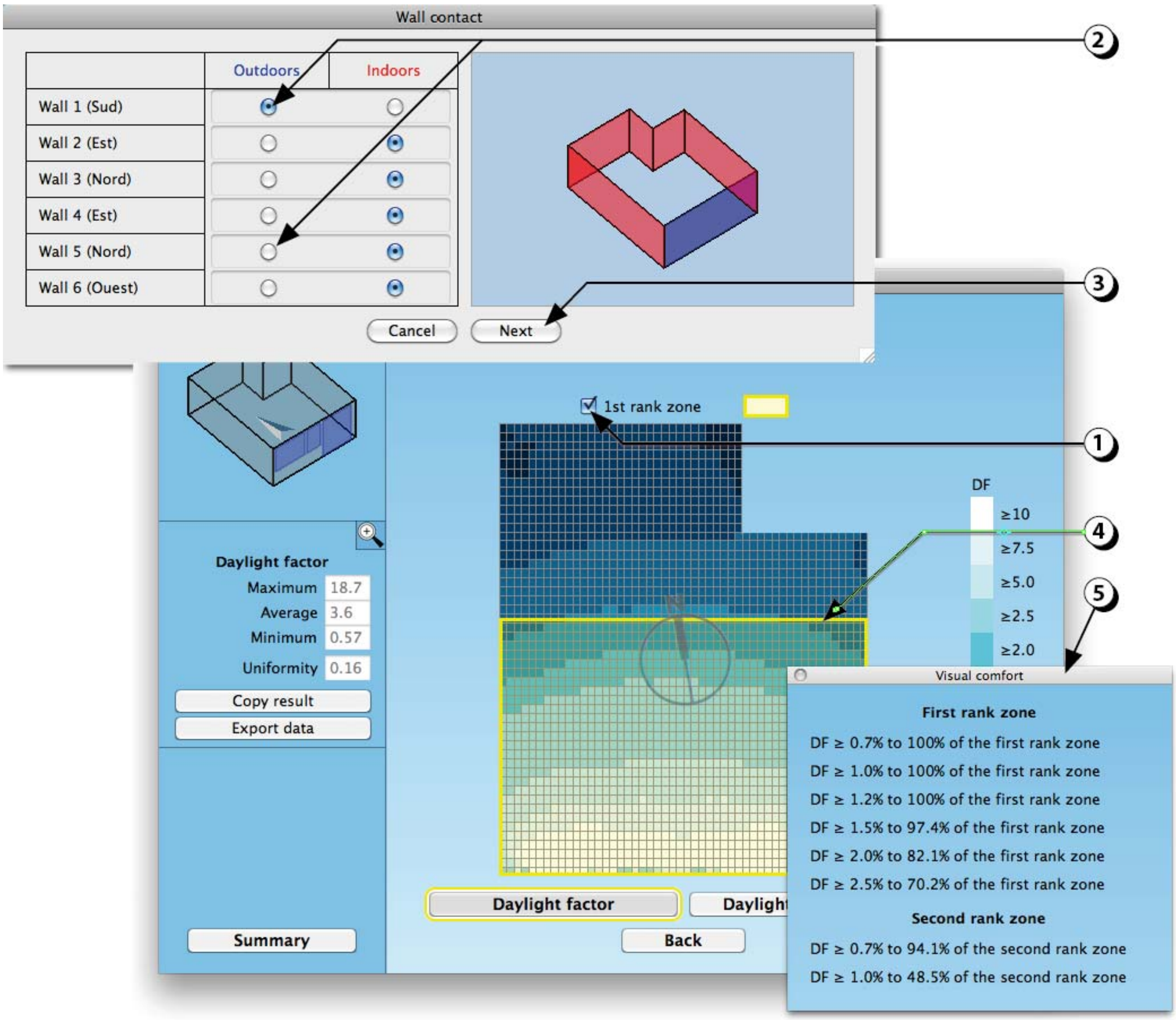


Figure 128: Display of the DF Profiles.

Daylighting: CERTIVEA® standard

1. Click on this button to calculate the daylight factor values within the “first rank” area (see schematic definition in Figure 130).
2. This leads to display a new window in which you have to indicate which of the vertical walls are in contact with outdoor.
3. Once you have selected the walls, click on “Next”.
4. The perimeter of the “1st rank area” is highlighted in yellow.
5. A specific window displays the results according to the thresholds of the Certivéa® standard.



	Outdoors	Indoors
Wall 1 (Sud)	●	○
Wall 2 (Est)	○	●
Wall 3 (Nord)	○	●
Wall 4 (Est)	○	●
Wall 5 (Nord)	○	●
Wall 6 (Ouest)	○	●

Daylight factor

Maximum	18.7
Average	3.6
Minimum	0.57
Uniformity	0.16

First rank zone

DF ≥ 0.7% to 100% of the first rank zone
DF ≥ 1.0% to 100% of the first rank zone
DF ≥ 1.2% to 100% of the first rank zone
DF ≥ 1.5% to 97.4% of the first rank zone
DF ≥ 2.0% to 82.1% of the first rank zone
DF ≥ 2.5% to 70.2% of the first rank zone

Second rank zone

DF ≥ 0.7% to 94.1% of the second rank zone
DF ≥ 1.0% to 48.5% of the second rank zone

Figure 129: Daylight factor values in the “First rank” area (Certivea® Standard).

Daylighting: Definition of the 1st rank area (CERTIVEA®)

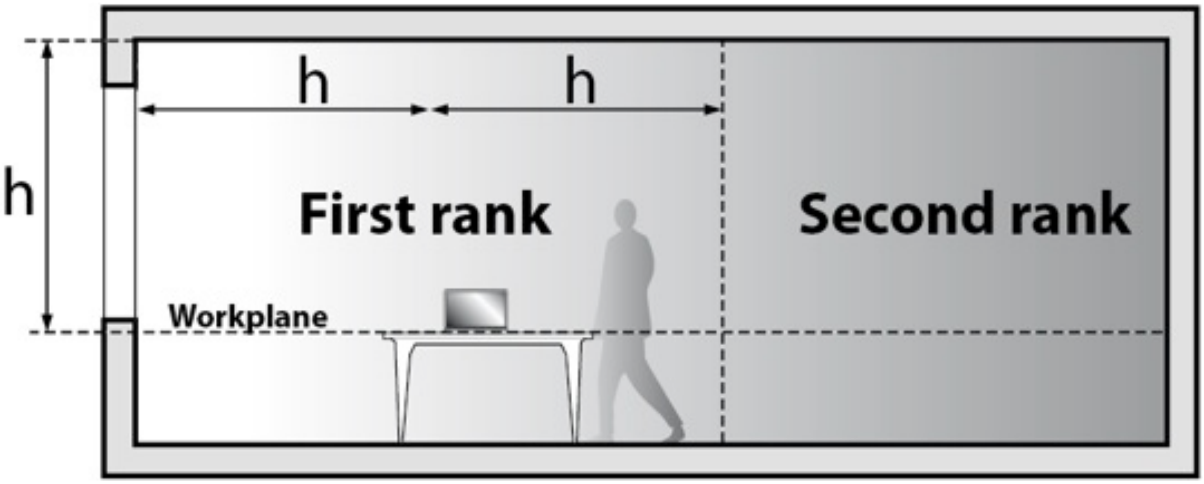


Figure 130: First and second rank area according to the Certives ® standard definition.

Diffuse Daylight Autonomy: Description

Several methods are available to estimate the daylighting potential of a given room. This potential is not only linked to the room characteristics (geometry and photometry) but also to the outdoors environment, the climatic conditions and the users behaviour.

Within DIAL+, the default method to estimate the daylight autonomy is based on the daylight factor values and only takes into account the light contribution of the sky vault (no sun). The principle is to use the climatic data corresponding to the room location to build the cumulated distribution of the diffuse outdoor illuminance (annual basis, hourly step).

For exemple, Figure 131 hereafter shows that in Geneva a 2.2% DF value allows the indoor illuminance to reaches 300lux during 64% of the opening hours (8:00AM-6:00PM, horizontal opening).

One of the advantages of this metric is that calculation time is very short (almost instantaneous from DF value). Another advantage lies in the fact that this method is completely independent of the shading device control (which is highly unpredictable if there is no automatism). It gives a good idea of the minimum daylighting potential regardless of the sun contribution.

This method is recommended in the new European Norm EN 17037 dealing with “Daylight of buildings”.

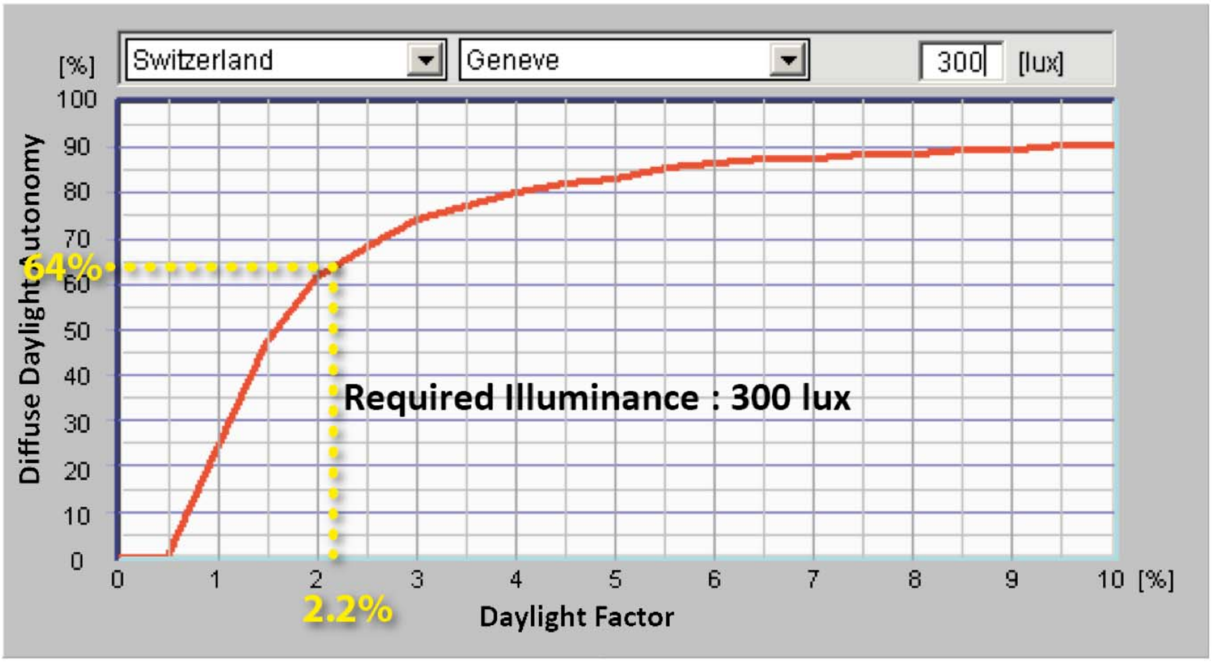


Figure 131: Relationship between Daylight Factor (DF) value and Diffuse Daylight Autonomy (DDA) for Geneva (8:00 AM- 6:00PM, horizontal aperture).

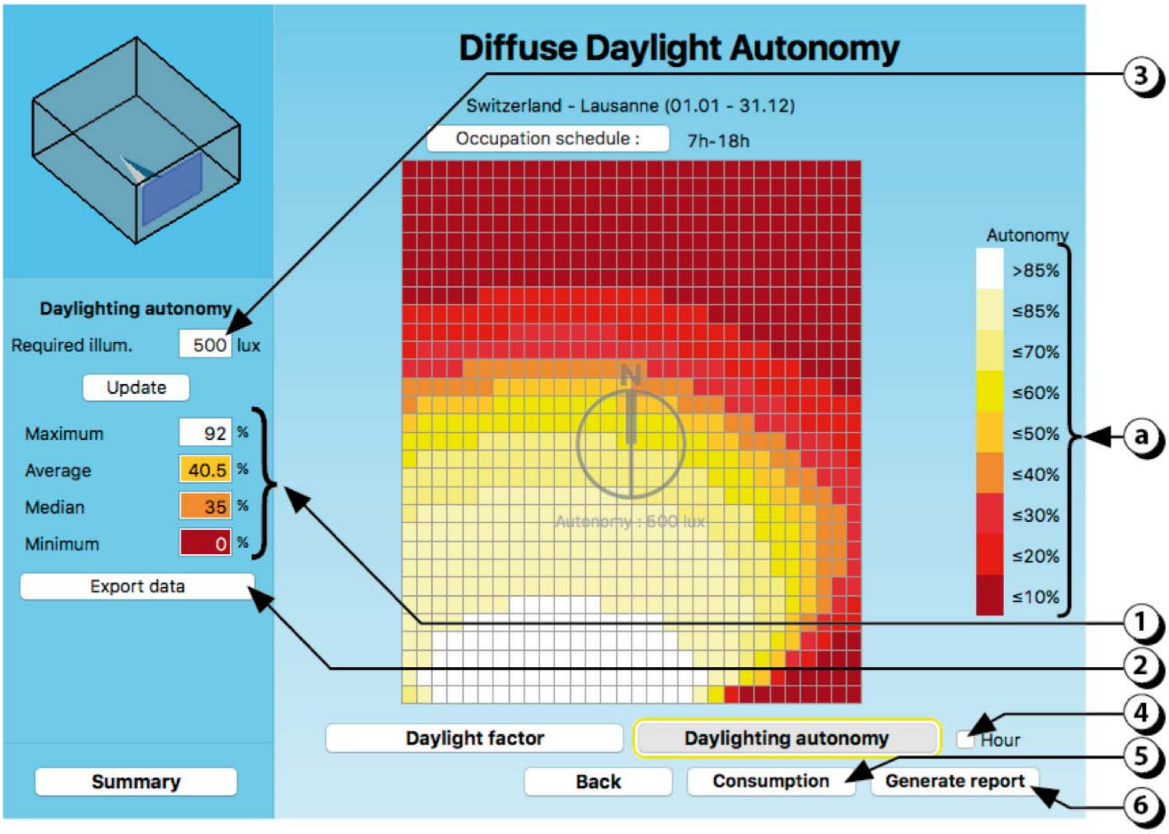
Diffuse Daylight Autonomy (DDA): Results

As mentioned before, the daylighting autonomy is calculated on the basis of the daylight factor values, and according to the cumulated distribution of the outdoor horizontal diffuse illuminance (hourly step Meteonorm data corresponding to the city you have selected).

Specific orientation factors are used to take into account the orientation of the different openings.

The results are displayed with colour patches according to this scale **(a)**.

1. These 4 fields allow you to quickly know the Maximum, Average, Median and Minimum values of the daylighting autonomy.
2. Click this button to export the results into a .csv file (you will be able to open this file with any spread sheet software like Excel).
3. You can use your keyboard to change the required illuminance value and to see the influence on the daylighting autonomy (cf. page 165).
4. Click this button to display the diffuse daylight autonomy in hours (cf. page 151).
5. Click this button to estimate the annual energy consumption due to electric lighting as a function of the daylighting autonomy (only available if you have described at least 1 luminaire).
6. Click this button to generate a report of the daylighting performance of the room.



Diffuse Daylight Autonomy

Switzerland - Lausanne (01.01 - 31.12)

Occupation schedule : 7h-18h

Daylighting autonomy

Required illum. 500 lux

Maximum 92 %

Average 40.5 %

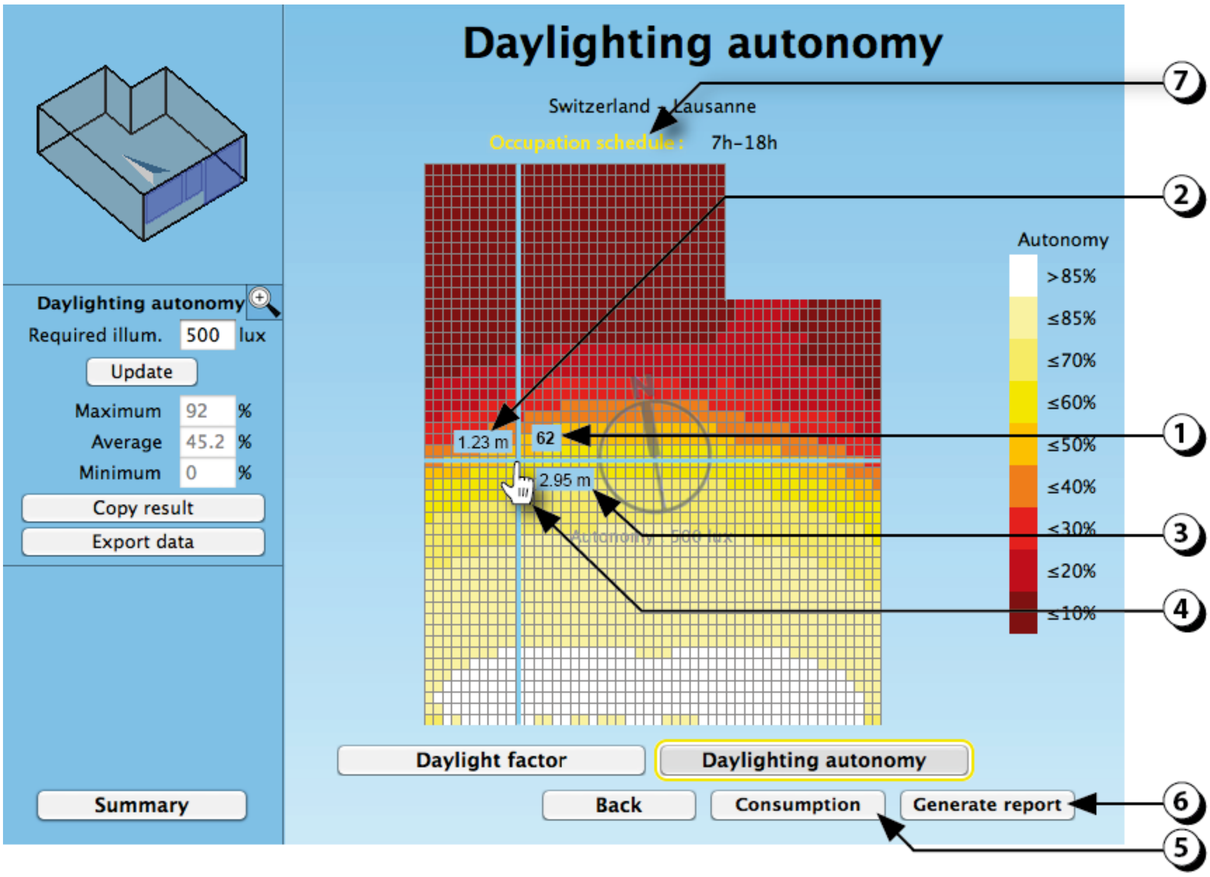
Median 35 %

Minimum 0 %

Figure 132: Daylighting autonomy: main display of the results.

Diffuse Daylighting Autonomy: Detail

1. If you move the mouse on the colour patches, the daylighting autonomy value corresponding to the position of your mouse is displayed.
2. The distance from left façade is displayed.
3. The distance from bottom façade is displayed.
4. If you click inside the colour patches, a profile of the values (horizontal or vertical) is displayed (see Figure 128).
5. Click this button to estimate the annual energy consumption due to electric lighting as a function of the daylighting autonomy (only available if you have described at least 1 luminaire).
6. Click this button to generate a report on the daylighting performance of the current room (only available if you have selected "accurate calculation" when launching the simulation).
7. Click here to modify the occupancy period (cf. page 152).



