DIALux

Version 4.4

The Software Standard for

Calculating Lighting Layouts

User Manual

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DIALux Version 4.4

The Software Standard for

Calculating Lighting Layouts

Function Overview

Welcome to DIALux 4.4

This manual is intended to assist you to work fast and effectively with DIALux. If you have experience with Windows applications, getting started in DIALux will present no problem. DIAL regularly offer courses where the professional use of DIALux can be learned. Information regarding the course dates and contents are available under www.dialux.com and www.dial.de or +49 (0) 2351 1064 360.
Latest information and updates are also available on our homepage.

In the following you will find a short description of the functions available in DIALux.

DIALux offers a number of textures that you are free to use for your lighting layouts. The following companies provided those textures:

- Texturenliste SuperFinish – Immobiliendarstellungen, Jochen Schroeder/ www.immobiliendarstellung.de
- Arroway Texturen/ www.arroway.de
- Ulf Theis/ www.ulf-theis.de
- Texturenland (Konstantin Gross)/ www.texturenland.de
- Noctua Graphics (Herbert Fahrnholz)/ www.noctua-graphics.de
- Thermopal/ www.thermopal.de
- Rathscheck Schiefer und Dachsysteme KG/ www.rathscheck.de

They offer many more textures. Check their websites for further textures.

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New functions in DIALux Version 4.4

The DIALux Version 4.4 has the following new features:

New features and increments

- The most significant change in DIALux 4.4 is the integration of the standards for the "Energy performance of buildings – Energy requirements for lighting". Under the Kyoto protocol, Europe is committed to reduce CO2 emissions seriously. One instrument to achive this is the directive 2002/91/EC „Energy Performance of Buildings Directive"of the European Parliament and Council. The directive's requirements hold for both new and to be renovated buildings and for both residential and non-residential buildings. Member states of the EU were committed to implement this directive into national right.
- In medium terms, the energy performance for buildings directive causes increased efforts for light planners. Besides the well known lighting data characteristics, they will also have to pay attention to new energy performance characteristics. Fortunately, a common light planning already contains a great deal of the needed information for an energy evaluation. These information can be analysed and recycled for the energy evaluation. So if the energy evaluation is integrated into the light planning process as efficient as possible, the additional expenses for this evaluation can be reduced significantly. That's why DIALux 4.4 offers the possibility to include an energy evaluation according to EN 15193 or DIN 18599. A DIALux user can include an energy evaluation project into a DIALux project with only two mouse clicks.
- In Spain there is the "Código Técnico de la Edificatión" defined to check and reduce the amount of energy used for lighting. DIALux can calculate the needed figure "Valores límite de eficiencia energética de la in-stalación" (VEEI límite).

Mayor changes in existing functionality

- In the rulers of the 2D views it is possible to insert help areas to align objects along those axes. A simple double click in the ruler is enough to define the help area. Alternately the help area can be dragged from the ruler to the position needed in the CAD

- Working with the mouse the user will recognize that in several positions the software will make suggestion to place or move an object. Moving an object along a wall, an automatic snap to the middle of the wall will appear when the object is close to it. The wall itself also has a "gravity" for objects and luminares.
- To align objects it is now possible to place lines or grids in the 2D views. It is also possible to copy any object (luminare furniture or a combination of them) along these lines.
- Helplines are also generated automatically by DIALux. These automatic help lines will appear when you move one object along an axis of another object. They will disappear when the action of movement is finished.
- Selected objects can no longer only be moved in their insertion point. Now you can also move it in any corner of the bounding box. That makes it very easy to place one object next to another. Moving an object at its bounding box will also automatically rotate it if the object where it is moved to (e.g. a wall) has a different rotation.
- Selecting an object in the 3D view and moving it around, you can now select the area you work on by hitting the space bar. For example you move a cube towards a wall until the mouse icon with the object is in front of the wall, now hitting the space bar will make the wall the area you move the object on. Instead of X and Y axis you are now working on X and Z. This works with any area also for tilted floors or ceilings.
- You can now change between the scale mode and the rotate mode of an object by hitting the tabulator key.
- In any CAD view there is now a tape measure available. In 2D views it gives you the distance between two points, in 3D it gives you the distance and the height.

Smaller changes in the existing functionality

- The automatic cutting of holes in calculation surfaces has been improved. If an object (furniture, room element) is going through a calculation surface, its shape is automatically cut from the calc surface.
- In the luminance diagram it is now possible to define four different gamma angles to be plotted.
- The settings for the emergency properties of luminares have been improved.

- Improvements in the presentation of luminous intensity diagrams
- DIALux is now completely Windows Vista compatible
- The standard directory for project files, raytracing pictures and log files has been changed to the "my documents" folder. Making an update, the files are copied automatically.
- Online PlugIns can now be used in the protected mode of the internet explorer in Win vista
- The DIALux file name is now stated in the title bar of the DIALux software.
- In the DIALux Light there is now a button to centre a luminaire arrangement in the room

Installation

The installation of DIALux is easy to do. Please close all other application programmes before installing DIALux.

Installation after Internet Download

After you have downloaded the DIALux Setup (version no.).exe from our homepage (www.DIAL.de or www.dialux.com) on your hard-disk, you can start this file by one double-click with the right mouse button. Afterwards you can follow the simple instructions on the screen. The installation program of DIALux may require you to install a newer version of the Microsoft Internet Explorer. Version 5.5 or higher is needed, this can be downloaded from www.microsoft.com. The setup checks automatically which components are needed for your computer and automatically downloads them.

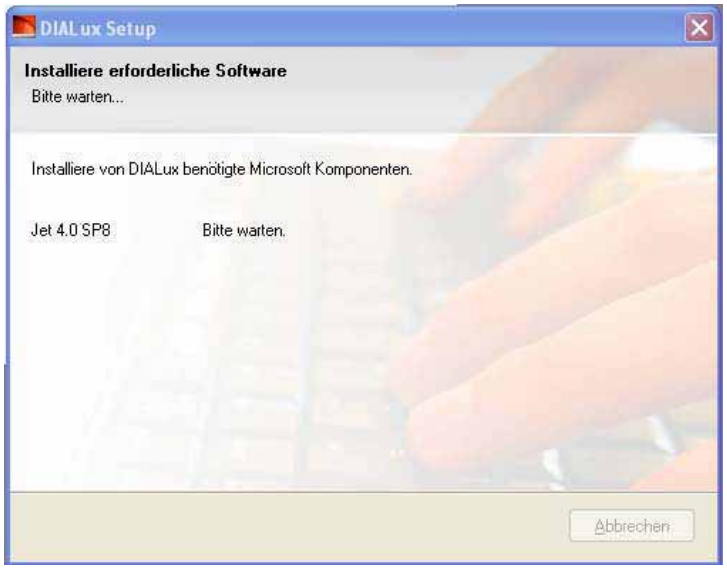


Fig. 1 DIALux Setup

The setup enables you to install only those components you really need. Missing components can be added easily later by starting the setup again.

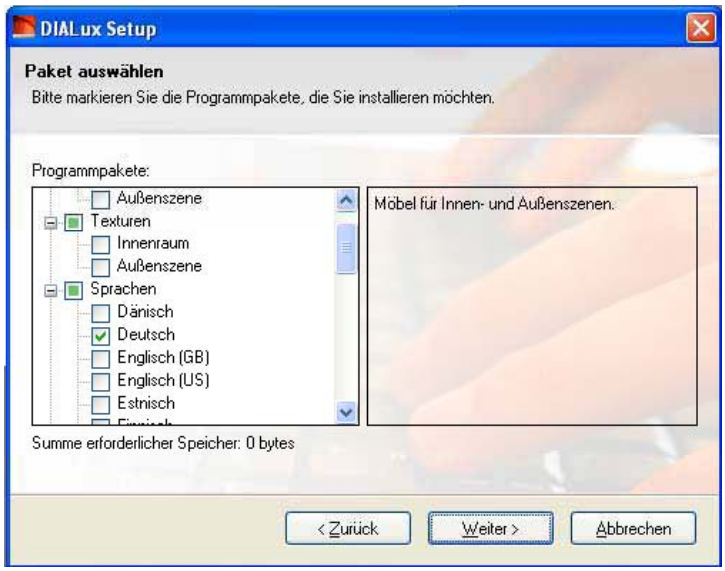


Fig. 2 Selection of the components to be installed.

Installation from CD

If you want to install DIALux from our CD, insert the DIALux CD and automatically a welcome screen starts. You can then click on install DIALux. If the installation program finds that your Microsoft Internet Explorer is later than version 5.5, you will be requested to install a newer version.

Fig. 3 DIALux CD browser

Online Menu

Online Update

In DIALux you will find a new menu named “Online”.

Fig. 4 DIALux online menu

In that new menu there are several useful features listed to contact DIAL. After selecting “Online Update…” DIALux automatically checks for newer versions of the software and for new online PlugIns.

Manage Newsletter subscription

Here you can enter your email address to subscribe (or unsubscribe) to the regular DIALux newsletter. It informs you about new versions and possibilities of DIALux. It is sent out every 6 to 8 weeks.

Wishes and Feedback / Send problem report

Maybe during working with DIALux you consider that an important feature is missing. Click on “wishes and feedback” and tell us what you need.

If a problem or even a crash occurs while using DIALux, click on the “Online“ menu and “Send problem report”. This will send an email to us that helps us solve the problem and helps you to get a more stable version. After a crash, this dialog opens automatically.

Install Luminaire Data

About PlugIns

DIALux is always delivered without luminaire data. The so-called PlugIns with the luminaire data of the manufacturers are directly available from our project partners. You can download the PlugIns either from the respective homepage of our project partners or you can request a CD with the luminaire data. You will find the appropriate links for our project partners alternatively there are telephone numbers and contact addresses on our homepage www.DIAL.de under *Data PlugIns* or you can click in the luminaire tree of DIALux on a *not installed* manufacturer. Afterwards a window opens, which displays the links of the corresponding manufacturers and contact addresses (see page 37).

After you have downloaded a PlugIn, close DIALux first before starting the PlugIn by one double-click. Then an installation program activates and you can follow the instructions on the screen. After completion of installation you can restart DIALux and in the luminaire tree a new PlugIn is now displayed (see page 37). You can activate the PlugIn by one double-click from DIALux.

If you want to install a PlugIn from a manufacturers CD, close DIALux before proceeding if it is open, then just insert the CD. Under normal conditions automatically a start window opens and you can follow the instructions. If no start window opens, please start the Windows Explorer and select the directory of the PlugIn of the CD. One double-click on the PlugIn opens it and you can follow the simple installation instructions.

About Online Catalogues

DIALux offers the possibility to use online catalogues. Online catalogues have the advantage that you can insert in each case the luminaires, which you need straight into the DIALux project, without installing a complete PlugIn on the PC. Working with online catalogues is described fully on page 90.

Lamp PlugIns

DIALux includes a lamp PlugIn interface. After selecting a luminaire from the luminaire catalogue, you can select the correct lamp for this fitting. Luminaire PlugIns only offer standard equipment data for the luminaires. The numerous variations of the same lamp type makes it absolutely necessary to select the exact lamp type which will be used in the installation. Some of the luminaire PlugIns directly offers the possibility to select the correct lamps from a lamp PlugIn for the desired luminaire. If

this feature is not (yet) integrated in the luminaire PlugIn, the lamp PlugIn can be started directly from DIALux. Lamp PlugIns have to be installed by the user like the luminaire PlugIns. DIALux offers for both lamp and luminaire PlugIns some demonstration data in the user database and in the DIALux Demo Lampdatabase.

DIALux directories

Background information

Microsoft has more and more strictly separated the user and the administrator privileges in Windows Vista and XP. So misuse of the computer by unauthorized persons or by malware was complicated. On the other hand users, administrators and manufacturer of software are more and more forced to follow the guidelines of the operating system strictly. To make sure that also users with restricted privileges can use DIALux with all it's features it was necessary to change some directories used by DIALux.

Furniture, textures, my database

These directories are now placed in the "application data common folder". This standard directory can be changed by the administrator. The following examples are standard settings after a windows installation.

Windows XP, Windows 2000
C:\dokuments and settings\All Users\application data\DIALux

- Drive is the system drive (standard: C:)
- subdirectory „documents and settings" is localized, (Standard: „Documents and Settings")
- subdirectory application data is localised and hidden (Standard: „Application Data")

Windows Vista
C:\ProgramData\DIALux

- driveis the systemdrive (standard: C:)
- subdirectory „ProgrammData" is hidden

Projects and raytracing files

Since DIALux 4.4 the dialux project files and the raytracing files are stored in the my documents folder.This was necessary to make sure, that users with restricted privileges can load and save files.

Windows XP, Windows 2000
C:\dokuments and settings\"user name" \my documents\DIALux

- Drive is the system drive (standard: C:)
- subdirectory „my documents " is localized, (Standard: „my documents")

Windows Vista
C:\User\"user name"\documents\DIALux

- drive is the systemdrive (standard: C:)
- subdirectory „user" is localized

- subdirectory „documents“ is localized

Program files, support

The DIALux directory is placed in the “Program files” folder. This standard directory can be changed by the administrator. The following examples are standard settings after a windows installation.

Windows 2000, XP, Vista
C:\Program files\DIALux

- drive is the systemdrive (standard: C:)
- subdirectory „program filesr“ is localized

Common used program files (DIALux, PlugIns)

The DIALux directory is placed in the “Program files” folder. This standard directory can be changed by the administrator. The following examples are standard settings after a windows installation.
Windows 2000, XP, Vista
C:\program files\common files\DIALux

- drive is the systemdrive (standard: C:)
- subdirectory „program files“ is localized

DIALux Light

DIALux Light *Wizard* has been available since DIALux version 3.1. With the help of this wizard it is possible to complete lighting designs quickly and simply. This means that infrequent users of DIALux can readily use the program without having to train themselves fully in using the software.

After the installation you will find the DIALux Light Wizard on your desktop near the "normal" DIALux icon. You can start the wizard by one double-click. If you have already started DIALux, you will find the DIALux Light wizard in the menu *File* → *Wizards*.

Fig. 5 DIALux Light Wizard – DIALux Light icon

After starting DIALux Light you are welcomed by a startup window. In this window the next steps that follow are explained. To move to the next window click on *Next*.

Fig. 6 DIALux Light Wizard – Start

In the window *Project Information* you enter your data and the data of your customer. Both will appear later on the printout. After completing the data entry, please click on *Next*.

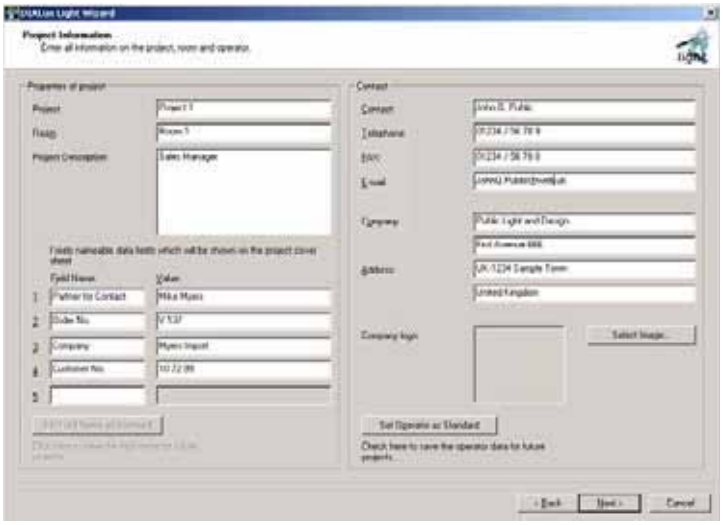


Fig. 7 DIALux Light Wizard – Project information

In the window *Data Input* you specify the room geometry on the left hand side. By default DIALux Light produces a rectangular room. If you check the box *Use L-Shaped Room*, DIALux Light shows a L-shaped room. Enter the relevant dimensions with regard to the room figure drawing. You can change on the left hand side the reflectance of the ceiling, walls and floor. The wall reflectance selected applies to all the walls.

