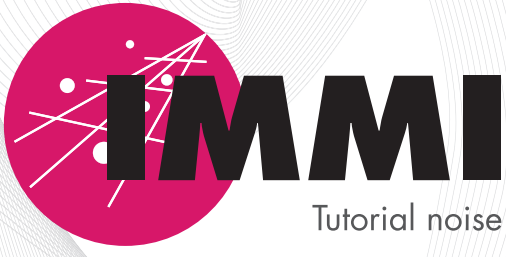


Tutorial noise

Wölfel

IMMI Tutorial Noise

IMMI 2017

Publisher: Wölfel Engineering GmbH + Co. KG
Max-Planck-Straße 15
97249 Höchberg/ Germany

Phone: +49 931/49708 - 500
Fax: +49 931/49708 - 590
E-Mail: immi@woelfel.de
Web: www.immi.eu

Author: Dipl.-Ing (FH) Denise Müller

Release date: April 2017

Standard Table of Contents

1 Introduction to the program and practical exercises

This section provides an introduction to the practical application of IMMI by means of examples.

- A first example: point sound source with attenuation
- A road as emission source of traffic noise: design with scanned-in maps
- Calculation of industrial noise
- Creating a conflict map

After having completed these exercises, you will not be an IMMI expert yet, but you will be familiar with using the program for a great number of noise forecast tasks.

1.1 Point sound source with attenuation

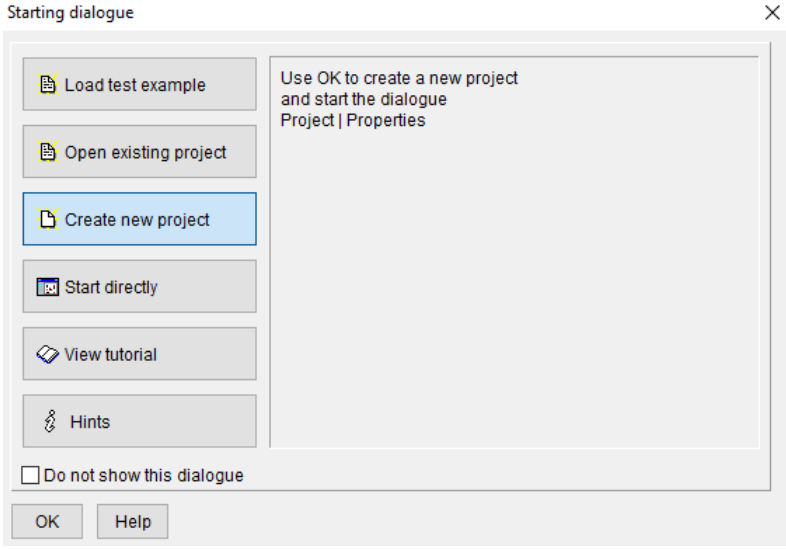
The following simple example will show you step by step how to edit an immission calculation with IMMI.

Naturally, there are alternative editing steps. That is why you should "search" the program for additional possibilities after you have become familiar with the procedure described here. Reading the explanations on the menu system will be particularly helpful.

1.1.1. Starting the program

In the first step, IMMI is started and a new project is created.

- Double-click on the IMMI program icon to start IMMI.
- This will open the starting dialog. Click on the Create new Project button and then on OK to edit an "empty" project.



1.1.2. Preparatory steps

In the beginning, only make the settings below. This first example is particularly intended to facilitate working with IMMI. For that reason, element libraries are not yet used at this point.

- Verify that **Topic** is set to **Noise (Outdoor propagation)**.
- In the **Emission variant** field, set the number of emission variants to **1** so that only one rating period will be taken into account. Use the arrow buttons next to the input field.

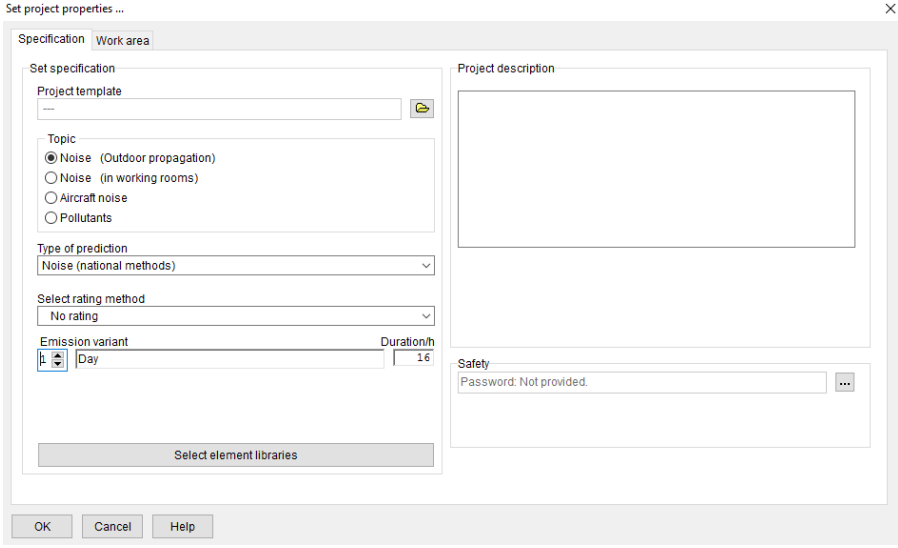


Figure 1: Setting the properties of the project

- Select the **Work area** tab and apply the work area limits which are preset there:

x/ m	0 to 1000
y/ m	0 to 1000
z/ m	0 to 100

Terrain height in the corners:

z1 bis z4	0 m

- Click on the **OK** button to confirm these values. This will open the map which is the central editing window in IMMI.

1.1.3. Entering a point source and a noise barrier

In the following steps, the geometry of a source and the screening wall is designed on the monitor by means of the mouse.

- Select **ISO 9613-2** from the tool box to the left.

- Select the **Point source** (Point source/ ISO).
- Click on - **Draw elements** in the **Design** tool box.

Note: Choose the function - **Draw elements** to create new elements. The function - **Edit elements** is chosen for editing existing elements or for opening the element dialog.

- Left-click on the desired position (**x = 500 m, y = 500 m**) on the map.
- Since the - **Open element dialog instantly** button is activated, the appropriate input mask will open directly after you have generated the point sound source.

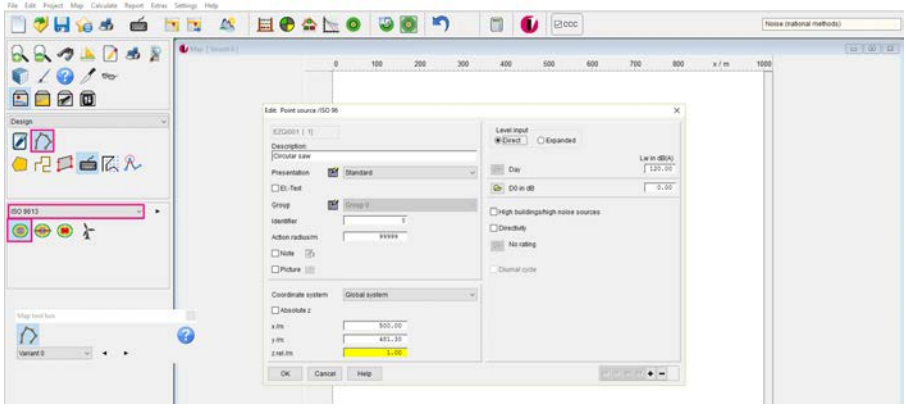


Figure 2: Digitizing a point sound source

- Enter the following data in the input dialog:
  - The point sound source is a **Circular saw**.
  - Emission value for the period **Day**: **Lw = 120 dB(A)**.
  - z-coordinate **z rel/m = 1m**
- Confirm your entries with **OK**.
- Move to the **Standard element library**.
- Click on the - **Wall element** button to select the wall element type.

- Left-click approx. at **x = 400 m, y = 450 m** to set the first node.
- Set the second node approx. **at x = 600 m, y = 450 m**.
- **Right-click** to complete your entry of the element geometry.
- This will open an input dialog.
- Click on Geometry input and, in the **z(rel/m) column, enter z = 5.0 m as the height for the first node and z = 7.0 m for the second node (inclined wall)**.
- Exit the input dialog by clicking on **OK** twice.

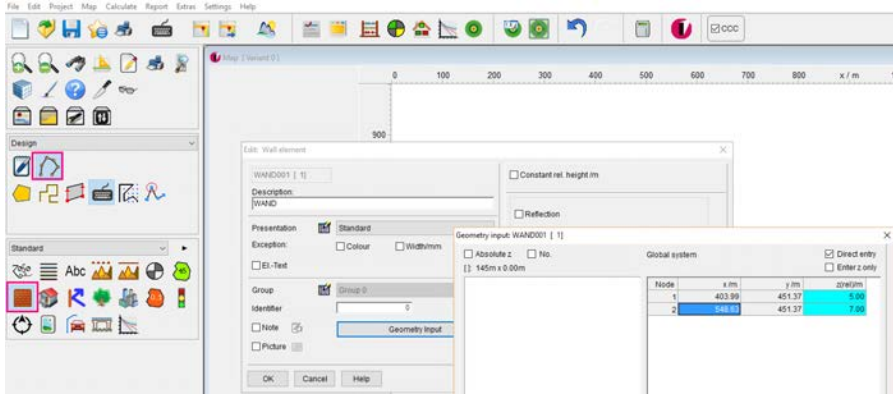


Figure 3: Entering the screening wall

1.1.4. Calculating a reception point grid

In the next step, an area-type reception point grid is calculated.

- Select the **<Calculate | Definition | Calculation area>** menu item.
- Click on **Edit...** to define the grid dimensions.
- Ensure that the step sizes in both **x- and y-direction is 20 m**. Leave the grid field setting as it is, i.e. **Work area**.

- Enter 2 m under z/m (relative).

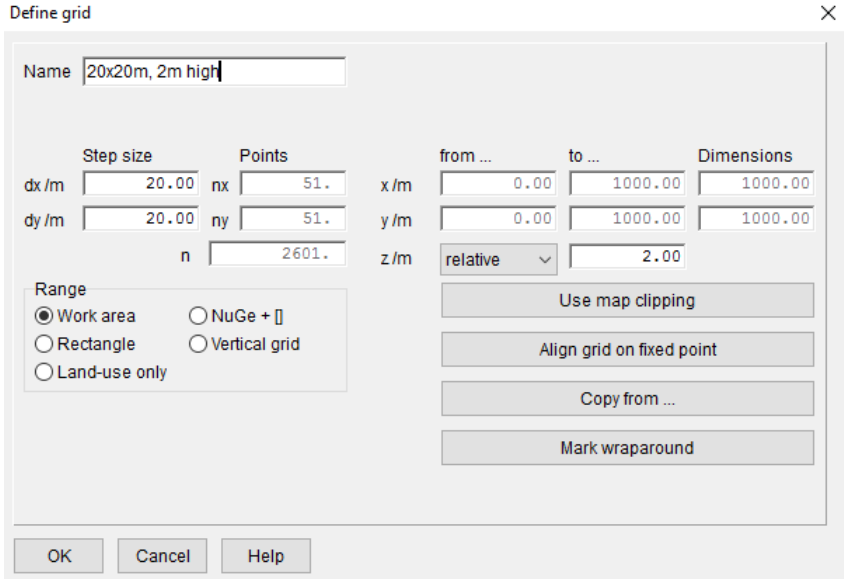


Figure 4: Defining a grid

- Click on OK and then on Close to complete your entry.
- Save the project with <File | Save Project As ... >. Enter a name.

Note: The filename extension of IMMI project files is .IPR.

- Start calculation of the grid by selecting the **<Calculate | Calculate grid>** menu item or clicking on the  button.

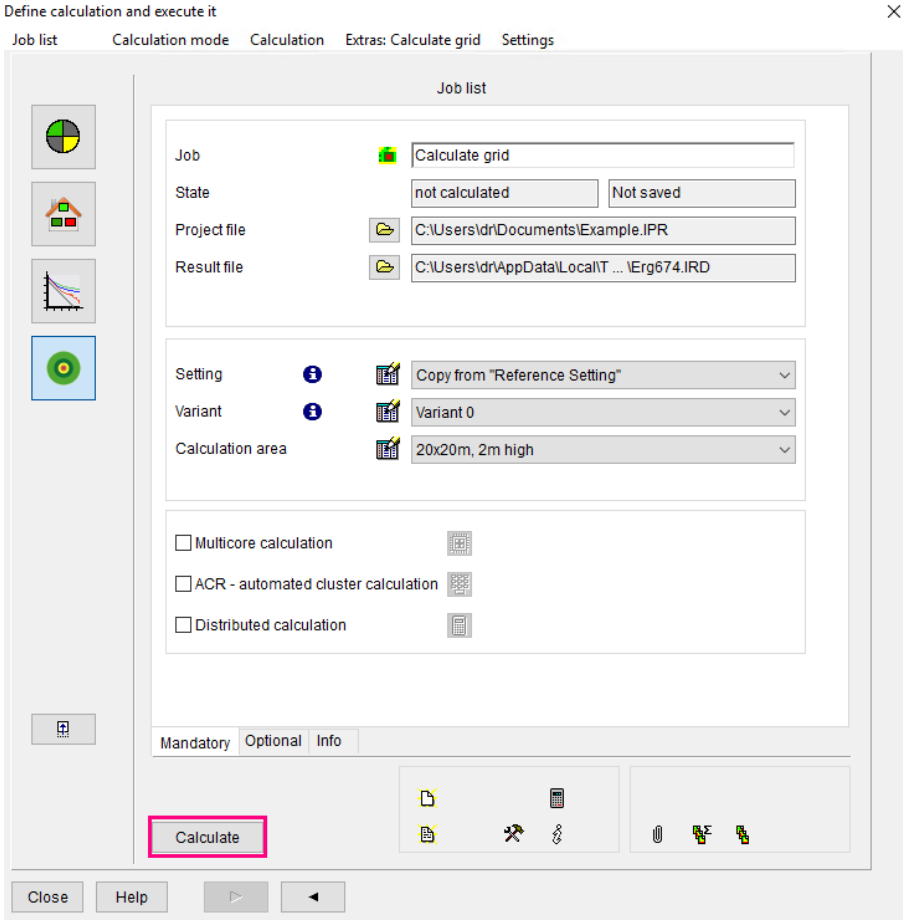
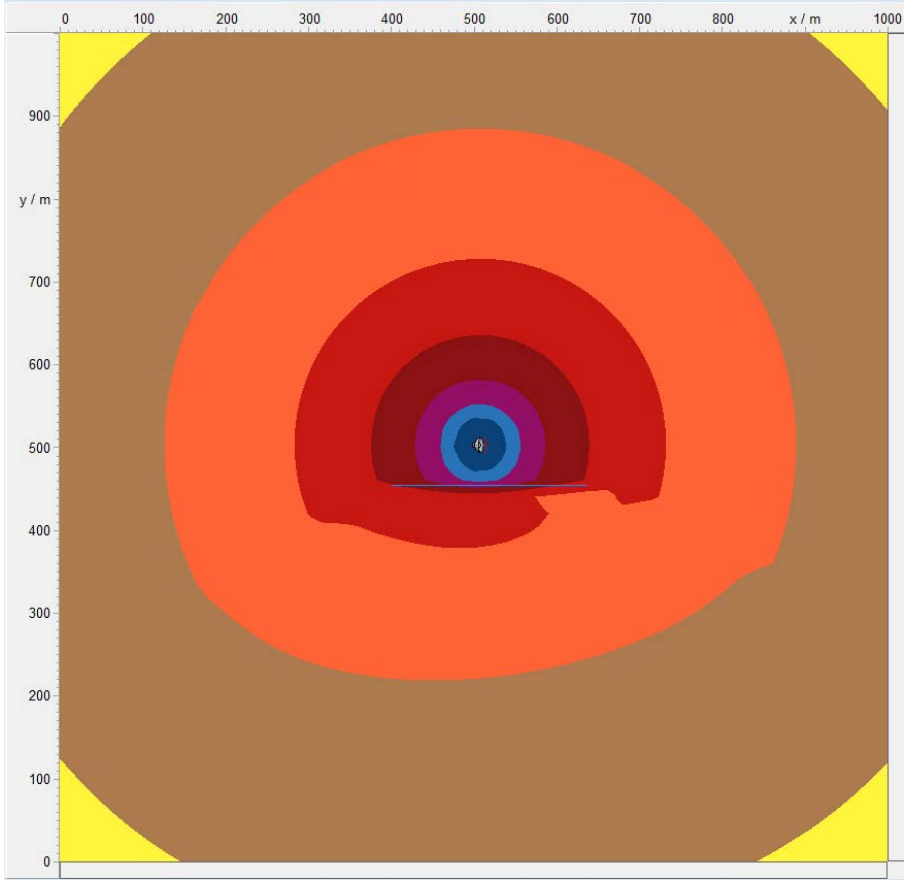


Figure 5: Calculation control center - Start the grid calculation

- Use the default settings of the calculation dialogue.
- Click on **Calculate** to start calculation.
- The reception point grid calculated is displayed.
- Select the **<Calculation | Save>** menu item in this dialog. Enter a name and save the grid.