Daylighting autonomy

Switzerland - Lausanne

Occupation schedule : 7h-18h

Required illum. 500 lux

Maximum 92 %

Average 45.2 %

Minimum 0 %

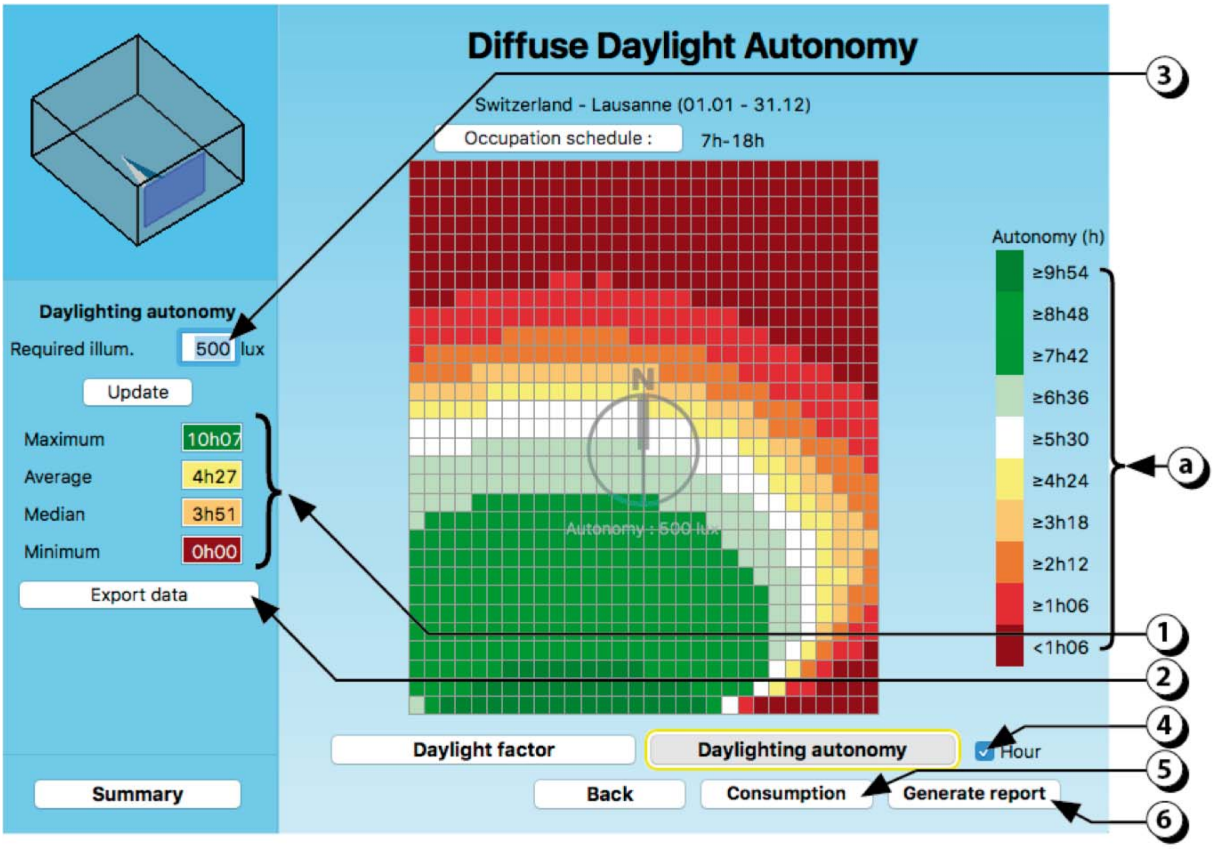
Figure 133: Daylighting autonomy: Display of the results.

Diffuse Daylight Autonomy (DDA): Hours

It is also possible to display the DDA results as hours (average time during which the indoor illuminance exceeds the required values thanks to diffuse light from the sky vault).

The results are displayed with colour patches according to this scale **(a)**.

1. These 4 fields allow you to quickly know the Maximum, Average, Median and Minimum values of the daylighting autonomy.
2. Click this button to export the results into a .csv file (you will be able to open this file with any spread sheet software like Excel).
3. You can use your keyboard to change the required illuminance value and to see the influence on the daylighting autonomy.
4. Click this button to display the diffuse daylight autonomy in %.
5. Click this button to estimate the annual energy consumption due to electric lighting as a function of the daylighting autonomy (only available if you have described at least 1 luminaire).
6. Click this button to generate a report of the daylighting performance of the room.



Diffuse Daylight Autonomy

Switzerland - Lausanne (01.01 - 31.12)

Occupation schedule : 7h-18h

Daylighting autonomy

Required illum. 500 lux

Maximum 10h07

Average 4h27

Median 3h51

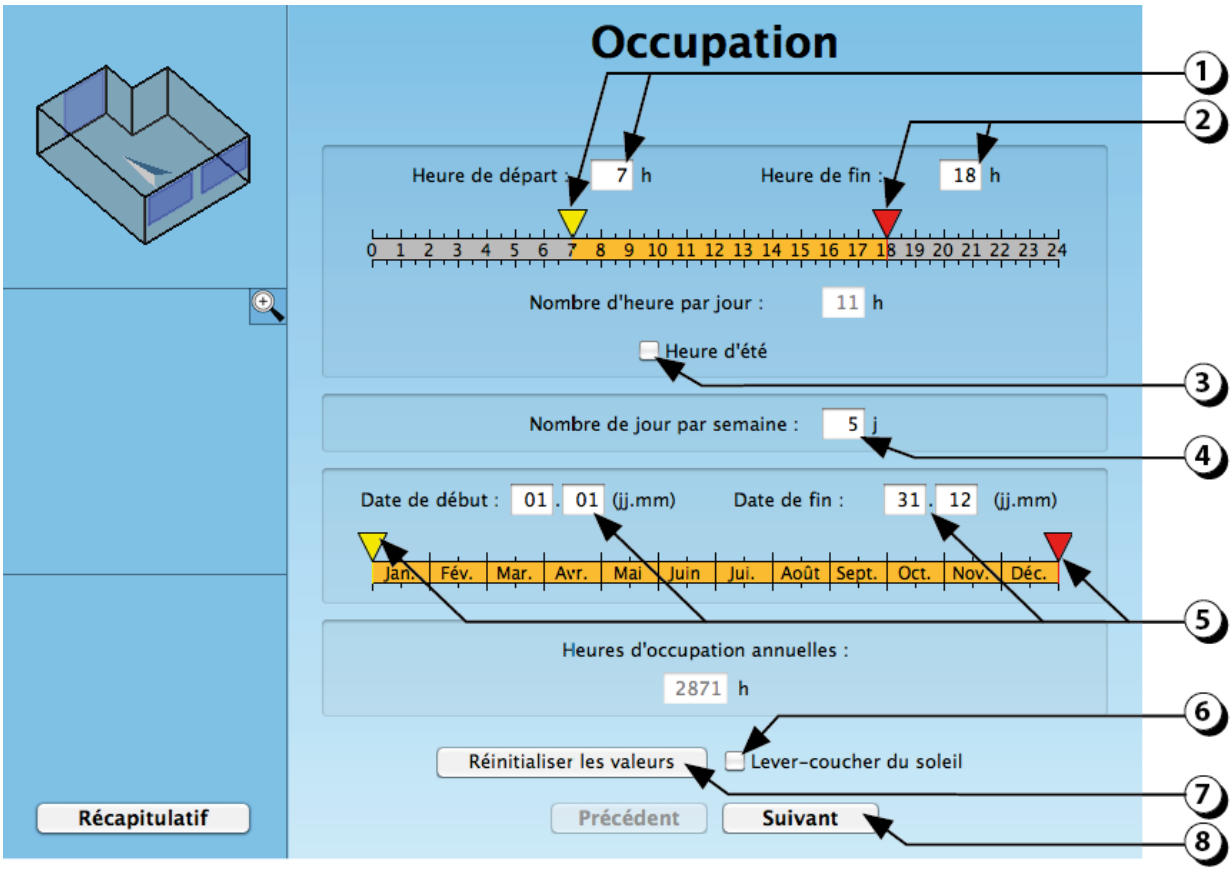
Minimum 0h00

☑ Hour

Figure 134: Diffuse Daylight Autonomy displayed as hours.

Daylighting autonomy: Occupancy schedule

1. Adapt the **starting** hour with the slider or by modifying the value in the corresponding field.
2. Adapt the **ending** hour with the slider or by modifying the value in the corresponding field.
3. Click here if you want to take into account the savings due to summer time.
4. Indicate the number of days/week during which the room is occupied.
5. Select the starting and ending dates. This function is particularly useful if you want to know the daylighting autonomy for a given period (or if you want to exclude some weeks during summer for school).
6. Click here if you want the analysis to be conducted between sunrise and sunset (no schedule).
7. Click here to reset the values (the default values are taken form the Swiss standard: “Cahier technique 2024”).
8. Once all parameters are consistent, click here to recalculate autonomy.



Heure de départ : 7 h Heure de fin : 18 h

Nombre d'heure par jour : 11 h

☐ Heure d'été

Nombre de jour par semaine : 5 j

Date de début : 01 . 01 (jj.mm) Date de fin : 31 . 12 (jj.mm)

Heures d'occupation annuelles : 2871 h

☐ Lever-coucher du soleil

Figure 135: Occupancy schedule for daylighting autonomy.

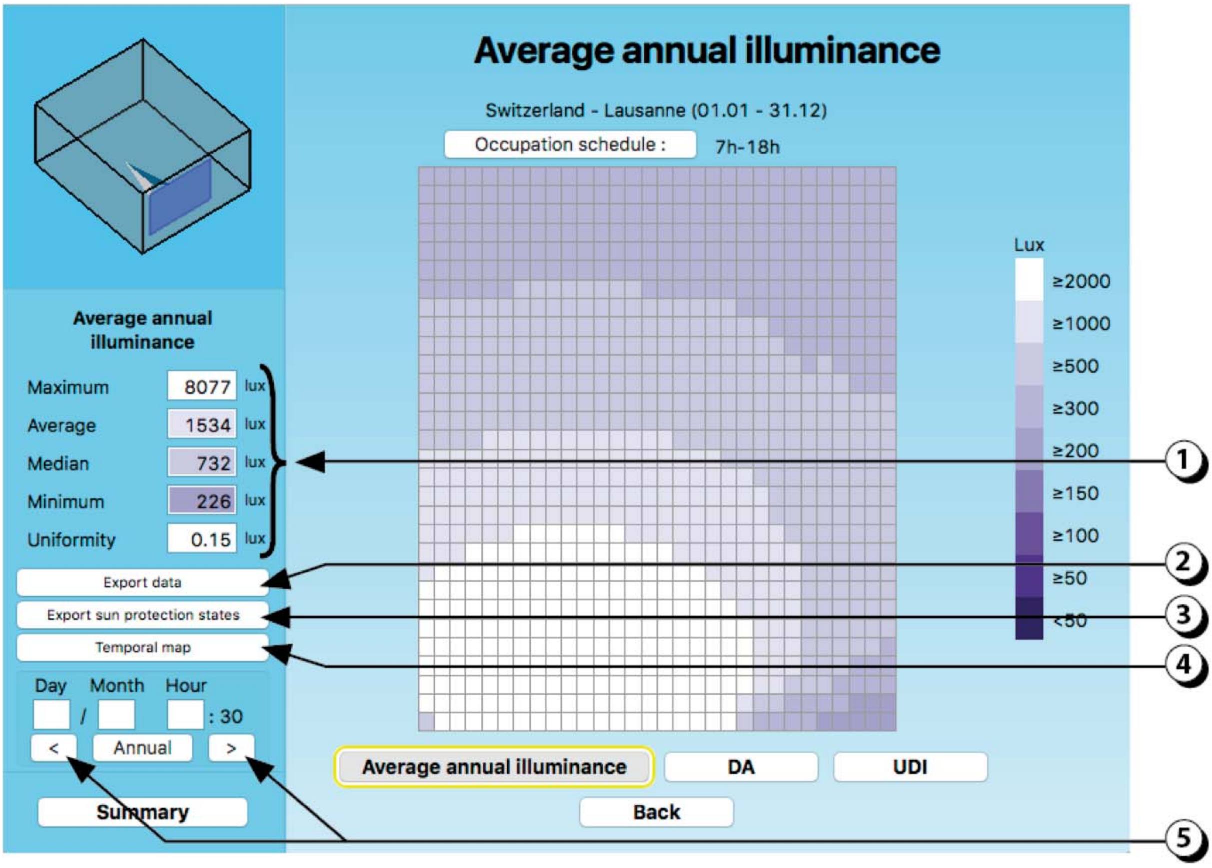
Dynamic simulations: Annual Average Illuminance

Dynamic simulations are run with the Radiance three-phase method. Those simulations are based on hourly calculations and take into account both diffuse and direct components. This type of calculation is suited for rooms equipped with automated shading devices.

The time requested to perform dynamic simulations can take several minutes, it is thus recommended, during the design/optimisation phase, to start with DDA and to run dynamic simulation once the design parameters are stabilized.

For each time step the indoor illuminance is calculated on the work plane and DIAL+ builds a map of the average illuminance value.

1. Here are displayed the maximum, average, median and minimum values of the average annual illuminance as well as the uniformity ratio (Min/Average).
2. Click here to export the average illuminance values (.csv file).
3. Click here to genertate a .csv file describing the blind status at each time (hourly step).
4. Click here to display a temporal map (carpet diagram) of the blinds status (cf. Figure 138).
5. Click on these buttons to display the illuminance maps on an hourly basis (cf. next page).



Average annual illuminance

Switzerland - Lausanne (01.01 - 31.12)

Occupation schedule : 7h-18h

Average annual illuminance

Maximum 8077 lux

Average 1534 lux

Median 732 lux

Minimum 226 lux

Uniformity 0.15 lux

Figure 136: Average annual illuminance (dynamic simulation)

Dynamic simulations: Hourly Illuminance

It is possible to display an illuminance map of the room for each hour of the year (click the buttons mentionned at point 5 of previous page).

Figure 137 shows how daylight is dstributed into the room during the day (here form 8AM to 6 PM for a south oriented individual office located in Lausanne).

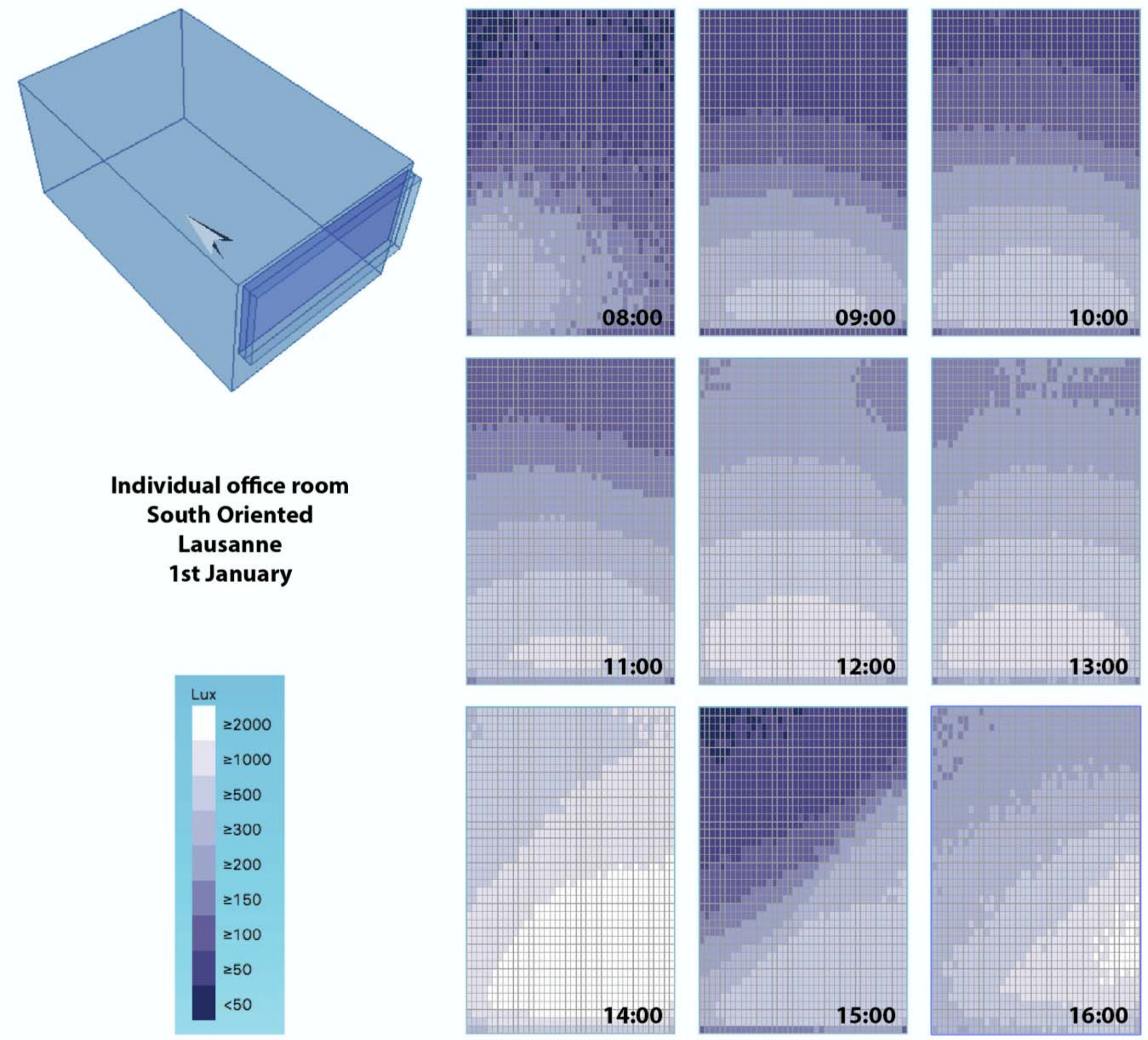


Figure 137: Hourly illuminance, display of the illuminance values for the 1st of January, 8AM-6PM.

Dynamic simulations: Temporal maps

As mentioned in Point 4 of page 153, it is possible to display, on a temporal map, the status of the shading device at each hour of the year.
On this diagram hours (0-24) are represented on the vertical axis and months (1-12) are represented on the horizontal axis.

1. Select the type of temporal map you would like to displax.
2. If you have selected “”Sun Protection State”, and if your room is equipped with several openings, select the corresponding wall and window.
3. The blinds status (here automated external venetian blinds) is represented by color patches whose signification is reported in the lower right corner of the figure.

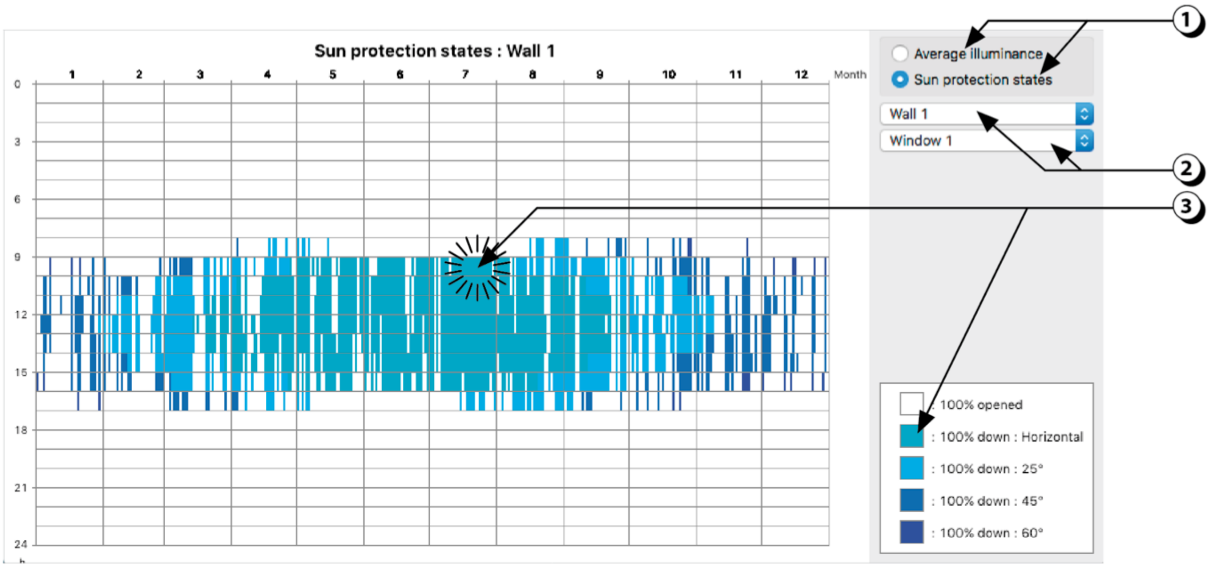


Figure 138: Display of the shading devices status along the year.