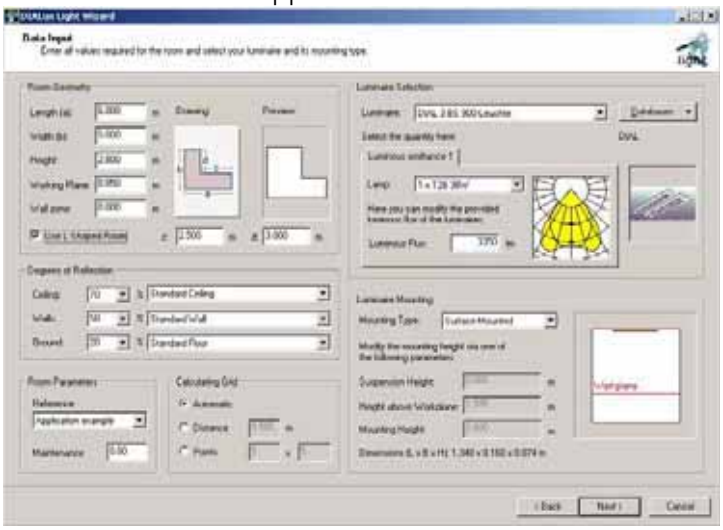


Fig. 8 DIALux Light Wizard – Data Input

One click on *Databases* starts a manufacturer PlugIn. In the PlugIn you can select the luminaire which you want to use and then click on *Apply* or *Use*. Then close the PlugIn. Now DIALux Light shows you the selected luminaire on the right above. (By default the last used luminaire is always displayed.) After completing the data entry, please click on *Next*.

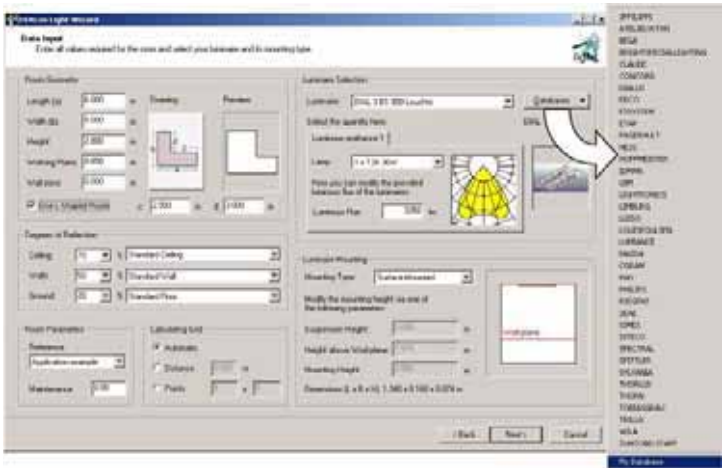


Fig. 9 DIALux Light Wizard – Launch a PlugIn

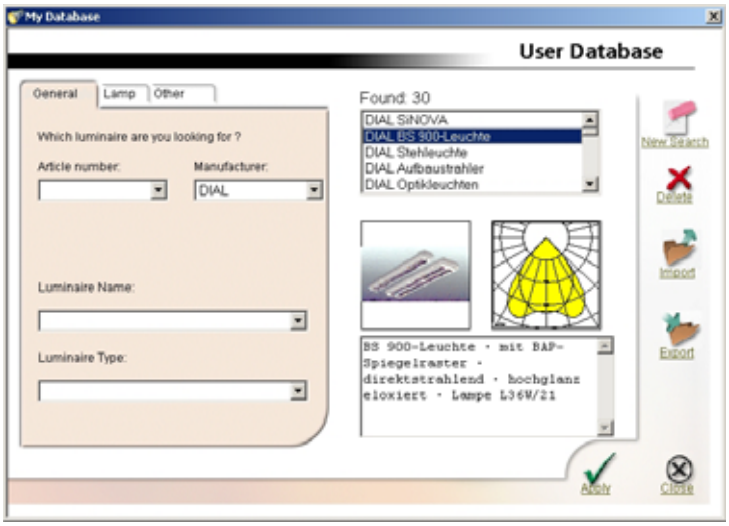


Fig. 10 DIALux Light Wizard – User Database

In the window *Calculation and Results* DIALux Light calculates the number of luminaires by the efficiency method that you need to achieve the desired illuminance. You can enter the desired illuminance in the field *Planned Em*. The luminaires, which are outside the room, are not considered by DIALux Light in the calculation. By using the entry *Horizontal arrangement* or *Vertical arrangement* you can specify the distances of the luminaires to each other and from the wall. After you have inserted all values correctly, click on *Calculate* and DIALux Light will start the calculation.

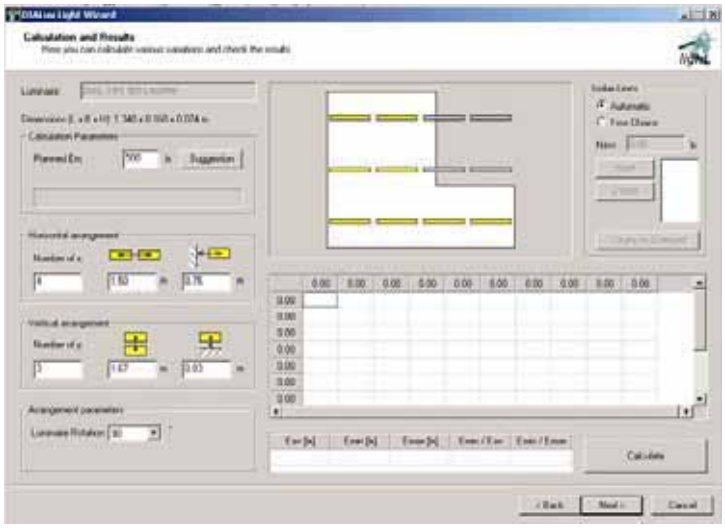


Fig. 11 DIALux Light Wizard – Calculation

Afterwards DIALux Light displays the results in a figure of isolux lines and a table for the work plane.

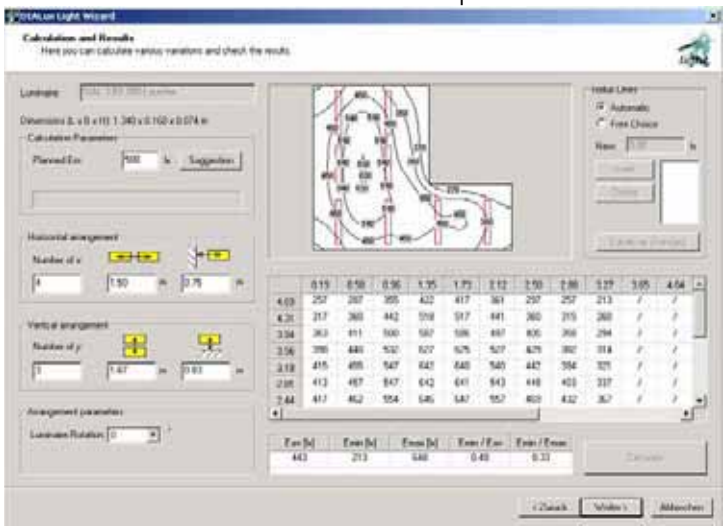


Fig. 12 DIALux Light Wizard – Calculated Result

In the *Result Output* window you have several choices, you can print the results or save them in electronic format as a pdf file. So click the appropriate button. By using the check boxes next to the printout symbols you can affect which outputs are actually printed out. By default all outputs are activated. If you would like to provide for example only a short overview, activate only the summary. If you would like to present the results to your customer, you may wish to activate all outputs.

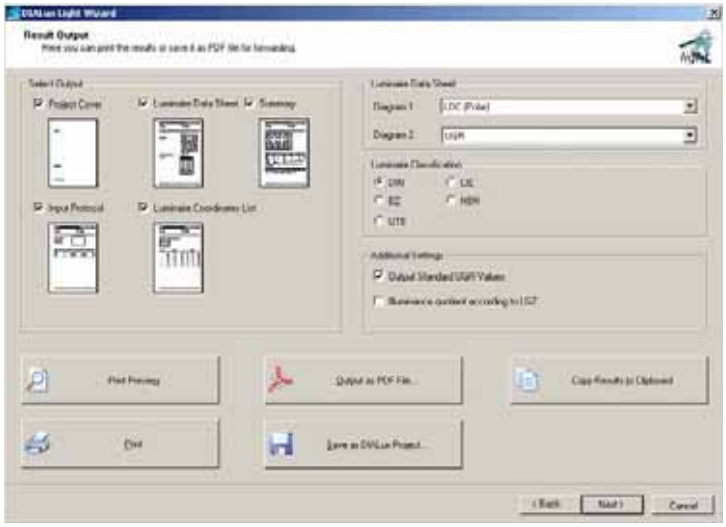


Fig. 13 DIALux Light Wizard – Result Output

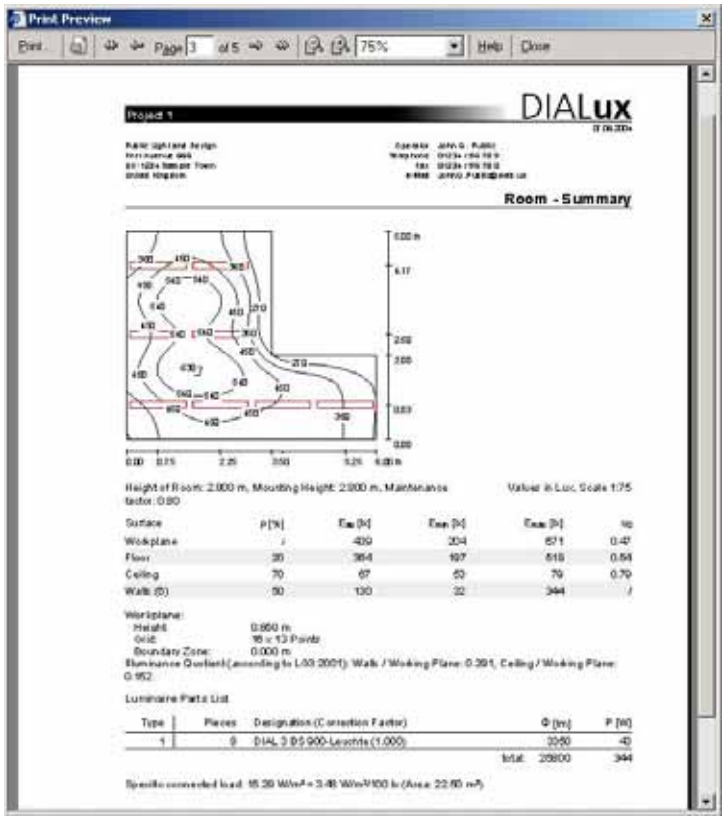


Fig. 14 DIALux Light Wizard – Output

At the end of the DIALux Light Wizard a dialogue is displayed. After you have completed DIALux Light, the calculated result is displayed as 3D rendering in DIALux. Here you have the option to save your calculation results under the menu *File* → *Save*.

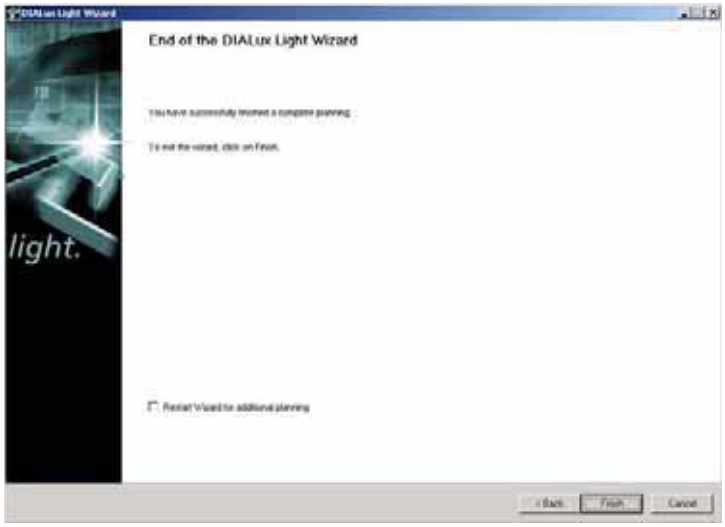


Fig. 15 DIALux Light Wizard – End

Working with Wizards

If you are using DIALux for the first time and you do not have much experience with CAD programs, we recommend that you create your first projects with the help of our wizards.

Experienced users can skip this chapter.

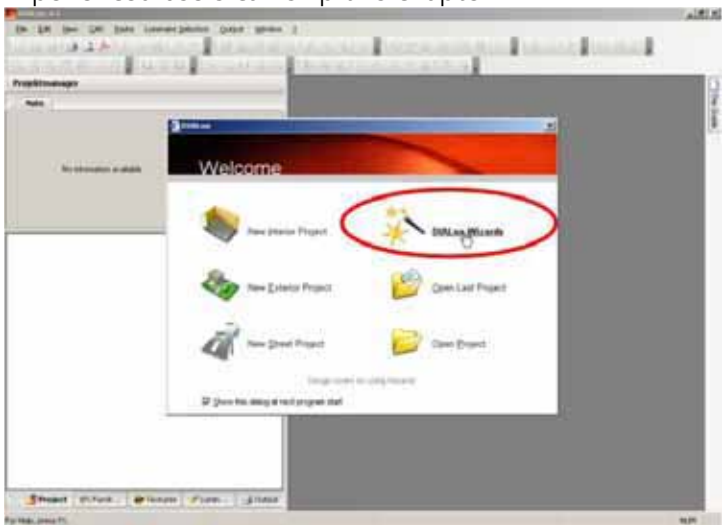


Fig. 16 DIALux Startup Dialogue

After the installation DIALux always starts with a *Welcome* window. In this window you can click with the left mouse button on *DIALux Wizards*. If you do not see this *Welcome* dialogue any more, you will find the wizards in the menu *File* → *Wizards*.

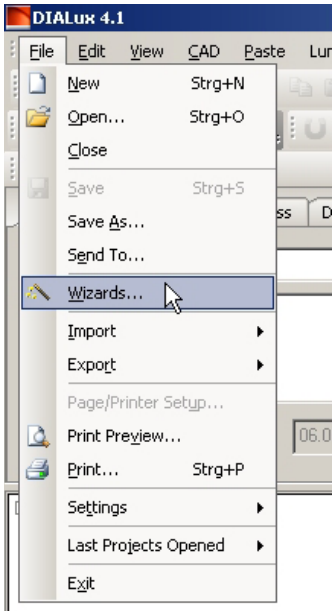


Fig. 17 Launch DIALux Wizard

A worked example using the wizard follows for a L-shaped room with a luminaire arrangement to provide 500 lx on the work plane.