Note: The filename extension of IMMI grid files is .IRD.

- Click **Close** to leave the dialogue.



- To use the possibilities of an additional graphical evaluation, click on the **Define map content** button ( ) and select **Map: Grid and Layers: Day**.
- Select **Grid of squares** from Presentation in the same dialog.
- Click on **OK** to view the grid.

Also try the other presentation options.

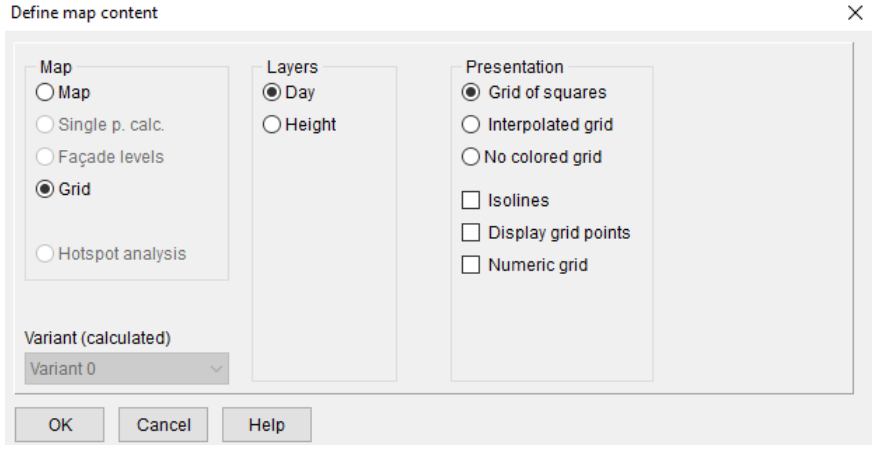


Figure 6: Changing the grid presentation

- To change the colour scale, select the  - **Edit colour scale** or  - **Select colour scale** function in the **Calculation results** mode.

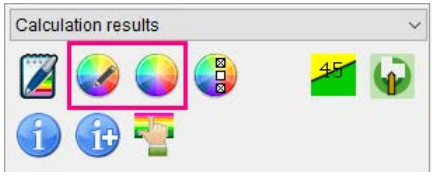


Figure 7: Changing the display of calculation results

- Try the other functions and change the grid presentation.

You have now successfully completed your first self-created project. Congratulations!

Note: You can open the **Simple.IPR** example by selecting the **<File | Open Project ...>** menu item and then moving to the **Examples\Noise\Tutorial** subfolder in the IMMI installation directory.

1.2 Traffic noise – Design with scanned-in maps

A major tool for editing projects in IMMI is designing them on the screen on the basis of scanned-in maps. This is illustrated by the following example of a traffic noise project.

1.1.5. Fitting the background image

In the first step, a background image is downloaded and fitted. This image will form the basis of the entire project which is established as follows.

- Select <File | New Project> to open the Set project properties ... dialog.
- On the Specification tab, select No Rating from the Select rating method field.
- Move to the Work area tab and define the work area in x- und y-direction by selecting -500 - 1250 m for the x- and y-values.
- Click OK to close the input dialog.
- To open the background image, select the <Map | Install | Open background image> menu item.
- Click on Add single image to open a new background image.
- Click on Search and select UETTING.BMP from the IMMI installation directory (...\Examples\Noise\Tutorial).

  There are four functions to support you in fitting the background image selected:

  1. With reference points: Enter the number of reference points.
  2. With image parameters: Define the dimensions of the image (height and width) and specify the image origin.
  3. With scanner parameters: Enter scale and resolution.

Note: Pictures with georeferencing will be fitted automaticlly.

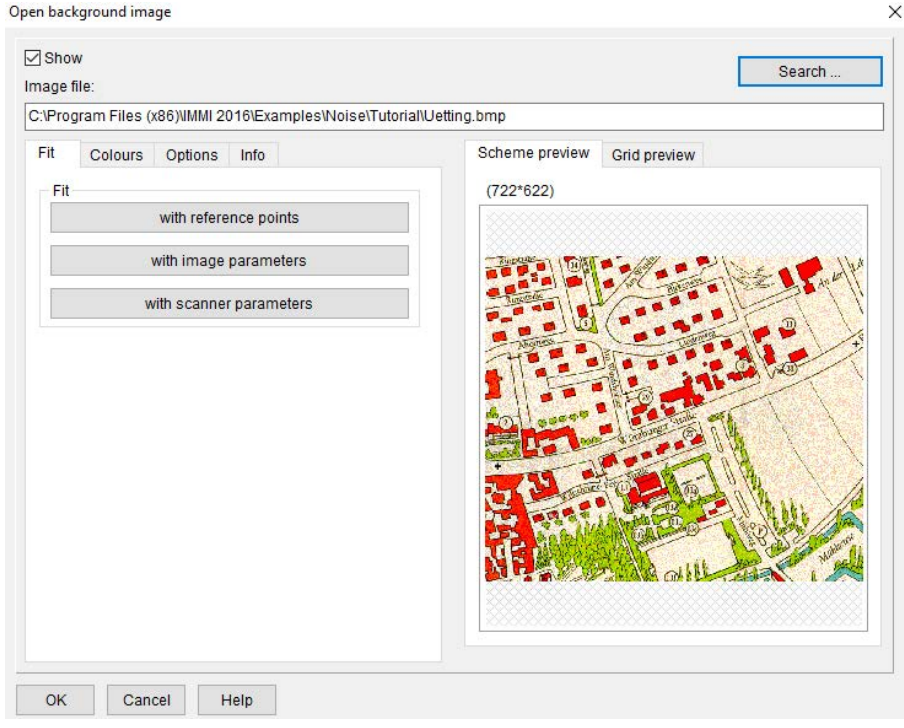


Figure 8: Fitting a background image

- Click on the **with reference points** button.
- The image will be displayed in the preview window. The zooming buttons allow you to zoom into and out of the image.
- Click on the left-hand cross on the Würzburger Straße to set the first reference point. Enter the following coordinates in the dialog for the first reference point:

  x = 0, y = 0
- Click **OK** to exit the dialog.
- Click on the right-hand cross and enter the following coordinates for the second reference points:

  x = 905, y = 310

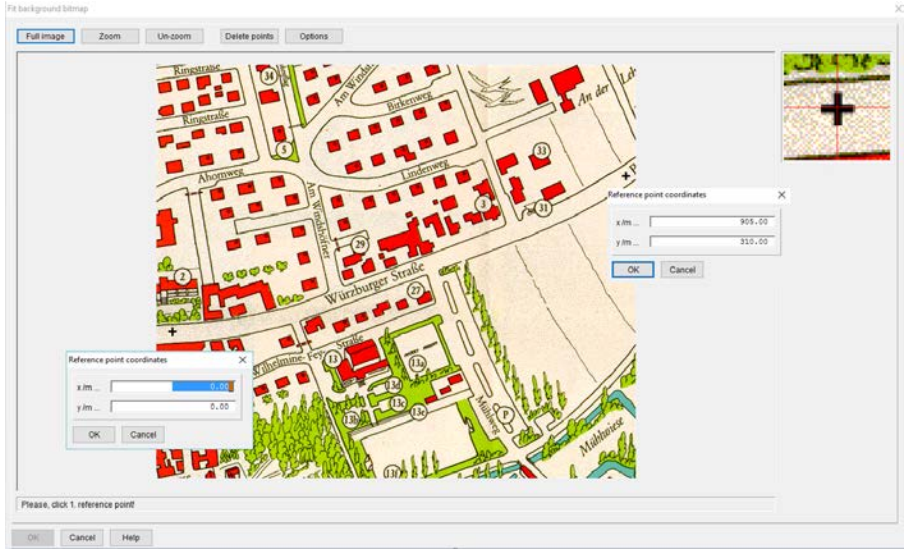


Figure 9: Entering reference point coordinates

- Confirm your entries with **OK**.
- Exit the dialog with **OK**.
- The fitting result will be displayed. Click on **Close** to exit the display.

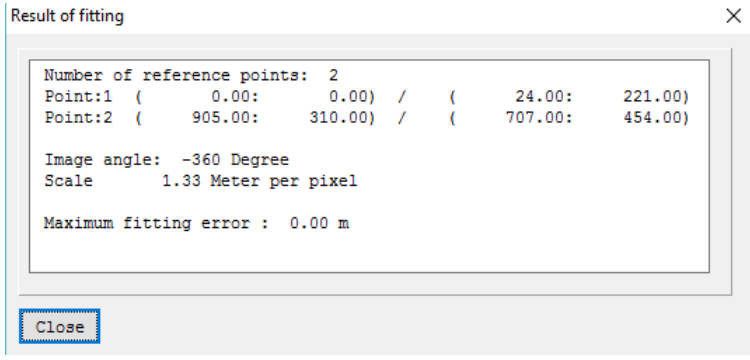


Figure 10: Displaying the fitting result

- Close all dialogues.

1.1.6. Editing the project - Modeling a road and a building element

In the next step, a road and several buildings are designed on the basis of the fitted background image.

- Choose the **Design** mode from the tool box to the left and select **XP S 31-133** as the element library.
- Initially, design the road axis along the "Würzburger Straße".

Since we start from the fact that the actual assessment area is limited to the background image, the roads should extend a little beyond the image.

Initially, you should digitize the roads only roughly. You can later fine-adjust the course of the road axis by means of the following useful functions: **Move**, **Turn**, **Move node** and **Insert node**.

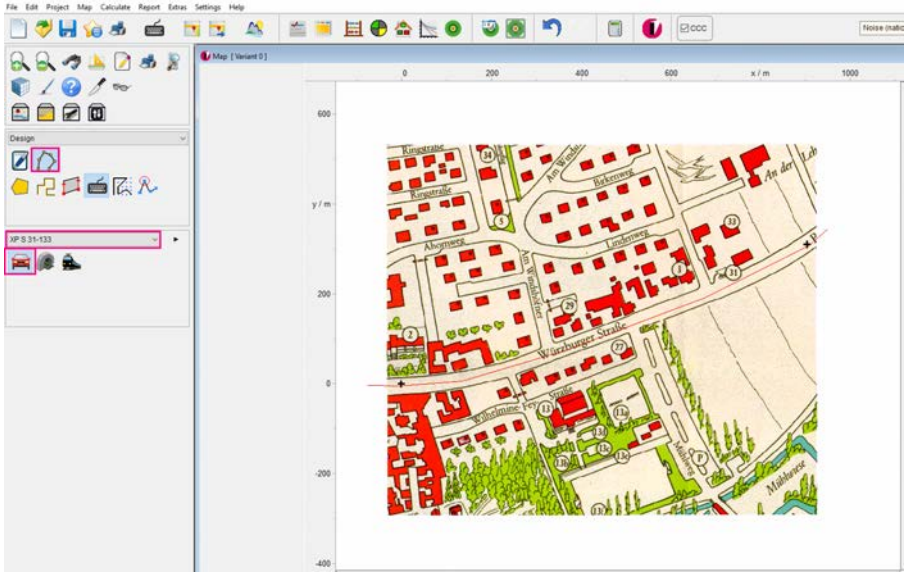


Figure 11: Designing the road axis on the map

- Right-click to complete your design. This will automatically open the input dialog.
- Enter **Würzburg Street** as the element name.
- To enter traffic data, select **ADT** (average daily traffic load) from the Input field and click on the button for opening the input dialog ( ).

- Enter 10,000 in the ADT in **vehicles/day** input field. The rating periods and emission variants are automatically calculated for **Day and Night**.

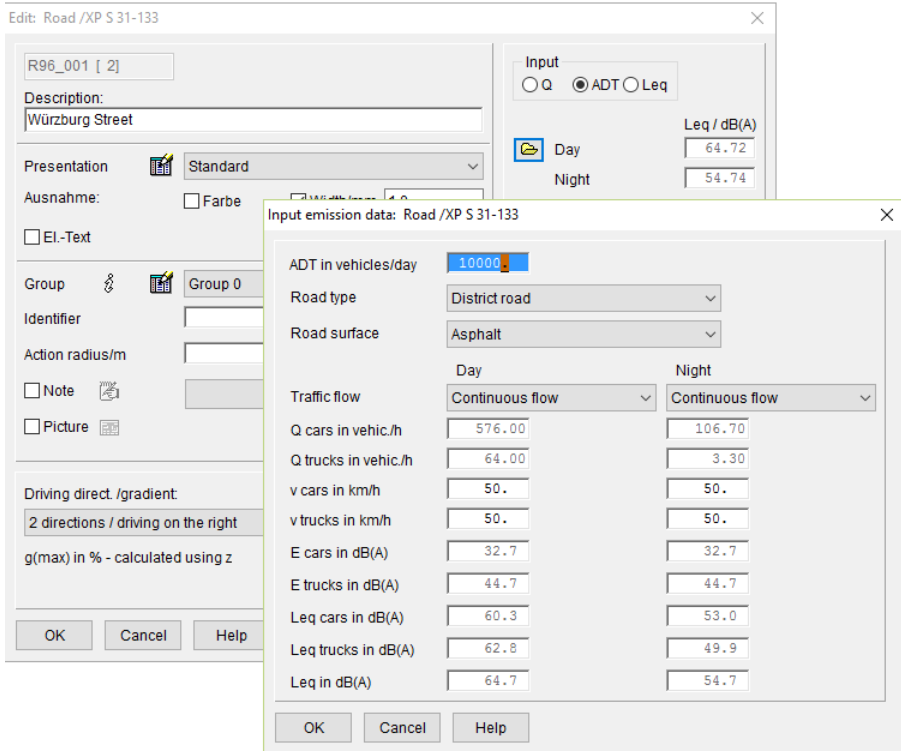


Figure 12: Input dialog for a road according to XP S 31-133

- From the Road type list box, select **District road** and **Asphalt** as road surface layer.
- Select **continuous flow** as traffic flow.
- Ensure that the speeds for both passenger **cars and trucks is 50 km/h**.
- The following emission levels are calculated:

  Leq = 64,7 dB(A) Day

  Leq = 54,7 dB(A) Night

Now try to change the editable values to better understand the influence of the various parameters. As you will see, the new Leq emission levels will be updated immediately, based on the values edited.

- Click **OK** to quit.
- Enter **2m** for the Distance carriageway centreline to road centreline
- Complete your entry with **OK**.
- Save the project with **<File | Save Project as>**.

Note: The filename extension of **IMMI project files is .IPR.**

In the next step, a building obstructing the free propagation of sound will be entered.

- Using the lens  –**Select new clipping** – zoom into the centre of the map to show the big rectangular house directly at the Road in the clipping.

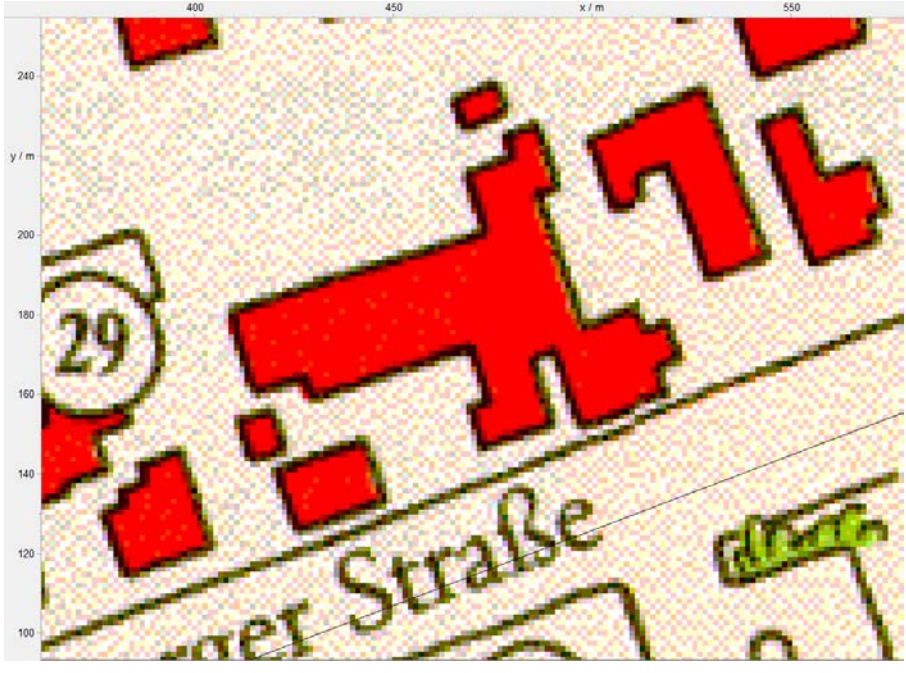


Figure 13: Zooming into the map clipping to be edited, using the lens

---

Note: You can move the map clipping with using the arrow keys on the keyboard or by pressing the mouse wheel [Edit mode].

- Ensure that you have selected  - **Draw elements** in the **Design mode**.

- Select the  - **Building** element from the **Standard element library**.
- Re-digitize the building on the background image. Right-click to close the building automatically.

