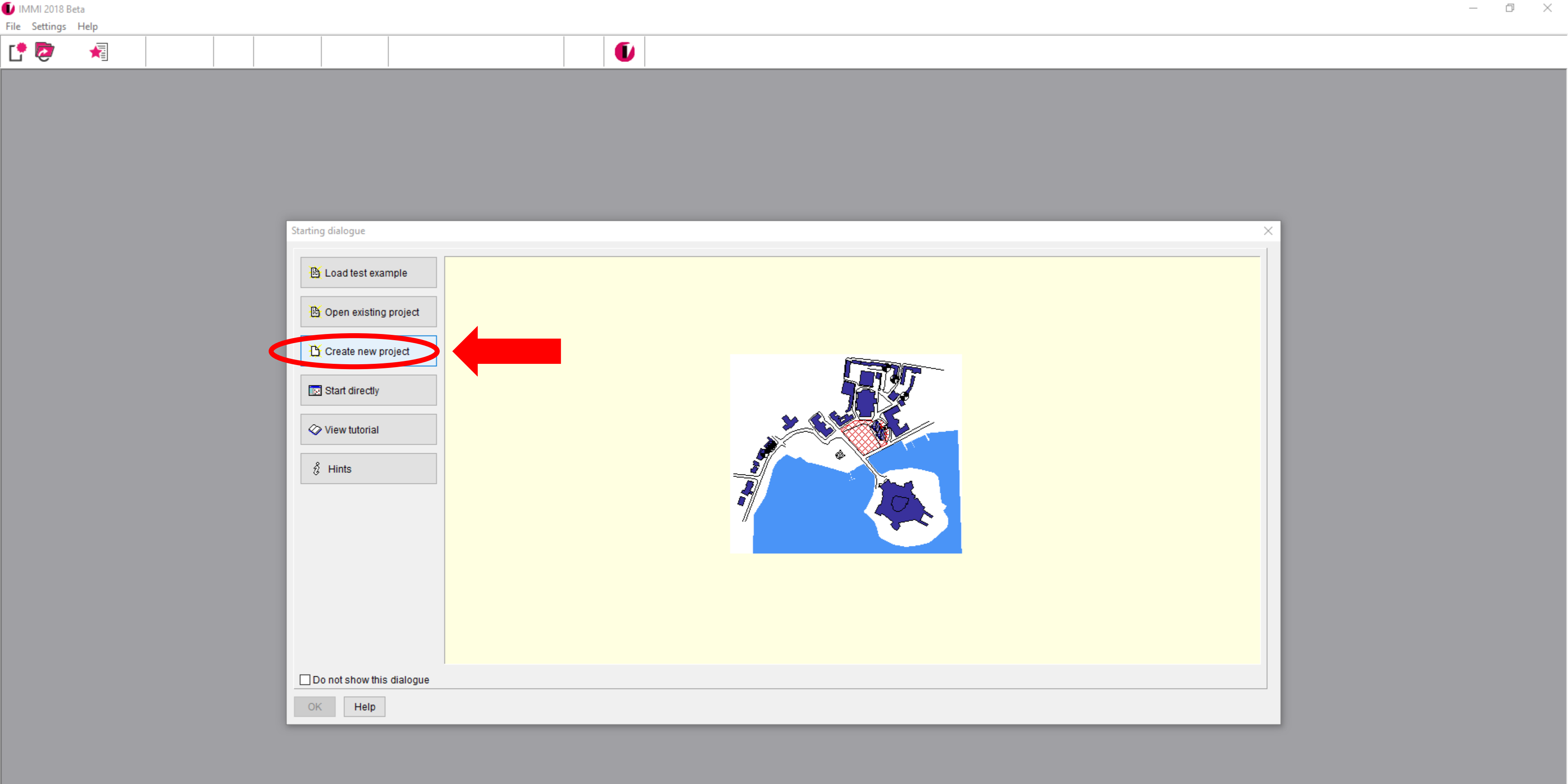


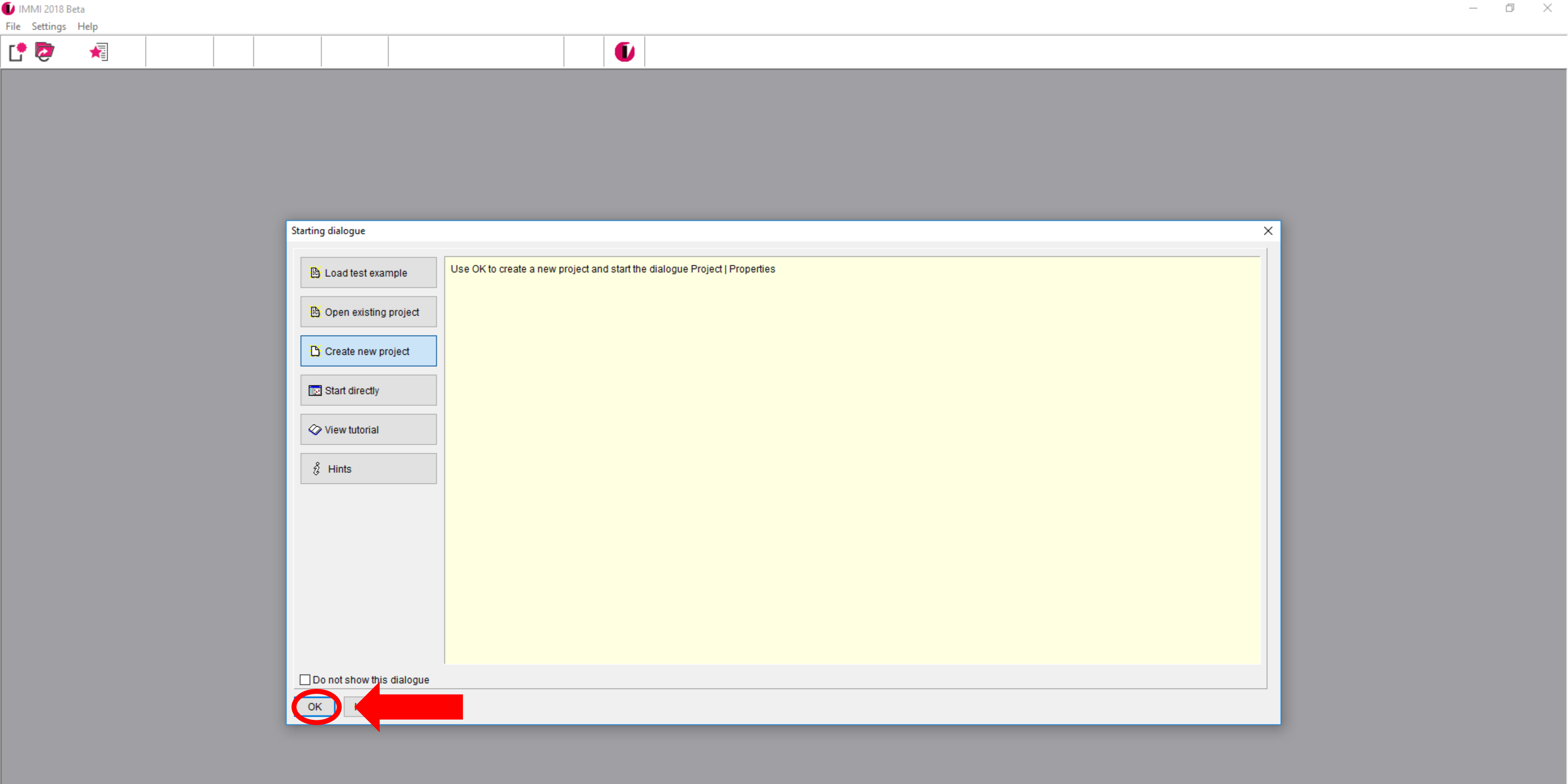


IMMI 2018 – Indoor Module

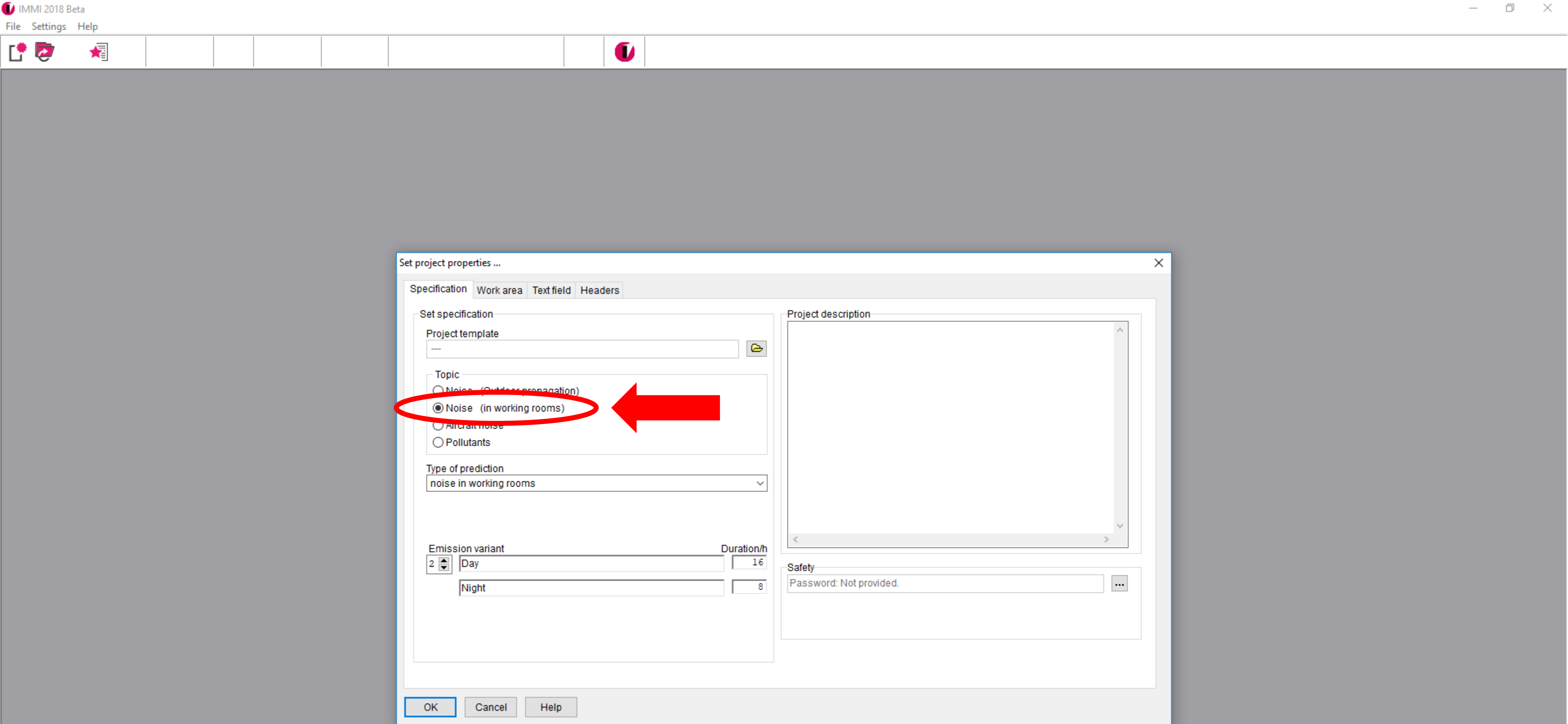




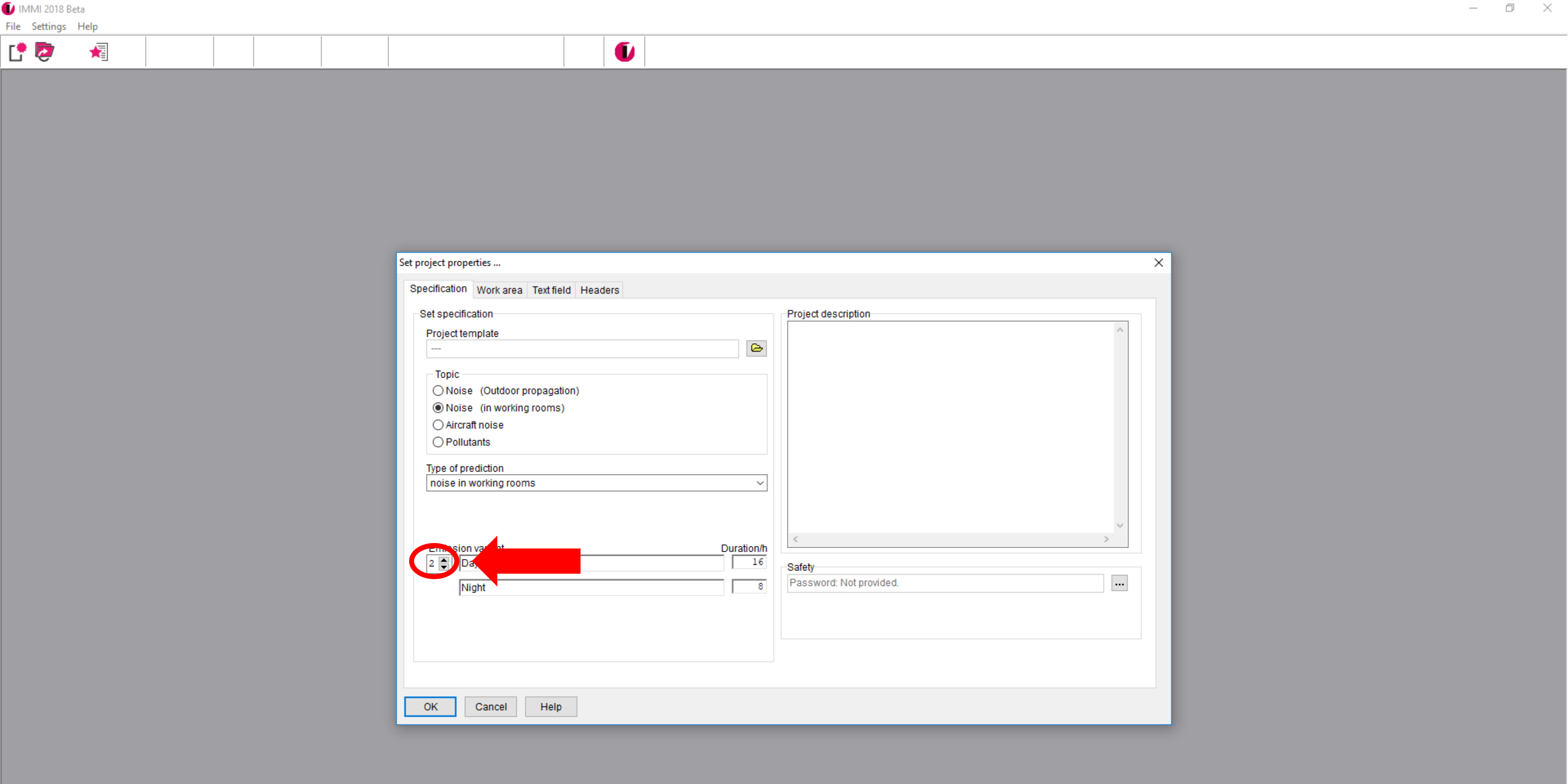
Start IMMI, choose "create new project" and confirm with OK.



Start IMMI, choose "create new project" and confirm with OK.

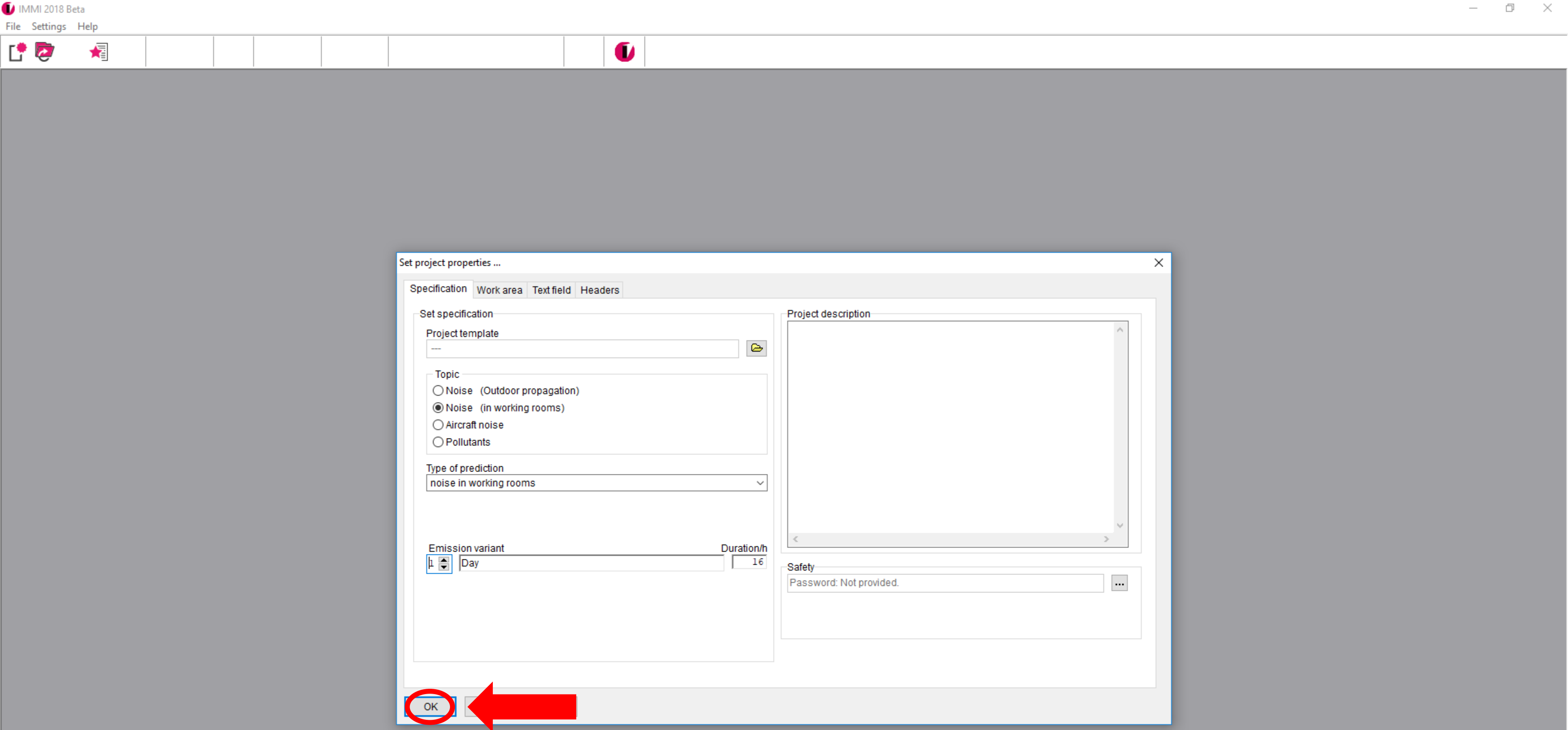


In project properties, select "Noise (in working rooms)".

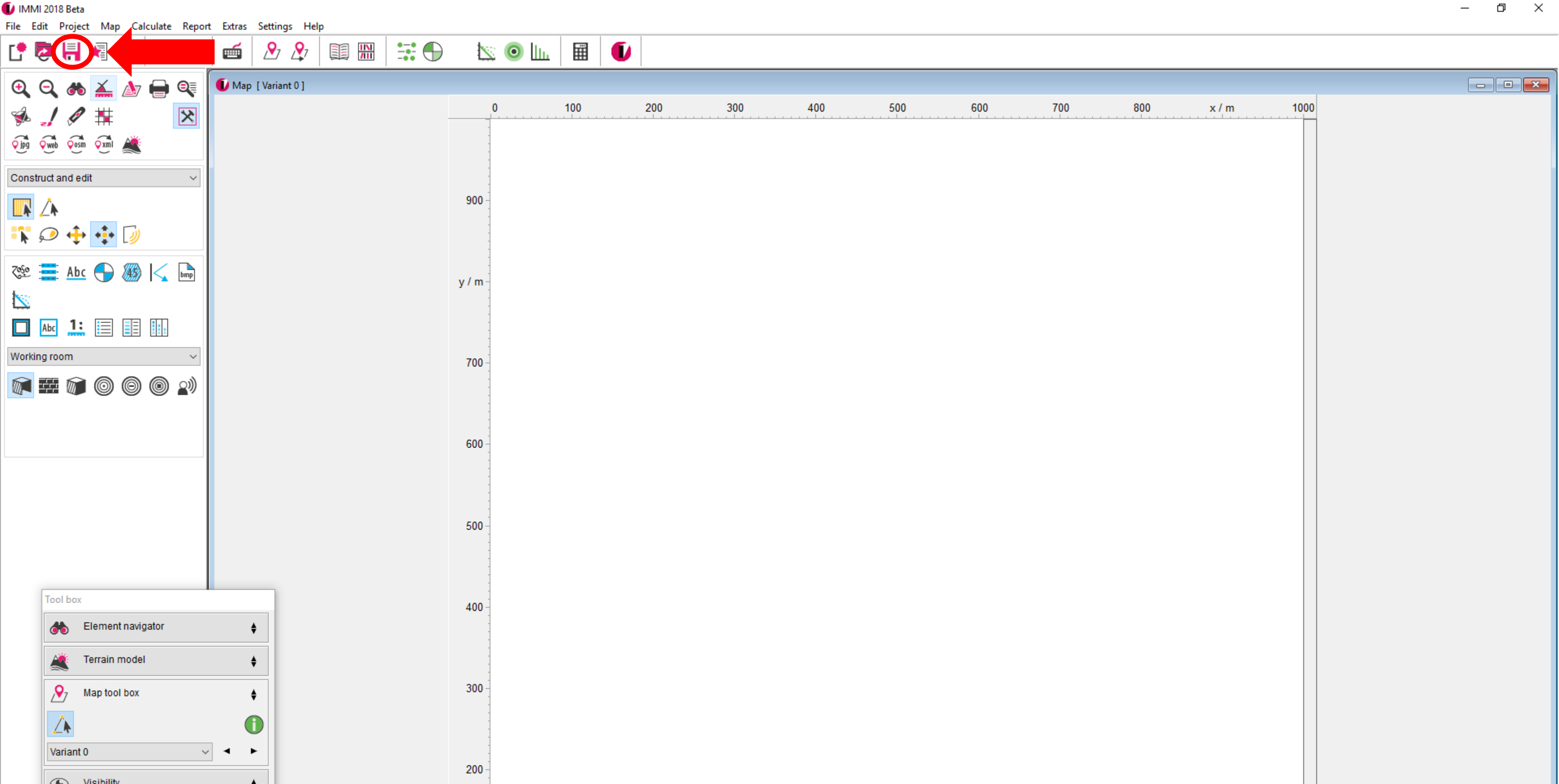


Reduce the number of emission variants to "1" and press OK.

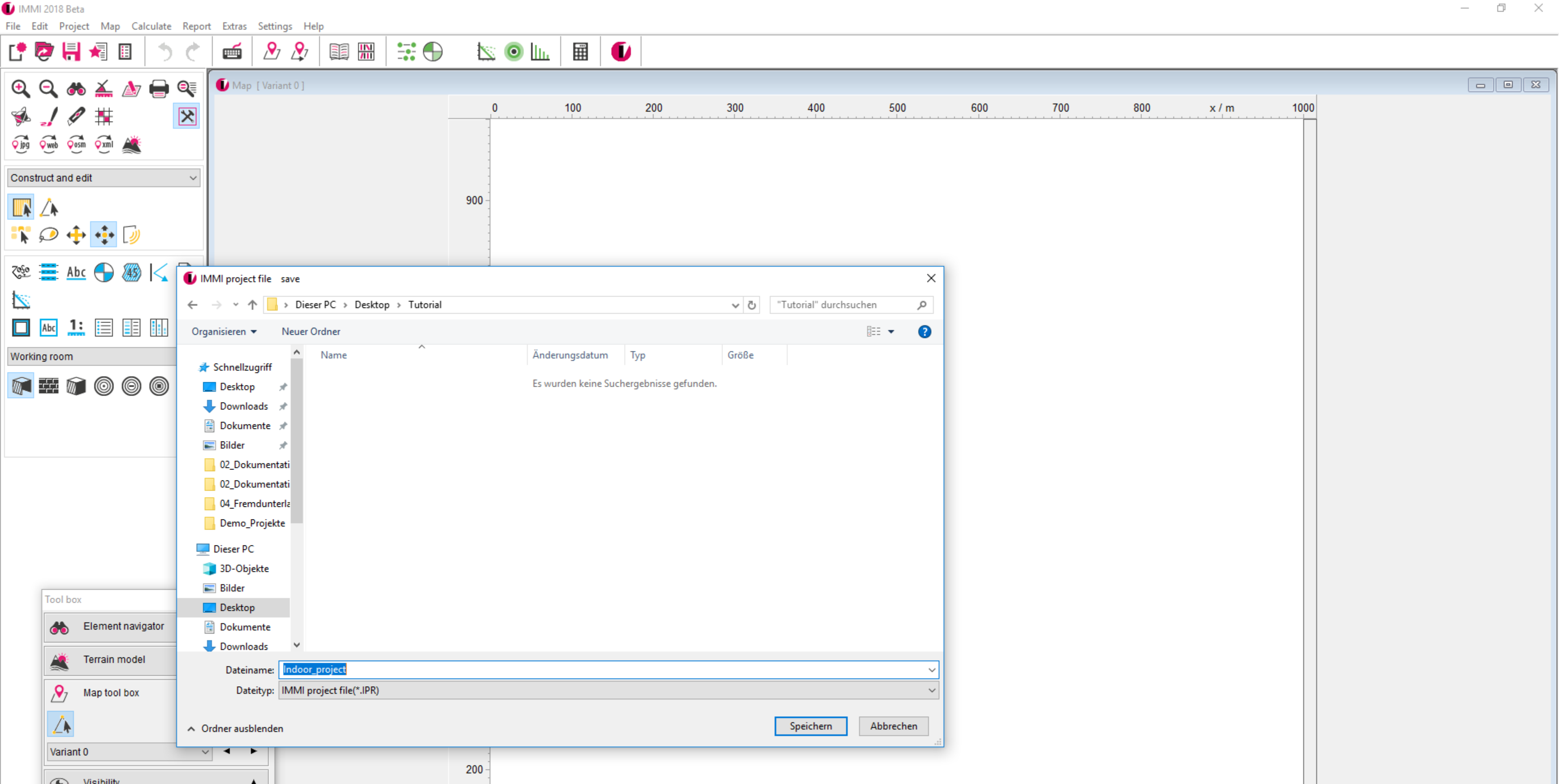




Reduce the number of emission variants to "1" and press OK.

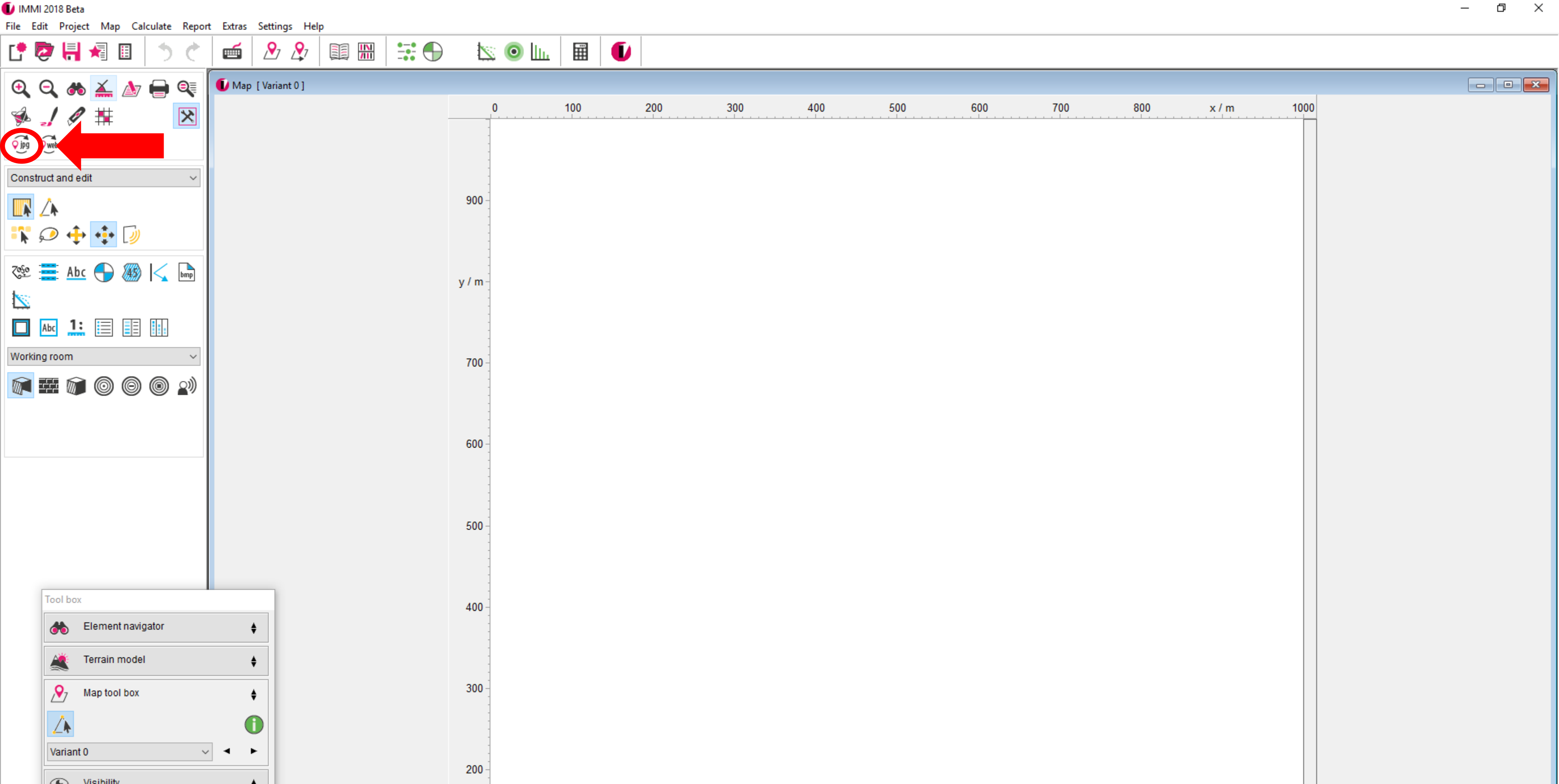


First it is recommended to save the project.  
Please click the floppy icon in the upper bar...

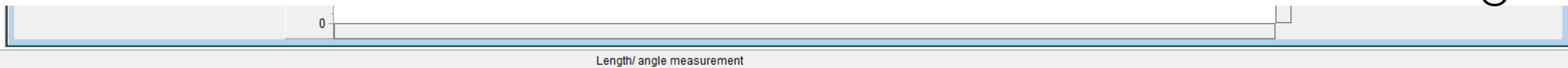


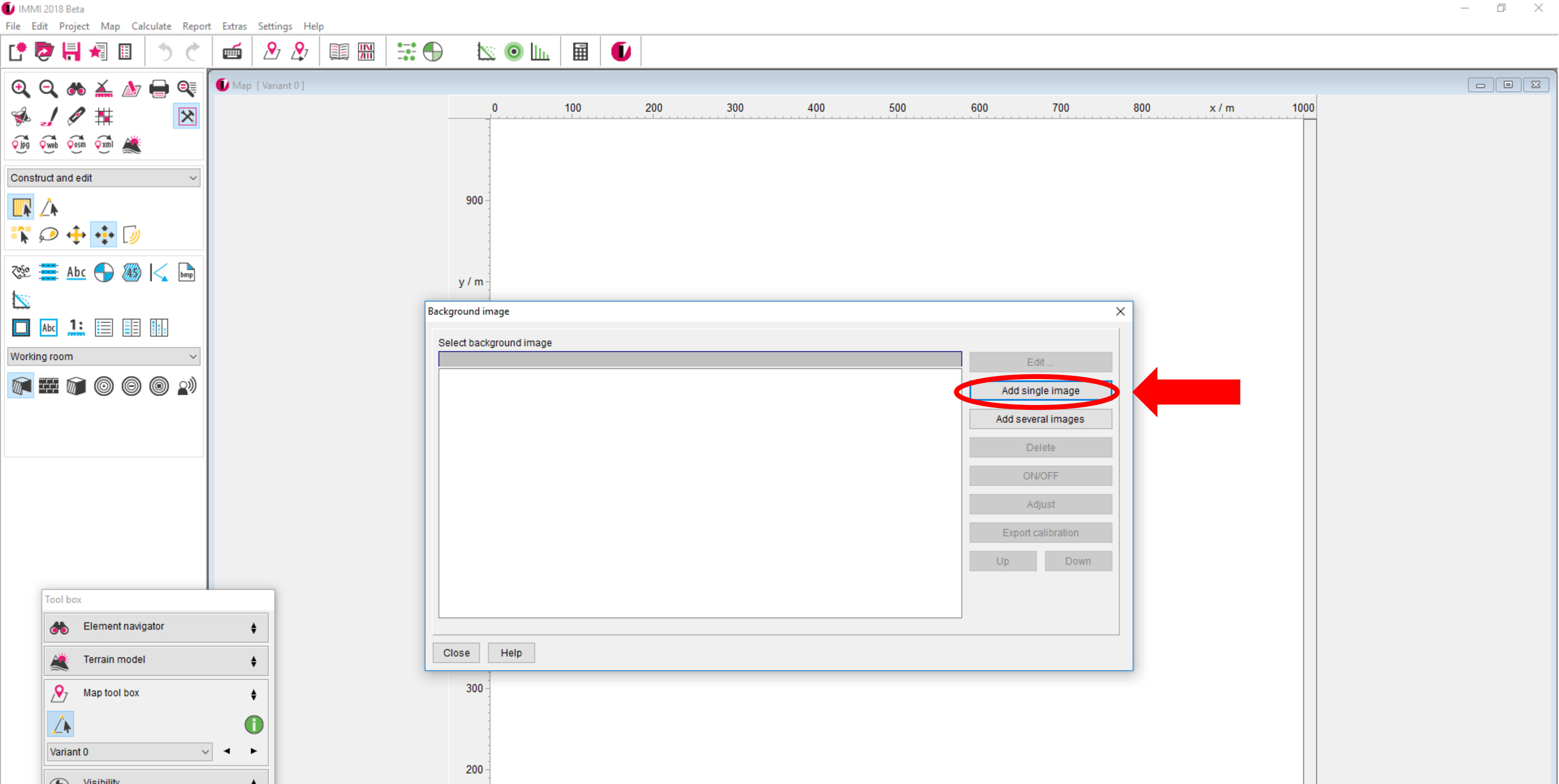
...select a project name and path and confirm with OK.



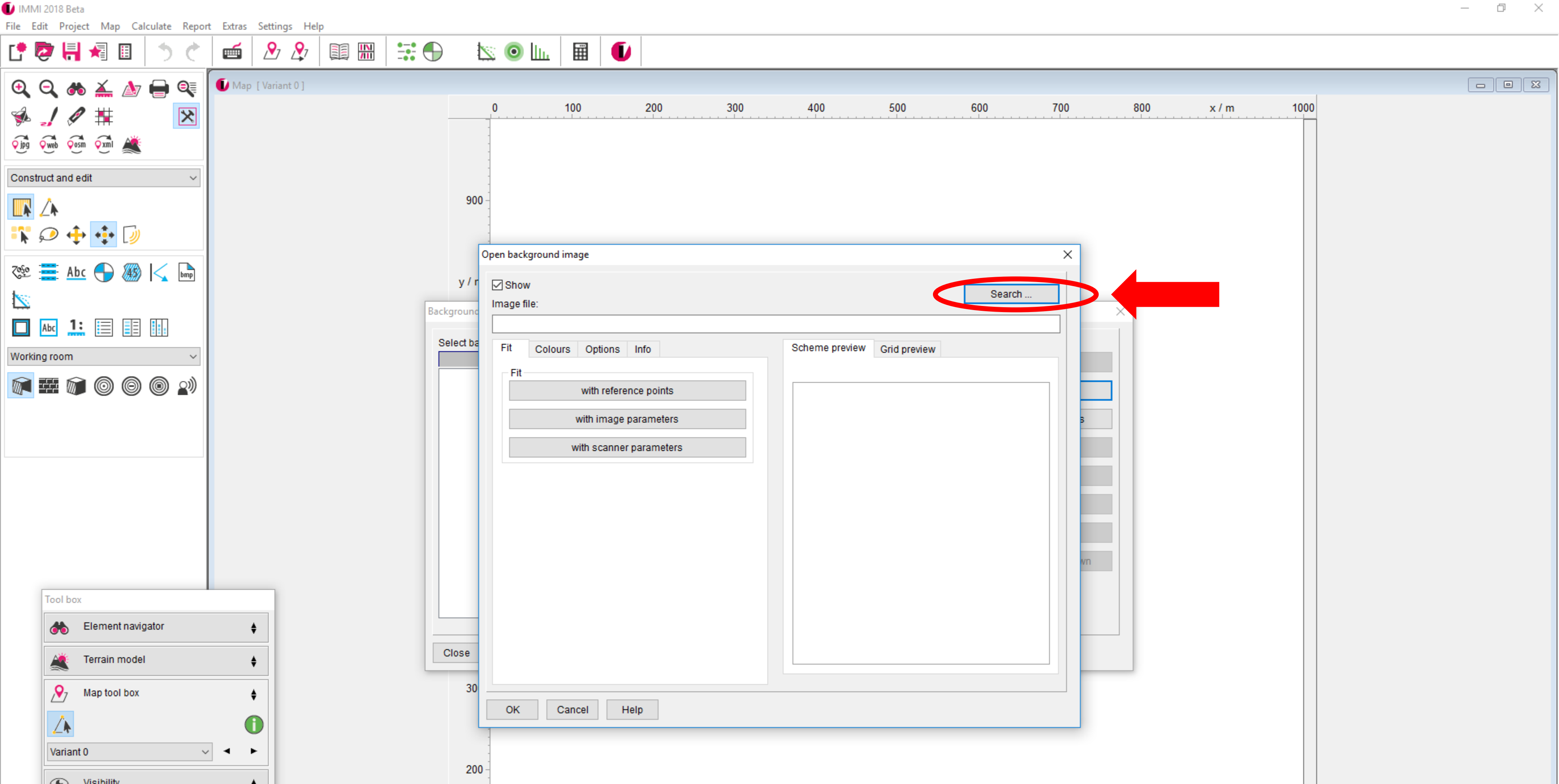


Click the respective icon to load a ground plan as the background image.

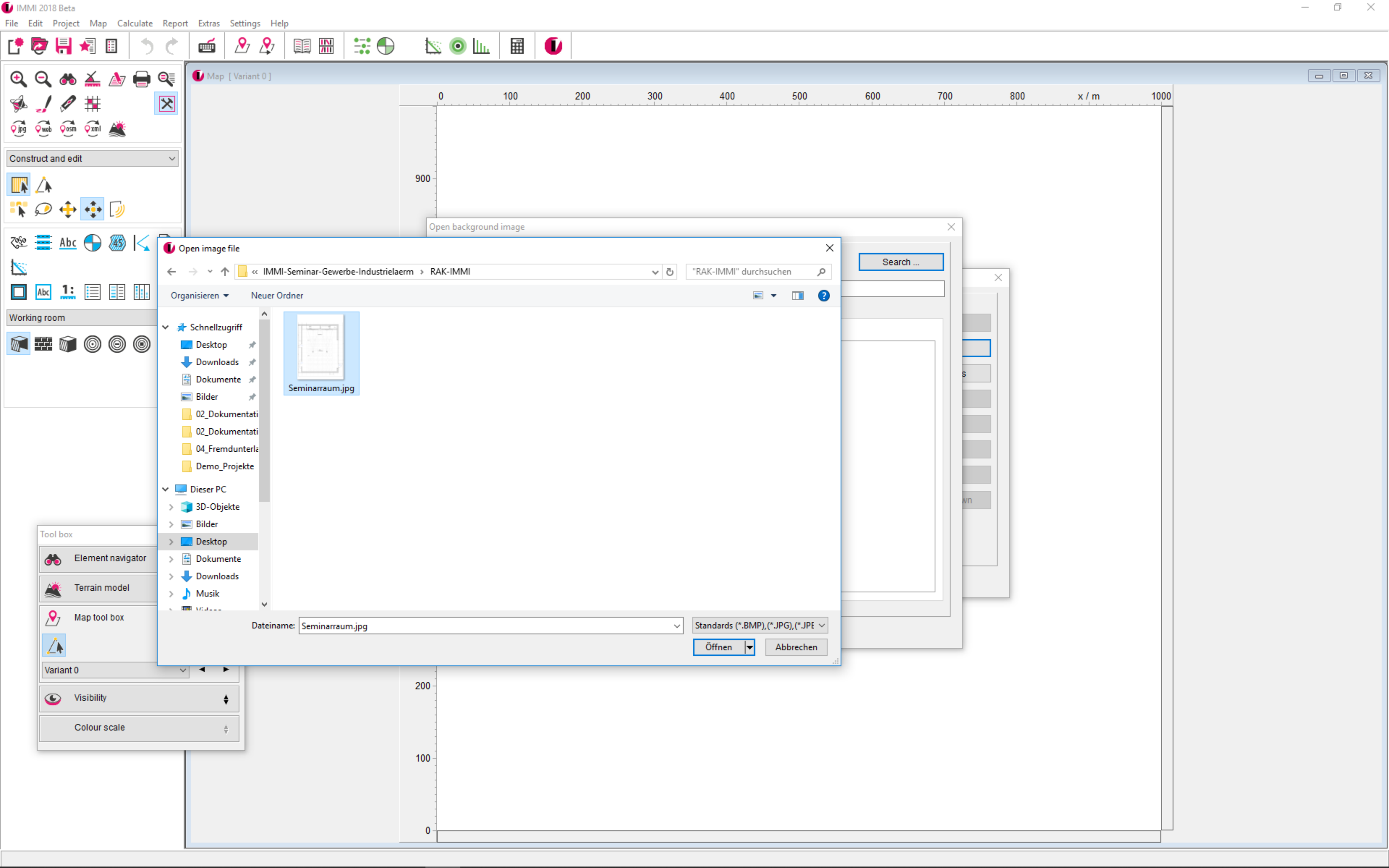


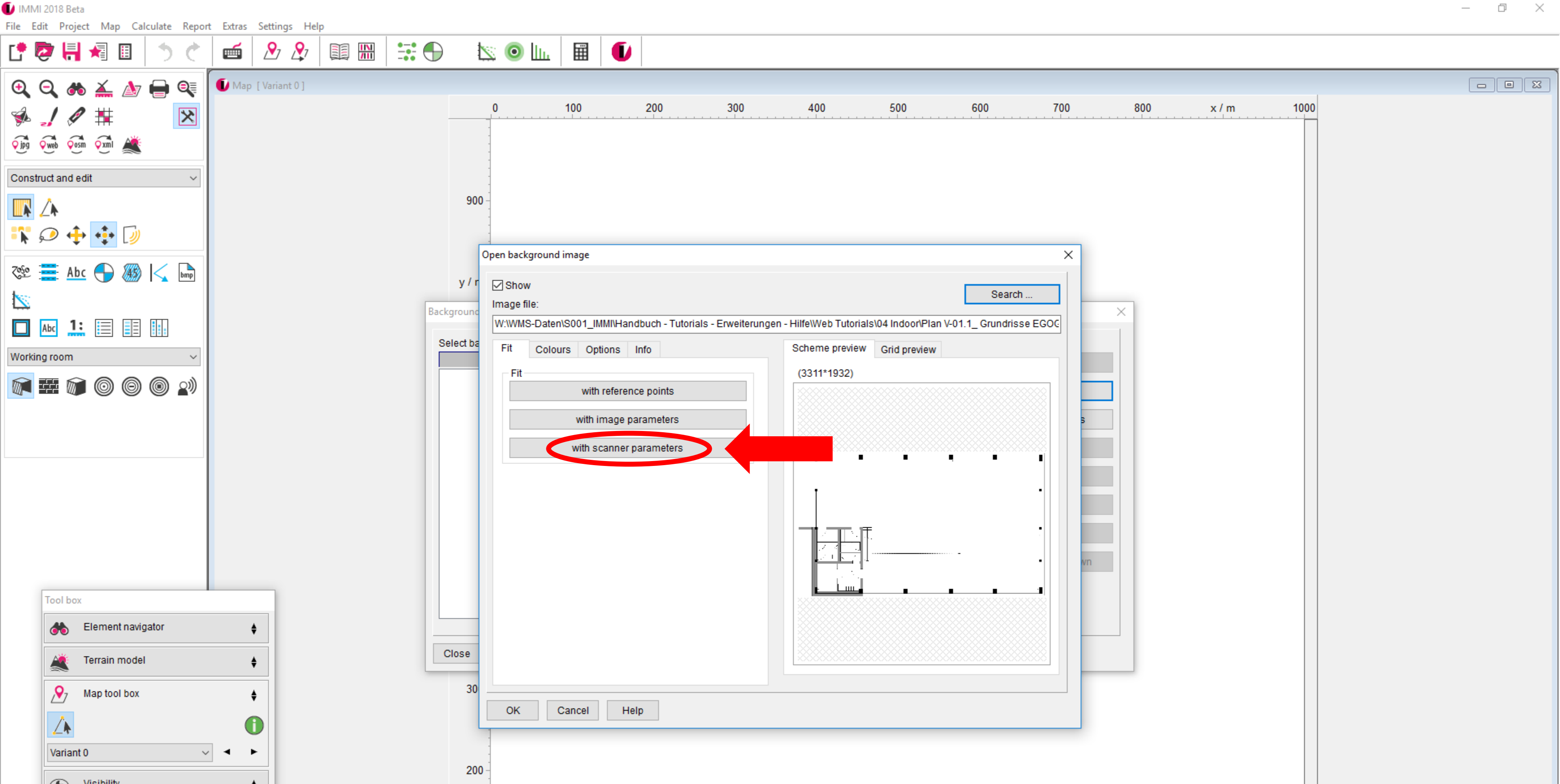


Go to "Add single image".

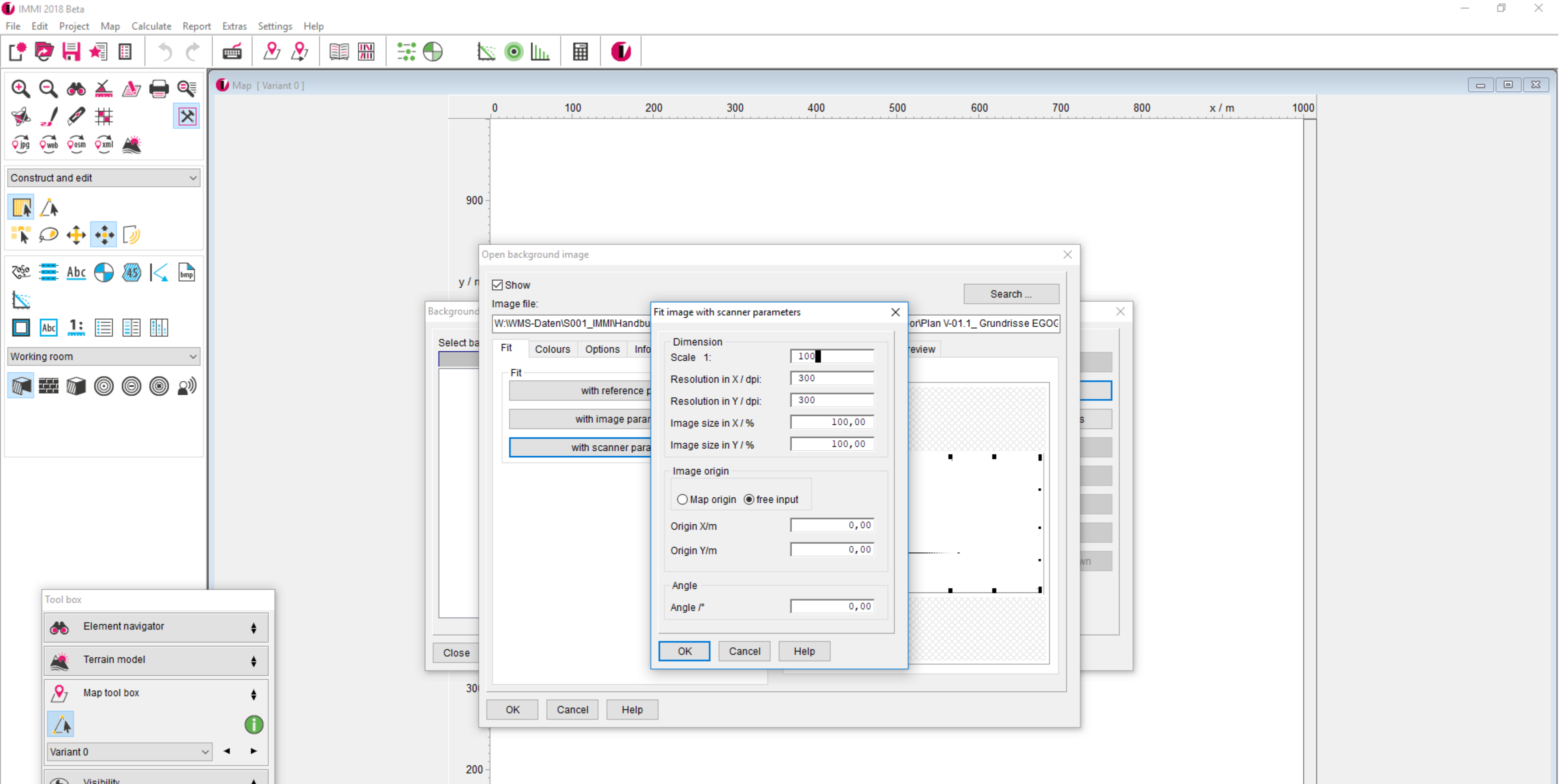


Search for the respective file (image format or pdf required).



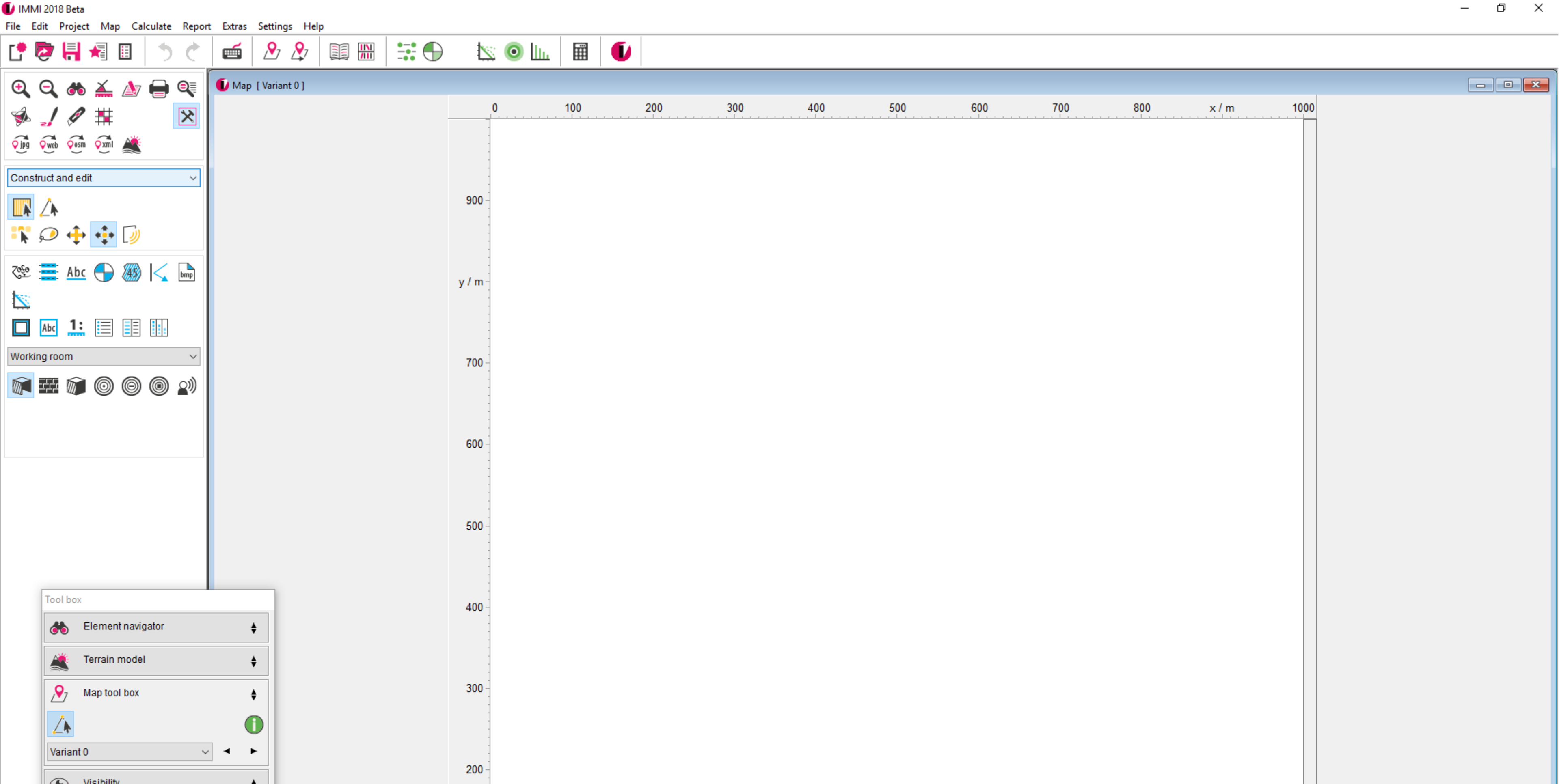


Now size the image to fit the work area.  
In this example we'll use the "scanner parameters".

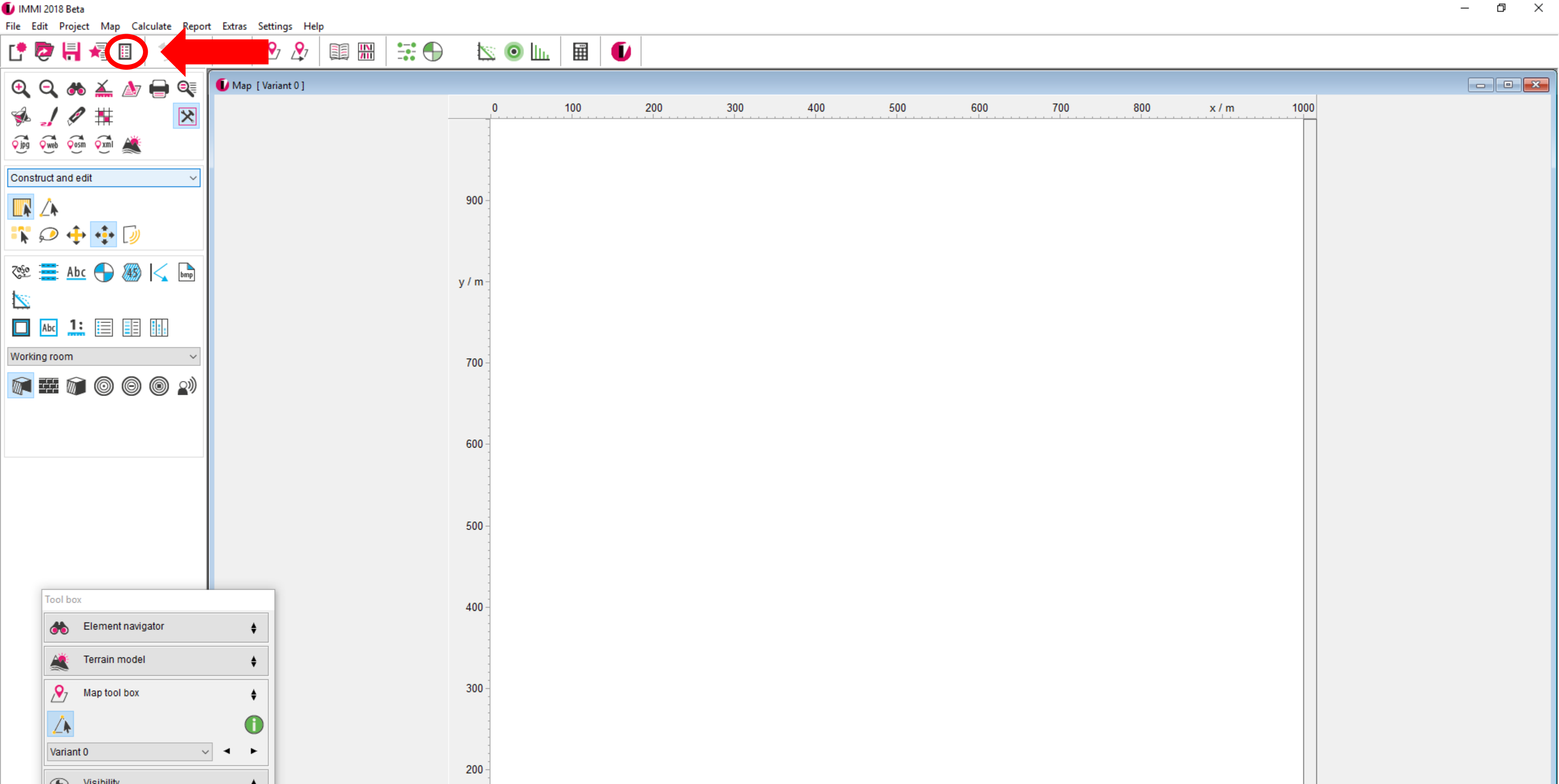


Enter the scale and the resolution of the image.  
You can also use reference points instead...