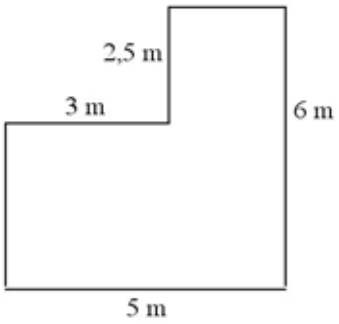


Fig. 18 Working with Wizards – Start

Click on the *Quick Planning Wizard* and then the following steps will be executed. Confirm each of your steps by clicking on *Next*.

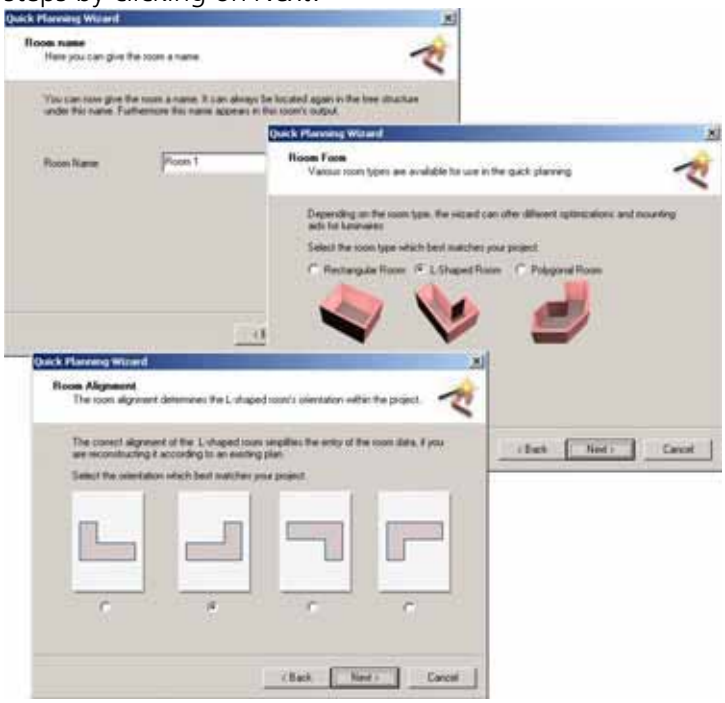


Fig. 19 Working with Wizards – Room Name, Room Form, Room Alignment

Enter the name of the room, select L-shaped room and afterwards define the orientation.

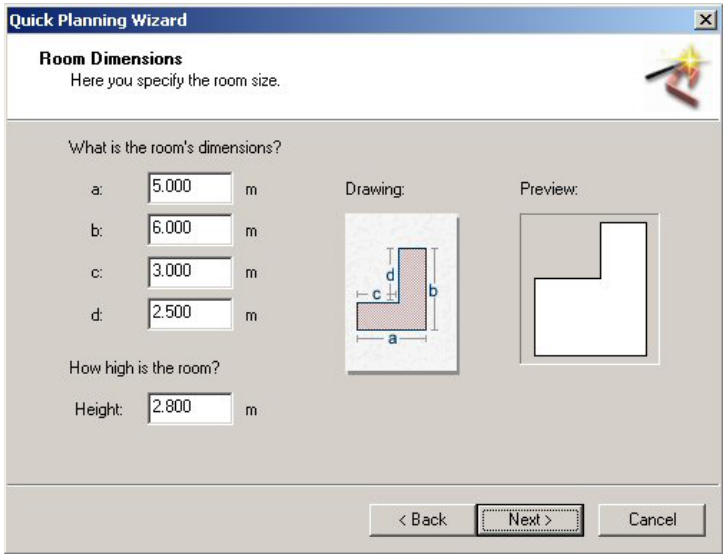


Fig. 20 Working with Wizards – Room Dimensions

Specify the *Room's Dimension* and the *Room Height*. Which wall symbolizes each letter a to d is displayed on the drawing.

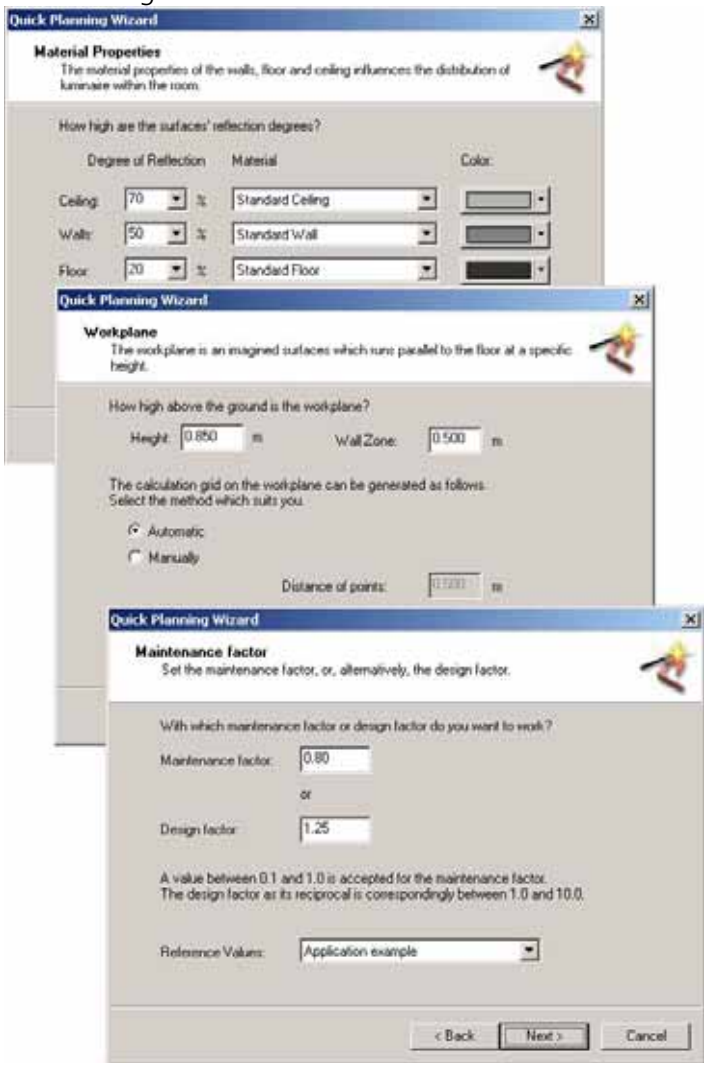


Fig. 21 Working with Wizards – Reflection, Work plane, Maintenance Factor

Specify the *Reflectance*, *Work plane* and the *Maintenance factor*. You can accept also the standard values of DIALux by clicking directly on *Next*.

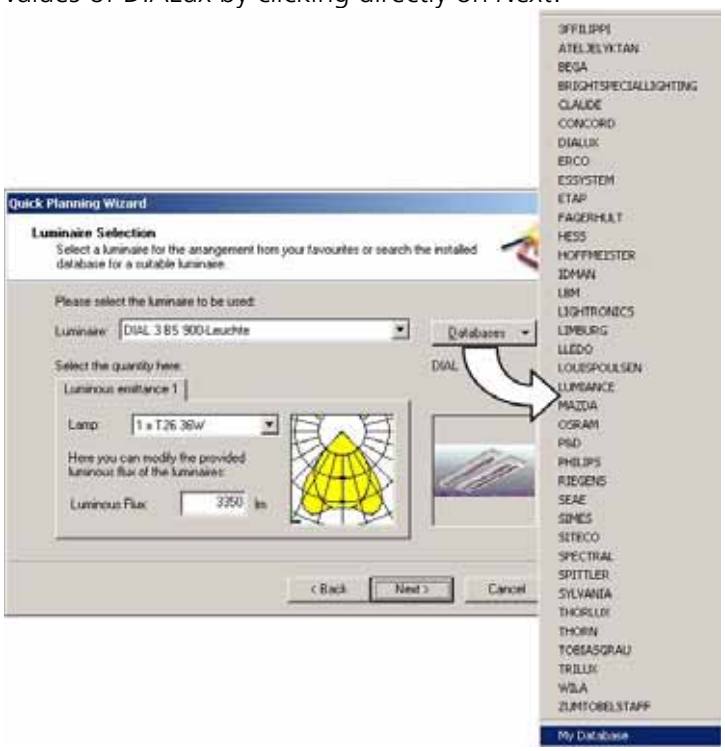


Fig. 22 Working with Wizards – Luminaire Manufacturer Selection

If you click in the dialogue of *Luminaire Selection* on *Databases*, you can launch the installed PlugIns or start the *User Database*. Always a few luminaires are arranged in the user database. In the user database you can save your favoured luminaires, in order to have fast access to your frequently used luminaires.

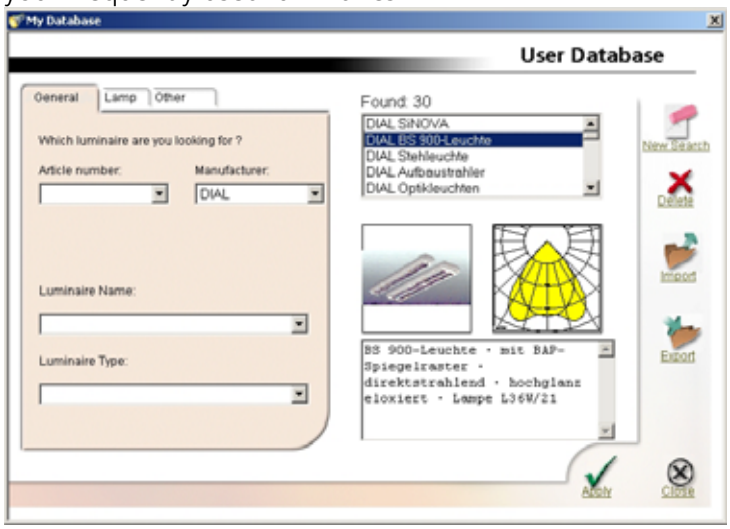


Fig. 23 Working with Wizards – PlugIn / User Database

Select the desired luminaire with the help of the filter functions of a PlugIn or the user database and then click on the button *Apply*. Then please click on the C*lose* button.

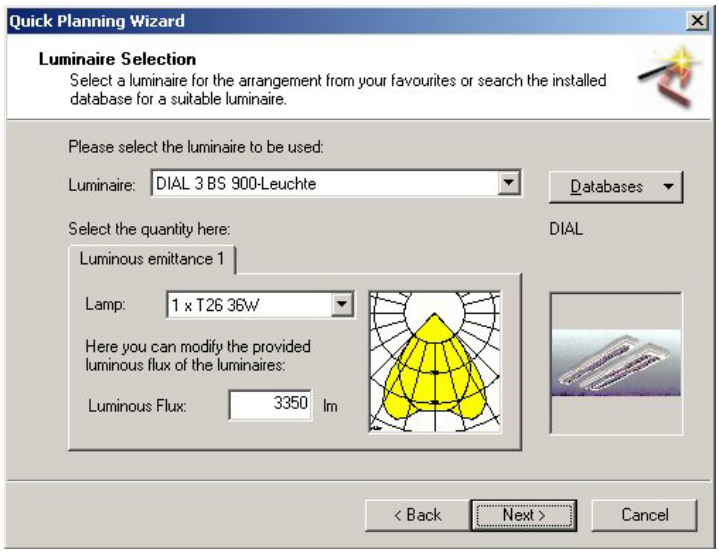


Fig. 24 Working with Wizards – Luminaire Selection

DIALux displays the selected luminaire in the dialogue of *Luminaire Selection*.

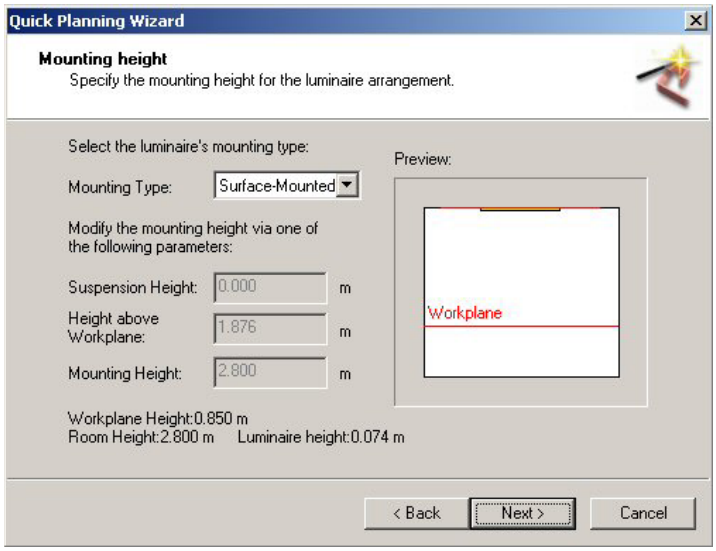


Fig. 25 Working with Wizards – Mounting height

Select the *luminaire's mounting type*.

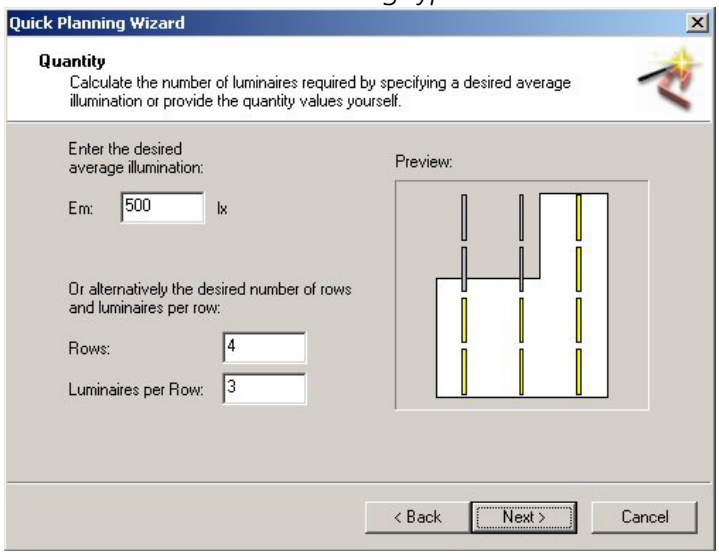


Fig. 26 Working with Wizards – Calculate the number of luminaires

On the basis of the efficiency method DIALux calculates the necessary *number of luminaires* for a specified illumination. The luminaires, which are outside the room, are not considered in the calculation.

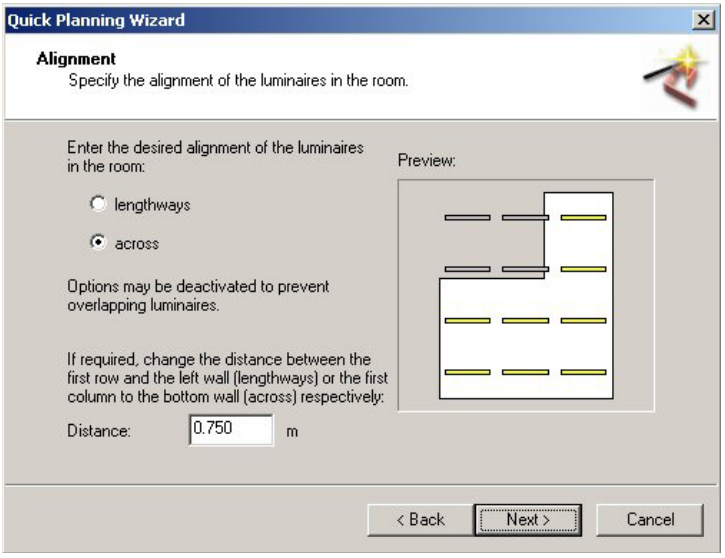


Fig. 27 Working with Wizards – Alignment of the luminaires

In the *Alignment* dialogue you can specify the orientation of the luminaires as lengthways or across.