Since the Open element dialog instantly button () is activated by default, the appropriate dialog for entering the building parameters is opened automatically.

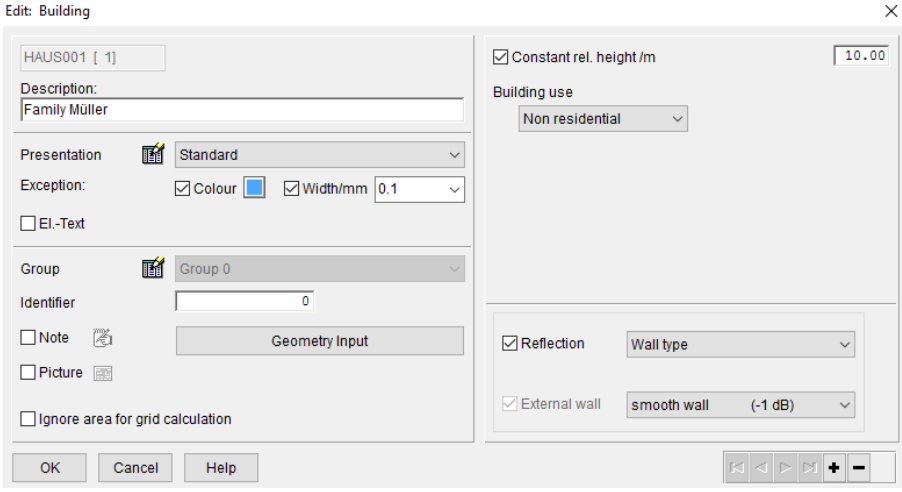


Figure 14: Input dialog for defining a building

- Enter an element name.
- Enter **10 m as constant relative building height**.
- Activate **Reflection** and select **smooth wall** as **Wall type** with an absorption loss of **1 dB**.

- Complete your entry with **OK**. The map should now show the following building presentation:

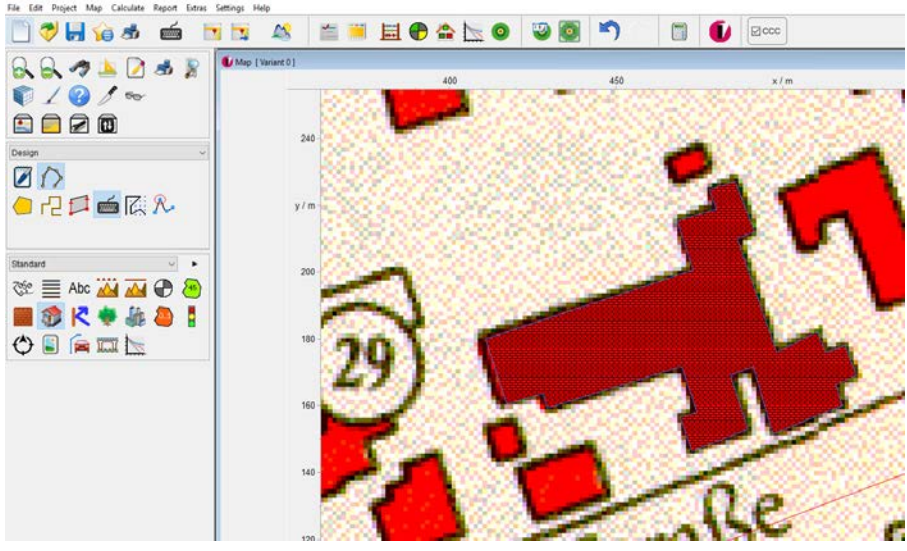


Figure 15: Designed building on the map

1.1.7. Changing display attributes

You can, of course, select the type of element presentation as desired.

- Draw three to four additional buildings and set the appropriate individual parameters.
- To change the presentation, select the **<Settings | Display attributes | Additional attributes>** menu item.

Note: Select **Standard** to change the default setting.

- This opens the selection list of the various element types. Click on **Add** to define a new attribute.
- Enter an attribute name in the field **Description**.
- In the **Area** field: Click on **Hatches** to select **Filled**.
- Click on the Colour-Button to select a **Colour**.

- In the **Line** filed: Click on the Colour-Button and select the same colour.

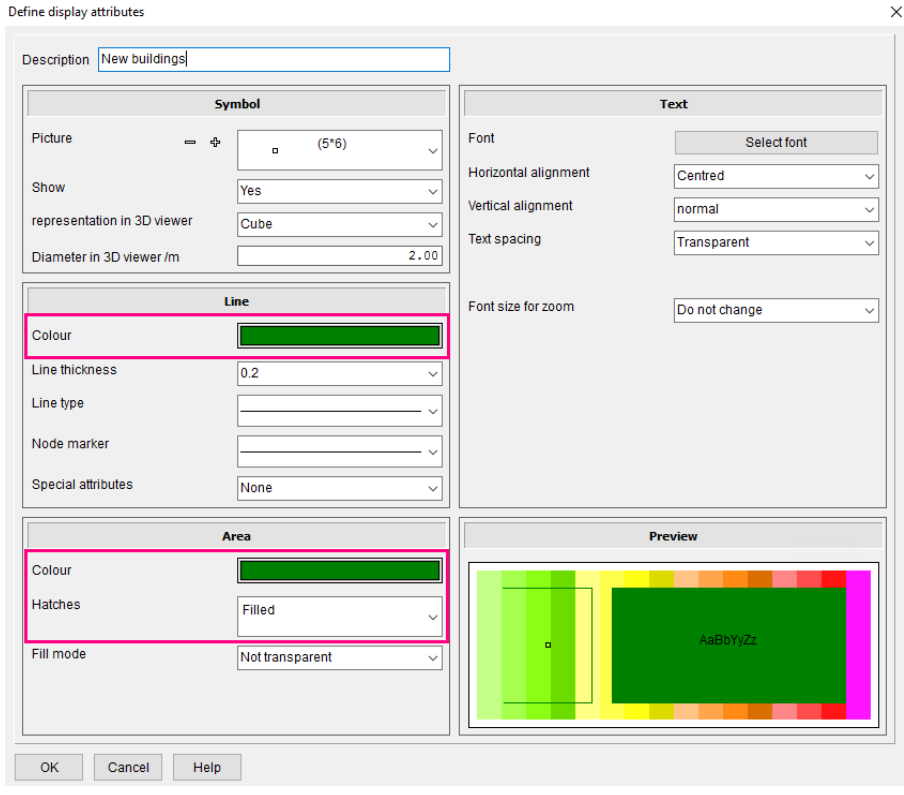


Figure 16: Defining additional attributes

- Exit the dialog with **OK** and **Close** the dialog.
- Be sure that you are in mode  - **Edit elements**.
- Select a building by left-clicking on the edge of the element.
- Double-click on the edge of the element. This opens the input dialog of the element where you select the **Edit element** menu item.
- Select the new defined attribute from the **Presentation** list box.

- Exit the dialog with **OK**.

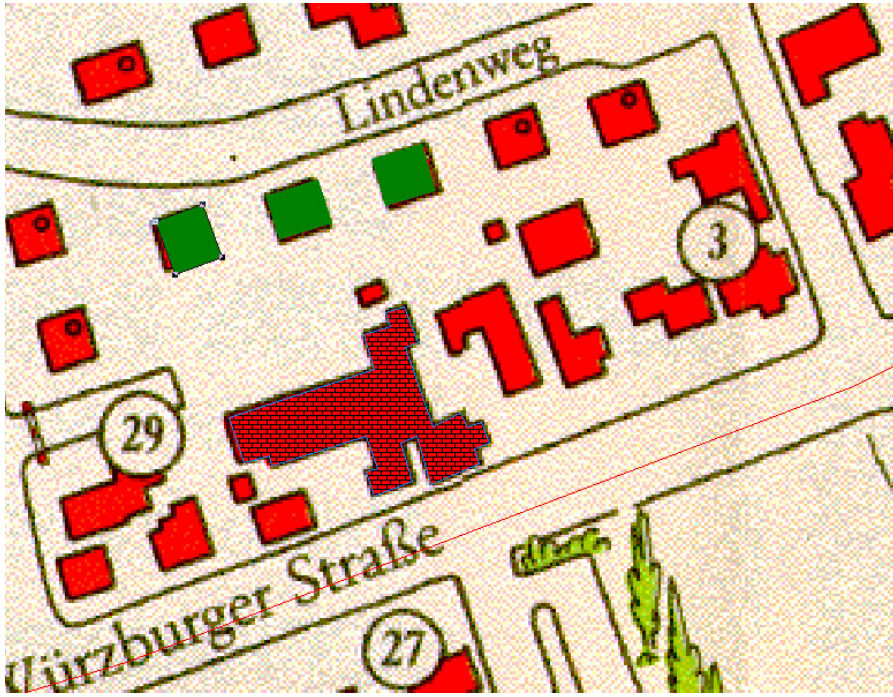


Figure 17: Building with different colour attributes

- Do the same with the other buildings.

1.1.8. Defining receiver points

In the next step, the essential receiver points are entered. These are the points to be subsequently subjected to single-point calculation.

This can be achieved in two ways:

1) **Use the mouse and design as you desire:** This requires that you activate the Receiver point button ( ) in the Standard element library and left-click to position the point on the map in the Design mode.
2) **Use the Generate reception points macro:** A certain number of receiver points are automatically generated at a building. This has the advantage that, in addition to selecting the exact position (e.g. distance of 0.5 m from the wall of

the building), time can be saved while several different reception point heights are generated (e.g. modelling the various floors).

We use the macro in our example.

- Select the  - **Edit element** function in the **Design** mode.
- Left-click on the building on the map to select it. The footer will show the element type and name. The display of the building changes (nodes are shown clearly).
- Right-click to open the pop-up menu.
- Click on the **Macros** option and select **Generate receiver points**.

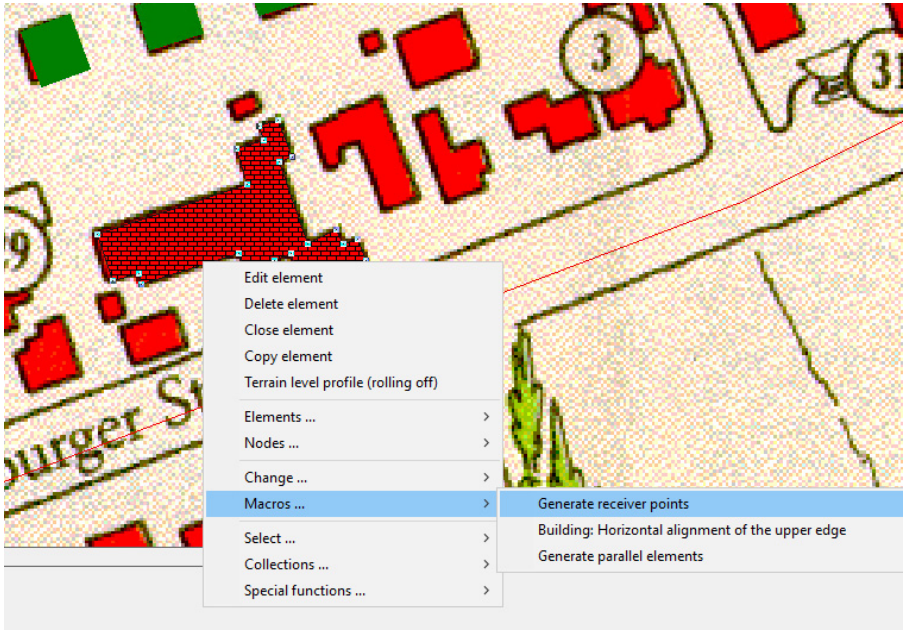


Figure 18: Generating reception points automatically

- Enter the parameters specified in the figure below.

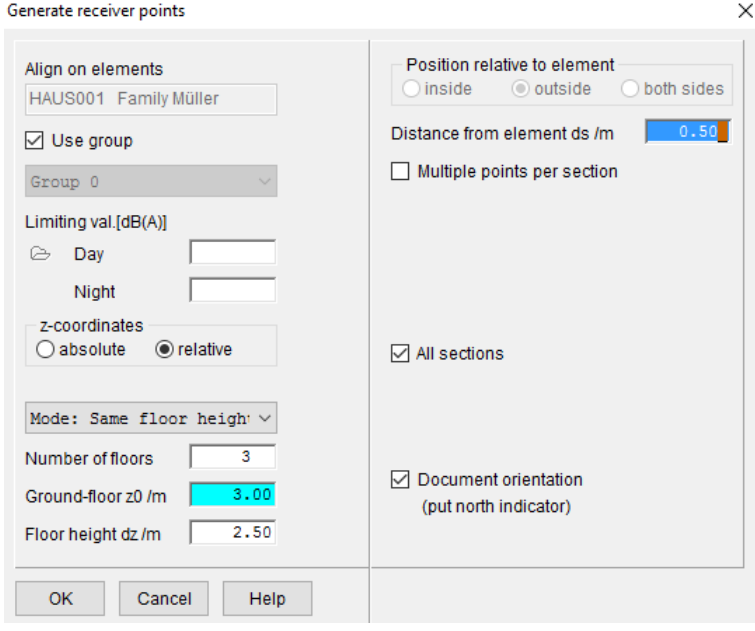


Figure 19: Input dialog for generating reception points

- The system will now generate receiver points on each building wall – always centrally between the bordering nodes. These receiver points are located at a distance of 0.5 m from the wall both on the ground floor and on the second and third floors.
- Complete your entry with **OK**.

- A list showing the generated reception points appears.

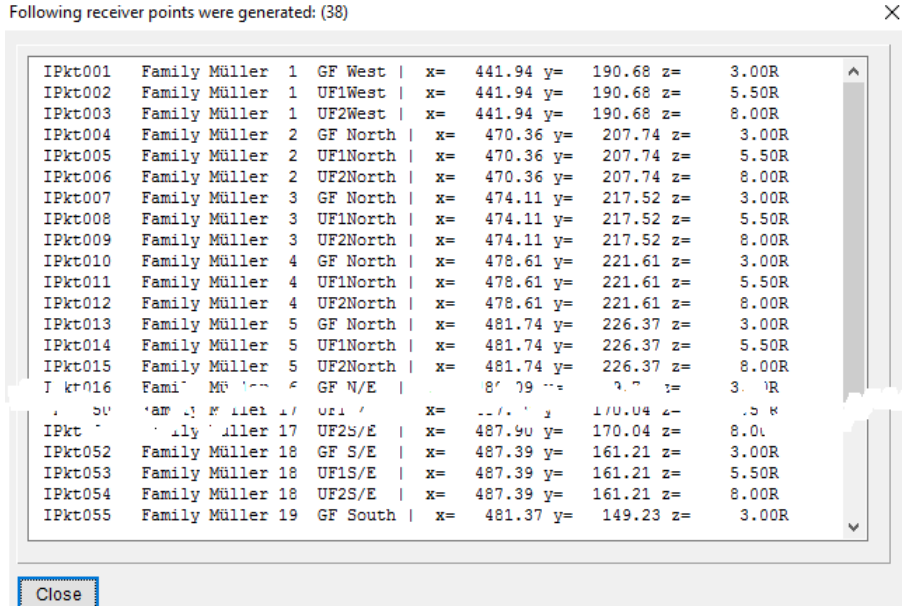


Figure 20: List of generated reception points

- Click on **Close** to return to the map.
- Save the project with **<File | Save Project As ... >**.

You can now see the receiver points that have been generated on the various sidewalls. In the next step, the display of the map is switched to 3D mode where it is easier to examine the spatial arrangement.

- To start the 3D Viewer, select the **<Map | Edit layer | Generate 3D view >** menu item or click on the **Generate 3D-View** ( ) button.

- Deactivate the Apply formal control checkbox.

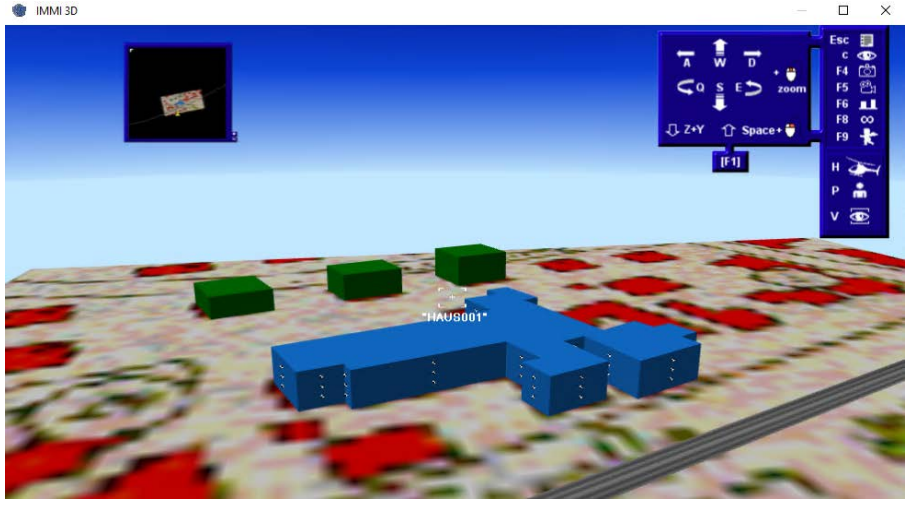


Figure 21: 3D view of the generated reception points

For detailed information about the 3D Viewer, please refer to the online help or the 3D Viewer Manual.