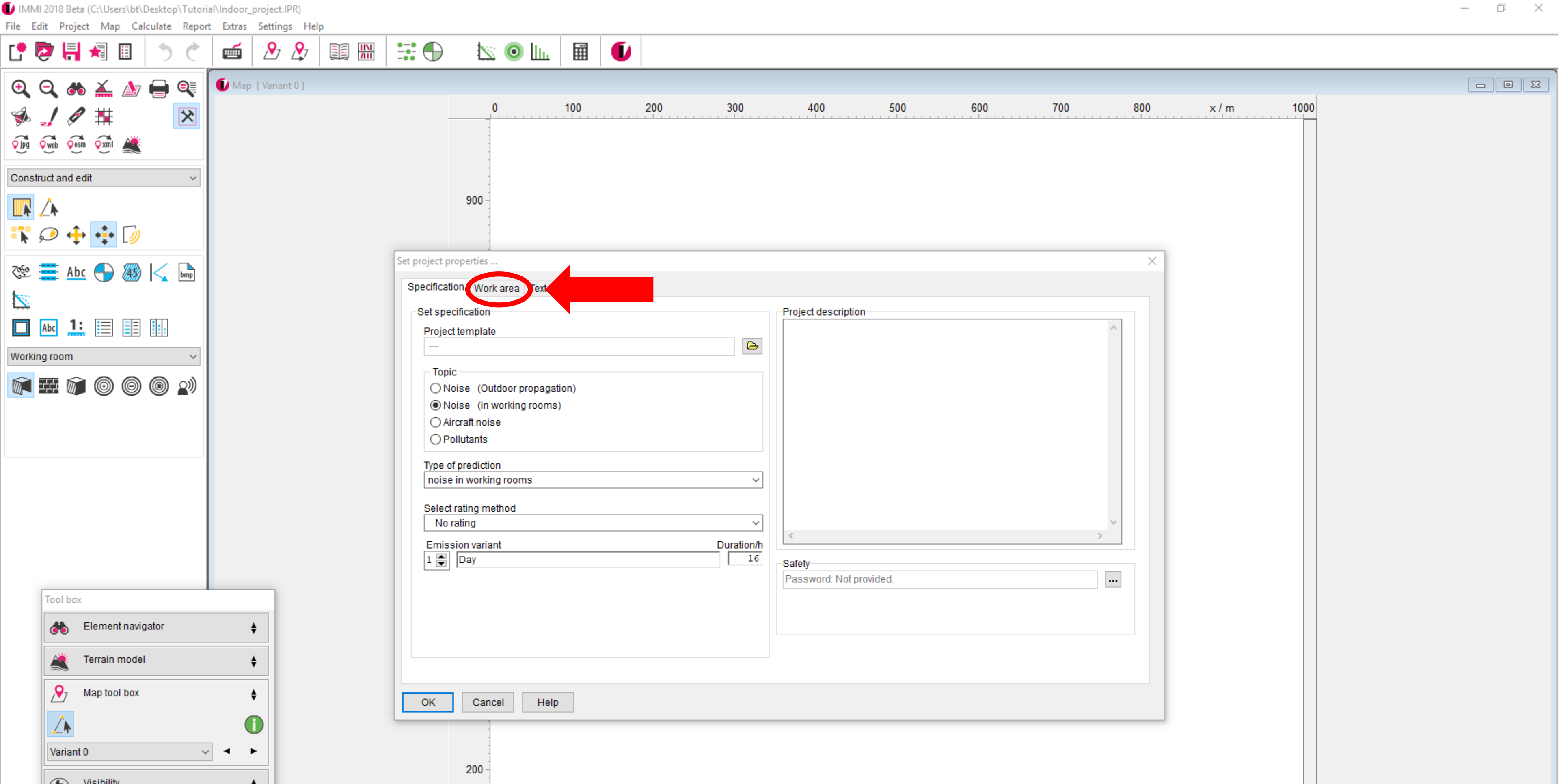




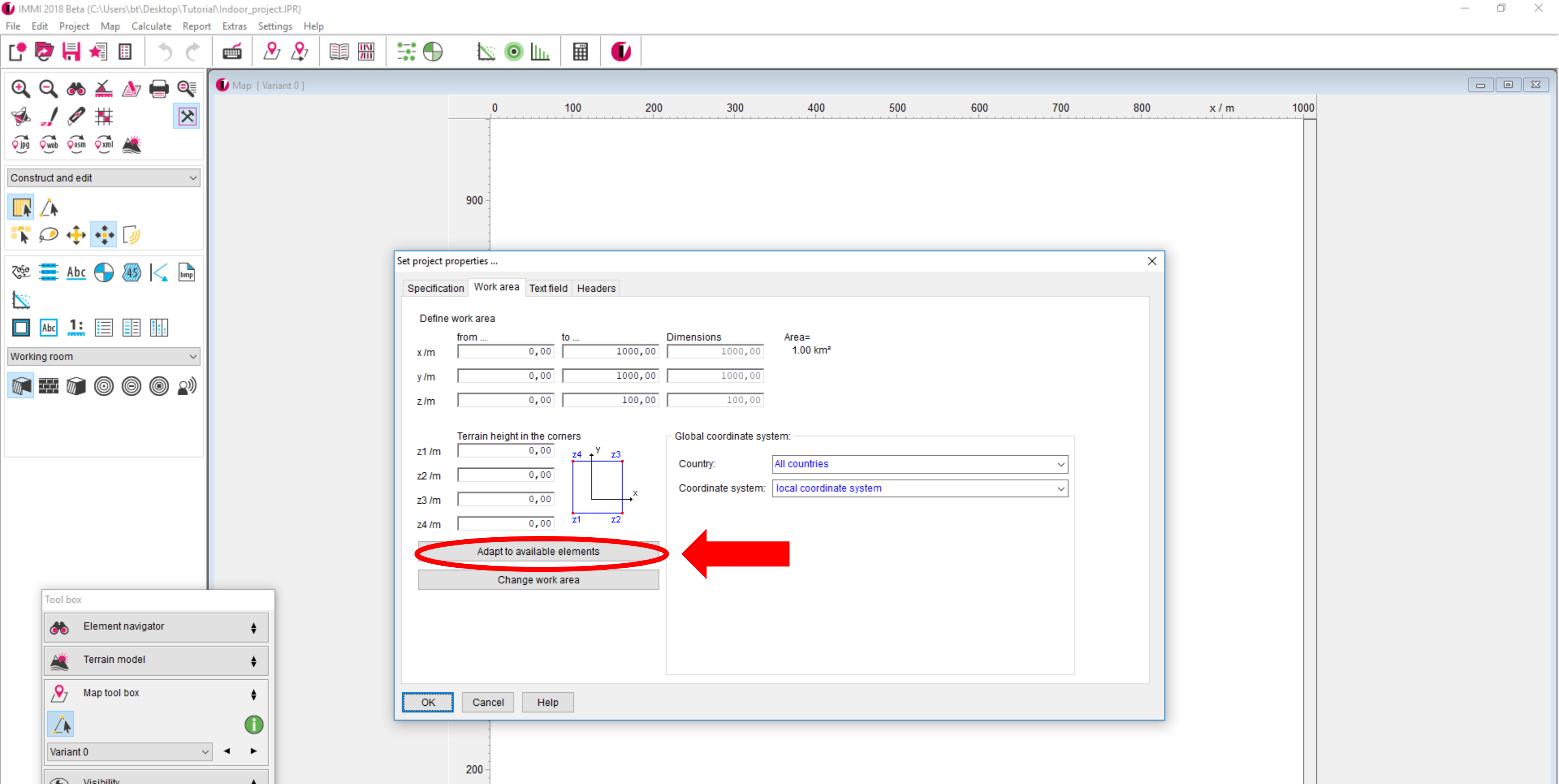
The image will be loaded to the lower left corner of the coordinate system (0/0).



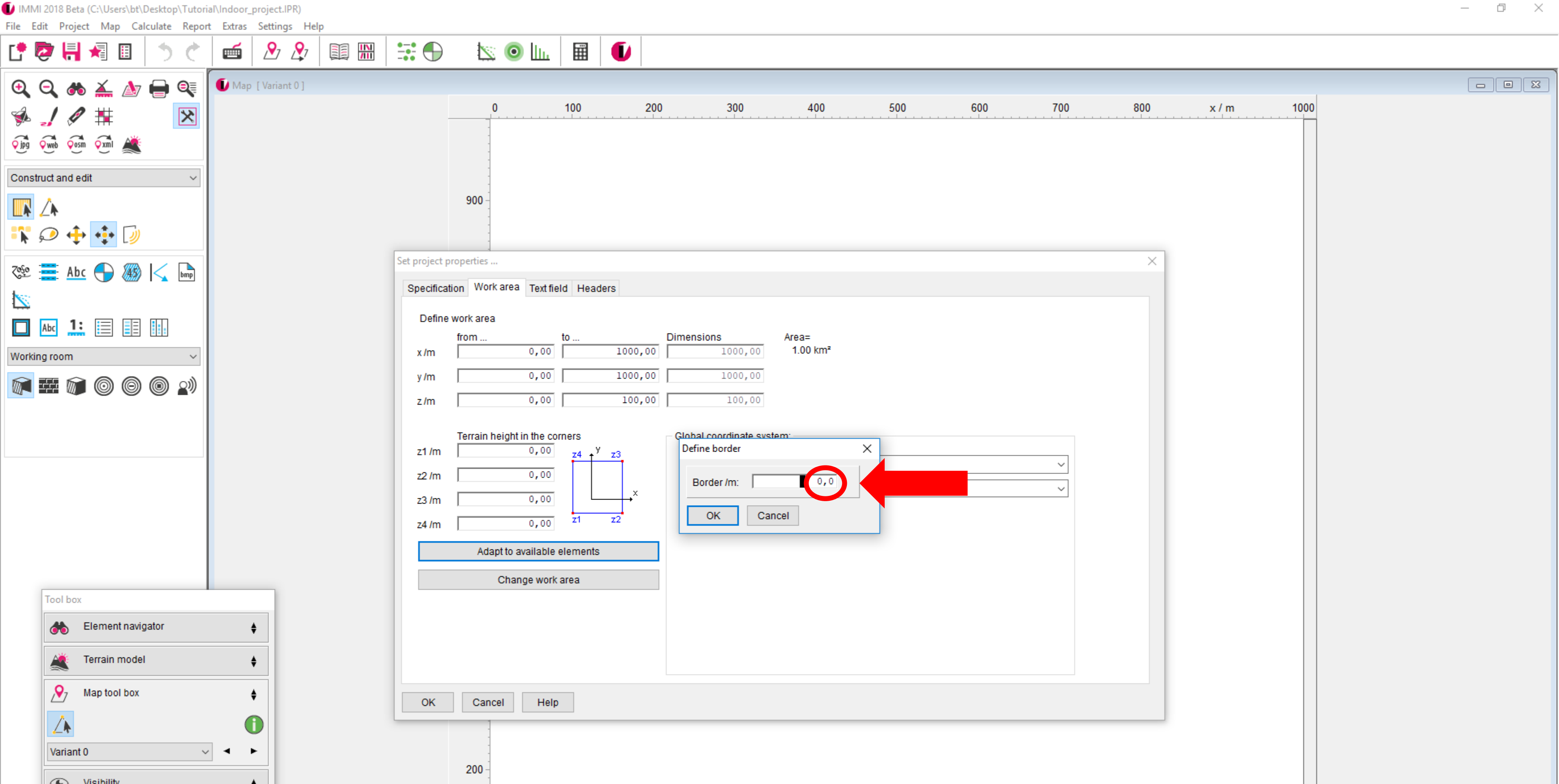
In order to adapt the work area, please go to project properties.



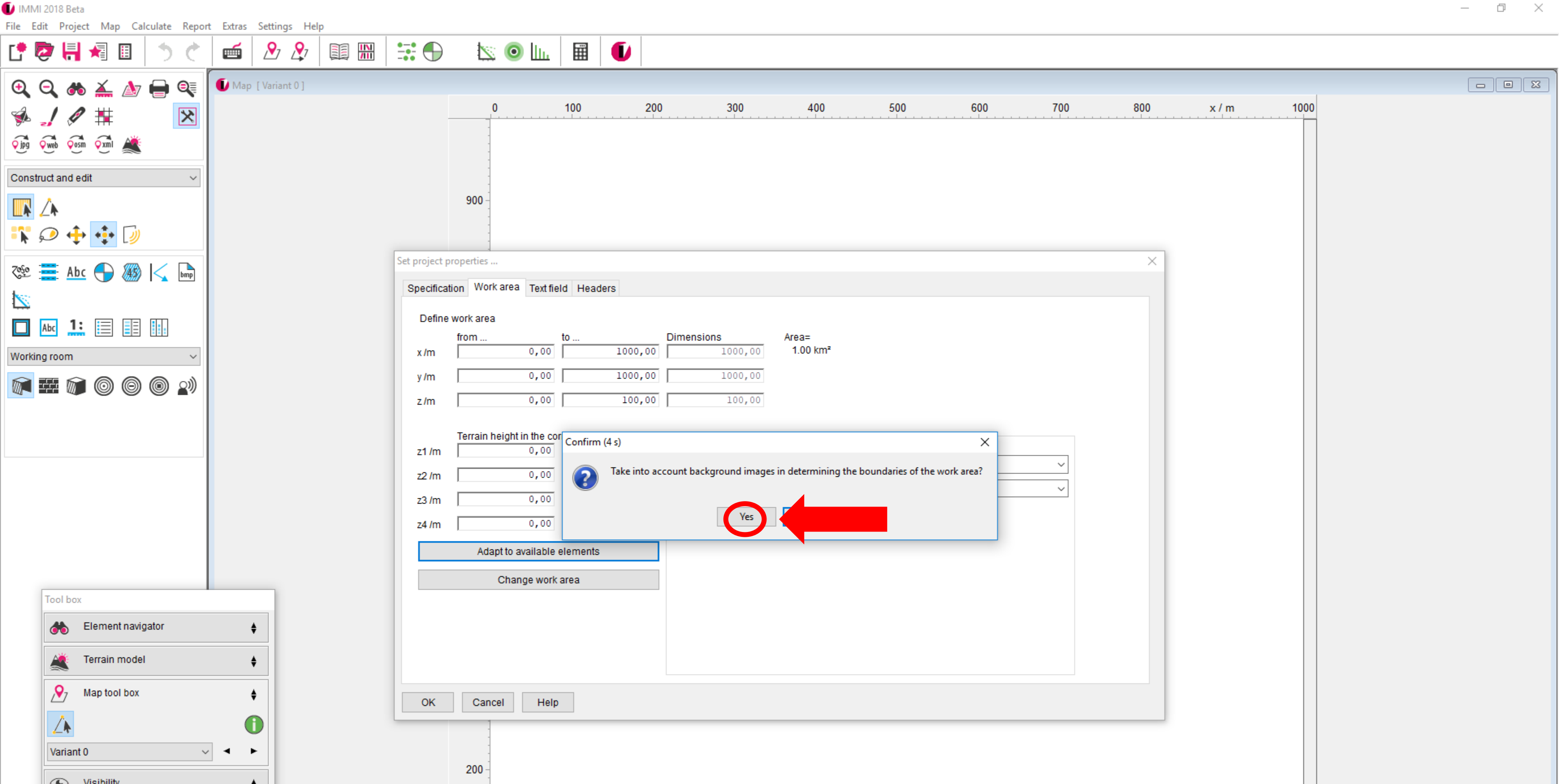
Change to the tab "work area".



Choose "adapt to available elements".

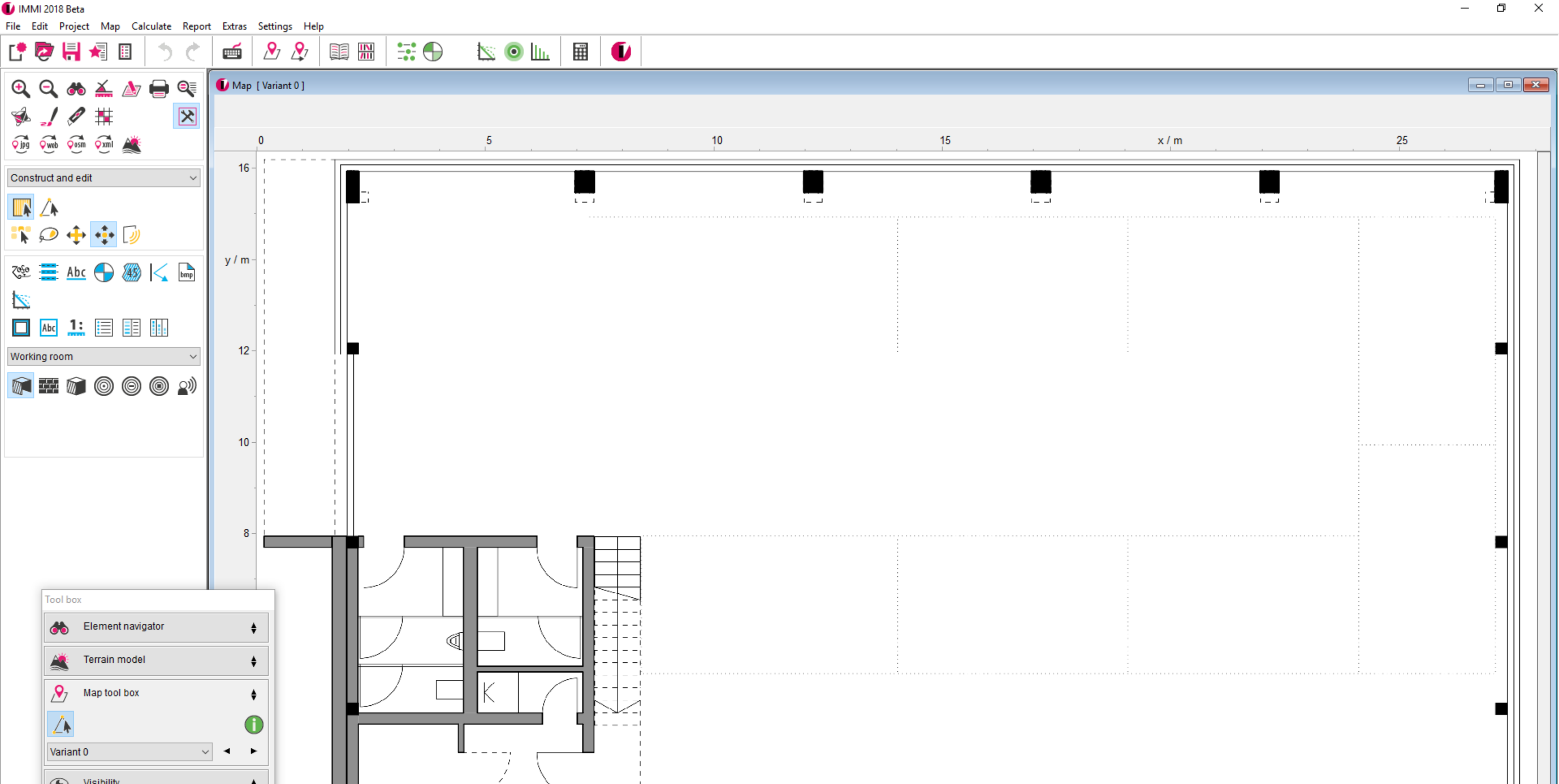


Enter a border of 0 m.

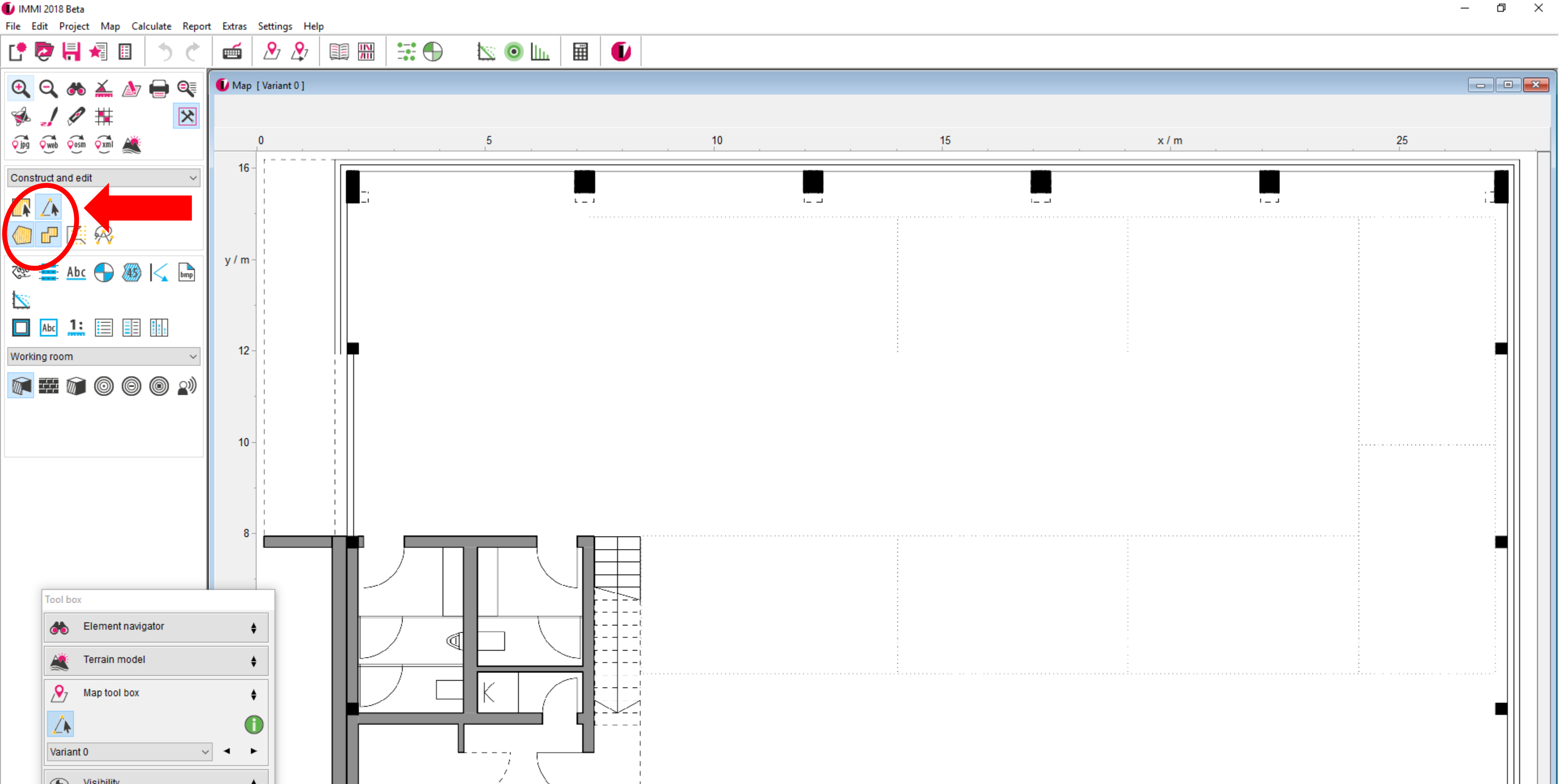


Confirm the dialogue with "Yes".

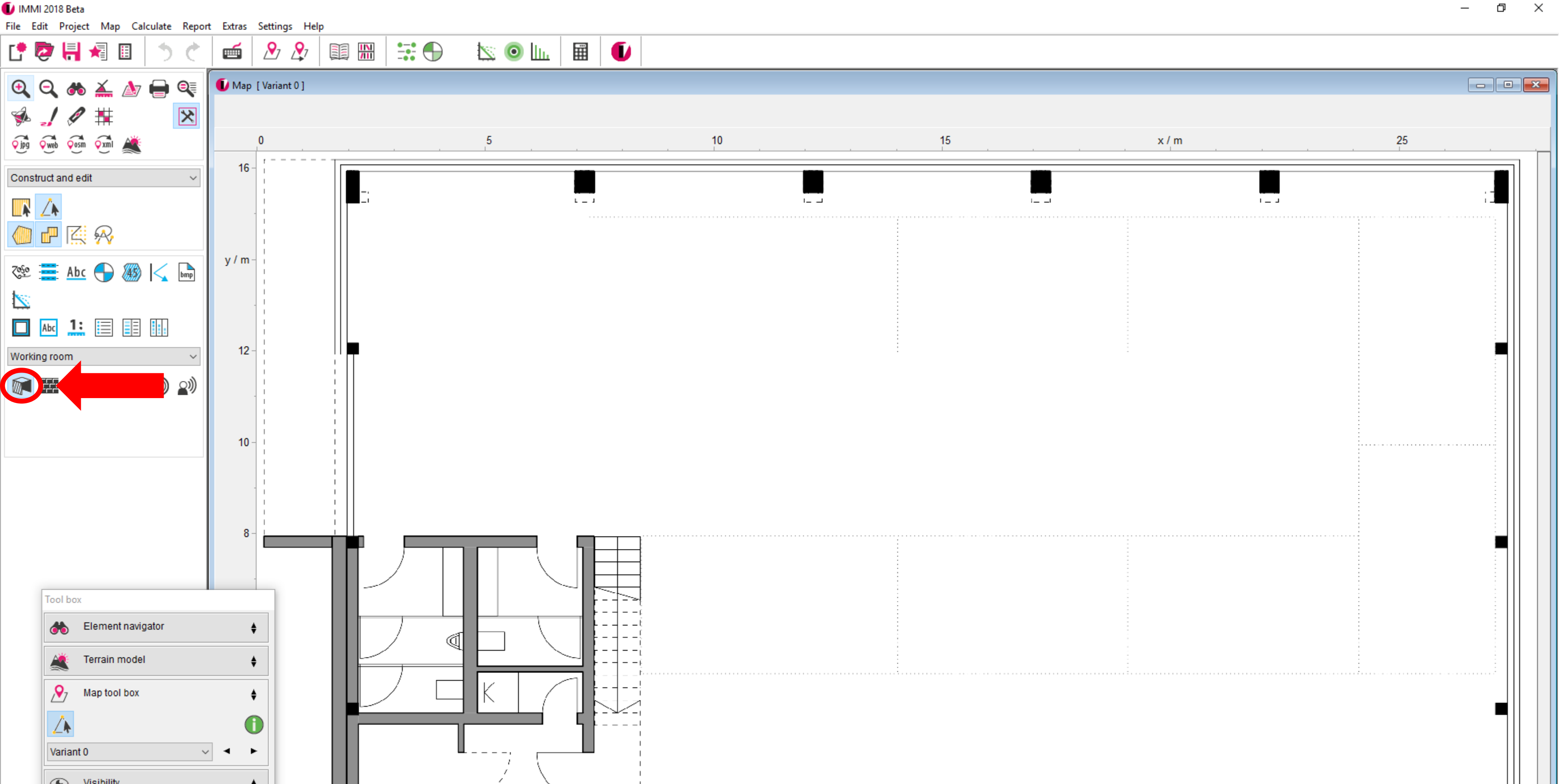




The work area is now adjusted to the dimensions of the ground plan.



Now we'll model the room. Select the construction tool and the icons for rectangular and closed elements.



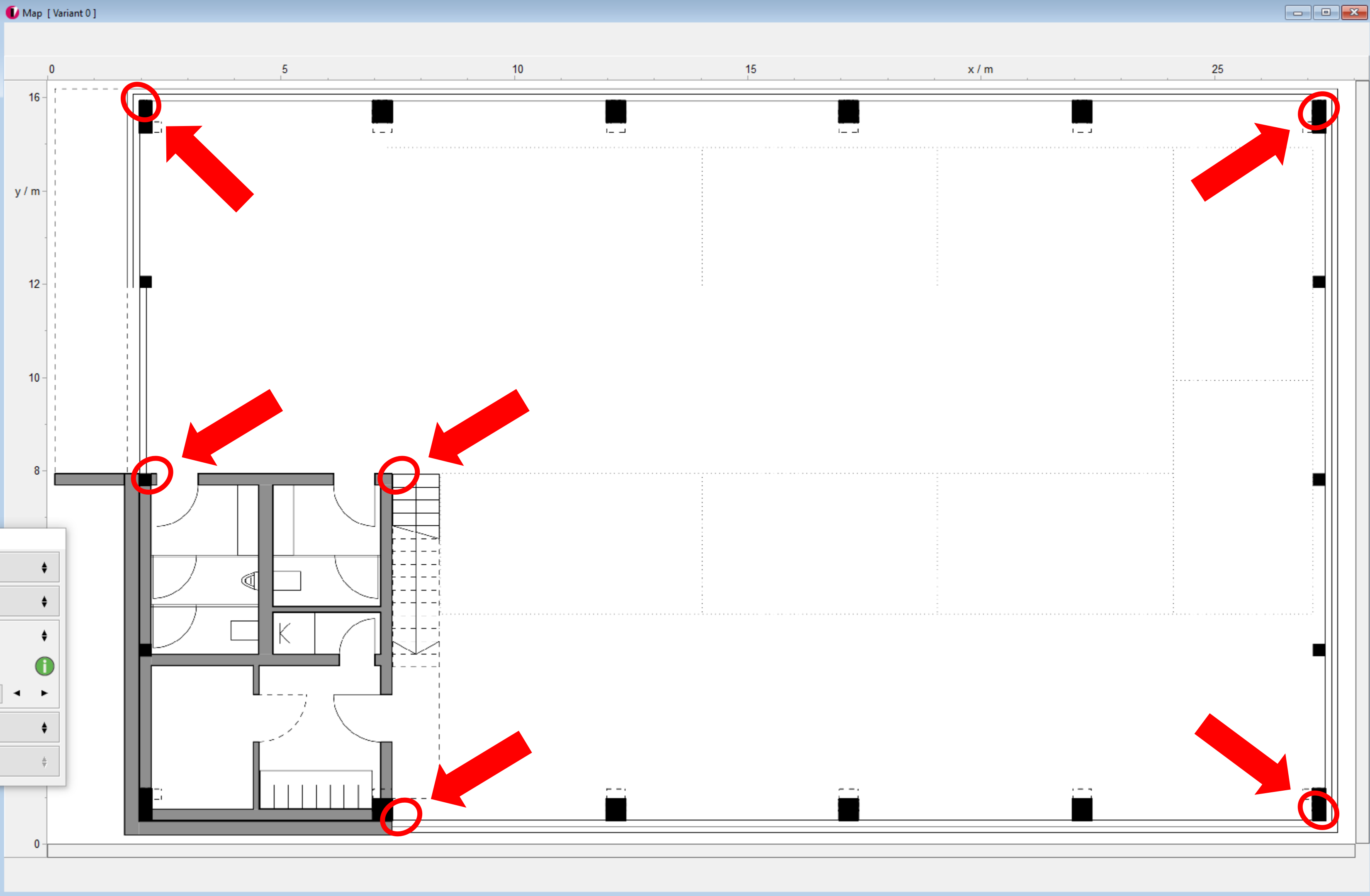
Make sure the element "working room" is selected and start drawing the room. Left click at each corner and close the element with a right click.



Map [ Variant 0 ]

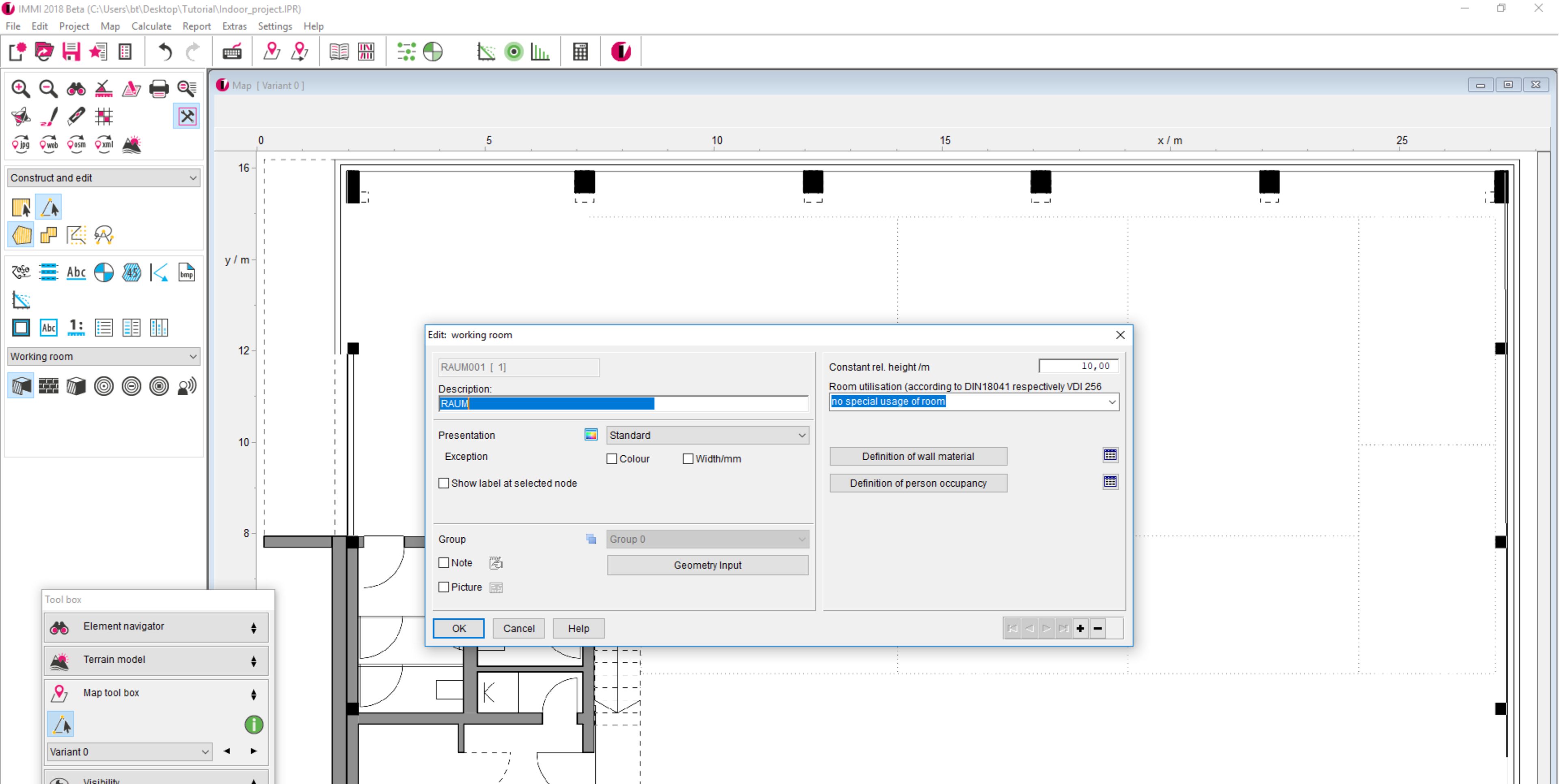
Construct and edit

Working room

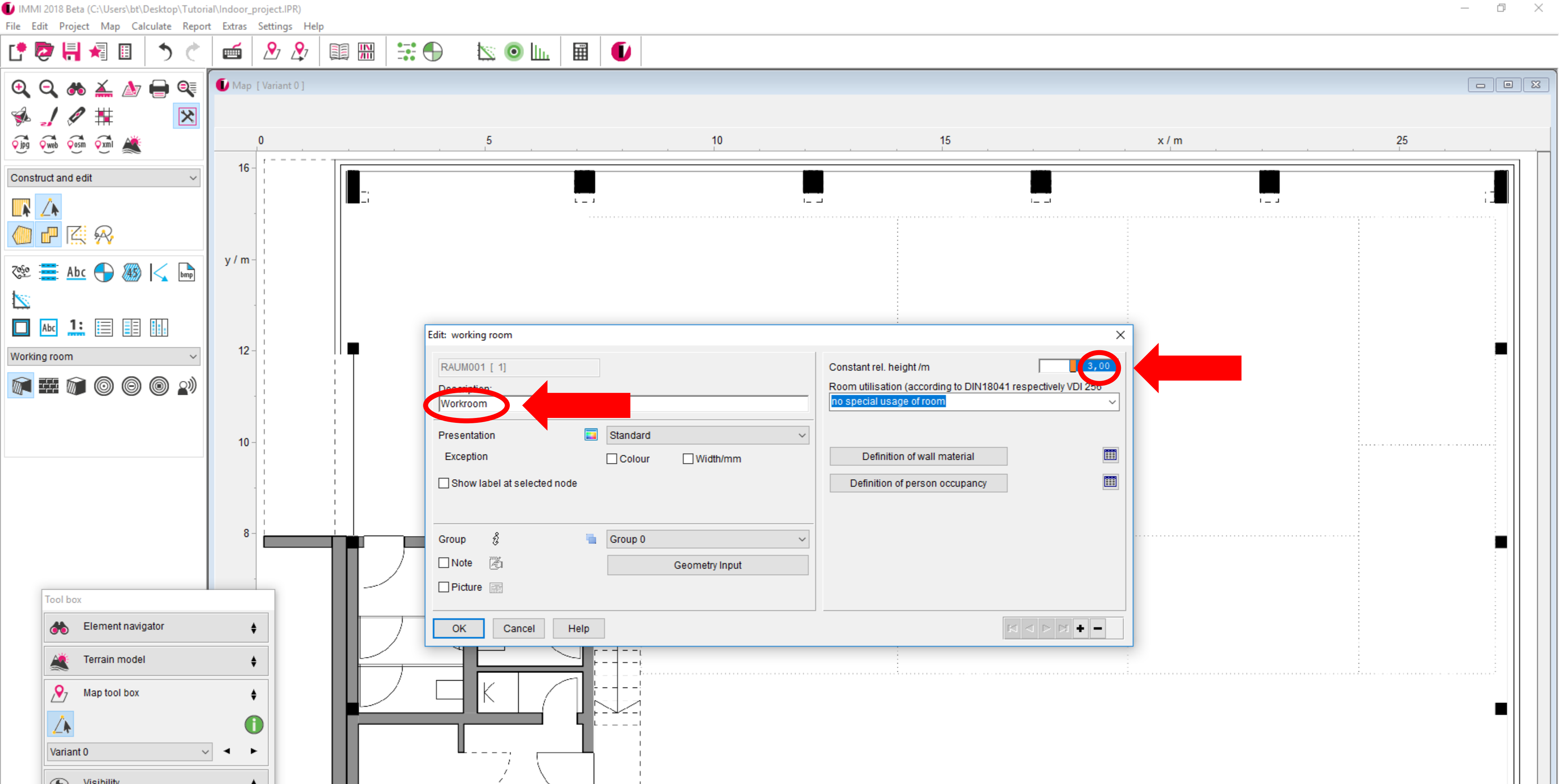


Tool box

- Element navigator
- Terrain model
- Map tool box
- Variant 0
- Visibility
- Colour scale

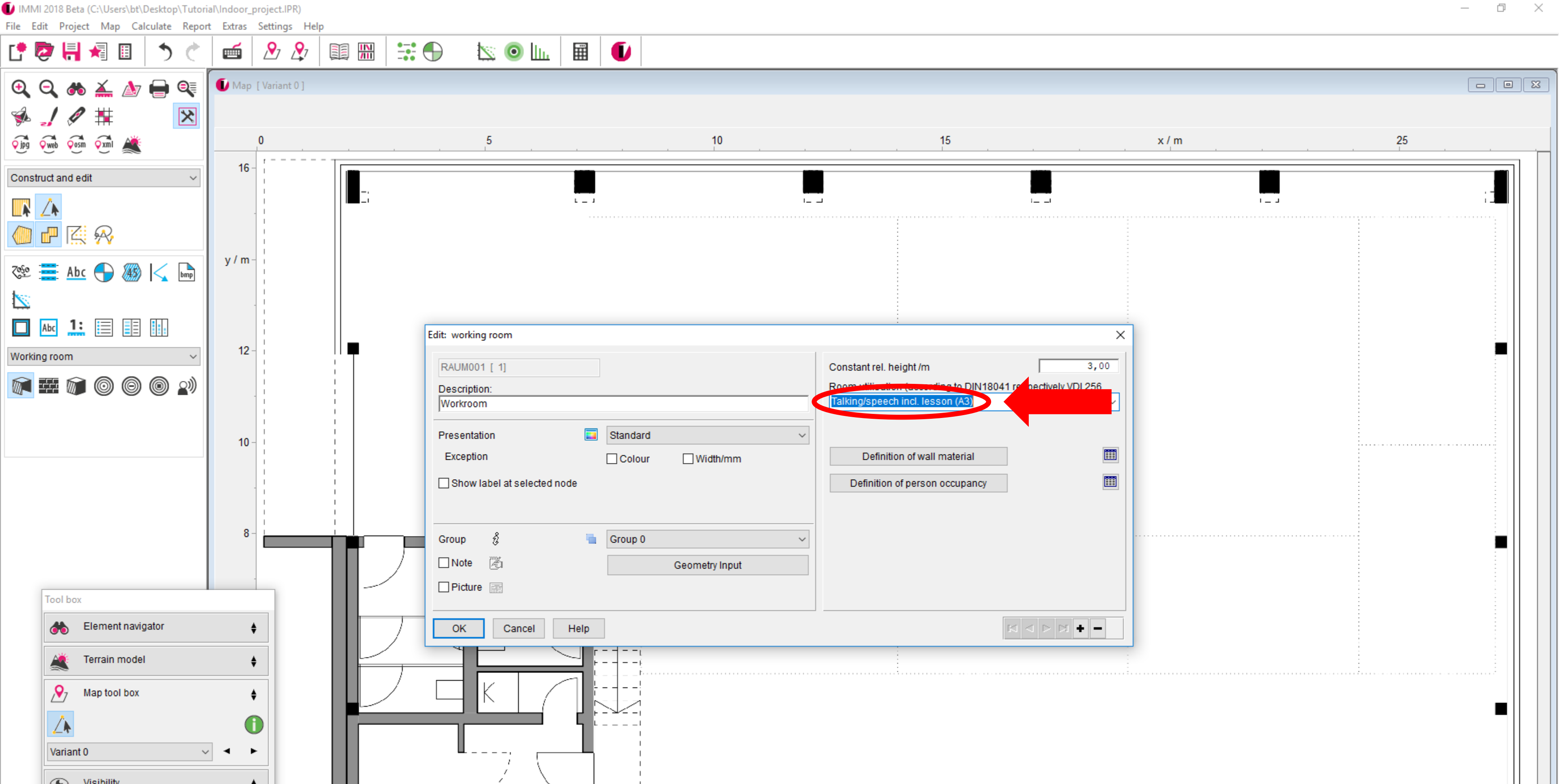


After the right click, the element dialogue appears .

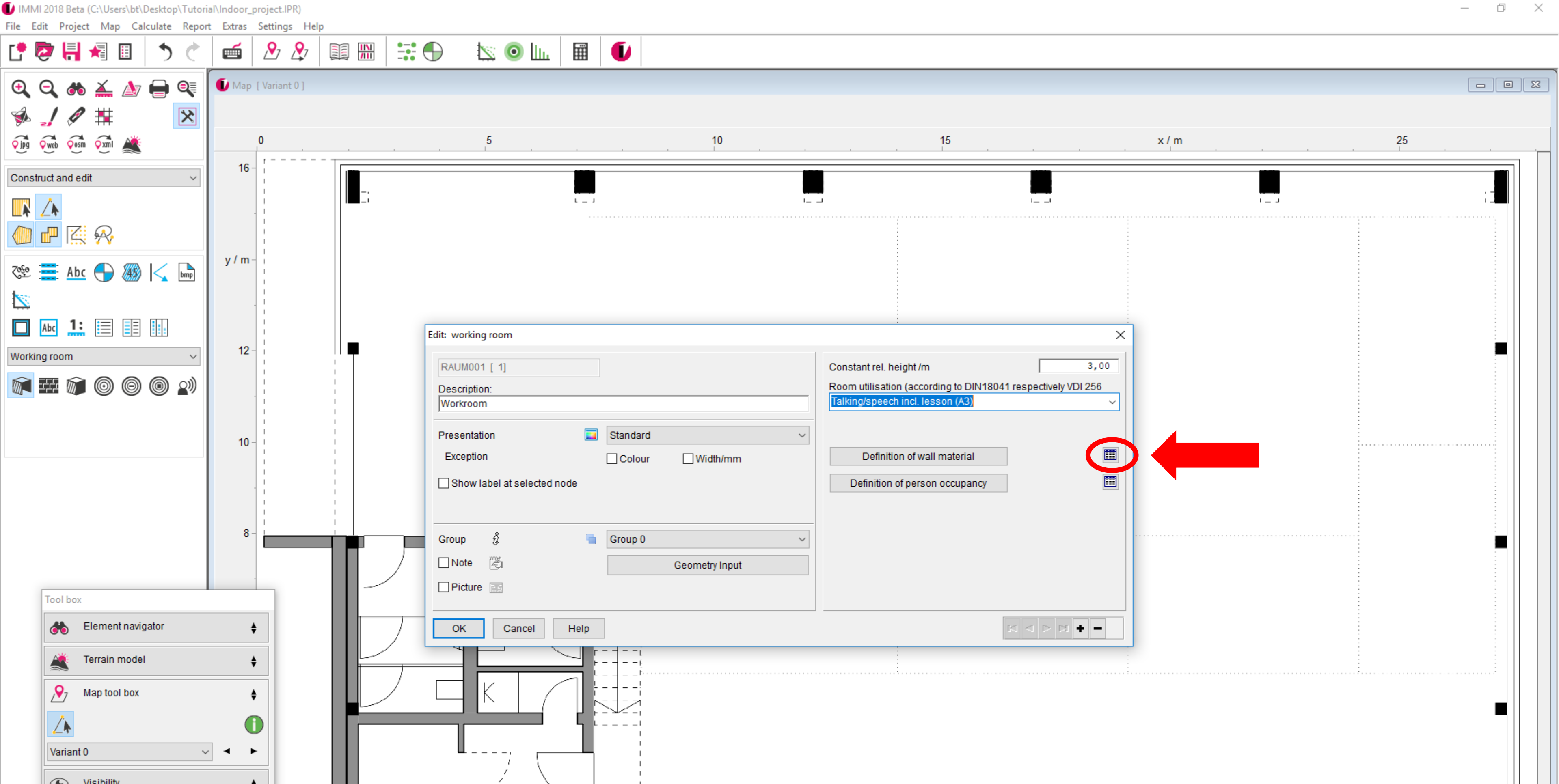


Enter a name for the room and the height.

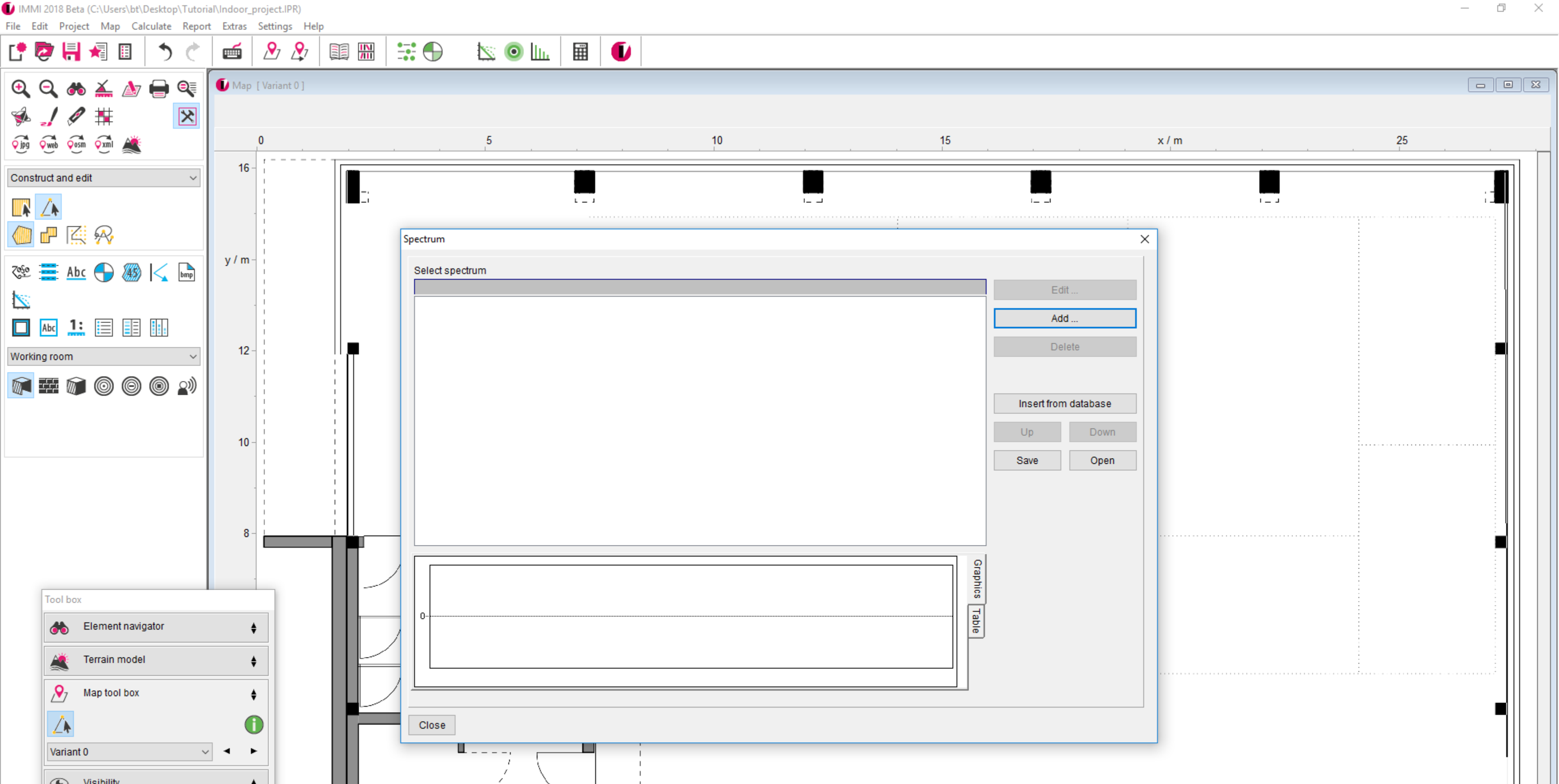




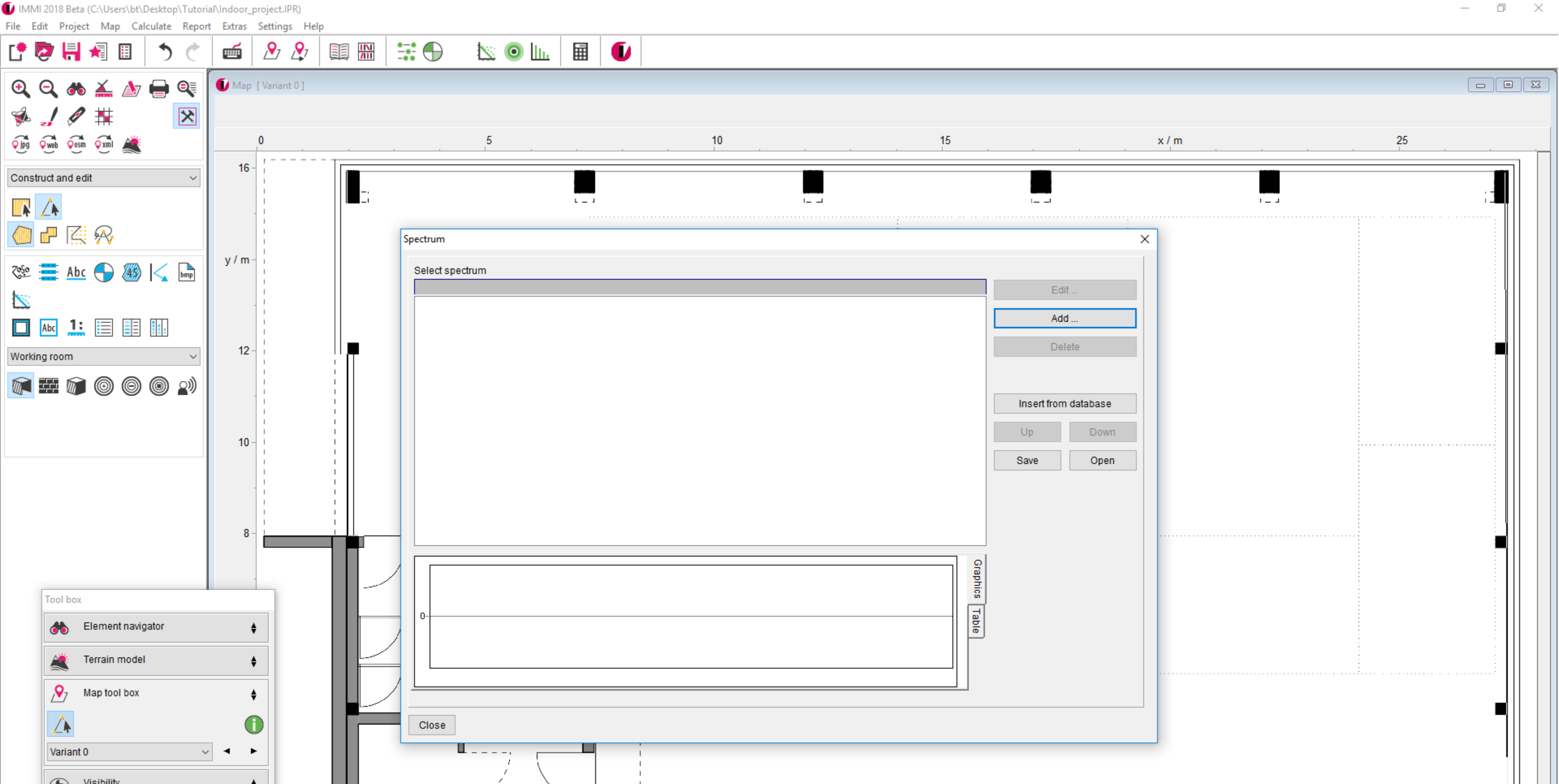
For the room utilization, select "Talking/speech incl. lesson (A3)" from the dropdown menu.



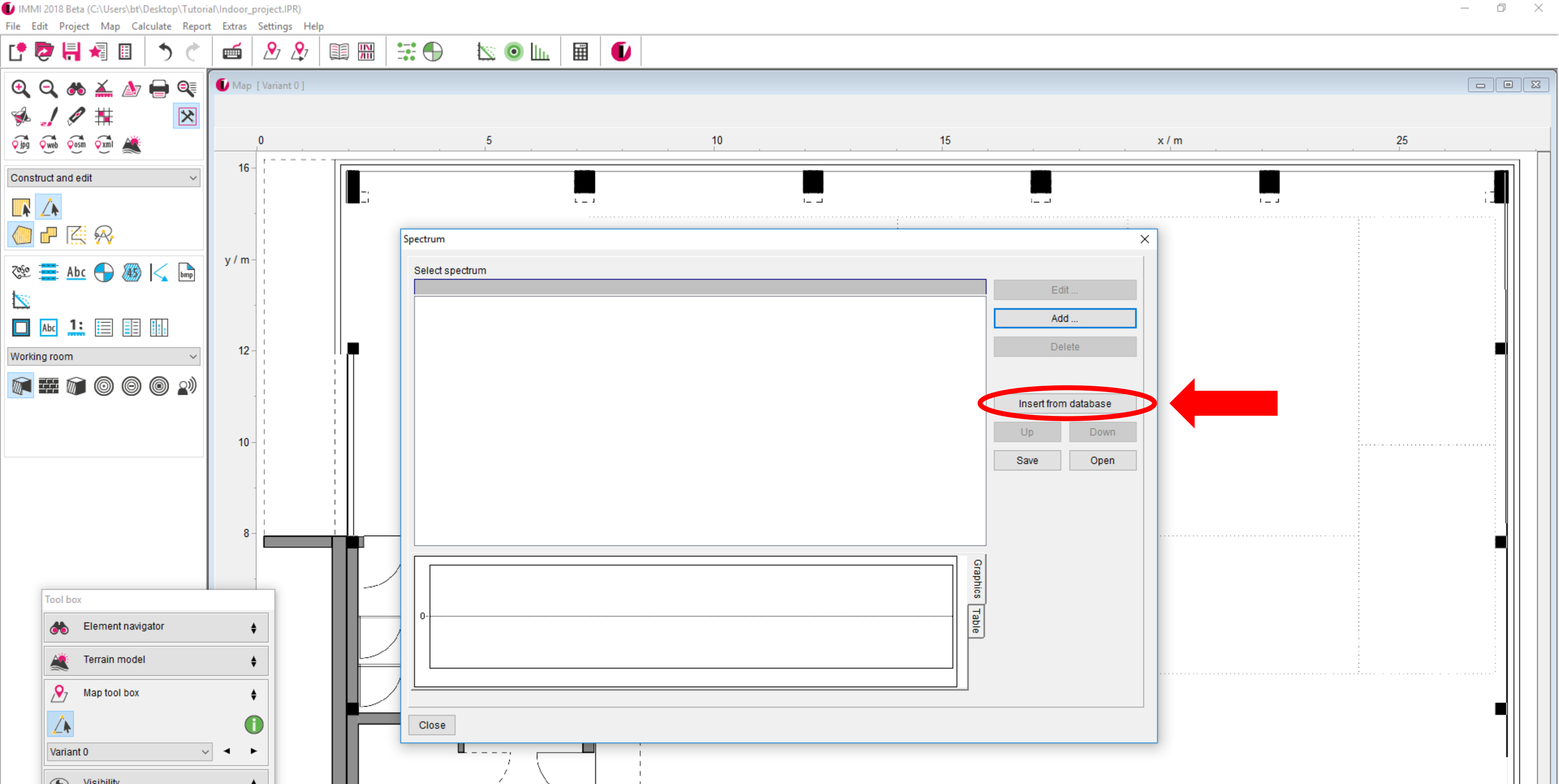
The next step is to load some materials with their absorption properties to the project by clicking the icon on the right.