Fig. 28 Working with Wizards – Calculate result

Click on the *Finish* button and DIALux will begin the calculation and afterwards the calculated result will be displayed.

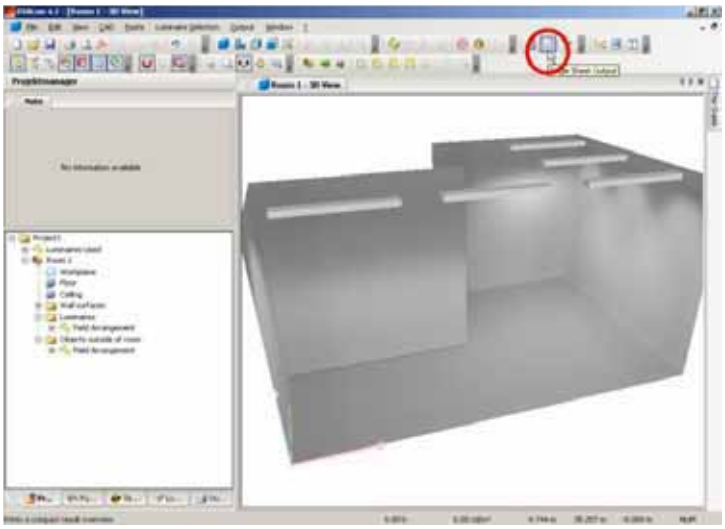


Fig. 29 Working with Wizards – Visually represented result

In order to display the calculated results click in the toolbar on the *Single Sheet Output* button. Afterwards you will see a summary, which displays all the important details on one page.

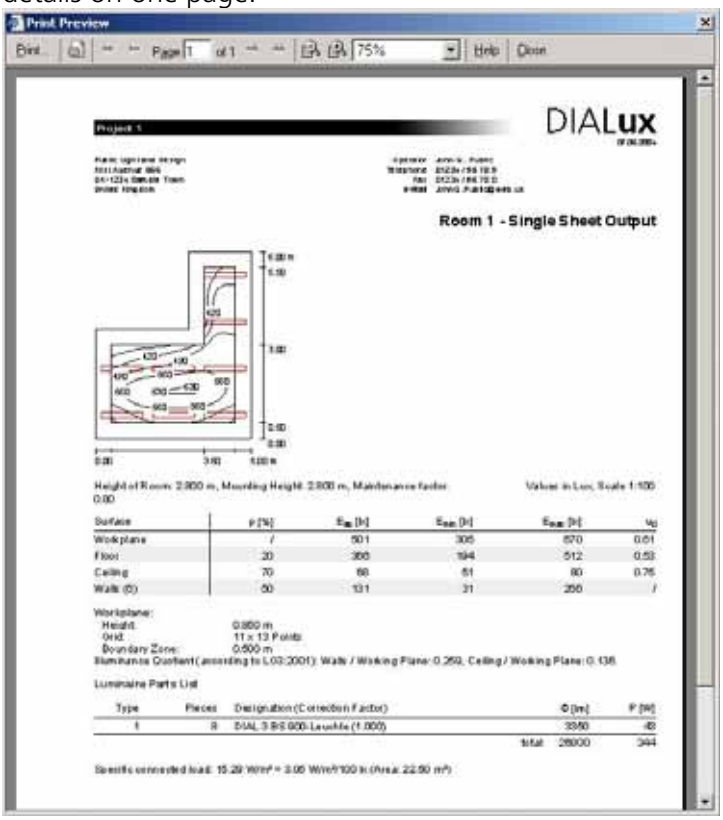


Fig. 30 Working with Wizards – Single Sheet Output

The DIALux User Interface

DIALux has adopted the user interface of Windows XP. Dynamic settings of the toolbar, the new and much more comprehensive *Guide*, simpler dialogues to guide the user all make working much easier and much faster.

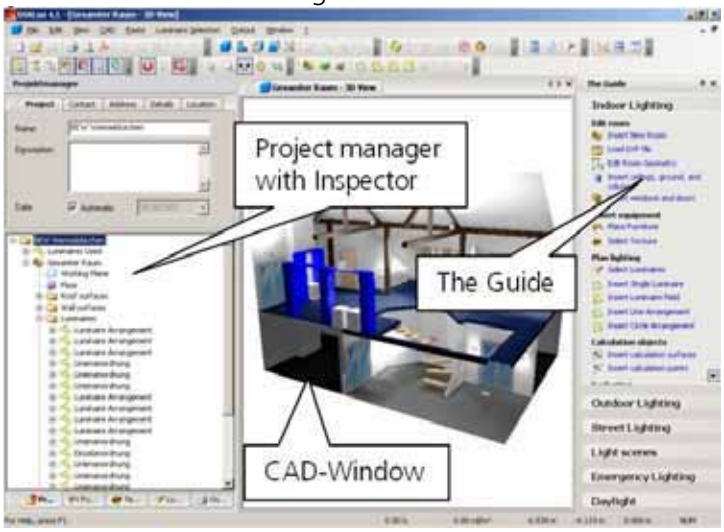


Fig. 31 DIALux user interface

The DIALux *user interface* is divided into three main work areas.

- CAD window
- Project manager with Inspector
- The Guide

These three work areas enable effective and clearly arranged planning of lighting installation with DIALux. In each of these areas you can access certain software functions or edit objects. The *Project manager* includes the *Inspector* and the respective tree structure (project, furniture, colour, luminaire, and output).

The CAD Window

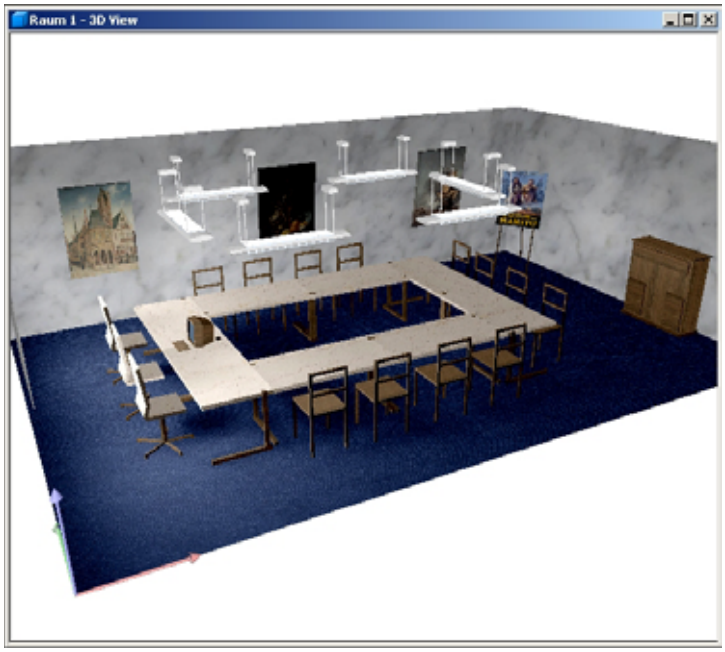


Fig. 32 3D view of a room

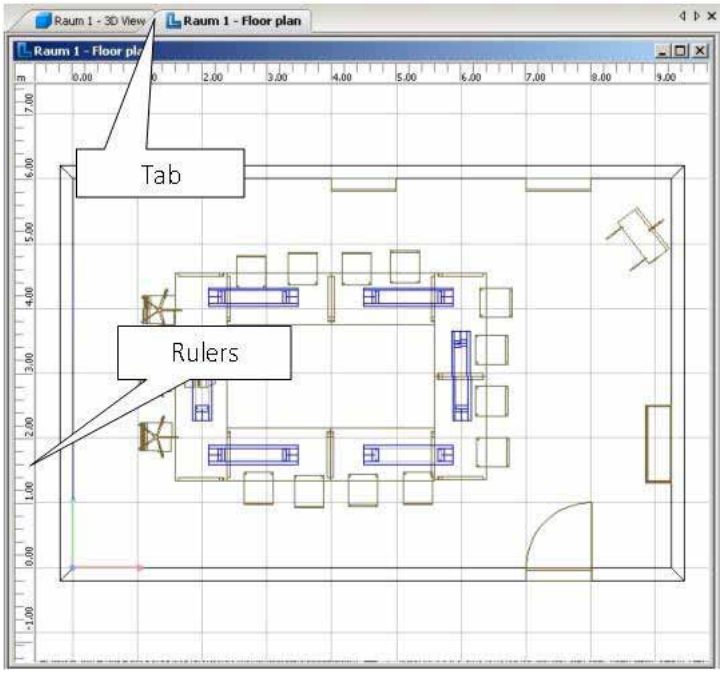


Fig. 33 Ground plan view of a room

In addition to the *3D* and *ground plan views*, you can also use the *side* and *front view* for interactive planning.

The *CAD window* is used for the interactive lighting design. With the mouse, you can graphically *rotate*, *zoom*, *move* and *roam* the room, the street or the exterior scene. The *PAN* or *move* option can always be accessed via the middle mouse button. The *Zoom* option is assigned to the wheel (if using a wheel mouse).

The right mouse button is very important when working with DIALux. Depending on the selected object, the program mode and the working area, different important options can be accessed.

Fig. 34 Right mouse button

Please note:
Open context menu with right mouse

Additionally you can move, scale, rotate or select objects inside or outside the room. Right-click to access a context menu.

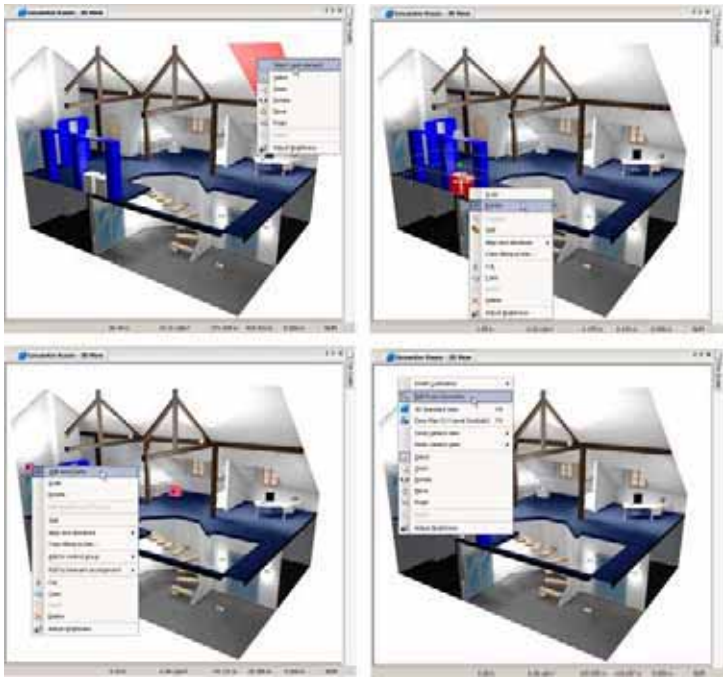


Fig. 35 3D CAD window context menu

Fig. 36 Ground plan view context menu

In the *project manager* you can right-click inside the room to select the 3D or the ground plan view. If more than one CAD window is open, you can arrange them as desired via the W*indow* menu. If the window is full screen, you can change to another view via the tabs at the top of the screen. Simultaneously working in multiple

windows is only recommended when working with a high screen resolution and a good display adapter.

If an object has been inserted into a room, its context menu can also be accessed with a right-click.

Please note:
The red rotation point enables a rotation around the red axis, likewise the blue and the green rotation points enable rotations around the blue and green axis respectively.

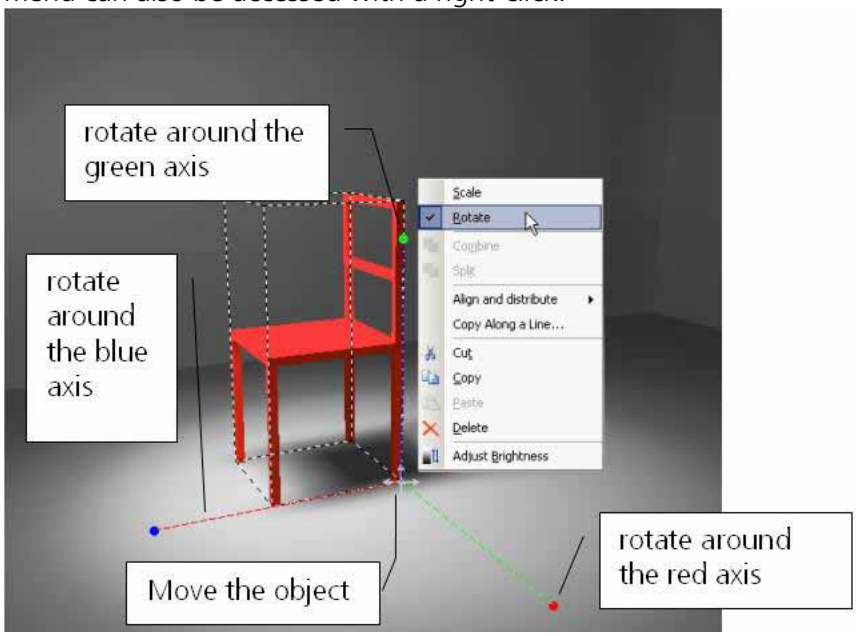


Fig. 37 Context menu of a selected object

If the *Rotate* option is activated, the object can be rotated by clicking and rotating the point on the boom. The red rotation point enables a rotation around the red axis, likewise the blue and the green rotation points enable rotations around the blue and green axis respectively. Please keep in mind that the object has its own coordinate system. The object can be moved by clicking and pulling on the arrow cross.

Please note:
Context menus are accessed via the right mouse button and "Properties" in the Inspector via the left mouse

The Project manager

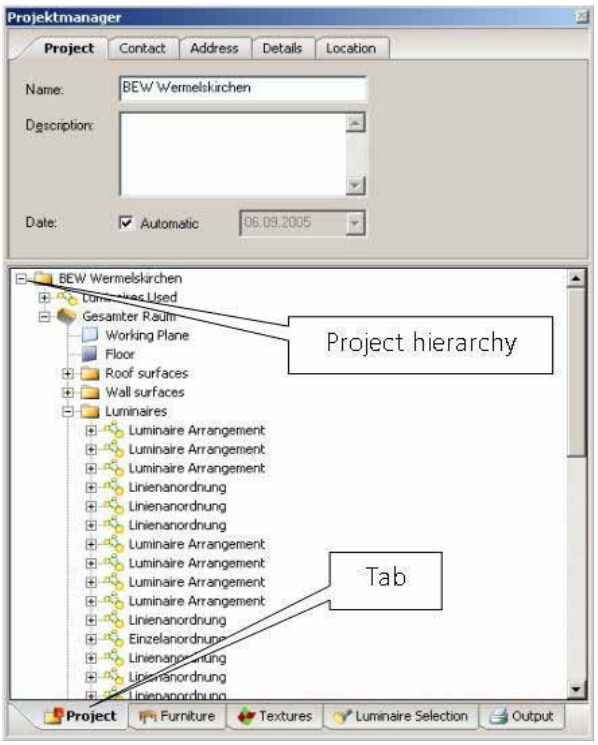


Fig. 38 Project manager

The *Project manager* enables a fast workflow with the elements used in your lighting design. Each individual element can be selected and its properties can be viewed and modified in the *Inspector*. The *Project manager* includes the *Inspector* and the respective tree structure (project, furniture, colour, luminaire selection, and output).