Spatial Daylight Autonomy (sDA): Definition

The spatial Daylight Autonomy has been defined by IEA (Illuminating Engineering Society)[2]. The sDA is defined as percentage of the task area that meets a minimum daylight illuminance level for a given fraction of operating hours per year, i.e., that meets a defined daylight autonomy level.

The recommended thresholds are 300 lux and 50% of operating hours, daily from 8am to 6pm local time incorporating daylight savings time, and the sDA value is given in percent.

sDA is calculated according as follows:

$$\mathrm{sDA}_{300,50\%} = \frac{\text{Analysis area with E} \ \geq \ \text{300lx for at least 50\% of the operating hours}}{\text{Overall analysis area}} * 100$$

According to IES target values for the spatial daylight autonomy are as follows:

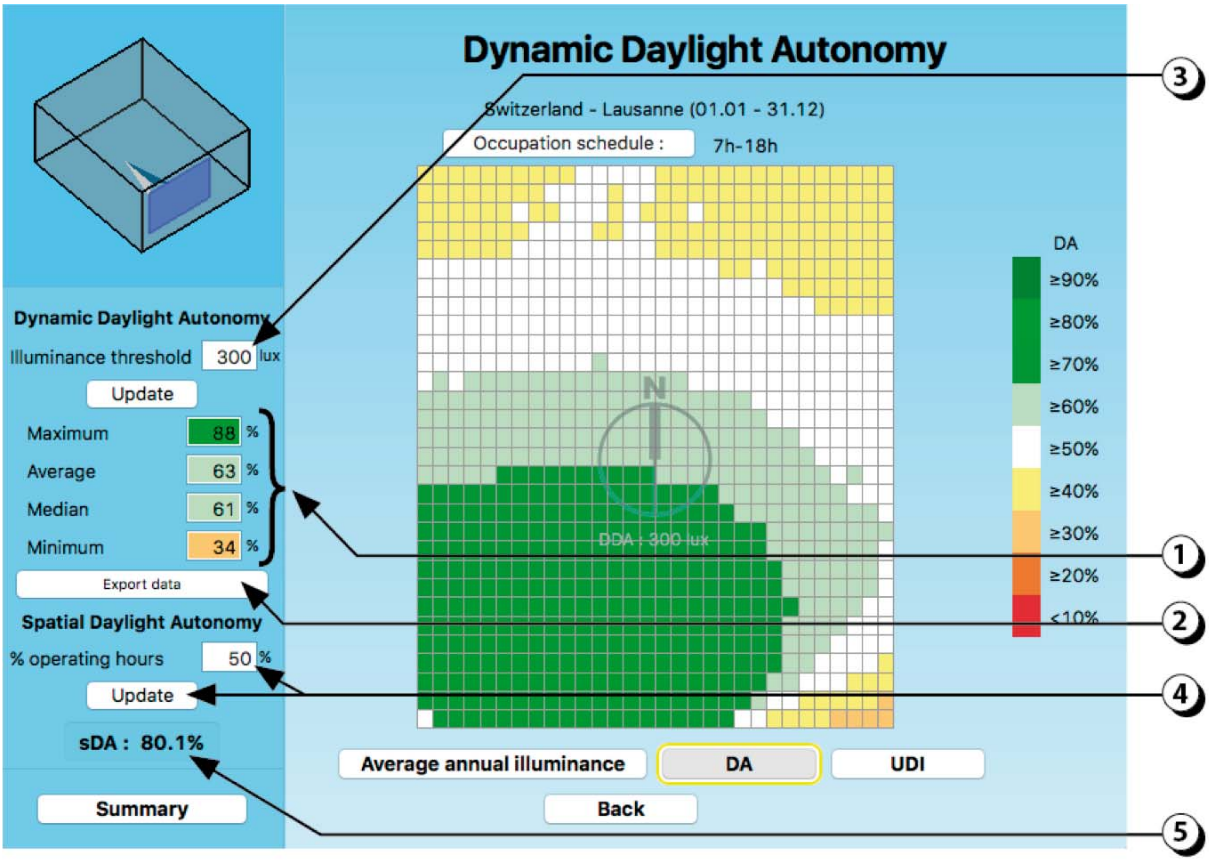
- sDA300,50% ≥ 55%: nominally acceptable daylight sufficiency,
- sDA300,50% ≥ 75%: preferred daylight sufficiency.

---

[2] IES, Illuminating Engineering Society, (2012). IES LM-83-12, Approved Method: IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE).

Spatial Daylight Autonomy (sDA): Results

1. These fields display the maximum, average, median and minimum values of DA.
2. Click here to export the data (.csv file).
3. You can modify the threshold for illuminance values.
4. You can modify the % of operating hours.
5. This field displays the corresponding value for Spatial Daylight Autonomy.



Dynamic Daylight Autonomy

Switzerland - Lausanne (01.01 - 31.12)

Occupation schedule : 7h-18h

Dynamic Daylight Autonomy

Illuminance threshold 300 lux

Maximum 88 %

Average 63 %

Median 61 %

Minimum 34 %

Spatial Daylight Autonomy

% operating hours 50 %

sDA : 80.1%

Figure 139: Dynamic Daylight Autonomy (DA) and Spatial Daylight Autonomy (sDA).

Useful Daylight Illuminance (UDI)[3] Definition

UDI is the annual occurrence of daylight illuminances across the workplane within a given range. This range was defined to encompass "useful illuminances for occupants" from a comprehensive review of occupant's behavior with artificial lighting, dimming and blinds. Unlike for artificial lighting, where the target is of 500 lx, some studies showed that daylight around 100 lx can be sufficient [20] and illuminances higher than 2000 to 2500 lx lead to a visual discomfort.

To summarize, four categories were defined:

- Daylight illuminances less than 100 lx are not sufficient.
- Daylight illuminances between 100-500 lx are generally sufficient and can be reinforced by artificial lighting.
- Daylight illuminances between 500-2000/2500 lx are autonomous towards artificial lighting.
- Daylight illuminances higher than 2000/2500 lx lead to visual discomfort.

Limits defined above can be discussed depending the local activities and occupants. Anyway, the scheme is more important than the exact value and the useful UDI is considered as the collection of illuminances between 100 and 2000/2500 lx.

As explained above, there are several ranges to classify satisfaction of illuminance level: not sufficient, useful and too high. Moreover in the useful UDI range, there are two complementary UDI ranges: supplementary and autonomous.

All ranges are defined as follows:

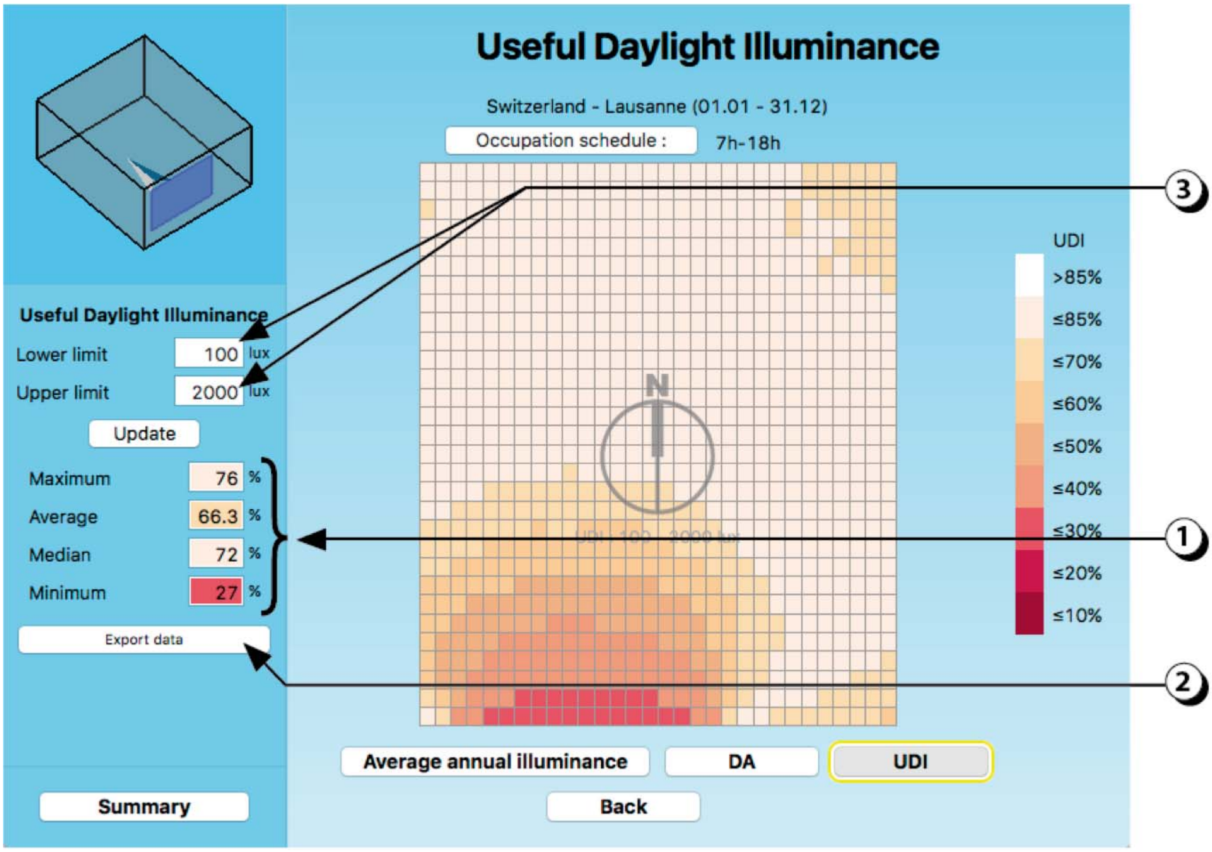
- UDI-f: UDI fell-short: The illuminance is less than 100 lx,
- UDI-s: UDI supplementary: The illuminance is greater than 100 lx and less than 300/500 lx,
- UDI-a: UDI autonomous: The illuminance is greater than 300/500 lx and less than 2000/2500 lx,
- UDI-e: UDI exceeded: The illuminance is greater than 2000/2500 lx.

---

[3] Nabil, A. and J. Mardaljevic, Useful daylight illuminance: a new paradigm for assessing daylight in buildings. Lighting Research & Technology, 2005. 37(1): p. 41-59.

Useful Daylight Illuminance (UDI): Results

1. These fields display the Maximum, Average, Median and Minimum values of the UDI.
2. Click here to export the results (.csv file).
3. You can adjust the minimum and maximum threshold values.



Useful Daylight Illuminance

Switzerland - Lausanne (01.01 - 31.12)

Occupation schedule : 7h-18h

Useful Daylight Illuminance

Lower limit 100 lux

Upper limit 2000 lux

Maximum 76 %

Average 66.3 %

Median 72 %

Minimum 27 %

Figure 140: Useful Daylight Illuminance.

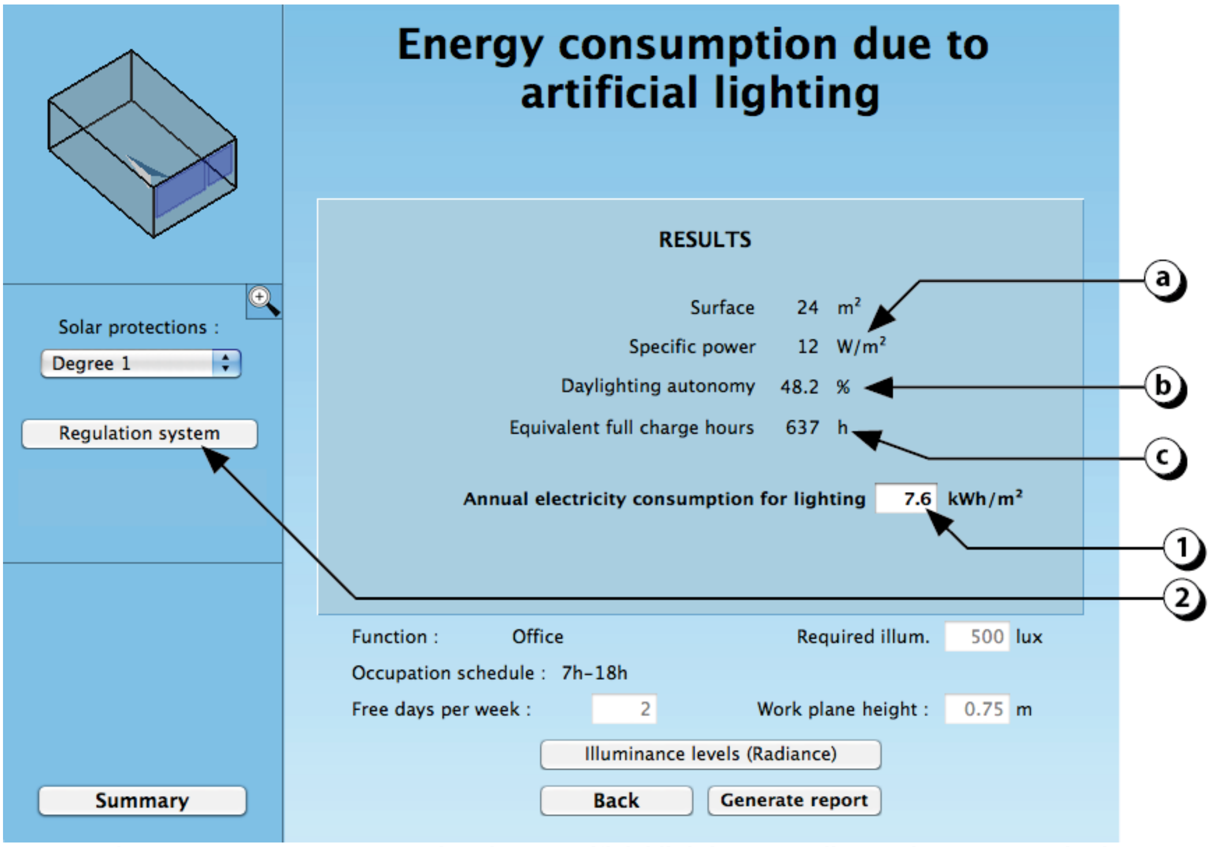
Electric lighting: Energy consumption according to DIAL+

Annual electricity consumption per room

Once you have calculated de daylighting autonomy, and provided that you have described a least one luminaire in the room, it is possible to estimate the annual energy consumption due to electric lighting. The scenarios are as follow:

1. The annual electricity consumption due to electric lighting is displayed.

   This value depends on the specific power (**a**), the average daylighting autonomy (**b**), which allows us to deduce the equivalent number of full charge hours (**c**), as a function of the regulation system.
2. You can modify the regulation system (electric lighting command) in order to evaluate its influence on the energy consumption.



Energy consumption due to artificial lighting

RESULTS

Surface 24 m²
Specific power 12 W/m²
Daylighting autonomy 48.2 %
Equivalent full charge hours 637 h
Annual electricity consumption for lighting 7.6 kWh/m²

Solar protections : Degree 1

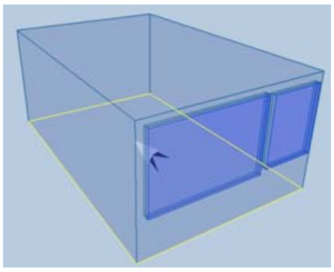
Function : Office
Occupation schedule : 7h-18h
Free days per week : 2
Required illum. 500 lux
Work plane height : 0.75 m

Figure 141: Energy consumption due to artificial lighting according to the DIAL+ method.

The different scenarios for lighting regulation are explained below in the following pages.

Electric lighting: description of the control scenarios

To explain the 6 different control scenarios, we take the following room example:



- S (room surface) = 24 m^2
- H_{occ} (Annual occupation): 2871 h per year (7h-18h, 5 day/week)
- $Auto_{Moy}$ (Average Autonomy DIAL+) = 47.3%
- P (specific power): 11.8 W/m^2
- Illuminance level (E_{req}): 500 lux
- Stand-by power (if applicable): 3W / luminaire

Whatever the scenario, the first step in the calculation of consumption relates to the equivalent number of full load hours (time during which 100% of the specific power will be called).

The average value of autonomy (here 47.3%) is used to derive the theoretical number of hours during which the required illuminance will not be reached only with daylight (“***Non-Autonomy***”).

In the selected example: Non Autonomy = 100% - 47.3% = 52.5% of the occupation hours.

The results of six selected scenarios are then weighted (k) depending on whether you use an occupancy sensor.

- No sensor: k = 1.0
- On/Off Occupancy sensor (the detector is used for turning on and off): k = 0.8
- Auto-OFF sensor (the detector is only used for turning off): k = 0.7

Scenario 1: Manual switch

Lamp management is totally manual.

Lighting sensor 	This scenario assumes that the total number of lighting hours is the number of hours of "Non-Autonomy" increased by 20%, to reflect the "imperfect" management of the users. (Hpc = 2871*(53.7/100) * 1.20)
Without	

OCCUPANCY SENSOR	Full charge hours	Consumption
Consumption without sensor	1814 h	21.4 kWh/m^2
Consumption without On/Off sensor	1451 h	17.1 kWh/m^2
Consumption with Auto-OFF sensor	1270 h	15.0 kWh/m^2

Figure 142: Example of electricity consumption with a conventional switch lighting control (manual switching).

Scenario 2: Manual switch with auto-off during the lunch break

<table>
<tr><td> </td><td colspan="3" rowspan="2">This scenario shows the assumptions of scenario 1 but using only a 10% increase in the number of full load hours.
This takes into account the shutdown during lunch break</td></tr>
<tr><td>Without</td></tr>
<tr><td colspan="2">OCCUPANCY SENSOR</td><td>Full charge hours</td><td>Consumption</td></tr>
<tr><td colspan="2">Consumption without sensor</td><td>1662 h</td><td>19.6 kWh/m^2</td></tr>
<tr><td colspan="2">Consumption without On/Off sensor</td><td>1330 h</td><td>15.7 kWh/m^2</td></tr>
<tr><td colspan="2">Consumption with Auto-OFF sensor</td><td>1164 h</td><td>13.7 kWh/m^2</td></tr>
</table>

Figure 143: Example of electricity consumption with a conventional switch lighting control (manual switching) with auto sutdown during the lunch break..

Scenario 3: Daylight sensor on/off

As soon as the indoor illuminance is lower than the required value, the lamps are switched on (100%).

<table>
<tr><td> </td><td colspan="3" rowspan="2">This scenario assumes that for an average daylight autonomy of 47.3 %, the time during which the lamps will be switched on corresponds to the complement of the occupied hours (here 52.7%).</td></tr>
<tr><td>On/Off</td></tr>
<tr><td colspan="2">OCCUPANCY SENSOR</td><td>Full charge hours</td><td>Consumption</td></tr>
<tr><td colspan="2">Consumption without sensor</td><td>1511 h</td><td>17.8 kWh/m^2</td></tr>
<tr><td colspan="2">Consumption without On/Off sensor</td><td>1209 h</td><td>14.3 kWh/m^2</td></tr>
<tr><td colspan="2">Consumption with Auto-OFF sensor</td><td>1058 h</td><td>12.5 kWh/m^2</td></tr>
</table>

Figure 144: Example of electricity consumption with a conventional switch lighting control (Daylight sensor On/Off).

Scenario 4: Constant diming without standby

A daylight sensor allows calling the request power to complete the indoor illuminance level. The system is active throughout the occupation schedule (the standby power be defined by the user).

	This scenario calculates the daylight autonomy for each 50 lux step. For each step, the number of utilization hours is multiplied by the percentage of the power requested to complete daylight level. The standby power is applied during all the occupied hours.
Continuous dimming	

OCCUPANCY SENSOR	Full charge hours	Consumption
Consumption without sensor	936 h	15.4 kWh/m^2
Consumption without On/Off sensor	749 h	13.1 kWh/m^2
Consumption with Auto-OFF sensor	655 h	12.0 kWh/m^2

Figure 145: Example of electricity consumption with a daylight sensor and continuous dimming without stanby.

Scenario 5: Constant diming with stand-by

A daylight sensor allows calling the request power to complete the indoor illuminance level.