- Press the **ESC key** and select **Exit** to return to the map.

1.1.9. Defining compass (Meteorology)

Do not forget the Compass: It is very important for calculations according to XP S 31-133!

- Choose the **Design** mode from the tool box to the left and select - **Compass** from the standard library.
- Insert the NPFL on the map.

Note: Meteorology according XP S 31-133: Select the **<Calculate | Calculation parameters | ... | Parameters for element libraries | XP S 31-133>** menu item. This opens a dialog where you can choose or insert meteorology. The meteorology for France according XP S 31-133 appendix 1 is already included.

1.1.10. Single-Point calculation

In the following, you learn how to perform an immission calculation at certain reception points.

- To start single point calculation, either click the  - button in the header or proceed via the **<Calculate | Calculate receiver points>** menu.
- In the lower frame of the central dialogue deactivate **All**.
- Click the button **Selection** under **Receiver points** to select 3 points. Select 3 receiver points at different heights.
- Select the points by means of the **arrow buttons**.

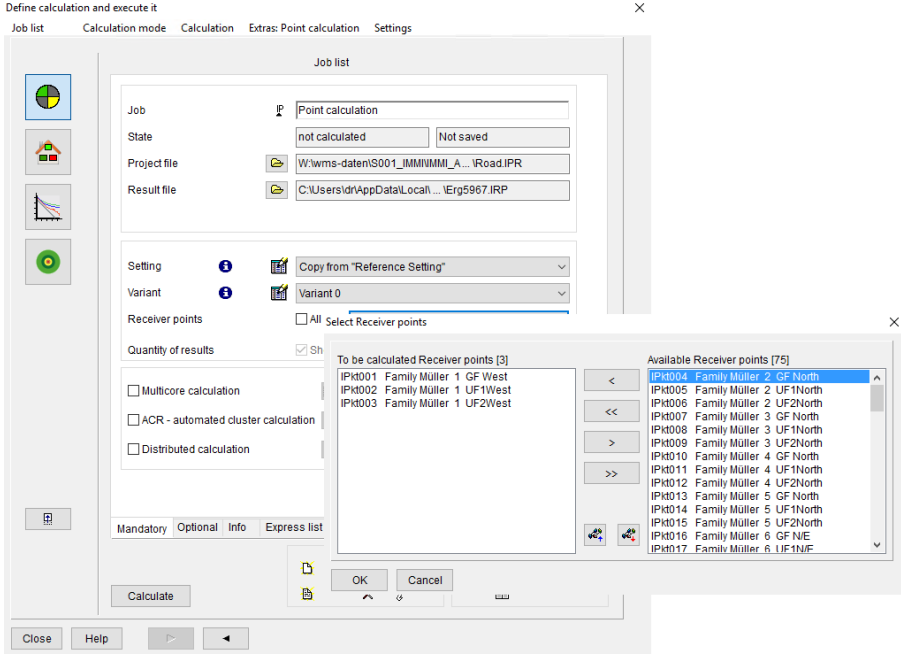


Figure 22: Dialog for calculating reception points

- Click **OK** to exit the selection.
- To start the calculation, click on **Calculate**. The calculation is completed within a few seconds. The result is shown in the Express list.
- Click on the **Results** tab.

- Under **Short list**, select **Noise level** and click **Show** and **OK**.

Short list		**Point calculation**			
Noise prediction					
Variant 0		**Setting: Copy from "Reference Setting"**			
		Day		Night	
		LV	L r,A	LV	L r,A
		/dB	/dB	/dB	/dB
IPkt001	Family Müller 1 GF West		39.7		29.7
IPkt002	Family Müller 1 UF1West		39.8		29.9
IPkt003	Family Müller 1 UF2West		40.8		30.9

Figure 23: Single-point calculation results – short list

- Study the results, and the numerous functions of lists.
- Click the  button to quit the list.
- Click on another list (black written) and the **Show** button to see the results on the screen. Additionally, a legend is available, depending on the applicable calculation regulation. If you like you can view all created lists one after the other.
- Once you have finished quit all open dialogues.

1.1.11. The concept for using variants

The established dataset consists of one calculation variant only, i. e. Variant 0. That means that, presently, all generated elements are included in calculation. Below, however, we will extend the dataset such that we can generate and calculate selected variants.

To achieve this, enter a further element – a section of a road –in the map.

- Select the **Design** mode and activate the **Draw elements** function.
- Open the **XPS S31-133** element library and select the **Road** element.

- Draw an additional road at the position shown in the figure below:

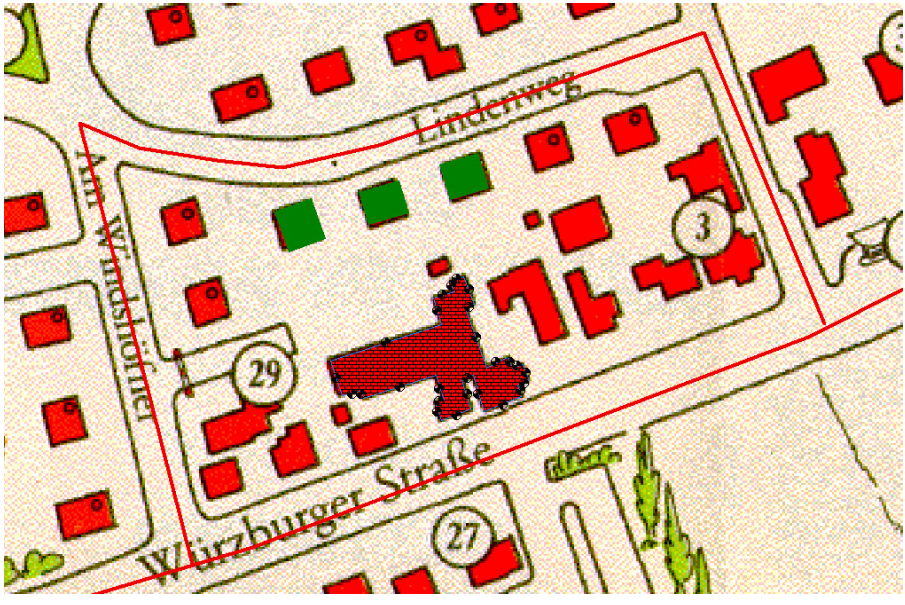


Figure 24: Adding a road

- Right-click to complete your entry. The input dialog will be opened automatically.

- Enter the parameters describing the street (traffic load, road type, name according to the figure below):

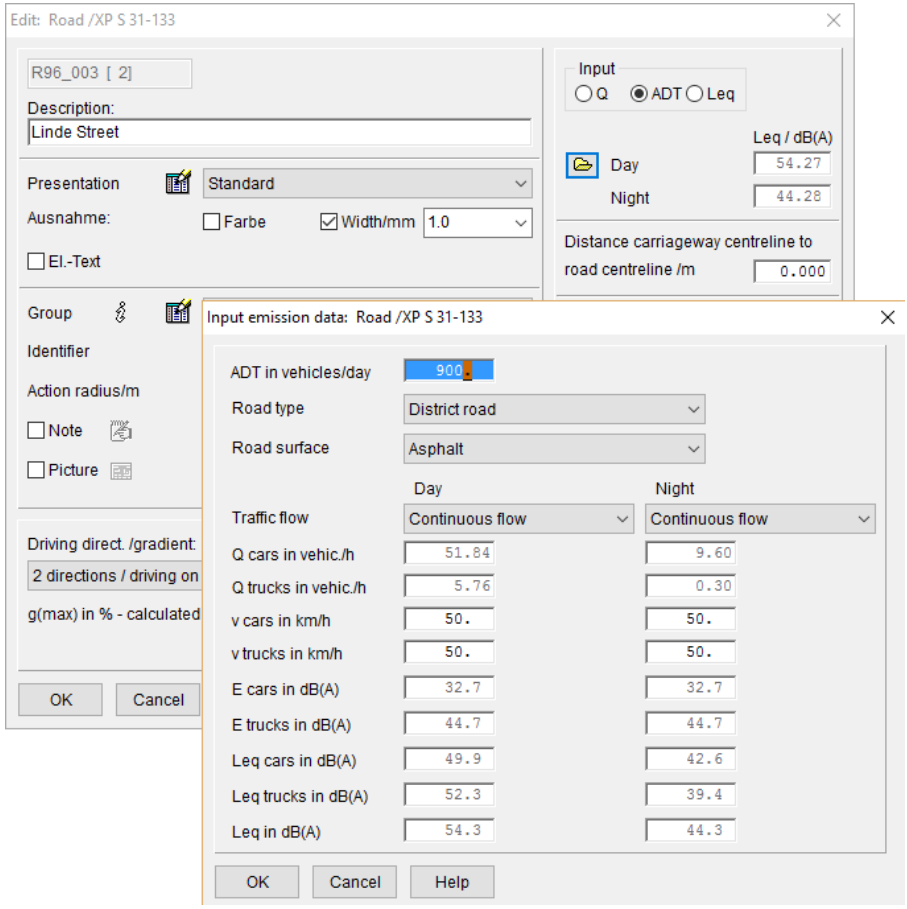


Figure 25: Input dialog for an additional road

In the following stage of the project, you will create several variants in order to become more familiar with the variants function. For a better understanding of variants and element groups, please read the following excerpt from the manual.

Using Variants:

The option of calculation variants allows editing of different variants within one and the same project. That means that, while a variant is calculated, specific elements are activated for or excluded from calculation.

This requires two steps:

- The first step is to assign elements which are to be activated in one variant but deactivated in another to a special element group.
- The second step is to define calculation variants and to determine the element groups to be activated in the particular variant.

Using Element Groups:

Element groups form the basis for the calculation of variants. Unless additional entries are made, there is always exactly one element group, i.e. Group 0.

Create the following variants:

- contributions of "Würzburg Street" and "Linde Street" on the 3 reception points,
- contribution of "Würzburg Street" only, and
- contribution of "Linde Street" only.

To achieve this, define these calculation variants in the program.

- Select the **<Project | Element Groups + Variants>** menu item.
- Activate the **Variants** tab.
- Click on **Add...Würzburg Street** to add the "Würzburg Street" variant.
- Enter **Würzburg Street** in the Label field.
- Complete your entry with **OK**.

- Proceed as described above to add the **Linde Street** variant.

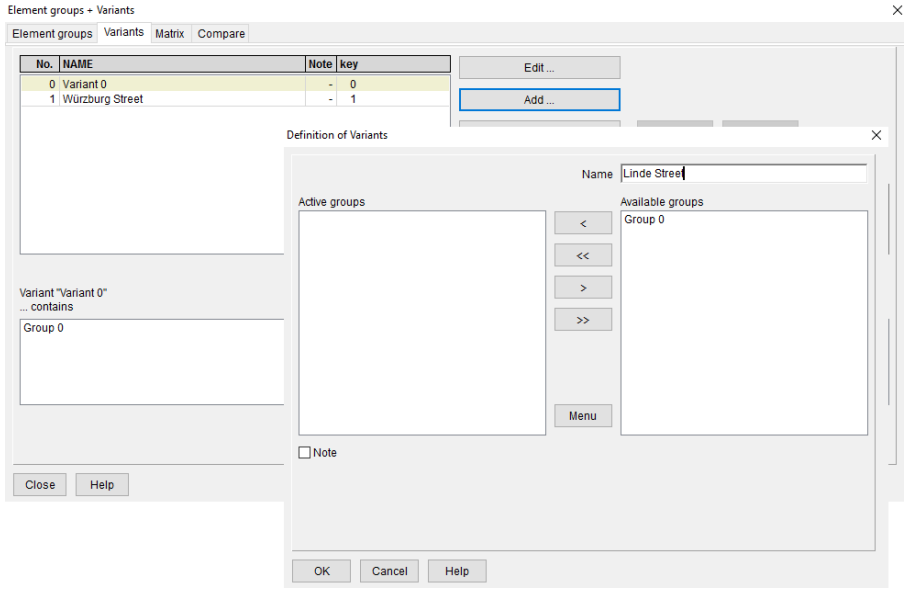


Figure 26: Creating variants

The default setting of all elements, on being generated, is "Group 0". The order of variants aims at assigning different group names to the various elements and to determine the groups to be active in the variants defined so that they are involved in calculation and also to determine the groups to be explicitly excluded so that they will not be included in calculation.

Our variants only differ in their noise causes, i.e. the roads. That is why a new group should be assigned to Würzburg Street and Linde Street. At first, however, new group names must be defined.

- Activate the **Element groups** tab.
- Click on **Add...** to enter a new group.
- Enter **Würzburg Street**.
- Confirm your entry with **OK**.

- Proceed as described above to define the Linde Street group.

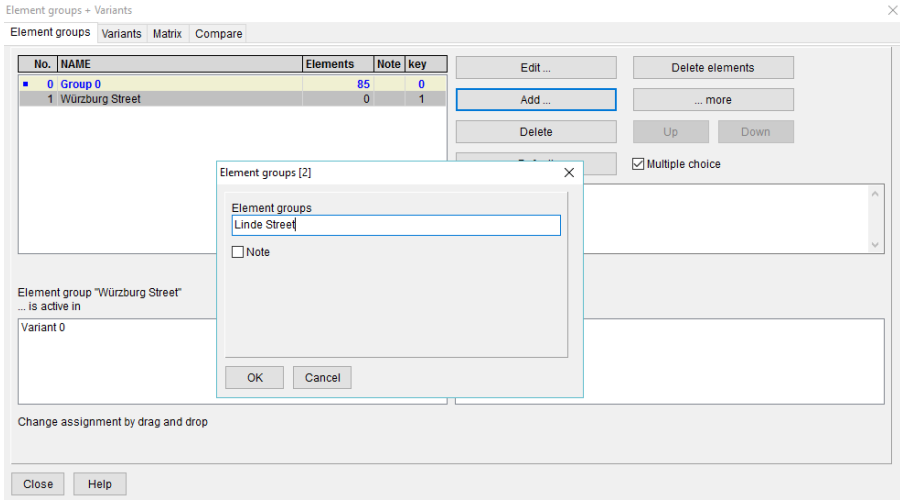


Figure 27: Creating element groups

The new groups are now defined. The next step is to assign the groups to the variants defined. This is achieved in the Variants tab.

Variant 0 cannot be edited because, here, all groups are always active. That means that, in our example, Variant 0 always includes both roads in calculation.

- Activate the **Variants tab**.
- Select the **Würzburg Street variant**.
- Click on **Edit...**. This will open the dialog for the definition of variants.

- Using the arrow buttons in the middle of the dialog, move the "Group 0" and "Würzburg Street" element groups to the left to the Active groups window.

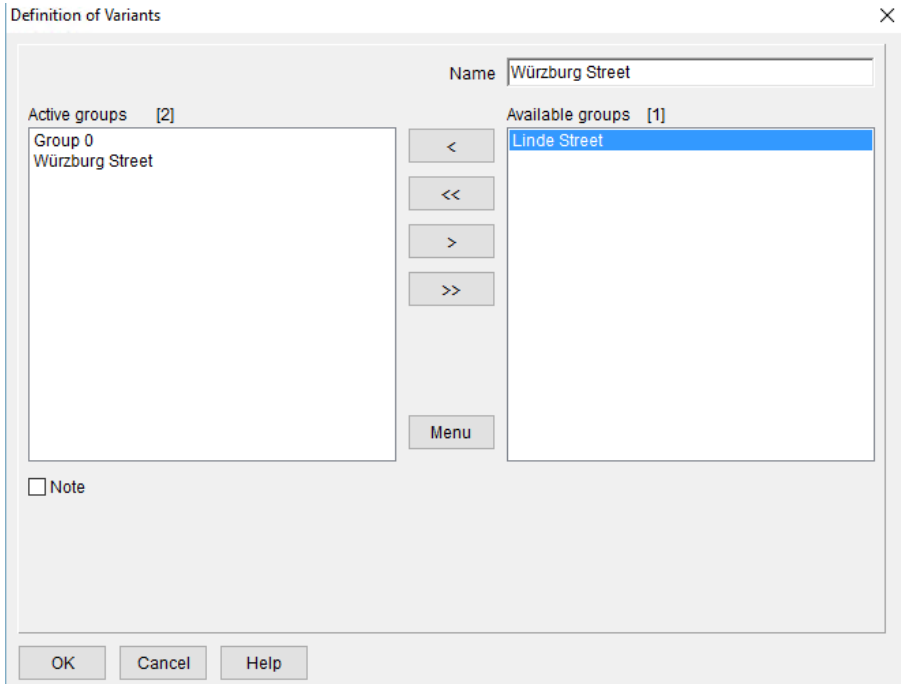


Figure 28: Assigning element groups in variants

- Exit the dialog with **OK**.
- Now select the **Linde Street variant** from the list and click on **Edit**.
- Using the arrow buttons in the middle of the dialog, move the "Group 0" and "Linde Street" element groups to the left to the Active groups window.
- Exit the dialog with **OK**.
- Activate the **Matrix** tab to verify the assignment.