The project, in this example called "BEW Wermelskirchen", organises the global project information such as the name and address of the operator and the customer, as well as all rooms, exterior scenes, streets and luminaires. In the luminaire list, all luminaires used in this project are listed, which were selected from a PlugIn via *Use*. Here the "alternative" luminaires, which have not (yet) been used in this layout, are also organised.

- The room consists of the following sub-objects: room defining surfaces (floor, ceiling, walls), work plane, furniture and luminaire arrangements.
- An exterior scene consists of the sub-objects: ground element, furniture and luminaire arrangements.
- A street consists the sub-objects: street elements (roadways and lanes, parking lanes, sidewalk, grass strip, bicycle lane and emergency lane) and the luminaire arrangement.

If you select one of these elements (left-click), its properties are displayed in the Inspector. A right-click opens the context menu for that object, just as it does in the CAD view.

The Luminaire Selection

Another tree structure exists for the luminaire selection. This becomes visible if you click on the *Luminaire Selection* tab at the bottom of the *Project manager*.

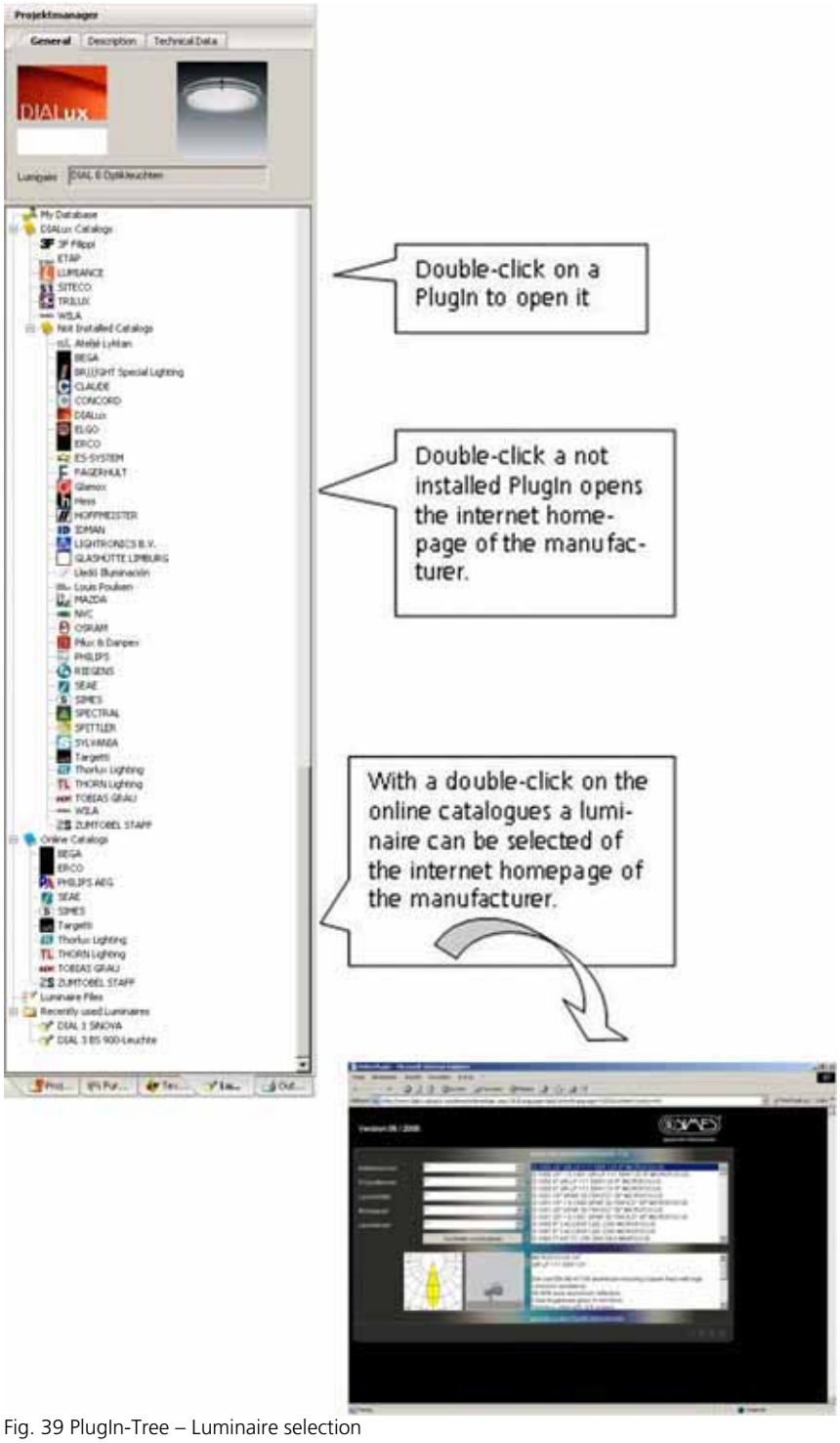


Fig. 39 PlugIn-Tree – Luminaire selection

Installed PlugIns are automatically recognized by DIALux. It is not required to reinstall the PlugIns after updating from older DIALux versions. Double-click on a PlugIn to open it. You can also access this option via the *Luminaire Selection* menu.
PlugIns provided by our partners that have not yet been installed are located a bit lower in the tree structure. A double-click on a PlugIn which has not been installed opens the Internet Explorer window and the homepage of the luminaire manufacturer is displayed, if available. Some manufacturers provide individual luminaires or entire plugins for downloading here.

Create your own luminaire database.
Insert, delete, search for specified criteria. Display of luminaire images and technical data.

The User Database

The user has the possibility to select those luminaires from the various manufacturers' PlugIns, which are regular used in the DIAlux project. These luminaires can be saved in the *User Database*. It is also possible to search for luminaires and to delete luminaires.

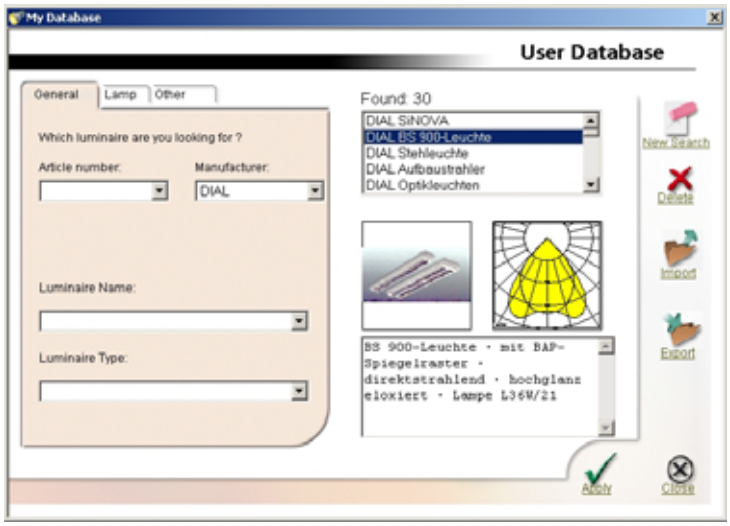


Fig. 40 The User Database

Use the *Import* button to transfer luminaires to the *User Database*. One or several *ULD*, *.ldt (Eulumdat), *.ies or *.cib files can be imported from any desired directory. If a luminaire has been imported into the project – i.e. it appears in the luminaire list – it can be copied to the user database via a right-click.

Insert Luminaire Files into DIALux

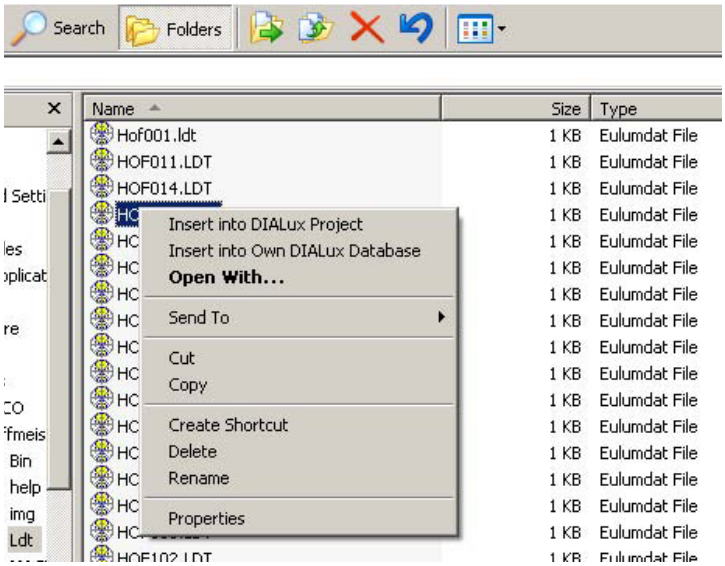


Fig. 41 Explorer context menu whilst DIALux 4.2 is running

When DIALux is running in the background, you can search any desired directories for luminaire data and import them to the current DIALux project, or you can insert them into your own database (right-click on the file). DIALux supports the following formats:

- Eulumdat (ldt)
- CIBSE TM14
- IES (all variations)
- LTLi

Lamp PlugIns

After selecting a luminaire in a luminaire PlugIn, some of them offer the possibility to start an installed lamp PlugIn to find a lamp that fits into the luminaire. The lamp PlugIn provides all the technical and marketing data needed including photometric files and maintenance factors. If a luminaire PlugIn is not yet prepared, to start a lamp PlugIn, the lamp selection can be started within DIALux instead.

In the Property Page "Technical data" of the luminaire, there is a button with three dots besides the lamp type drop down list. Clicking on this button you gets a selection of all installed lamp PlugIns. One has to be selected to find the correct equipment according to the requirements of the lighting layout and the fittings.

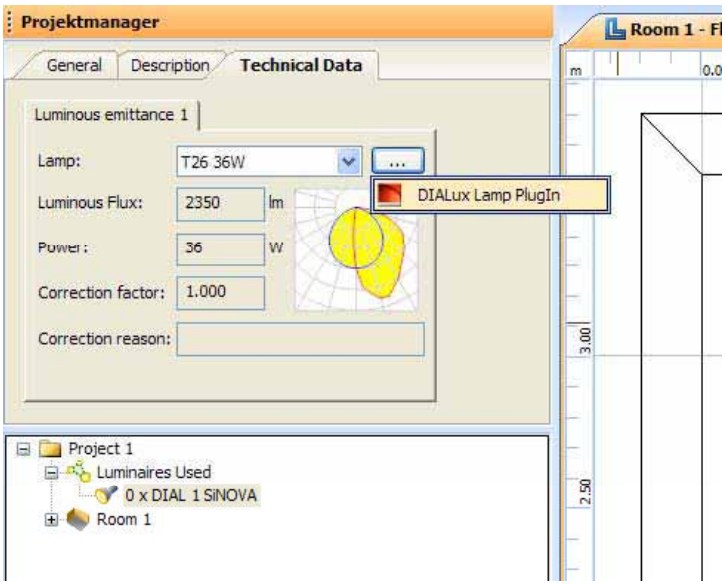


Fig. 42 Starting a lamp PlugIn in DIALux

If there is not yet a lamp PlugIn installed on this computer, you are able to try out the DIALux Lamp PlugIn. If the luminaire manufacturer has entered technical data, it will be used to pre select those lamps that fits into the luminaire. The search criteria can be: ILCOS-L code, power consumption, socket, voltage, etc. The lamp PlugIn then offers those products that fits into the luminaire. You can choose those lamps that are most suitable for the lighting layout. This choice could be a standard lamp or picking from special colours, colour rendering index, long maintenance lamps or other specific properties of the lamp. The lamps include all technical data, even light distribution curves for reflector lamps, so you can decide whether to use a spot or a flood reflector. If the "change" of the light distribution curve is not possible, the luminaire can restrict the replacement of the original LDC.

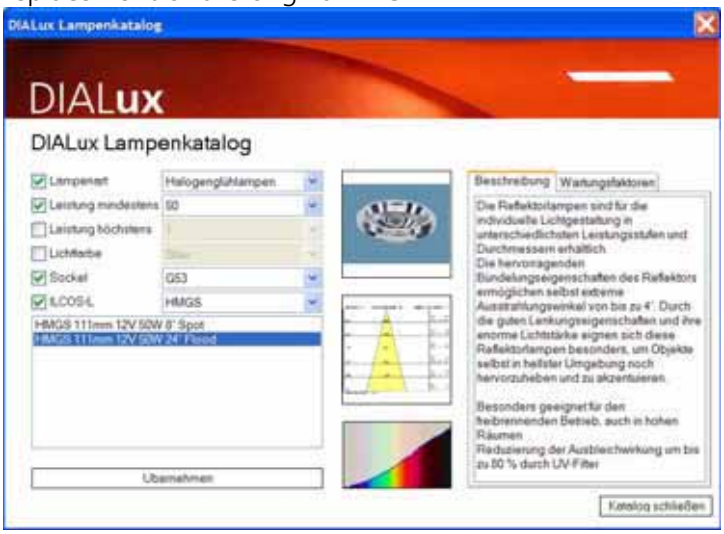


Fig. 43 DIALux lamp demo database

The user can insert one or more lamps to the luminaire. So it is possible to mix up spot and flood reflectors in a

line of spotlights or it is possible to mix the light colours within the some arrangement. The selected lamp can be added to the original equipment or it can replace it.

The Furniture Tree

Furniture can be moved from the *furniture tree* to the project (any view) via the mouse using drag and drop.

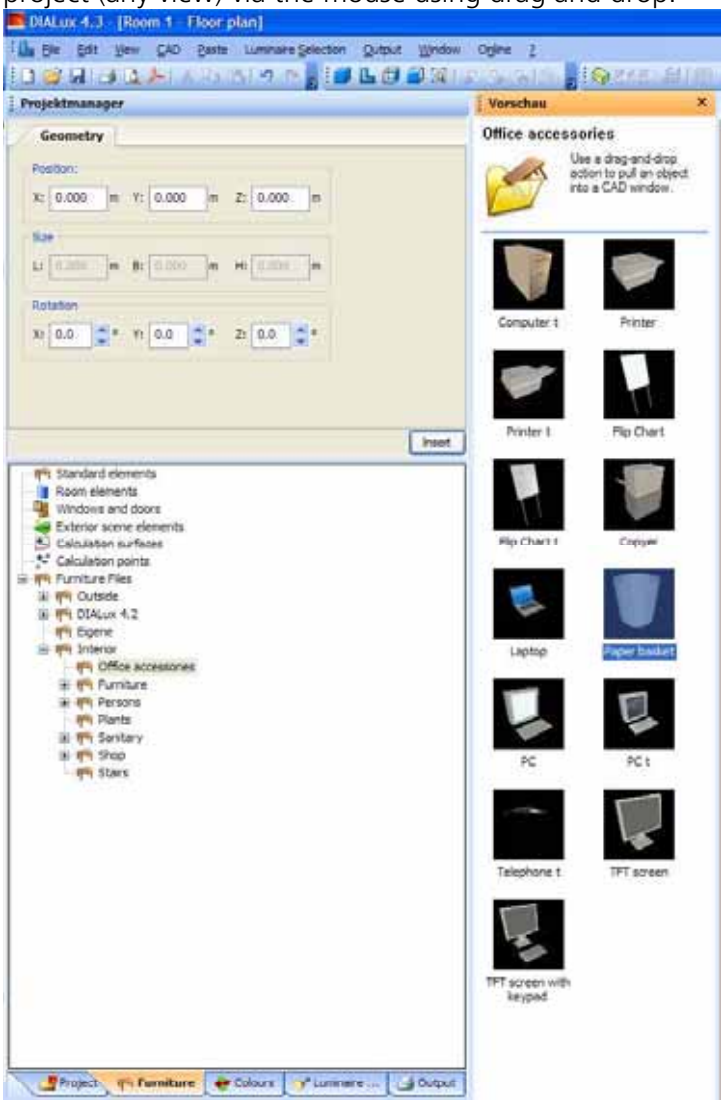


Fig. 44 The Furniture tree

Create your own tree structure. In the furniture tree DIALux shows all directories and *.SAT.files under C:\documents and setting\All Users\Aplication data\DIALux\furniture

The *furniture tree* is divided into seven subdirectories. You can move the preview window of the furniture tree and dock it in various positions in DIALux. You can move and copy furniture from one folder / directory to another. Also you can create new folder and you can delete existing ones. All this is available by a right click on the furniture or on the folder.