	This scenario calculates the daylight autonomy for each 50 lux step. For each step, the number of utilization hours is multiplied by the percentage of the power requested to complete daylight level.
Continuous dimming	

OCCUPANCY SENSOR	Full charge hours	Consumption
Consumption without sensor	936 h	11.0 kWh/m^2
Consumption without On/Off sensor	749 h	8.8 kWh/m^2
Consumption with Auto-OFF sensor	655 h	7.7 kWh/m^2

Figure 146: Example of electricity consumption with a daylight sensor and continuous dimming with stanby.

Scenario 6: Daylight sensor with auto-Off (manual switch On)

A daylight sensor allows switching off the light as soon as the indoor illluminance is higher than the required level.

It is assumed that the users will switch the lamps on only when the indoor illuminance in lower than 30% of the required value. (in the example: 150 lux for E_{req} = 500 lux).

	This scenario assumes that the lamps are off as soon as the diffuse daylight contribution is high enough to reach the required illuminance level. Furthermore, it is assumed that the users will switch the lamps on only when the indoor illuminance in lower than 30% of the required value.
Auto Off	

OCCUPANCY SENSOR	Full charge hours	Consumption
Consumption without sensor	1027 h	12.1 kWh/m^2
Consumption without On/Off sensor	821 h	9.7 kWh/m^2
Consumption with Auto-OFF sensor	719 h	8.5 kWh/m^2

Figure 147: Example of electricity consumption with auto-Off with manual switch on.

Daylighting autonomy / required illuminance level

Examples of the variation of the daylighting autonomy as a function of the indoor required illuminance.

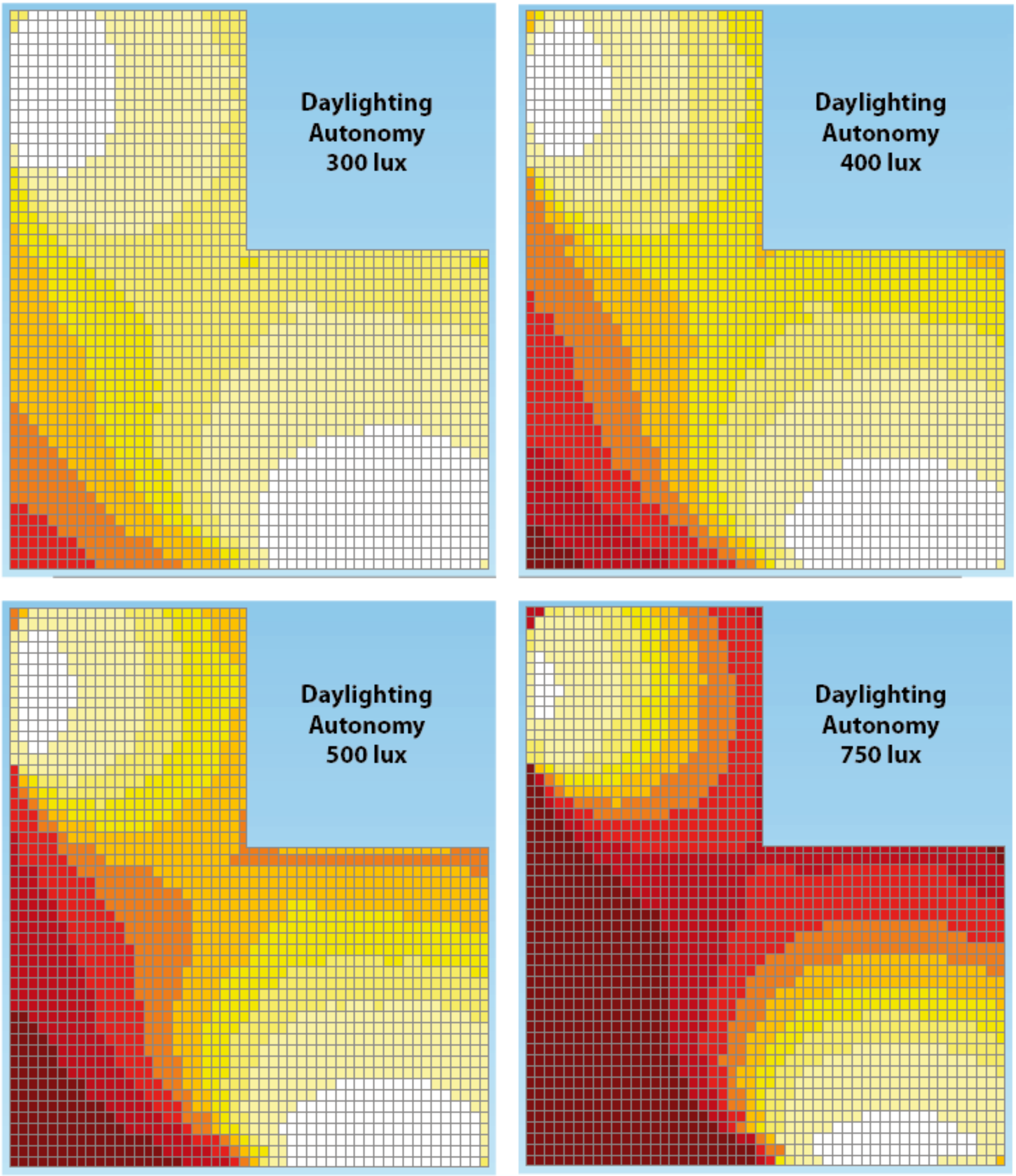


Figure 148: Daylighting autonomy as a function of the indoor required illuminance.

EVALUATION OF ELECTRIC LIGHTING

This module proposes several evaluation possibilities, as shown in Figure 149.

- Estimation of the electricity consumption according to the **Swiss Norm SIA 380/4.**

This function allows the user to analyse the lighting consumption for one or several rooms belonging to a same project and to generate a report corresponding to the SN 380/4 requirements.

This report also serves as **Minergie® proof**.

- Simulation of the indoor illuminance levels due to the electric lighting installation (RADIANCE simulation, DIAL+Lighting).

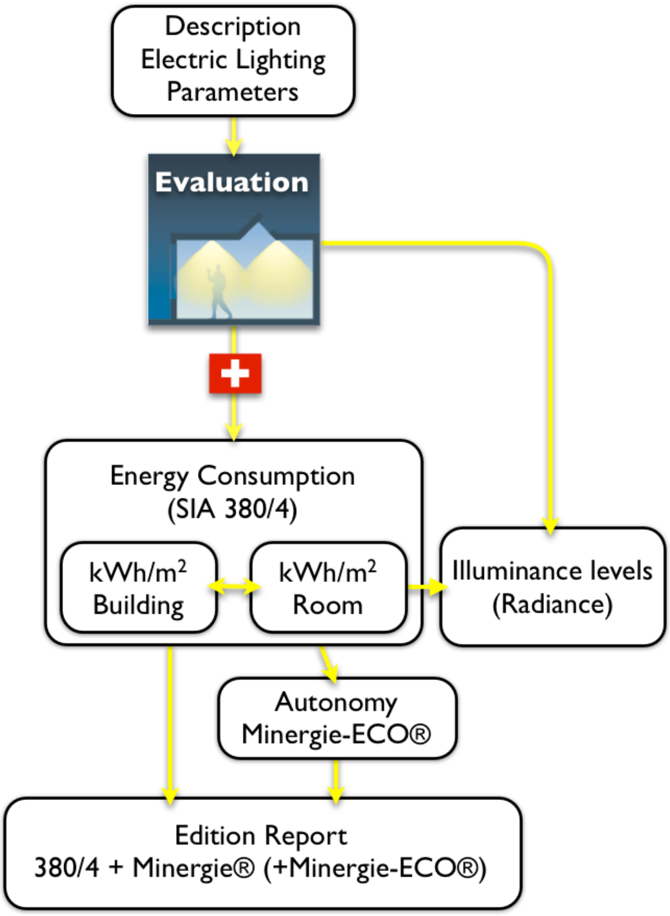
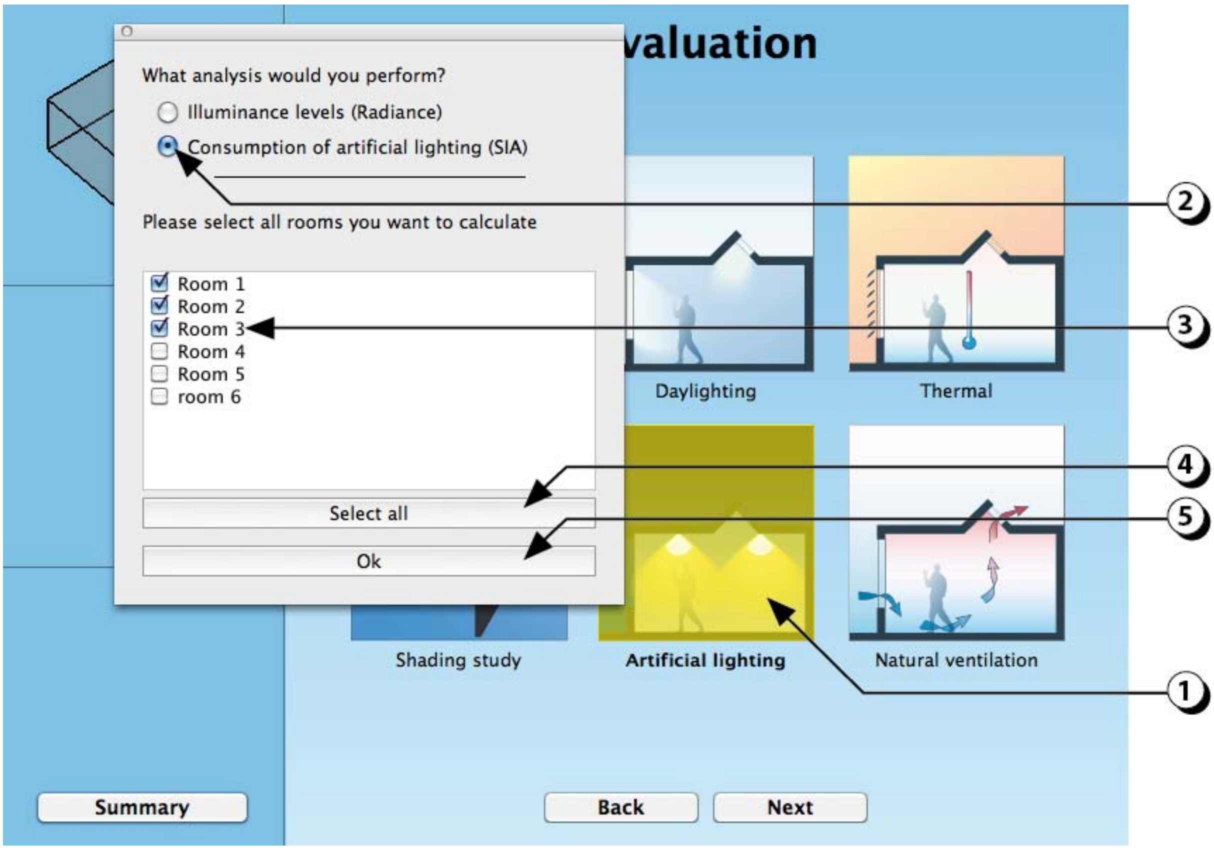


Figure 149: Different possibilities for artificial lighting evaluation.

Electric lighting: Energy consumption

According to the Swiss Norm SIA 380/4

1. Click on the “Artificial lighting” button. This displays a secondary window (2).
2. Click here to select the energy analysis according to the Swiss Norm SIA 380/4.
3. Select the room(s) you want to analyse (for each of the selected room an electric lighting installation should have been described before).
4. Click here if you want to select all the described rooms.
5. Click here to start the evaluation.


What analysis would you perform?

○ Illuminance levels (Radiance)
● Consumption of artificial lighting (SIA)

Please select all rooms you want to calculate

☑ Room 1
☑ Room 2
☑ Room 3
☐ Room 4
☐ Room 5
☐ room 6

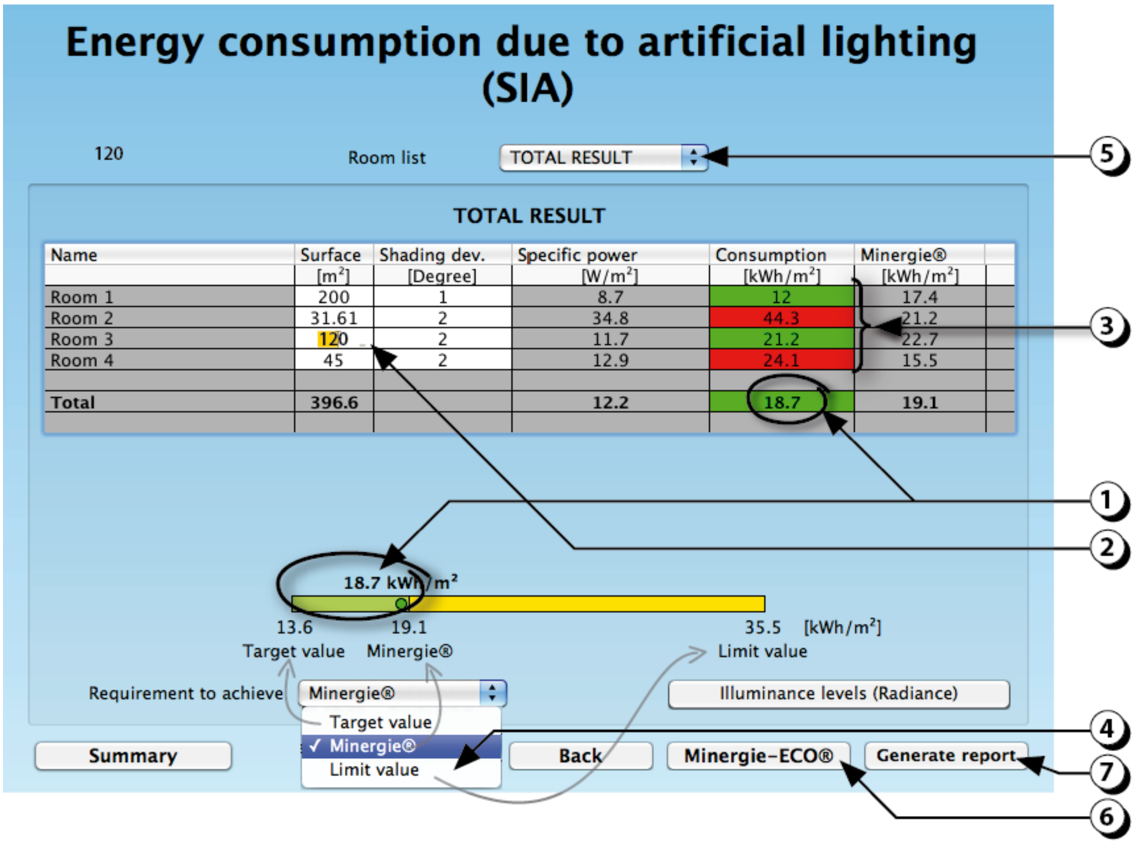
Figure 150: How to start the analysis of the lighting energy consumption according to the Swiss Norm SIA 380/4.

Electric lighting: “Target” and “Limit” and “Minergie®“

The Swiss Norm includes the three following levels of demand:

- Limit Value: This is a maximum value not to exceed.
- Target Value: This value corresponds to the implementation of "best practices" and the best available technologies.
- Minergie® Value: This is the performance value required by the Minergie® label. This requirement concerns the overall performance (all the rooms) of a given project (particularly efficient rooms can compensate for the relative weakness of others).

1. Dial+Lighting calculates the annual electricity consumption for all the selected rooms. The global value (here 18.2 kWh/m^2) corresponds to the average value weighted by the rooms’ surfaces (Green colour: the value reaches the required level).
2. You can modify the global surface of the rooms you have described. For example if you have describes a particular room which is representative of several similar rooms, you can enter the overall corresponding surface).
3. The specific consumption values of each of the described rooms are displayed.
4. Click to modify the level of demand ((Limit, Target or Minergie®).
5. Click to display the detail result of a given room.
6. Click to check whether the project reaches the Minergie-ECO® requirements.
7. Click to generate a report (cf. pages 170 & 171).



Name	Surface [m^2]	Shading dev. [Degree]	Specific power [W/m^2]	Consumption [kWh/m^2]	Minergie® [kWh/m^2]
Room 1	200	1	8.7	🟩 12	17.4
Room 2	31.61	2	34.8	🟥 44.3	21.2
Room 3	120	2	11.7	🟩 21.2	22.7
Room 4	45	2	12.9	🟥 24.1	15.5
Total	**396.6**		**12.2**	🟩 **18.7**	**19.1**

Figure 151: Display of the annual electricity consumption due to lighting (Swiss Norm SIA 380/4).

Electric lighting: Minergie-ECO® label

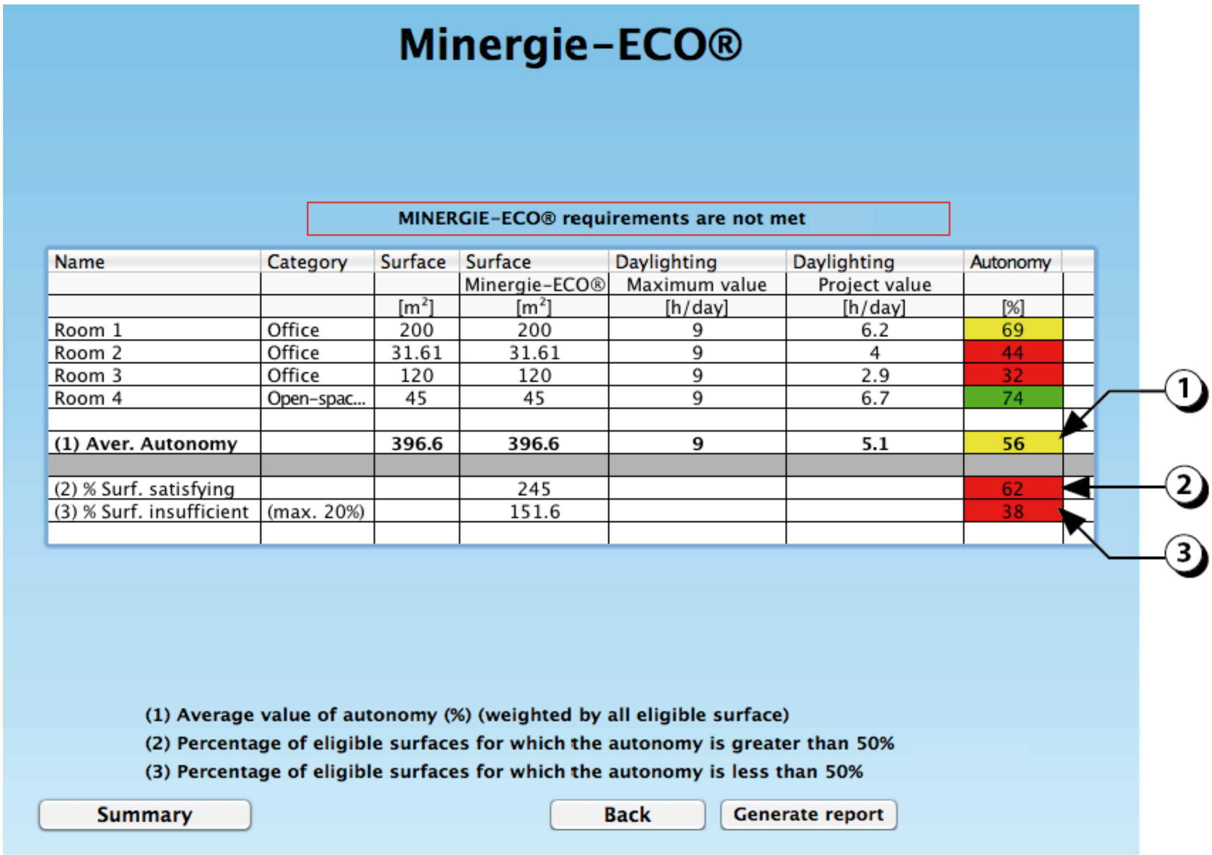
To satisfy the requirement of Minergie-ECO® lighting, the daylight autonomy of all “mainly used rooms”, weighted by their surface must be greater than or equal to 50%.