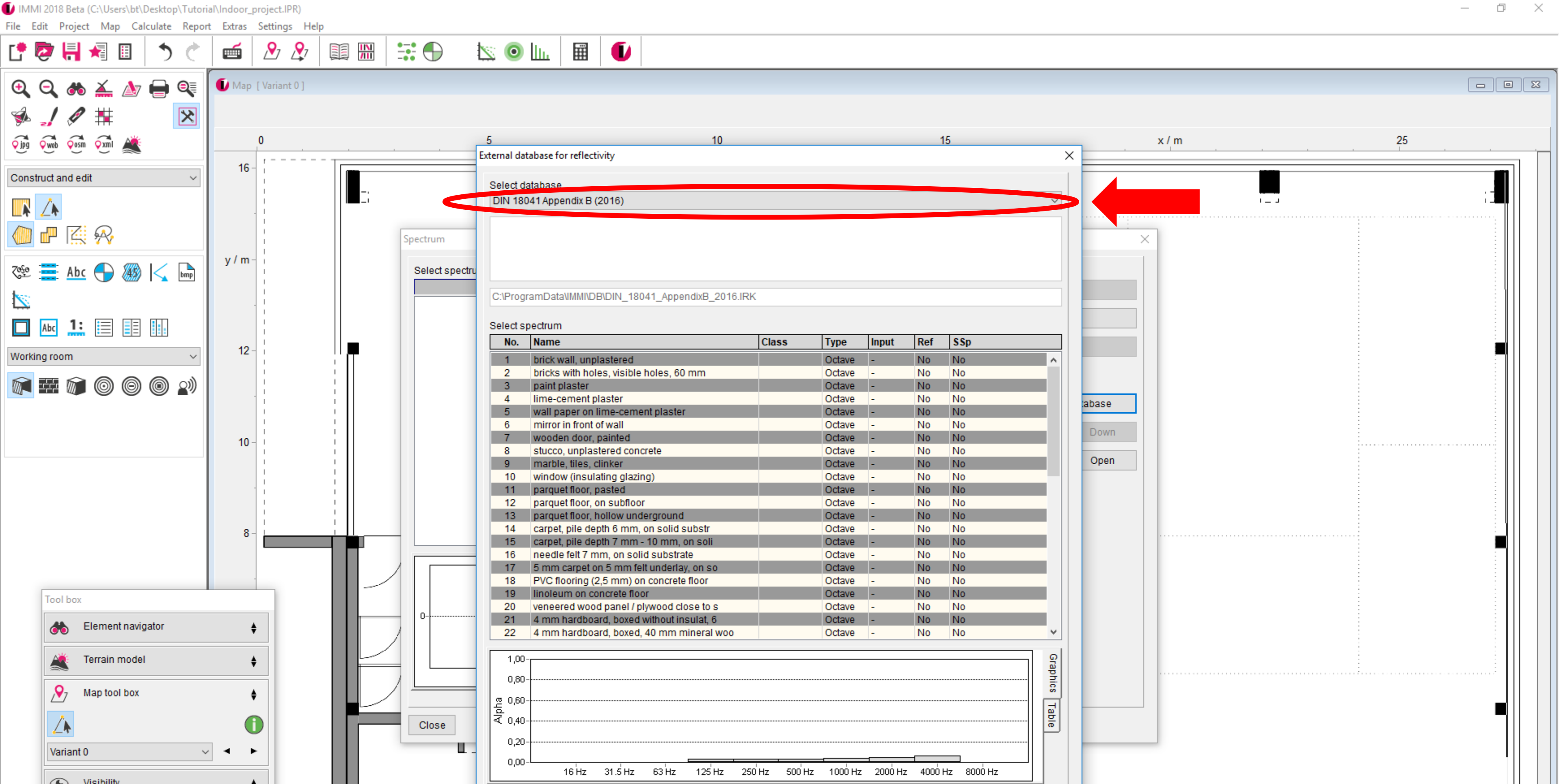
The dialogue box will open with the available materials, which is empty at this point. You can add your own materials...



.. or insert them from a database. In general, we recommend using the manufacturer's absorption values if available.

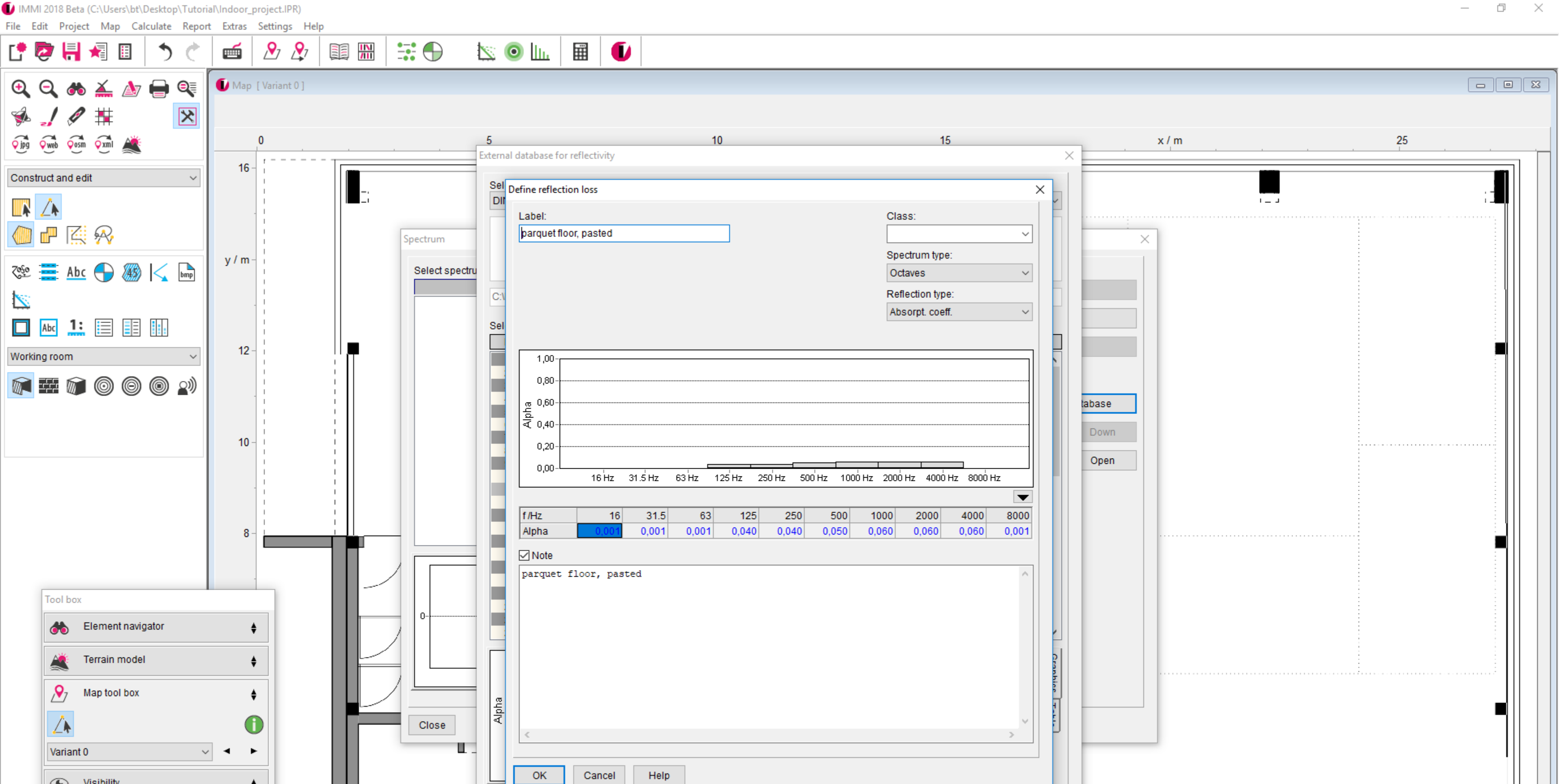


If the data is not available, one can use the predefined materials from DIN 18041. Please click "insert from database".

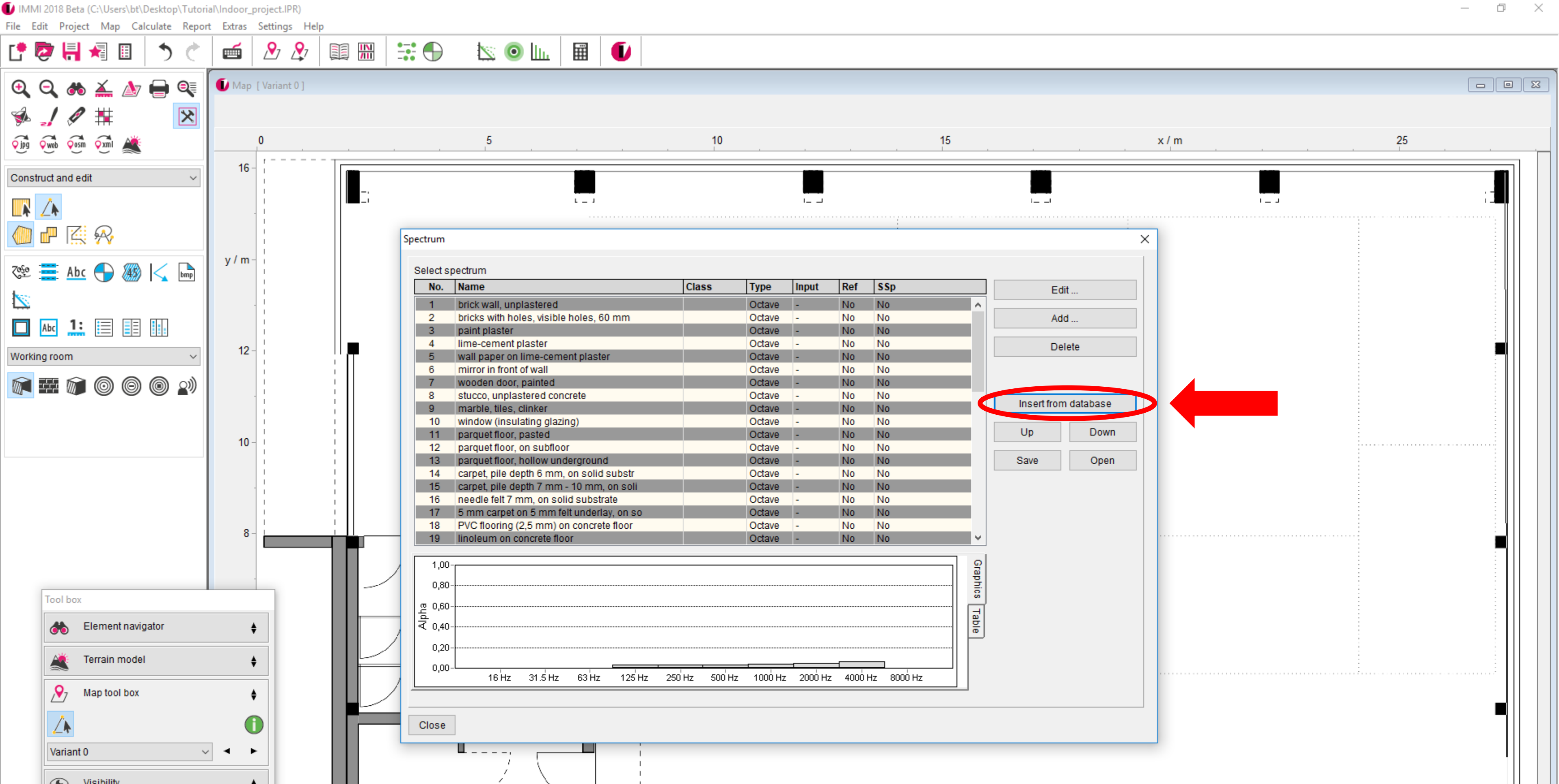


Choose the DIN 18041 Appendix B (2016) database in the upper dropdown menu.

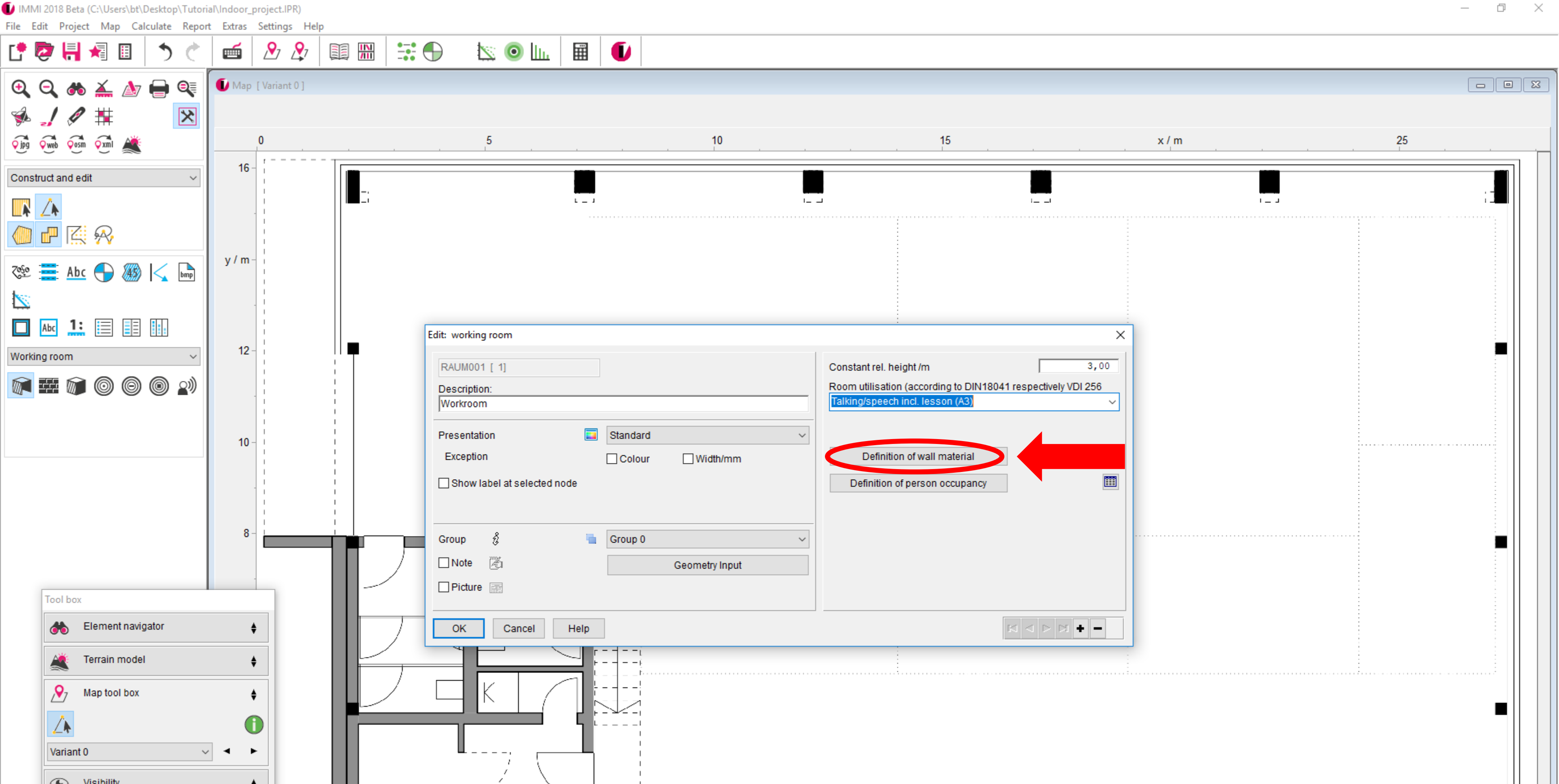




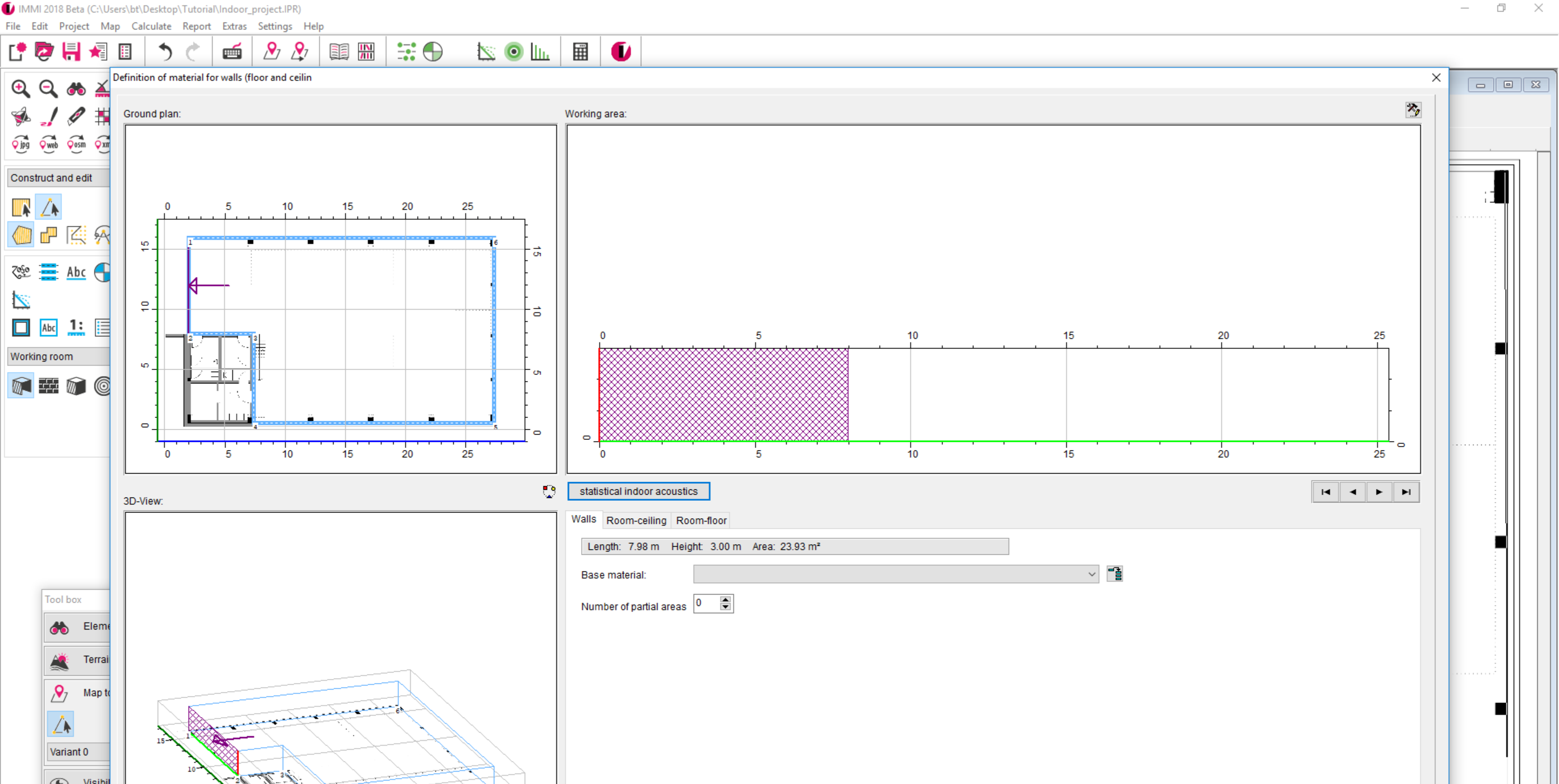
By double-clicking on the entries you can view the absorption spectra.



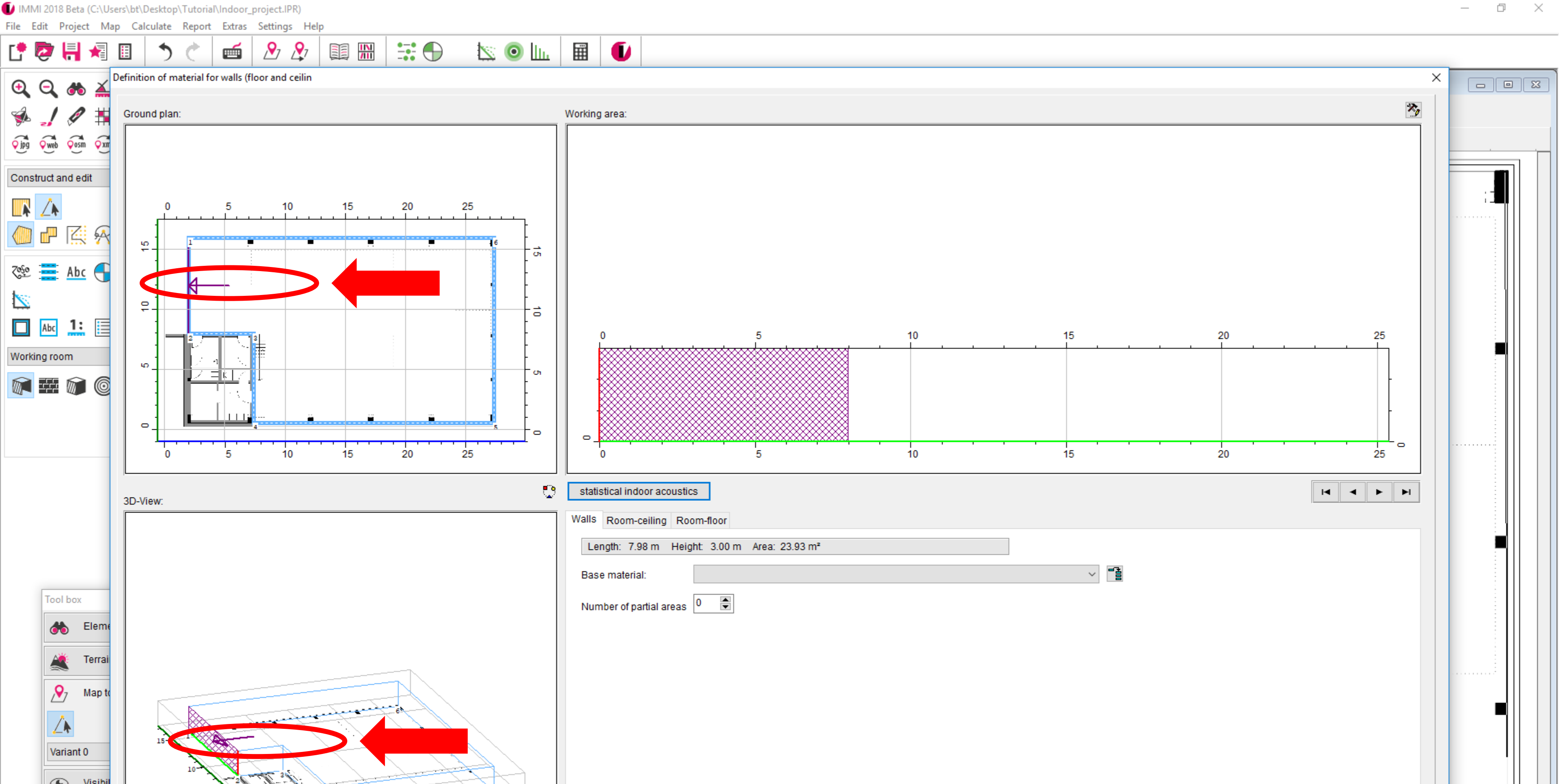
Please highlight all entries by selecting the first one, pressing the "shift" key and selecting the last one. Then press "Insert from database".



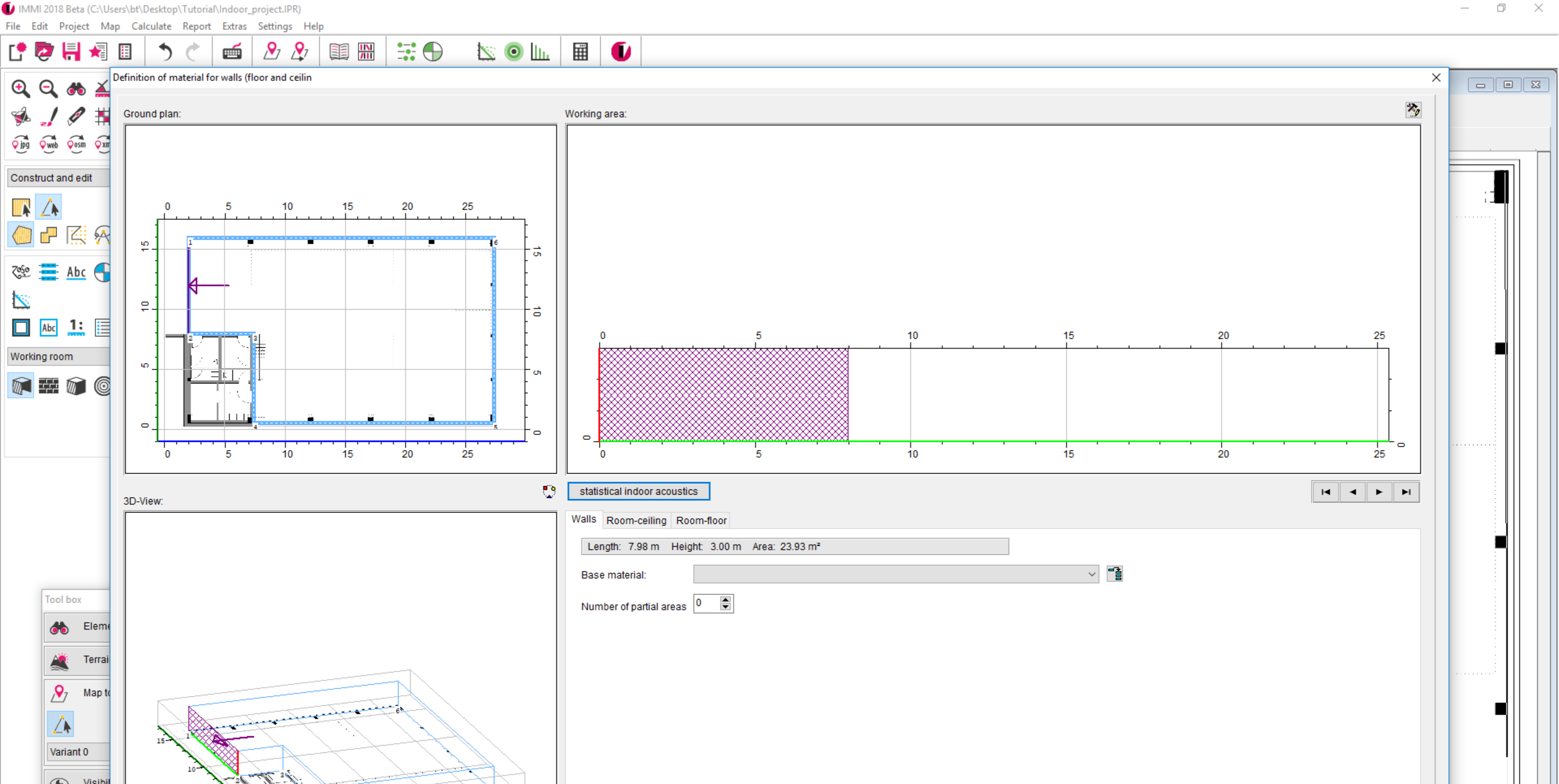
Now all materials from DIN 18041 are available and we can start to define the walls, ceiling and floor. Click the respective icon.



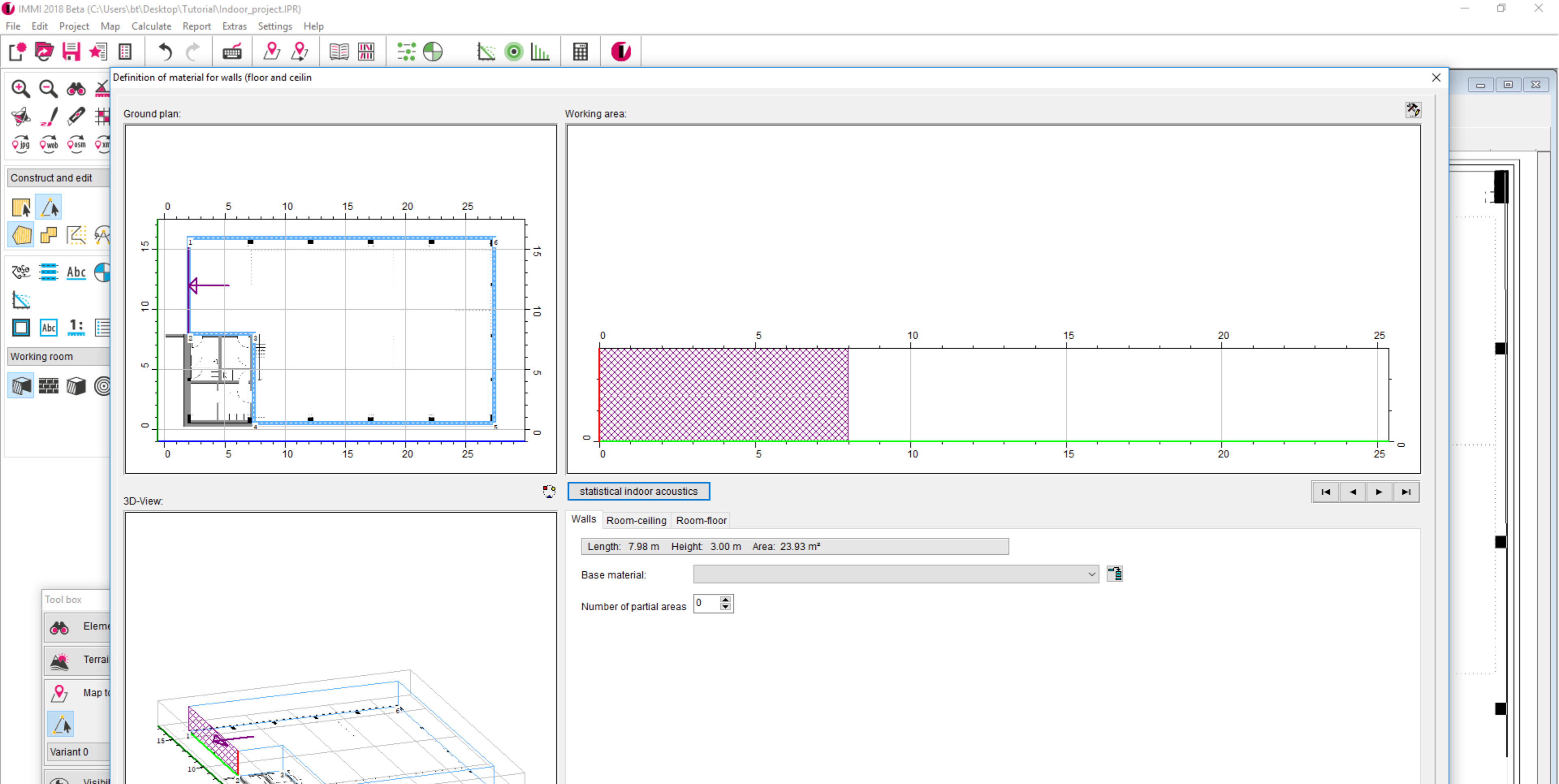
This dialogue gives an overview of the room. We have the ground plan in the upper left and a 3D view in the lower left corner.



An arrow indicates which wall is active.

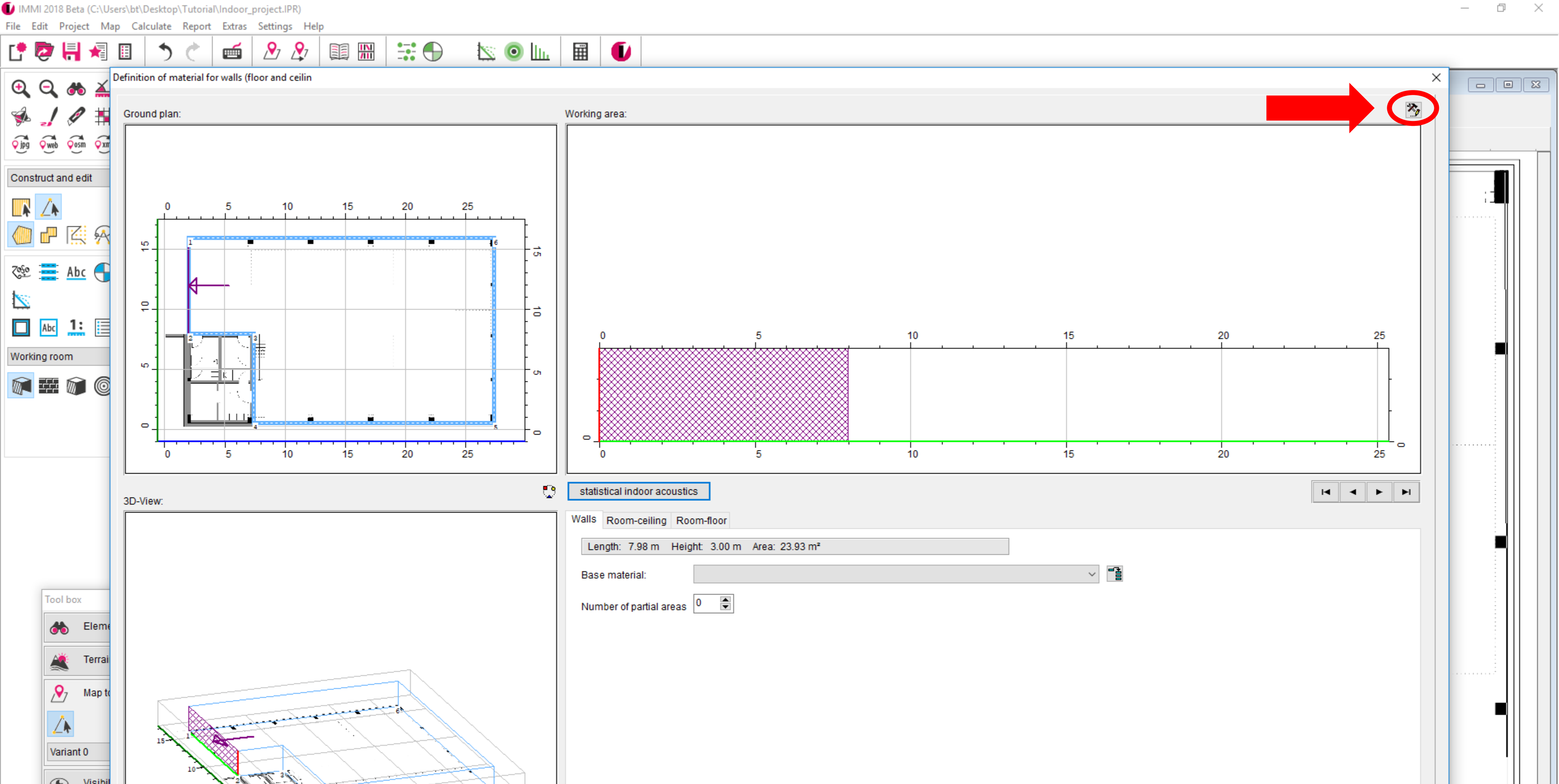


An additional view of the active wall and the chosen materials are displayed on the right side.

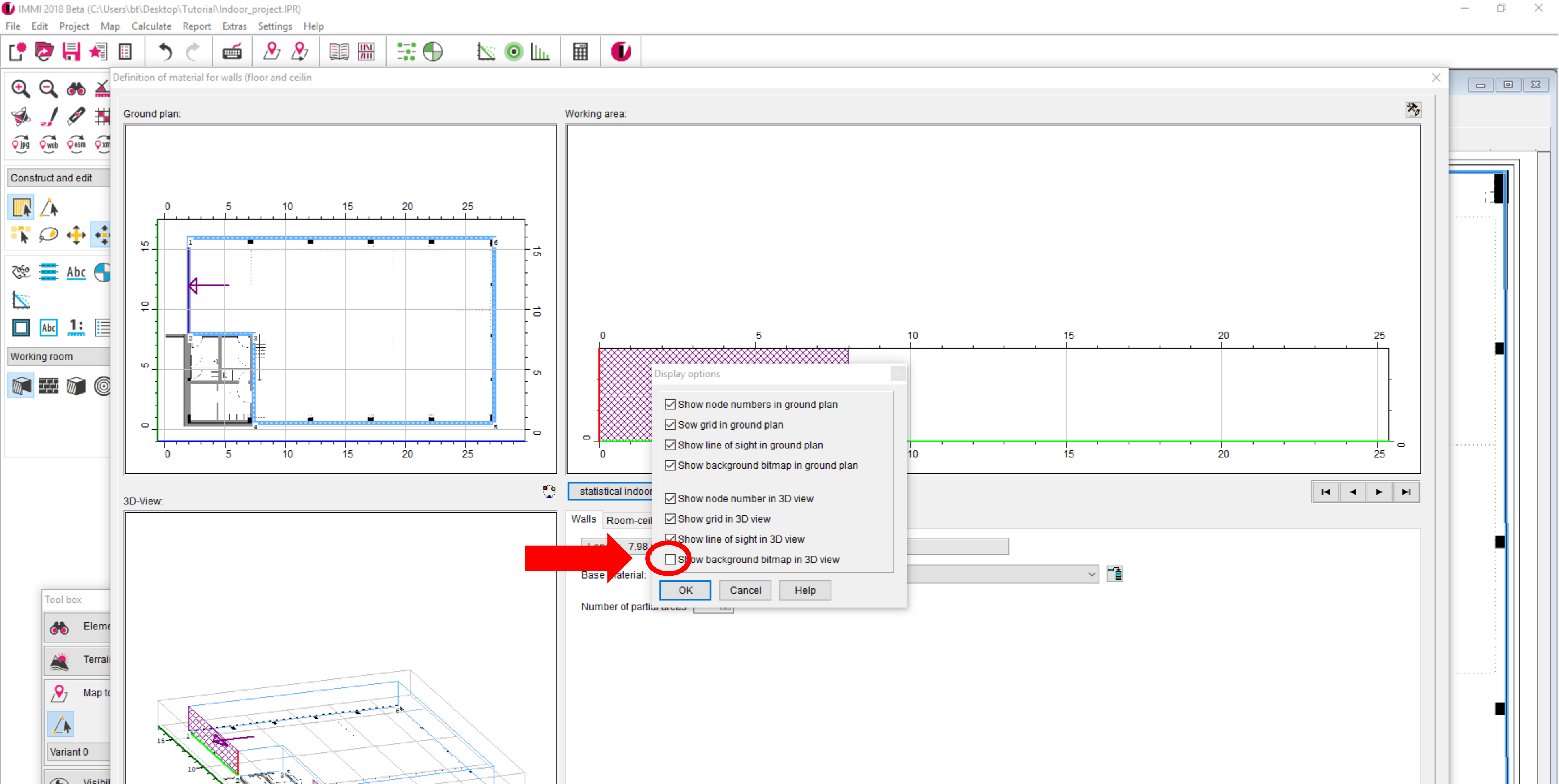


In order to accelerate the software, it might be useful to deactivate the display of the background image in the 3D view.

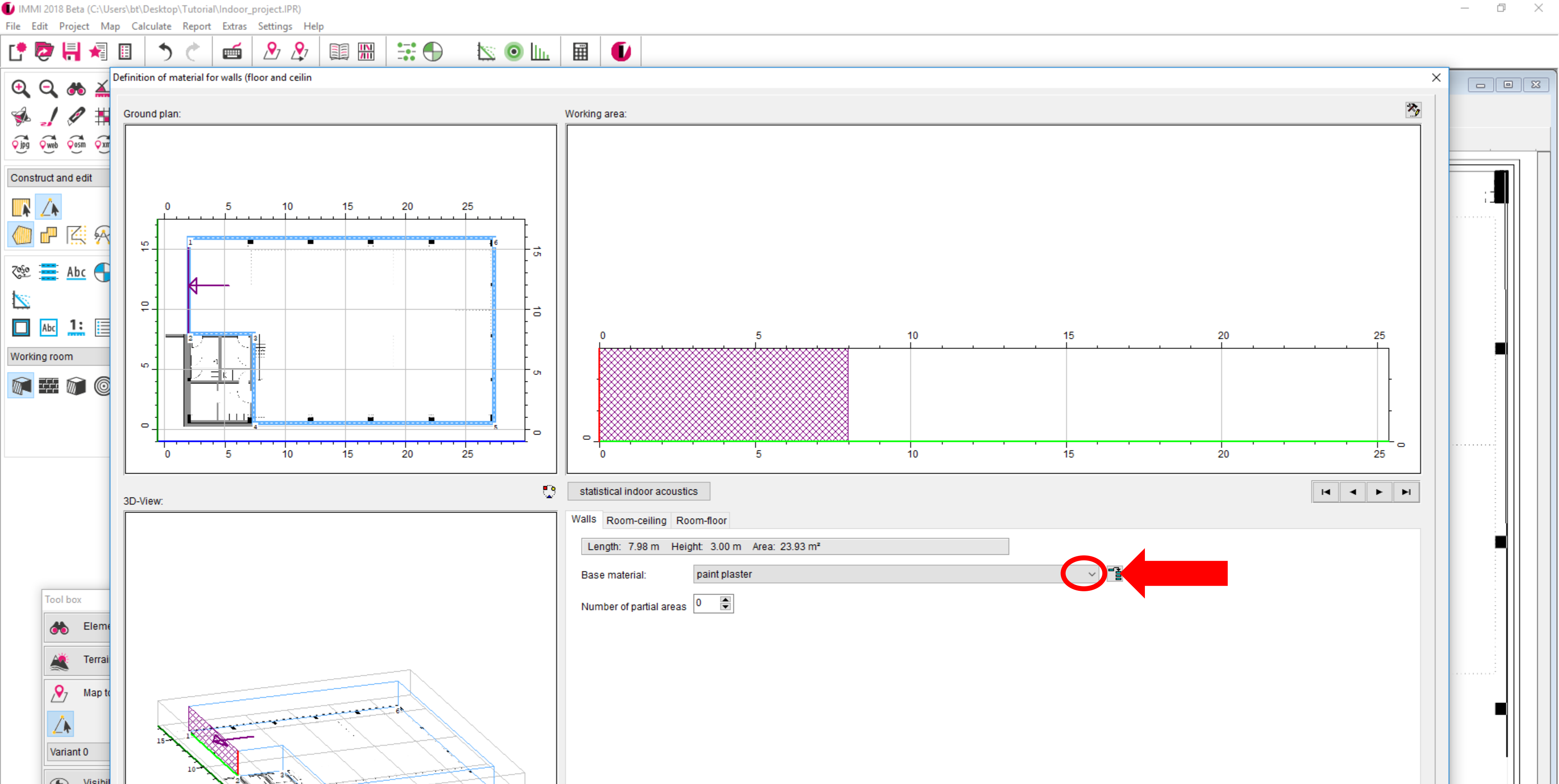




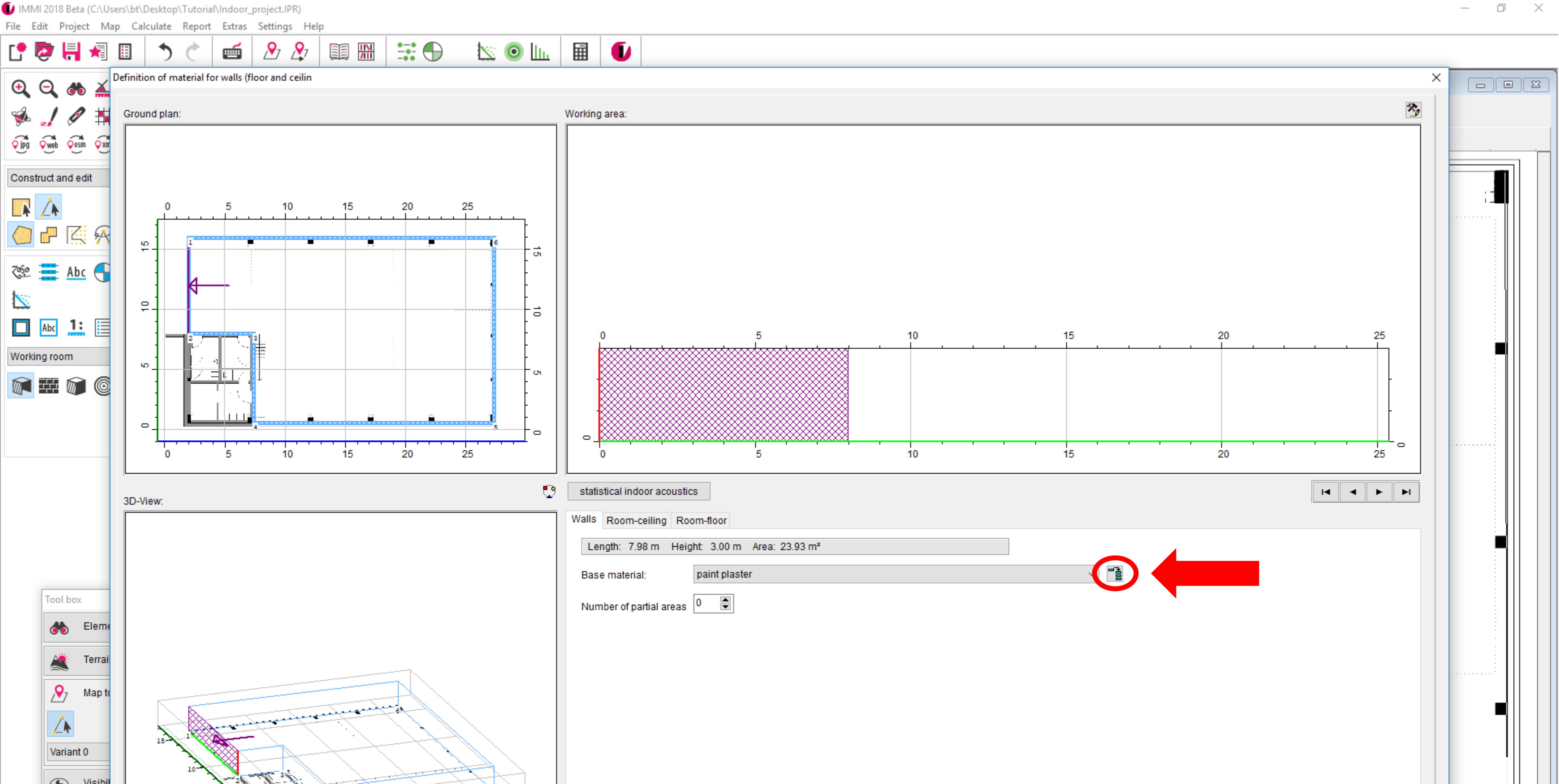
Click the icon in the upper right corner to access the display options.



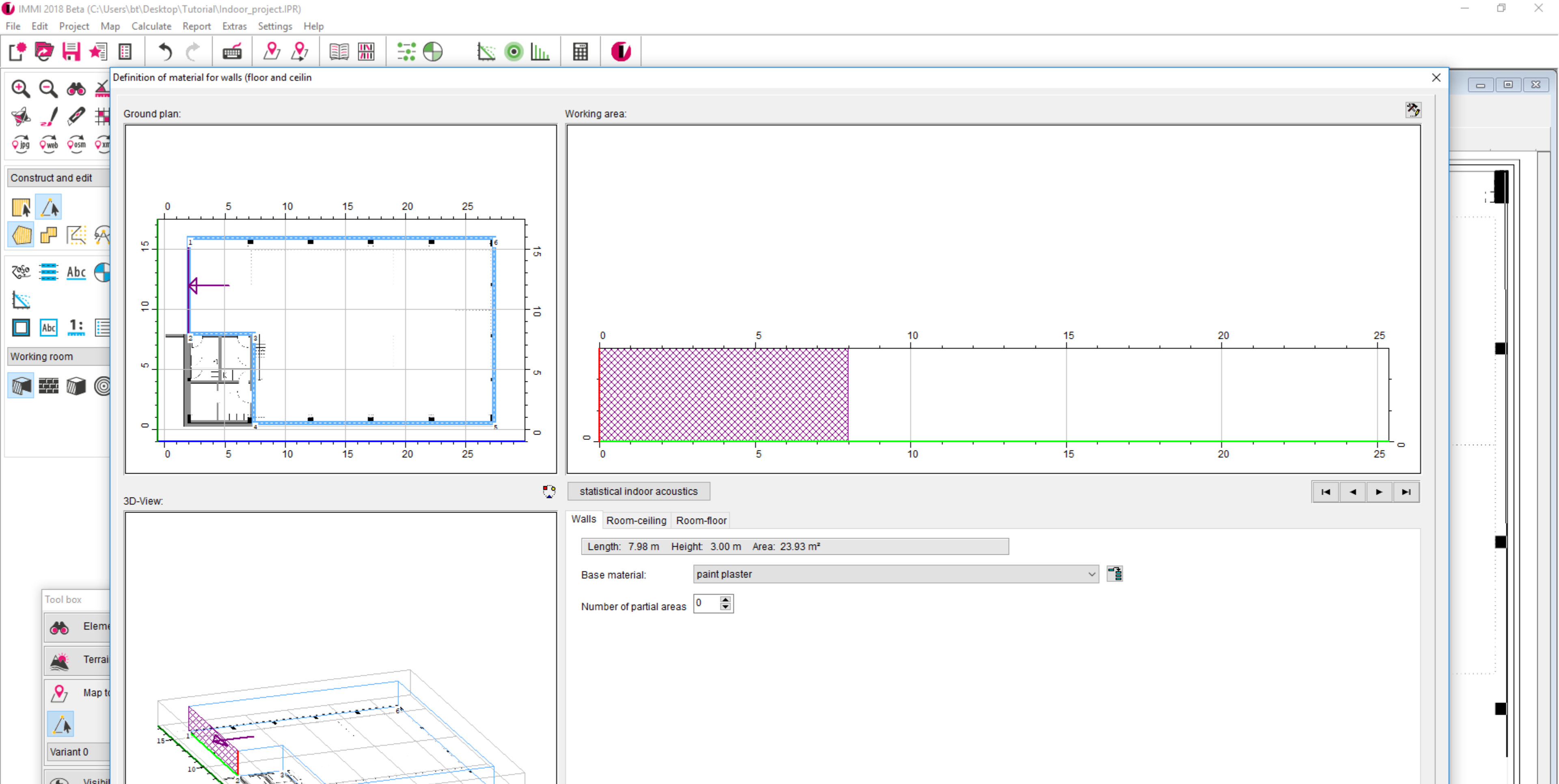
Deactivate "Show background bitmap in 3D view".



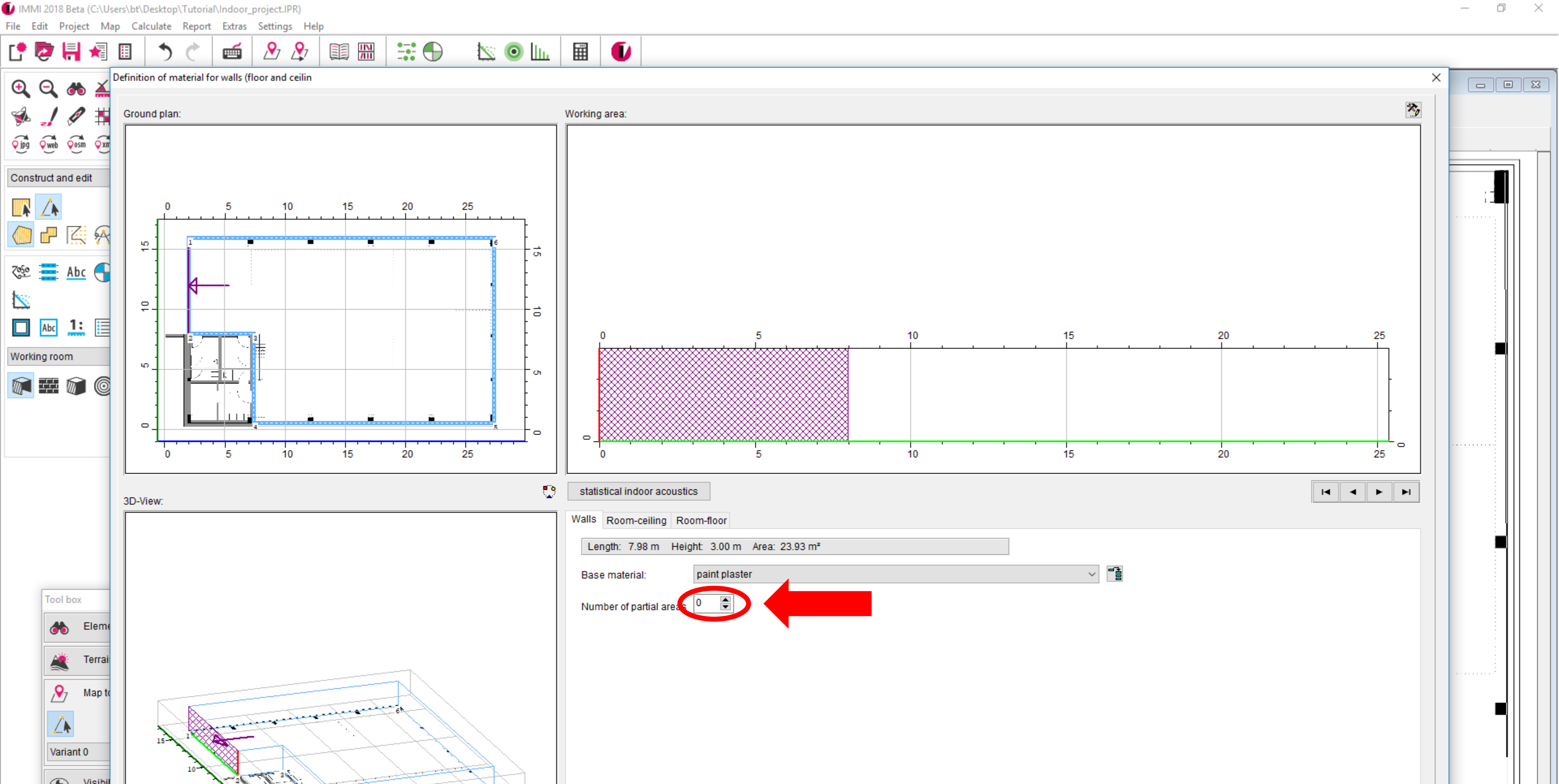
Now choose the wall material for the active wall. Please open the drop down menu and select "paint plaster".



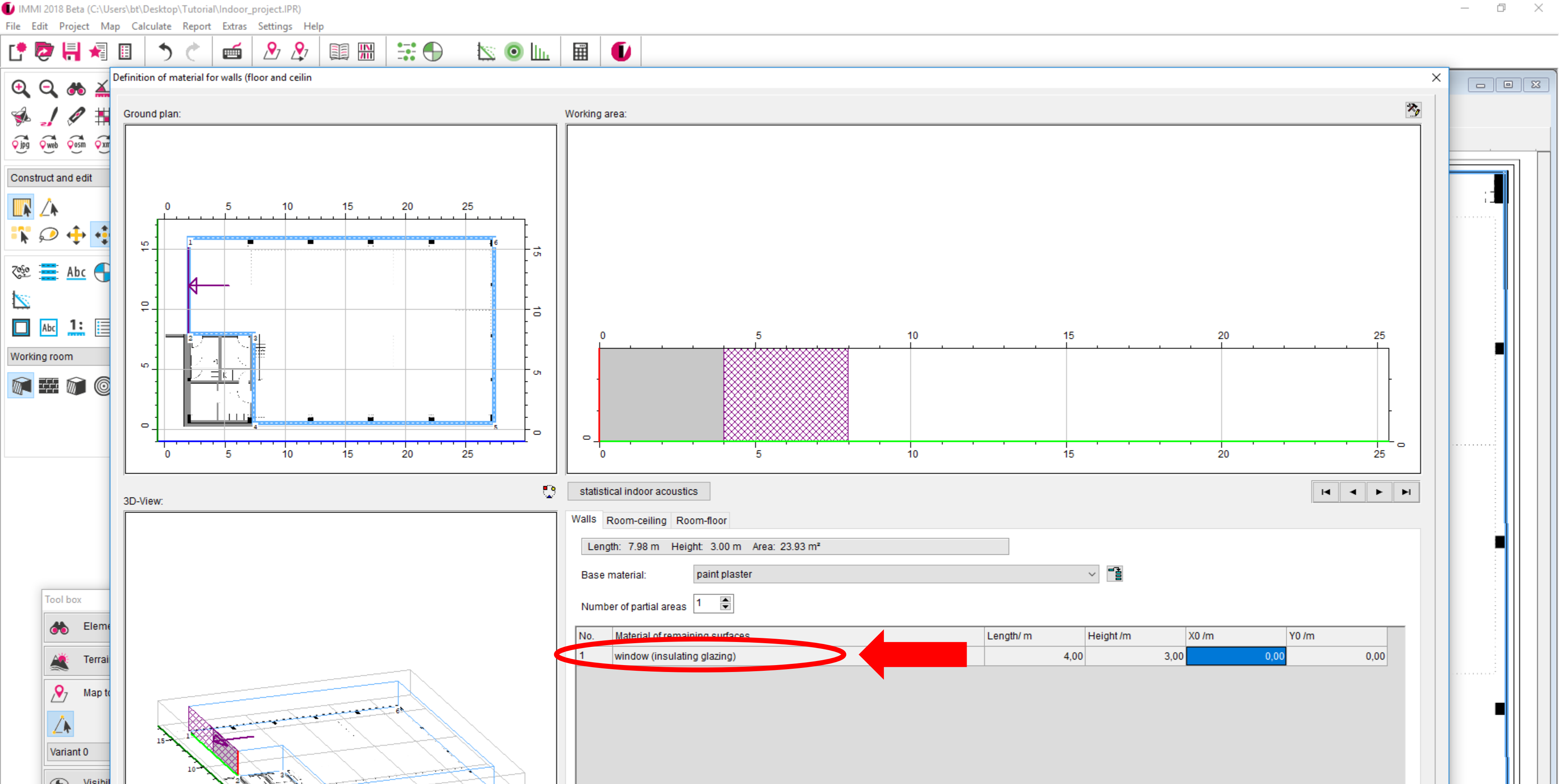
In order to assign this material to all other walls, click the icon next to the menu.



The next step is to assign partial areas such as windows, doors or room acoustic measures. We will create a window on this wall.