Now DIALux saves the furniture as *.m3d files. The benefit is that the preview pictures are saved also in that file. That makes it much easier to share DIALux furniture with friends and colleagues. Of course you can still save them as *.sat and *.jpg files.

The Colours Tree (since version 4.3, formerly Texture Tree)

You can use the *Colours tree* to modify the properties of surfaces via drag and drop - similar to inserting furniture into a room. In the *textures tree* you find predefined textures (surface pictures), RAL colours and you have the option to organise your own textures. You can move and copy textures from one folder / directory to another. Also you can create new folder and you can delete existing ones. All this is available by a right click on the texture or the folder.

The subfolder Light colours and Colour filter will be explained in the chapter Light Colours.

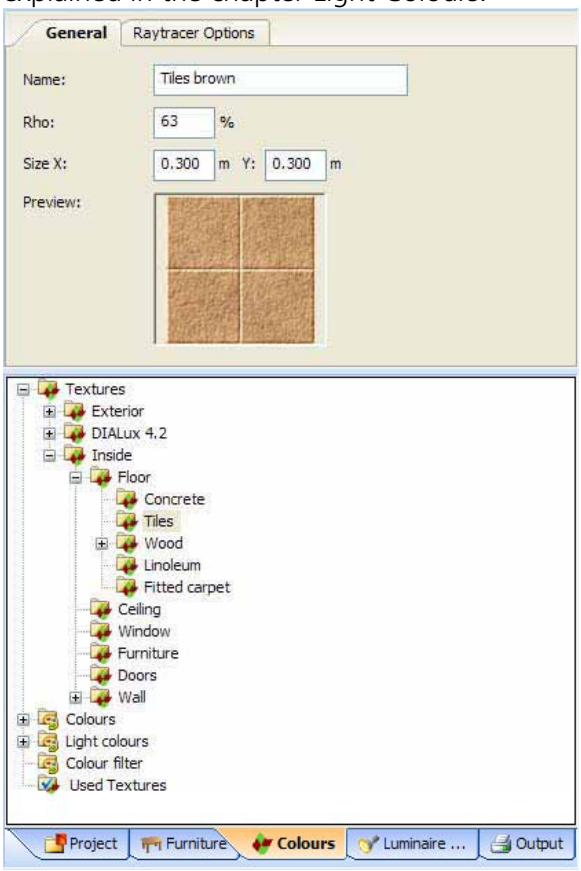


Fig. 45 The Colour tree

When you select a texture in the *texture tree*, the *Inspector* shows a preview of it. After the import the reflection is calculated according to the RGB-values of the texture. You may modify this value later. It is important to specify the real size of the texture. The default value is 1 x 1 m. If you take a photo for example of a building's facade and import this photo as a texture, you have to enter the real size of the building (length and height). After you drag a texture onto a surface, you may modify it (scale, rotate,…). Once a texture is placed on a surface, you can flip /mirror it by entering a negative length (e.g. -0.4m). This will only be used for the selected surface.

The Output Tree

Yet another tree structure exists for the output selection. You can open it by clicking on the *Output* tab in the *Project manager*

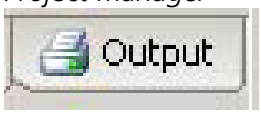


Fig. 46 Output Tab

or by selecting the icon in *The Guide.*

Outputs whose page icon is highlighted are immediately available. The output types which are not highlighted can only be obtained after the calculation has been done.

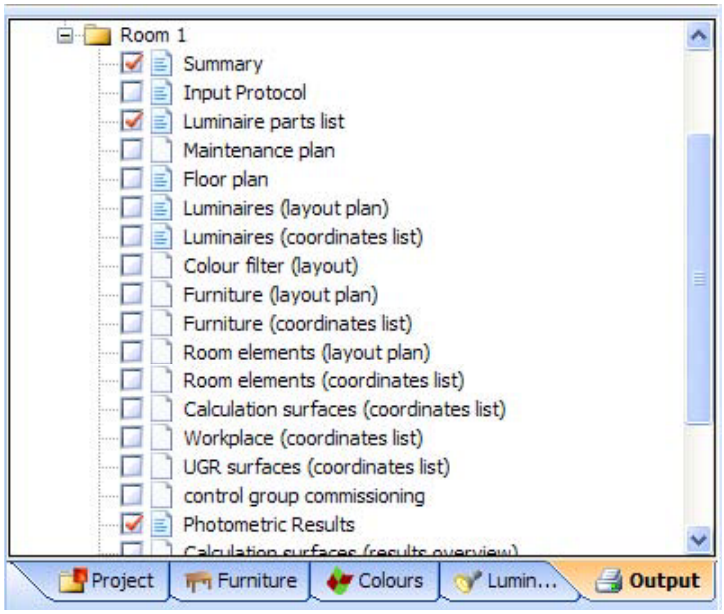


Fig. 47 Output tree

Please note:
The "Output" button in the Guide and the "Output" tab open the output tree

To view an output on the screen, double-click on the corresponding icon. To view multiple output types simultaneously, right-click an output icon and select *Open in New Window*. You can view all types of output on the screen. The output types which have a tick made in the checkbox are printed or displayed as print preview when the *File* → *Print* or *File* → *Print Preview* commands are used.

The observer position used in the CAD is used for the output 3D rendering.

You may save the 3D rendering as a *.jpg picture. Just move the rendering into the required position and select in the menu *File* → *Export* →*Save CAD view as JPG*. Here you can select a directory and enter a filename.

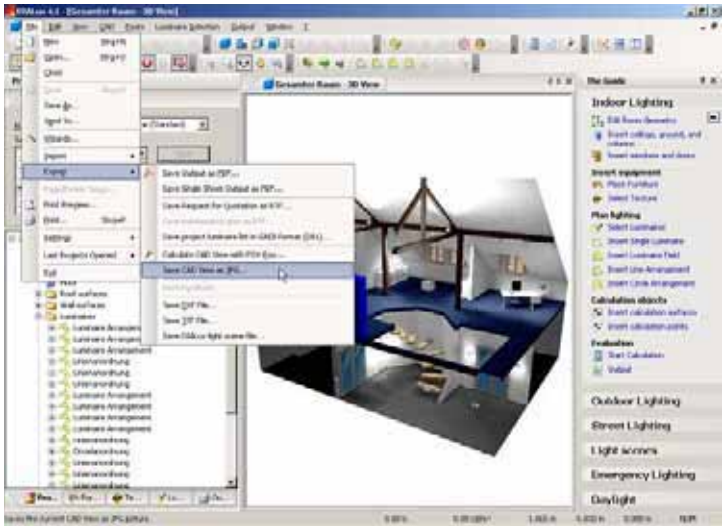


Fig. 48 Save a 3D rendering as ∗.jpg file

The Guide
The connecting element which guides you through the program.

The Guide

The Guide accesses all work steps required for the planning. It provides a "connecting thread" and helps you achieve your aims quickly.

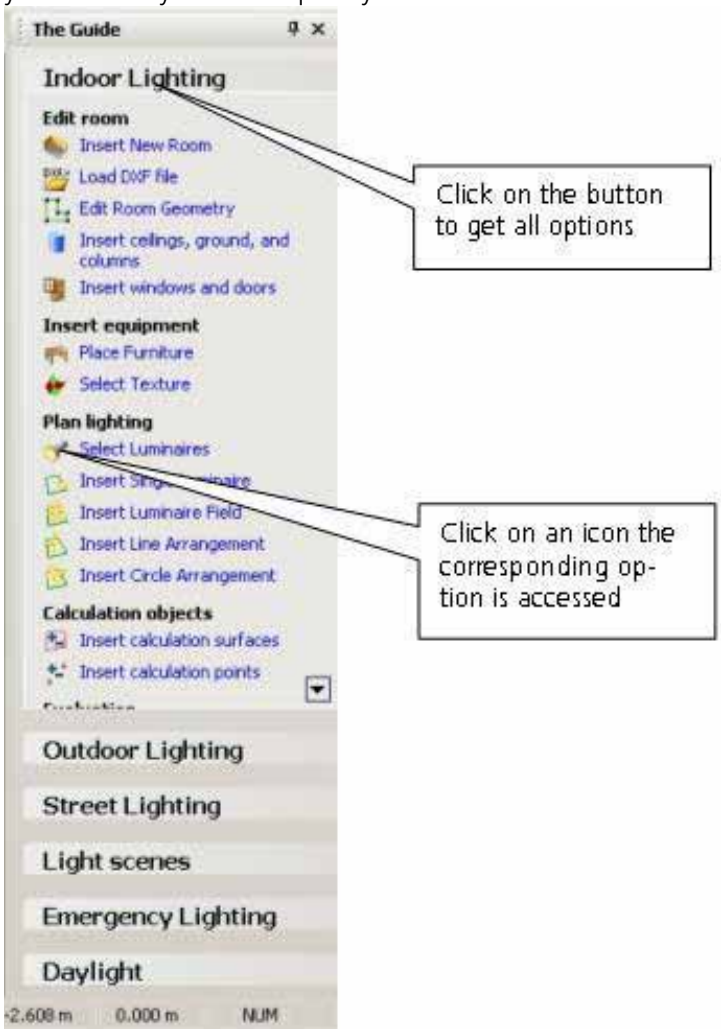


Fig. 49 The Guide

If you click on an icon in *The Guide*, the corresponding option is directly accessed. If you hold the mouse pointer on *Indoor Lighting* all options for planning a room will be available.

If *The Guide* is hidden you can access it with DIALux 4.2, the function *Display guide window* is in the menu *Window*.

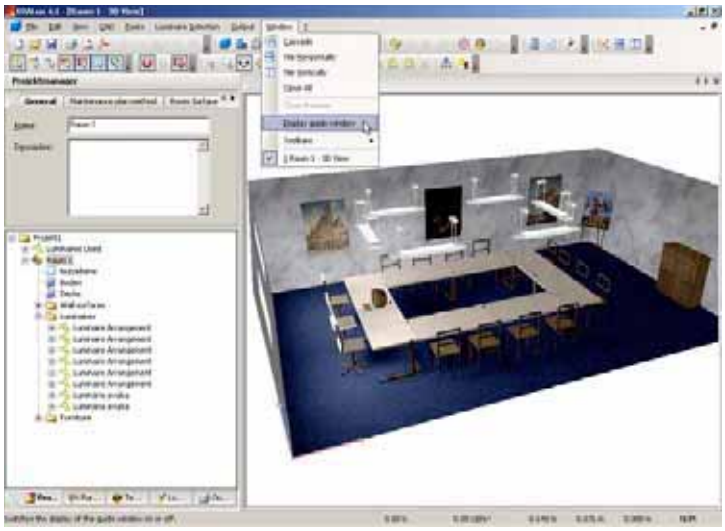


Fig. 50 Display guide window

New in DIALux 4.2:
Display Guide window

The Inspector

The Inspector
The Inspector displays the Property Pages, which contain the properties of the selected object (here Room 1).

With the *Inspector* you can view the properties of each object selected either in the CAD view or in the *Project manager*. Here you can also change the properties. Some values have a grey background. These cannot be modified here.

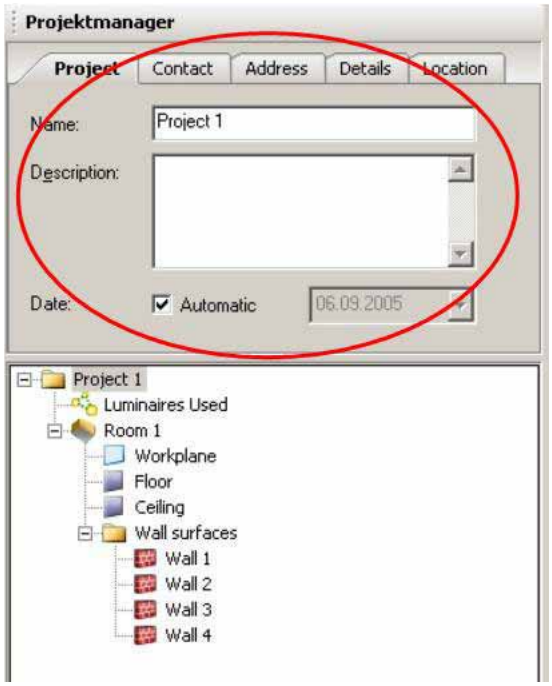


Fig. 51 Property Page of the selected room in the Inspector

Changes to individual walls or to the global setting for the entire room?

In the previous example you can see several properties of the selected room. Click on the *Room Surfaces* tab to change the *reflectance* properties globally.
Beware! Here you can only change the reflectance of all walls together. If you wish to change the reflectance of individual walls, you need to select the corresponding wall and then change its property in the Inspector.

Changes to the luminaire or to the luminaire arrangement?

Please keep in mind that the *Inspector* differentiates between individual luminaires and a luminaire arrangement.

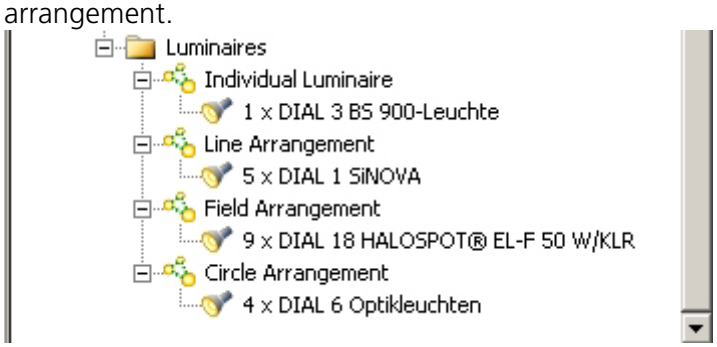


Fig. 52 Luminaire arrangement and its luminaires in the project manager

Here you can change the properties of the entire luminaire arrangement, but not the properties of individual luminaires

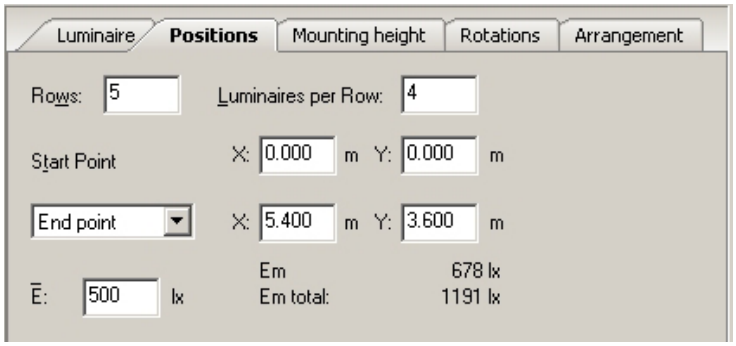


Fig. 53 Property Page "Position" of the selected luminaire arrangement

Here you can change the properties of individual luminaires within the luminaire arrangement, but not the properties of the luminaire arrangement itself.