In addition, the total surface of those of the “mainly used rooms” whose daylight autonomy is lower than 50%, should not exceed 20% of the total area of “main rooms”.

The page of results allows you to check:

1. The weighted value for daylight autonomy of the “mainly used rooms”.
2. The percentage of the area for which the daylight autonomy is higher than 50%.
3. The percentage of the area for which the daylight autonomy is lower than 50%.

CAUTION: The value for daylight autonomy issued from the Minergie-ECO® calculation is different from the one calculated with Radiance (DIAL+Lighting). This value is specific to the Swiss standard and is not based on climatic values.



Minergie-ECO®

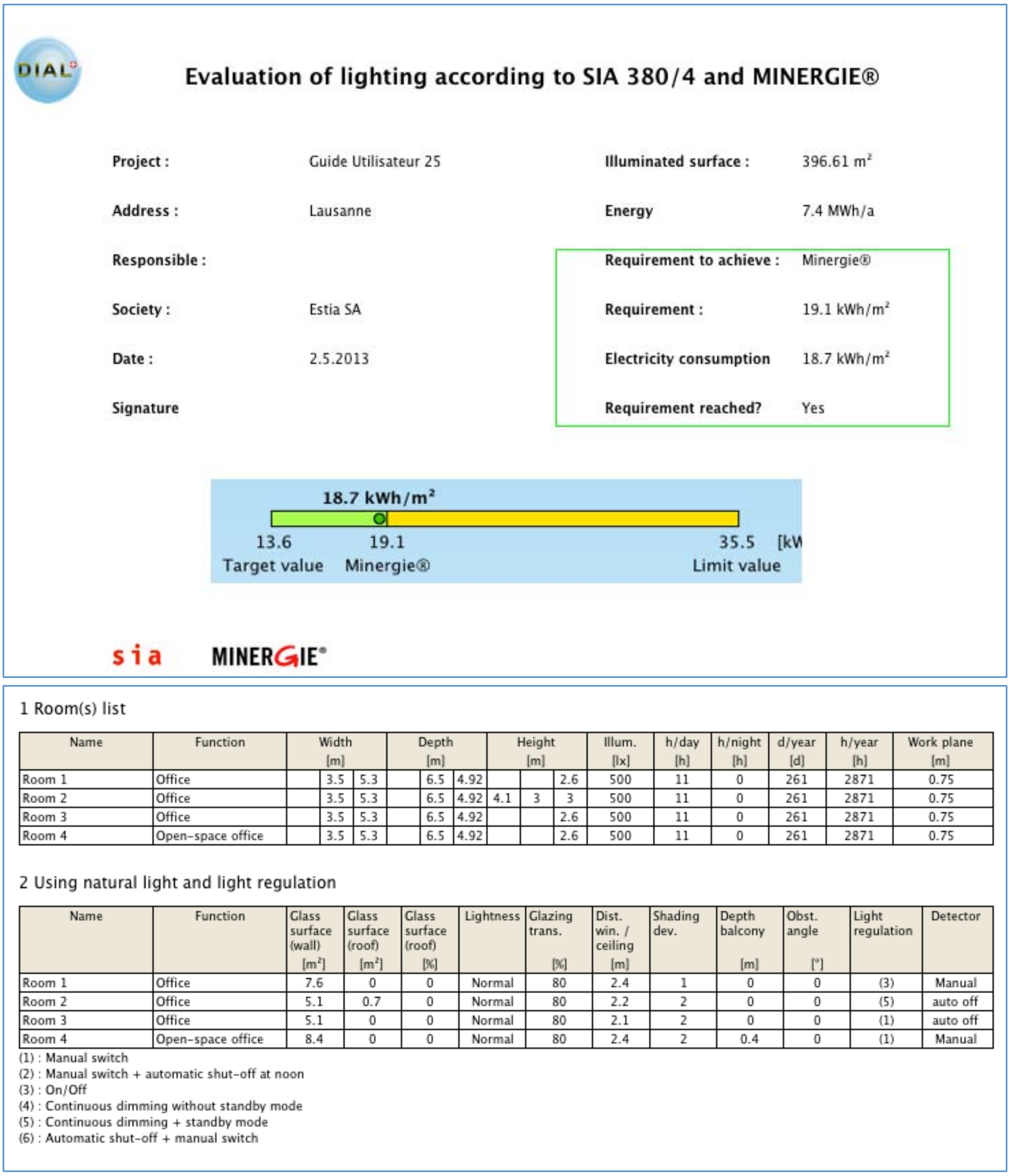
MINERGIE-ECO® requirements are not met

Name	Category	Surface	Surface	Daylighting	Daylighting	Autonomy
			Minergie-ECO®	Maximum value	Project value	
		$[m^2]$	$[m^2]$	[h/day]	[h/day]	[%]
Room 1	Office	200	200	9	6.2	69
Room 2	Office	31.61	31.61	9	4	44
Room 3	Office	120	120	9	2.9	32
Room 4	Open-spac...	45	45	9	6.7	74
(1) Aver. Autonomy		**396.6**	**396.6**	**9**	**5.1**	**56**
(2) % Surf. satisfying			245			62
(3) % Surf. insufficient	(max. 20%)		151.6			38

(1) Average value of autonomy (%) (weighted by all eligible surface)
(2) Percentage of eligible surfaces for which the autonomy is greater than 50%
(3) Percentage of eligible surfaces for which the autonomy is less than 50%

Figure 152: Report for Minergie-ECO.

Electric lighting: Report according to Swiss Norm SIA 380/4



Evaluation of lighting according to SIA 380/4 and MINERGIE®

Project : Guide Utilisateur 25

Address : Lausanne

Responsible :

Society : Estia SA

Date : 2.5.2013

Signature

Illuminated surface : 396.61 m²

Energy 7.4 MWh/a

Requirement to achieve : Minergie®

Requirement : 19.1 kWh/m²

Electricity consumption 18.7 kWh/m²

Requirement reached? Yes

1 Room(s) list

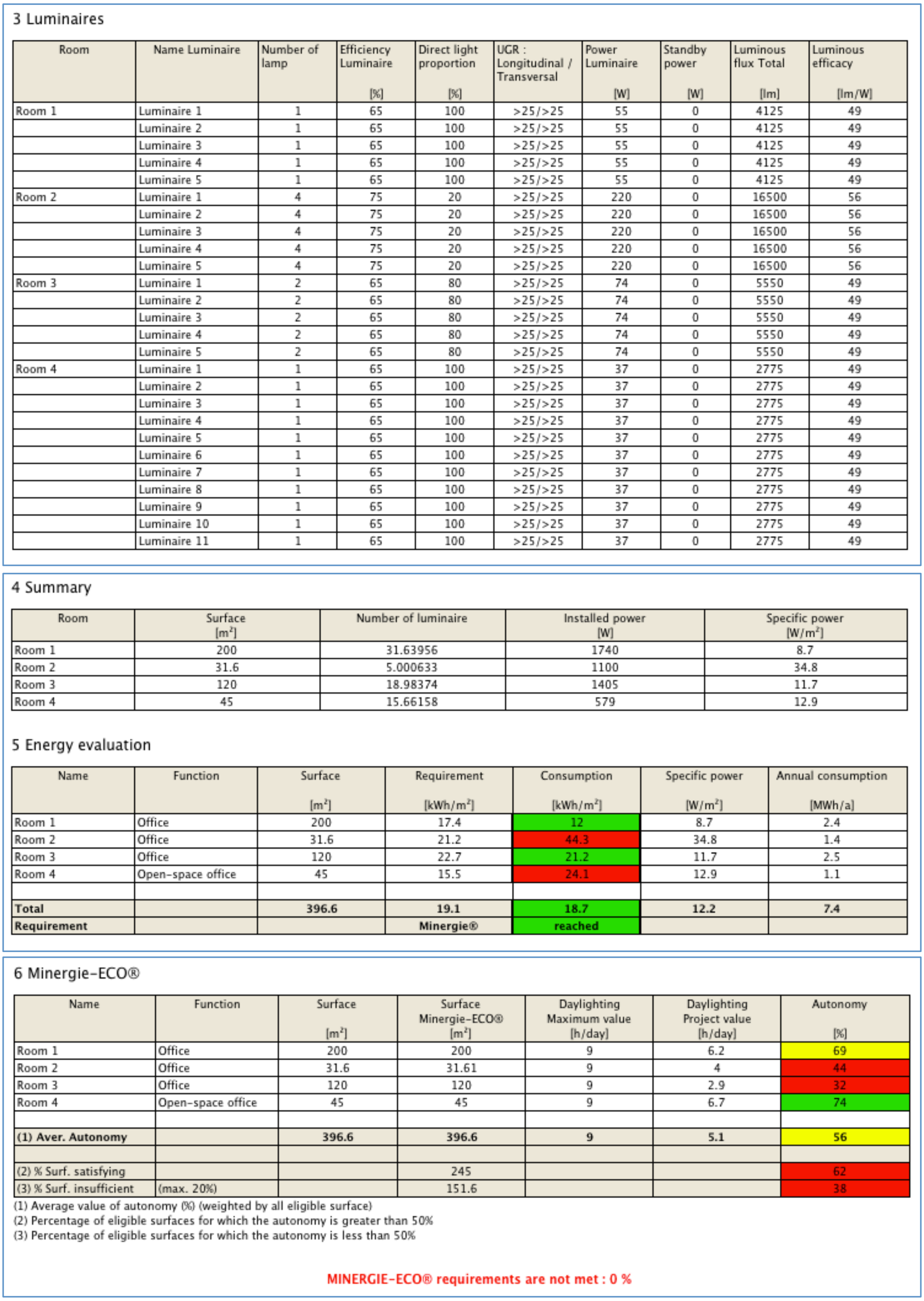
Name	Function	Width [m]			Depth [m]			Height [m]			Illum. [lx]	h/day [h]	h/night [h]	d/year [d]	h/year [h]	Work plane [m]
Room 1	Office		3.5	5.3		6.5	4.92			2.6	500	11	0	261	2871	0.75
Room 2	Office		3.5	5.3		6.5	4.92	4.1	3	3	500	11	0	261	2871	0.75
Room 3	Office		3.5	5.3		6.5	4.92			2.6	500	11	0	261	2871	0.75
Room 4	Open-space office		3.5	5.3		6.5	4.92			2.6	500	11	0	261	2871	0.75

2 Using natural light and light regulation

Name	Function	Glass surface (wall) [m²]	Glass surface (roof) [m²]	Glass surface (roof) [%]	Lightness	Glazing trans. [%]	Dist. win. / ceiling [m]	Shading dev.	Depth balcony [m]	Obst. angle [°]	Light regulation	Detector
Room 1	Office	7.6	0	0	Normal	80	2.4	1	0	0	(3)	Manual
Room 2	Office	5.1	0.7	0	Normal	80	2.2	2	0	0	(5)	auto off
Room 3	Office	5.1	0	0	Normal	80	2.1	2	0	0	(1)	auto off
Room 4	Open-space office	8.4	0	0	Normal	80	2.4	2	0.4	0	(1)	Manual

(1) : Manual switch
(2) : Manual switch + automatic shut-off at noon
(3) : On/Off
(4) : Continuous dimming without standby mode
(5) : Continuous dimming + standby mode
(6) : Automatic shut-off + manual switch

Figure 153: Example of SN 380/4 report (part 1).



3 Luminaires

Room	Name Luminaire	Number of lamp	Efficiency Luminaire [%]	Direct light proportion [%]	UGR : Longitudinal / Transversal	Power Luminaire [W]	Standby power [W]	Luminous flux Total [lm]	Luminous efficacy [lm/W]
Room 1	Luminaire 1	1	65	100	>25/>25	55	0	4125	49
	Luminaire 2	1	65	100	>25/>25	55	0	4125	49
	Luminaire 3	1	65	100	>25/>25	55	0	4125	49
	Luminaire 4	1	65	100	>25/>25	55	0	4125	49
	Luminaire 5	1	65	100	>25/>25	55	0	4125	49
Room 2	Luminaire 1	4	75	20	>25/>25	220	0	16500	56
	Luminaire 2	4	75	20	>25/>25	220	0	16500	56
	Luminaire 3	4	75	20	>25/>25	220	0	16500	56
	Luminaire 4	4	75	20	>25/>25	220	0	16500	56
	Luminaire 5	4	75	20	>25/>25	220	0	16500	56
Room 3	Luminaire 1	2	65	80	>25/>25	74	0	5550	49
	Luminaire 2	2	65	80	>25/>25	74	0	5550	49
	Luminaire 3	2	65	80	>25/>25	74	0	5550	49
	Luminaire 4	2	65	80	>25/>25	74	0	5550	49
	Luminaire 5	2	65	80	>25/>25	74	0	5550	49
Room 4	Luminaire 1	1	65	100	>25/>25	37	0	2775	49
	Luminaire 2	1	65	100	>25/>25	37	0	2775	49
	Luminaire 3	1	65	100	>25/>25	37	0	2775	49
	Luminaire 4	1	65	100	>25/>25	37	0	2775	49
	Luminaire 5	1	65	100	>25/>25	37	0	2775	49
	Luminaire 6	1	65	100	>25/>25	37	0	2775	49
	Luminaire 7	1	65	100	>25/>25	37	0	2775	49
	Luminaire 8	1	65	100	>25/>25	37	0	2775	49
	Luminaire 9	1	65	100	>25/>25	37	0	2775	49
	Luminaire 10	1	65	100	>25/>25	37	0	2775	49
	Luminaire 11	1	65	100	>25/>25	37	0	2775	49

4 Summary

Room	Surface [m²]	Number of luminaire	Installed power [W]	Specific power [W/m²]
Room 1	200	31.63956	1740	8.7
Room 2	31.6	5.000633	1100	34.8
Room 3	120	18.98374	1405	11.7
Room 4	45	15.66158	579	12.9

5 Energy evaluation

Name	Function	Surface [m²]	Requirement [kWh/m²]	Consumption [kWh/m²]	Specific power [W/m²]	Annual consumption [MWh/a]
Room 1	Office	200	17.4	12	8.7	2.4
Room 2	Office	31.6	21.2	44.3	34.8	1.4
Room 3	Office	120	22.7	21.2	11.7	2.5
Room 4	Open-space office	45	15.5	24.1	12.9	1.1
Total		**396.6**	**19.1**	**18.7**	**12.2**	**7.4**
Requirement			**Minergie®**	**reached**		

6 Minergie-ECO®

Name	Function	Surface [m²]	Surface Minergie-ECO® [m²]	Daylighting Maximum value [h/day]	Daylighting Project value [h/day]	Autonomy [%]
Room 1	Office	200	200	9	6.2	69
Room 2	Office	31.6	31.61	9	4	44
Room 3	Office	120	120	9	2.9	32
Room 4	Open-space office	45	45	9	6.7	74
(1) Aver. Autonomy		**396.6**	**396.6**	**9**	**5.1**	**56**
(2) % Surf. satisfying			245			62
(3) % Surf. insufficient	(max. 20%)		151.6			38

(1) Average value of autonomy (%) (weighted by all eligible surface)
(2) Percentage of eligible surfaces for which the autonomy is greater than 50%
(3) Percentage of eligible surfaces for which the autonomy is less than 50%

MINERGIE-ECO® requirements are not met : 0 %

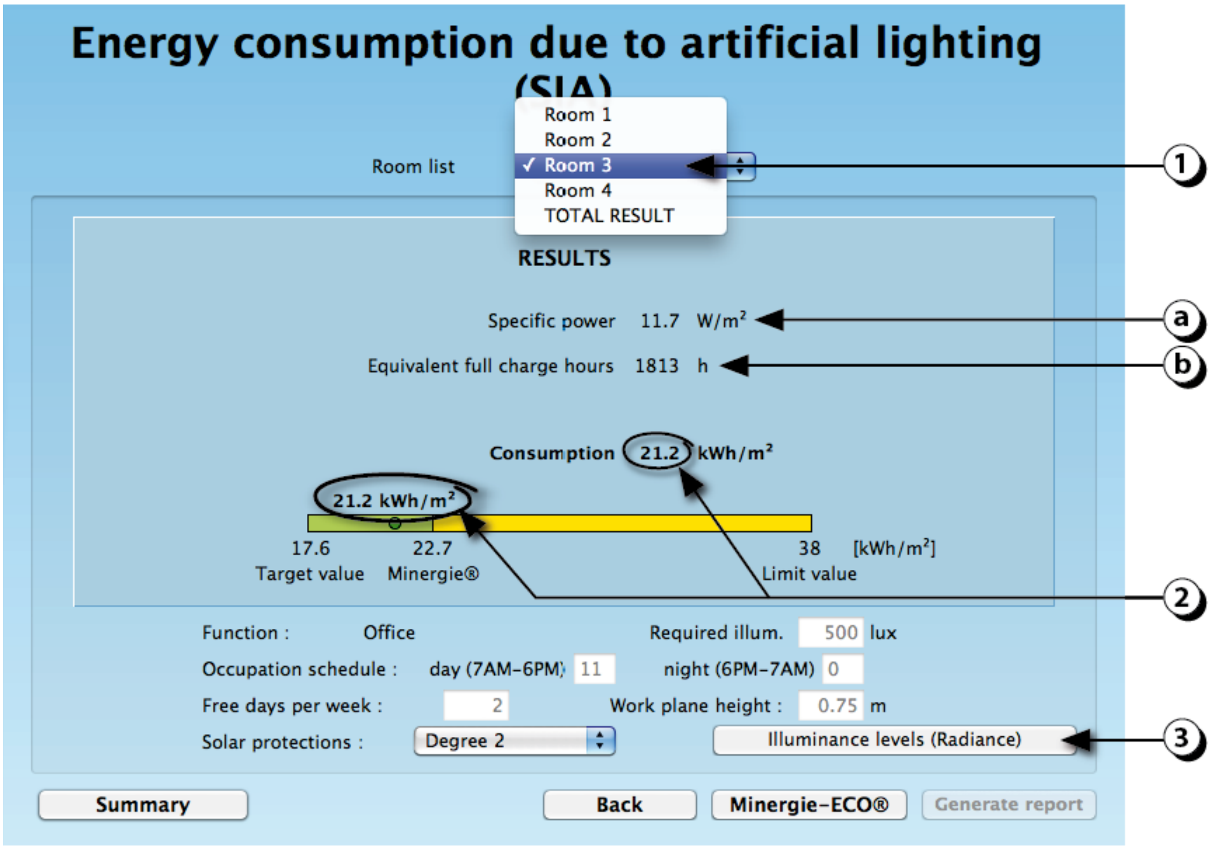
Figure 154: Example of SN 380/4 report (part 2).

Electric lighting: Energy consumption according to SIA 380/4

1. Select a given room in this list in order to display its specific energy consumption.

   The energy consumption is calculated on the basis on:

   a) The specific power (depends on the number of lamps),
   b) The number of full charge hours.
2. If you want to check whether the lighting installation allows you to reach the required illuminance level, click on this button (Radiance simulation). (cf. page 173).