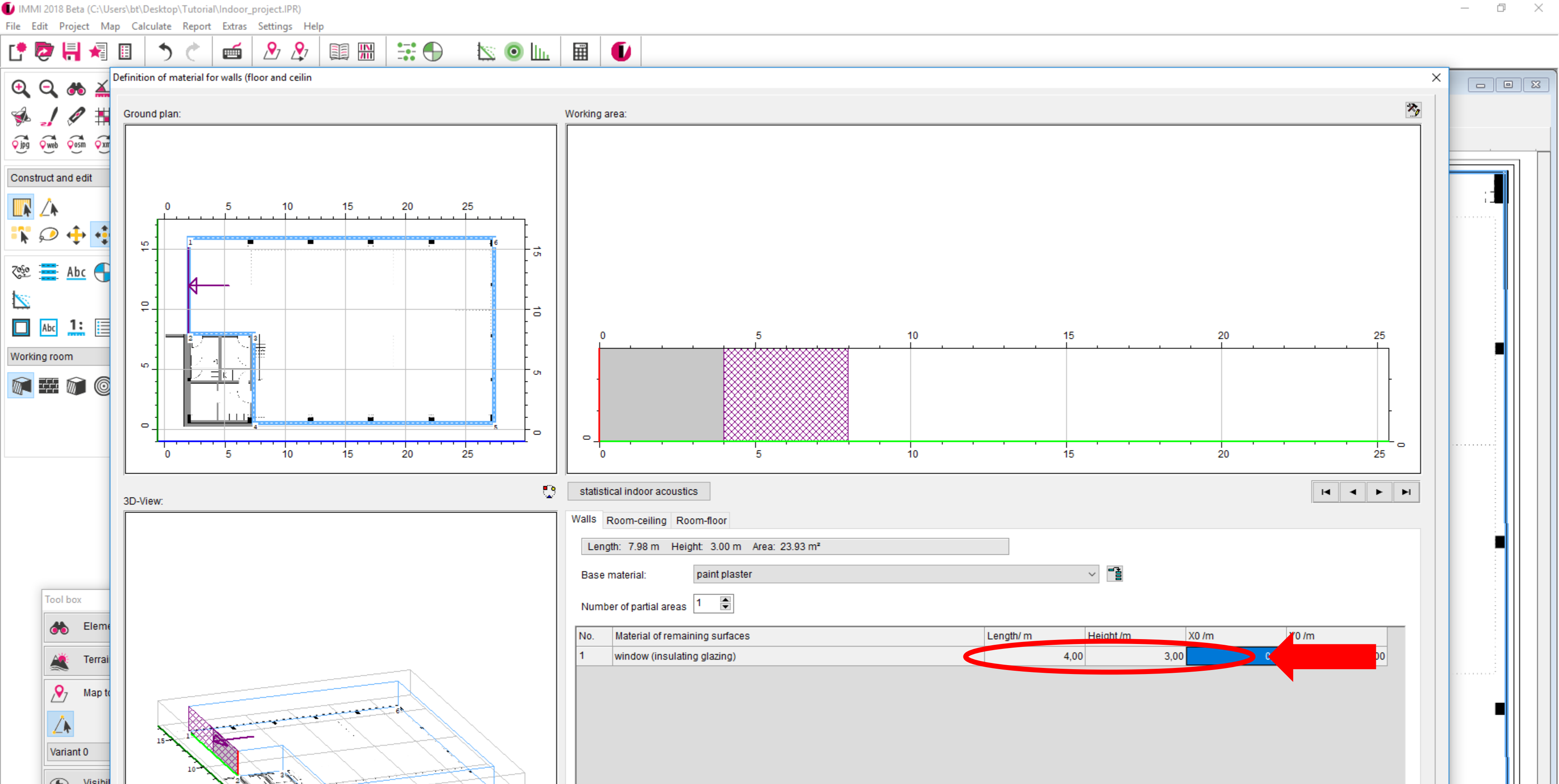


Therefore, set the number of partial areas to "1" and choose the material window from the drop down menu.

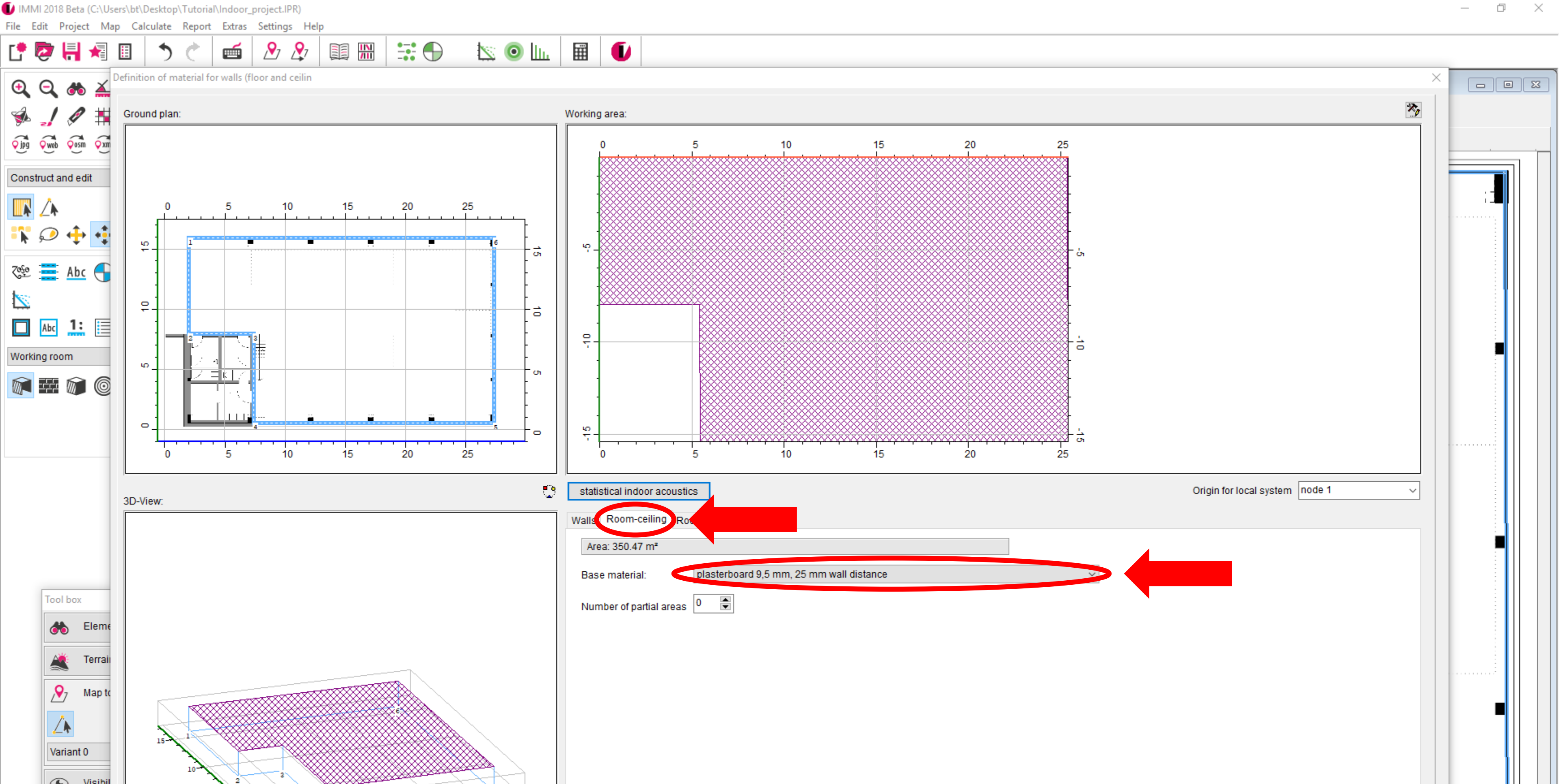


Set the number of partial areas to "1" and choose the material window in the drop down menu.

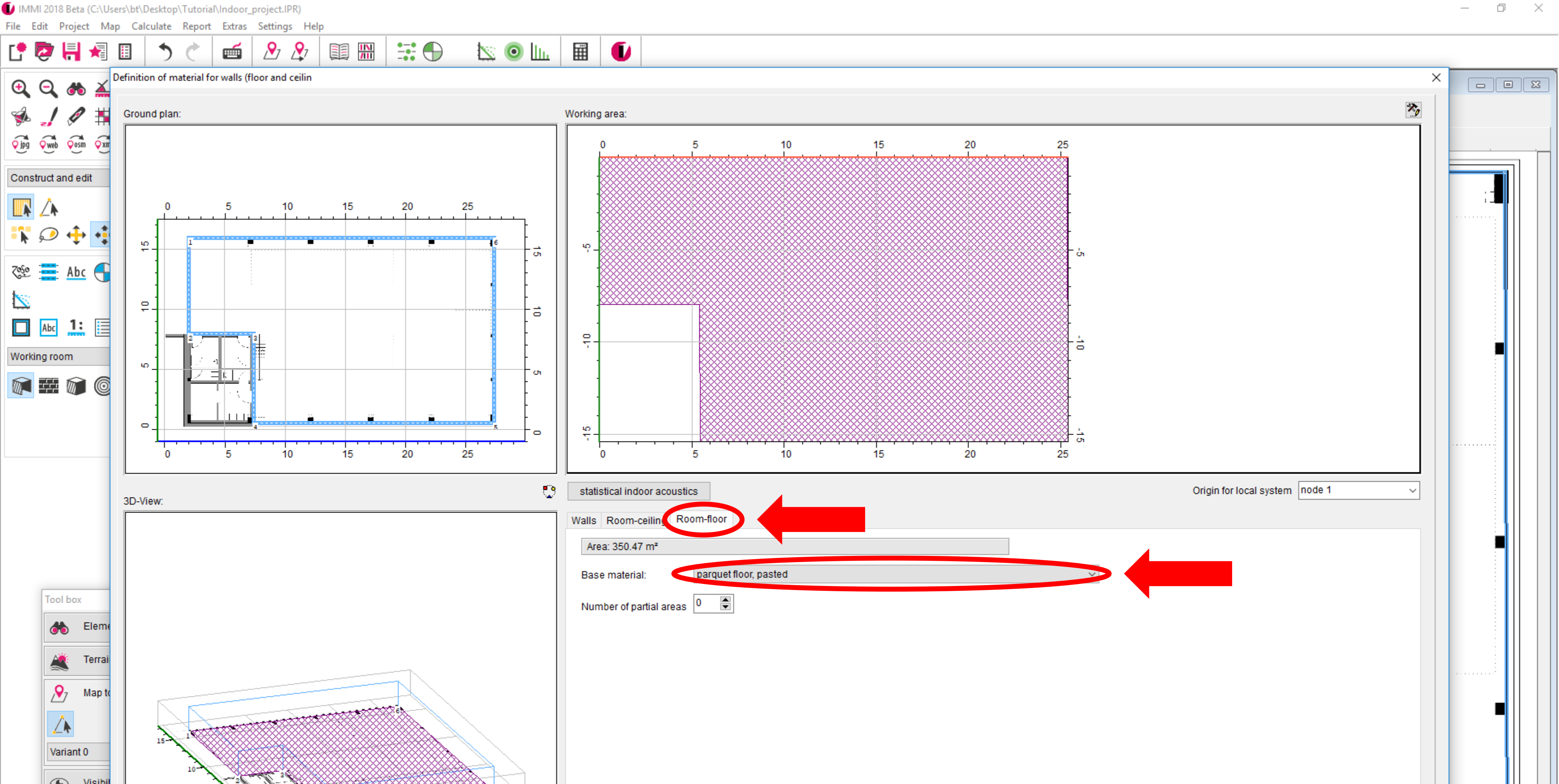




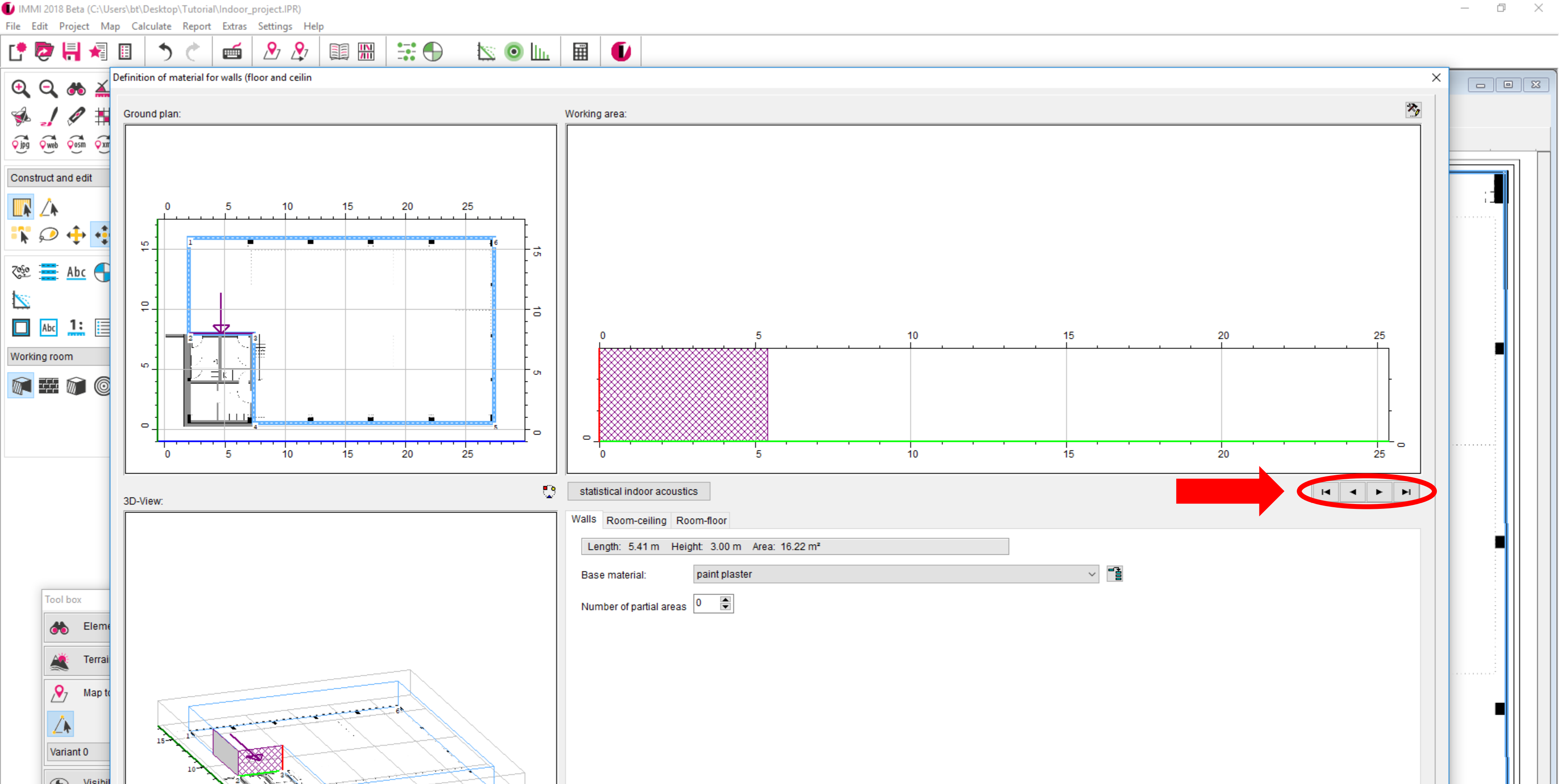
Please define the length and height of the window and set the x and y value if necessary. In this case we have a window of 4 by 3 m.



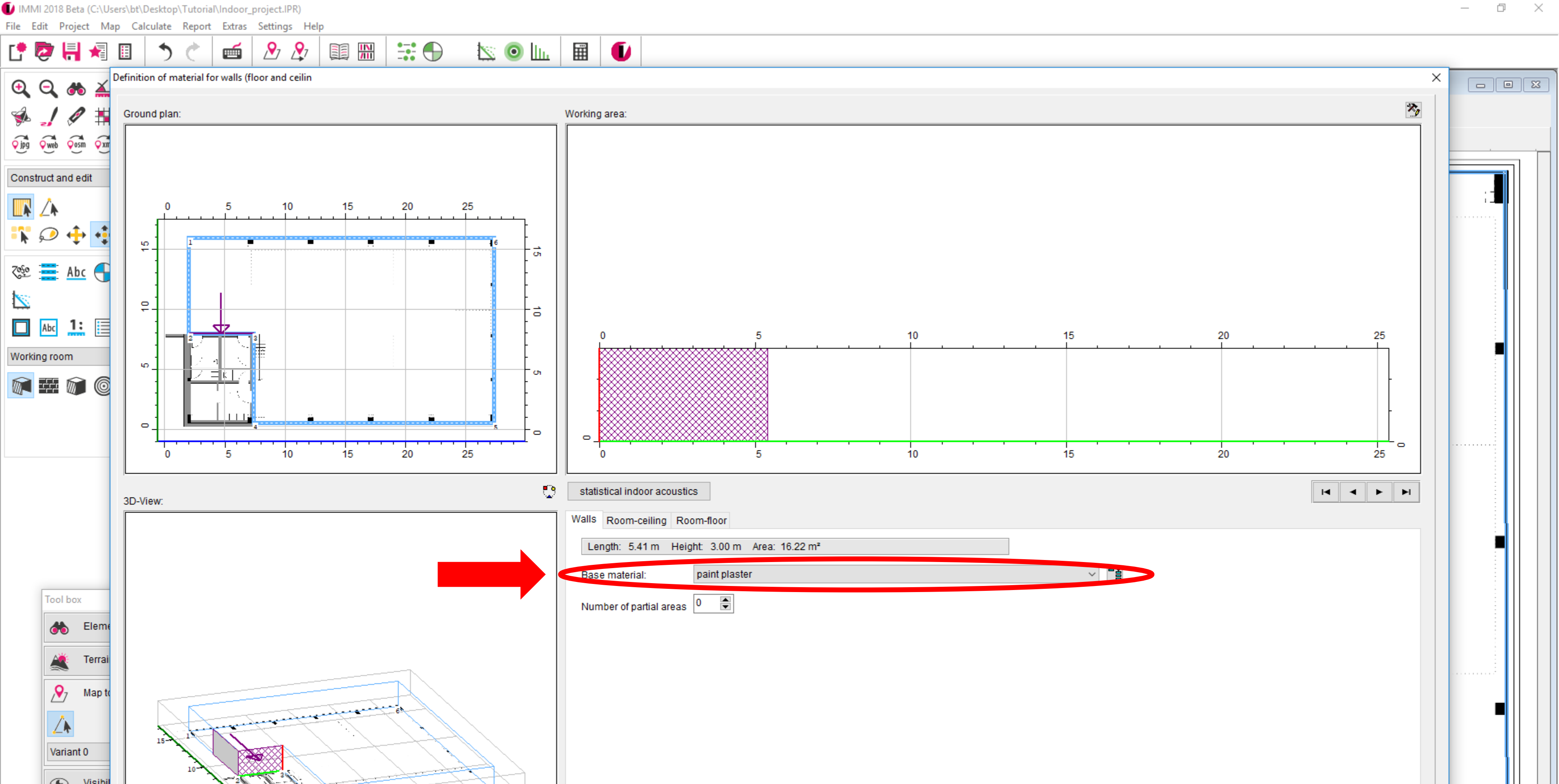
Now we will define the material of the room ceiling. Change to the respective tab and choose the material in the drop down menu.



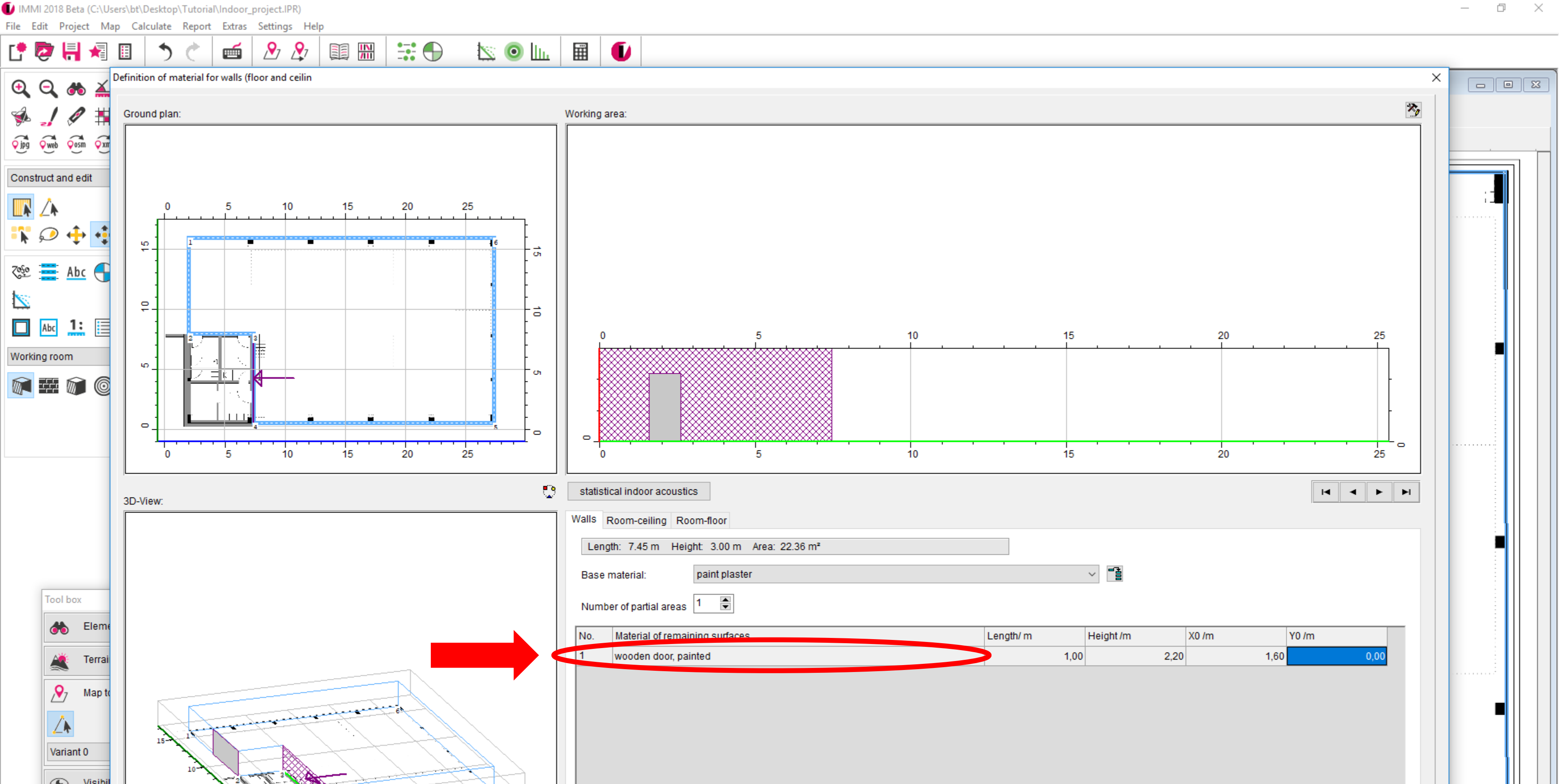
In order to define the material of the floor, proceed accordingly.



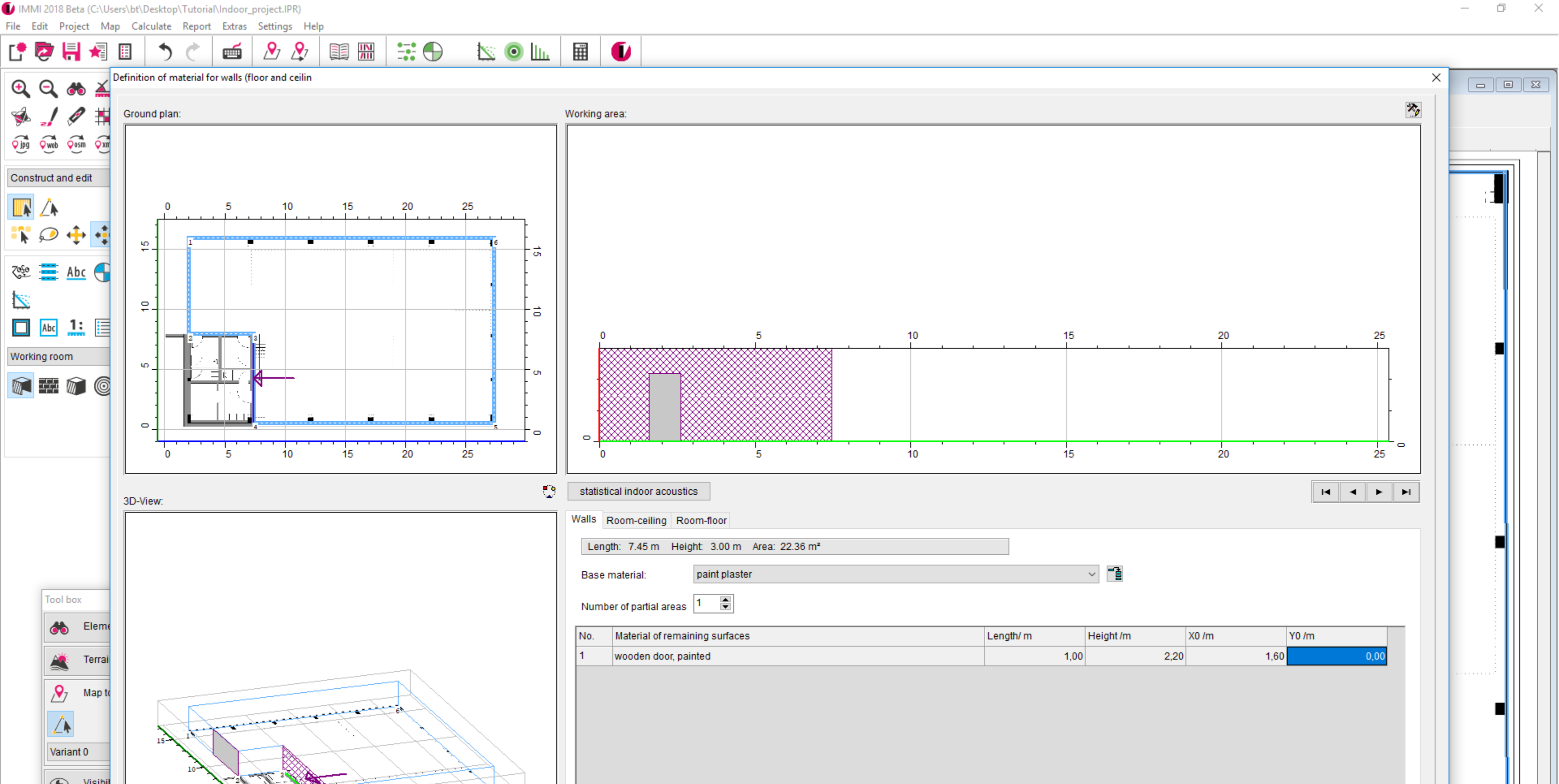
Now you can navigate through the different walls using the arrow buttons.



The base material was already defined when assigning it to all walls in the first step.

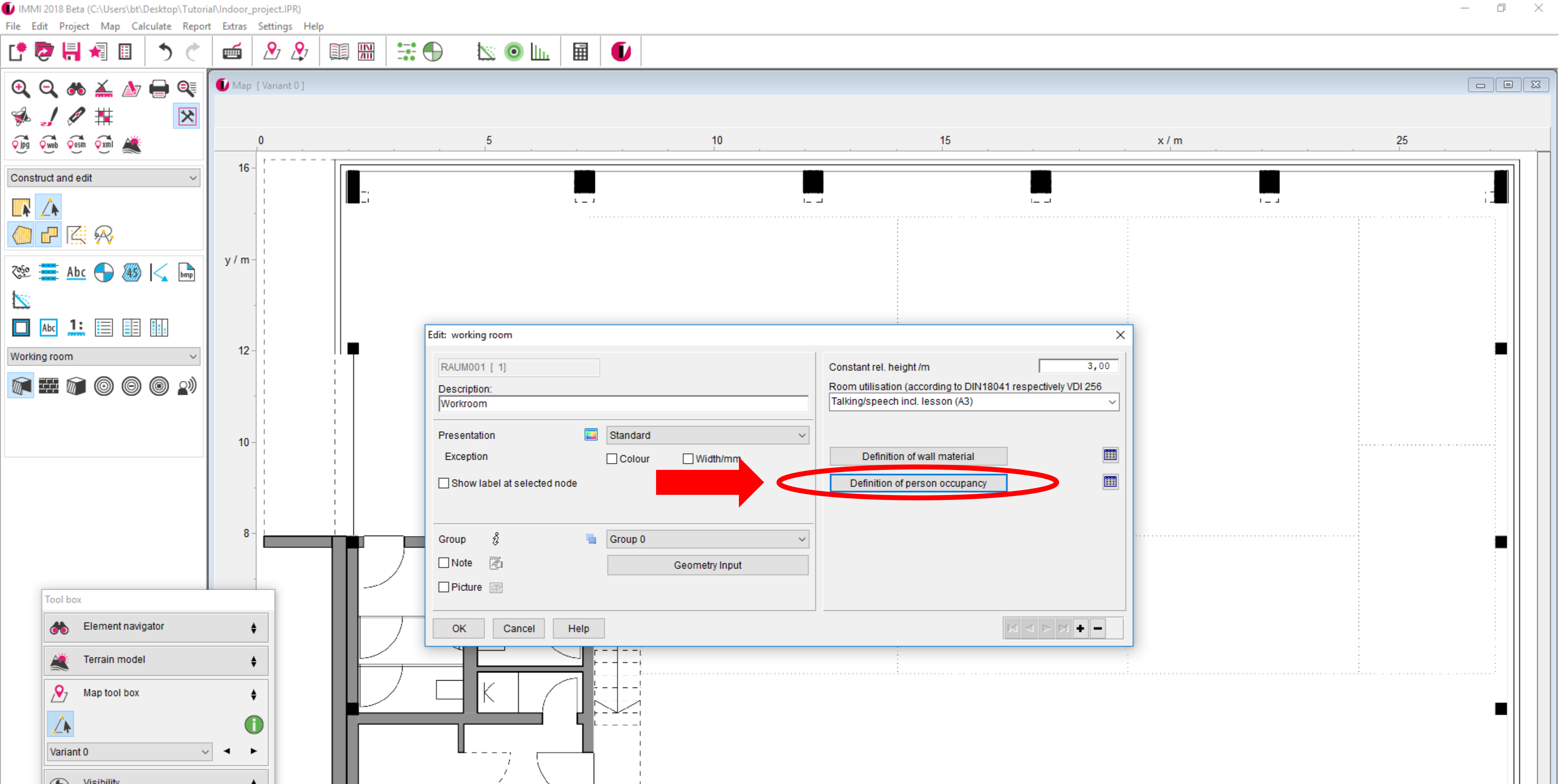


On the third wall, we define a door according to the ground plan.

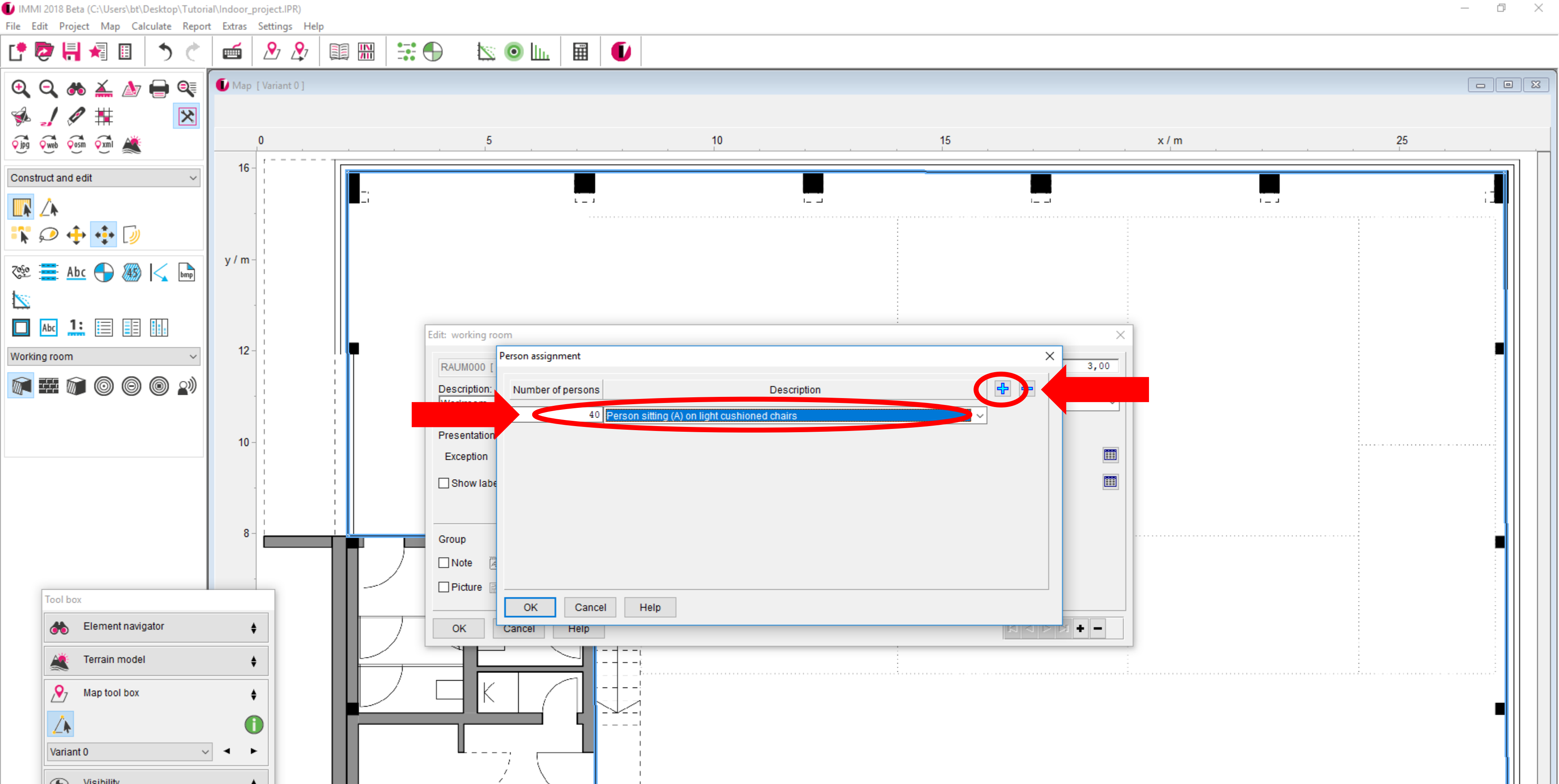


When all surfaces have been defined we can close the dialogue with the OK button in the lower left corner.

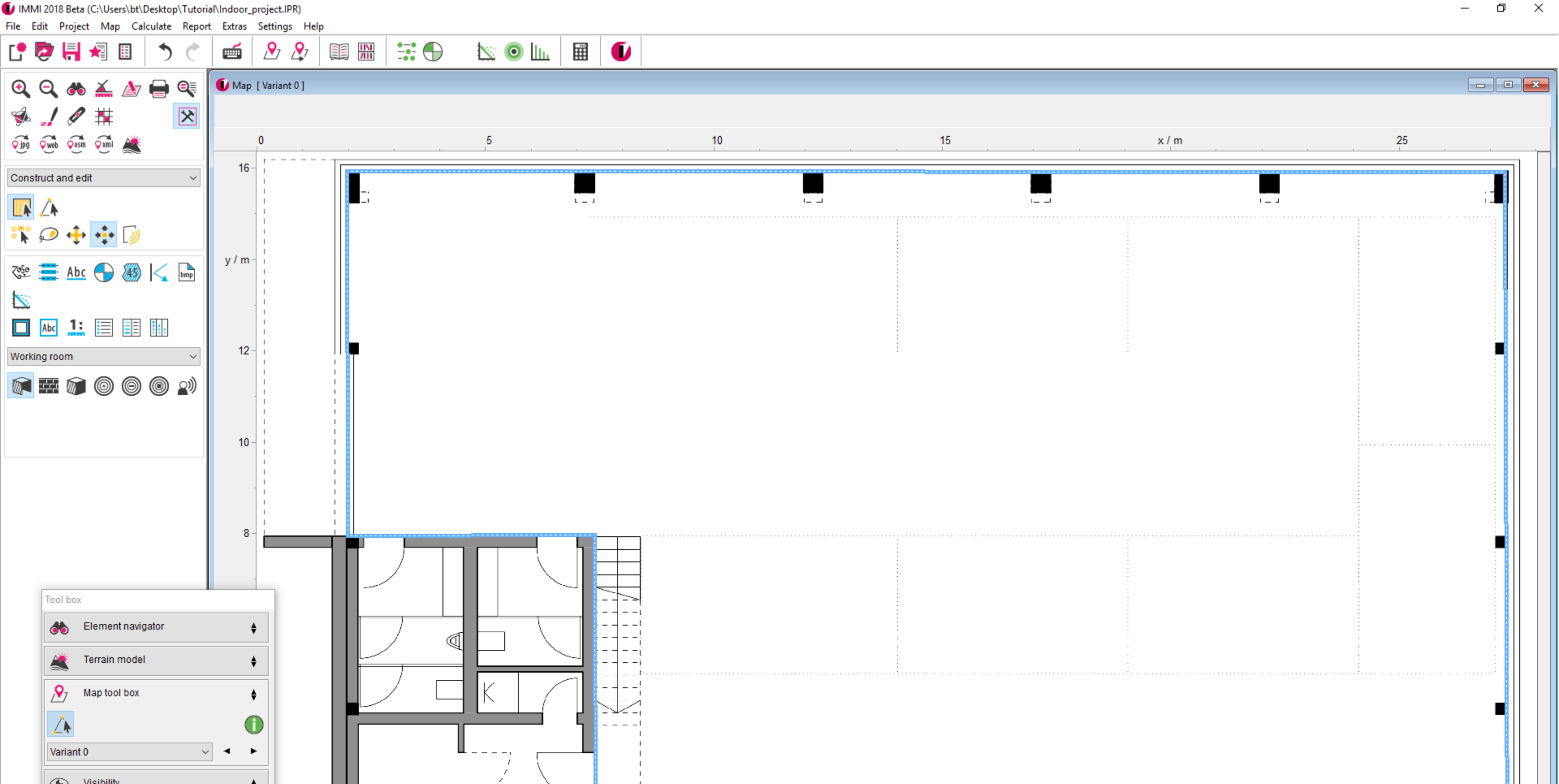




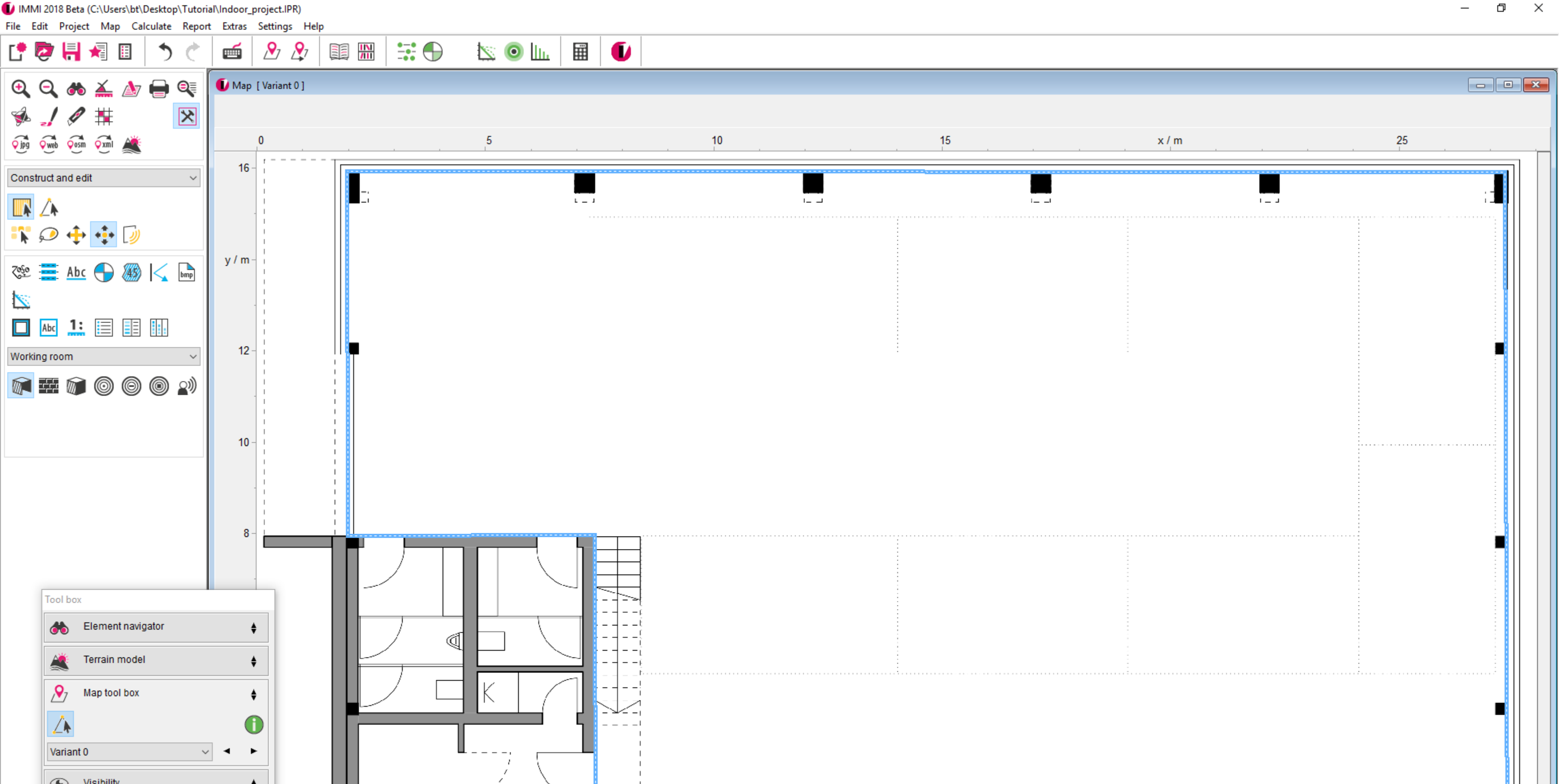
The next step is to define the average person occupancy of the room as this will also affect room acoustics.



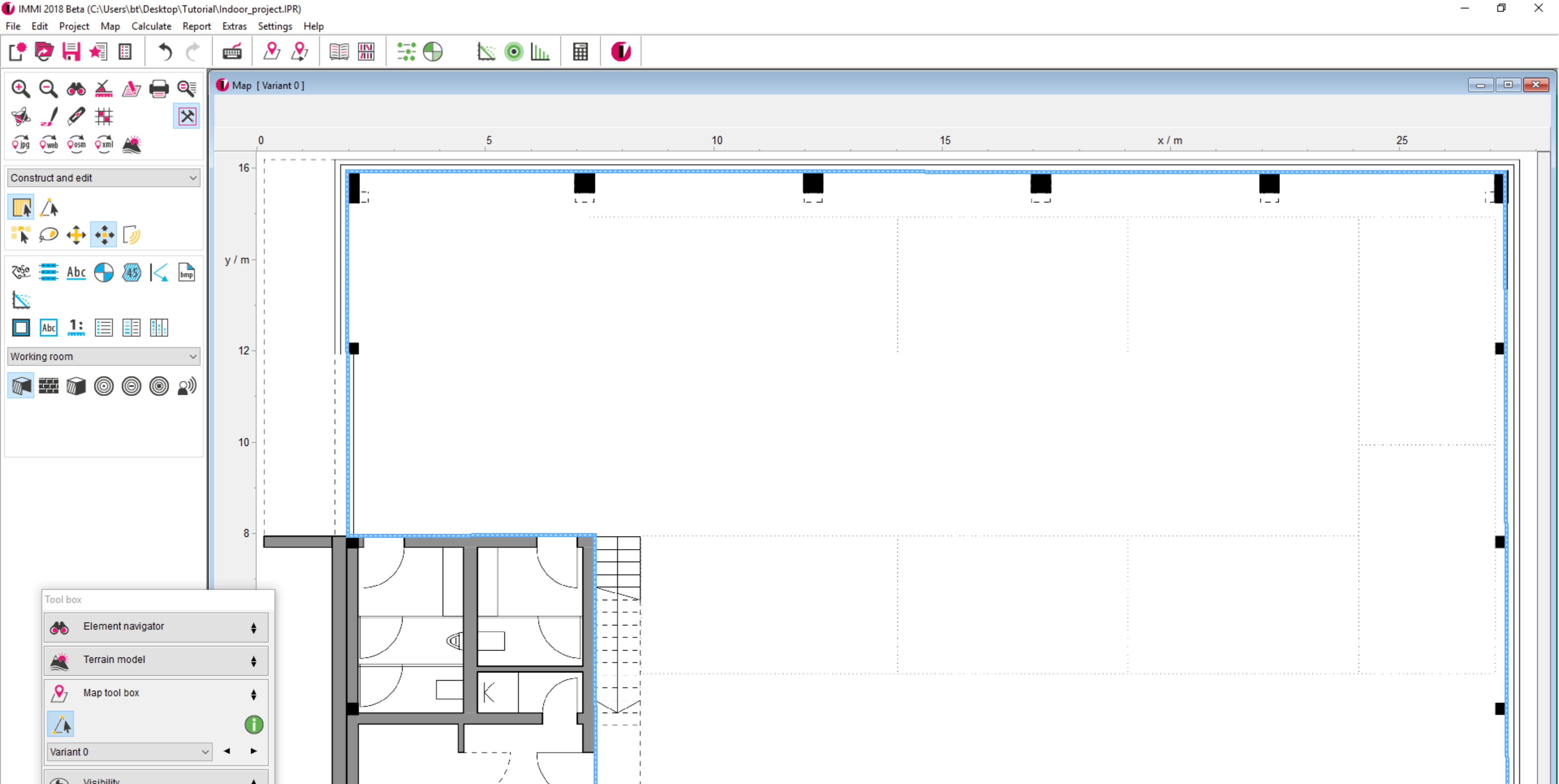
By the use of the "+" button you can create an entry. We set the number of persons to 40 and select the appropriate description.



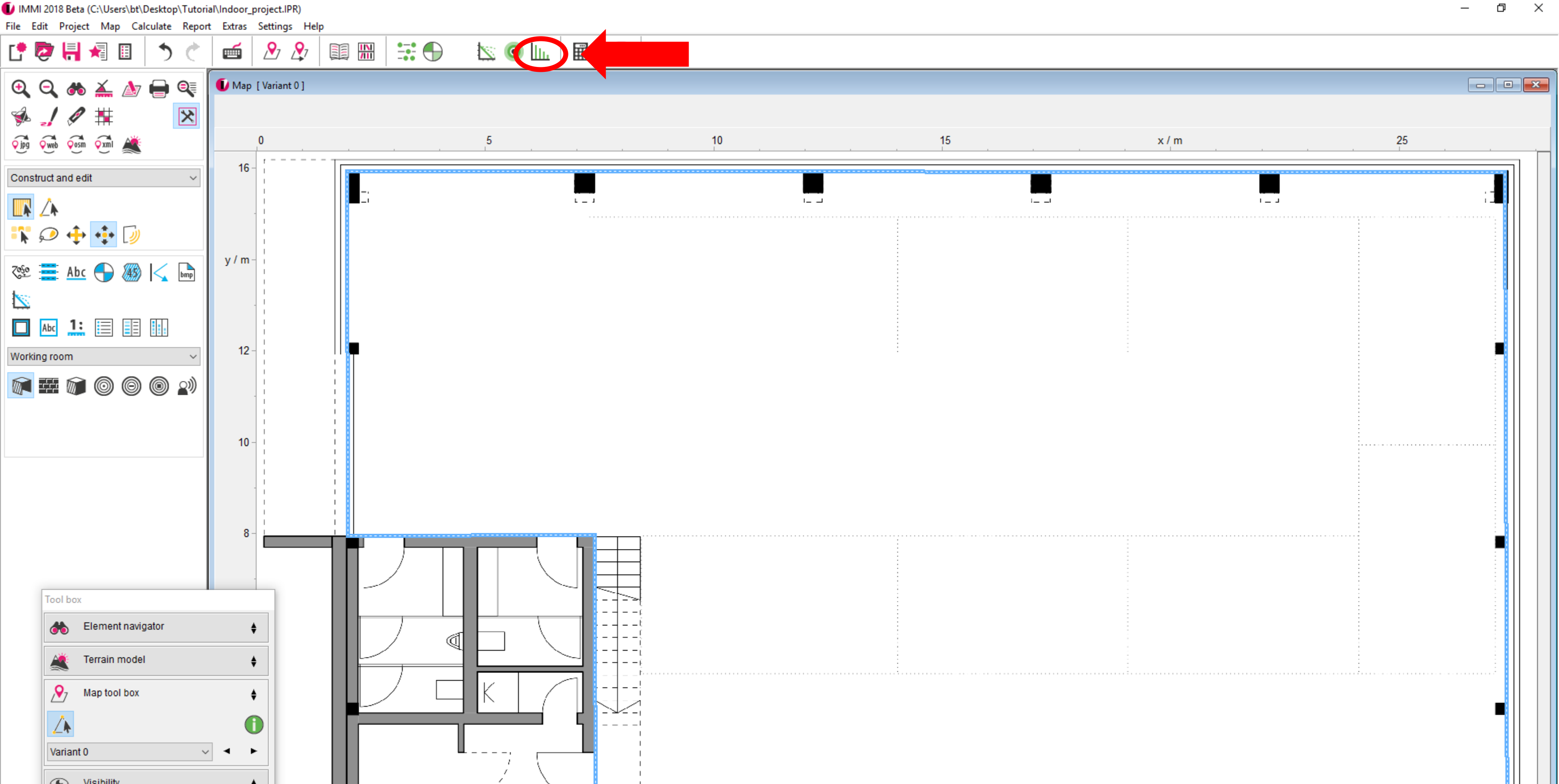
After closing the dialogues with OK, the definition of the room is complete.



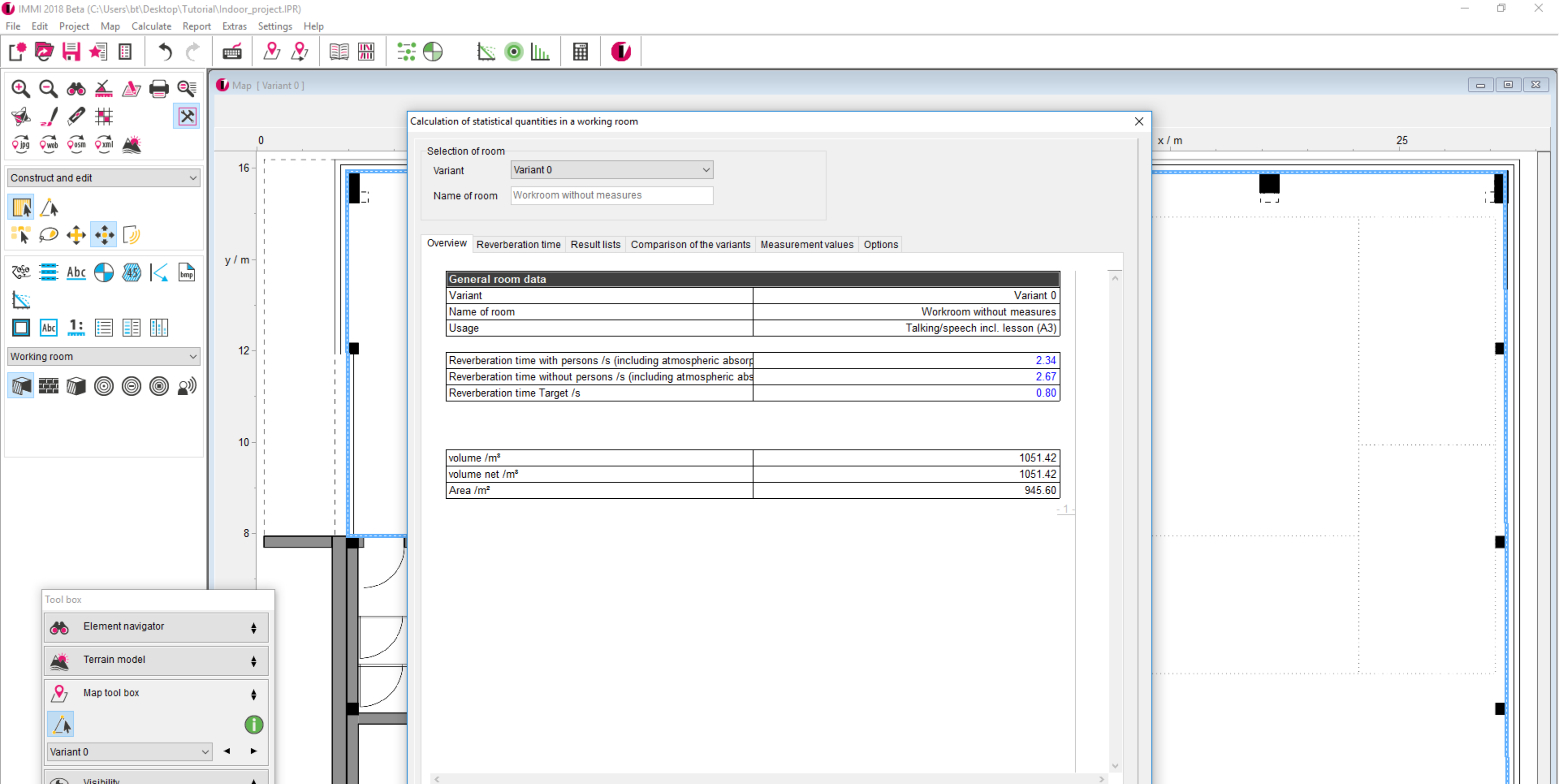
With our model we can now determine the room acoustic properties like reverberation time or we can model noise propagation indoors.



In the first part of this tutorial we will have a look at the reverberation time and apply some room acoustic measures if necessary.



Therefore, click on the button "room acoustics".



The first tab will give you an overview over the general room data and the reverberation time at 500 Hz with and without persons.



IMMI 2018 Beta (C:\Users\bt\Desktop\Tutorial\Indoor\_project.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [Variant 0]

Calculation of statistical quantities in a working room

Selection of room  
Variant: Variant 0  
Name of room: Workroom without measures

Overview Reverberation time Re... of the variants Measurement values Options

Reverberation time, including atmospheric absorption, with influence of persons

f / Hz	16	31,5	63	125	250	500	1000	2000	4000	8000
s	-	-	-	1,413	1,946	2,394	2,290	1,930	1,481	-

Reverberation time averaged (according to ISO3382) /s: 2.34  
Reverberation time target /s: 0.80

actual value chart target value chart

Predicted reverberation time in comparison to the tolerance range according to DIN 18041

The graph plots Reverberation time /s on the y-axis (0.00 to 3.00) against frequency f / Hz on the x-axis (125 to 4000). A solid red line with square markers represents the 'Workroom without measures-Predicted reverberation time'. Two dashed black lines represent the 'Tolerance limit acc. DIN 18041' (upper and lower limits). The predicted values are consistently above the upper tolerance limit.

f / Hz	Predicted Reverberation time /s	Upper Tolerance Limit /s	Lower Tolerance Limit /s
125	1.40	1.15	0.55
250	1.95	1.00	0.65
500	2.40	0.95	0.65
1000	2.30	0.95	0.65
2000	1.95	0.95	0.65
4000	1.45	0.95	0.55

On the second tab you will find a display of the frequency dependent reverberation time.