New in DIALux 4.3: Property Page colour appearence

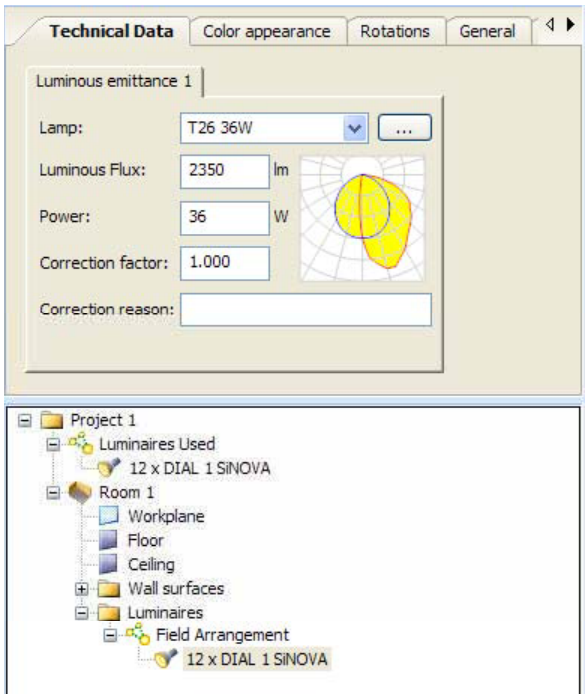
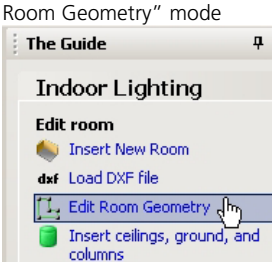


Fig. 54 Property Page of the luminaires within the selection

Switch DIALux to the "Edit Room Geometry" mode



Edit Mode

When certain options are used, DIALux 4.2 switches to an edit mode. For example, this happens in the following situations:

- Free input of a new room
- Change room dimensions at a later stage
- Edit a ground element in an exterior scene
- Edit a calculation surface
- Edit an extrusion volume

To switch to the edit mode, go to the *Project manager*, select the object you want to edit with the right mouse button, and click on *Edit Room Geometry*, *Edit Ground Element* or *Edit Calculation Surface*. Alternatively you can select the options from the menu *Edit*. A third way is to click on *Edit Room Geometry* in *The Guide*. It is advisable to modify the room geometry in the ground plan view.

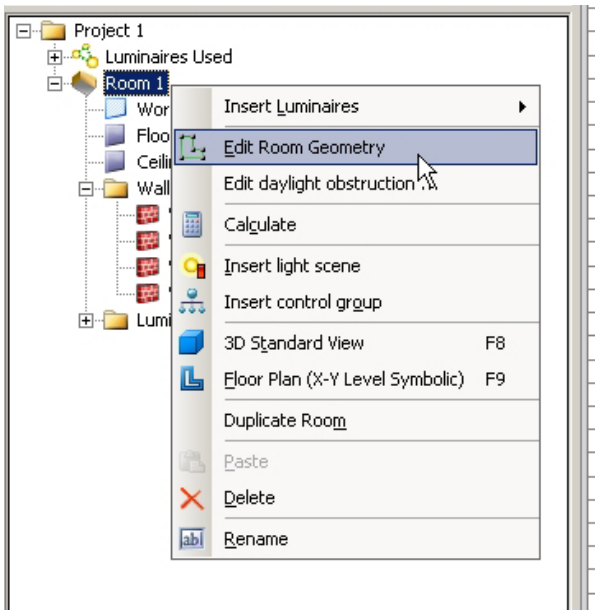


Fig. 55 Room context menu (right-click on room)

After this option has been activated, the room's ground plan can be modified individually. Relevant changes occur to ground elements and calculation surfaces.

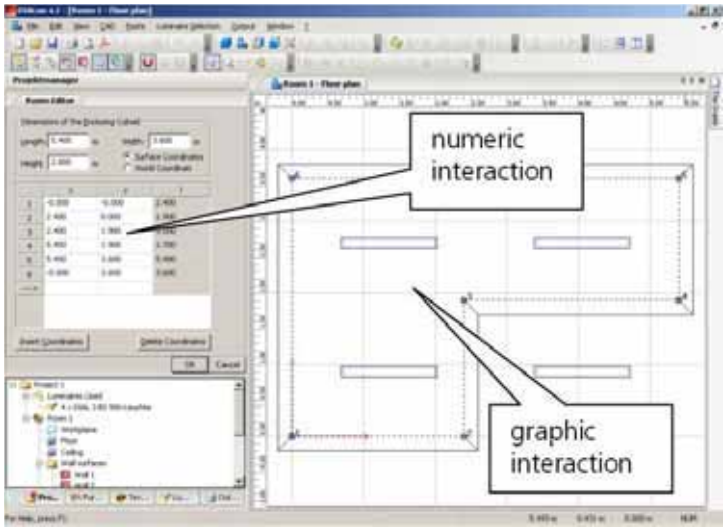


Fig. 56 Room edit mode

Interactive room editing

By clicking on the walls they can be moved interactively within the CAD view, parallel to their previous positions.

Click on the room coordinates to move them to another position in the room as desired.

Right-click on any position on the wall to insert a point at this position via the context menu.

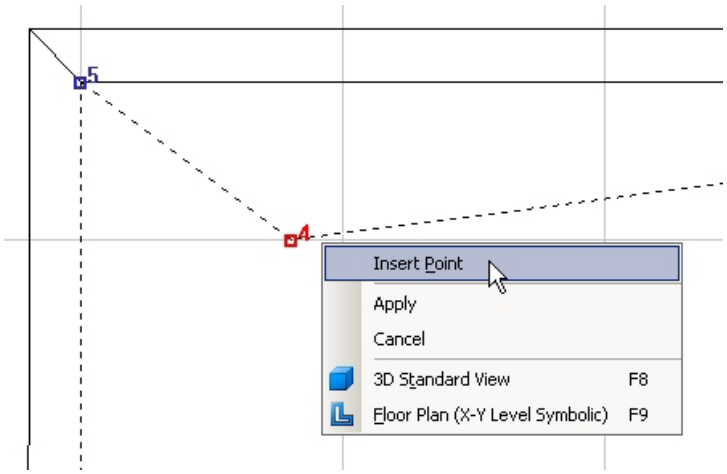


Fig. 57 Insert a new corner

Further room coordinates can be added or deleted in the Property Page by clicking on the corresponding row and selecting *Insert Coordinates* or *Delete Coordinates*. Then you can enter the coordinates numerically. You can also enter the maximum room dimensions via *length* and *width*. All lengths are then correspondingly transformed.

DIALux automatically recognizes whether luminaires are positioned inside or outside the room.

Please note that in the previous example (Fig. 56) the luminaire at the bottom right will not be displayed or calculated after the new coordinates have been applied. If, however, the room is enlarged again, the luminaire is automatically reinserted.

You can edit ground elements of an exterior scene in a similar way. To insert a ground element into the exterior scene use *The Guide* or the *furniture tree*.

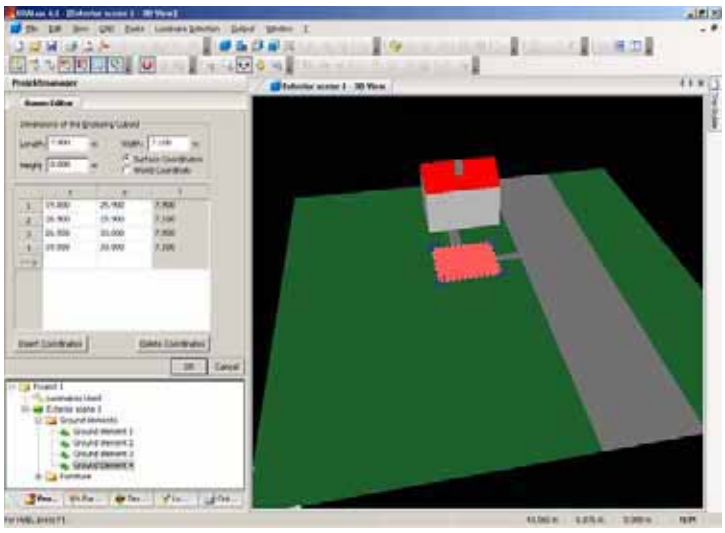


Fig. 58 Edit a ground element

Calculation surfaces and ground elements can have any polygonal shape.

DIALux can handle calculation surfaces with any shapes. You can click with the right mouse button to edit the calculation surface. For example you may create a polygonal task area above a polygonal desk.

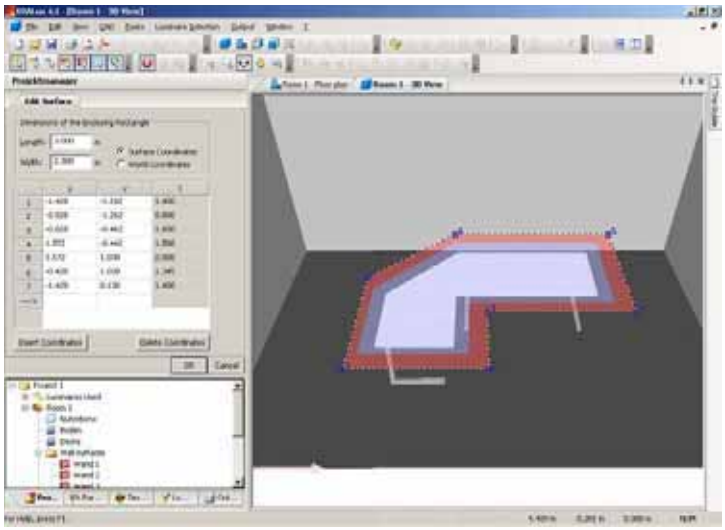


Fig. 59 Create a polygonal "Task Area" above a desk

If there are already placed help lines in the room or exterior scene available, their shape can be used for the surface which is currently in the edit mode. This is very helpful if firstly the shape of a template (DXF/DWG) has been copied with a helpline and secondly this shape should be taken over for the surface (room, ground element, calculation surface or extrusion volume). This function is started when making a right click on a helpline while the surface is in edit mode.

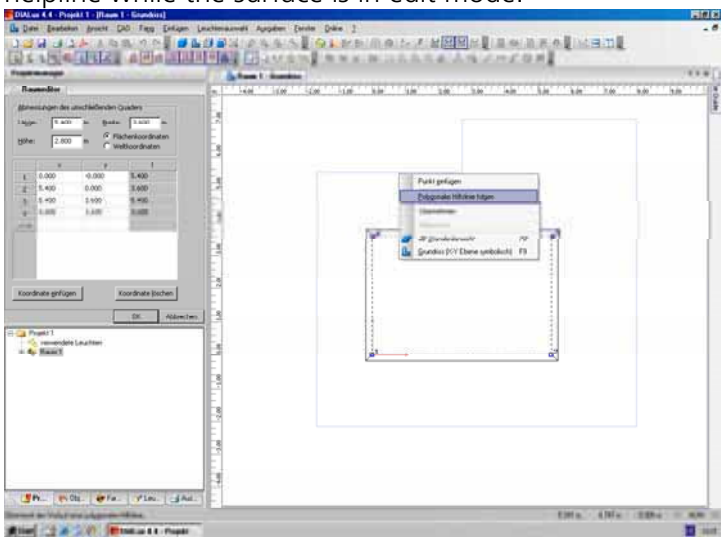


Fig. 60 Taking over the shape of a helpline for the room geometry

Optimise Personal Settings

The presetting that DIALux has can be changed. You can find all the menus for modification under *File* → *Settings*.

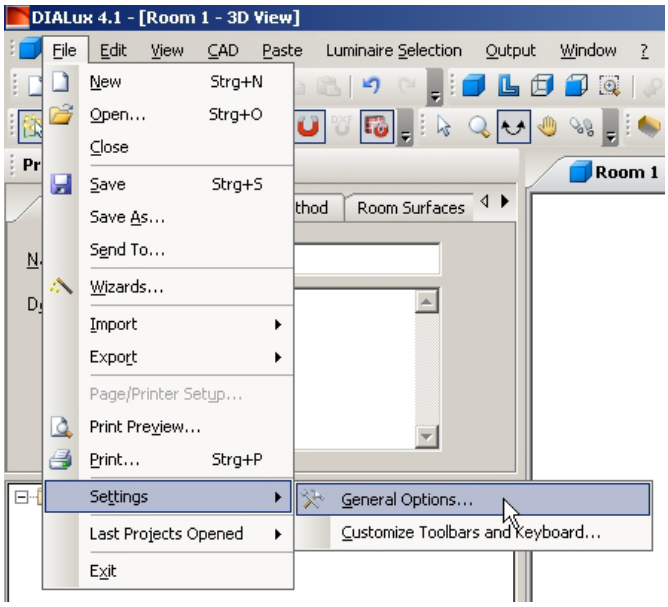


Fig. 61 Menu Settings

General Options

The menu *General Options* has 5 tabs with various settings. Under *Standard Values* you can specify the national typical settings *Room Dimensions*, *Reflectance*, *Work Plane* etc.. Here you can determine which standard values DIALux should use. When creating new rooms, these values are used as presets. Of course you can change the current planning values or standard presets at any time. That means if you want to accomplish calculations for another country you do not have to change each entry individually. DIALux has the relevant parameters for all the usual standards and regulations of individual countries.

Hint: These changes do not change the DIALux language setting.

As an alternative you can change the values individually.

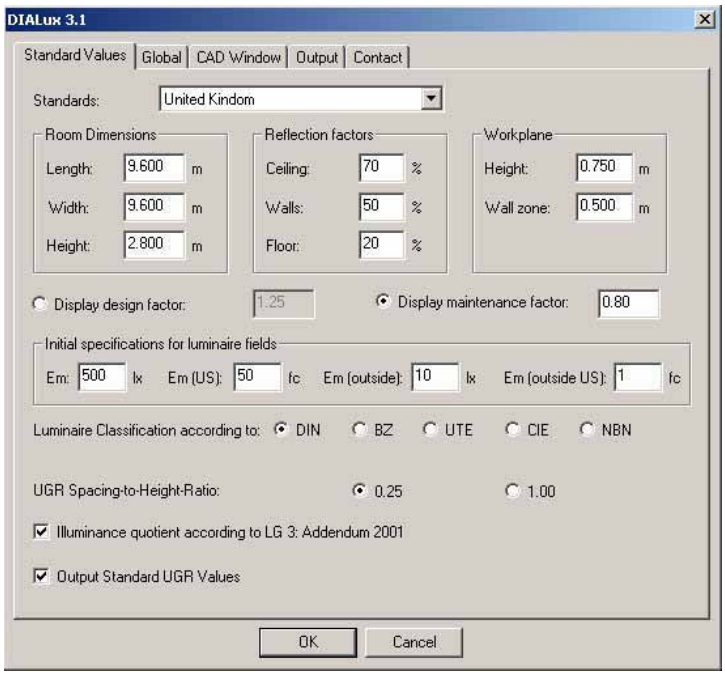


Fig. 62 General Options – Standard Values

If the *Global* tab is selected, you can define the directory (the folder), in which you will save the projects.