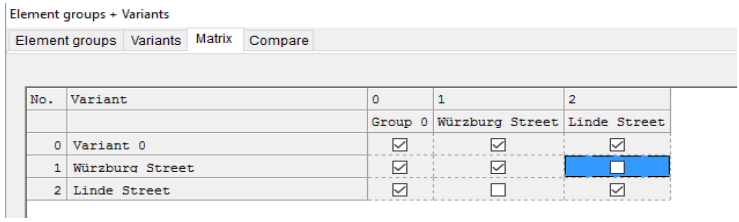


Figure 29: Matrix showing an overview of the variants including assigned element groups

- Click on **Close** to exit the dialog.

In the final step, the "Würzburg Street" and "Linde Street" elements must still be assigned to the new group. This is achieved on the elements level.

- Open the input dialog of the "**Würzburg Street**" element by **double-clicking on the element**.

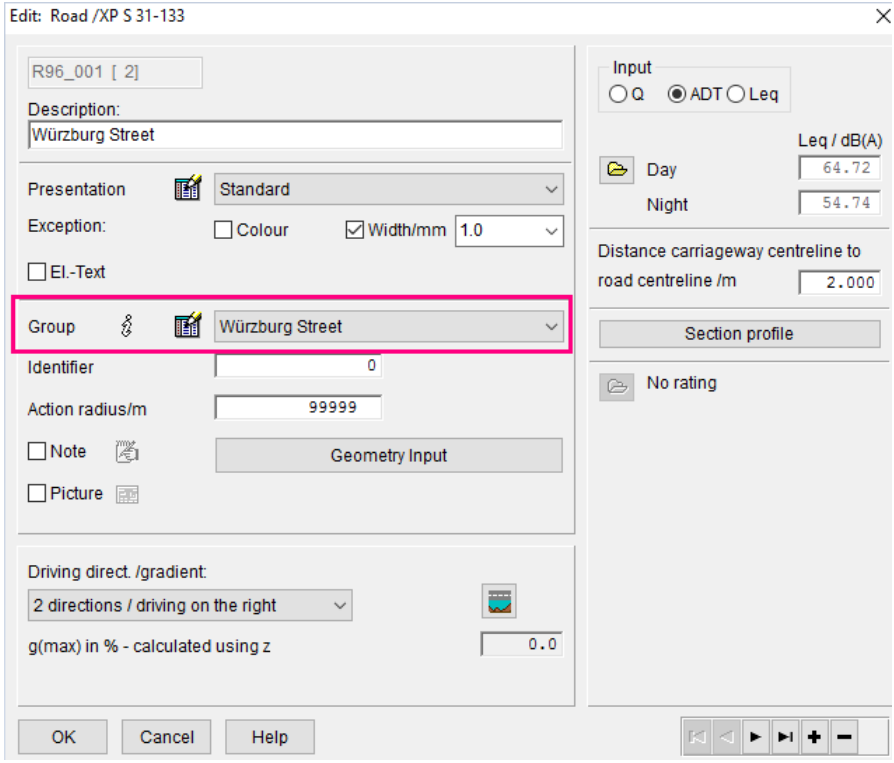


Figure 30: Assigning the element group in the element

- Confirm your entry with **OK**.
- Proceed as described above for assigning the **Linde Street** element to the **Linde Street** element group.

The effects of the variants created can be simply seen from the map.

- Using the arrow button of the **Map tool box** ( ), switch between variants and look at the changes in the map.

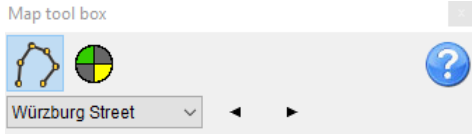


Figure 31: Map tool box for switching between variants

Once all assignments have been made correctly, both roads will be displayed whenever you call Variant 0. However, if you call the "Würzburg Street" or "Linde Street" variant, only the related road will be displayed.

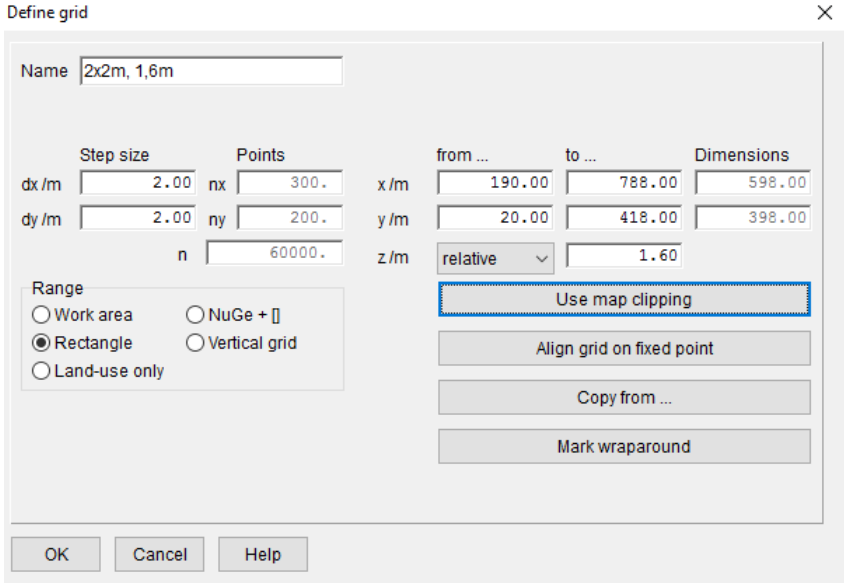
If you wish, you can make another single-point calculation as described above. You can then also select variants after having selected the reception points.

It is obvious that the variants function is extremely flexible so that a great number of variants can be involved, such as typically with/without noise barrier, with/without by-pass, with/without industrial noise percentage and with/without individual emission sources.

1.1.12. Grid calculation

In this chapter you will learn how to calculate a grid.

- Before starting the calculation zoom to the area of the background image.
- Choose <**Calculate | Definition | Calculation area**> and click **Edit...** to change the predefined grid. The step size should be 2m x 2m, the height 1,6m.



- Click on **Use map clipping** to take over the area you zoomed.
- Close all dialogues.

- Choose <**Calculate | Calculate grid**> from the main menu or  to start the calculation.

- Choose the variant **Würzburg Street** for calculation.

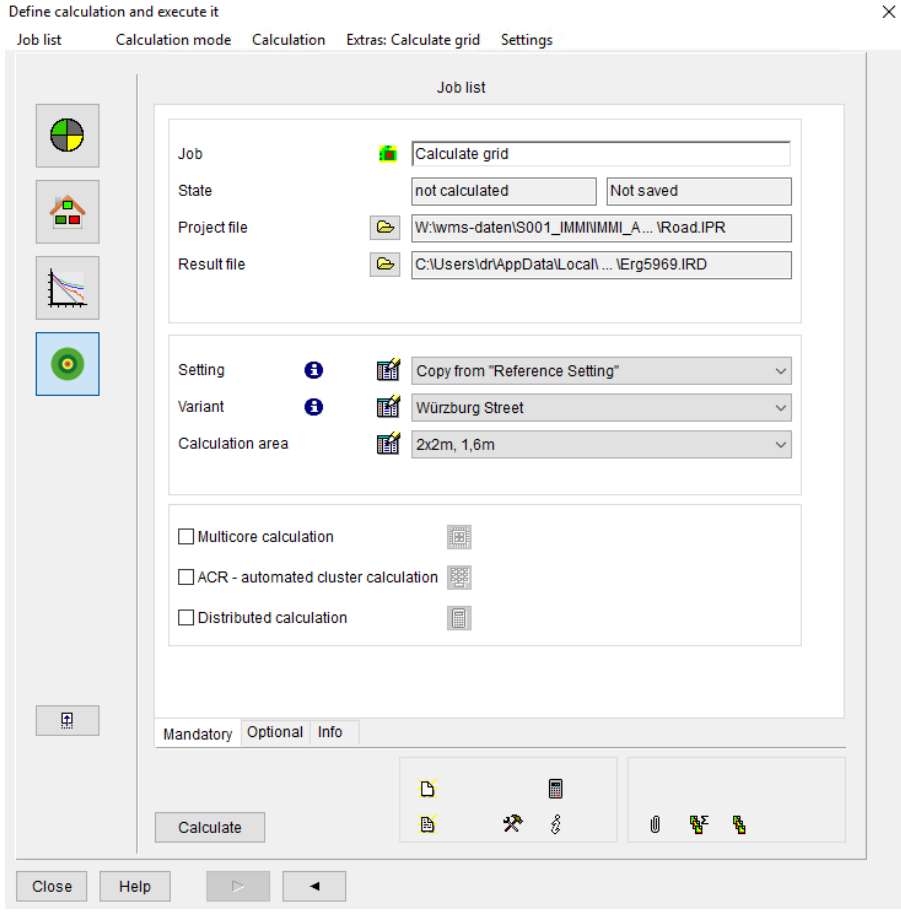


Figure 32: Start the calculation of the grid

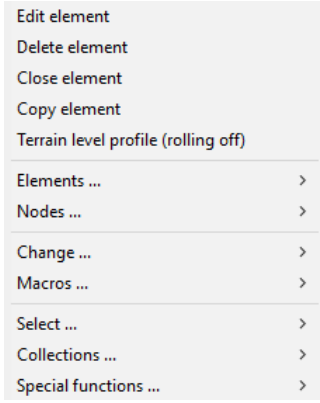
- Click **Calculate** to start the grid calculation.
- After the calculation, select <**Calculation | Save**> in the CCC menu to save the grid.
- Close the dialogue and study the result showing in the map.

1.1.13. Further features

The section below treats some features of IMMI once again in more detail so that you will get to know further options provided by the program.

In many cases, you can right-click to open a pop-up menu providing many useful functions.

- Select a building and right-click. This opens the following pop-up menu:



- Activate and try the various functions.

1.1.14. Documentation

The last section provides information about important documentation tools.

1.2.1.1 Building a report page

Print layouts are the graphical basis of reports. A project can contain any number of layouts. These layouts are managed in a list.

A lot of layouts are already predefined in IMMI, e. g. format A4 to A0, portrait and landscape.

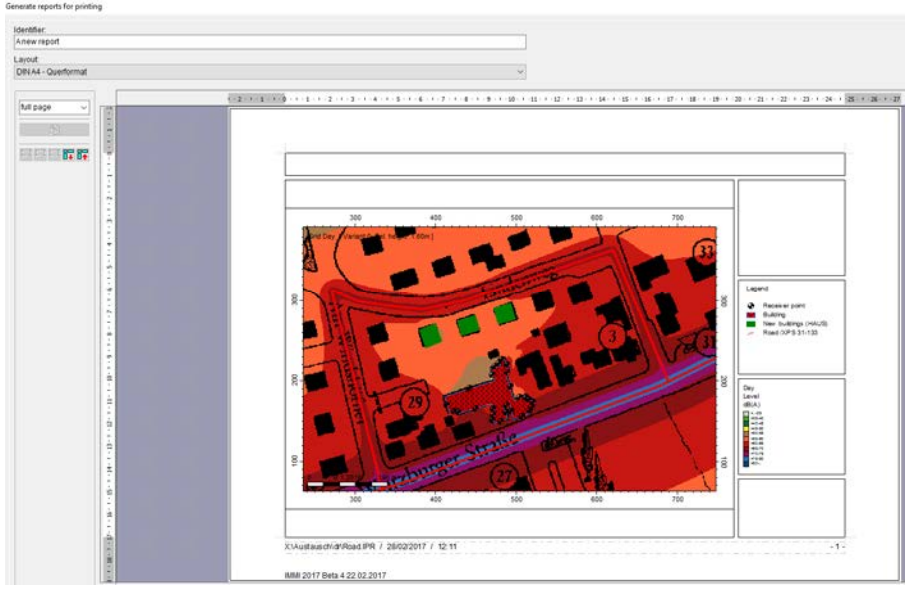
The following report is to be created on an already existing print layout. In the first step we will have a look on the print layout.

- Open the menu <Report | Print layouts> .
- Choose the page layout A4-Hochformat and click on Edit... .
- Have a look on the page layout with the several components. You will find further information in the IMMI online Help.

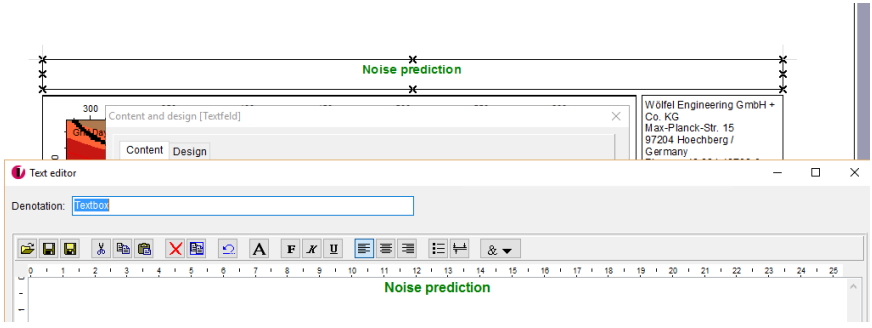
- Close the layout with **OK**.

In the next steps several components should be filled with content.

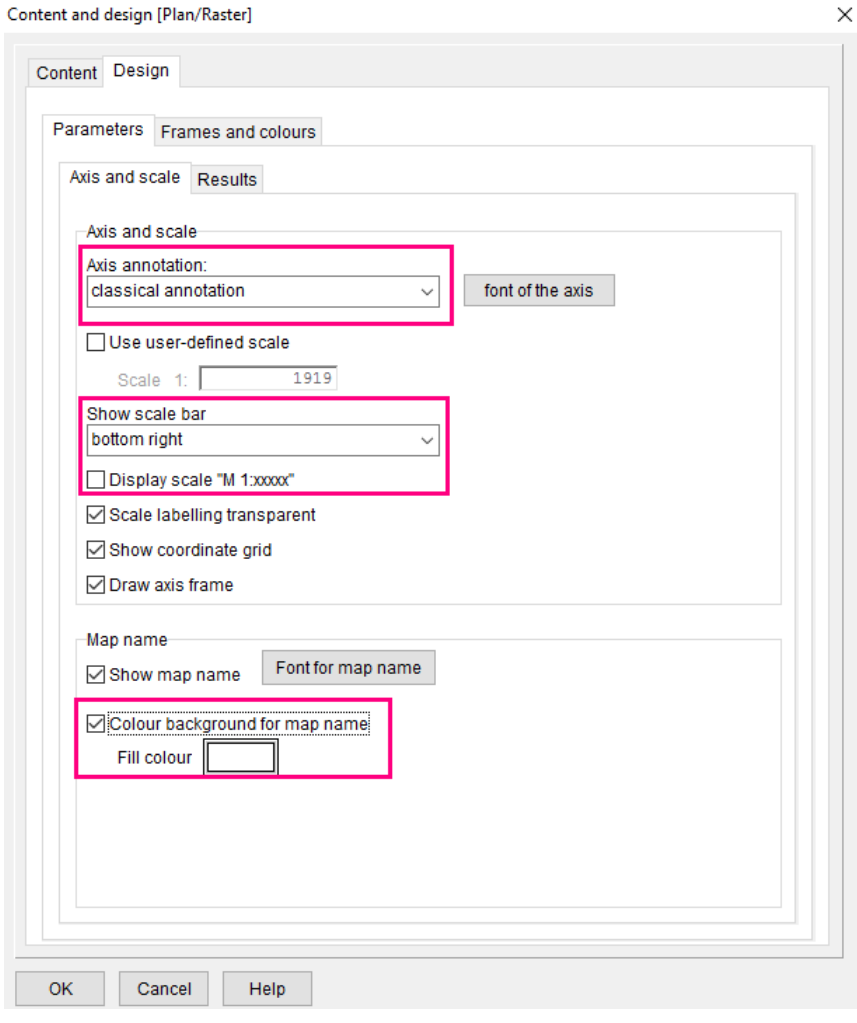
- Open the menu **<Report | Report pages>** .
- Click on **Add...** to design a new page.
- Enter a name and choose the layout **DIN A4 - Querformat**.
- Choose **Switch layout an preserve as much content as possible.**



- Double-click on the text field in upper left corner to fill in the component.
- Choose **Own text** and click on **Edit text**. .
- Give the report page a headline (e. g. Noise prediction).
- Do the formatting as you like.
- Close the dialogue with **OK.** .
- Do the same with the text field on the upper right side and type an address.



- The component Plan/Raster is filled automatically.
- Double-click on the component field to open the input dialogue
- Click on **Design** to change the **Axis annotation** and the **scale bar**.



- Close the dialogue with **OK** and **Close**.
- The report page is completed and ready for printing.

1.2.1.2 Printing the Map

- Select the <Report | Print> menu item.