Energy consumption due to artificial lighting (SIA)

Room list: Room 3

RESULTS

Specific power 11.7 W/m²

Equivalent full charge hours 1813 h

Consumption 21.2 kWh/m²

Function : Office

Required illum. 500 lux

Occupation schedule : day (7AM-6PM) 11 night (6PM-7AM) 0

Free days per week : 2

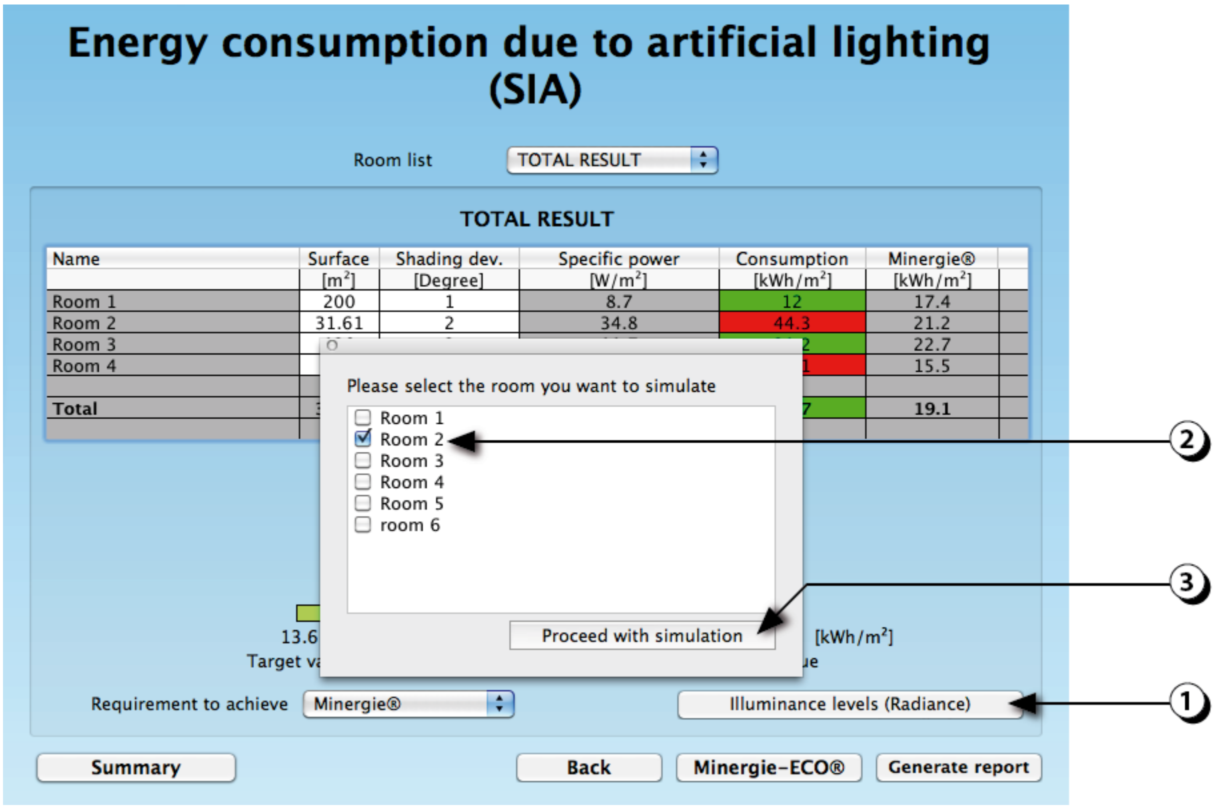
Work plane height : 0.75 m

Solar protections : Degree 2

Figure 155: Annual electricity consumption due to artificial lighting, according to the Swiss Norm SIA 380/4.

Electric lighting: Start a Radiance Simulation (room)

1. Click this button to launch a detailed simulation of the lighting installation (Radiance).
2. Select the room you would like to simulate.
3. Start the simulation.



Energy consumption due to artificial lighting (SIA)

Room list: TOTAL RESULT

TOTAL RESULT

Name	Surface [m²]	Shading dev. [Degree]	Specific power [W/m²]	Consumption [kWh/m²]	Minergie® [kWh/m²]
Room 1	200	1	8.7	12	17.4
Room 2	31.61	2	34.8	44.3	21.2
Room 3	[illegible]	[illegible]	[illegible]	[illegible]	22.7
Room 4	[illegible]	[illegible]	[illegible]	[illegible]	15.5
Total	[illegible]			[illegible]	**19.1**

Please select the room you want to simulate

☐ Room 1
☑ Room 2
☐ Room 3
☐ Room 4
☐ Room 5
☐ room 6

Requirement to achieve: Minergie®

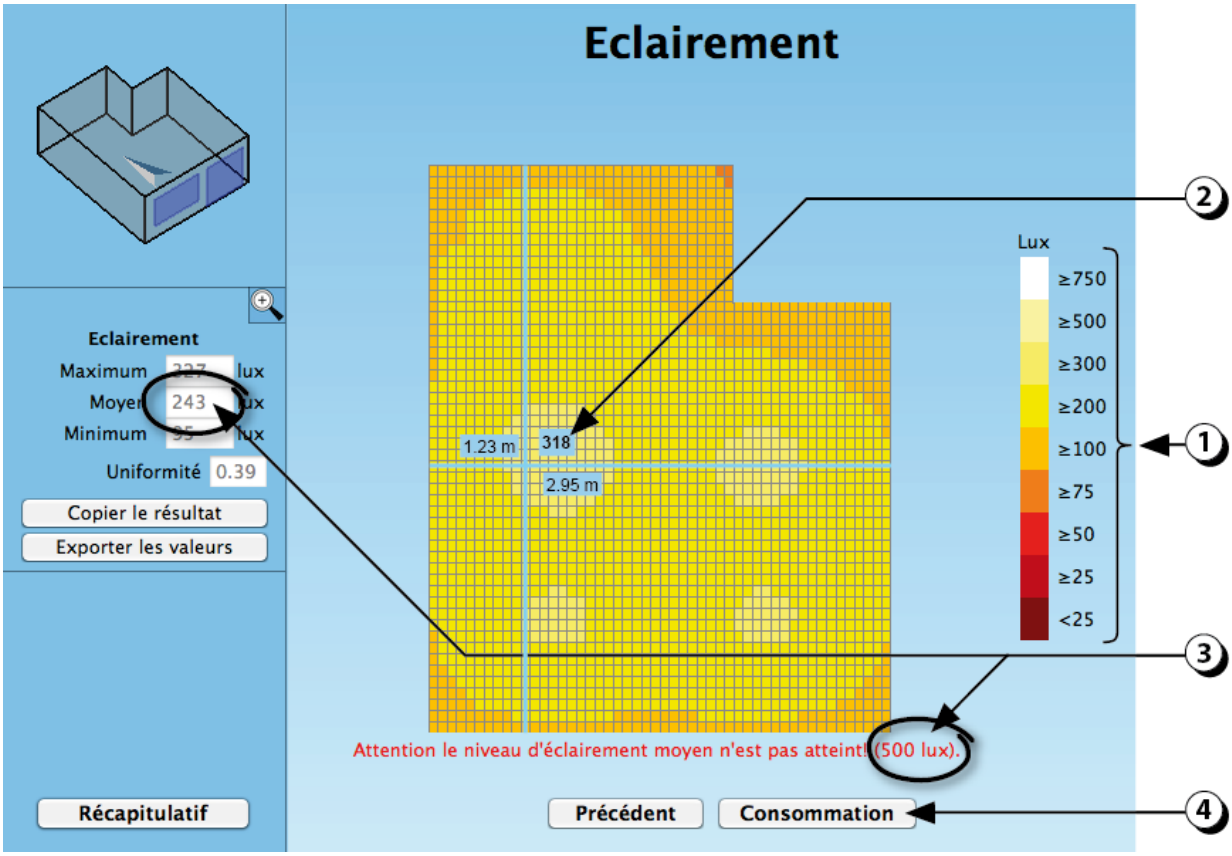
Figure 156: How to start a Radiance simulation of the artificial lighting of a given room.

Electric lighting: Results of a Radiance simulation

1. The result of the Radiance simulation allows you to display the illuminance levels on the work plan (coloured scale from 25 to 750 lux).
2. If you move the mouse, punctual illuminance values are displayed.
3. If the average illuminance value does not reach the requirements linked to room function, an alarm is displayed (you can then re-dimension the installation and boost the specific power).
4. Click this button to start a DIAL+ calculation of the daylight autonomy (on the basis of Daylight factor values) (cf. pages 149).

CAUTION: This calculation is different from the one of SIA 380/4. (cf. page172). It is more precise and is based on meteorological data (hourly value of the diffuse horizontal illuminance, orientation factors of the location you have selected for your project).

6.



Eclairement

Maximum 327 lux

Moyen 243 lux

Minimum 95 lux

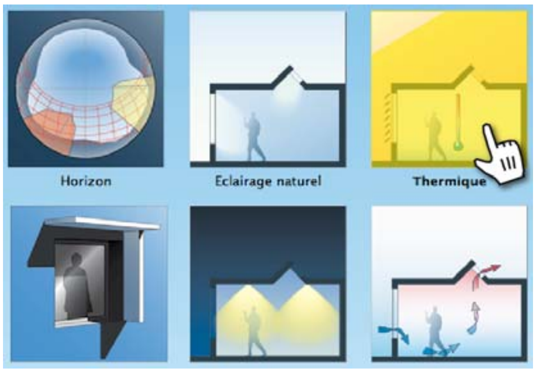
Uniformité 0.39

Attention le niveau d'éclairement moyen n'est pas atteint! (500 lux).

7.

Figure 157: Simulation of the illuminance levels due to artificial lighting (Radiance).

THERMAL EVALUATION



This module allows you to start dynamic thermal simulation (room by room analysis).

The results (hourly step) are as follow:

- Air temperature,
- Indoor surfaces temperature,
- Sensible temperature,
- Solar gains, internal gains,
- Airflows (natural and mechanical ventilation),
- Heating & cooling power,
- Number of overheating hours (EN15251 & Swiss Norm SIA 180).

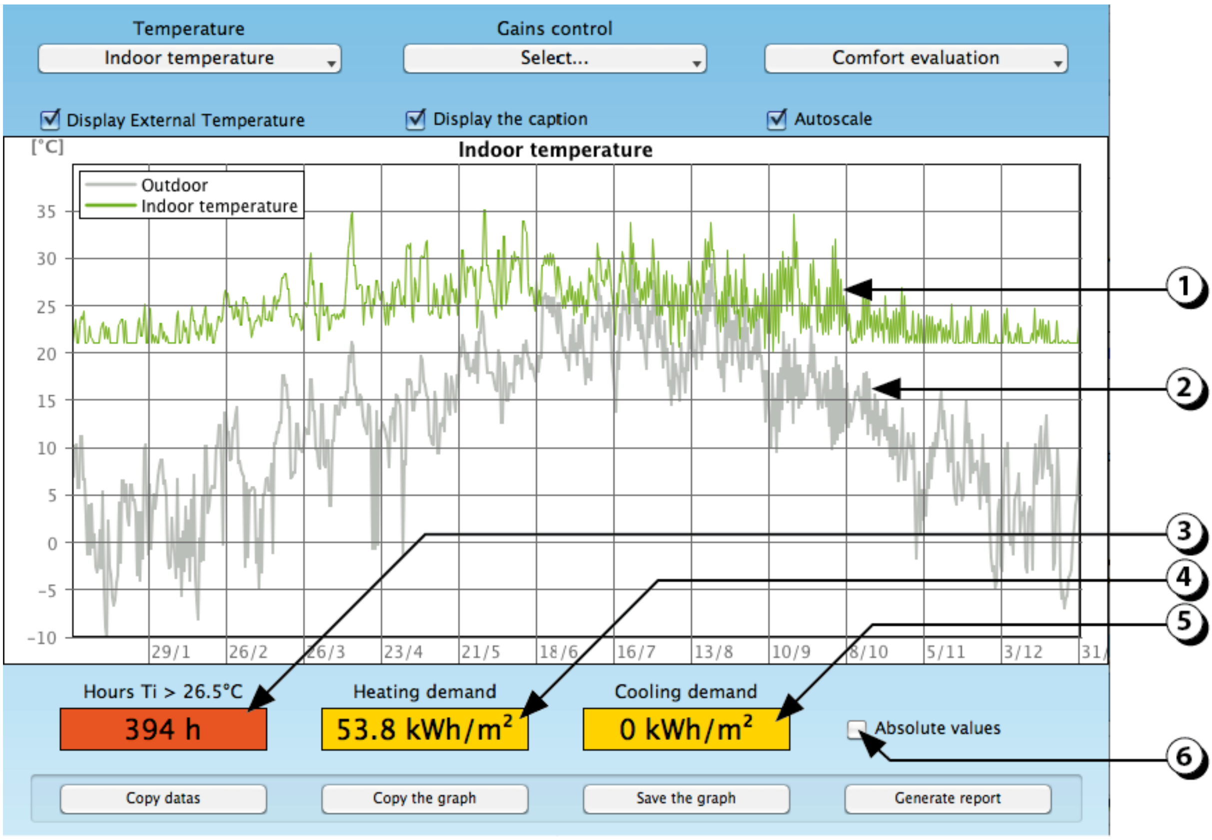
Thermal module: detailed analysis

The meteo files for thermal simulation are generated with METEONORM 7 (www.meteonorm.com).

To start the thermal analysis, click first on the “Evaluate” button in the Summary page (cf. page 132), then click on the “Thermal” pictogram (cf. Point 3, page 133).

The simulation, which only takes a few seconds, ends with the opening of a new screen displaying the results.

1. The green curve corresponds to the annual profile of the indoor temperature.
2. The grey curve corresponds to the annual profile of outdoor air temperature.
3. This value corresponds to the number of overheating hours per year, calculated according to T_{max} (cf. Thermal preferences, Point 3, page 129).
4. This value corresponds to the annual heading demand per m^2.
5. This value corresponds to the annual cooling demand per m^2 (=0 if no active cooling, cf. point 6: page 110).
6. Click here to display the absolute values of the room demand.



Temperature: Indoor temperature

Gains control: Select...

Comfort evaluation

☑ Display External Temperature

☑ Display the caption

☑ Autoscale

Hours Ti > 26.5°C: 394 h

Heating demand: 53.8 kWh/m²

Cooling demand: 0 kWh/m²

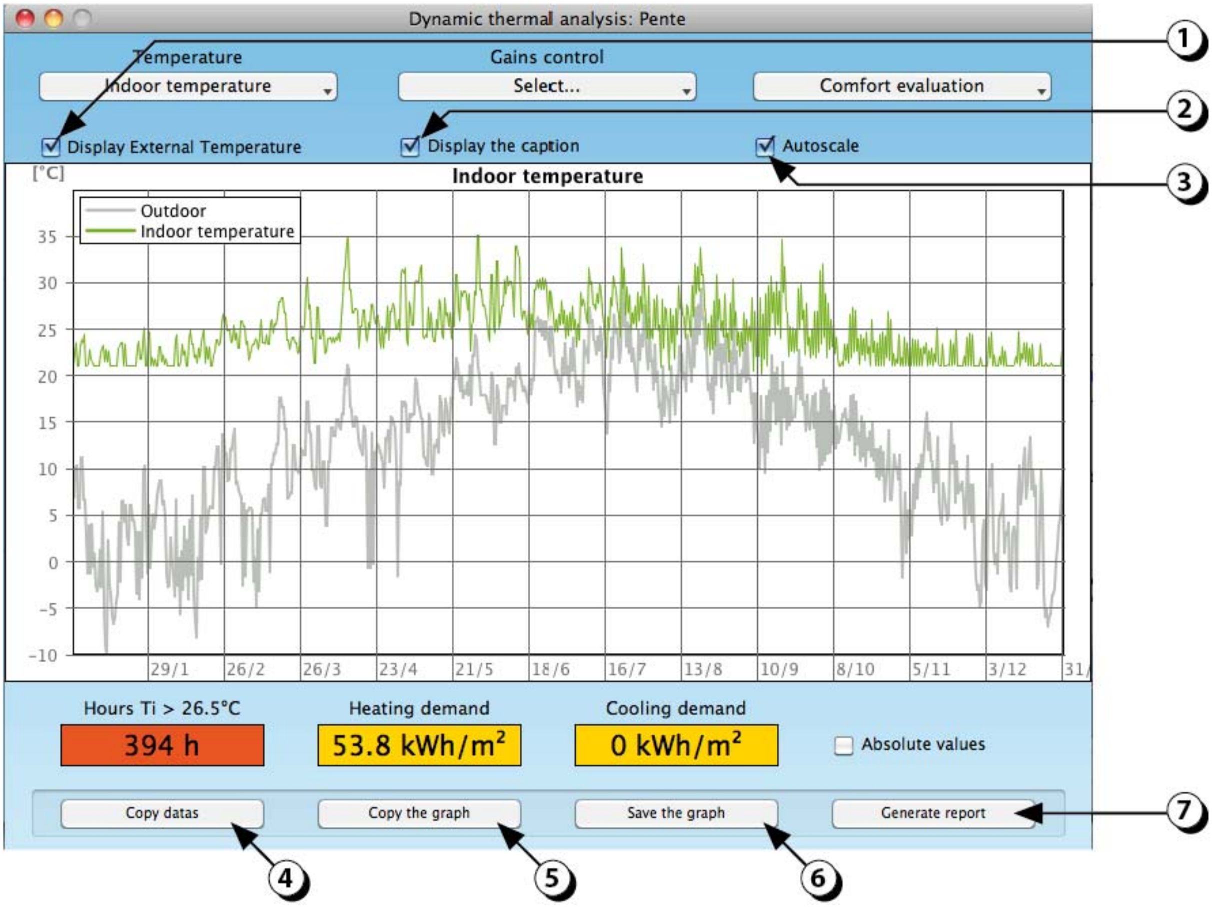
☐ Absolute values

Figure 158: Main display of the results of the dynamic thermal simulation of the room.

Thermal module: editing functions

The following functions are available:

1. Tick to display or hide the outdoor temperature profile.
2. Tick to display or hide the caption.
3. Tick to select the range of temperature (y axis).
4. Button to copy the data into the buffer memory (list of values to be pasted in a document).
5. Button to copy the graph into the buffer memory (image to be pasted into a document).
6. Button to save the graph (.png file).
7. Button to generate a report (.pdf file).



Temperature: Indoor temperature

Gains control: Select...

Comfort evaluation

☑ Display External Temperature ☑ Display the caption ☑ Autoscale

Hours Ti > 26.5°C: 394 h

Heating demand: 53.8 kWh/m²

Cooling demand: 0 kWh/m²

☐ Absolute values

Figure 159: Editing functions of the thermal module.

Thermal module: Zoom on the results

1. **Zoom-in:** It is possible to zoom-in on the graph by using the left-click while moving the mouse towards the right hand side. The focused period is highlighted in yellow (The graph is updated when mouse-button is up).

To zoom-out, use the left-click without moving the mouse.

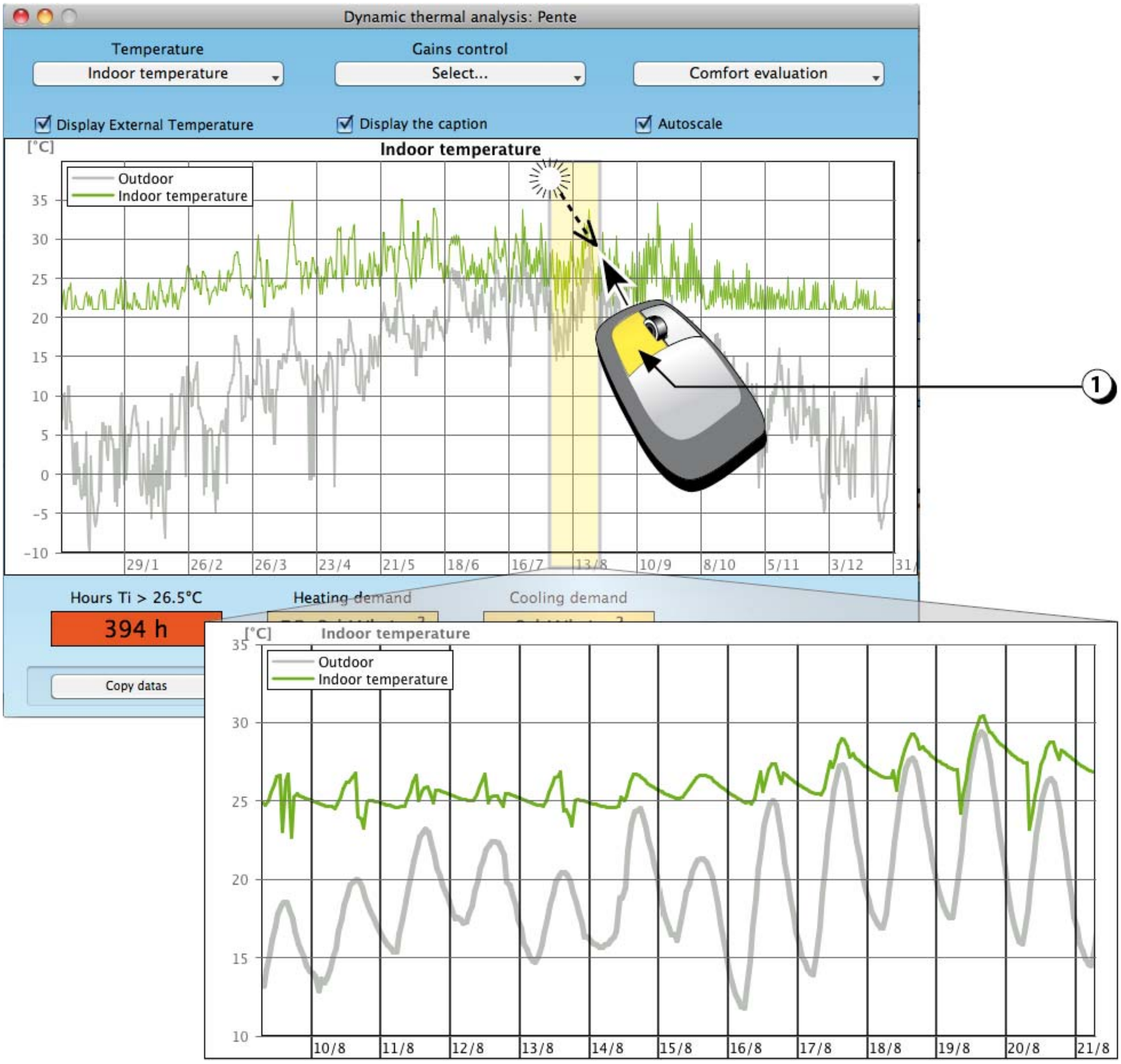


Figure 160: Zoom-in or zoom-out functions.