IMMI 2018 Beta (C:\Users\bt\Desktop\Tutorial\Indoor\_project.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [Variant 0]

Calculation of statistical quantities in a working room

Selection of room  
 Variant: Variant 0  
 Name of room: Workroom without measures

Overview Reverberation time Result lists Comparison of the variants Measurement values Options

Reverberation time, including atmospheric absorption, with influence of persons

f / Hz	16	31,5	63	125	250	500	1000	2000	4000	8000
s	-	-	-	1,413	1,946	2,394	2,290	1,930	1,481	-

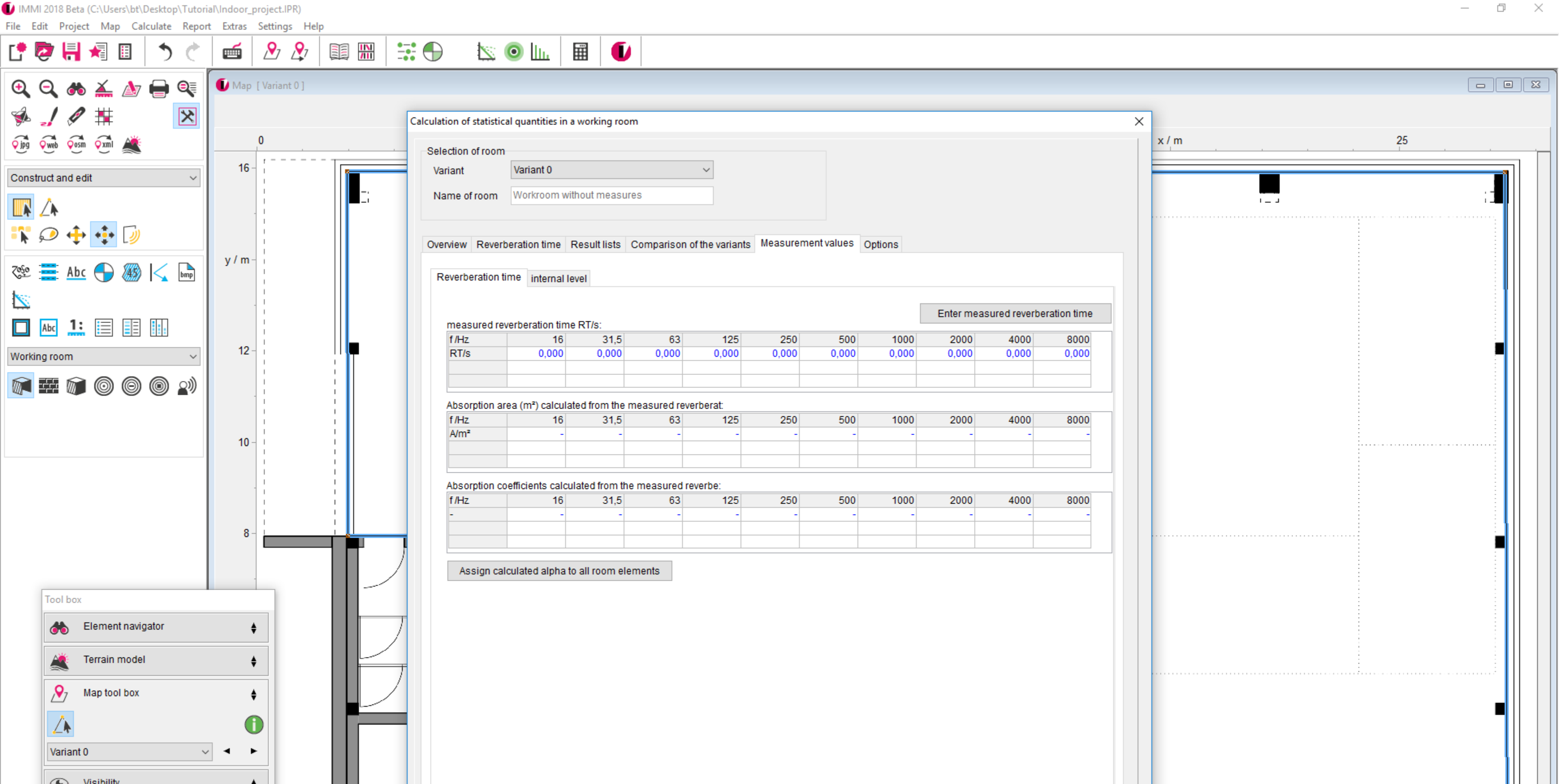
Reverberation time averaged (according to ISO3382) /s: 2.34  
 Reverberation time target /s: 0.80

actual value chart target value chart

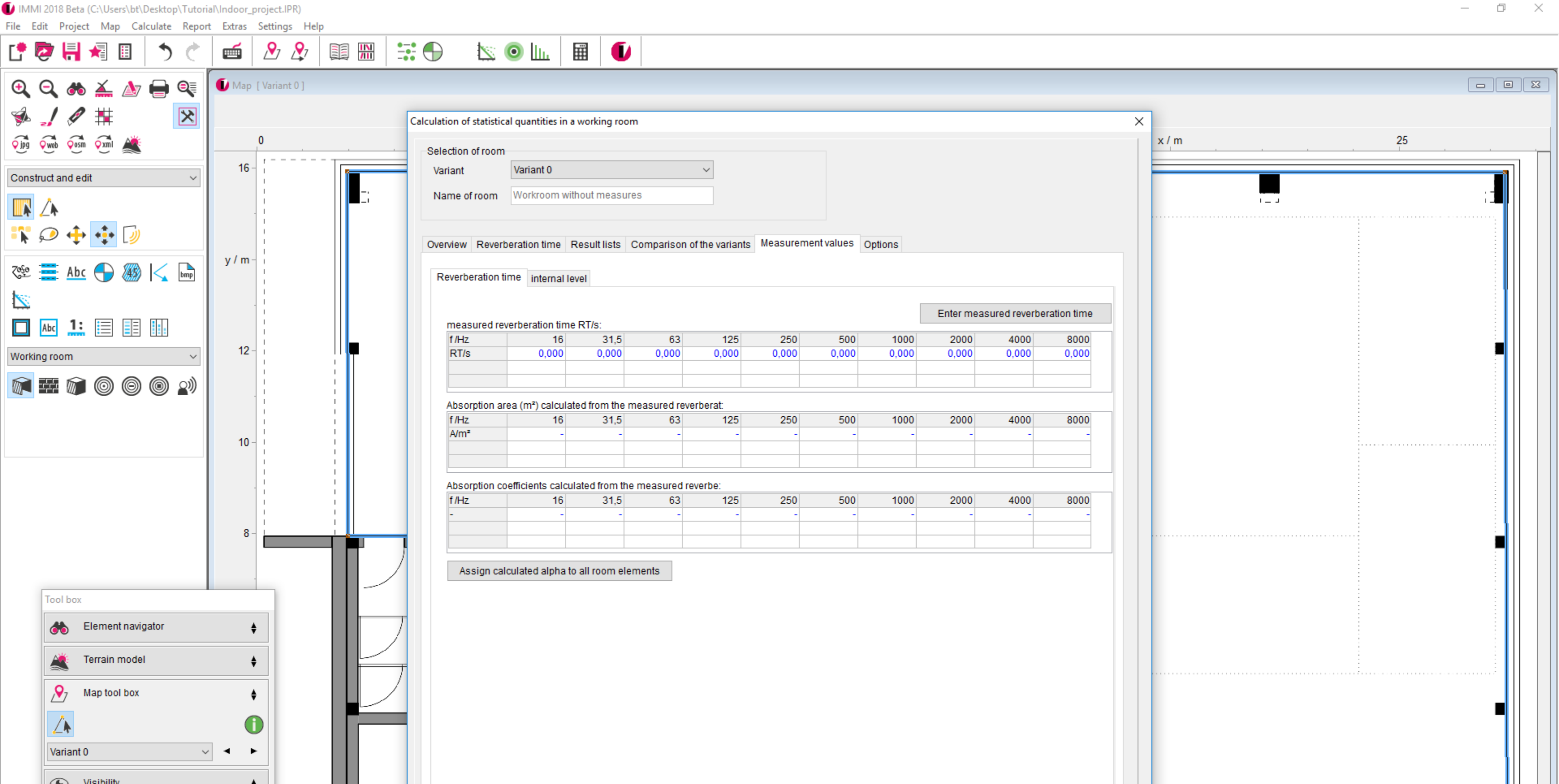
**Predicted reverberation time in comparison to the tolerance range according to DIN 18041**

f / Hz	125	250	500	1000	2000	4000
Workroom without measures - Predicted reverberation time	1.40	1.95	2.40	2.30	1.95	1.48
Tolerance limit acc. DIN 18041 (upper)	1.15	1.00	0.95	0.95	0.95	0.95
Tolerance limit acc. DIN 18041 (lower)	0.55	0.65	0.65	0.65	0.65	0.55

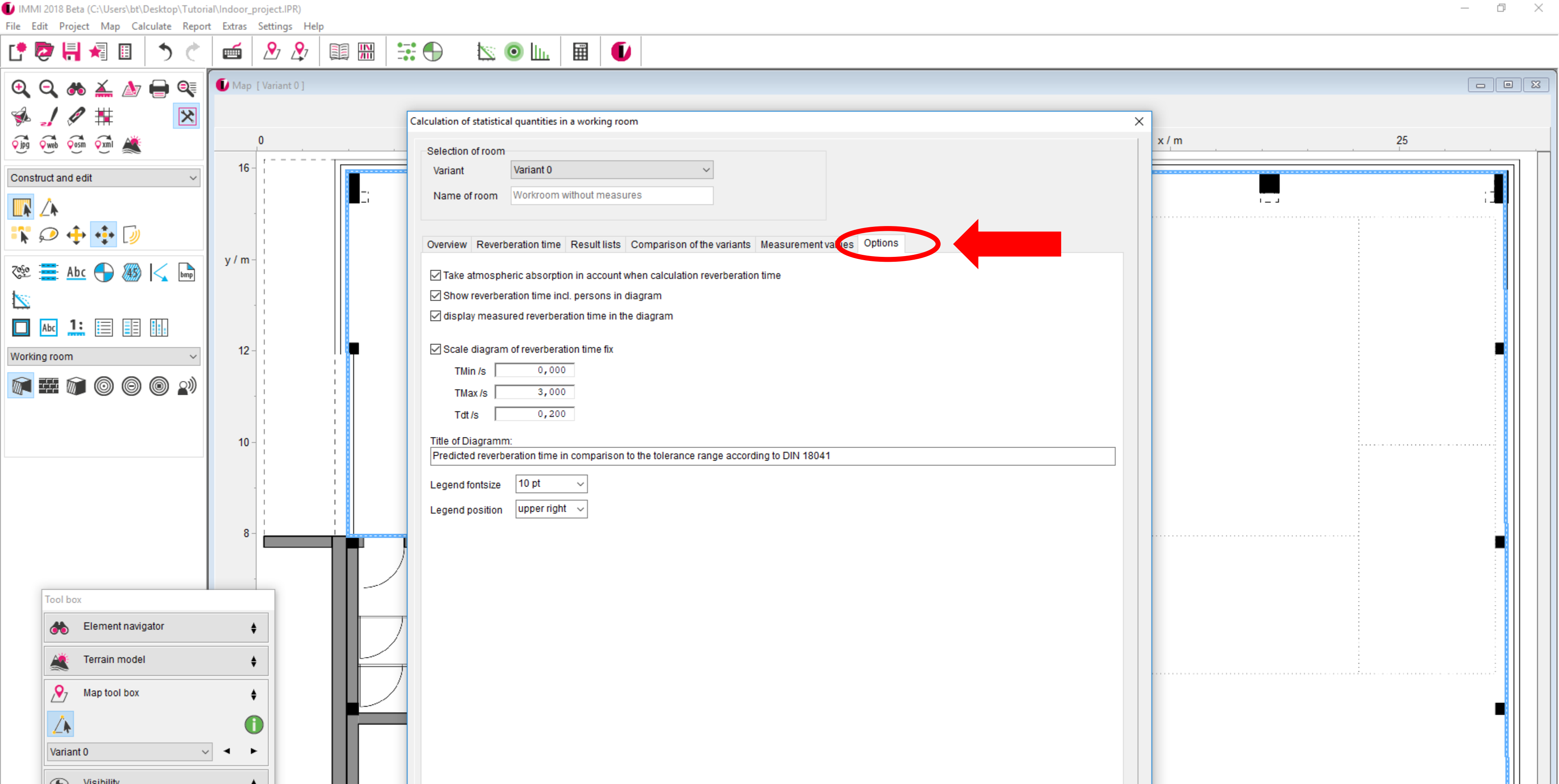
The reverberation time is compared to the tolerance range acc. to DIN 18041 for the selected room utilization. In this case it is well above it.



On the tab "measurement values" the user can enter measured reverberation times.



This can be used to assign room acoustic properties from a measurement to the model and to proceed with room acoustic measures.



On the tab "Options" it is possible to adjust the display options of the graph.

IMMI 2018 Beta (C:\Users\bt\Desktop\Tutorial\Indoor\_project.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [Variant 0]

Calculation of statistical quantities in a working room

Selection of room  
 Variant: Variant 0  
 Name of room: Workroom without measures

Overview Reverberation time Result lists Comparison of the variants Measurement values Options

Reverberation time, including atmospheric absorption, with influence of persons

f / Hz	16	31,5	63	125	250	500	1000	2000	4000	8000
s	-	-	-	1,413	1,946	2,394	2,290	1,930	1,481	-

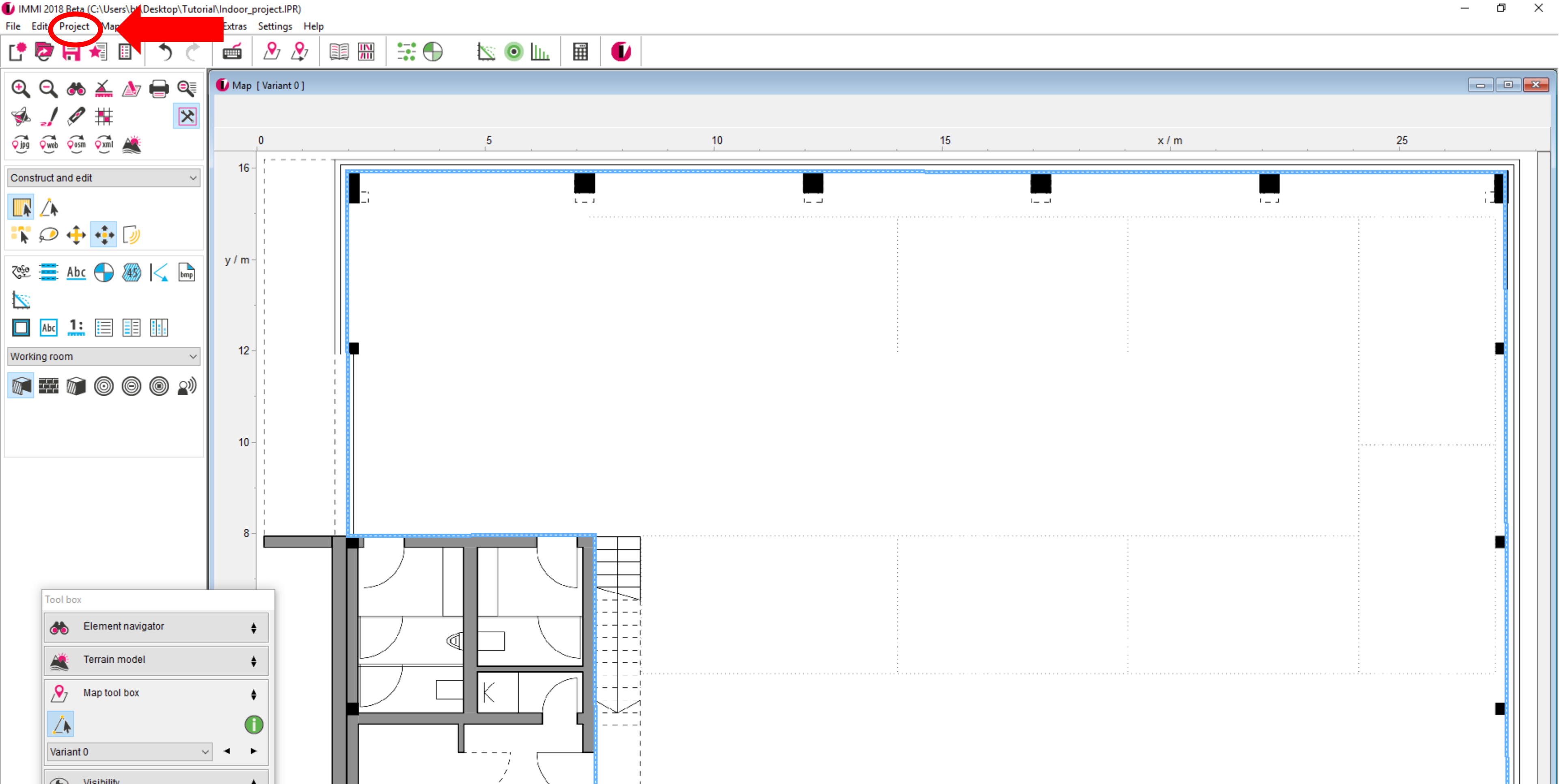
Reverberation time averaged (according to ISO3382) /s: 2.34  
 Reverberation time target /s: 0.80

actual value chart target value chart

**Predicted reverberation time in comparison to the tolerance range according to DIN 18041**

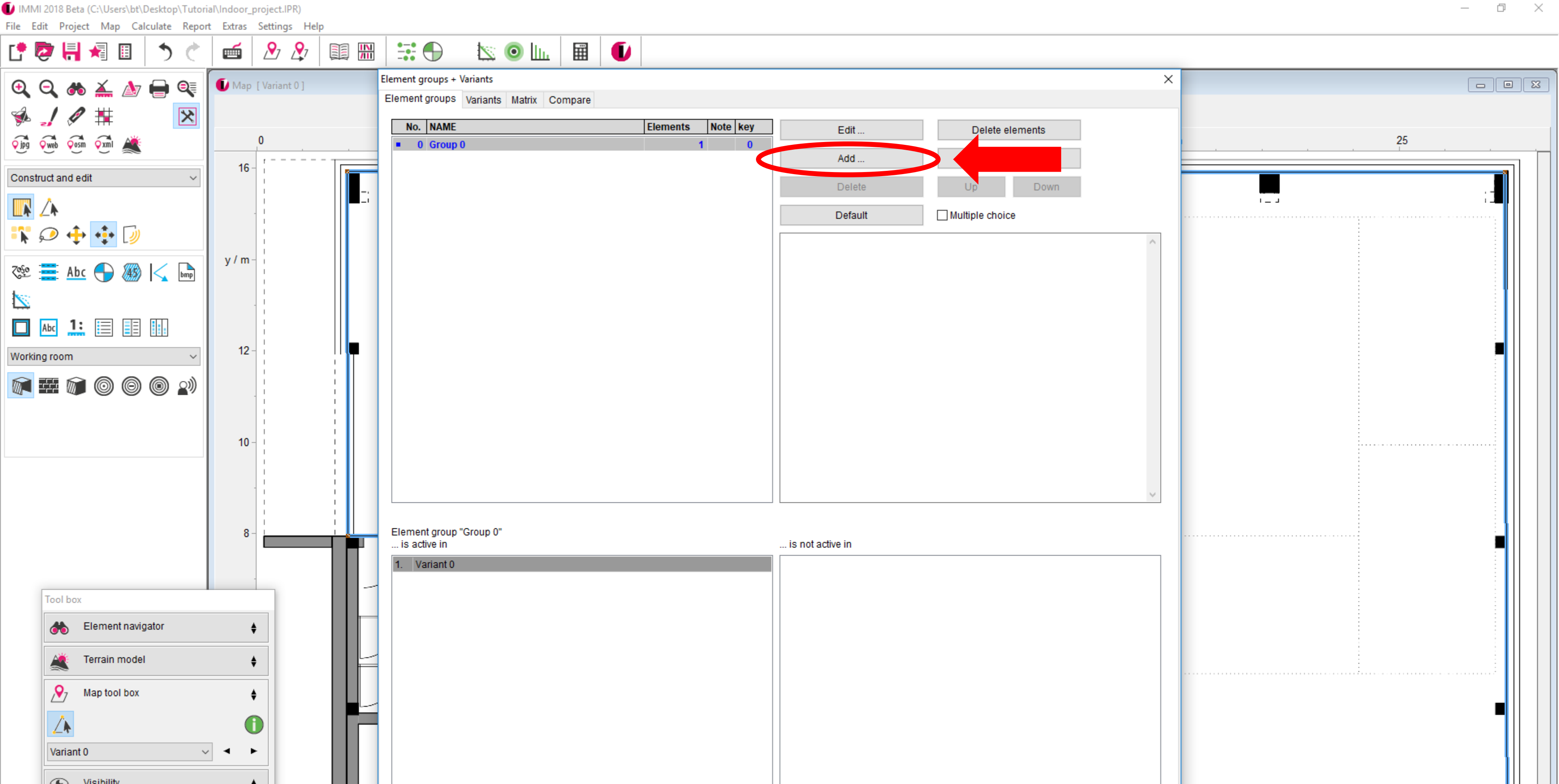
Legend:  
 - Workroom without measures-Predicted reverberation time (Red line with squares)  
 - Tolerance limit acc. DIN 18041 (Upper, Dashed line)  
 - Tolerance limit acc. DIN 18041 (Lower, Dashed line)

Since the reverberation time is well above the recommended value, we will now create a variant with room acoustic measures.

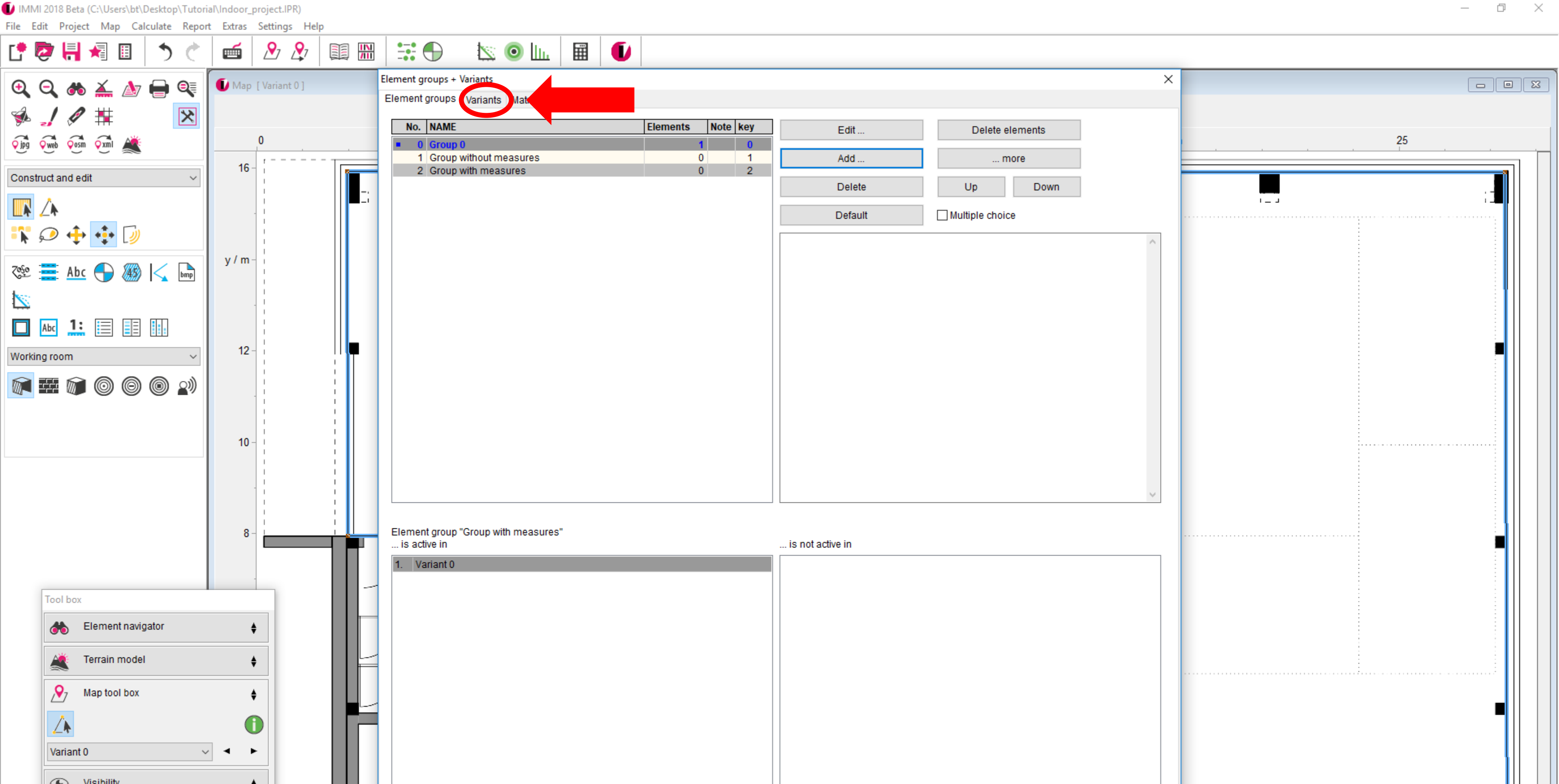


Therefore go to <Project/Element groups + variants>.

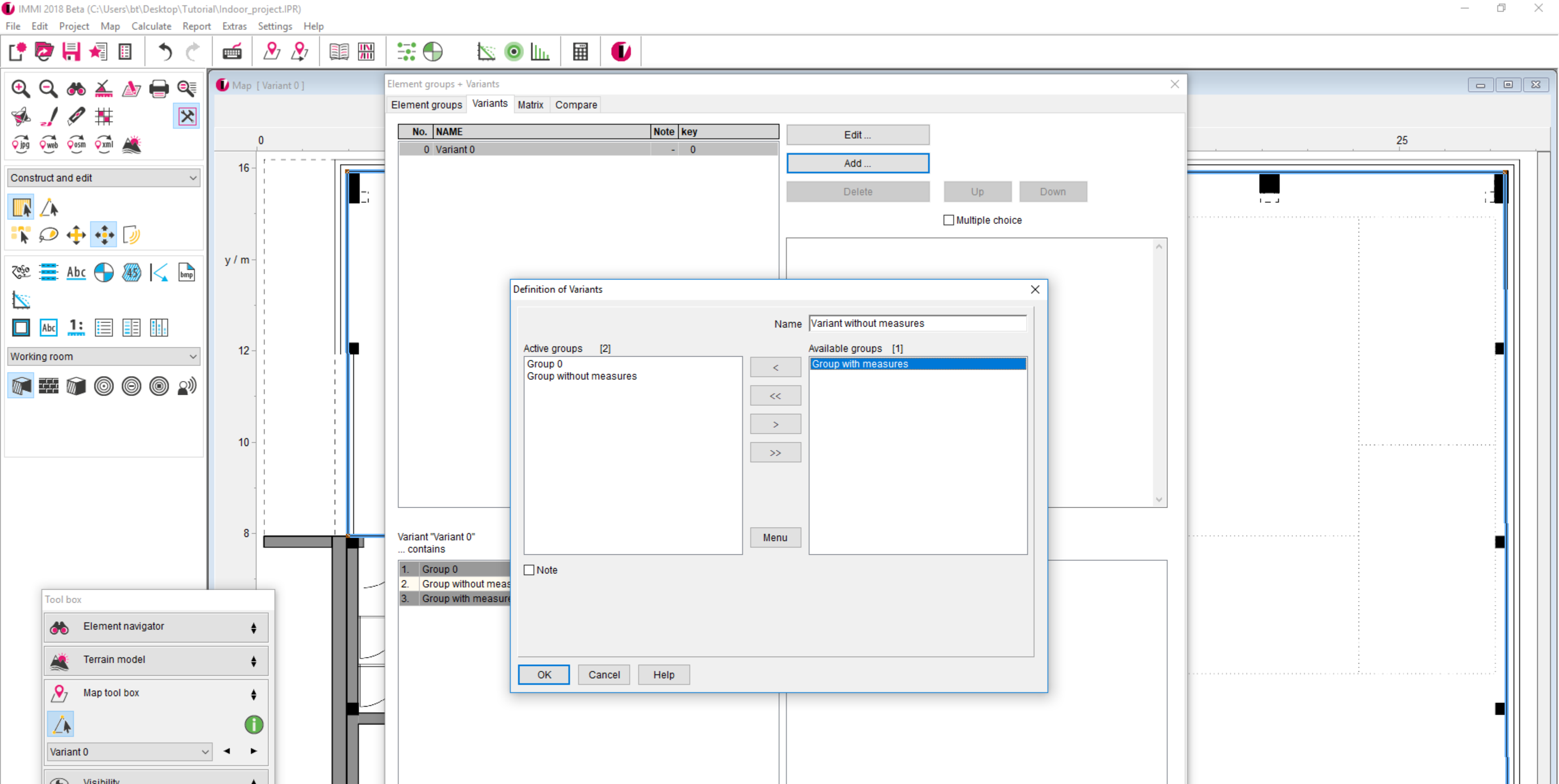




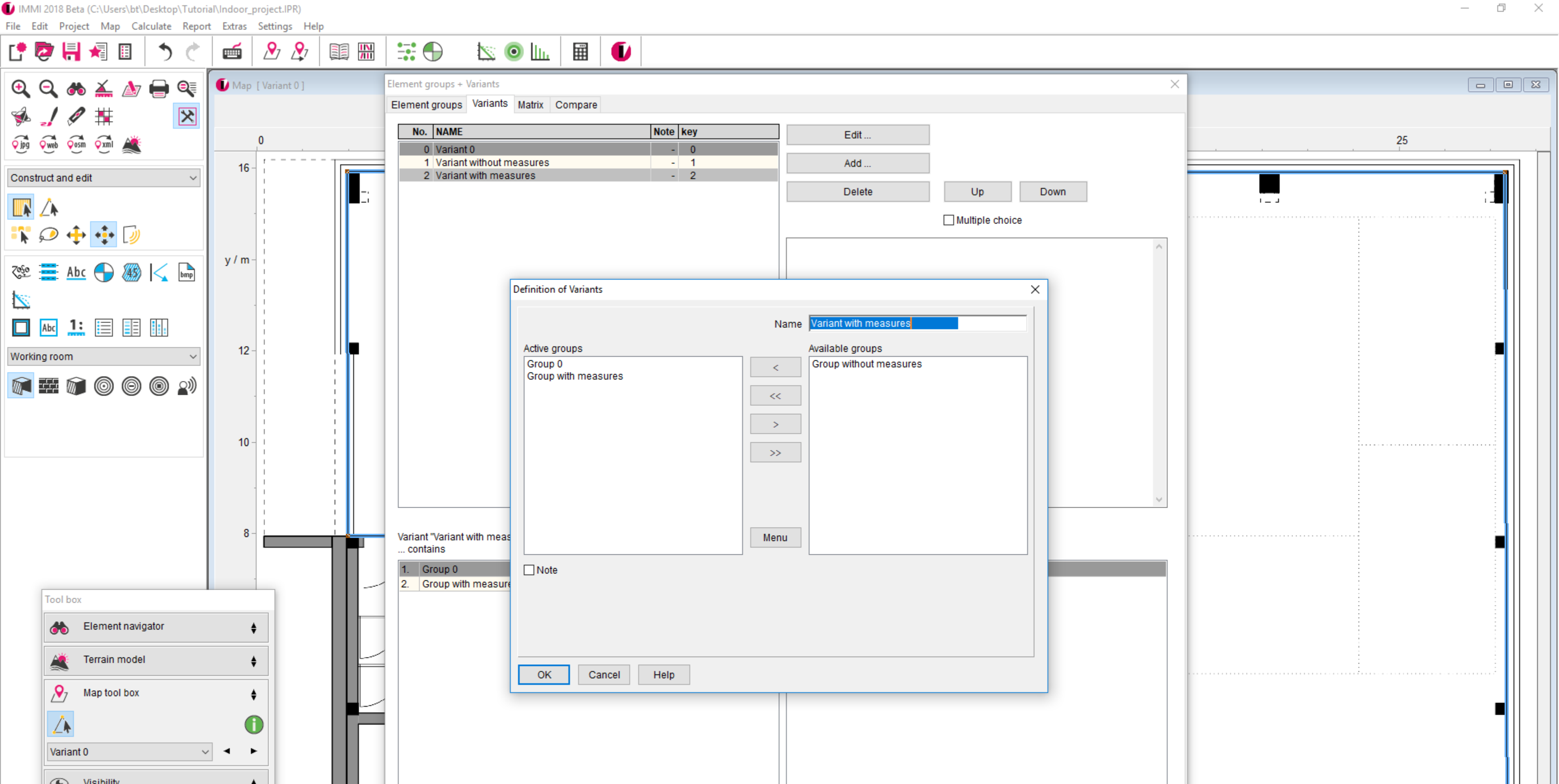
Now create element groups "without" and "with measures" by clicking the "Add" button.



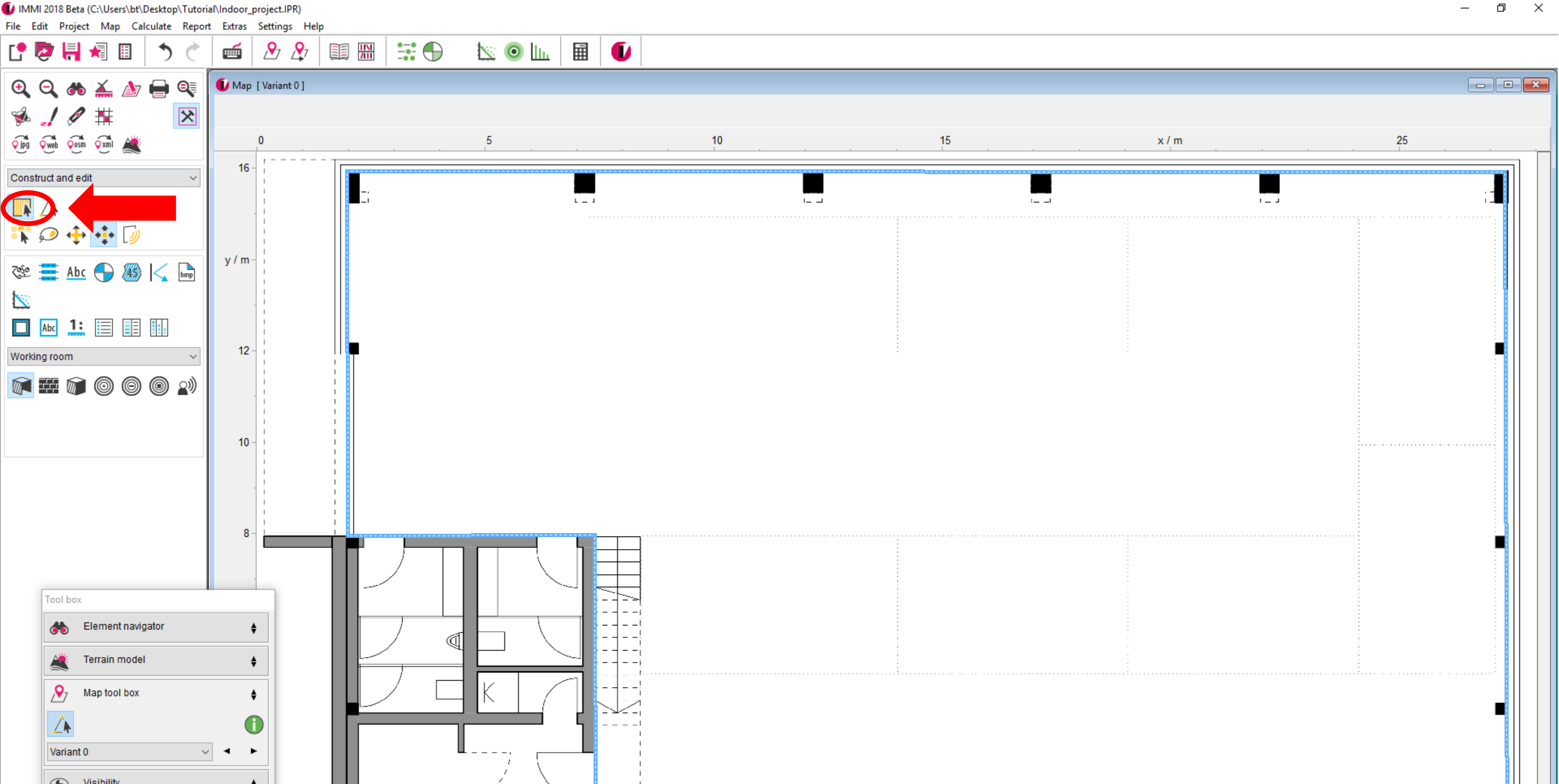
Then change to the tab "Variants".



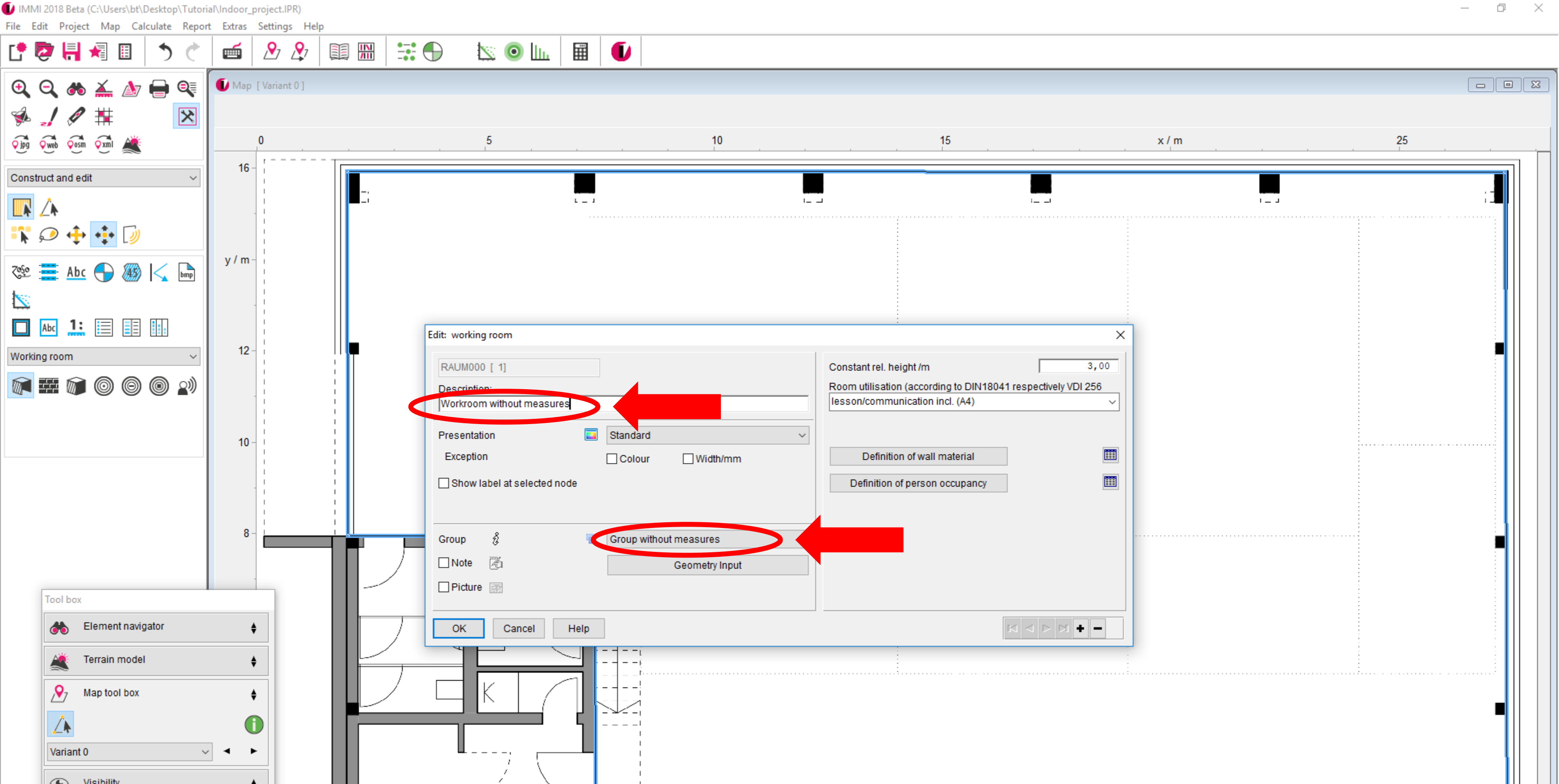
Here we create the according variants and include the respective groups using the arrow button.



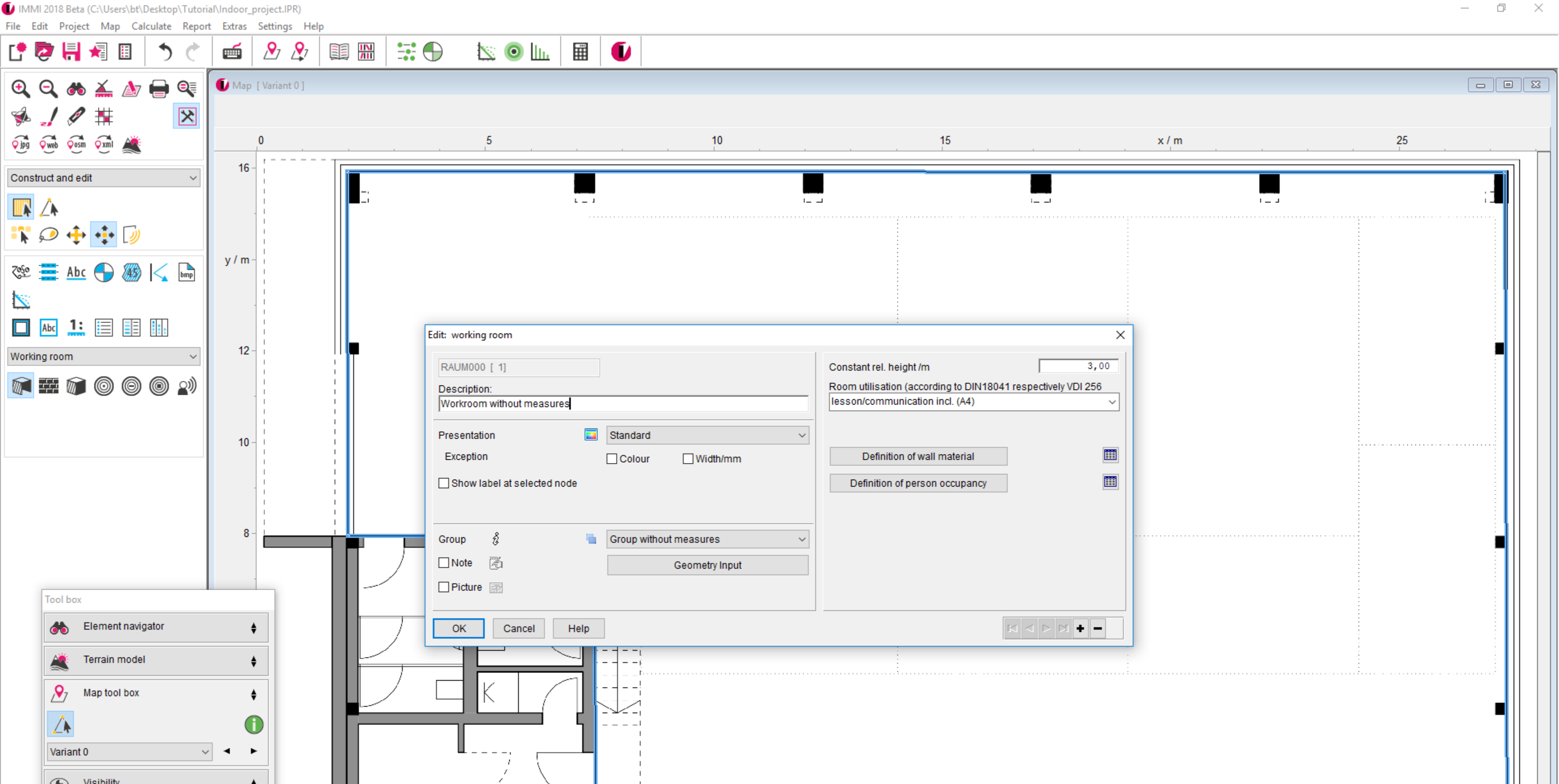
We end up with two new variants "without measures" and "with measures".



Select the room by double-clicking the "edit" tool in the sidebar.

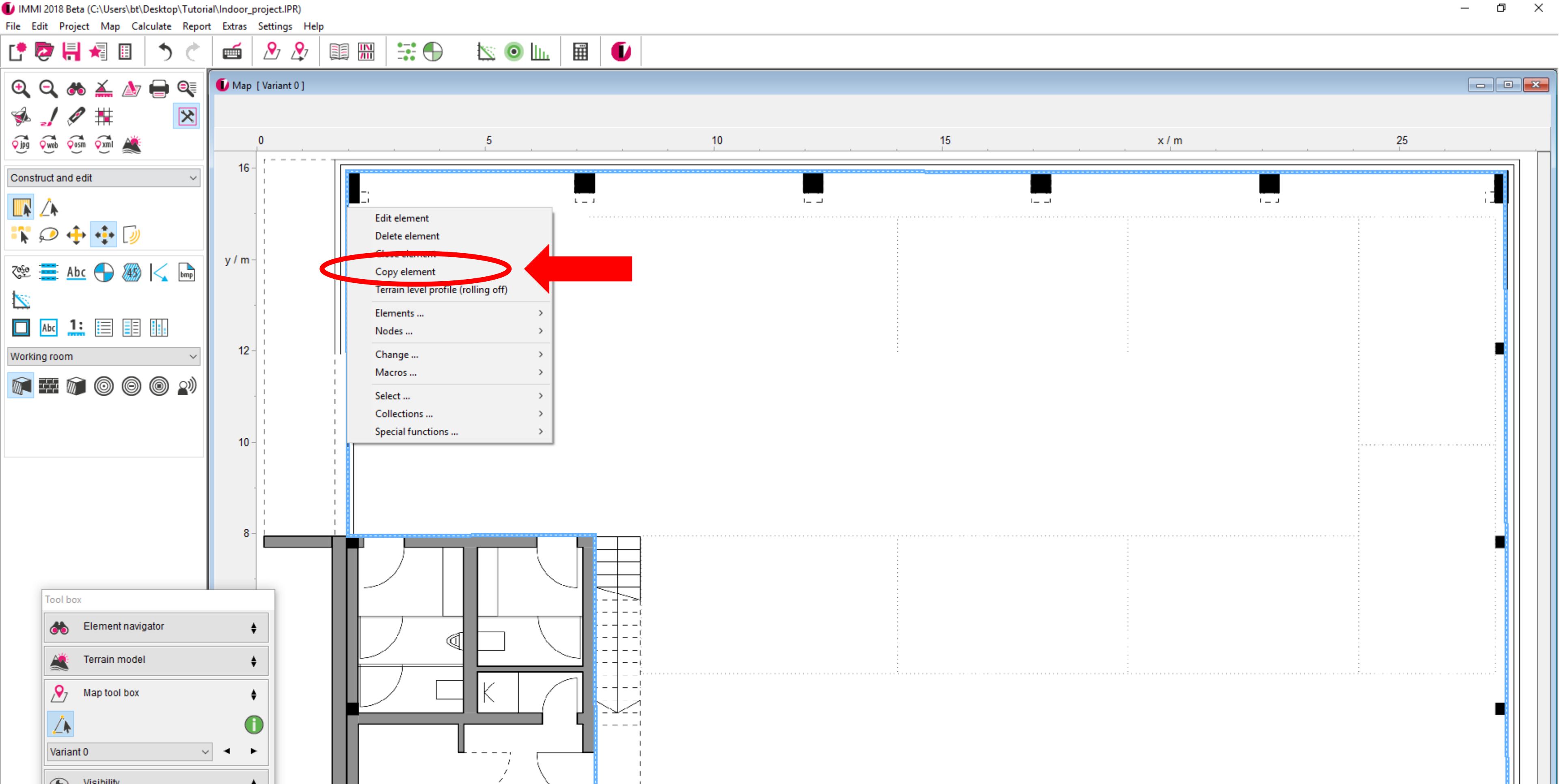


In the element dialogue enter the name "Workroom without measures" and change the group to "Group without measures".

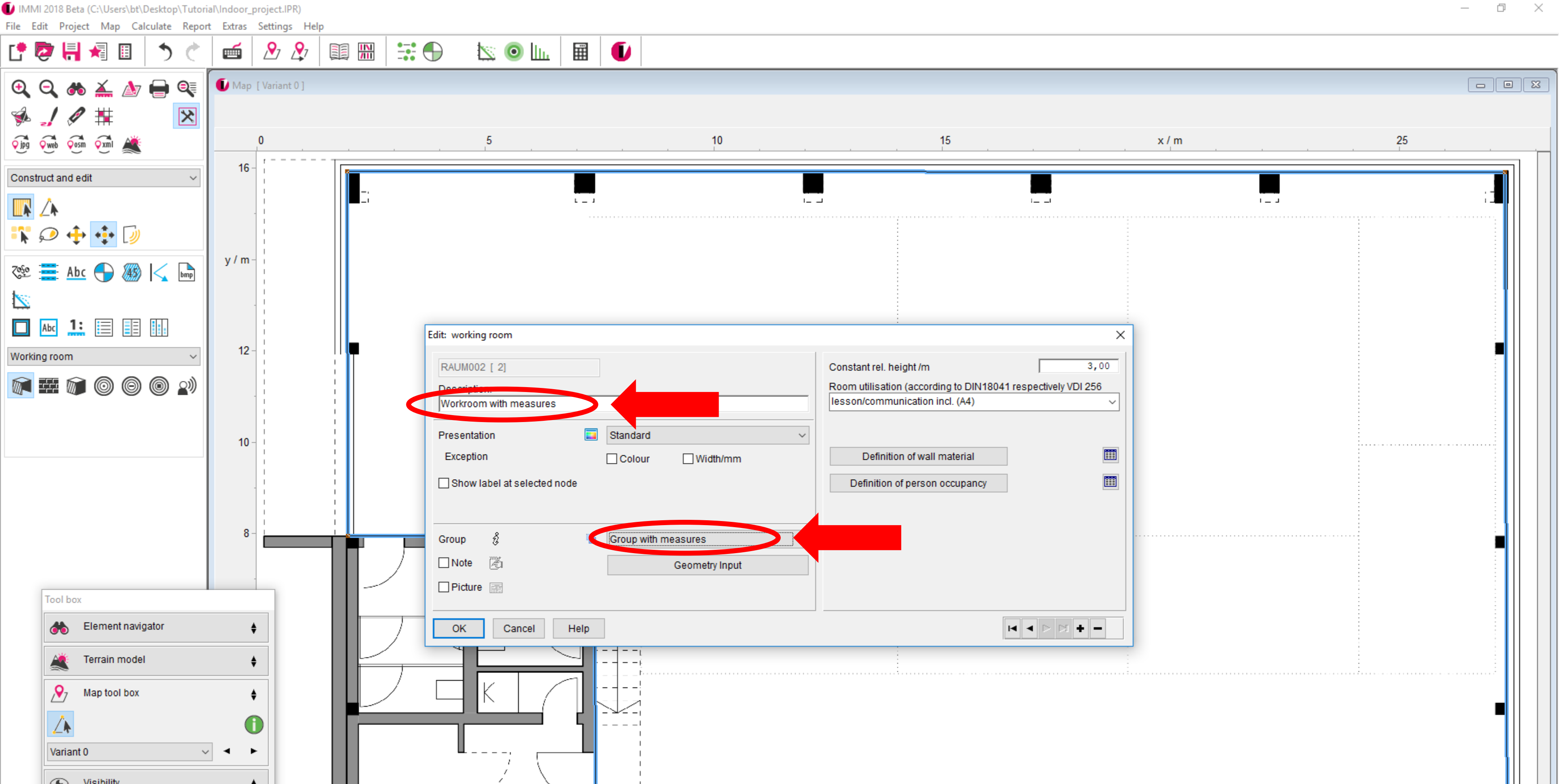


Close the dialogue with OK.

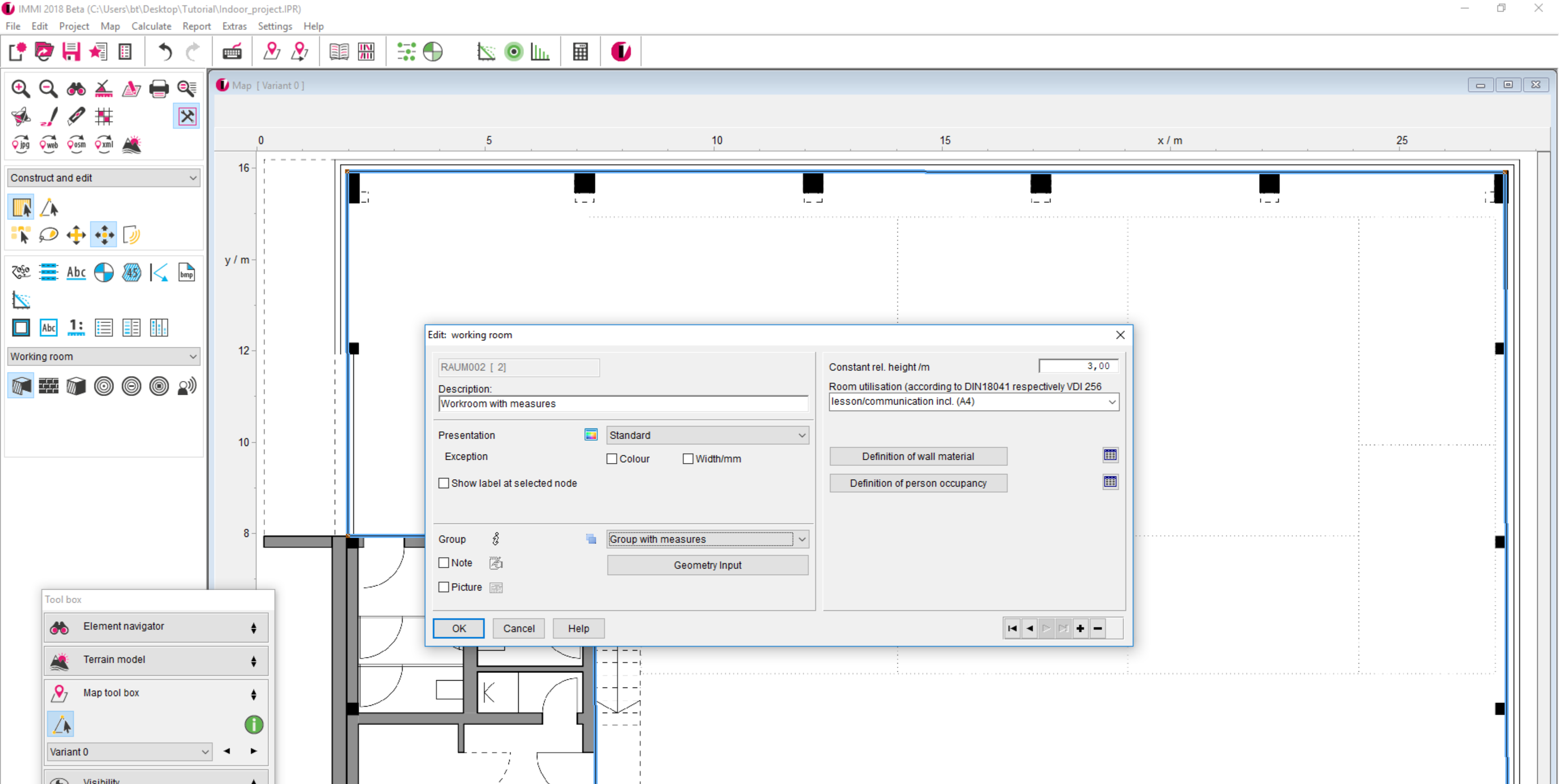




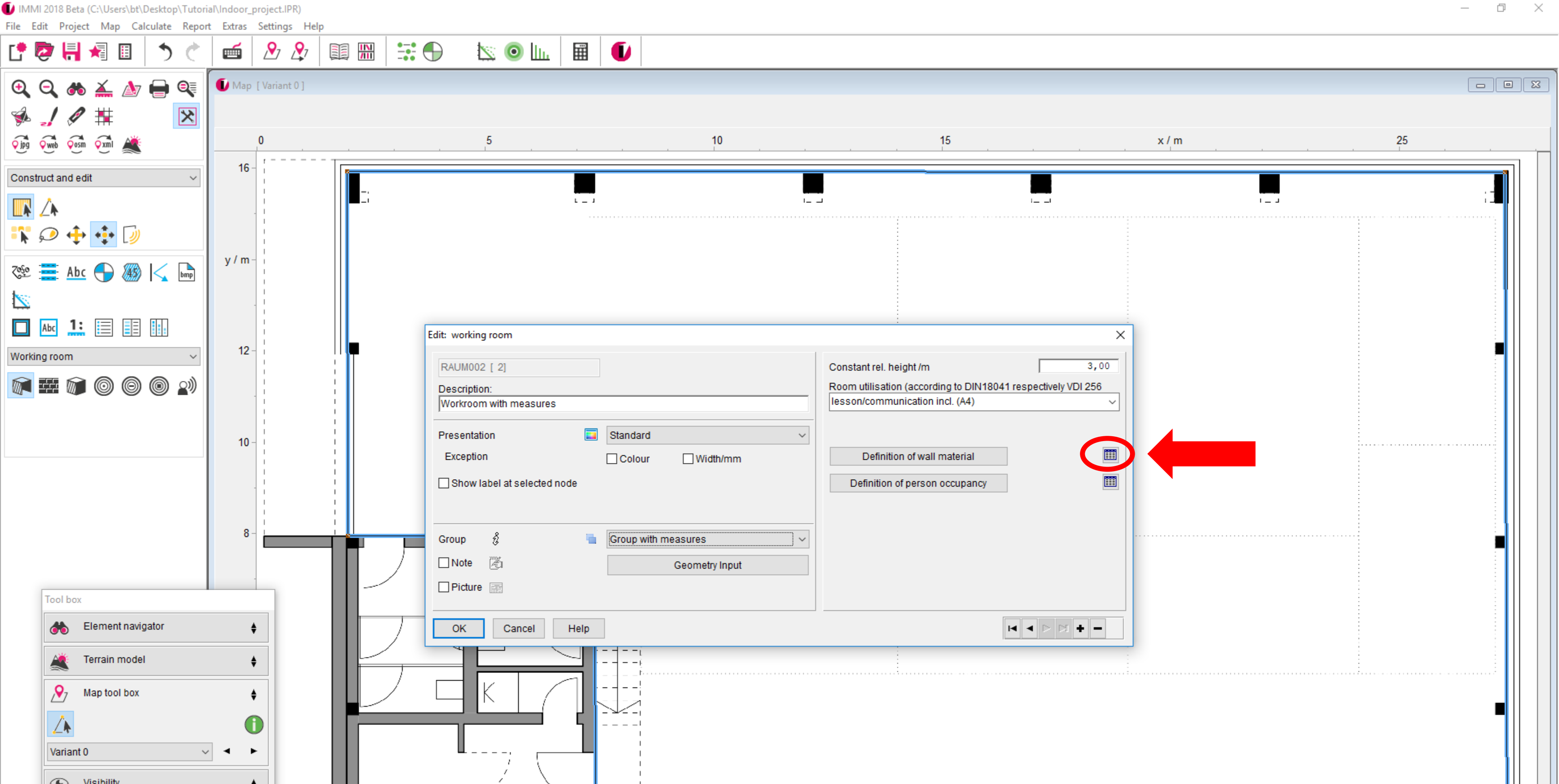
Then right click on the outer border of the room and choose "Copy element" from the appearing menu.



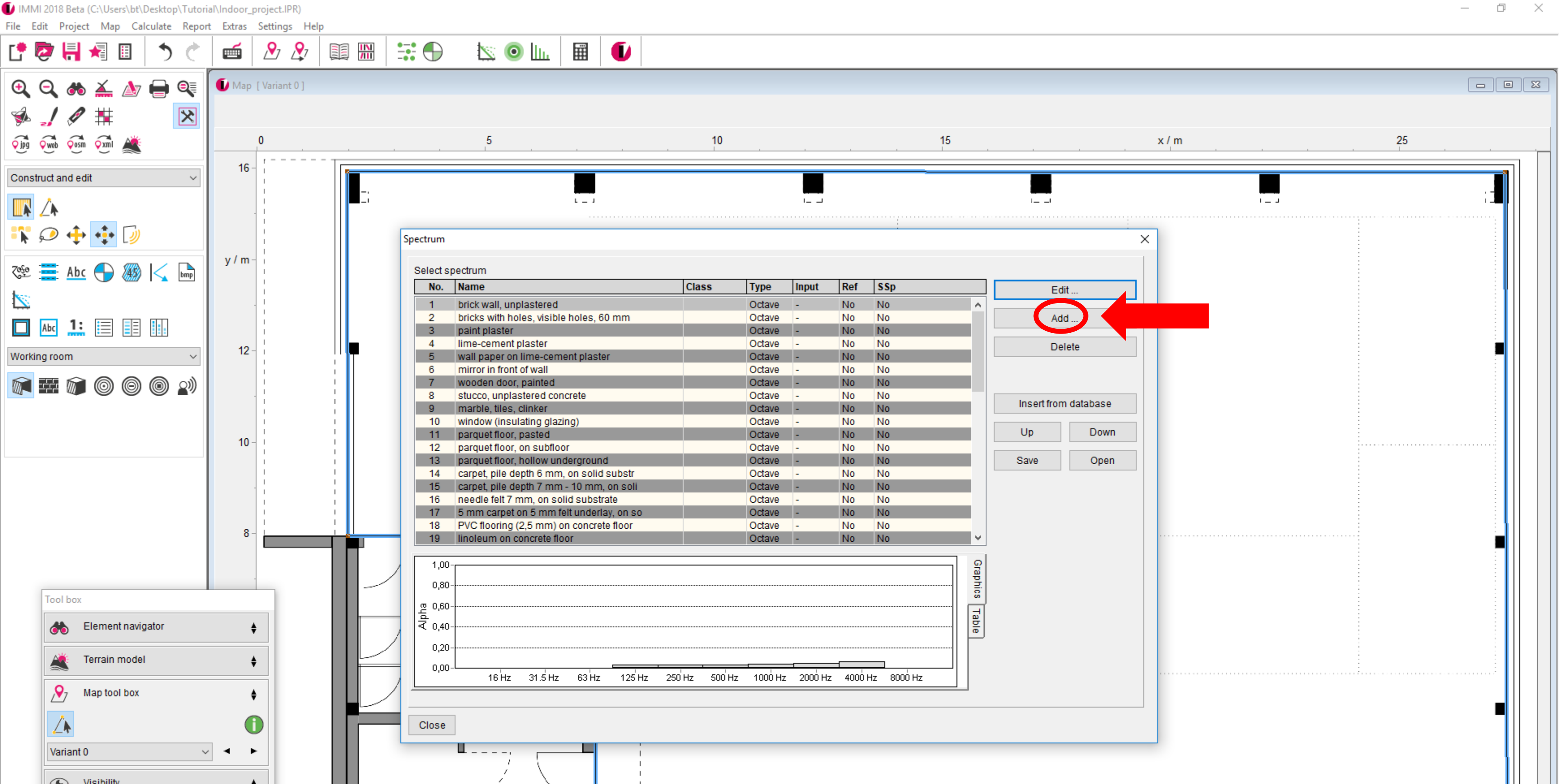
In the element dialogue enter the name "workroom with measures" and change the group to "Group with measures".