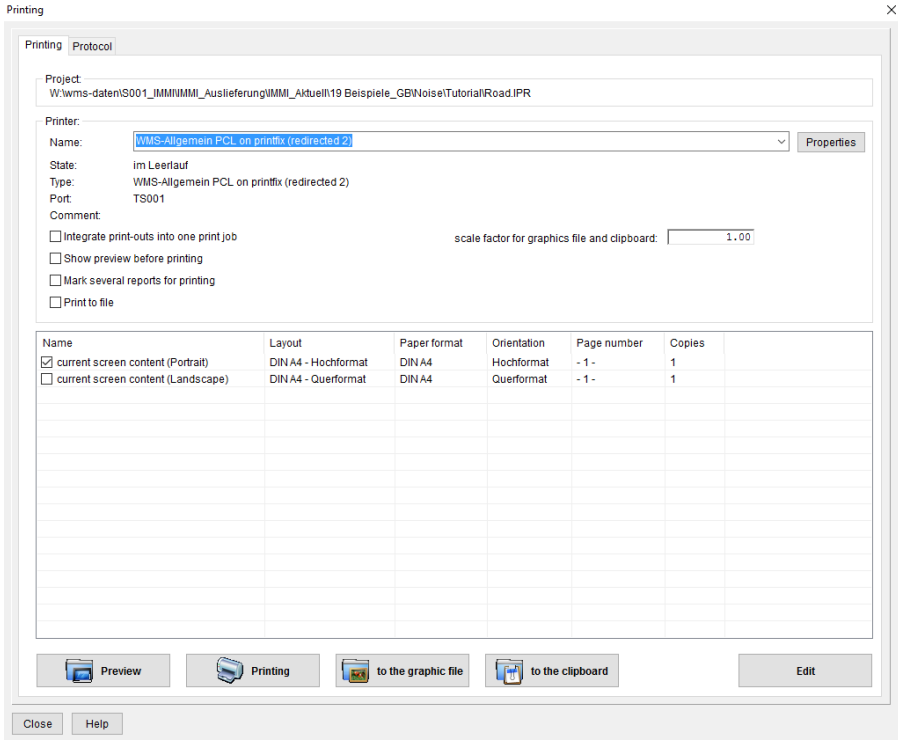


Figure 33: Printing the map

This opens a dialog where you can make settings for the printer and for the graphical representation.

- Select **current screen content (Portrait)** layout and click on **Printing.**
- Exit the dialog with **Close**.

1.2.1.3 List of Input Data

A documentation should also contain a list of all input data of the project as well as a list of variants, the dimensions of the work area, etc.

- Select the <Report | List of input data> menu item.
- Select the **Sound sources only** list and click on **Show lists**.

- Look at the list.
- Try the various functions.

Road /XP S 31-133 (2)								Variant 0
R96_001	Label		Würzburg Street		Action radius/m			99999.00
	Group		Würzburg Street		Emi. variant			Emission
	Number of nodes		7					dB(A)
	Length/ m		1099.01		Day			64.72
	Length/ m (2D)		1099.01		Night			54.74
	Area /m²		---		Max gradient % (z-coord.)			0.00
					Driving direction			2 direct./driving on the right
					Dist.:centreline lane - road /m			2.00
					ADT in vehic/day			10000.00
					Road type			District road
					Road surface			Asphalt
	Emiss. variant	Traffic flow		Q car /vehic/h	Q HGV /vehic/h	v car /km/h	v HGV /km/h	Leq /dB(A)
	Day	Continuous flow		576.00	64.00	50.00	50.00	64.72
	Night	Continuous flow		106.70	3.30	50.00	50.00	54.74
R96_003	Label		Linde Street		Action radius/m			99999.00
	Group		Linde Street		Emi. variant			Emission
	Number of nodes		8					dB(A)
	Length/ m		797.54		Day			54.27
	Length/ m (2D)		797.54		Night			44.28
	Area /m²		---		Max gradient % (z-coord.)			0.00
					Driving direction			2 direct./driving on the right
					Dist.:centreline lane - road /m			0.00
					ADT in vehic/day			900.00
					Road type			District road
					Road surface			Asphalt
	Emiss. variant	Traffic flow		Q car /vehic/h	Q HGV /vehic/h	v car /km/h	v HGV /km/h	Leq /dB(A)
	Day	Continuous flow		51.84	5.76	50.00	50.00	54.27
	Night	Continuous flow		9.60	0.30	50.00	50.00	44.28

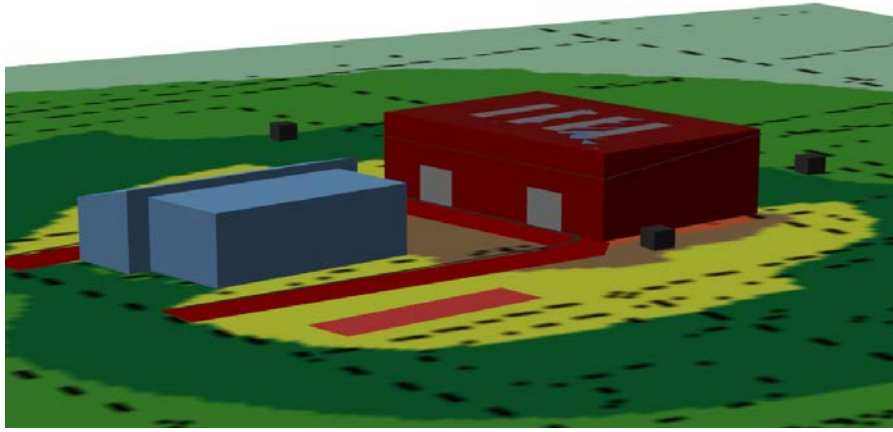
Figure 34: List of input data

- Additional task: Create an individual list.

1.3 Getting started with the calculation of industrial noise

The present example relates to the planned erection of a storehouse for an existing industrial establishment. The property is located in a commercial area.

The construction licensing procedure requires that a technical sound expertise should be submitted, proving that the allowed noise impact values are complied with in the neighbourhood.



1.1.15. Local situation and noise impact protection requirements

The terrain of the newly planned storehouse is located to the west of the Rhine-Main-Danube Canal on plot no. 1642. The land development plan includes industrial establishments neighbouring to the south and west. Residential buildings in a general residential area are located to the west, outside the land development plan.

The following relevant receiver points (RP) in the neighbourhood of the planned facility form the basis of the assessment:

RP 1: Second-floor south-facing façade/GE (commercial area)/ 6 m above top ground surface

RP 2: Second-floor north-facing façade/GE (commercial area)/6 m above top ground surface

RP 3: First-floor west-facing façade/WA (residential area)/2 m above top ground surface

RP 4: Second-floor east-facing façade/GE (commercial area)/6 m above top ground surface

The sound impact of the facility to be assessed is determined for the aforementioned relevant receiver points and documented in detail, including the noise impact percentage of all sound sources.

Pursuant to L_{den}, the following recommended noise impact values (RNIV) are applicable for the rating levels determined from the overall business of the interfering facility noise as a whole in general residential areas and/or commercial areas:

Rating period	RNIV / dB(A)		Rating time
	WA (residential Area)	GE (commercial)	
During the day 6:00 am to 6:00 pm During the evening 6:00 pm to 10:00 pm	55	65	16 hours
During the night 10:00 pm to 6:00 am	40	50	8 hours

The facility is reached and left on the service road in the commercial area. There, the traffic immediately mixes with the remaining traffic. From a technical point of view, it is therefore not necessary to examine this issue in detail.

1.1.16. Creating the 3D model

The first step includes starting IMMI and opening the prepared project.

- Start IMMI.
- Open the example project **Storehouse.IPR** from the example folder of the installation directory (C:\Program Files (x86)\IMMI …\Examples\Noise\Tutorial).

- From the <**Project | Properties**> menu item, select the L_{den} rating method.

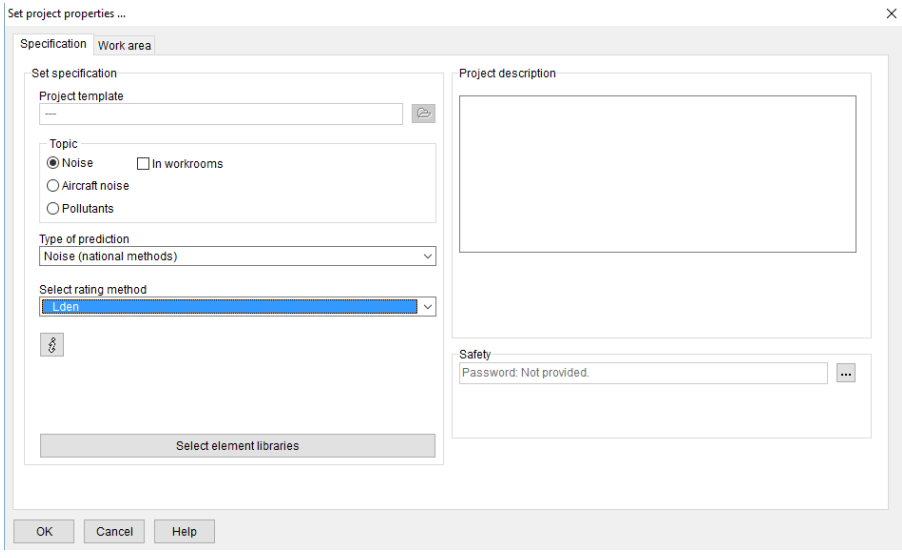


Figure 35: Selecting the rating method

- Close the dialog box and have a look at the project.

The adjacent buildings and the receiver points (RPs 1 – 4) have already been plotted. Assign the guideline values to the receiver points based on your rating and pursuant to L_{den}.

- Double-click on the receiver point (IPkt) to open the input dialog box for a receiver point.
- From the Select land-use type button, select the land-use type according to its name. Enter the guideline values.

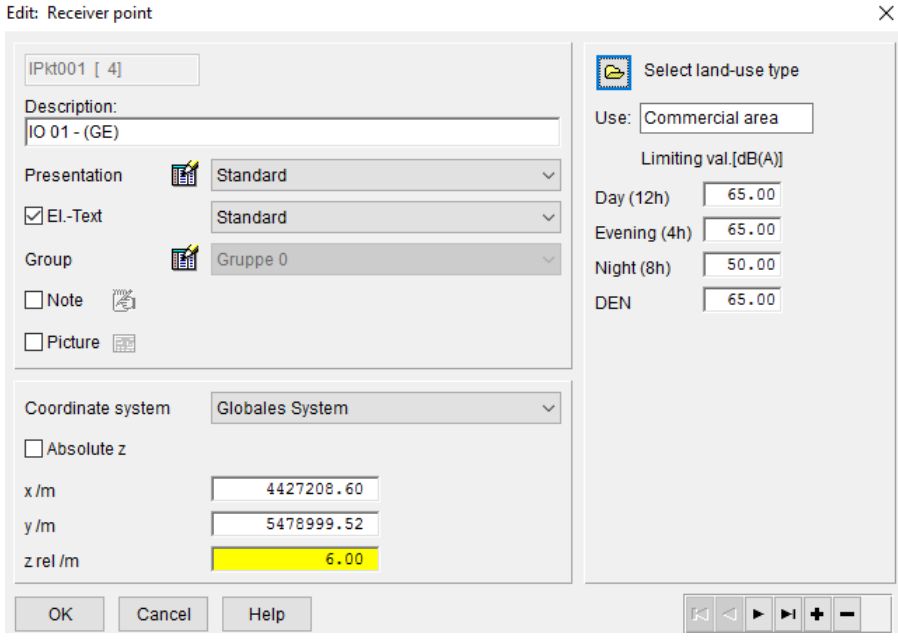


Figure 36: Enter the limiting values for the receiver points

- Click the arrow keys in the right bottom corner to go to the next receiver point (IPkt). Repeat the above steps for all of the other receiver points. As regards IPkt003, select residential area as land-use type.

The sound impact of the facility to be assessed is to be determined for the aforementioned relevant receiver points and documented in detail including the noise impact percentages of all sound sources.

1.1.17. Sound radiation from the storehouse

Business hours of the storehouse are planned on workdays between 7:00 am and 5:00 pm. There will be no business on Sundays and holidays or at night.

1.3.1.1 Determining the indoor level and the sound insulation utilizing the databases

On the east-facing side, the planned storehouse will be made of reinforced concrete. Sandwich panels will be used on the remaining facades and on the roof. The business time in the storehouse will be 10 hours. The following emission values

are taken as a basis according to VDI 2571(Sound radiation from industrial buildings; German guideline).

f/Hz	63	125	250	500	1000	2000	4000	8000
Lw (dB(A))	85	85	90	100	100	100	95	95

This covers business in the storehouse.

The sound insulation of the outside components of the storehouse is based on the sound insulation indices of the existing IMMI database.

The sound radiation of the outside components is included in the calculations pursuant to DIN EN 12354-4.

Before entering the indoor levels and insulation spectra, some explanatory remarks have to be made on the internal and external databases of IMMI.

External databases

Emission and insulation spectra that are frequently used in IMMI can be stored in an external database. The spectrum type can be separately defined for each spectrum, i.e., octave spectrum, third-octave spectrum, linear and A-weighted. This database does not depend on the project and is always available.

When a spectrum is selected from the spectrum database, the values are copied to the sound source. **Whenever the spectrum is changed in the database at a later point, the corresponding spectra of the sound sources will not be automatically updated.**

You do not have to enter the emission and insulation spectra separately for each sound source. Instead, you can just select the spectra desired.

Internal databases

If you must expect that you will **have to change the spectra while processing the project**, e.g., in case of noise control measures, we **recommend that you use the internal database**. **Whenever spectra are changed in the internal database, IMMI will automatically update the spectra of the associated sound sources**.

This minimizes the time and effort required for noise control measures (e.g., when the indoor level of the storehouse or the insulation values of the walls are changed).

1.3.1.2 Inserting spectra in the internal database

The next step in the project involves creating the emission and insulation spectra for noise-radiating components. Manually enter spectra or import them from MS Excel to fill the internal database.

The following example shows how to enter values manually using the external databases.

The starting point is the emission spectrum for the storehouse.

- Open the internal databases in the <Project | Internal databases - Spectra | Emission spectra> menu where you can define the octave spectrum for the indoor level of the storehouse. The empty emission spectrum list shows that there are no data yet.
- Click Insert from database to enter the first spectrum.
- Select the first spectrum Sheet metal – grind, hammer and click OK.

- The spectrum is applied to the internal database. Click **Edit** to view the spectrum.

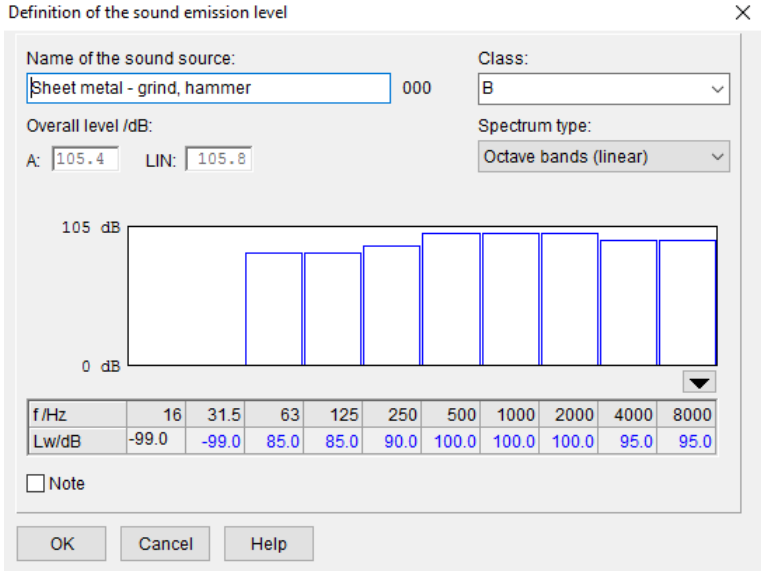


Figure 37: Display of the spectrum for the storehouse

- Click **OK** and **Close** to close the dialog boxes.

In the next step, enter the insulation spectra for the outside components, gates and windows.

- Open the **internal databases** for insulation spectra in the <**Project | Internal databases – Spectra | Sound Insulation**>.
- The values for the reinforced concrete wall on the east-facing side of the building, the sandwich panels and the windows are already included in the database. Now, enter the value for the gates.
- Click on the end of the list and select **Add**.

- Define the spectrum as shown in the following picture.

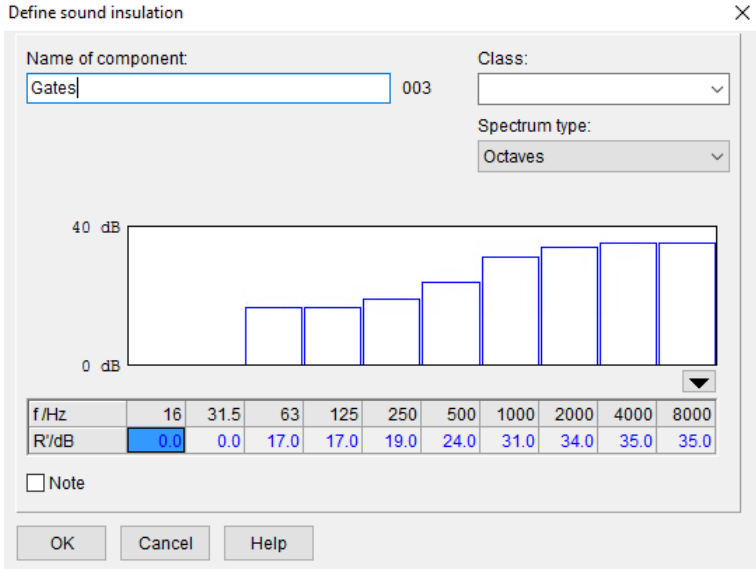


Figure 38: Entering the insulation spectrum for gates

- Click **OK** and **Close** to close the dialog boxes.