Scrolling of the graph: press the right-click while moving toward right or left as desired.

Vertical scale: It is possible to fix the vertical scale (see Point 3 previous page).

Thermal module: Detailed analysis of the temperatures

1. Click here to display the list of temperature profiles:
    a. Indoor Temperature (air temp.),
    b. Sensible Temperature (mean value of air and surfaces temperatures),
    c. Surface Temperatures,
    d. Slab Temperature (only available for “floor-heating”).

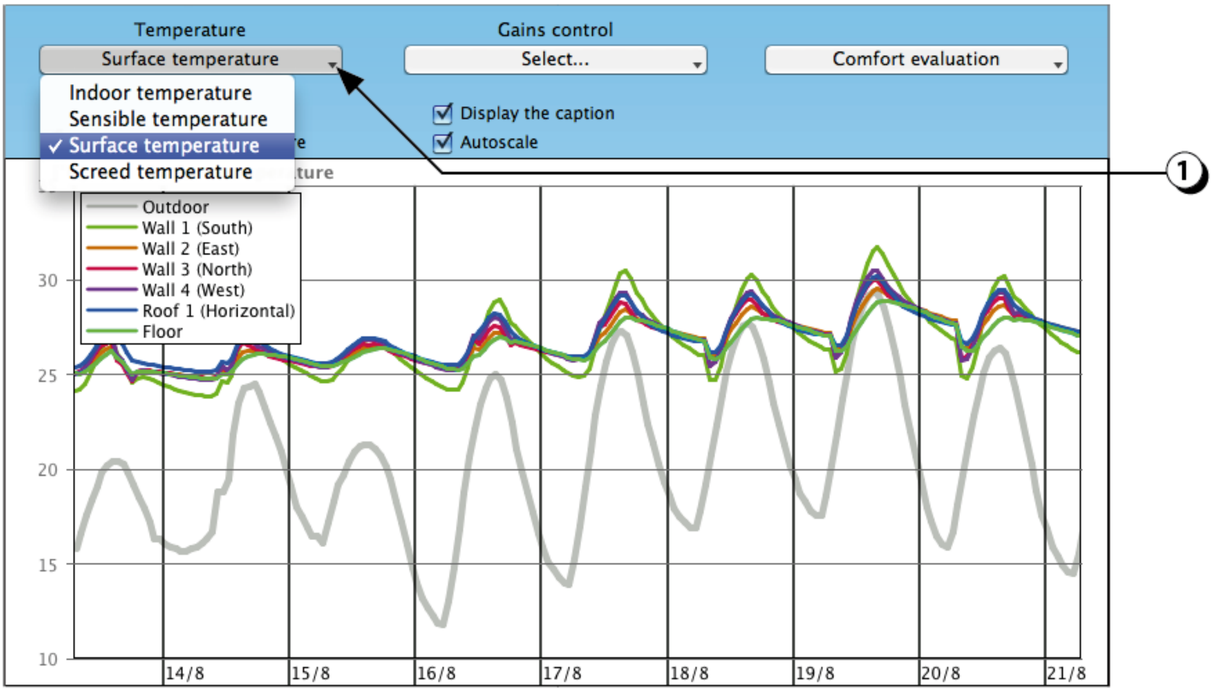


Figure 161: Menu for temperature display [°C]

(Here, the surfaces temperatures are displayed).

Thermal module: Solar gains

1. The "Gains control" menu allows you to display various auxiliary profiles such as:
    a. Solar gains per façade (here south façade, with and without shading devices respectively green and grey profiles).
    b. Solar gains for all the walls.
    c. Total solar gains.

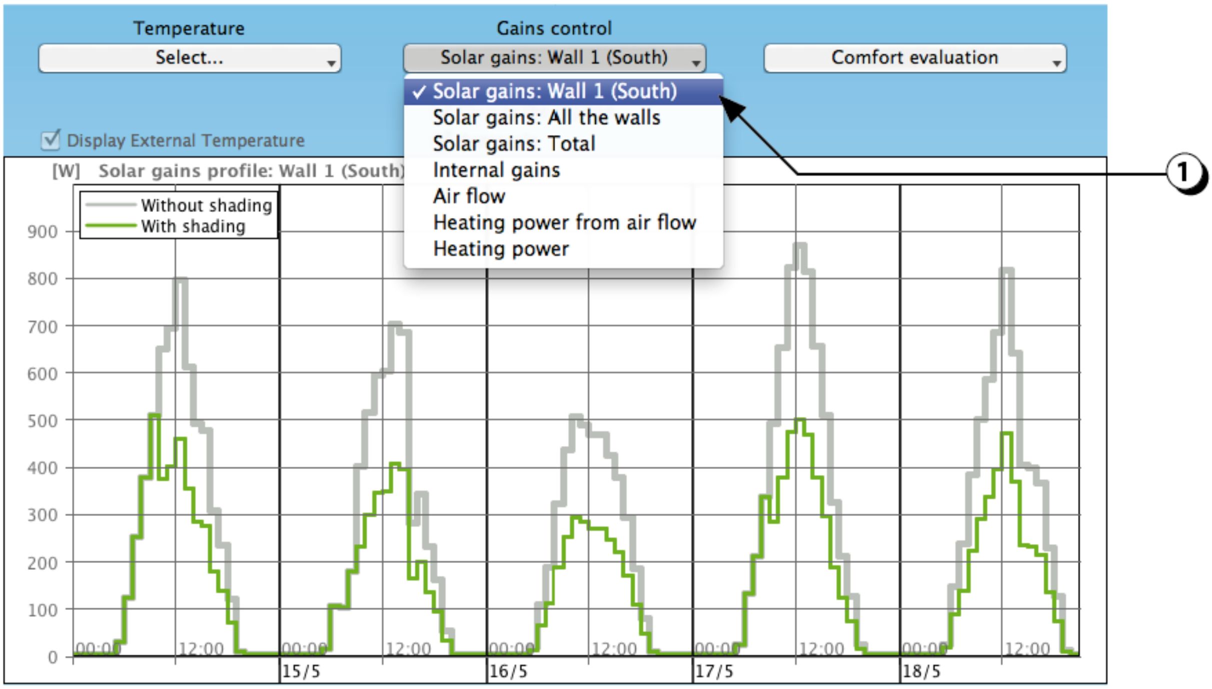


Figure 162: Display of the solar gains (here south façade, with and without shading devices) [W].

Thermal module: internal gains

1. The “Gains control” menu also allows you to display the internal gains. The profiles are representative of the room function and schedule. Figure 163 hereafter shows a typical sequence of 5 days from Friday to Tuesday, including 2 unoccupied days (Saturday & Sunday).

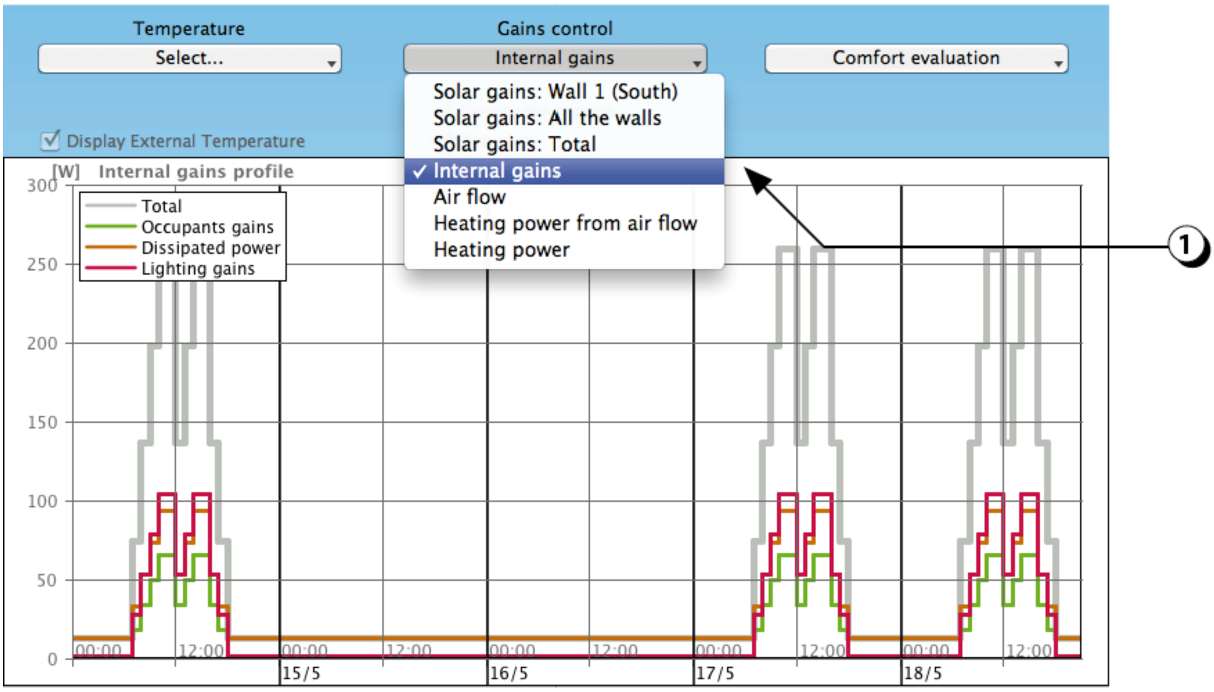


Figure 163: Internal gains according to the room occupation [W].

Thermal module: air flows

1. The “Gains control” menu also allows you to display the air flows (mechanical and natural ventilation) as a function of the selected scenario.

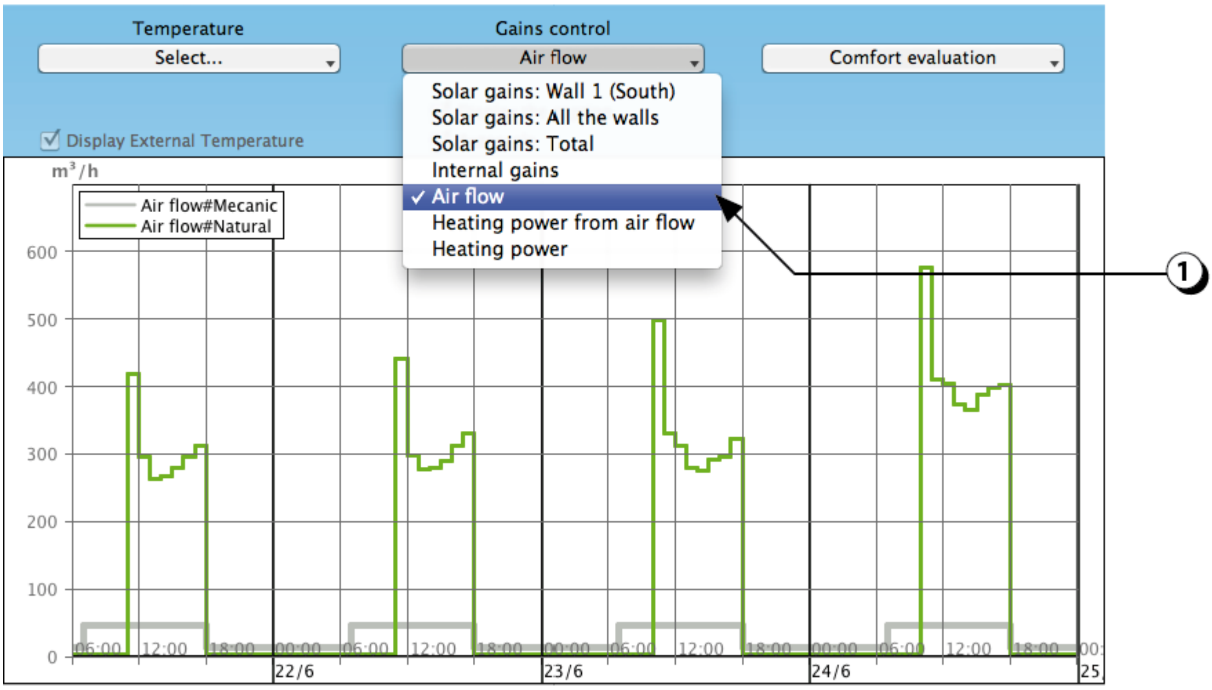


Figure 164: Display of the air flows [m3/h].

Thermal module: Heat flux extracted by ventilation

1. The “Gains control” menu also allows you to display the heat flows extracted by ventilation (mechanical and natural ventilation) as a function of the selected scenario.

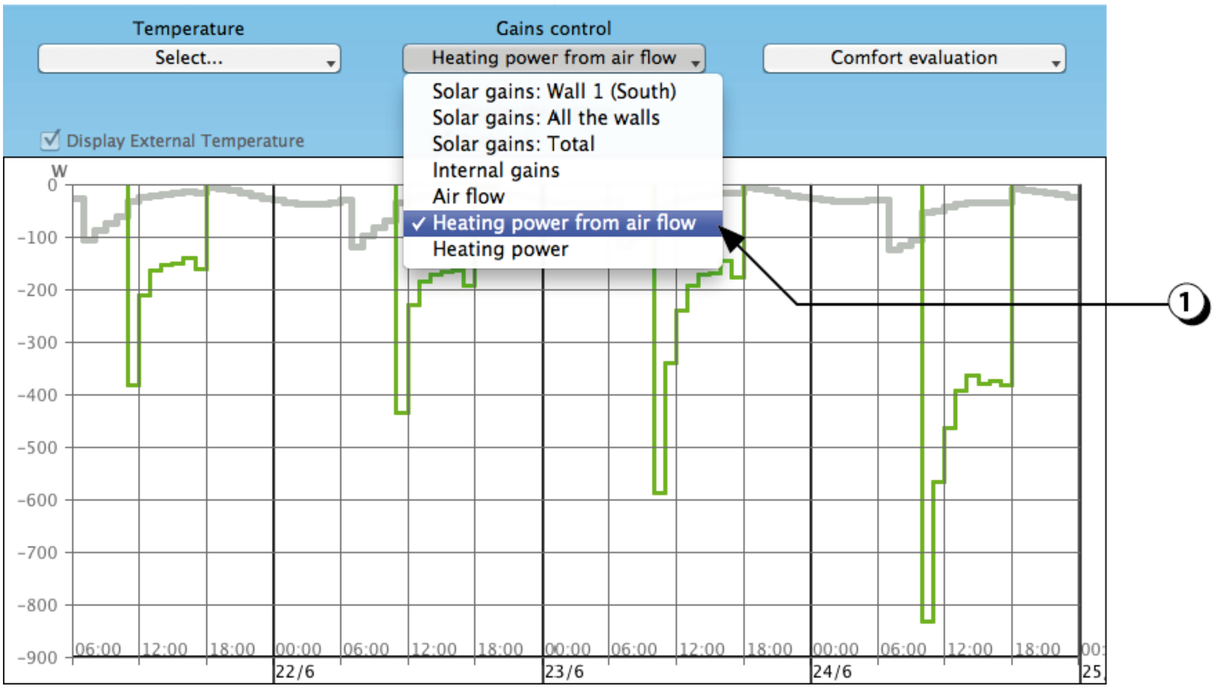


Figure 165: Display of the heat flows extracted by ventilation [W].

Thermal module: Heating power

2. The “Gains control” menu also allows you to display the heating power as a function of the selected scenario.
5. **Nota**: power can be negative in case of mechanical cooling.

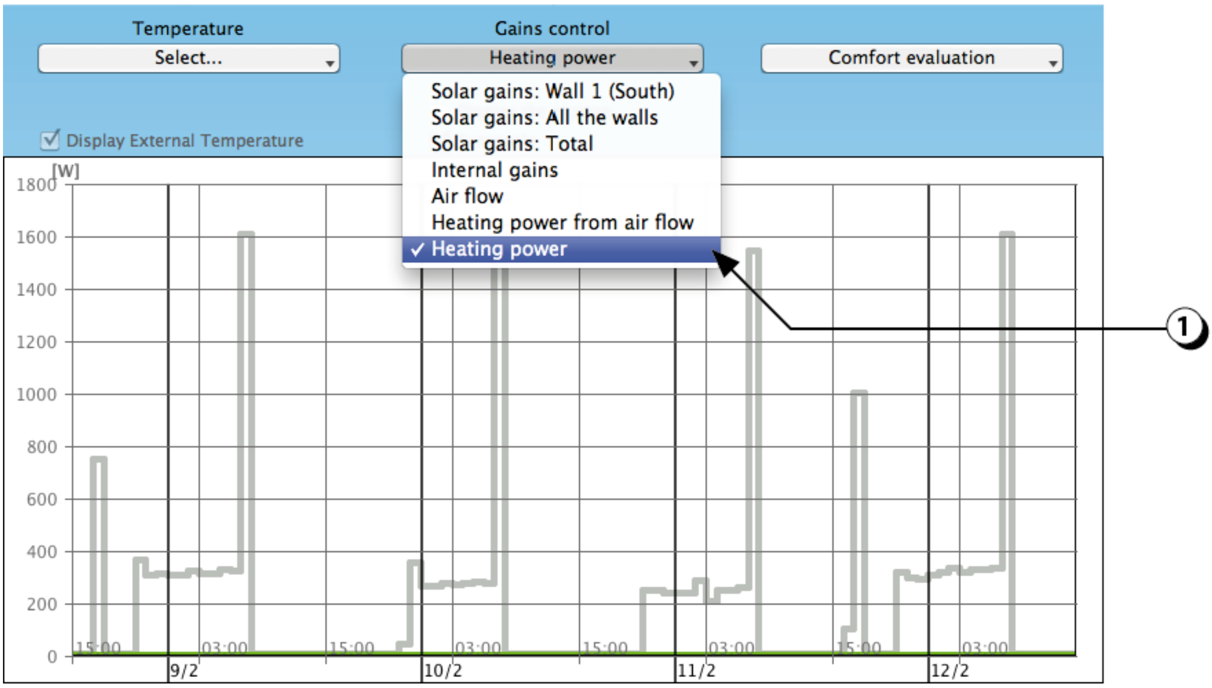


Figure 166: Heating power [W].

Thermal module: Comfort zone SIA 382/1

The ““Comfort evaluation”” menu allows you to display the indoor temperature distribution as a function of the outdoor temperature.