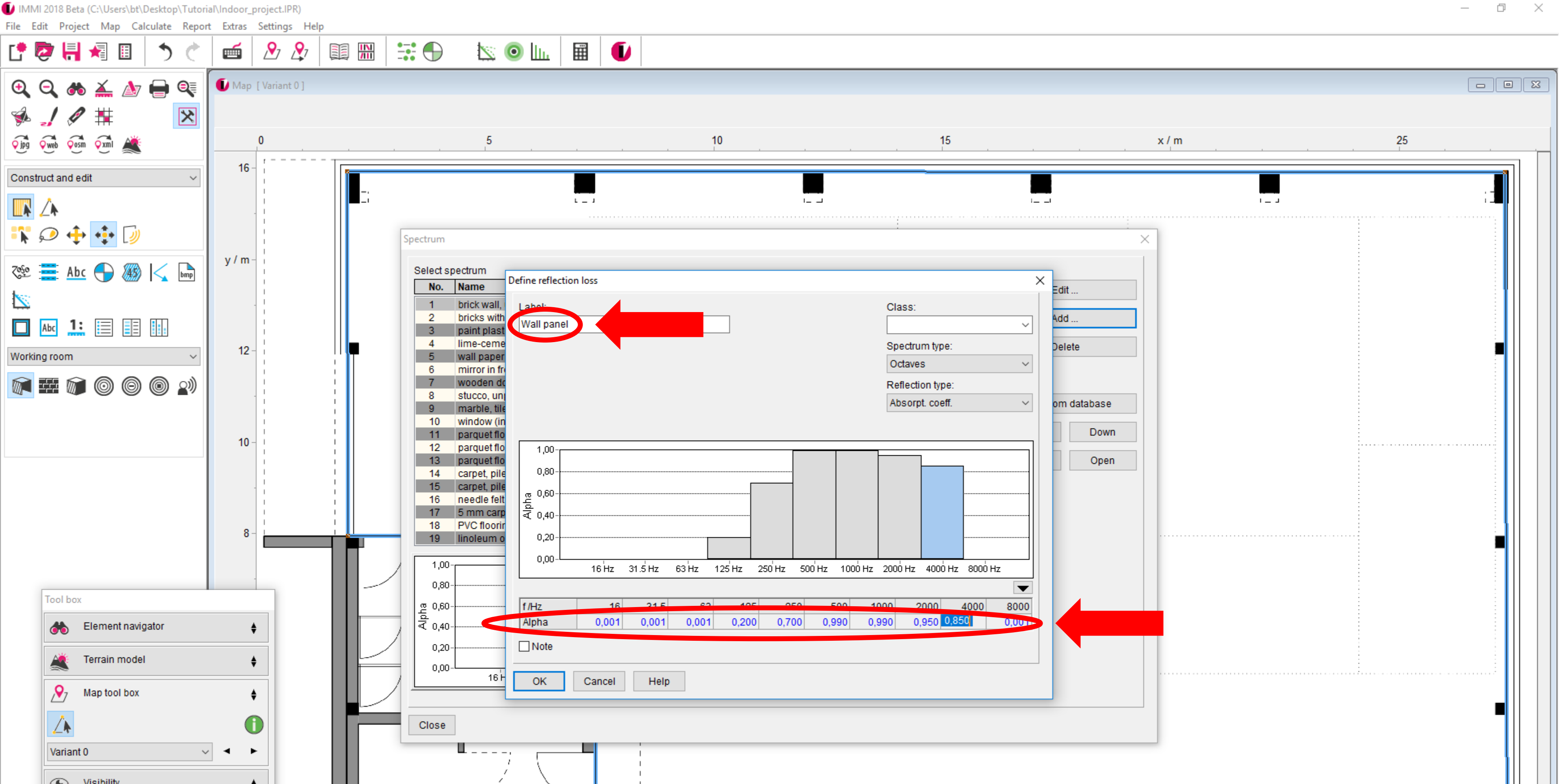
At this point the rooms are identical. We will now introduce our own materials (recommended procedure, if data is available).



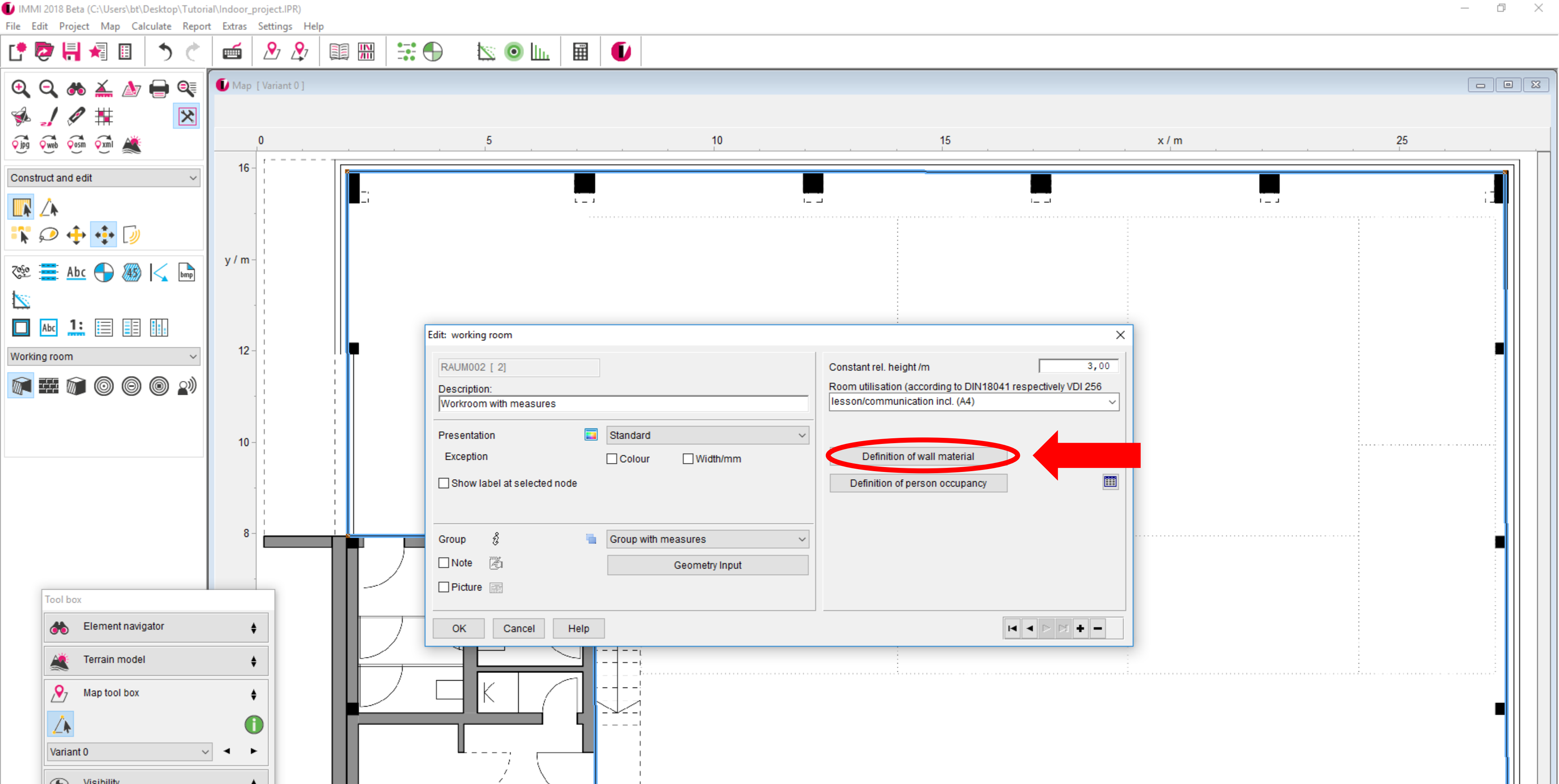
Open the dialogue with the materials.



Now use the button "Add" to open the dialogue for the definition of a new material.

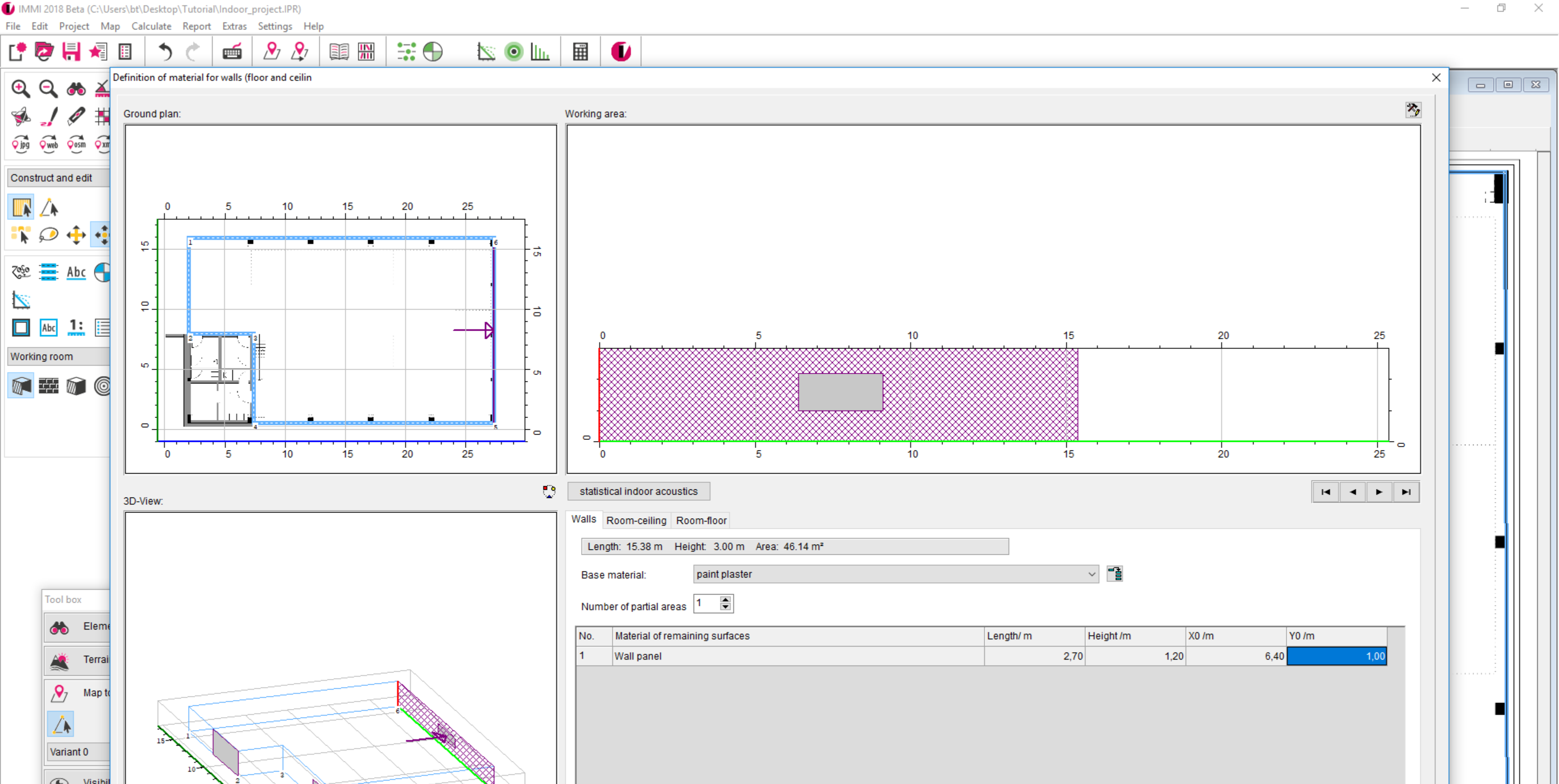


Enter a name and the frequency dependent alpha values from the technical sheet.

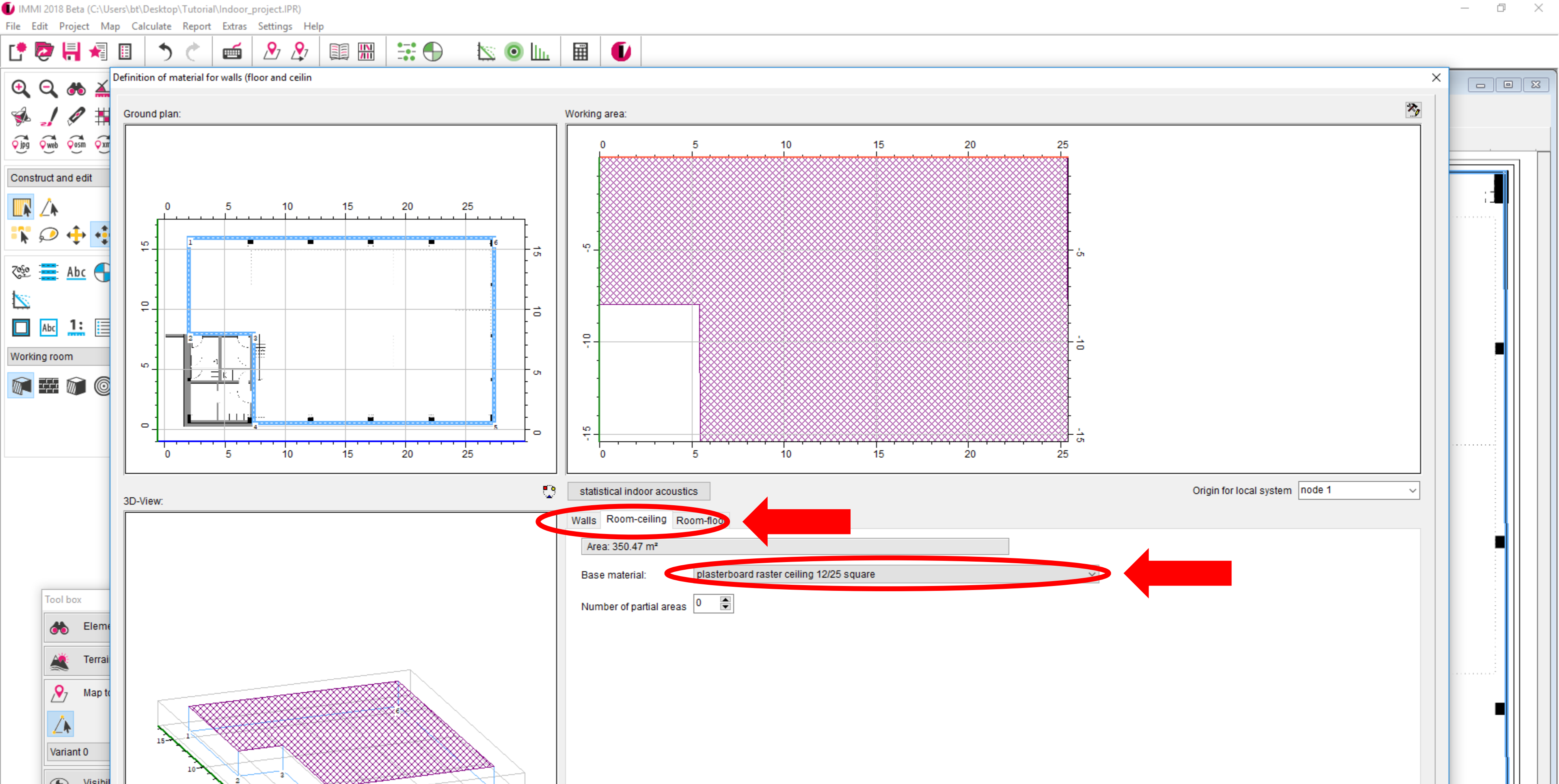


Now enter the dialogue for the definition of wall materials.

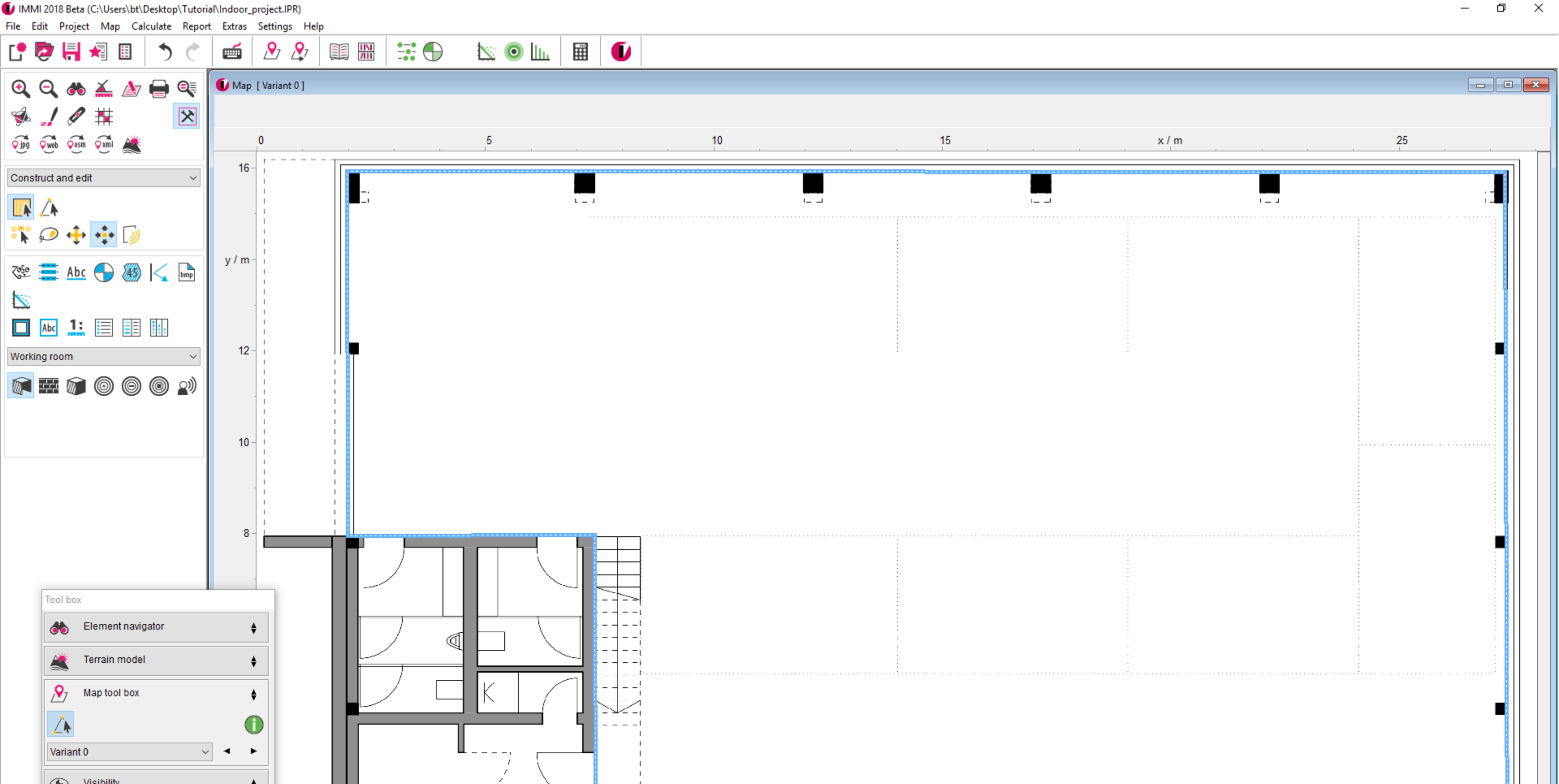




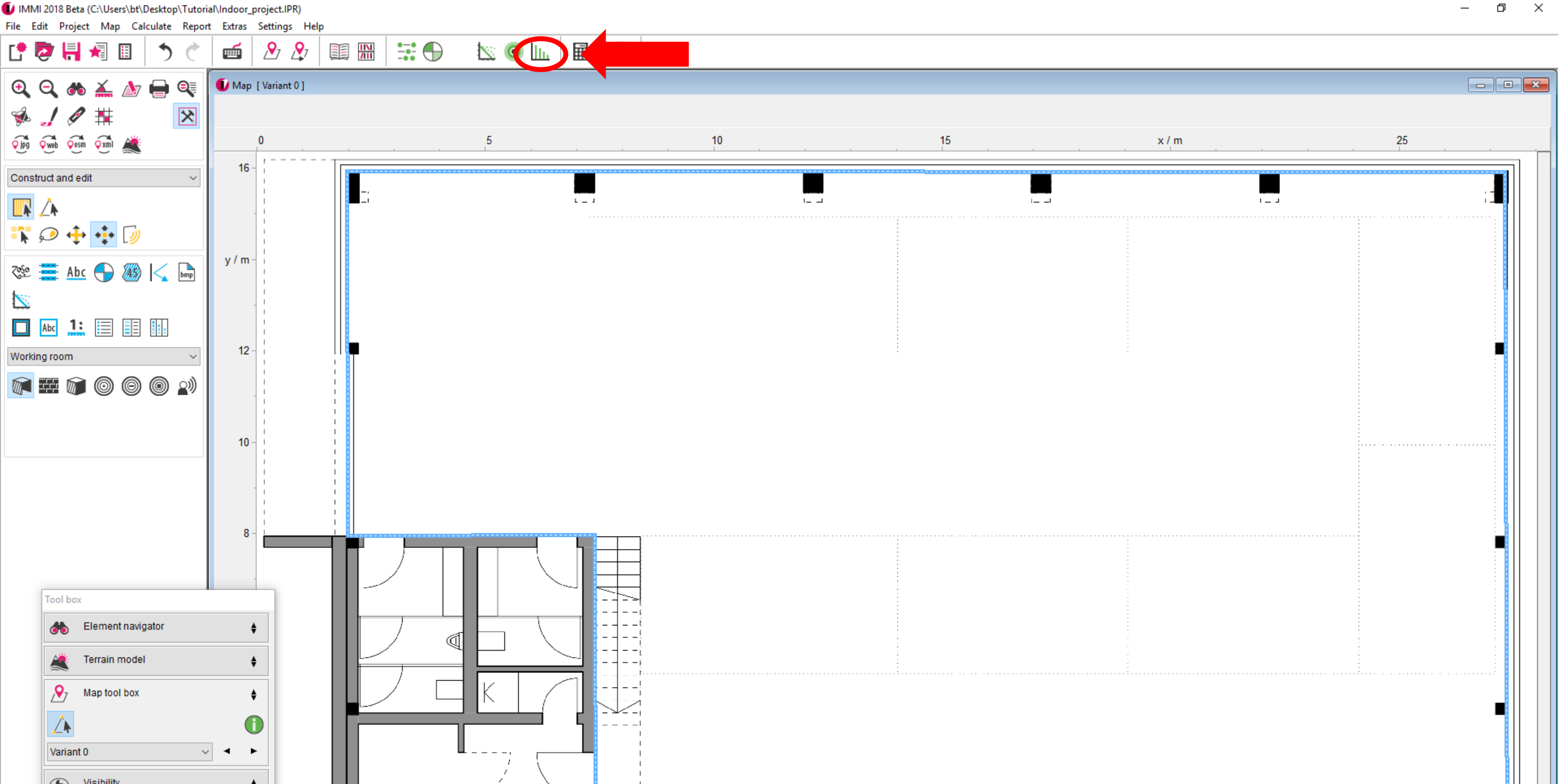
Introduce a wall panel on the right hand wall of the room by adding a partial area and using the above values.



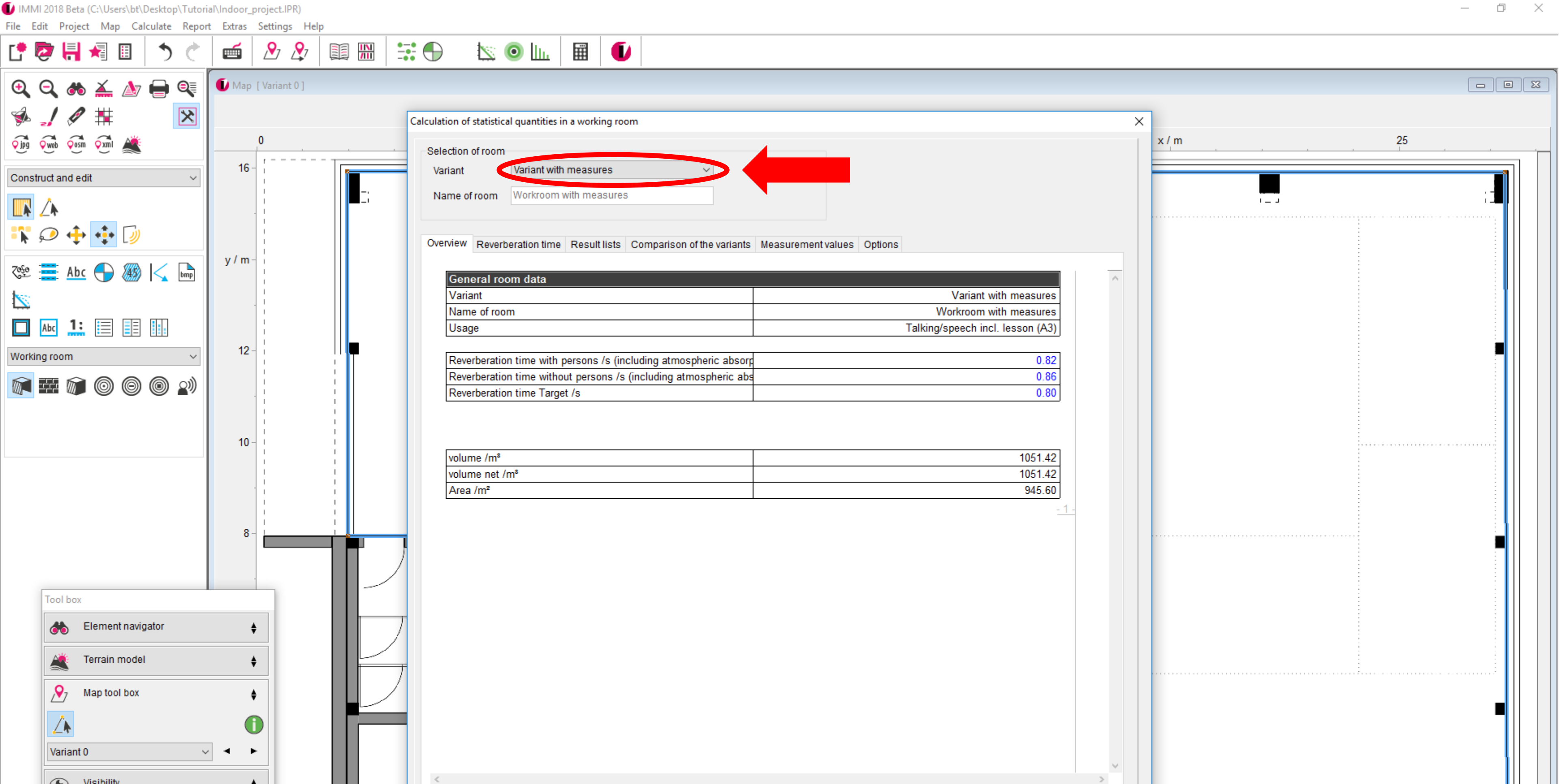
Change to the tab "room ceiling" and change the material of the ceiling as shown above.



After closing the dialogues with OK, the definition of the room with measures is complete and we can have a look at the results.



Therefore, click on the button "room acoustics".



On the tab overview, it is now possible to change between the available variants.

IMMI 2018 Beta (C:\Users\bt\Desktop\Tutorial\Indoor\_project.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [ Variant 0 ]

Calculation of statistical quantities in a working room

Selection of room  
 Variant: Variant with measures  
 Name of room: Workroom with measures

Overview Reverberation time Result lists Comparison of the variants Measurement values Options

Reverberation time, including atmospheric absorption, with influence of persons

f /Hz	16	31,5	63	125	250	500	1000	2000	4000	8000
s	-	-	-	1,024	0,910	0,798	0,840	0,886	0,945	-

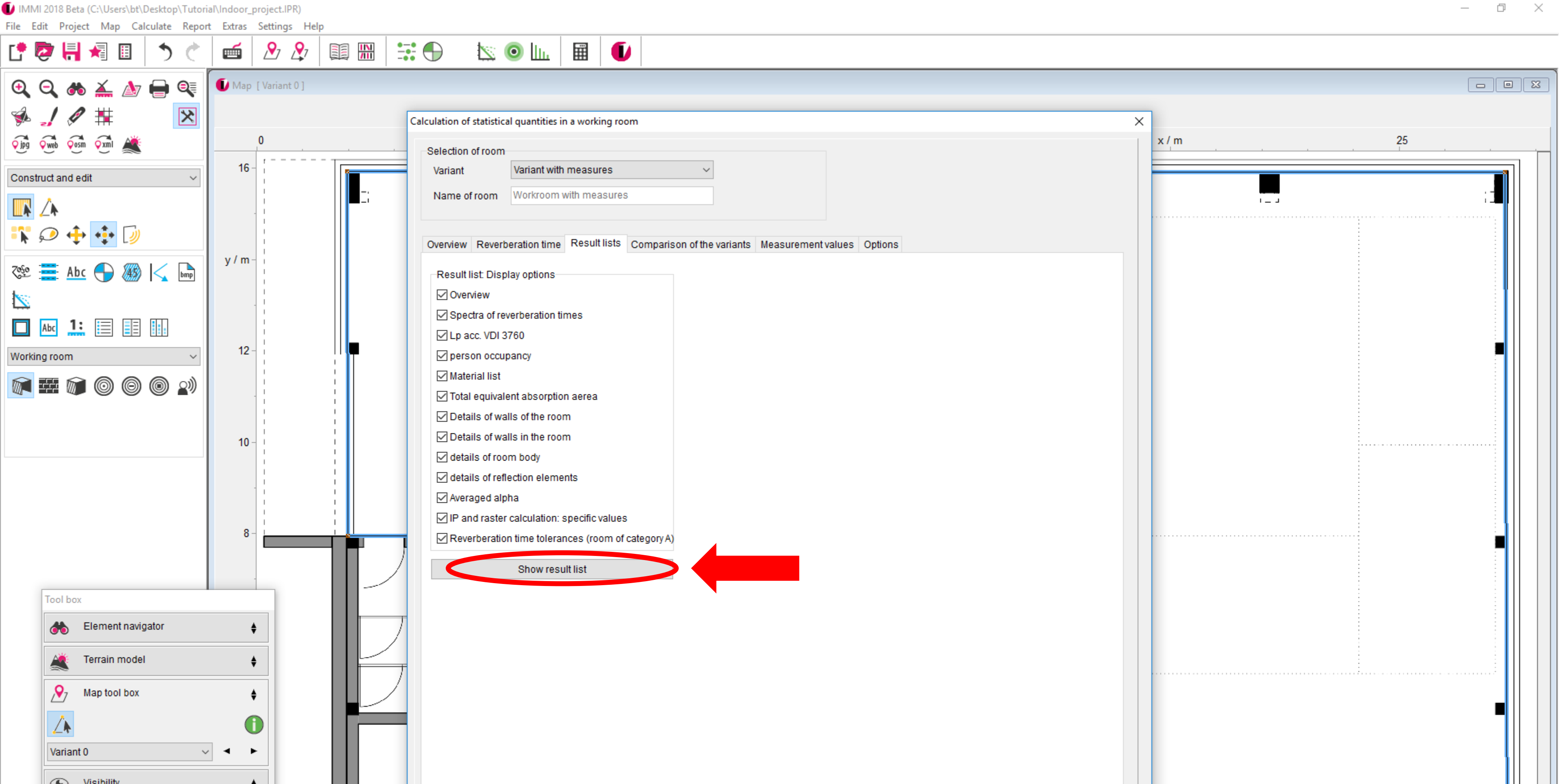
Reverberation time averaged (according to ISO3382) /s: 0.82  
 Reverberation time target /s: 0.80

actual value chart target value chart

Predicted reverberation time in comparison to the tolerance range according to DIN 18041

Legend:  
 - Workroom with measures-Predicted reverberation time (Red line with squares)  
 - Tolerance limit acc. DIN 18041 (Upper dashed line)  
 - Tolerance limit acc. DIN 18041 (Lower dashed line)

On the tab "reverberation time" you will find the values for the selected variant (with measures in this case).



On the tab "result list", it is possible to select the list features and display them in a separate window, which will open after clicking the button.



General room data	
Variant	Variant with measures
Name of room	Workroom with measures
Usage	Talking/speech incl. lesson (A3)

Reverberation time with persons /s (including atmospheric absorption)	0.82
Reverberation time without persons /s (including atmospheric absorption)	0.86
Reverberation time Target /s	0.80

volume /m <sup>3</sup>	1051.42
volume net /m <sup>3</sup>	1051.42
Area /m <sup>2</sup>	945.60

Lp diffuse (acc. VDI3760) (Day)									
16 Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Overall level (LIN) /dB									-99.00
Overall level (A) /dB									-99.00

Lp diffuse (with persons, acc. VDI3760) (Day)									
16 Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Overall level (LIN) /dB									-99.00
Overall level (A) /dB									-99.00

person occupancy	
40	Person sitting (A) on light cushioned chairs

Predicted reverberation time: lower and upper limit									
Reverberation time without persons /s									
16 Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
			1.156	0.956	0.956	0.956	0.956	0.956	0.956
			1.049	0.940	0.828	0.883	0.934	1.000	
			0.518	0.638	0.638	0.638	0.638	0.638	0.518
Reverberation time with persons /s									
16 Hz	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
			1.156	0.956	0.956	0.956	0.956	0.956	0.956
			1.024	0.910	0.798	0.840	0.886	0.945	

The list can now be saved or exported for documentation purposes. Scroll down to view all parameters and results.

IMMI 2018 Beta (C:\Users\bt\Desktop\Tutorial\Indoor\_project.IPR)

File Edit Project Map Calculate Report Extras Settings Help

Map [Variant 0]

Calculation of statistical quantities in a working room

Selection of room  
 Variant: Variant 0  
 Name of room: Workroom without measures

Overview Reverberation time Result lists Comparison of the variants Measurement values Options

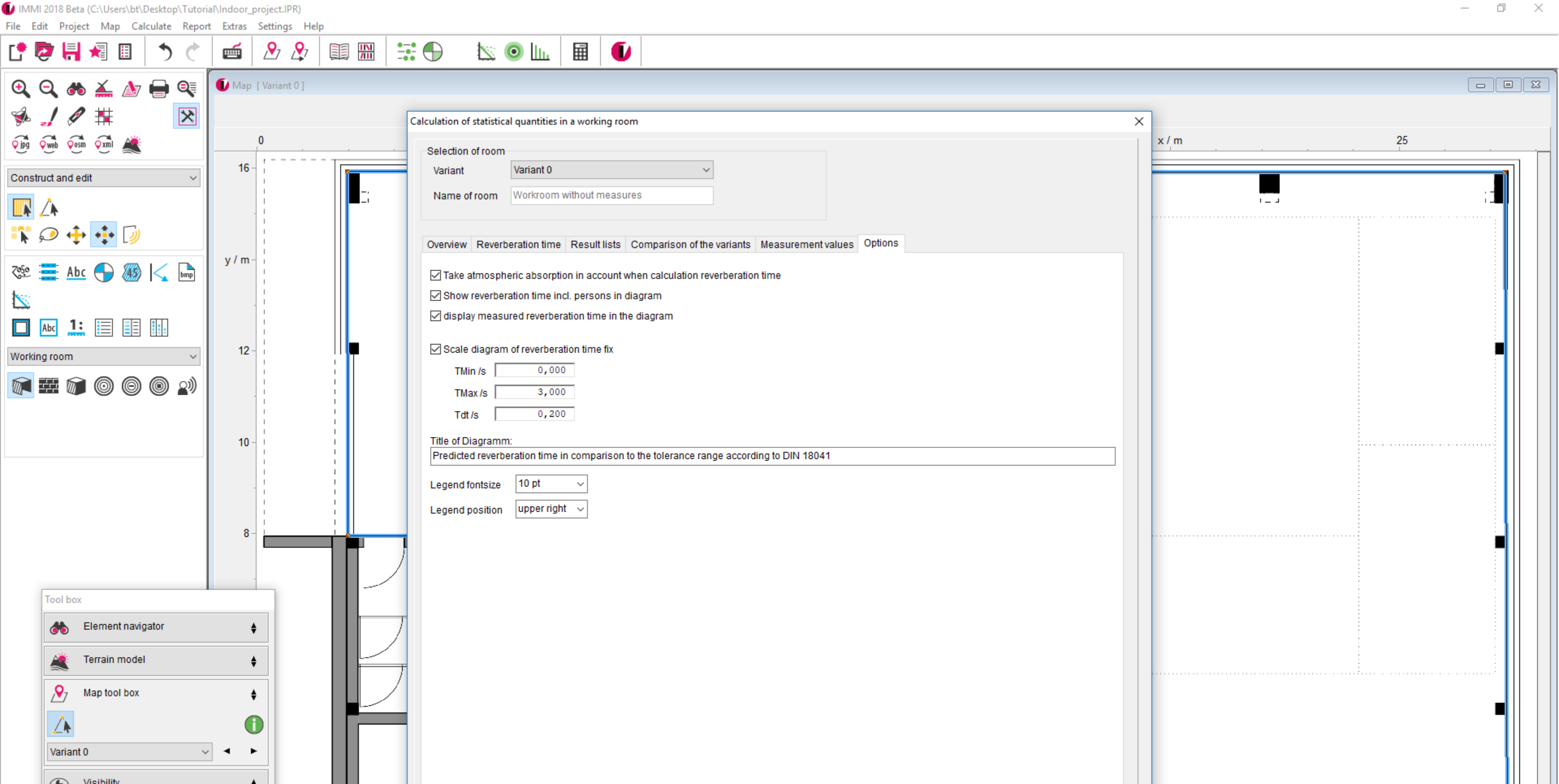
Variant 1: Variant 0  
 Variant 2: Variant with measures

Reverberation time internal level

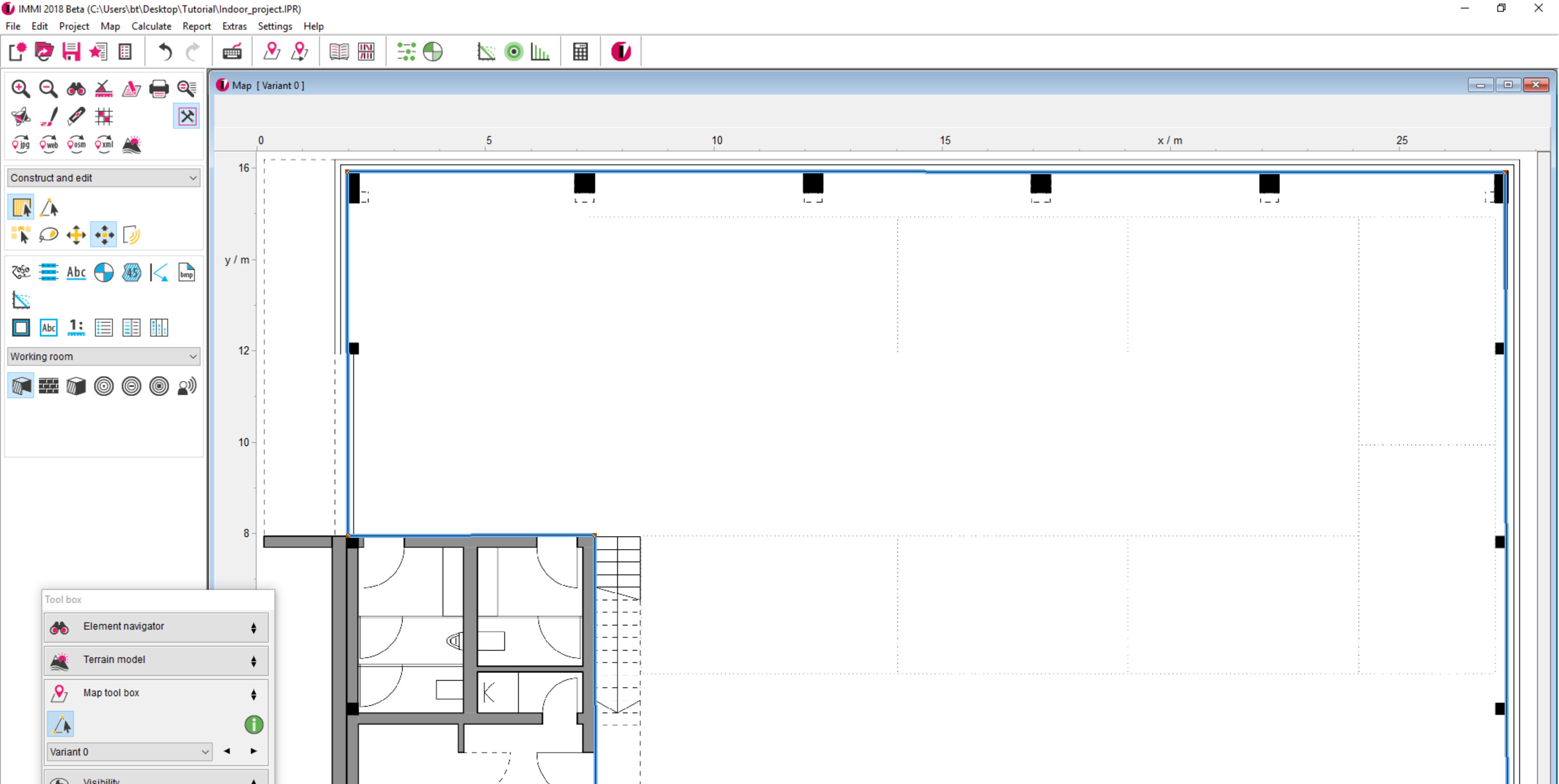
**Predicted reverberation time in comparison to the tolerance range according to DIN 18041**

Frequency (Hz)	Workroom without measures - Predicted reverberation time (s)	Workroom with measures - Predicted reverberation time (s)	Tolerance limit acc. DIN 18041 (Upper) (s)	Tolerance limit acc. DIN 18041 (Lower) (s)
125	1.40	1.00	1.15	0.55
250	1.95	0.90	0.95	0.65
500	2.40	0.80	0.95	0.65
1000	2.30	0.85	0.95	0.65
2000	1.95	0.88	0.95	0.65
4000	1.45	0.95	0.95	0.55

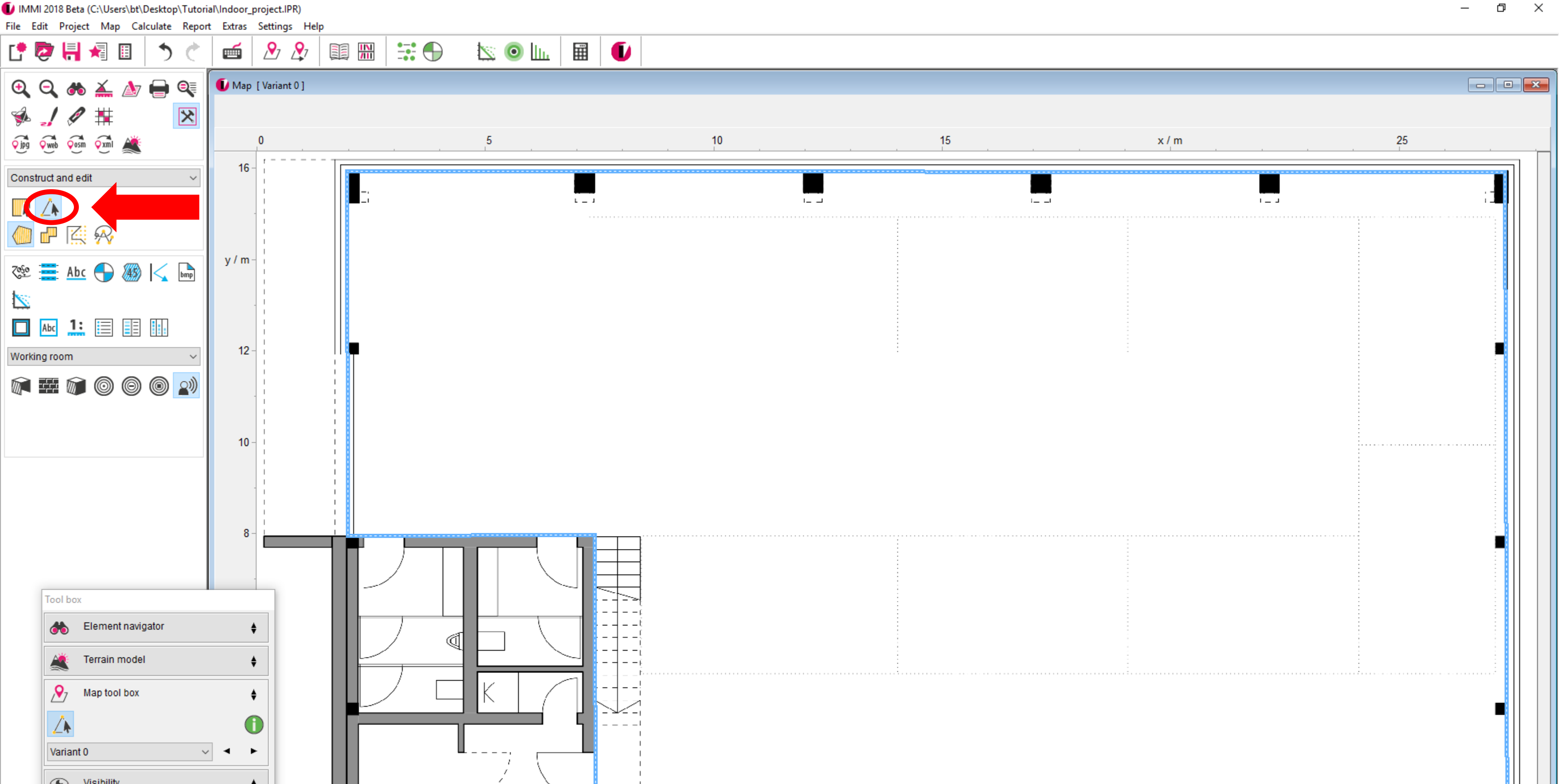
The tab "comparison of variants" shows a graphic display of the reverberation times for the different variants of the project.



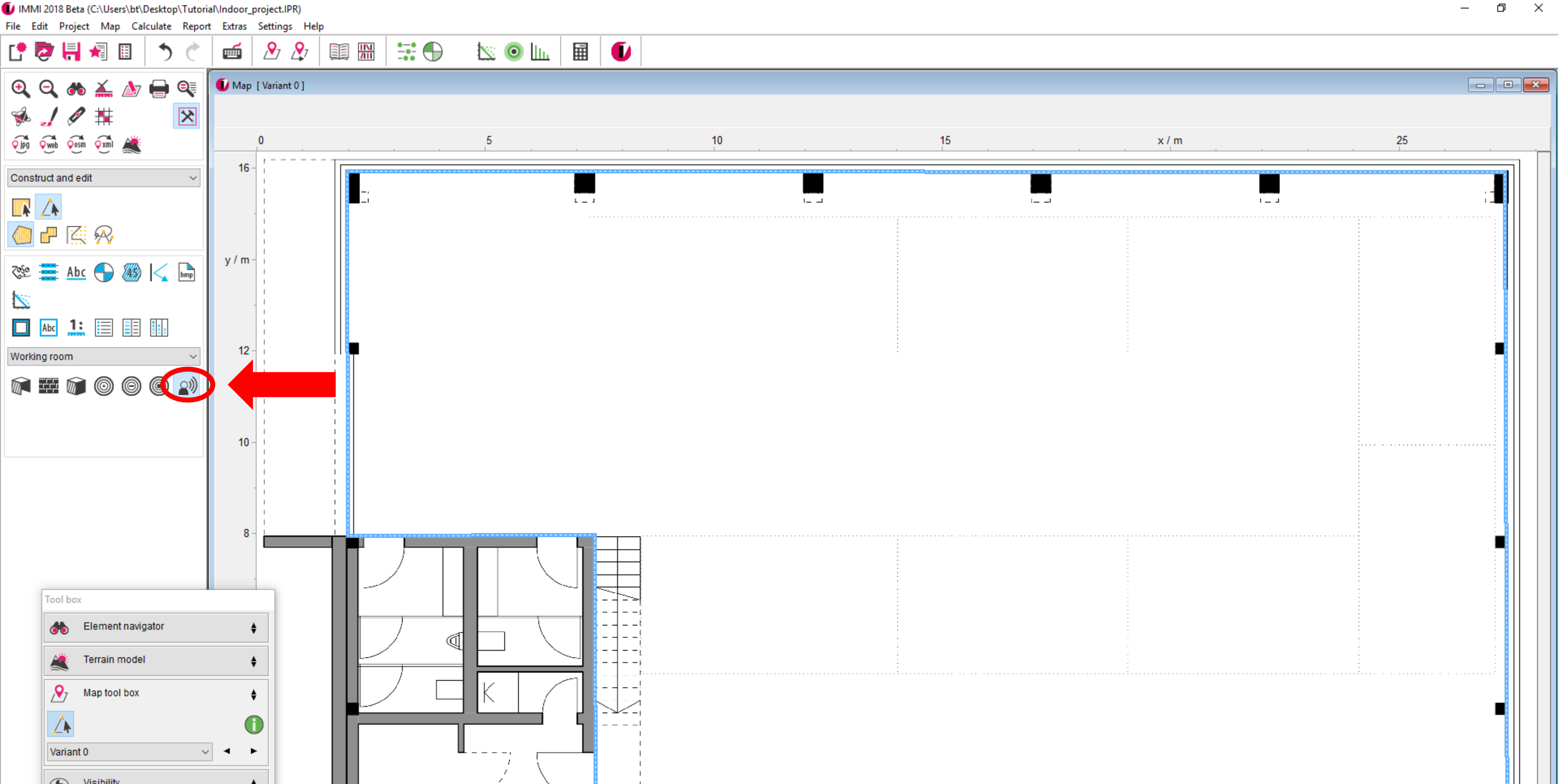
The tab "options" can be used to adjust the display properties of the graphs "reverberation time" and "comparison of variants".



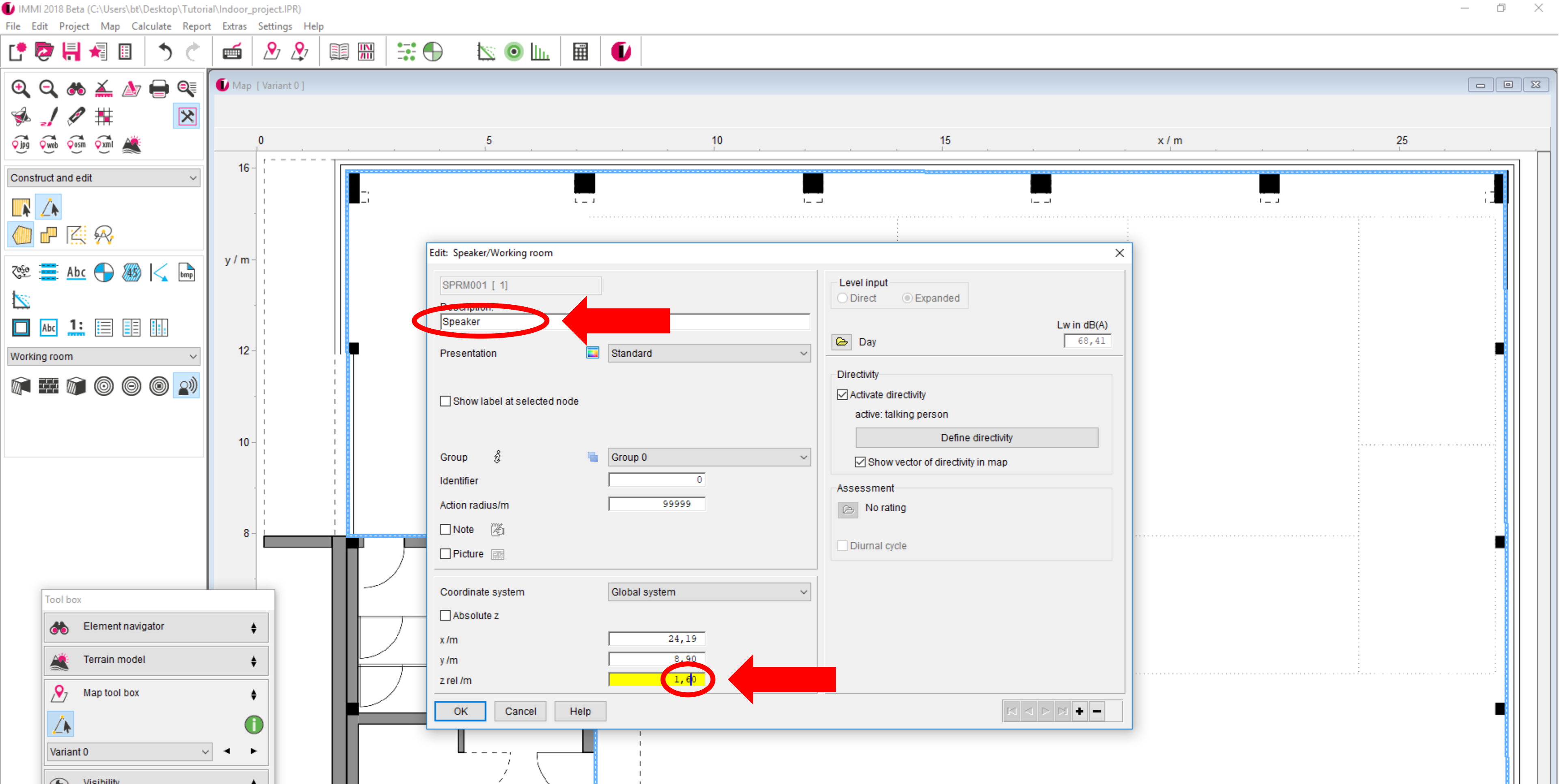
So far we had a look at the statistical room acoustics. In the second part, we will determine the indoor level caused by a noise source.



Therefore, choose the "draw element" tool.

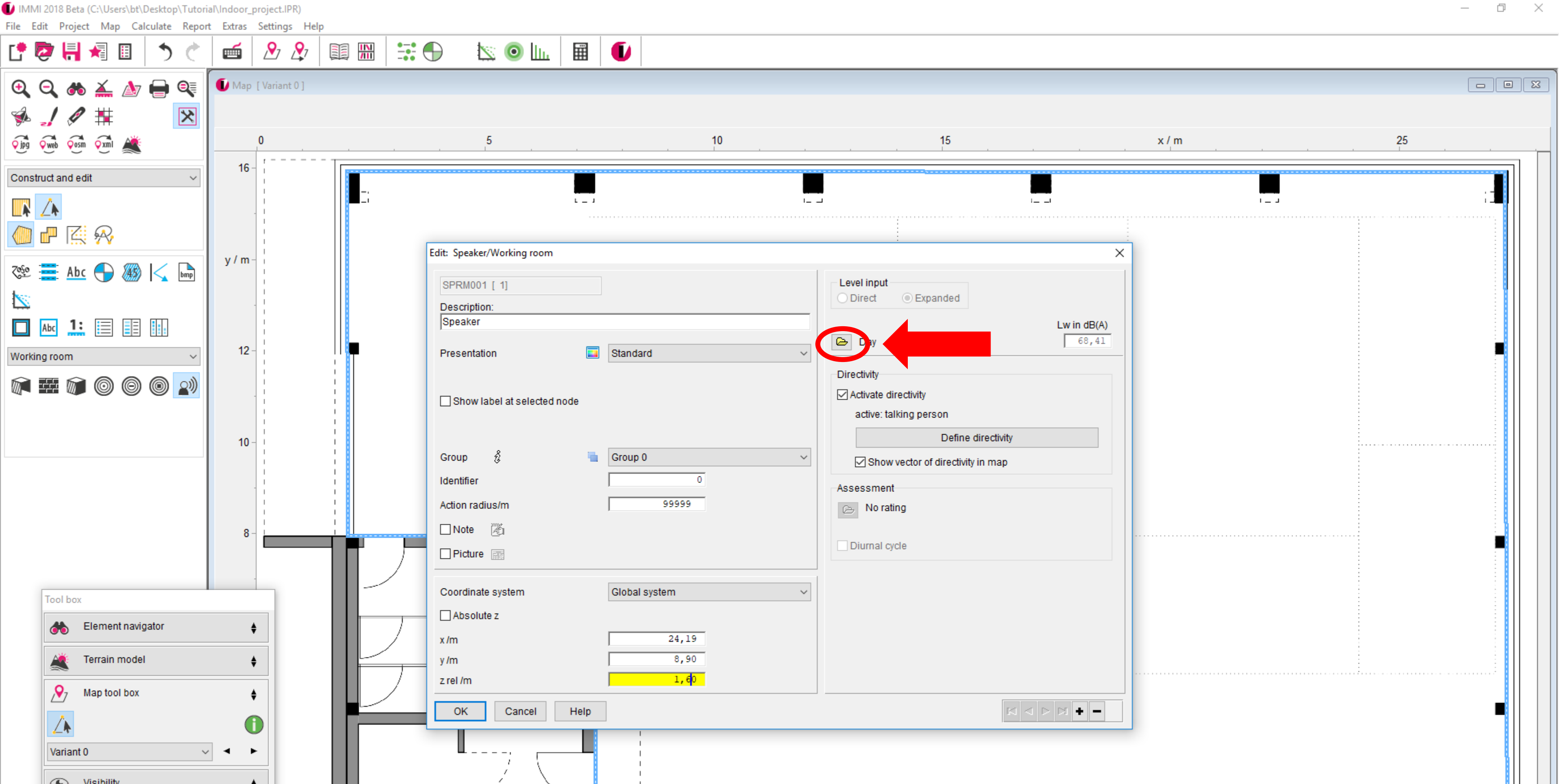


In the element library "working room" we have a point, line and area source available as well as a human speaker which we will now use.