This completes your input of spectra.

1.3.1.3 Erecting the new storehouse

In the next step, erect the storehouse with sound-radiating walls.

- Zoom in the background image in the area of the storehouse.

- The ground plan of the storehouse is already defined as a help line. Click on the help line (name: Storehouse) and press the Enter key to open the input dialog box.

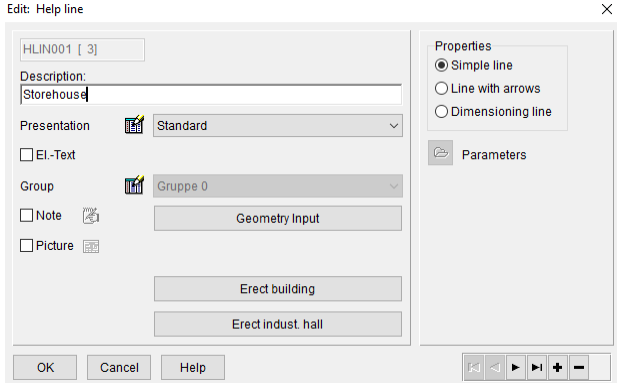


Figure 39: Start the function "Erect building" on basis of a help line

- Click the **Erect building** button in the help line input dialog box to generate the building with its sound-radiating and screening elements.
- Enter the parameters as shown in the following picture:

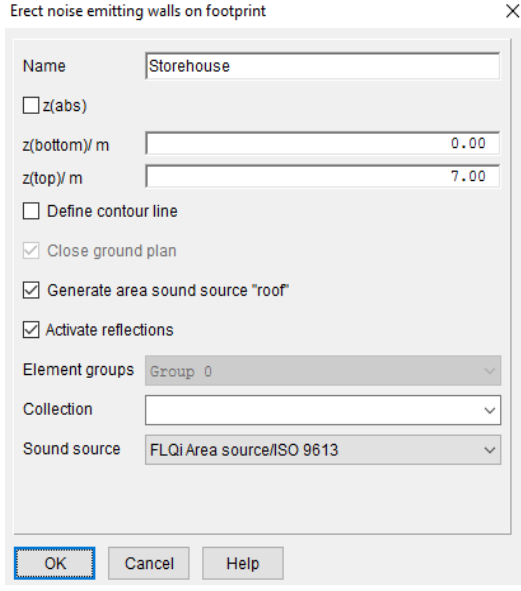


Figure 40: Settings for erecting the storehouse

- Confirm your entry and the prompt whether elements are to be generated with **OK** and **Yes**.

As a result of this operation, 4 sound-radiating walls, a sound-radiating roof, a screening house element with activated reflections, and the "roof" reflection surface have been generated.

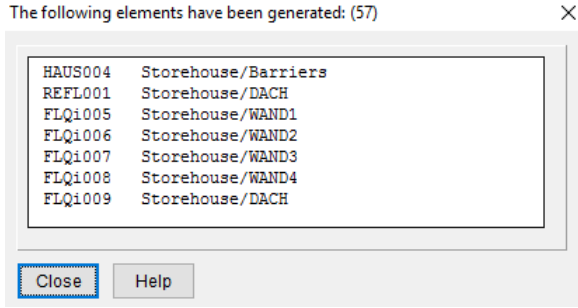


Figure 41: List of generated elements

- Click **Close**.
- The new elements are displayed in the Map. If not, actuate the brush ( ).

The erection of the storehouse is completed.

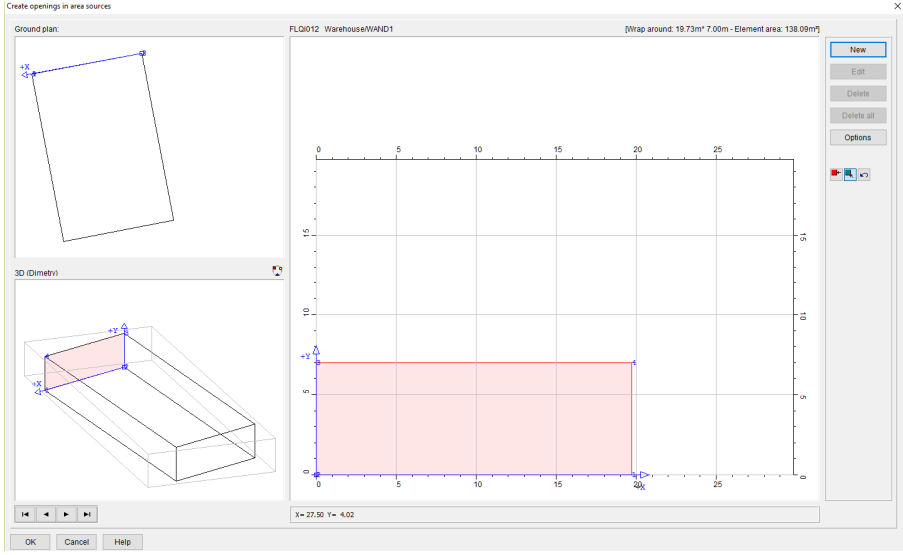
1.3.1.4 Designing windows and gates as openings

After having designed the storehouse, create windows and doors and allocate the emissions to the various sources.

- Select the <**Map | Design | Create openings**> ( ) menu where you can model the openings on sound-radiating walls.
- Tick the **Edit adjacent area sources** check box. As a result, IMMI automatically recognizes that the sound-radiating walls form a coherent area.
- Click **Area source** and select the first area source from the list. Click **OK**.
- Select **Create opening** to open the input dialog box.

This opens a dialog box comprising three panels. The left upper panel shows the ground plan, while the left lower panel presents a three-dimensional view where the perspective can be changed. Options are isometric, dimetric, and cavalier. All wall surfaces that belong together can be selected using the navigation bar at the bottom of this panel. The right-hand panel shows the active area sound source with

local coordinates, with the origin being positioned in the left lower corner of the partial area.



- Use the arrow keys to go to WALL 4 (WAND 4).
- Click **New** to generate the first openings belonging to the current area.
- Enter the following parameters:

Name:	Gate 1
Origin x/m:	5,2
Origin y/m:	0,01
Width /m:	4,5
Height/m:	4,5

- Click **OK** to confirm your entry.
- Make the same entries for gate 2.

Name	Gate 2
Origin x/m:	20,0
Origin y/m:	0,01
Width /m:	4,5
Height/m:	4,5

In the next step, insert a row of windows on the roof of the storehouse.

- Click the arrows on the left to go to the roof element. Click **Yes** to confirm the changed elements.
- Click **New**.
- Enter the parameters as shown in the following picture.

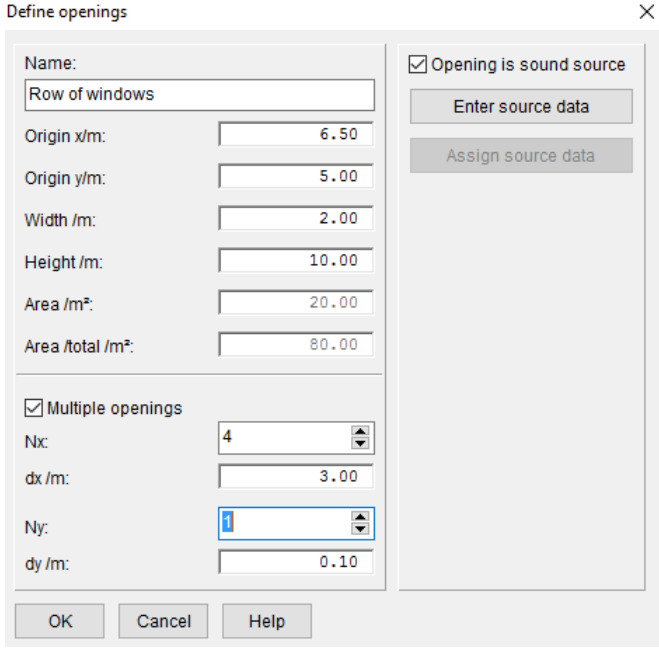


Figure 42: Creating a row of windows

- Confirm your entry with **OK** and **Close** all dialog boxes.

When calculating the noise impact, IMMI automatically takes into account that the openings reduce the area content of the individual walls.

- View the project in detail in the 3D Viewer. Click the  button in the tool kit to the upper left to start the 3D Viewer.

1.3.1.5 Allocating emission data

In this step, the emission and insulation data are allocated to the sound-radiating walls. This can be done block by block for several elements.

- To specify the emission spectra, right-click to select all area sound sources (FLQi) of the ISO 9613 library (**Mark all elements**) in <**Project | Elements | ISO**>.

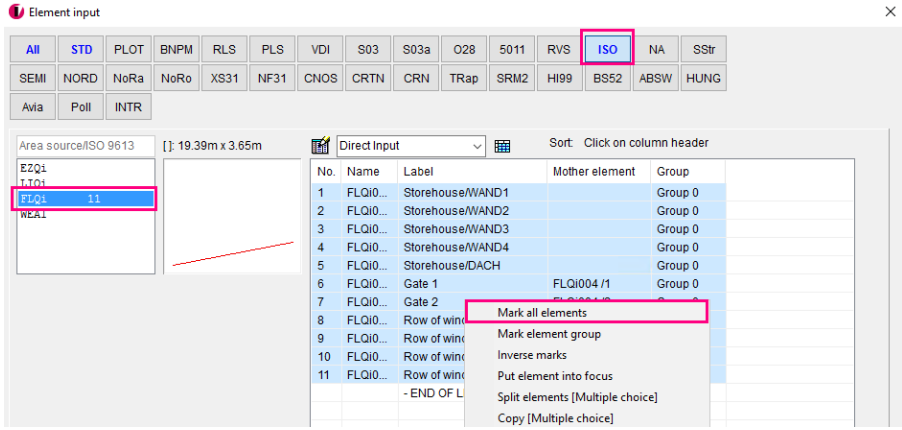


Figure 43: Selecting all area sound sources according to ISO 9613

- First, set the type of the sound source on indoor level.
- Click **Edit block**.
- Select **Type of sound source** from the data field. Then, select **Indoor level (Lp)** by clicking the button.
- Click **Execute** and **All** and **OK**.

Since all spectra are available as octave spectra, set the spectrum type to octave level (linear).

- Select **Overall level or either octave or third-octave band** level from the data field. Then, select **Octave bands (linear)** by clicking the button.
- Click **Execute** and **All**.

In the next step, the indoor level spectrum is allocated to all sources.

- Select the **Reference spectrum (emission) (Day (12h))** function from the data field.
- Click to open the internal emission spectra database.
- Select the **Sheet metal – grind, hammer spectrum**.
- Click **OK** and **Execute**.
- Click **All** to confirm your entry for all sources.

- **Close** the dialog box.

Insulation spectra are allocated in the same manner.

- First, activate the insulation spectrum function for all sources.
- Mark all elements and select **Edit block**.
- Select the **Is sound insulation defined for the sound source?** function, tick the box (**HAS...**) and confirm your entry with **Execute** and **All** and **OK**.
- **Close** the dialog box.

Now, allocate the insulation spectra of the east-facing outside wall (Wand2) to the remaining outside walls and to the roof as well as to the gates and the row of windows.

- Double-click **Storehouse/WAND2** to open the input dialog box.
- Click (at level input) to go to the dialog box where you can enter the insulation spectrum.
- Right-click in the **Insulation field** (grey area) and select **Sound insulation from internal database**.
- Select **Reinforced concrete - East-facing side** wall and click **OK**.
- Close all dialog boxes to return to the elements list.
- Select the remaining 3 walls and the roof.
- Click **Edit block** and select **Reference spectrum (sound insulation) (Day (12h))** from the data field.
- Click to select the **Sandwich panels** insulation spectrum.
- Click **OK** and **Execute**.
- Allocate the insulation spectrum to windows and gates in the same manner.

In the last step, ambient conditions are allocated pursuant to EN 12354-4.

- Mark all sources.
- Click **Edit block**.
- Select the Select **EN 12354-4: Select CDiffuse via space requirements** from the data field.

- Click  to select re. small rooms in front of abs. walls (C=-3dB).
- Click OK and Execute.
- Click All to confirm your entry.

Close all dialog boxes. This moves you back to the map.

1.1.18. Non-commercial traffic

Non-commercial traffic involves the arrival of 7 staff members during day time and their departure in the evening. Additionally another 7 occupation cases (14 parking operations) are taken into account during day time for visitor's traffic and traffic at lunch time. 14 parking lots are considered.

Noise emissions are determined according to the integrated method of the Parkplatzlärmstudie (study on parking area noise), chapter 8.2.1.

- Insert a parking lot area at the plot boundary. Use the available help line for your design. Tip: Right-click, change function, edit element type, PLS.
- Double-click the new element to open the input dialog box.

- Enter the data as shown in the following picture:

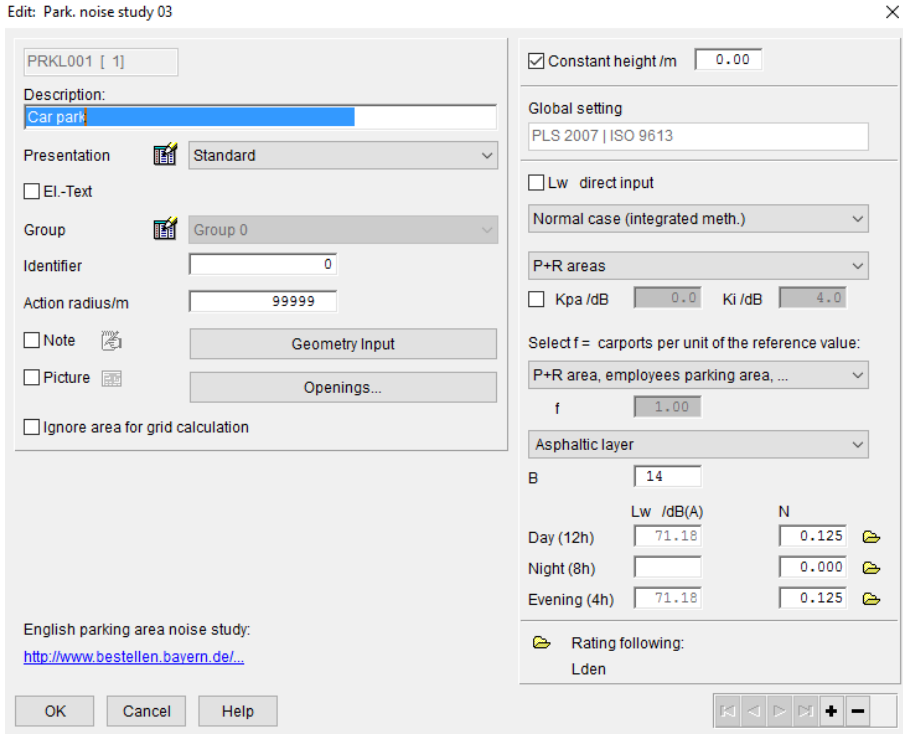


Figure 44: Defining the parking lot for staff members

- You have completed your entries. Regarding the parameter N the calculation is the following: During day time you have 21 movements for 14 parking lots in 12 hours. This means 21/14/12 = 0.125. During the evening you have 7 movements for 14 parking lots in 4 hours. This means 7/14/4 = 0.125.
- Close the dialog box with **OK**.

1.1.19. Commercial traffic

The arrival and departure of 4 trucks is assumed per day. The calculation of the sound power is based on the study of the Hessian State Office for Environment and Geology (Book 3).

This study specifies the sound power level for **1 truck > 105 kW per hour on a 1-m route to be 63.0 dB (A)**, averaged over time.

Model the driveway using the available help line. To do this, select the Line source element of the ISO 9613 element library and use Design.

- Trace the existing help line.
- Right-click to complete the modeling step and to open the input dialog box.