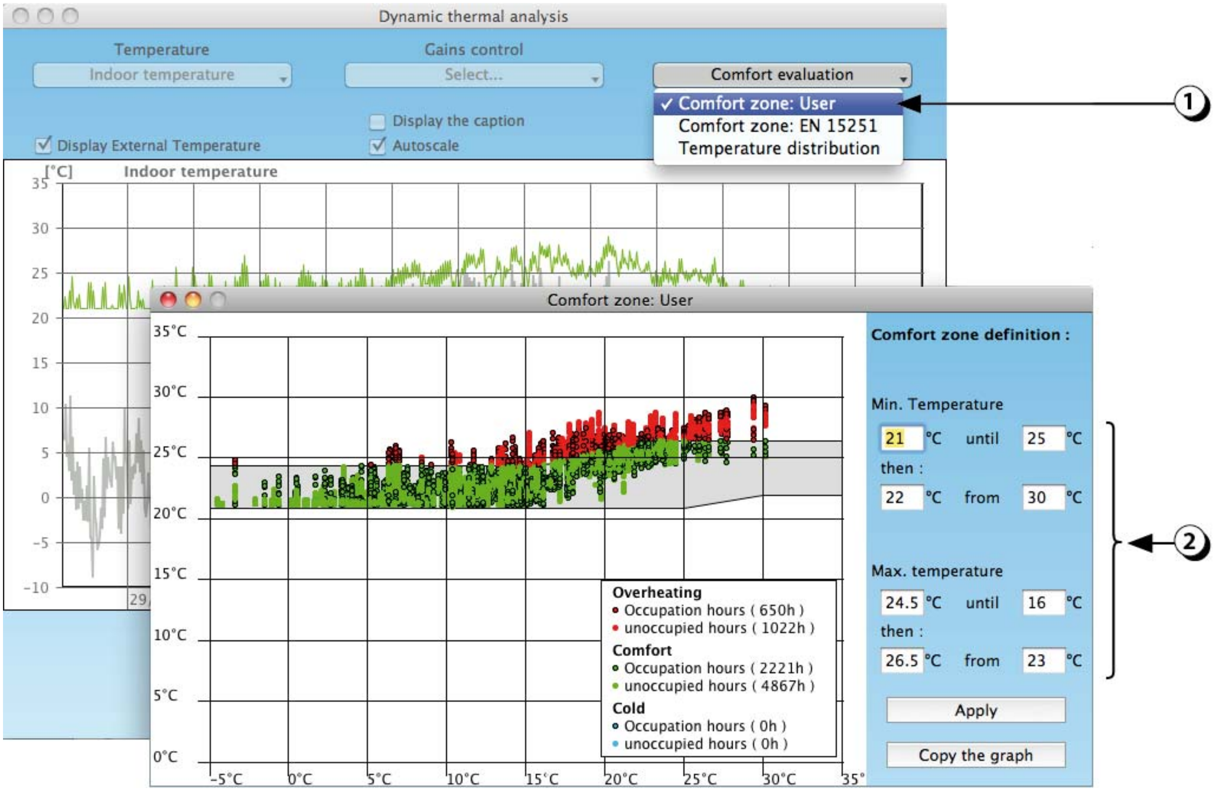
1. Comfort zone according to SIA 382/1.

This graph represents on the vertical axis, the indoor sensible temperature and, on the horizontal axis, the minimum outdoor air temperature during the day.

This representation is compatible with the requirements of the Swiss Norm SIA 382/1. You can adapt the minimum and maximum temperatures in the fields located on the right.

2. The graph “Comfort zone: EN 15251” display the same type of results according this specific European Norm.

The red point represents the overheating hours.



Overheating
- Occupation hours (650h)
- unoccupied hours (1022h)

Comfort
- Occupation hours (2221h)
- unoccupied hours (4867h)

Cold
- Occupation hours (0h)
- unoccupied hours (0h)

Comfort zone definition :

Min. Temperature
21 °C until 25 °C
then :
22 °C from 30 °C

Max. temperature
24.5 °C until 16 °C
then :
26.5 °C from 23 °C

Figure 167: Display of the thermal comfort zone according to Swiss Norm SIA 180.

Thermal module: Comfort zone EN 15251

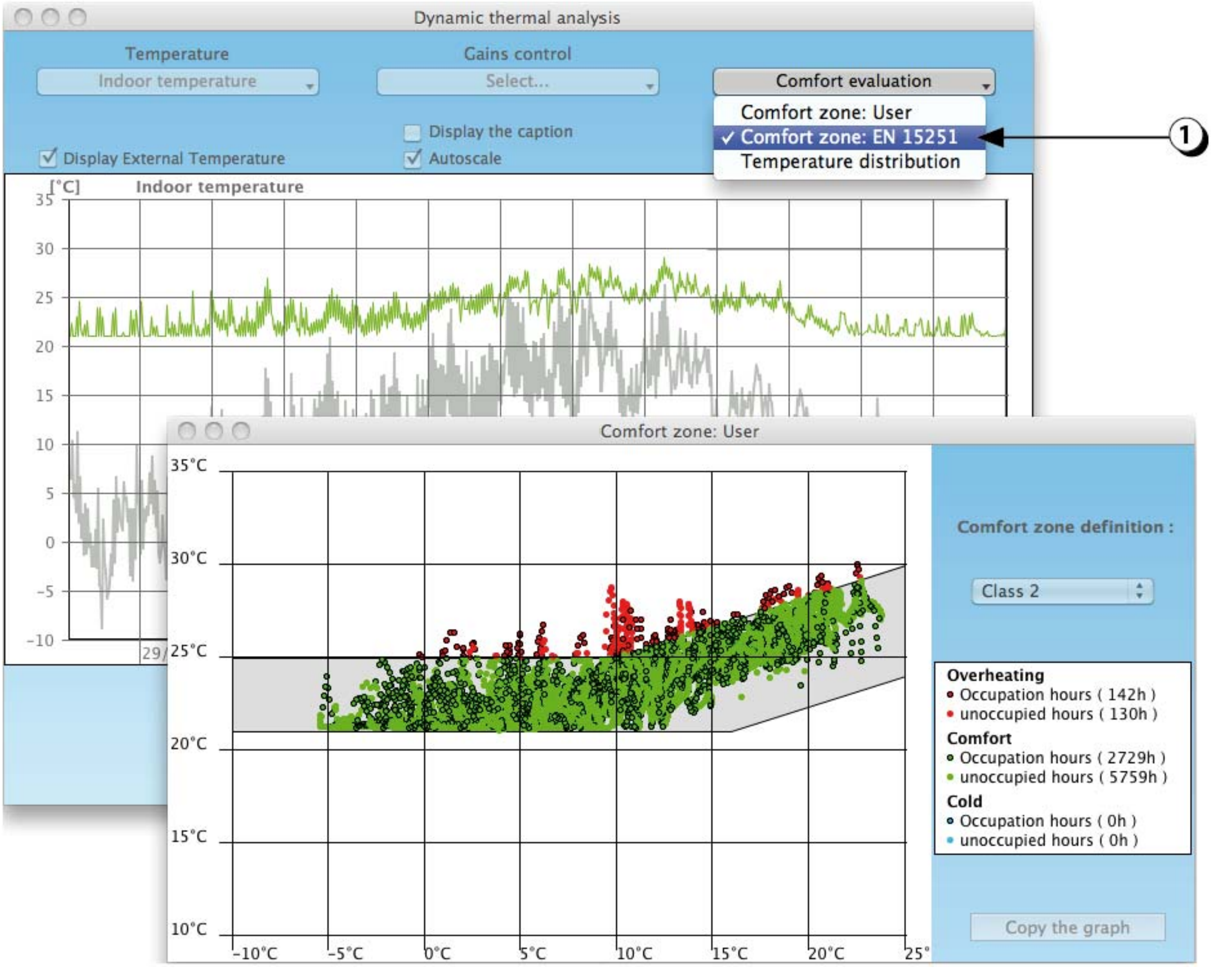
The “Comfort evaluation” menu also allows you to display the indoor temperature distribution as a function of the outdoor temperature.

1. Comfort: EN 15251.

This graph represents on the vertical axis, the sensible temperature and, on the horizontal axis, the average outdoor temperature (sliding average over 48 hours).

This representation is compatible with the requirements of the European Norm EN 15251.

The red point represents the overheating hours.



Overheating
- Occupation hours (142h)
- unoccupied hours (130h)

Comfort
- Occupation hours (2729h)
- unoccupied hours (5759h)

Cold
- Occupation hours (0h)
- unoccupied hours (0h)

Figure 168: Display of the thermal comfort zone according to EN 15251.

Thermal module: Distribution of the indoor temperatures

1. The “Comfort evaluation” menu also allows you to display the histogram of the distribution of indoor air temperature (1°C steps).

If you click on one of the bars, the corresponding annual number of hours is displayed in red.

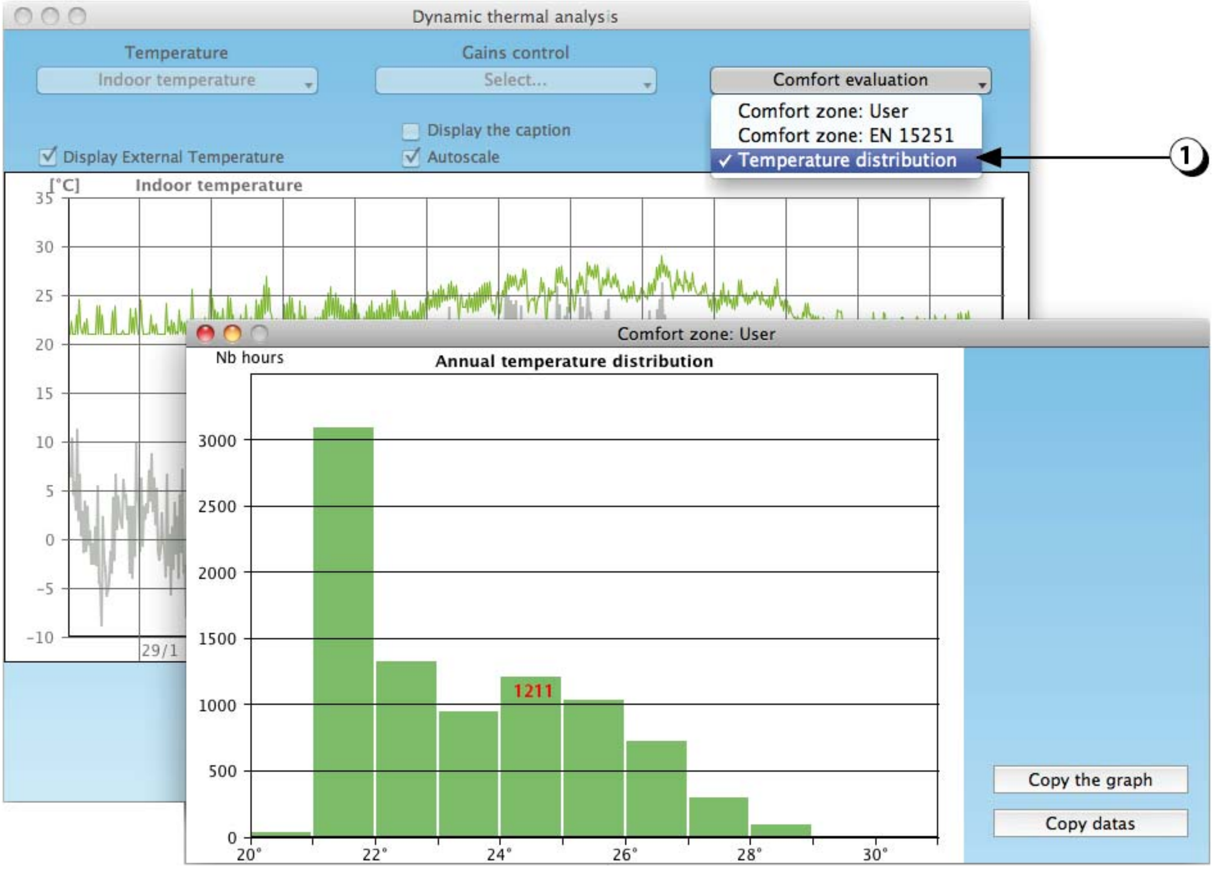


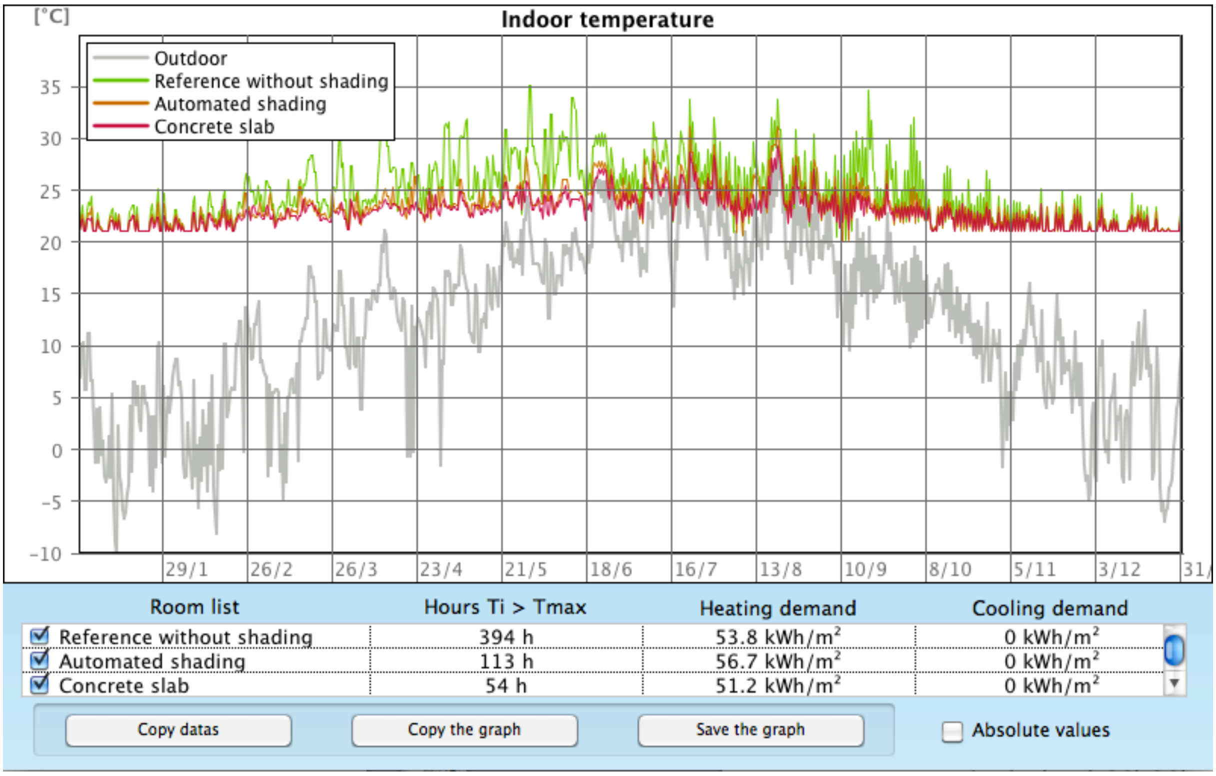
Figure 169: Distribution of the indoor air temperature inside the room.

Thermal module: Comparison of several rooms

It is possible to compare the thermal behaviour of several rooms. To start this kind of analysis, please see Point 4 page 132.

DIAL+ launches the successive calculations of the selected variants and displays on the same graph the different temperature profiles, as shown below.

This facility is particularly useful to evaluate the influence of a specific parameter (thermal mass, shading device & ventilation strategies, etc).



Room list	Hours Ti > Tmax	Heating demand	Cooling demand
☑ Reference without shading	394 h	53.8 kWh/m^2	0 kWh/m^2
☑ Automated shading	113 h	56.7 kWh/m^2	0 kWh/m^2
☑ Concrete slab	54 h	51.2 kWh/m^2	0 kWh/m^2

Figure 170: Display of the thermal behaviour of 3 variants of the same room.

NATURAL VENTILATION EVALUATION

This module allows you to evaluate the air change due to natural ventilation through the apertures.

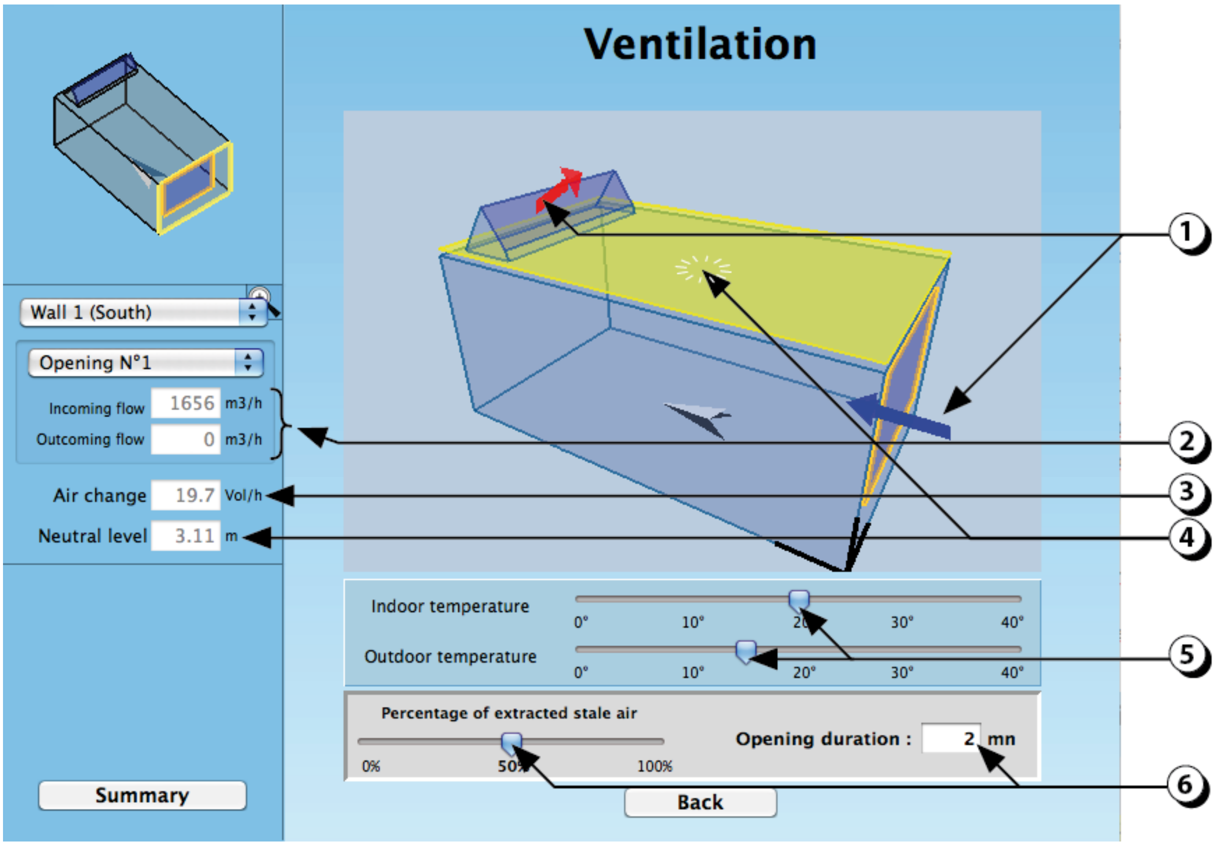
According to the indoor and outdoor temperature, it calculates for each window:

- The incoming and out coming airflows,
- The air change per hour,
- The neutral level position,
- The time requested to renew the indoor air of the room.

Natural ventilation

To start the analysis of the natural ventilation potential, see Point 5, page 133.

2. DIAL+ displays the entering and outgoing airflow, as a function of the difference between indoor and outdoor temperatures (see point 5).
3. For each opening, the incoming and/or outgoing flow is displayed [m^3/h].
4. The instantaneous air change is displayed [vol/h].
5. The altitude of the neutral level (altitude where indoor and outdoor pressure are equivalent) is displayed with a yellow plane as well as in [m].
6. The sliders allows you to change both indoor or outdoor temperatures (the graph and the values are readjusting in real time).
7. DIAL+ calculates the time requested to extract a given percentage of stale air.



Wall 1 (South)

Opening N°1

Incoming flow 1656 m3/h

Outcoming flow 0 m3/h

Air change 19.7 Vol/h

Neutral level 3.11 m

Indoor temperature 0° 10° 20° 30° 40°

Outdoor temperature 0° 10° 20° 30° 40°

Percentage of extracted stale air 0% 50% 100%

Opening duration : 2 mn

Figure 171: Potential for natural ventilation of the room.

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