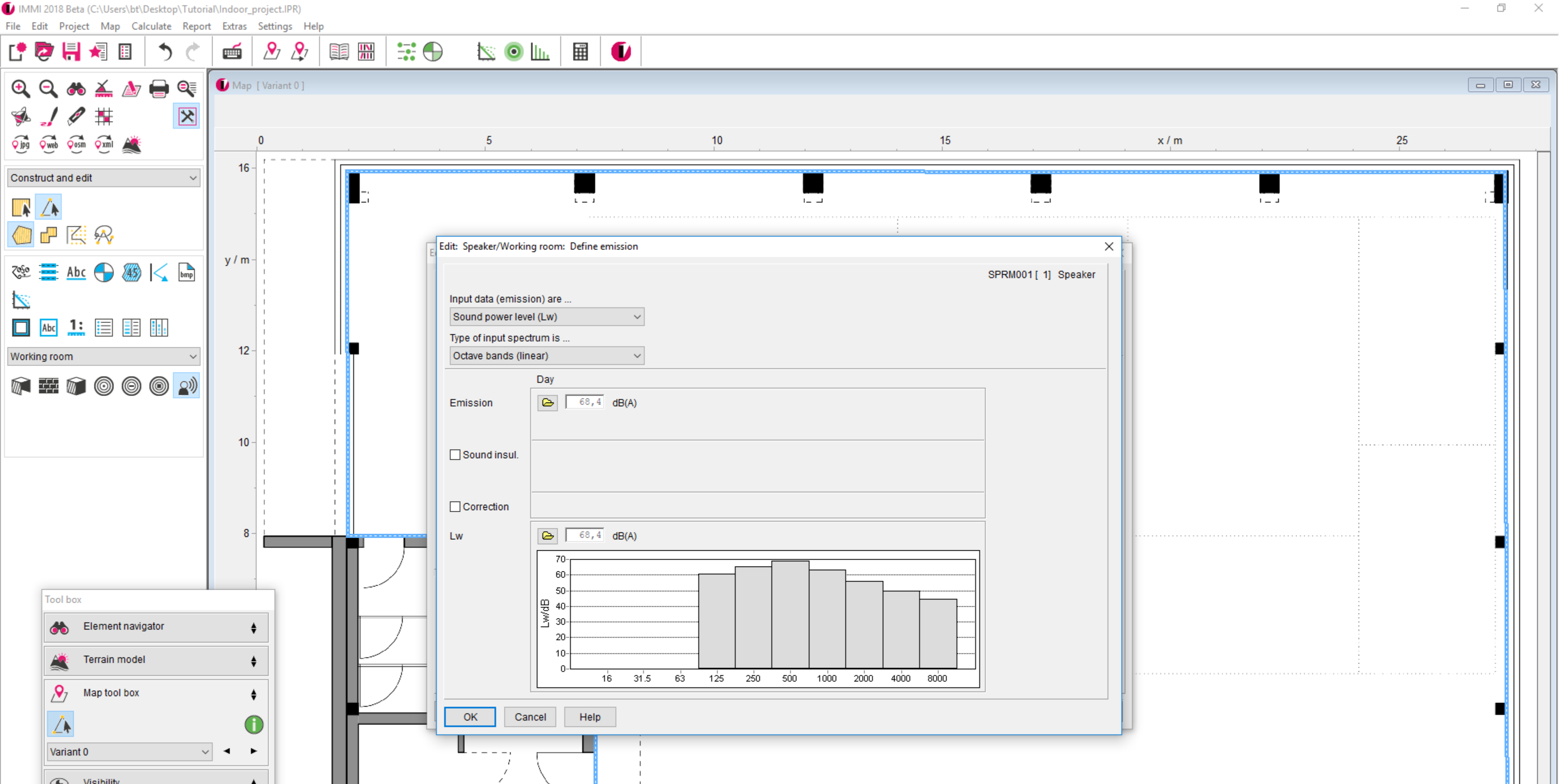


After placing the speaker in the right hand part of the room, the element dialogue opens. Enter a description and a relative height of 1.6 m.

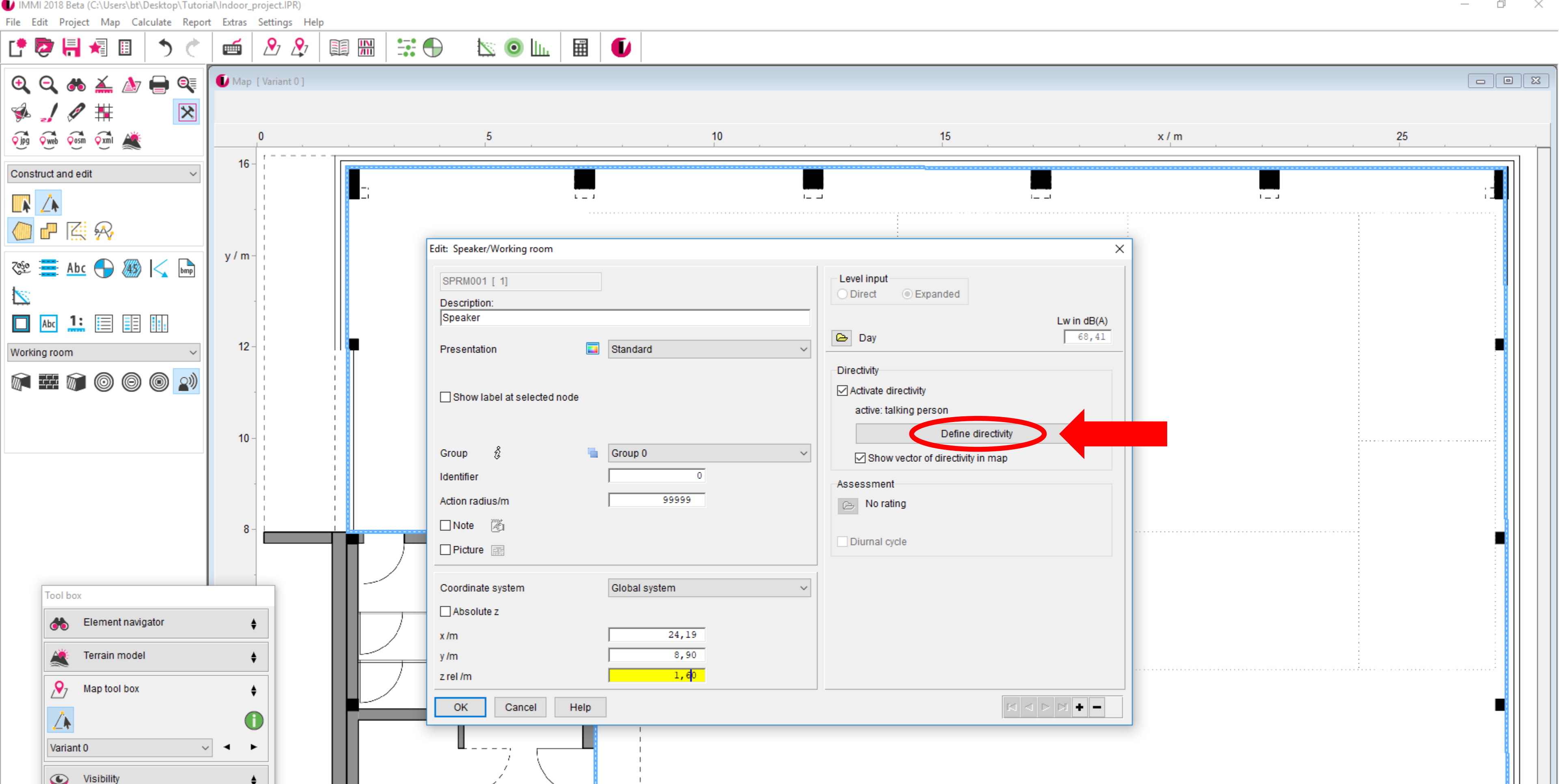




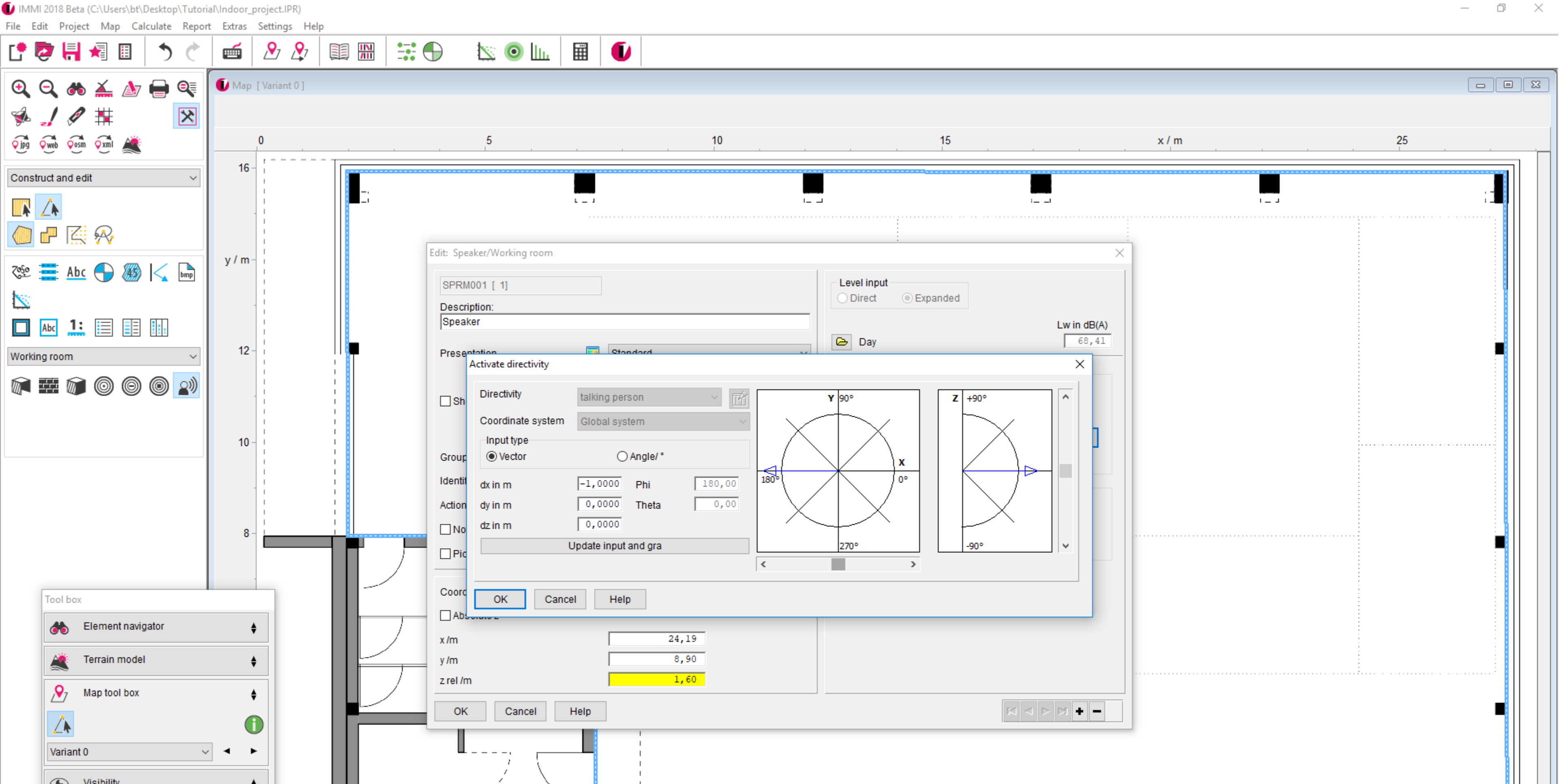
The emission level of the speaker is predefined. You can access the emission spectrum by clicking on the folder symbol.



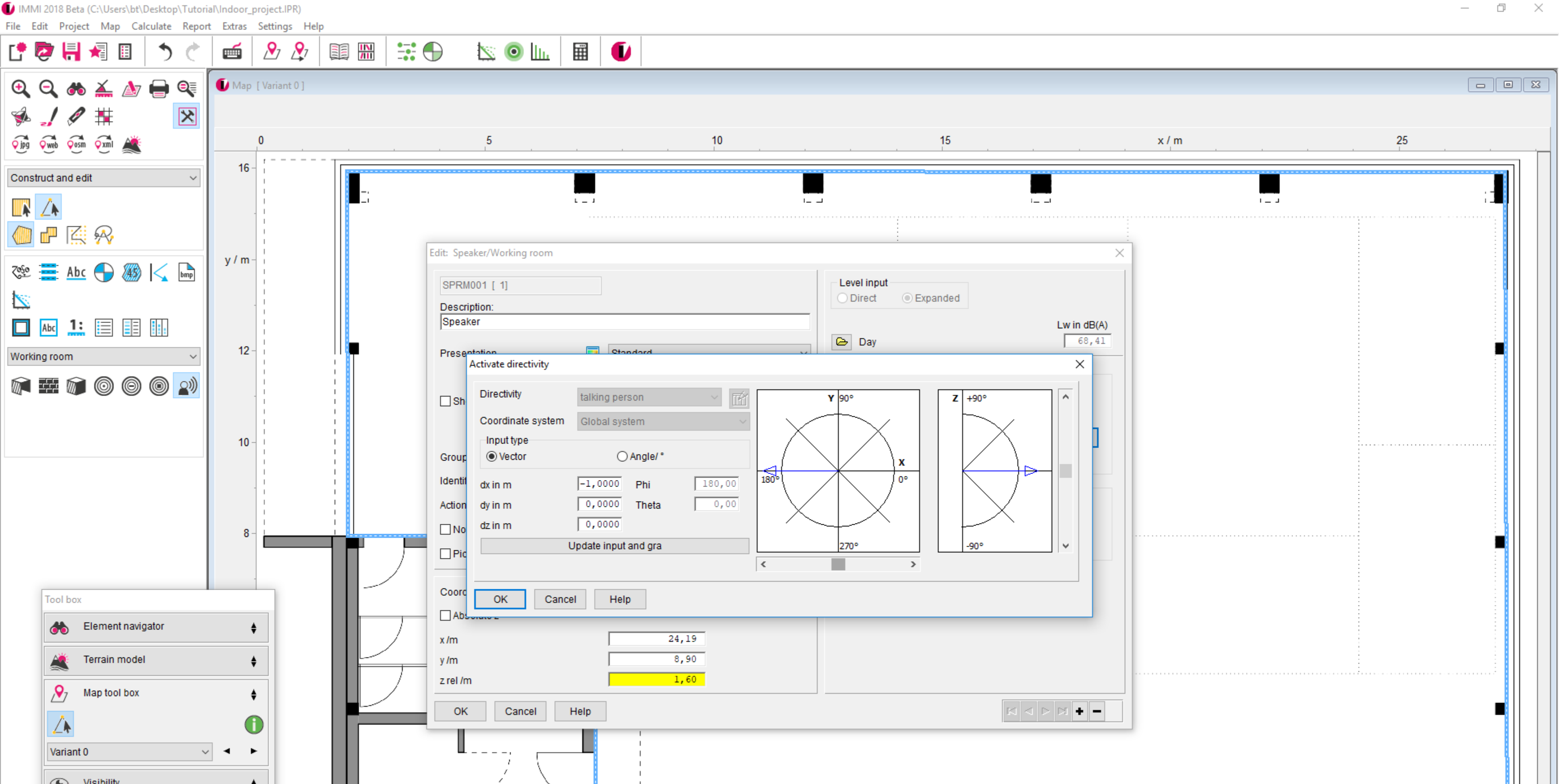
This shows the spectral information of the emission values as well as the sum level. Both can be adjusted if necessary.



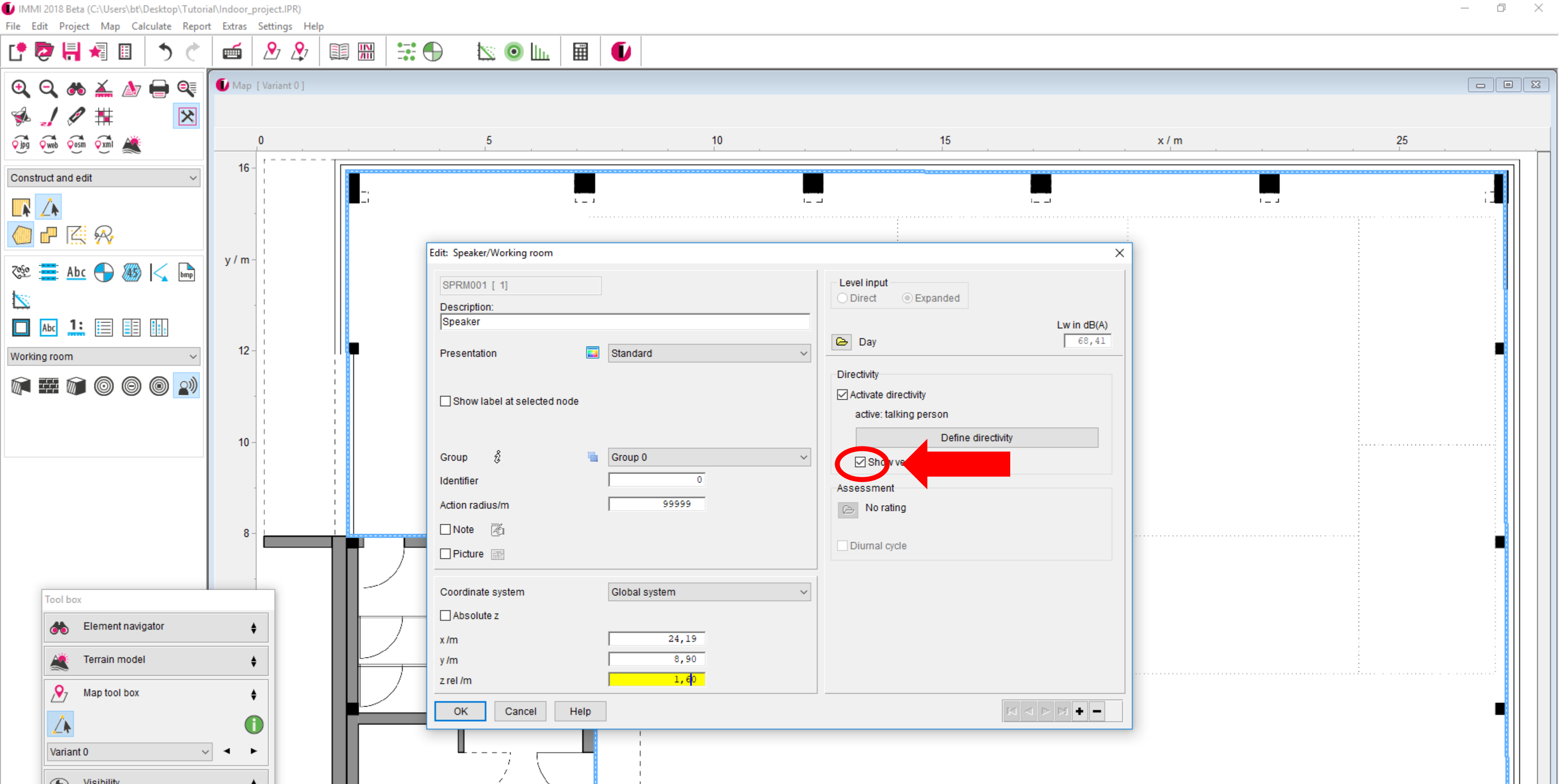
Close the dialogue again and define the directivity.



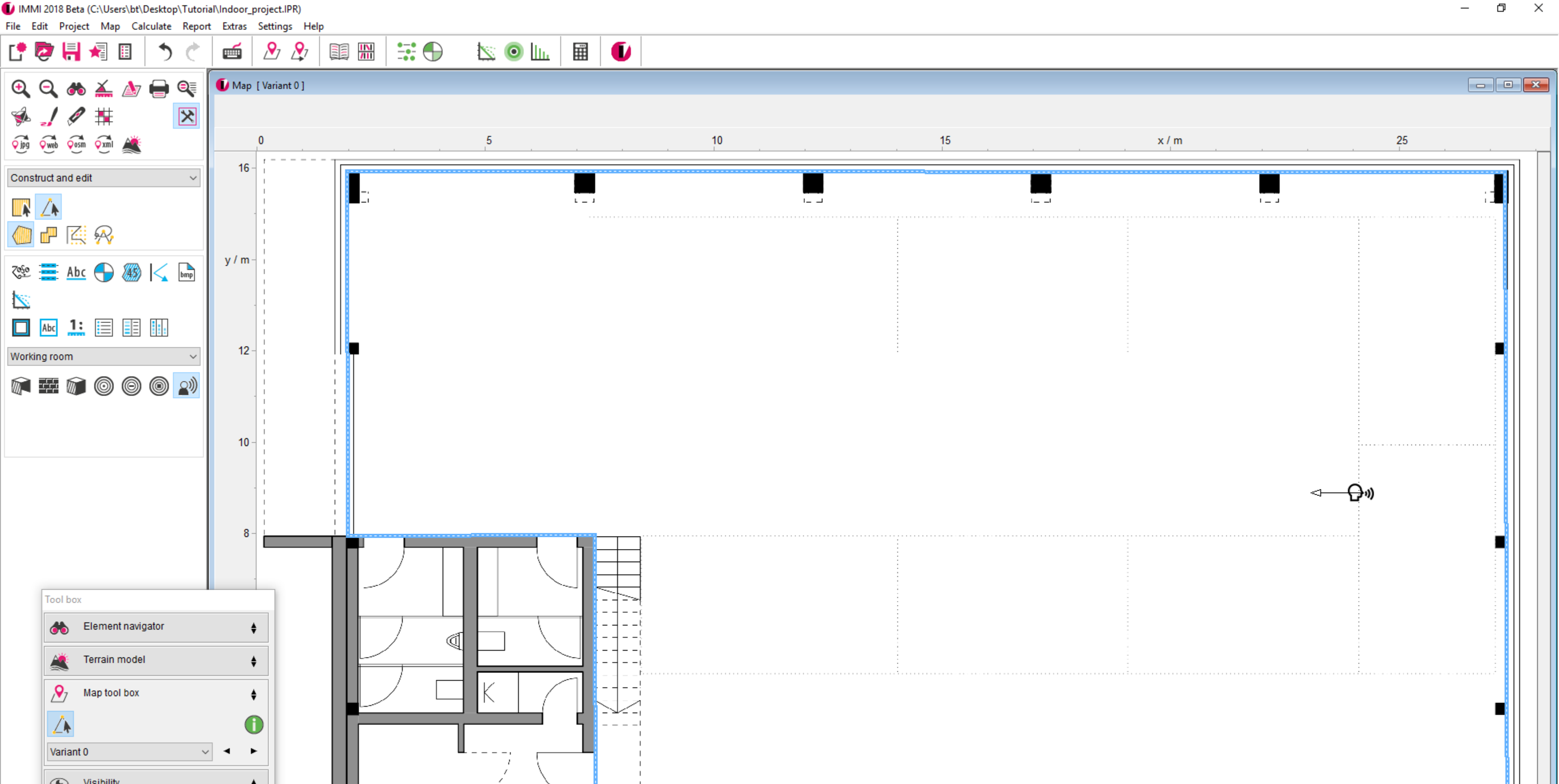
You can either type in the angles for the directivity or set the arrow to the desired direction.



In the coordinate systems the one on the left is the direction as seen in the ground plan and the one on the right is the vertical orientation.

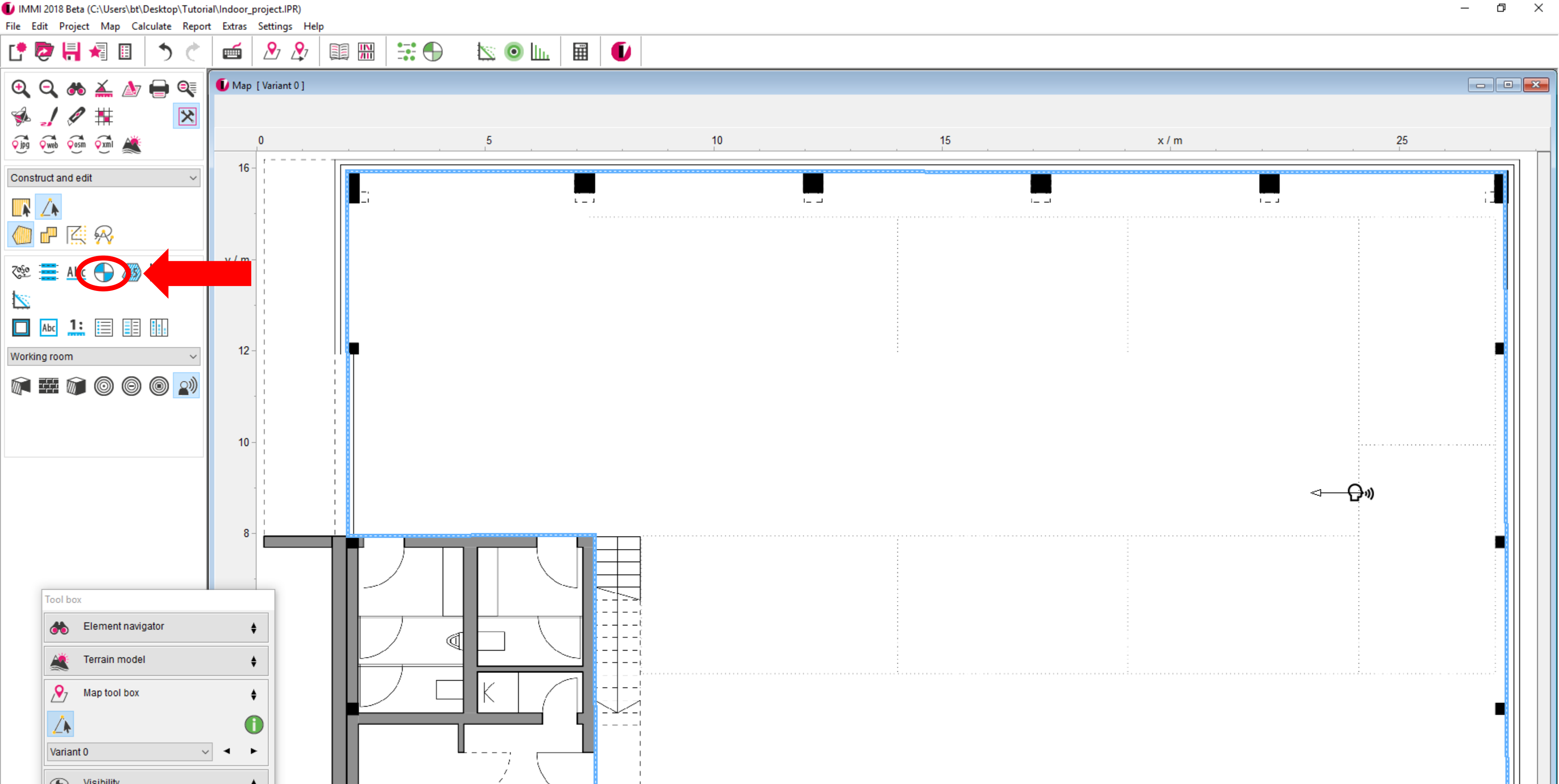


You can activate or deactivate the display of the directivity vector in the ground plan.

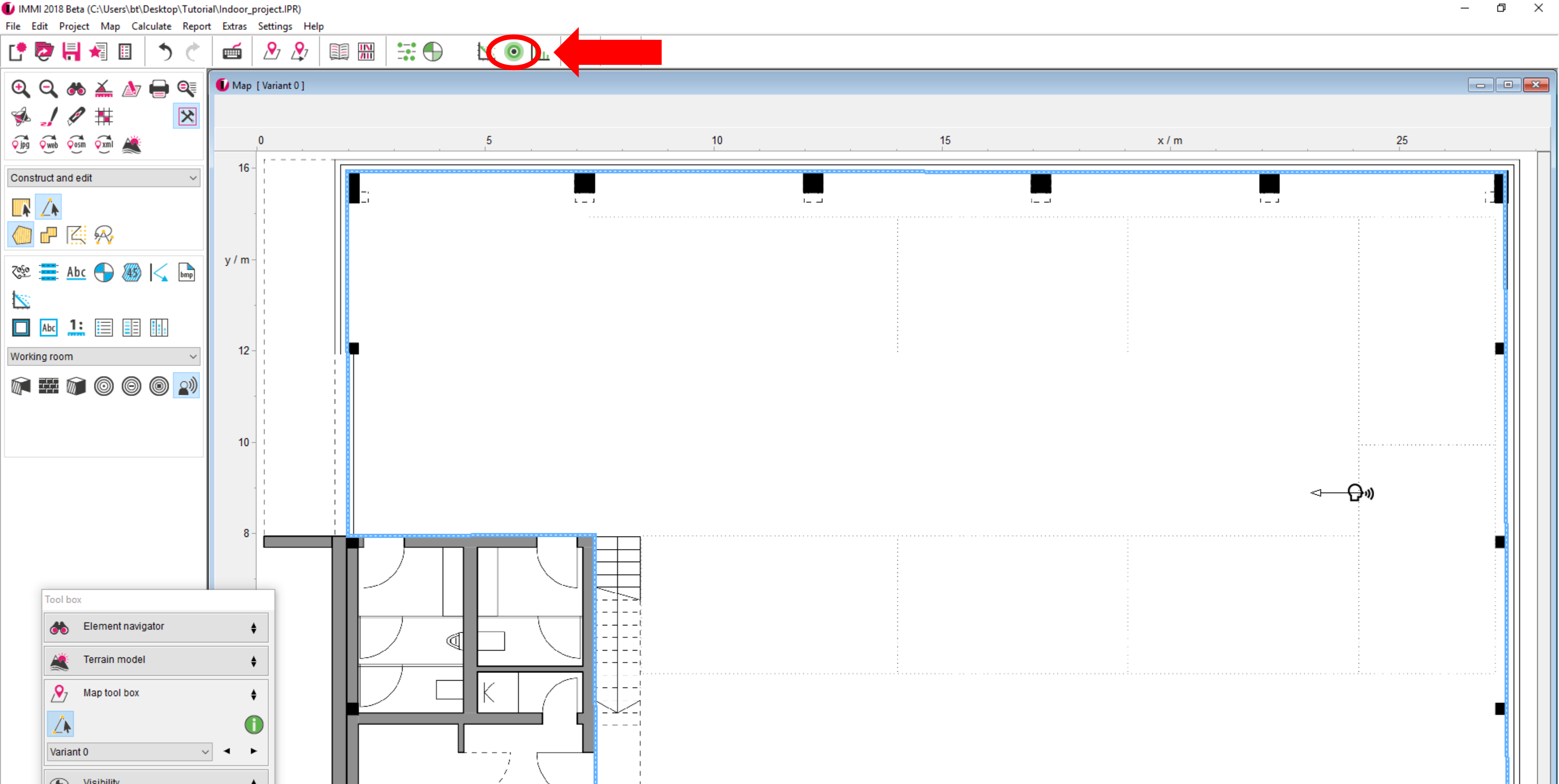


After closing the dialogue we can perform the noise propagation calculation.

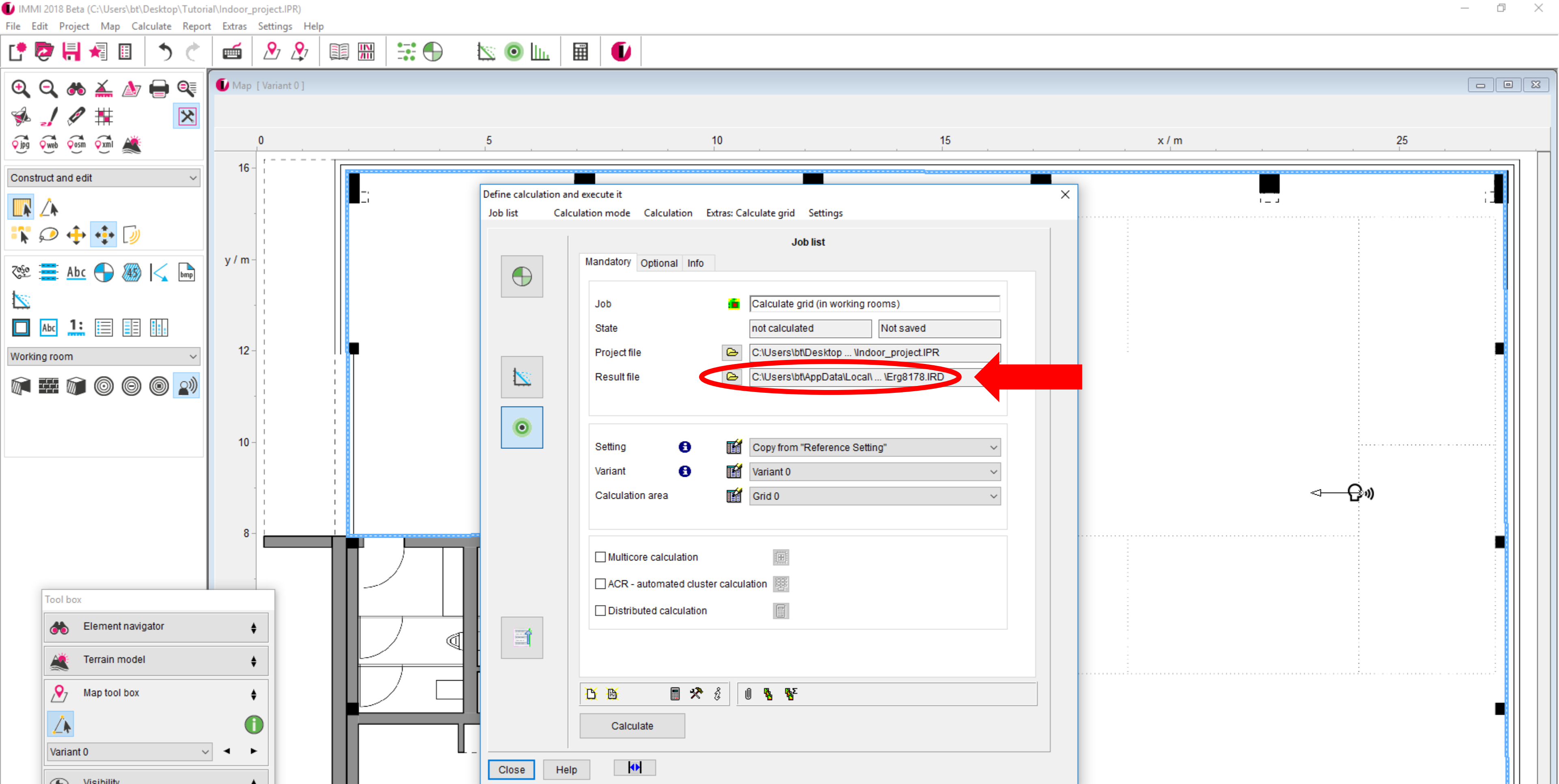




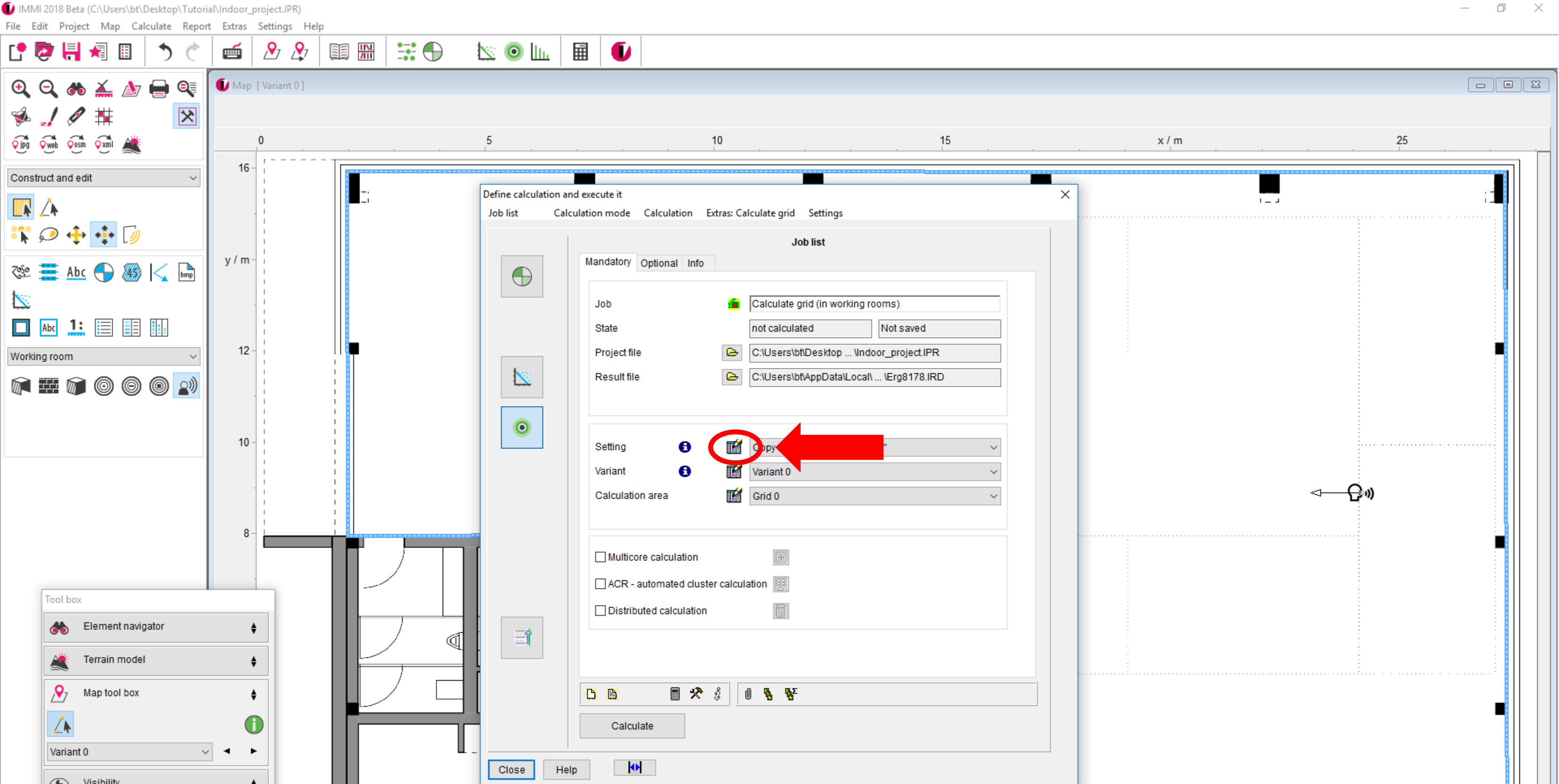
This can either be done as a receiver point or a grid calculation. For point calculations you would have to set up a receiver point first.



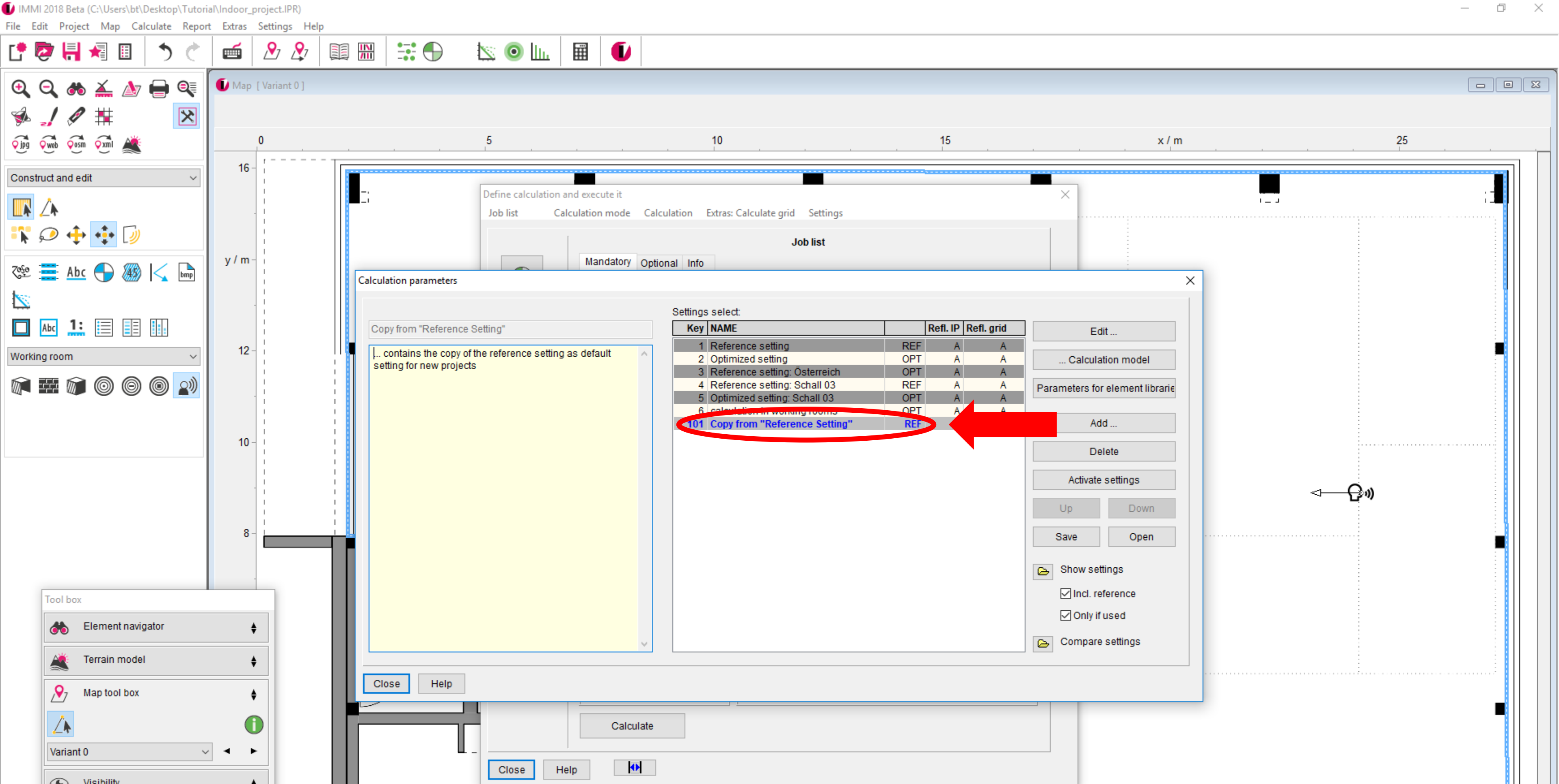
In this example we will instead calculate a noise map of the room.  
Therefore go to the respective dialogue.



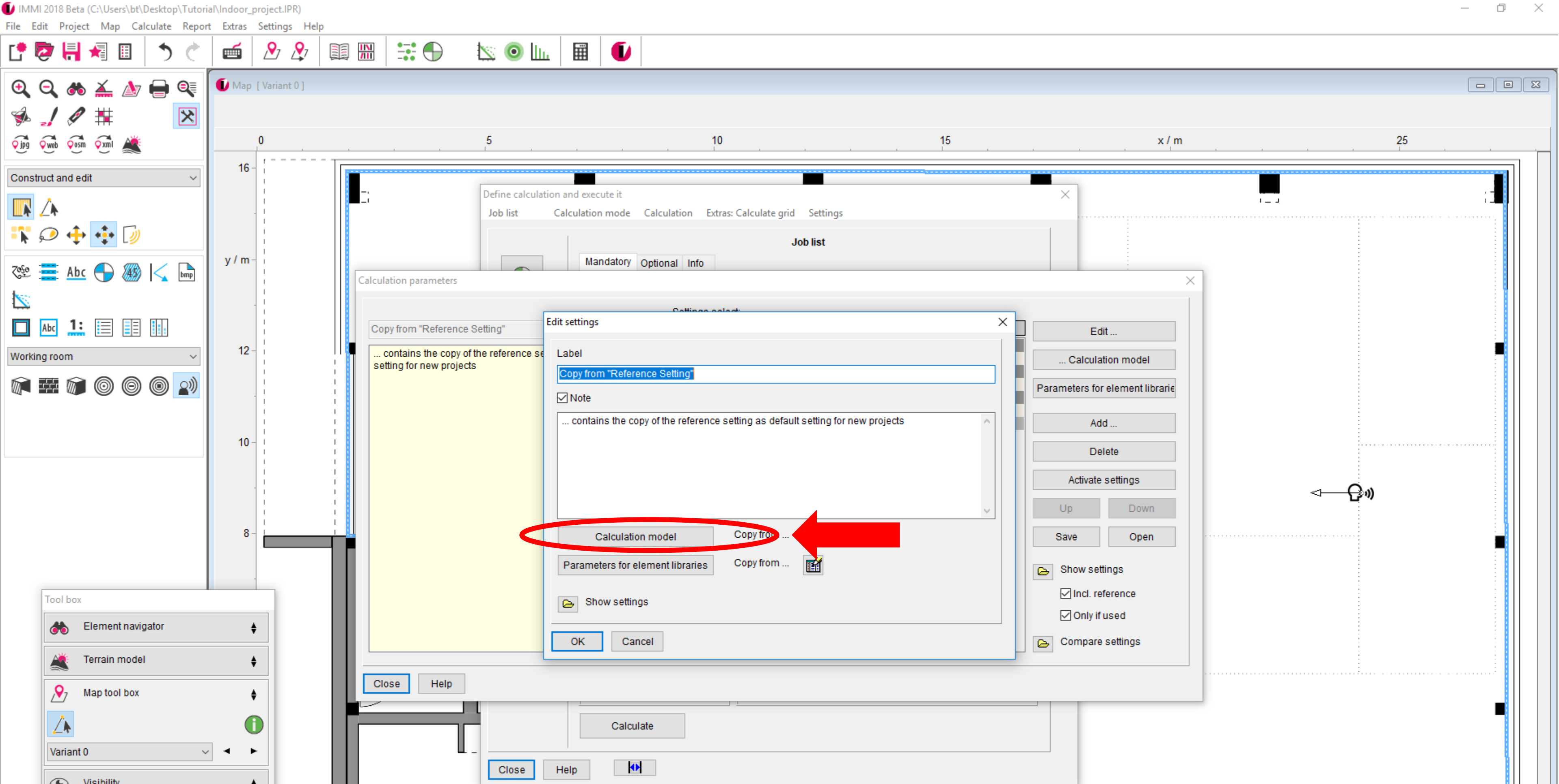
Here we can define the settings for our calculation. First it is recommended to define a path for the result file.



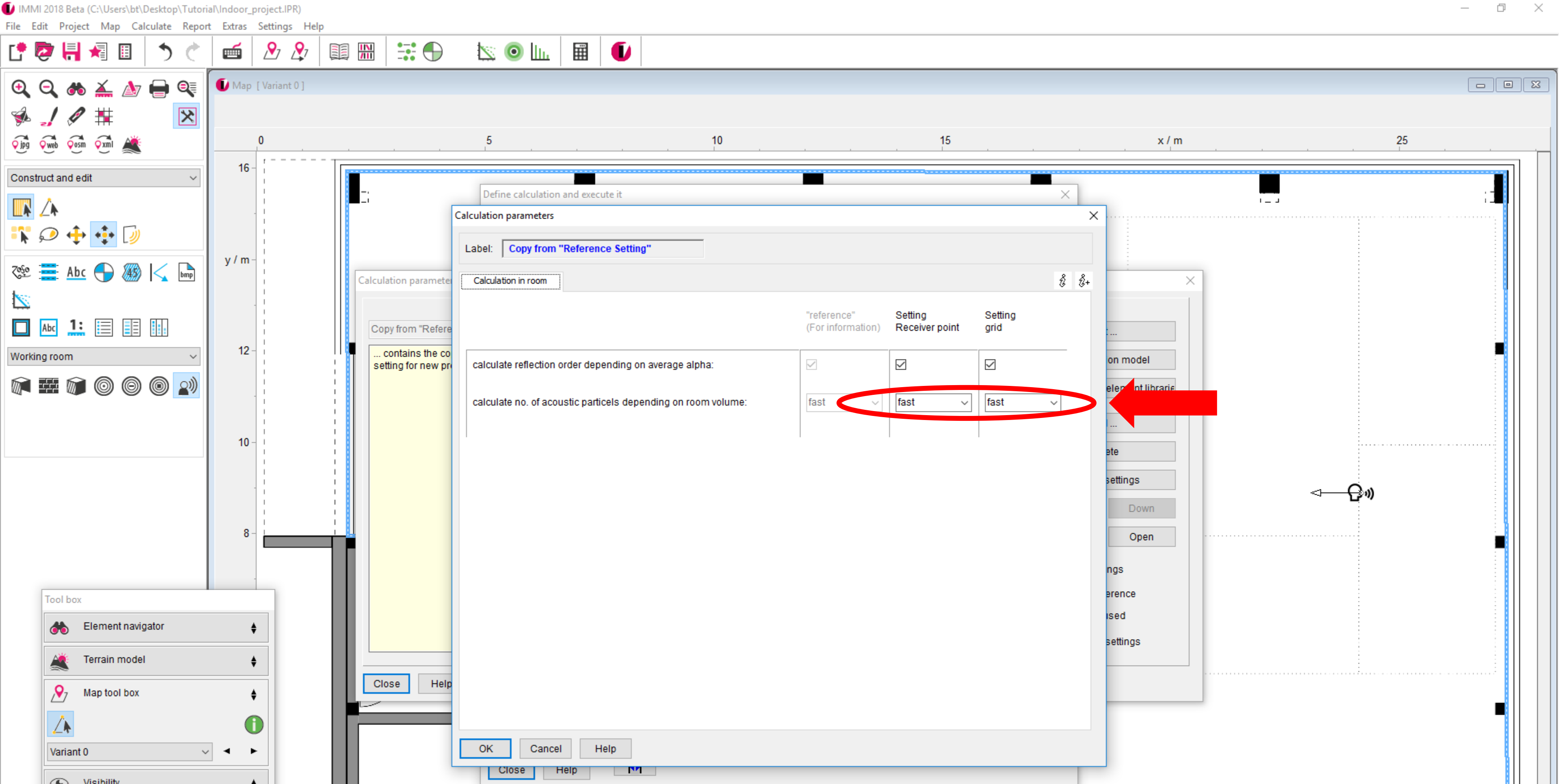
Then enter the dialogue for the calculation parameters.



Enter the activated settings by double-clicking the entry or pressing the edit button after highlighting the entry.

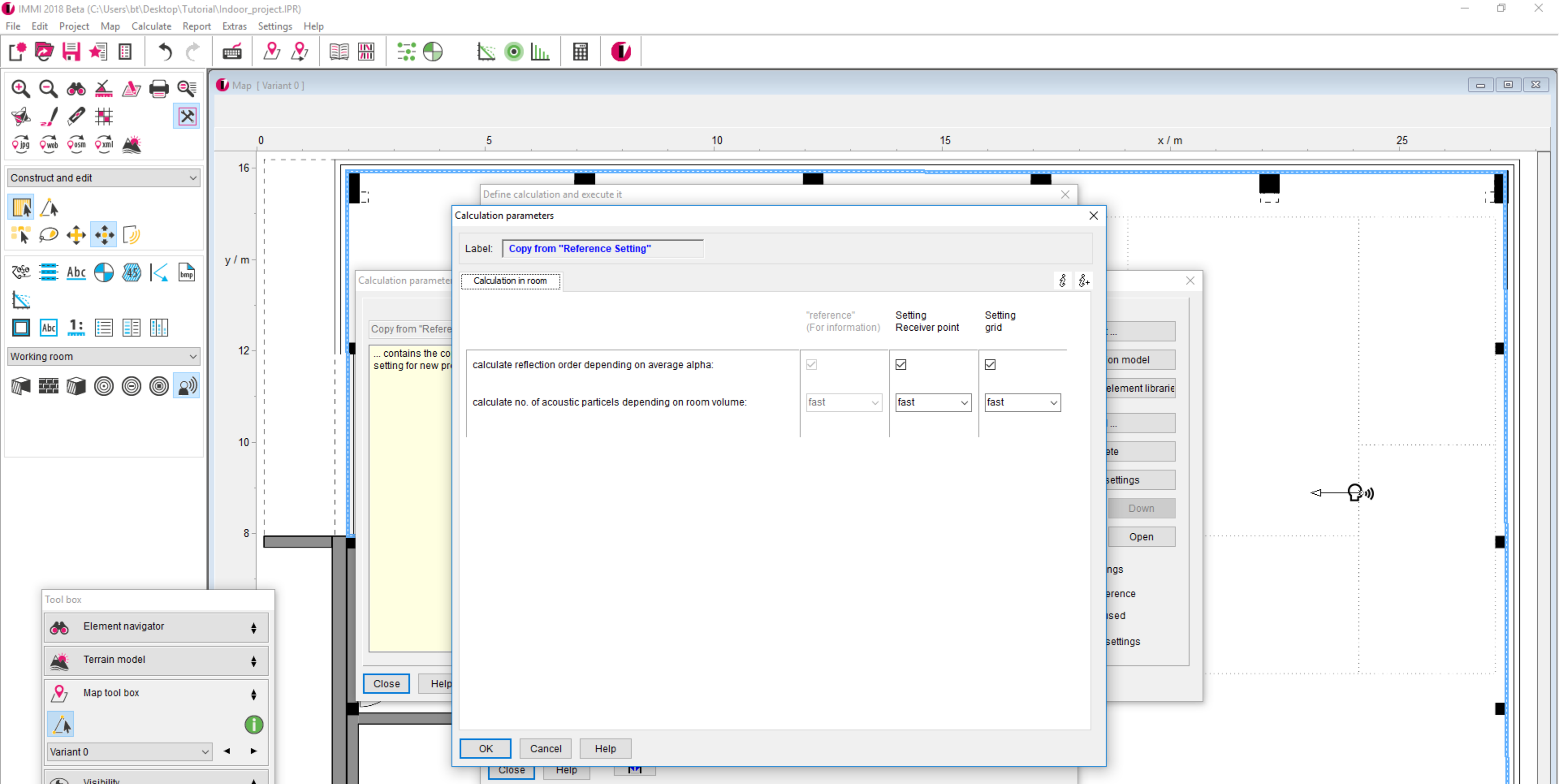


Click the button "calculation model".

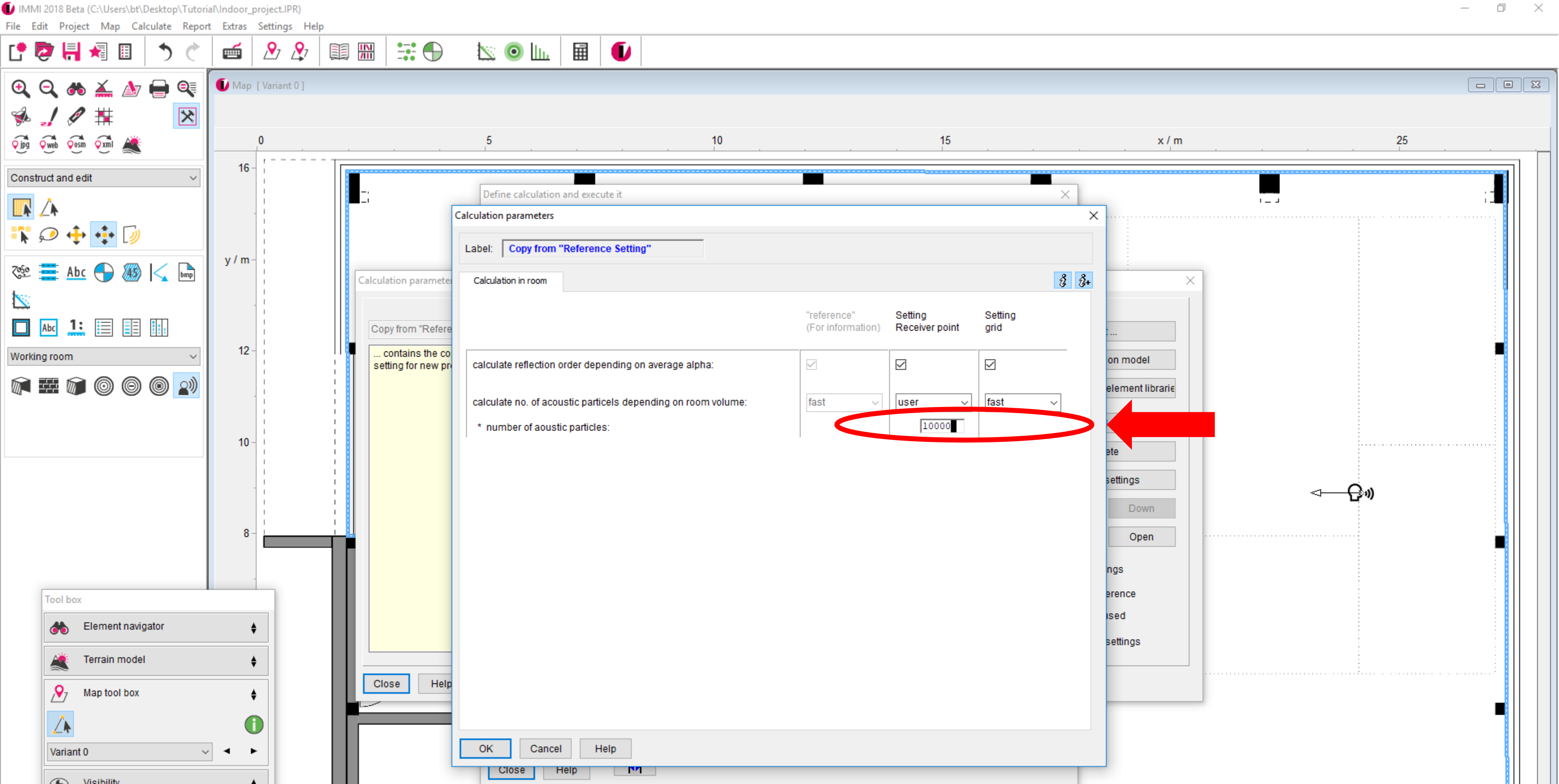


The dialogue shows an overview of the settings for receiver point and grid calculations. The user can select from pedefined settings.