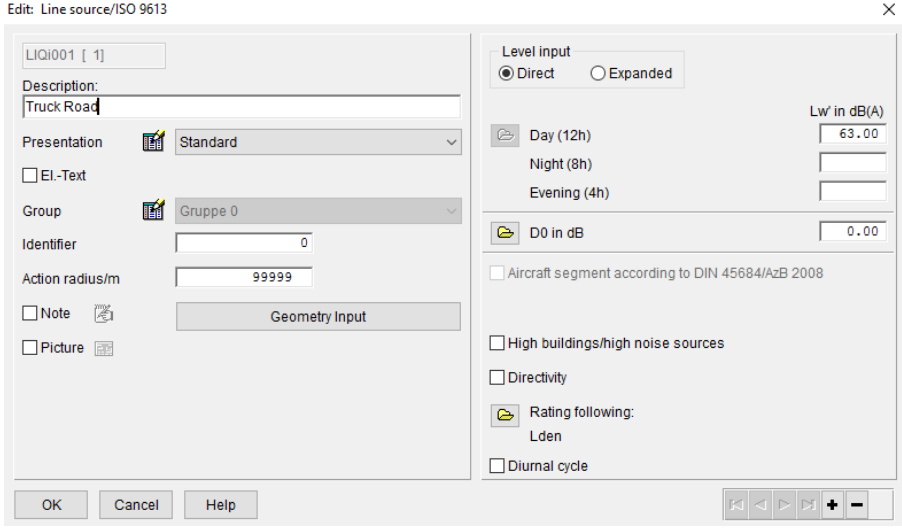


Figure 45: Input data for truck driveway

- Enter 63 dB(A) in the direct level input panel.
- Click the folder icon ( ) to open the rating according to L_{den}.
- Enter 4 in the n-times field and 1 in the Impact time/h field. The one-hour impact time value results from the level specification taken from the Study Book 3 because, there, the value relates to one hour.

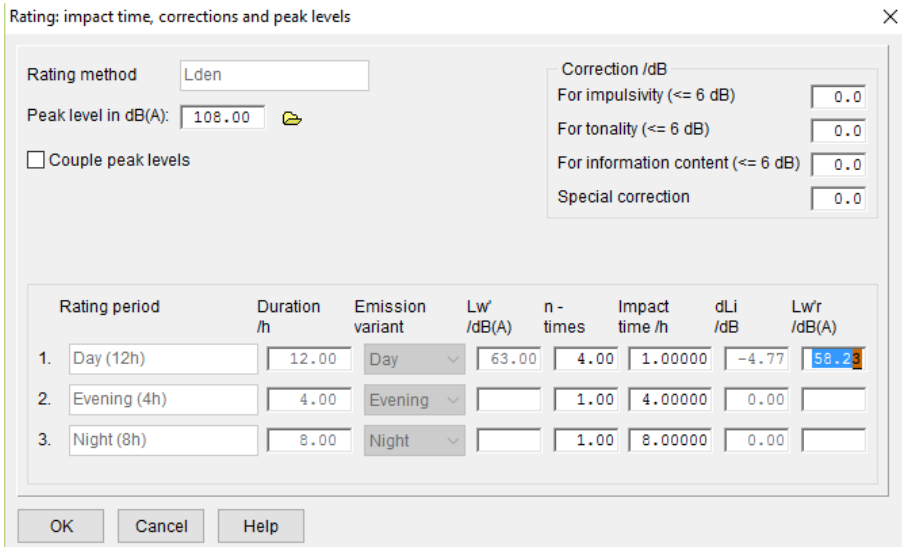


Figure 46: Truck driveway rating

- Additionally enter the **Peak level** of **108 dB(A)** (= decompression noise of the truck air brake system, Book 3).
- You have now completed your entry and can start calculation.
- Close all dialog boxes.
- The 3D Viewer provides a preview of the model ( ).

1.1.20. Calculating the noise impact at individual receiver points

The rating levels to be expected for the day rating period are determined and documented based on the rating method to be used, including subordinated rules and regulations. To simplify matters, the topography of the terrain is supposed to be flat.

The results of the single point calculations at the relevant receiver points, including the noise impact percentages of the individual sound sources, can be viewed in the respective lists. Open <**Calculate | Calculate receiver points**> ( ) and start single point calculation.

- Click **Calculate**. Close any messages that are displayed and start calculation with **Yes**.
- Have a look at the results. You should already be familiar with the results lists.

		Day (12h)	
		LV	L r,A
		/dB	/dB
IPkt001	RP 1 - (commercial area)	65.0	59.3
IPkt002	RP 2 - (commercial area)	65.0	61.8
IPkt003	RP 3 - (residential area)	55.0	39.4
IPkt004	RP 4 - (commercial area)	65.0	63.7

- You can also view the peak levels list to check any values that are too high.

The planned business on the property complies with the percentages of the allowed recommended noise impact values.

The quality of the results meets the standard of the detailed forecast of current standards. The rating levels specified are tailwind averaged levels LAT (DW). The calculation approaches for the sound sources have been determined based on recognized studies and empirical values gained with comparable facilities and yield reliable values just like the currently known use specifications that are taken as a basis.

The requirements for the protection of the neighbourhood against harmful environmental impact by noise are therefore fulfilled.

1.1.21. Calculating the noise impact on areas

The area for which noise impact calculation is to be carried out must first be defined to allow making the grid calculation.

- Zoom in on the storehouse area.
- Go to the <**Calculate | Definition | Calculation areas**> menu to define the calculation area.

- Click **Edit** and define the grid as shown in the following picture.

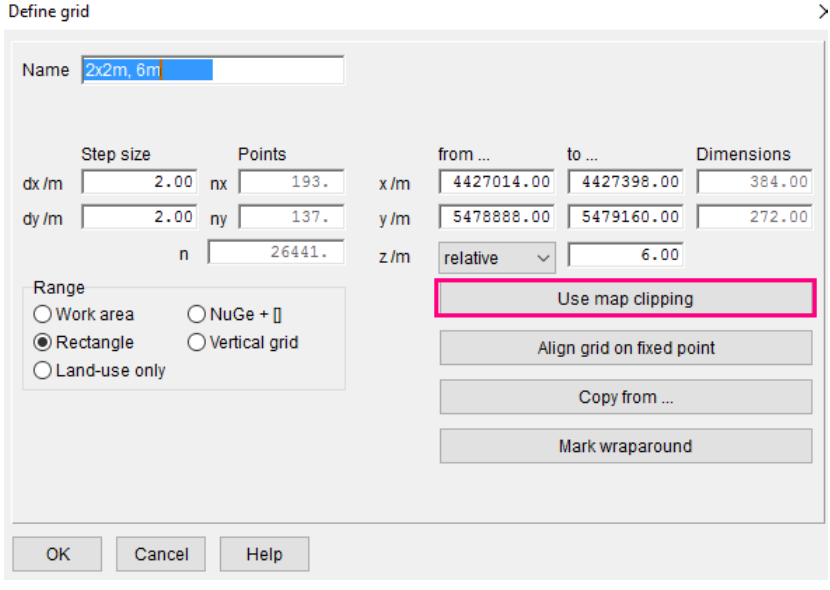


Figure 47: Defining the calculation area

- Do not forget to click the **Use map clipping** button.
- Confirm your entry with **OK** and close all dialog boxes.

- Click on the  button in the header or go to the <**Calculate | Grid calculation**> menu to start grid calculation.

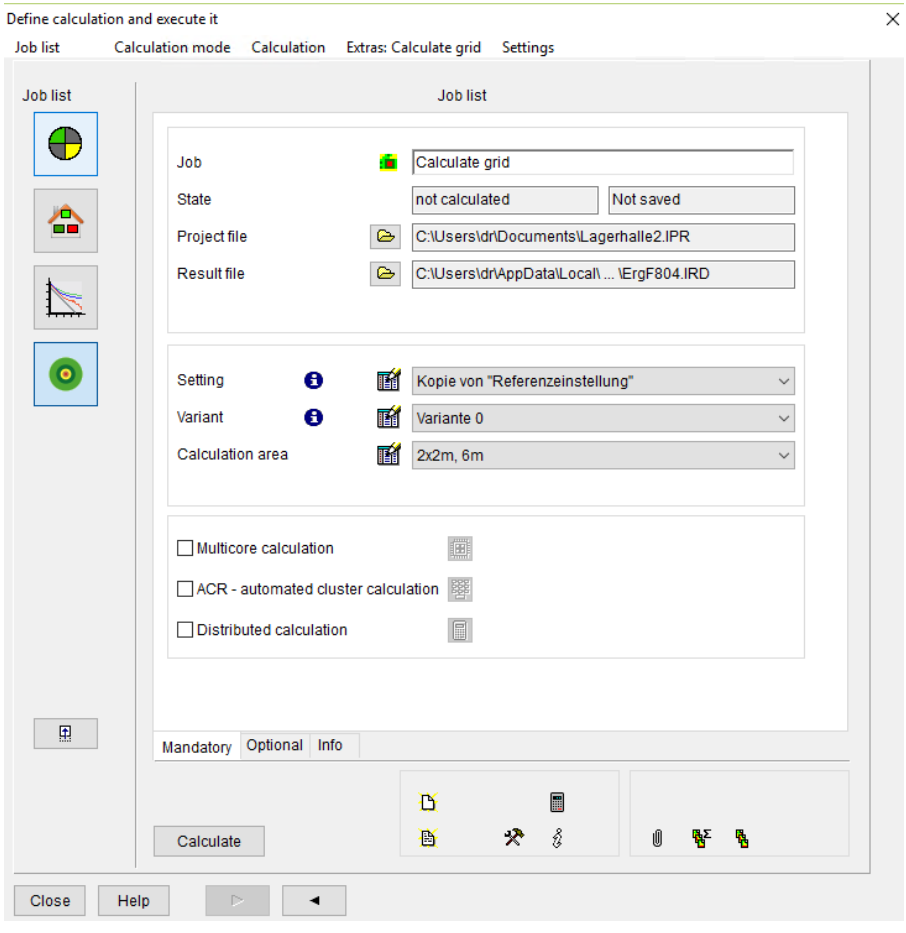
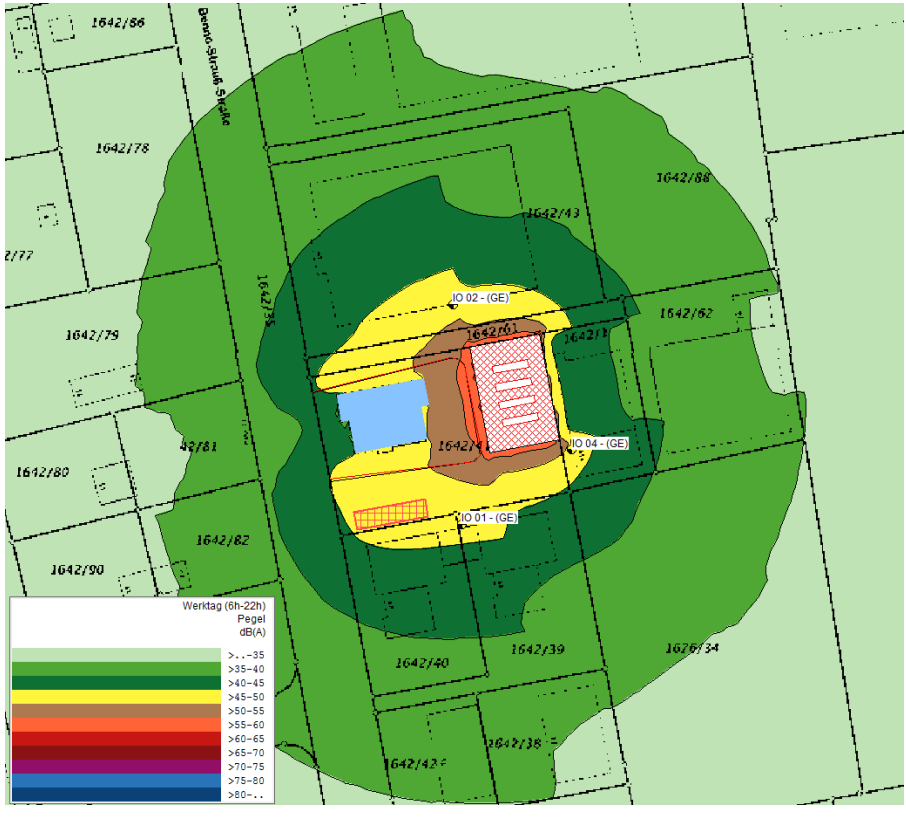


Figure 48: Starting grid calculation

- Click **Calculate**. The grid is being calculated.
- After completed calculation, go to the <**Calculate | Save**> menu and save the grid as .IRD file.
- **Close** the dialog box. The calculated grid will be displayed.



- You have now completed your first industrial noise project.

1.4 Creating a conflict map

In your IMMI installation directory, you will find the exemplary data record Staedtep_Lden.ipr under <Examples | Noise | Tutorial>. By way of this example, we will show you how to create conflict maps and difference grids.

To get an overview of the target values for the various utilization types, the representation of a Sensitivity map (Noise target values) is created in a first step.

- In the Toolbox on the left, select the **Thematic maps** mode.
- Click the  - **Sensitivity map** button to show the target values. Select an evaluation period. The resulting screen should look like this:

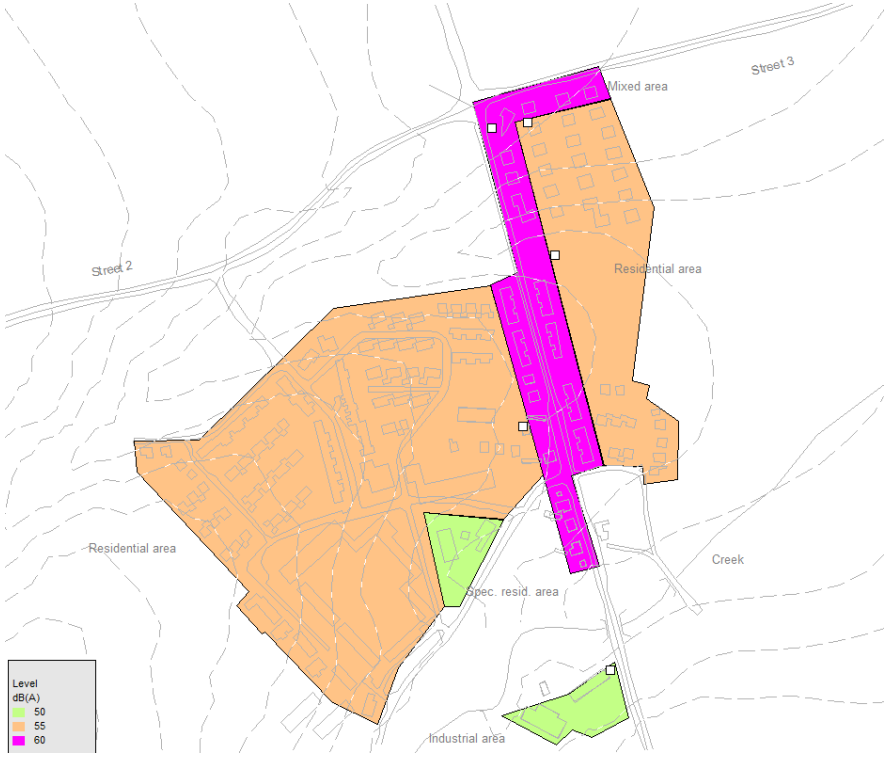


Figure 49: Display of the target values for daytime

- Now, via <**Calculate | Calculate grid | Calculate | Open**>, load the grid Staedtep.IRD from the IMMI Examples file.

- Select the menu <Extras: Calculate grid | Processing | Evaluate>.
- Click on **Evaluate**. Under **Select operation**, select: **Conflict map**. It is possible to activate all time periods.

  The grid that is shown now displays the comparison between the target values and the calculated noise levels.

  But the representation could be made even more meaningful for reporting purposes. Accordingly, only exceedences of the target values should be shown. Non-exceedances, though desirable in the interest of noise protection, are not meaningful in the representation of conflicts.
- Quit the dialog for grid calculation.
- In the Toolbox on the left, click on the  - **Change colour scale** button to re-define the grid scaling.
- Under **Scale**, select **Fixed-linear scale**, as well as 0 as a Minimum and **1 dB(A) as Step size**. Now, you see the new colour scale in the preview. In the preview, click on the **first line ...< 0.0 dB(A)** and assign the **colour white** (bottom right of the colour range chart). Now, the conflict map will be displayed in the desired manner. The conflicts are readily visible.

Figure 50: Conflict map

List of figures

What moves Wölfel?

Vibrations, structural mechanics and acoustics – this is the Wölfel world. Here we are experts, this world is our home. More than 90 employees daily do their best for complete satisfaction of our customers. For more than four decades we support our customers with engineering services and products for the analysis, prognosis and solution of tasks in the fields of vibrations and noise.

Are vibrations really everywhere? Yes! That's why we need a wide variety of solutions!
Whether it is engineering services, products or software – there is a specific Wölfel solution to every vibration or noise problem, for example

- simulation-based seismic design of plants and power stations
- measurement of acoustic emissions of wind turbines
- universal measuring systems for sound and vibrations
- expert reports on noise immission control and air pollution forecasts
- dynamic occupant simulations for the automotive and aviation industry
- and many other industry-specific Wölfel solutions ...

IMMI

IMMI is a product of the Wölfel Group.

Wölfel-Group
Max-Planck-Straße 15 / 97204 Höchberg
Phone.: +49 931 49708 0 / Fax: +49 931 49708 150
info@woelfel.de / **www.woelfel.de**

Wölfel