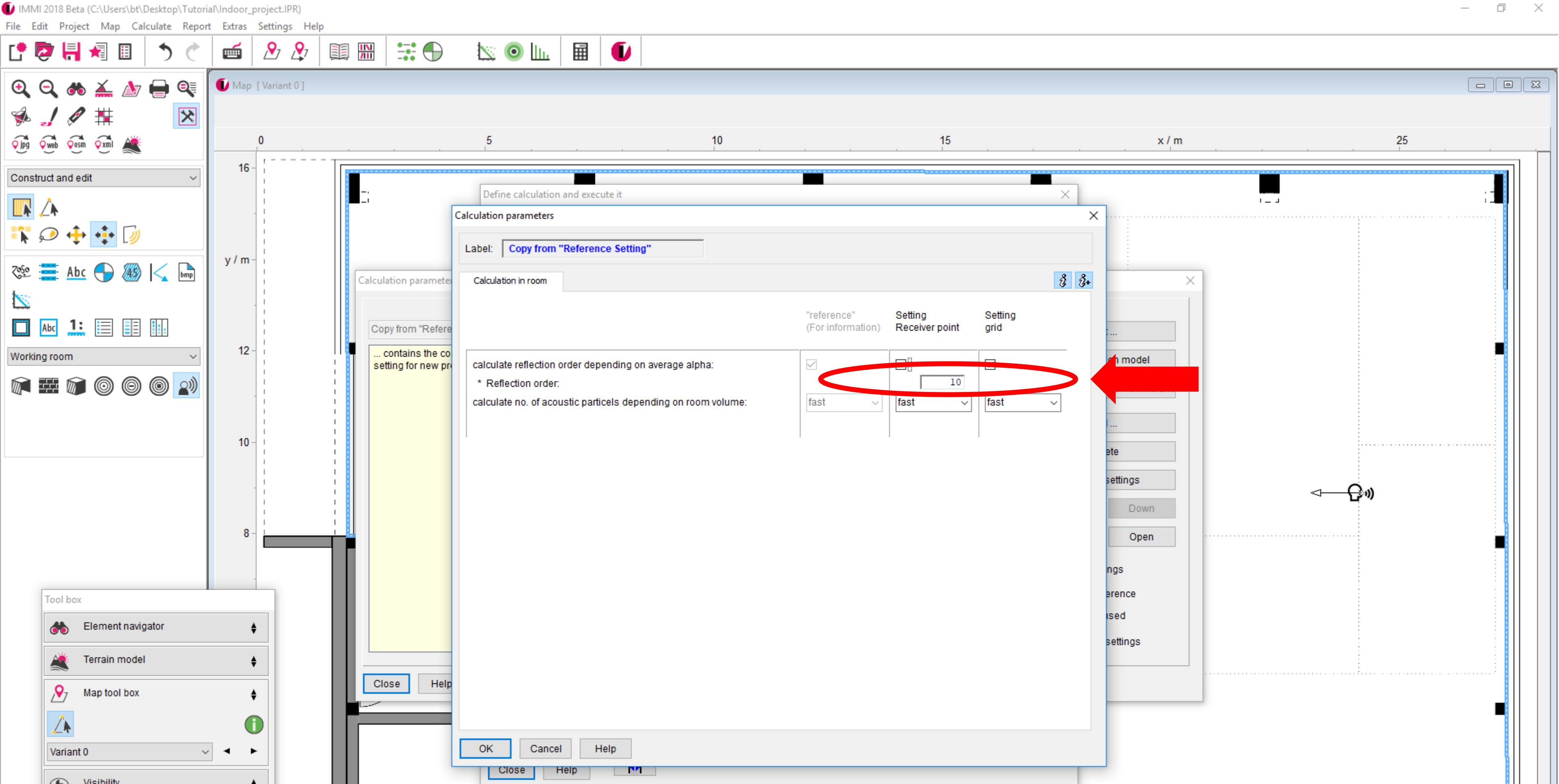




For preliminary results, the setting "fast" is recommended, especially for the grid calculation.

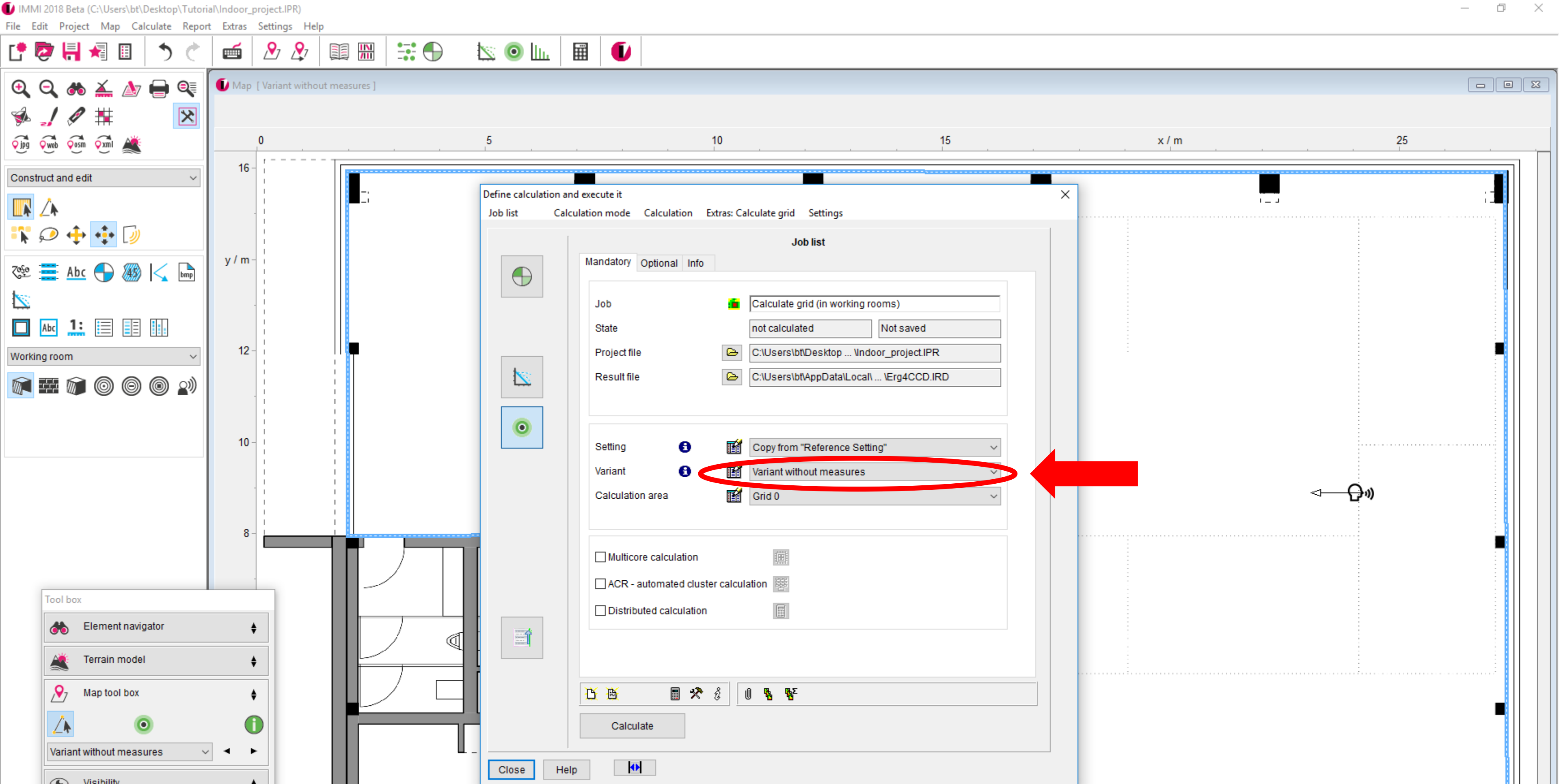


In addition to the predefined settings, the user can define own parameters. This applies to the number of particles...

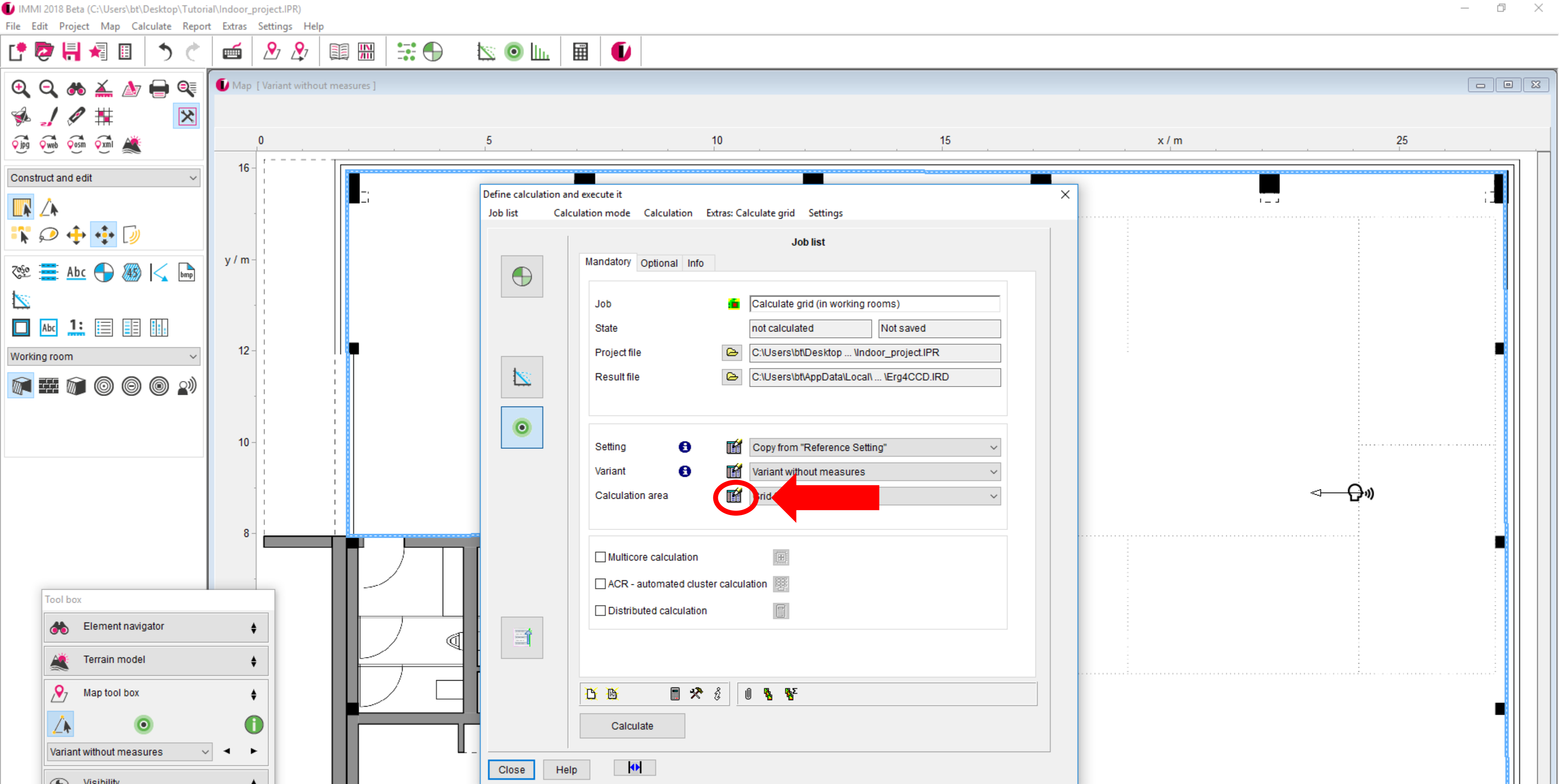


...as well as to the number of reflections to be calculated.

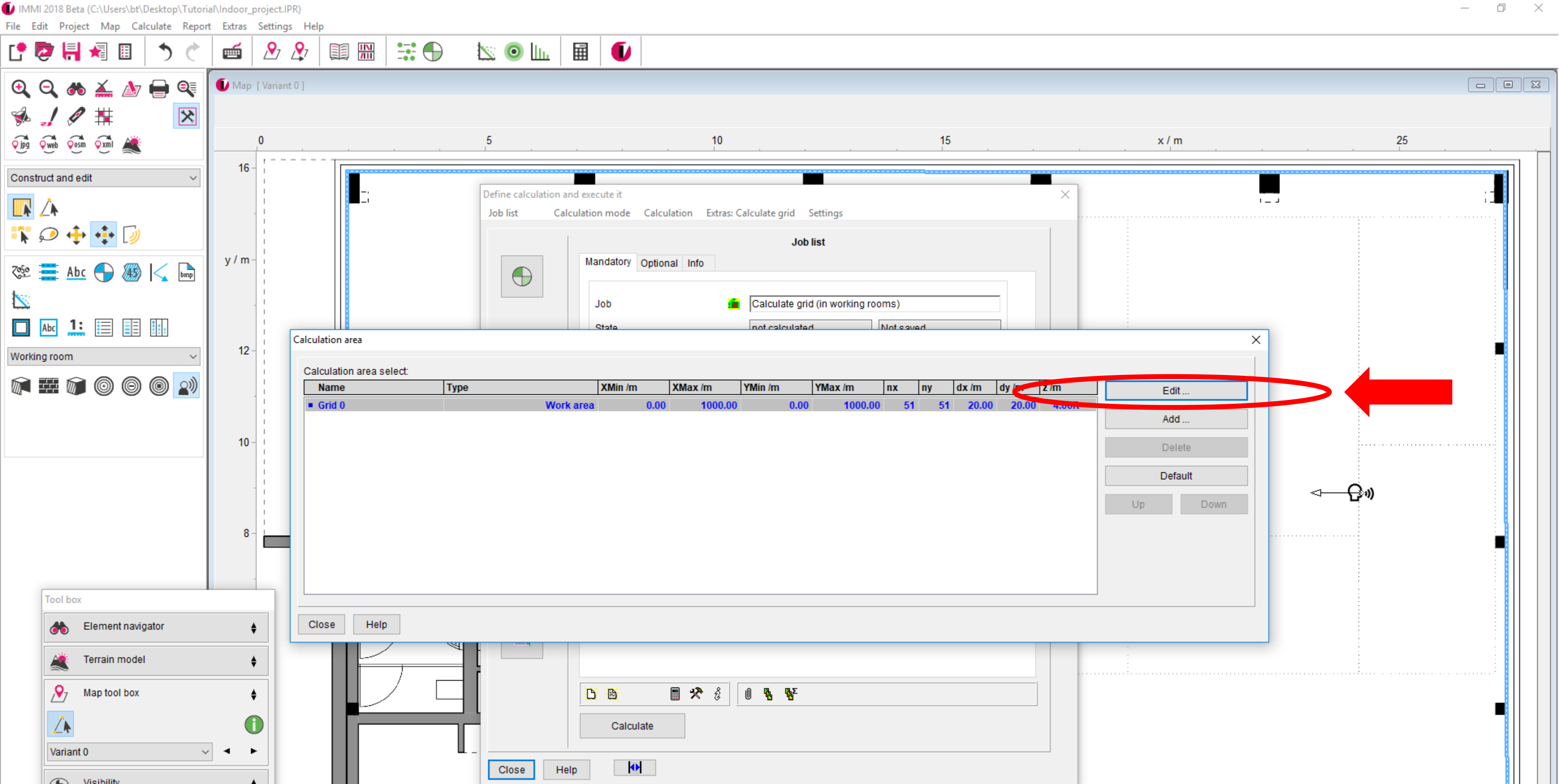




After setting the parameters choose a variant to be calculated (here: variant without measures).

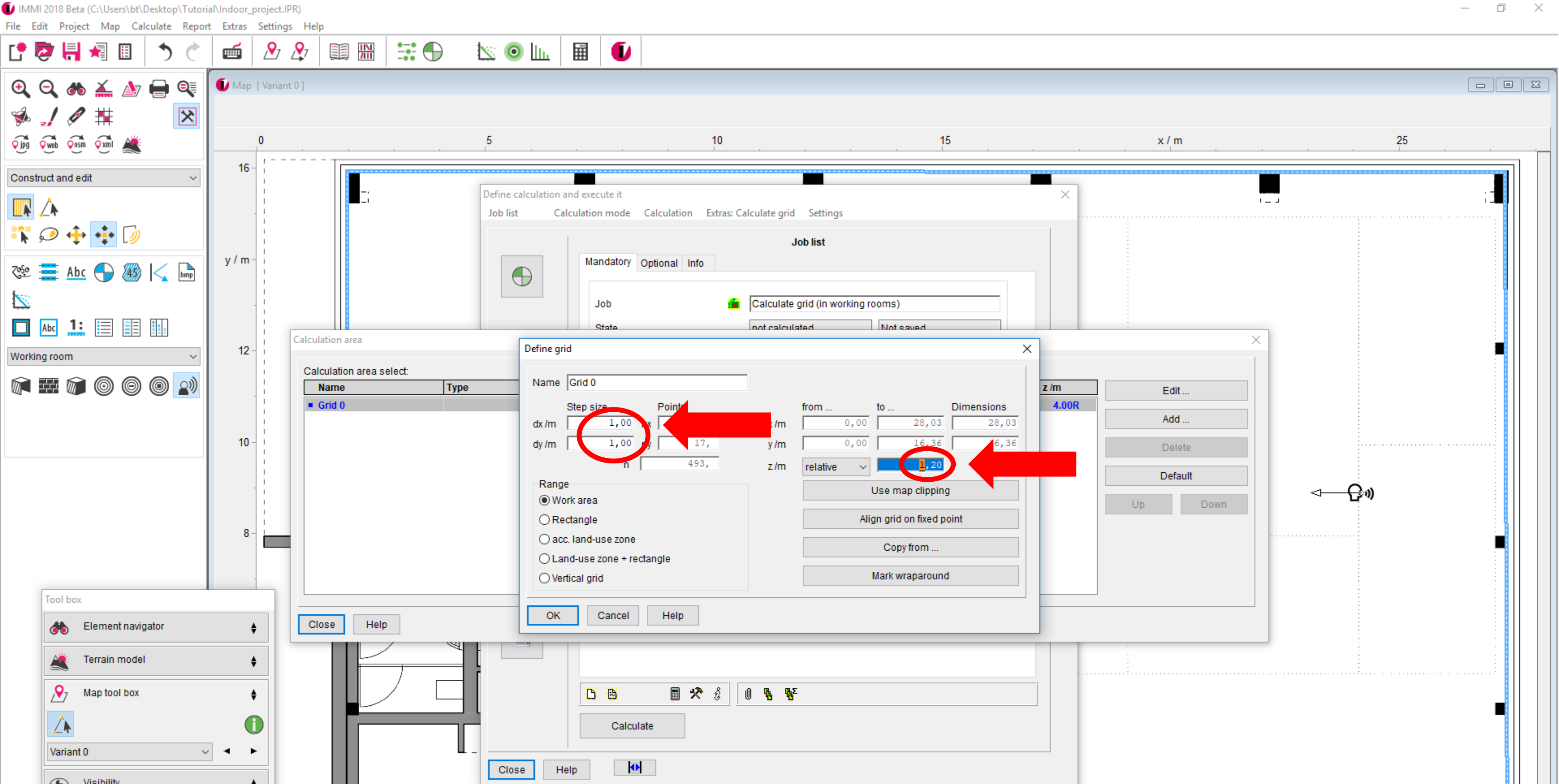


The next step is to define the grid. Click on the edit button.

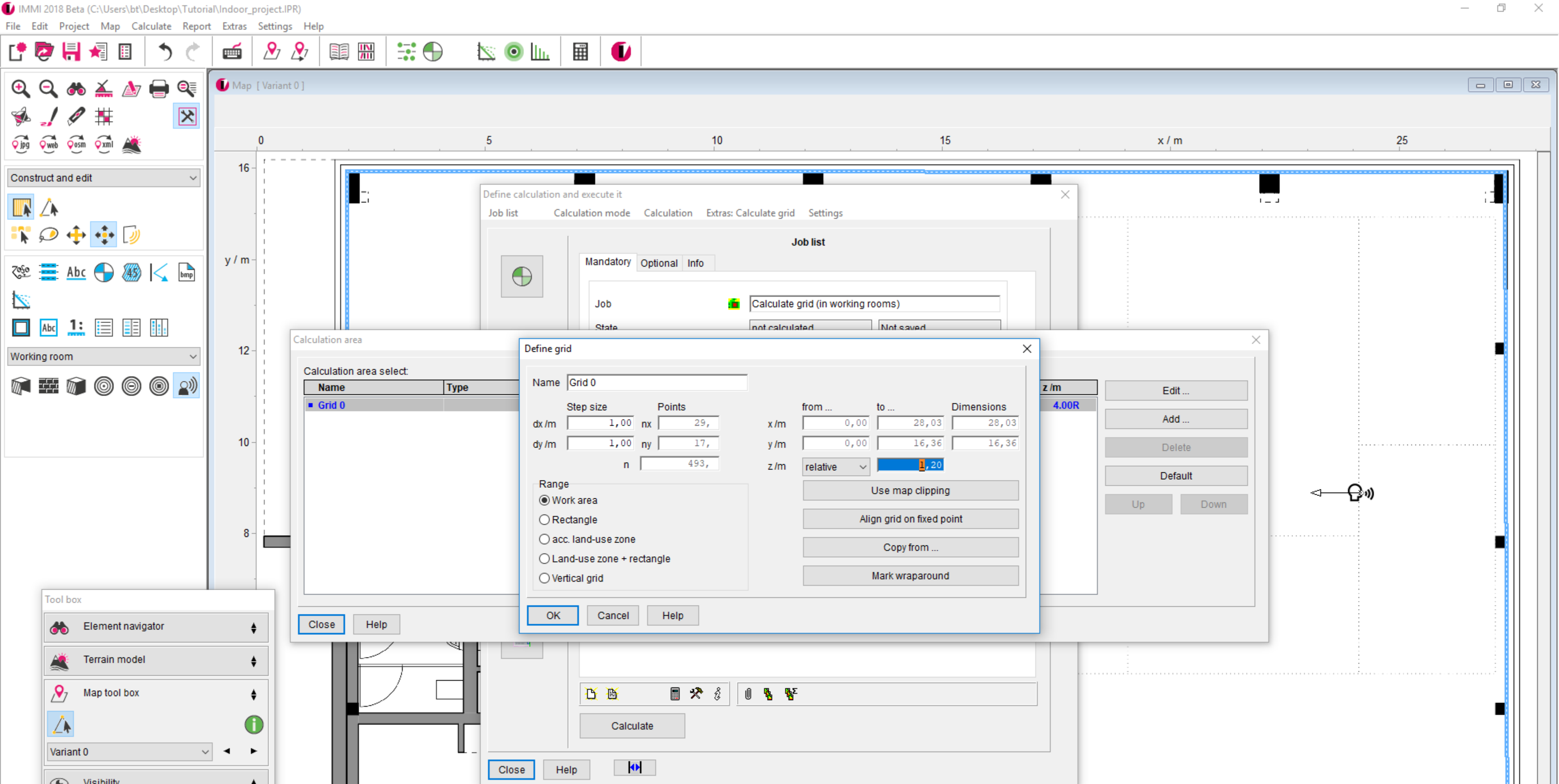


This opens the list with available grids. Choose the first entry and open it by double-clicking or pressing the "edit" button.

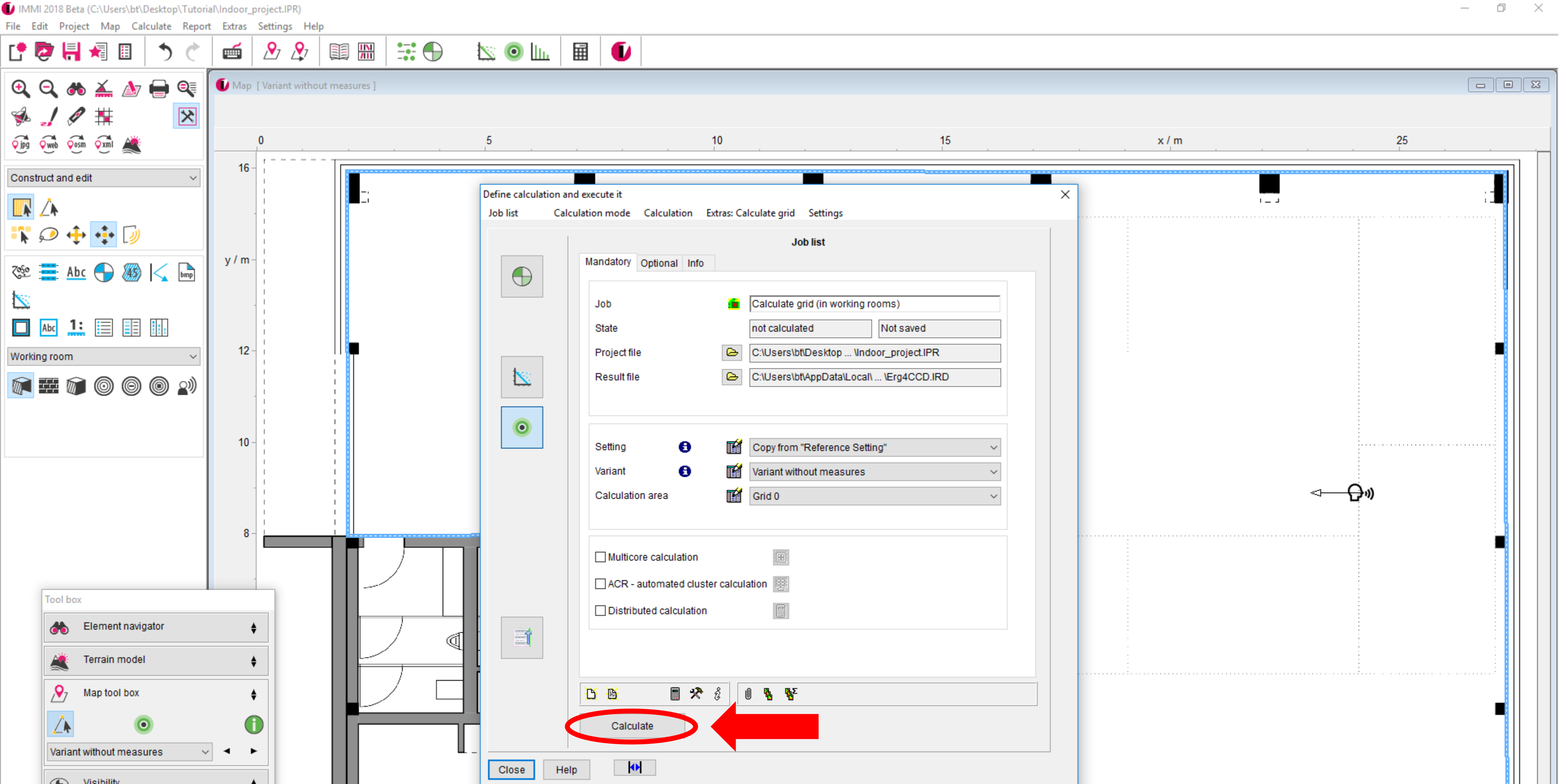




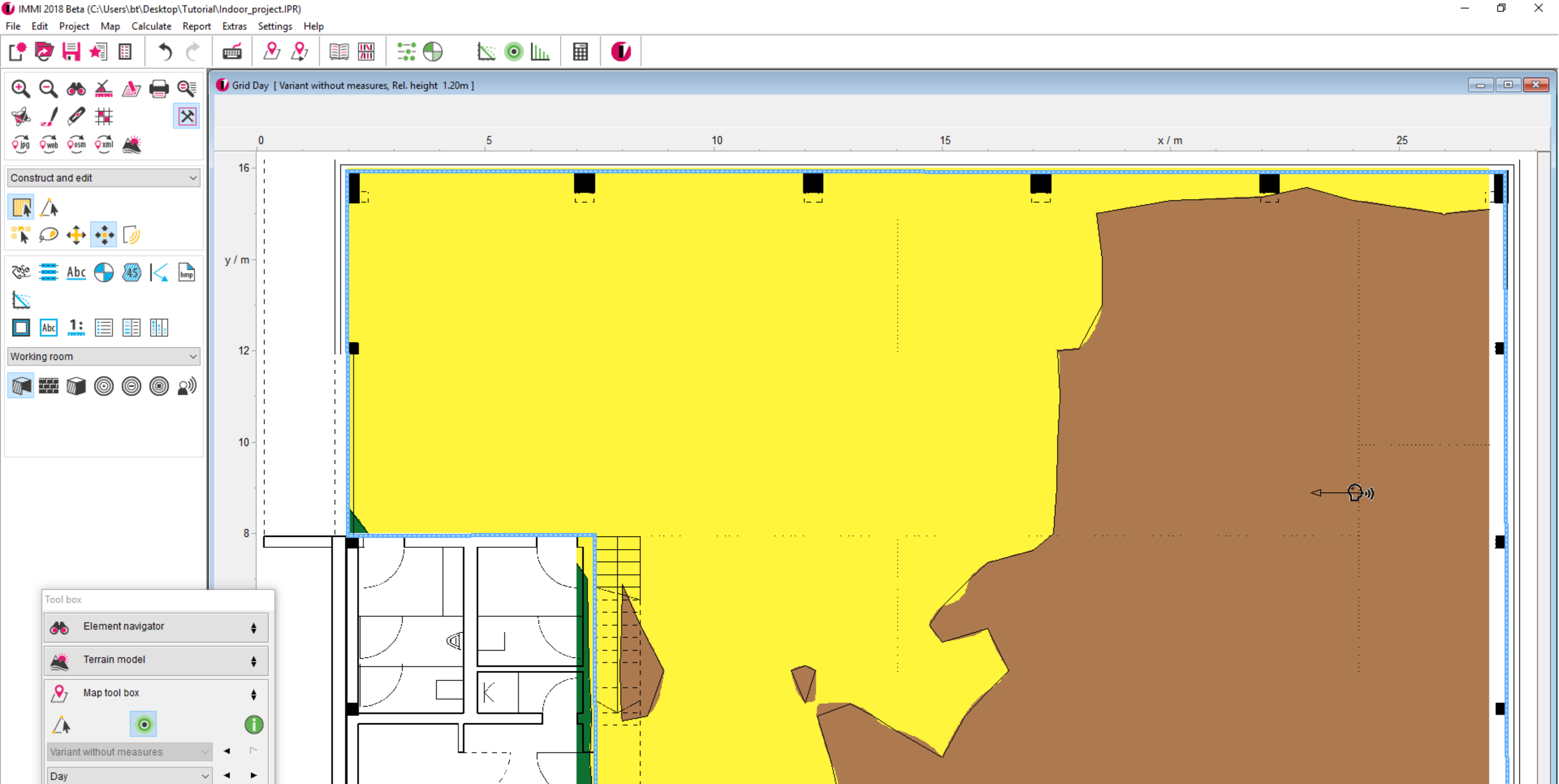
Now set the horizontal resolution to 1 m for the x and y direction and enter 1.2 m as the relative height for the grid.



Close the dialogue with OK.

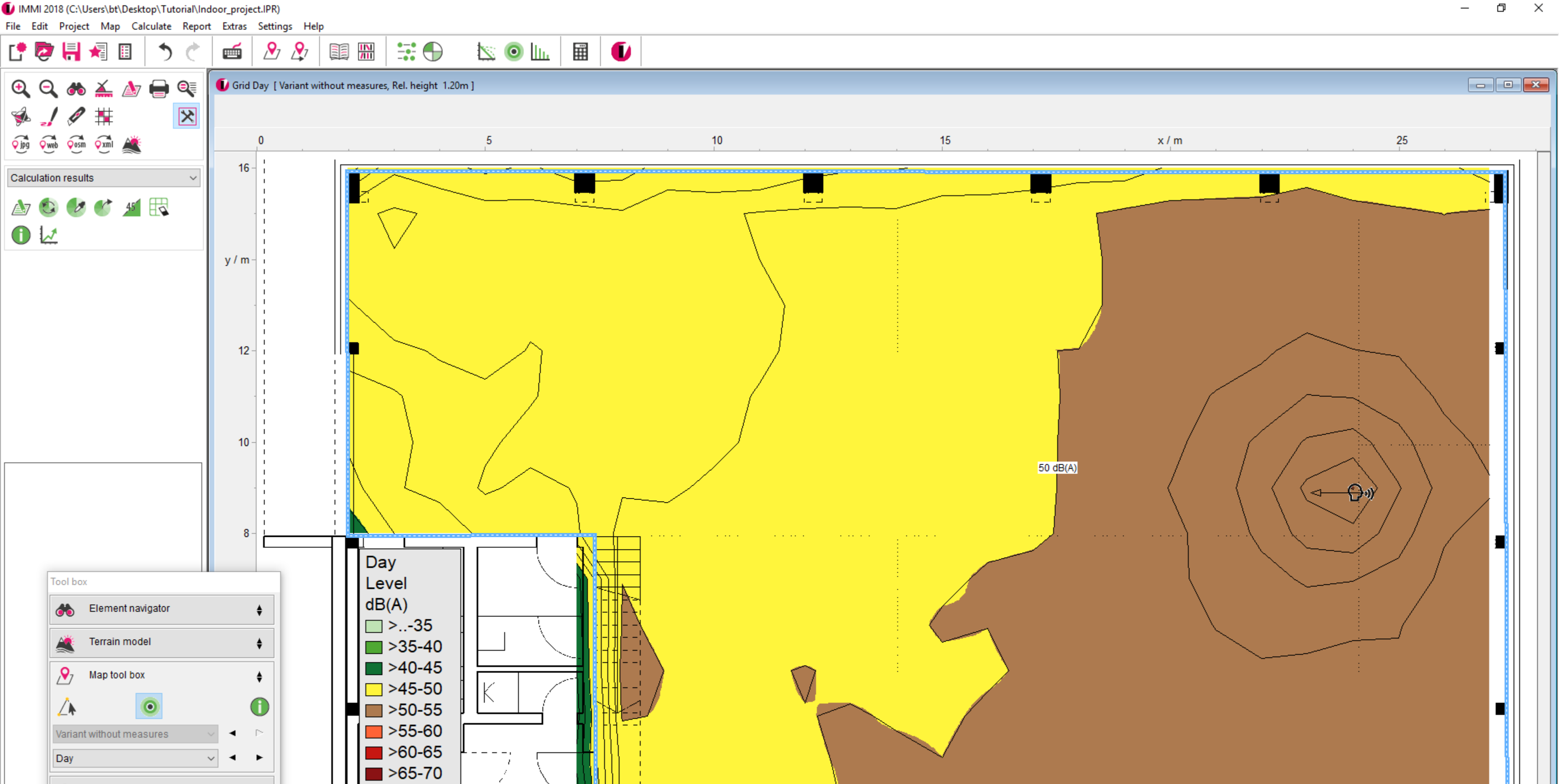


Now start the calculation by clicking the button "Calculate".



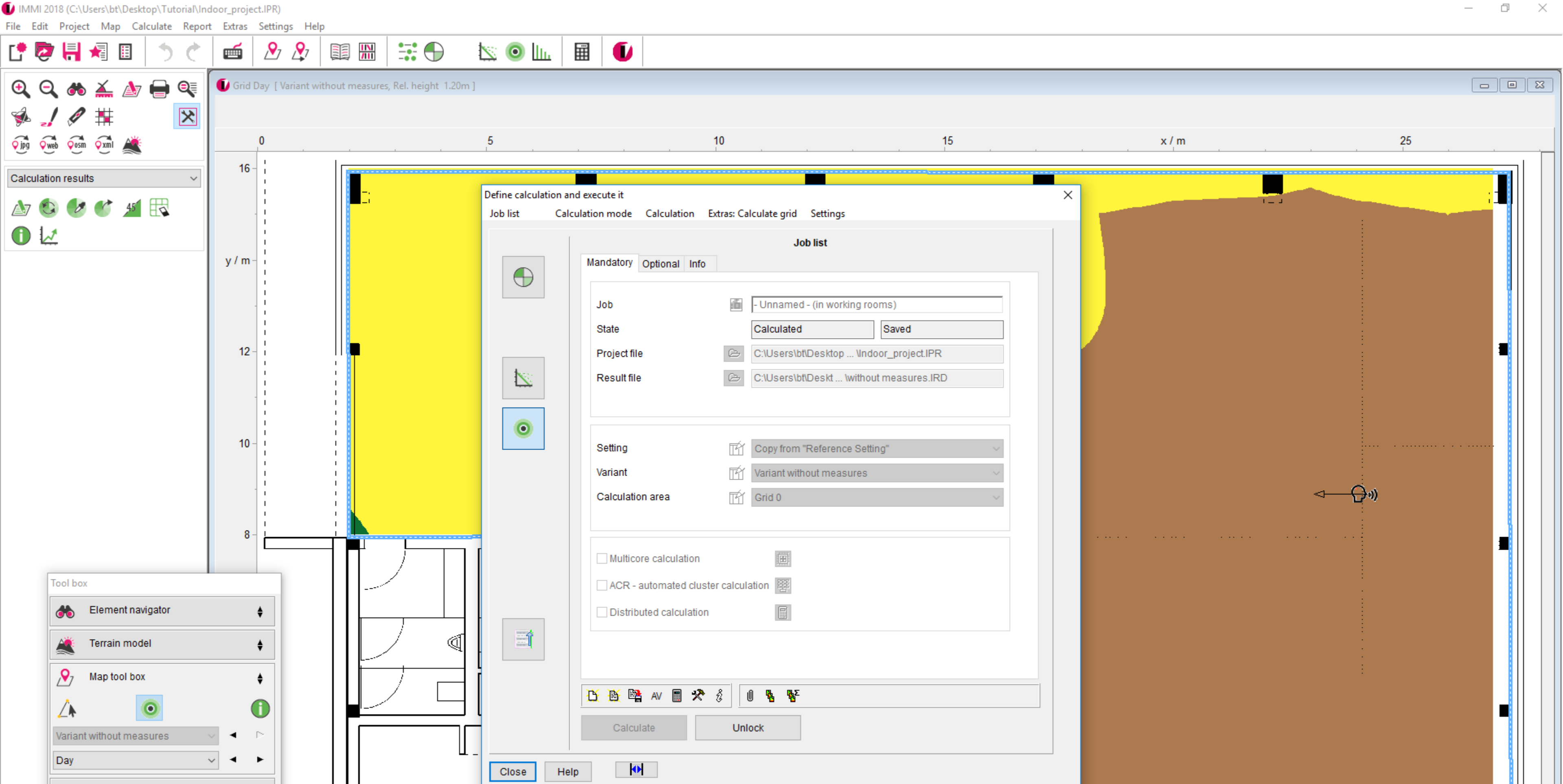
After the calculation finishes, we get a graphic display of the noise pressure levels inside the room without measures.





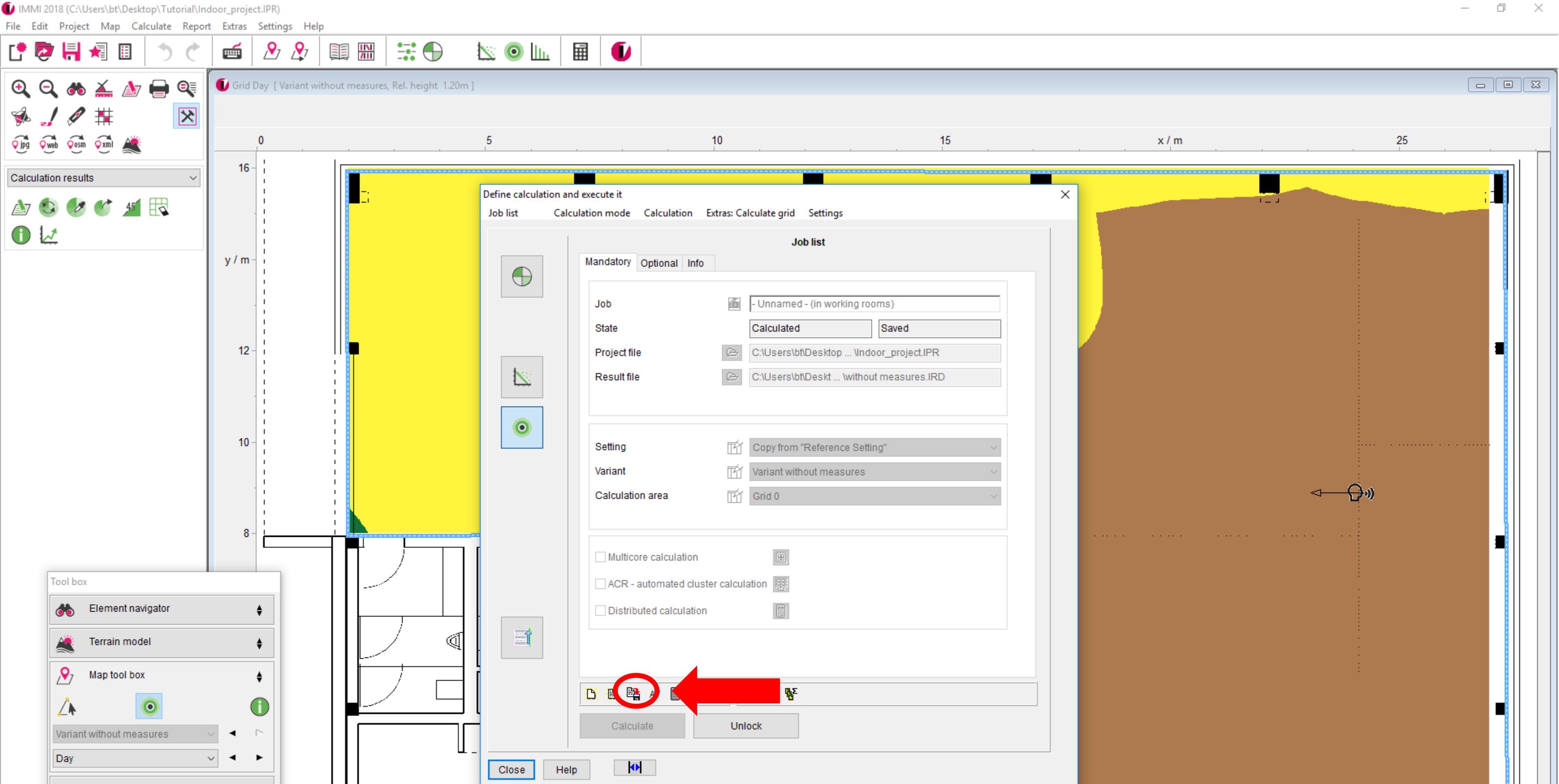
We can add isolines and a colour scale to the groundplan and export it for documentation purposes.





Before calculating the noise distribution for the variant with measures, make sure that the results have been saved.

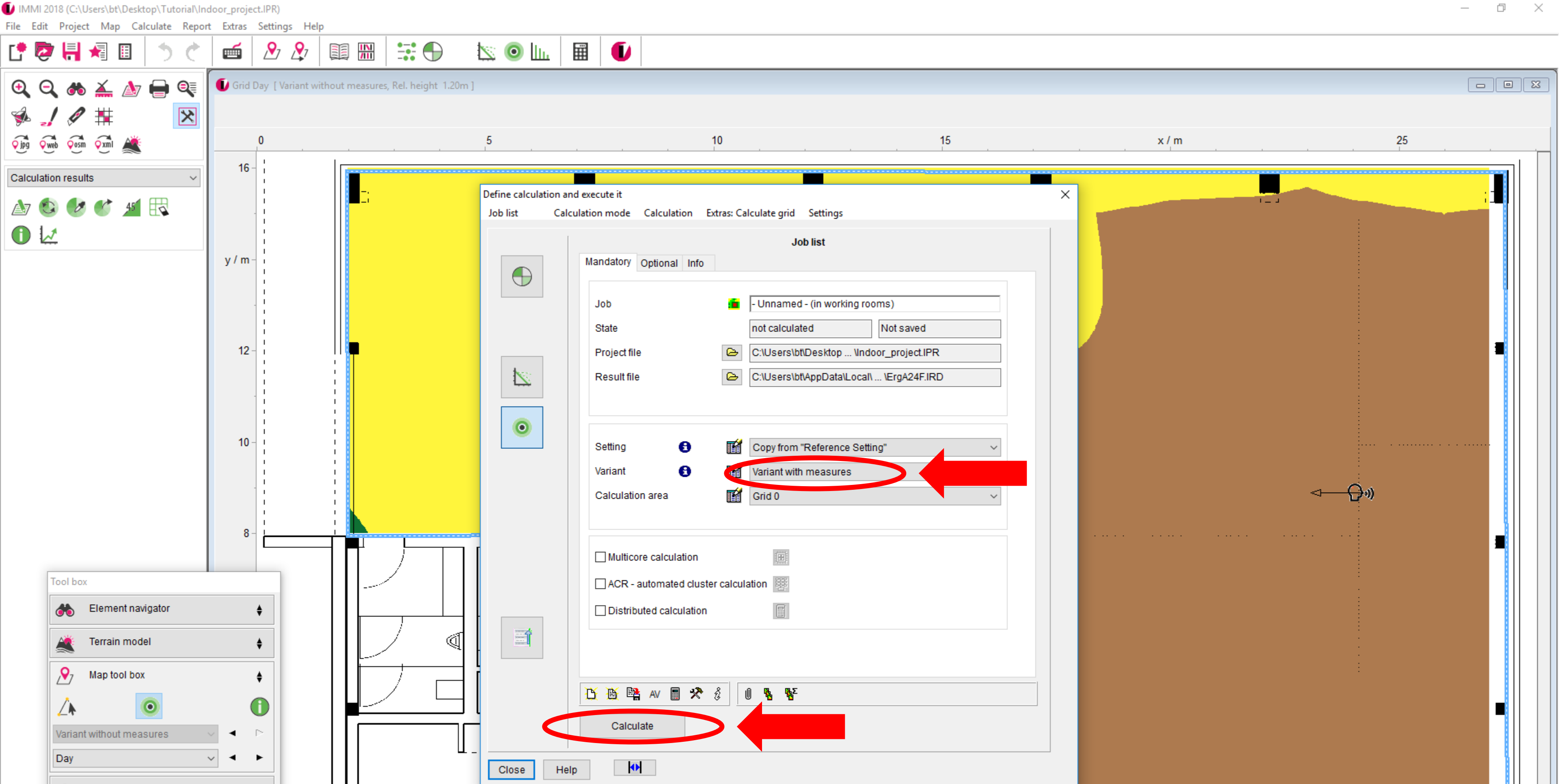




If you don't define a path for the result file, you can still save the results before unlocking the calculation dialogue with the respective icon.

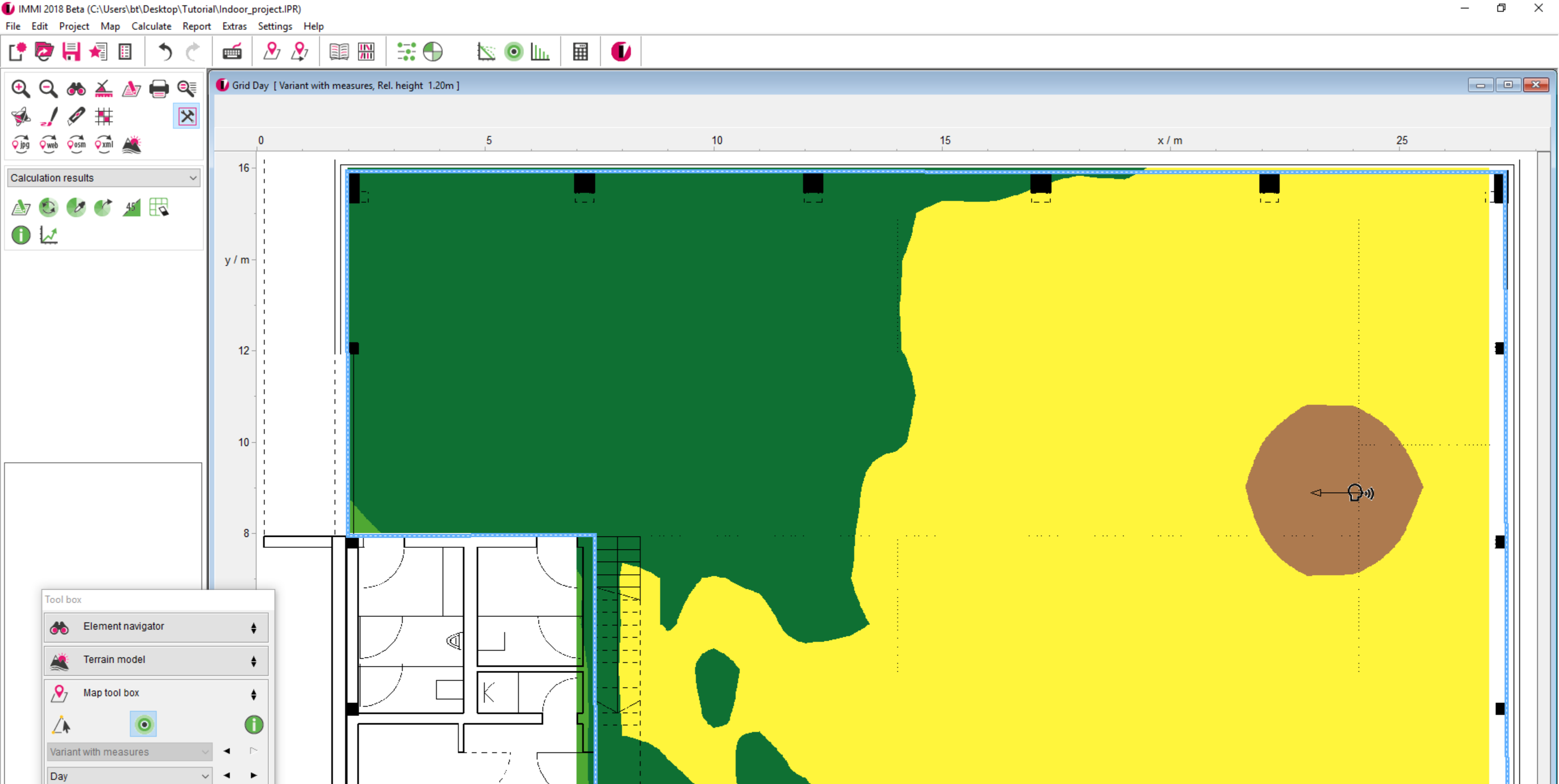
>45-50  
>50-55  
>55-60  
>60-65  
>65-70





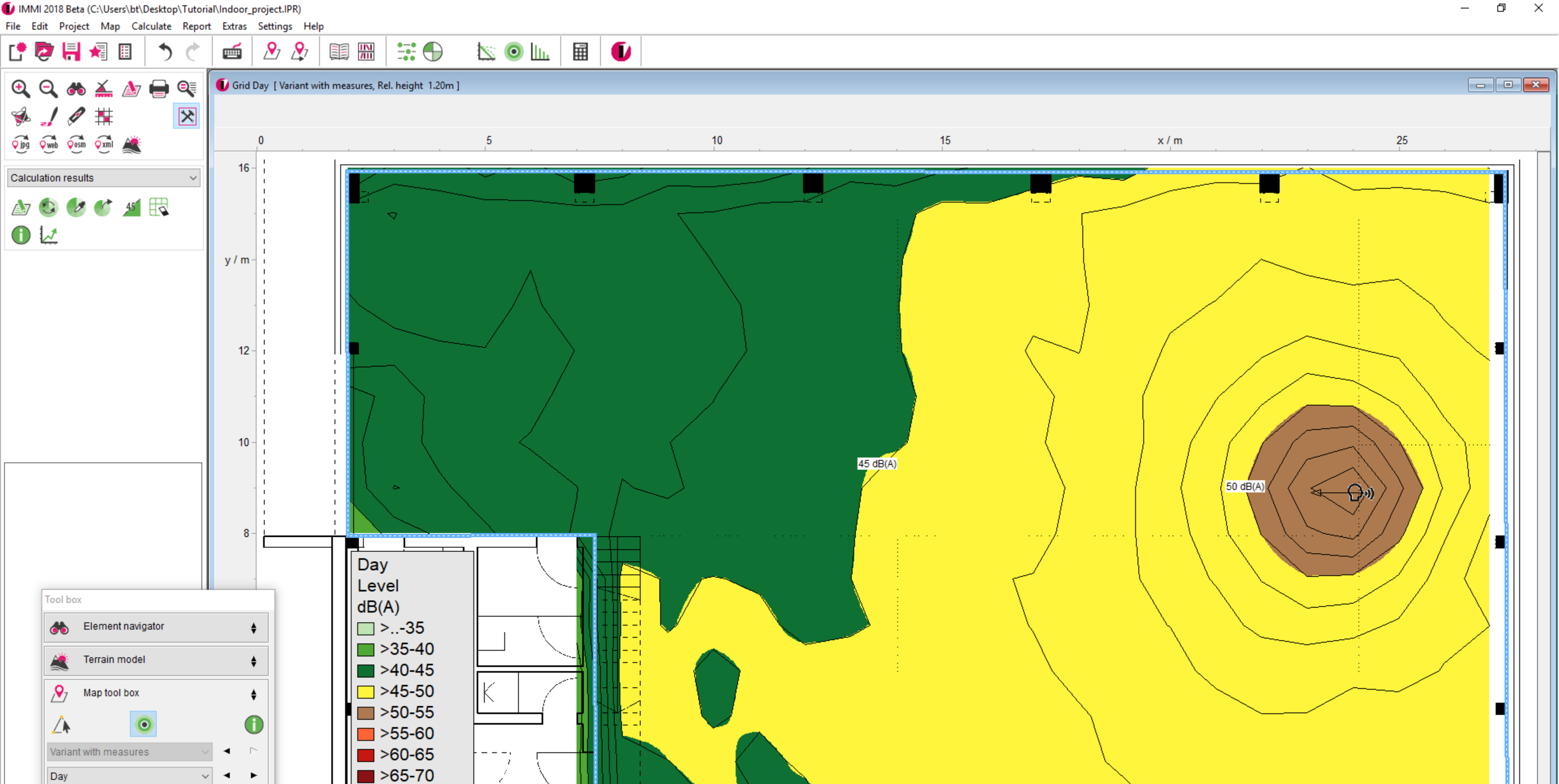
Then click unlock, change to the variant with measures and press calculate.





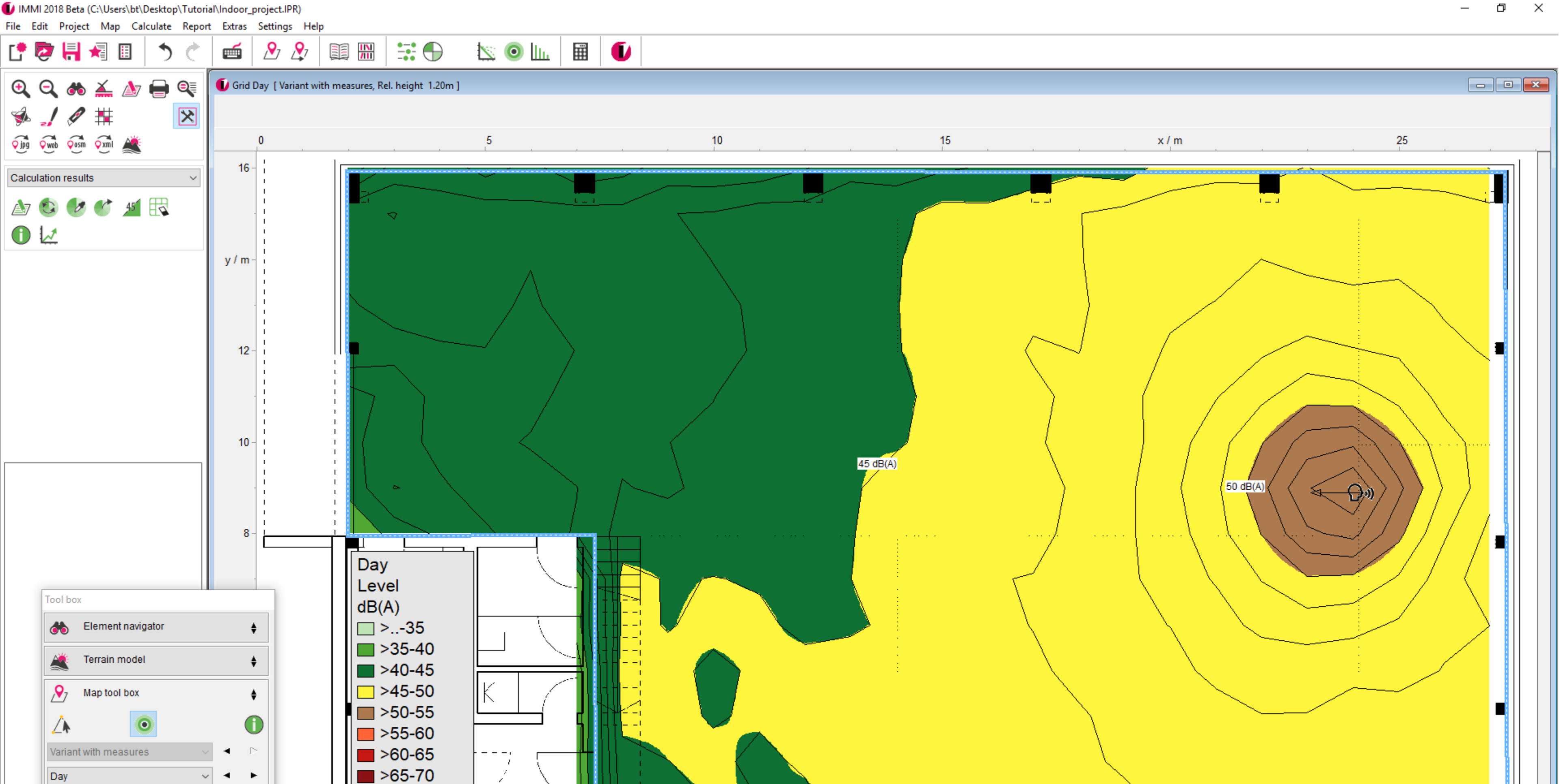
This gives you the noise map for the room with measures.





After displaying iso lines and a colour scale we can also export the graph for further use.





Thank you for your attention!