By using the entry *Language* you will change the language of the DIALux user interface. By default DIALux always starts with the language of the computer operating system.
If a different language is selected DIALux will need to be closed and restarted to activate the language change.

Under the *Global* tab you can specify additionally the dimensional units (metric or imperial) and the photometric units (European or American).

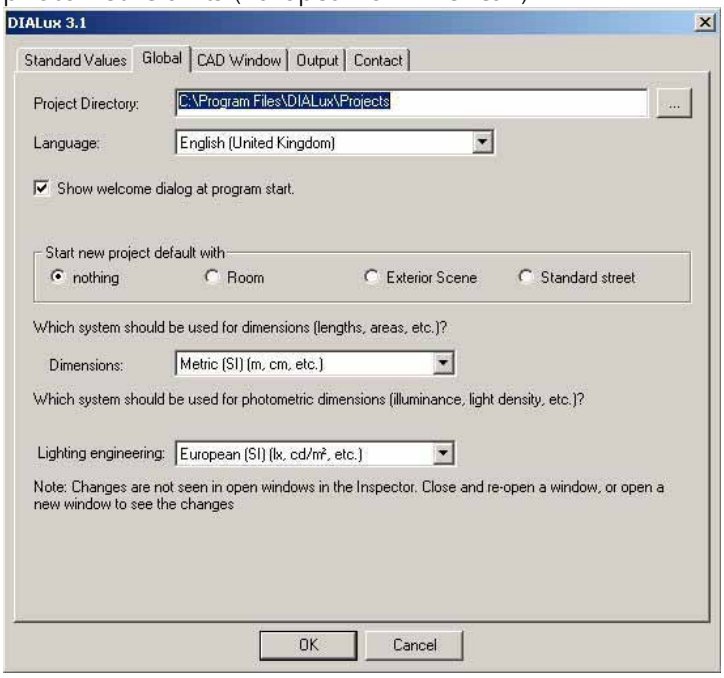


Fig. 63 General Options – Global

If the *CAD Window* tab is selected, you can select the *Background Colours* for your project and for the printout.

Direct3D as an alternative to OpenGL

DIALux uses the most modern techniques for visualisation of the lighting design. Before OpenGL or the MESA mode was used. Because several graphic card drivers, especially those from the "chip on board" cards, don't have good support of OpenGL, DIALux is now also able to use Direct3D for the visualisation. Several graphic card drivers offer a better support for Direct3D than for OpenGL. We recommend working in OpenGL mode. If some problems in the visualisation or even crashes occur, you should switch over to Direct3D mode. If your graphic card doesn't support this mode you will have to work in the MESA mode. This is the slowest mode but it is also the most reliable. The graphic mode can be selected from the Windows All Programs menu by selecting Start Options for DIALux or you can define the standard mode for your PC in file -> settings -> general options -> CAD window.

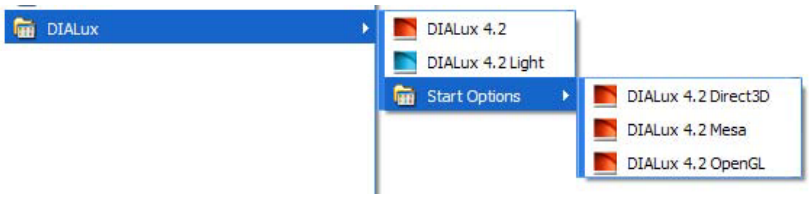


Fig. 64 Start options

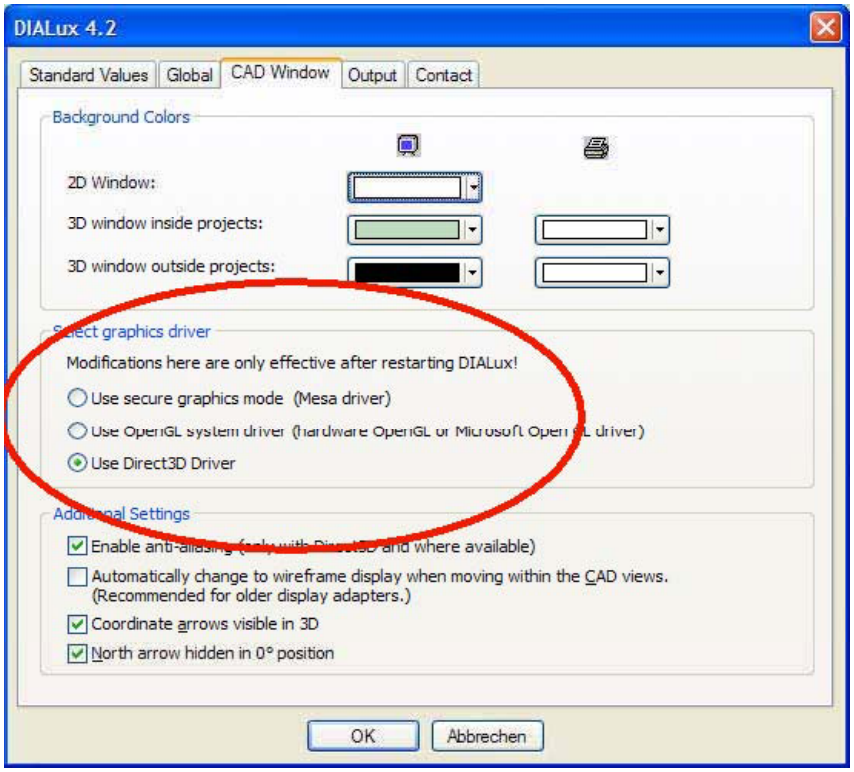


Fig. 65 Graphic mode

If you have an "older PC" it is advisable to select the *Automatically change to wireframe display when moving within the CAD views* option. If you move within the CAD while this option is activated, the room display is updated smoothly, following the mouse movement. After the mouse button is released, the entire scene is displayed again. Thus the calculation time is reduced and you can work with DIALux without disturbing "jerking" on the screen.

Hint: By default the upper setting is activated. If you have an "efficient" PC, it is worthwhile trying the deactivated function. We suggest you use OpenGL mode if possible.

If you want the X, Y and Z coordinate arrows to be visible in the 3D view, switch the *Coordinate arrows visible in 3D* option on. Since DIALux 4.1 you can hide the north arrow in 0° position.

In the Output tab you can adjust general settings for your output that appears on the relevant pages. You can specify font sizes and line thickness of the outputs in the *Output* tab.
Here you can modify the output *footer* and the *logo*. For the logo please click on the three-point-button besides the field *Logo* and then select the file in the opening window, which contains your logo. DIALux opens bitmaps (BMP) or JPG's.

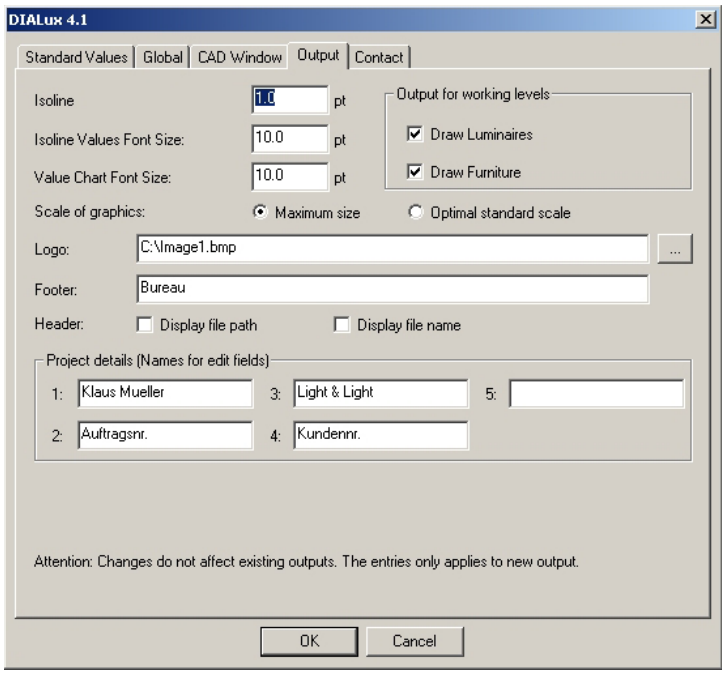


Fig. 66 General Options – Output

In the last tab *Contact* you can register your name and address. Here the address of the company doing the layout planning is entered. It appears in the output header. These entries are used in the Property Page of the project. Information about the operator is entered here too. This is then transferred in each new project.

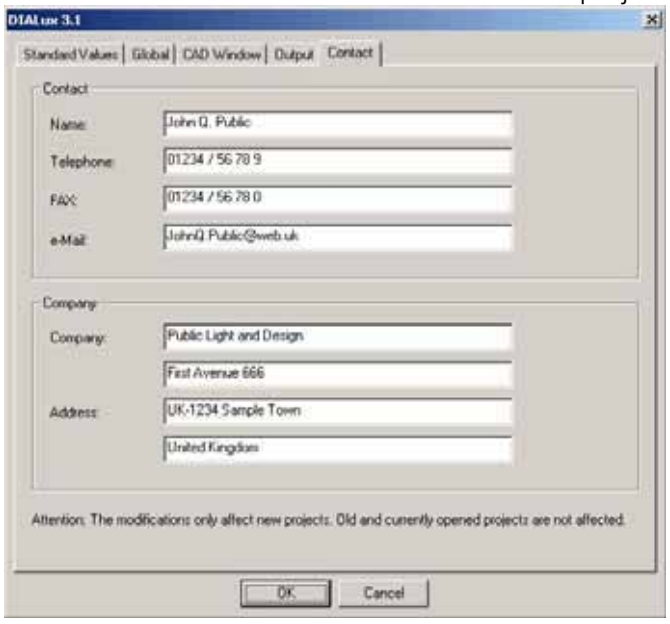


Fig. 67 General Options – Contact

If the *Customise* function is selected, which you can access via menu *File* → *Settings* → *Customize Toolbars and Keyboard*, you can select the toolbars, which you need most frequently. As soon as you launch this function, you can alter the existing *Toolbars*. With the left mouse button you can drag the functions, which you do not need, into the *Command* tab. You can extract the functions, which you need, from the tab to the desired

position. DIALux supports the standard Window's *Shortcuts*, which you can launch by combinations of shortcut keys. You can specify additional combinations in the tab *Shortcut Keys.* The tab *Options* provides the option to select more settings in the menu.

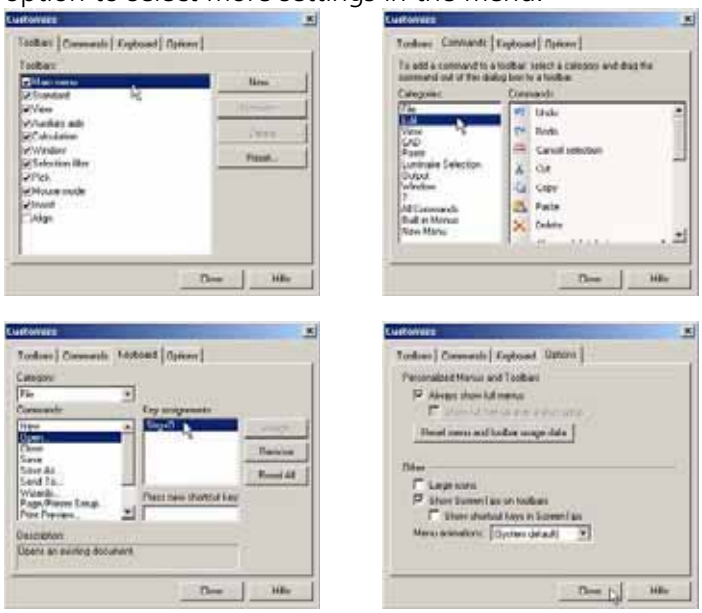


Fig. 68 Menu Customise

Menu "?":
Reset user interface

You can reset the user interface of DIALux in the menu **?** to restore the default setting at the next start of DIALux.

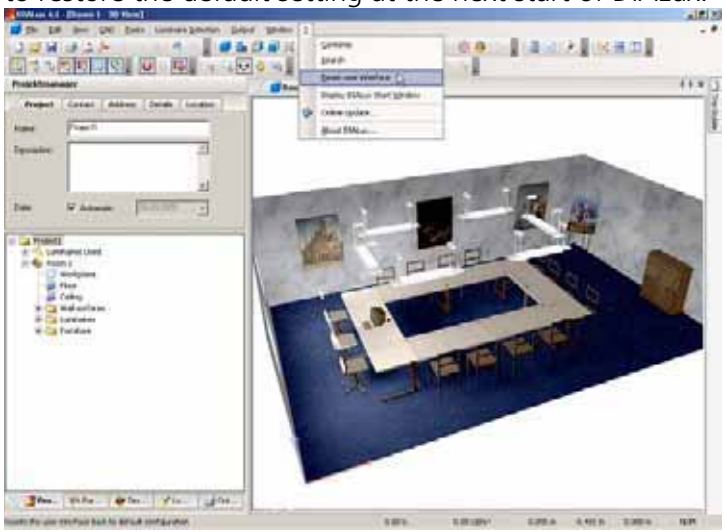


Fig. 69 Reset user interface

Create a New Project

If you click on the *New* button you will generate a new project. DIALux can handle only one project at a time. An already opened project must therefore be closed before the new project can be generated. In the *Inspector* you can define the *Project Name* and *Descriptions* of the project. DIALux adds automatically the creation date. Alternatively you can edit the date, by deactivating the *Automatic* box.

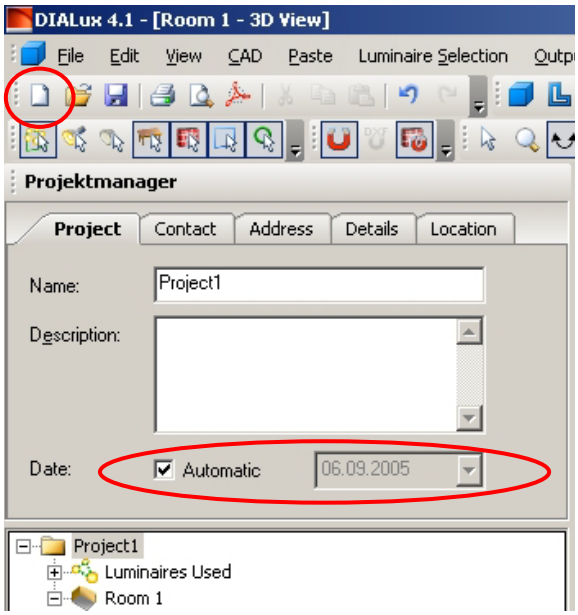


Fig. 70 Create a new project

On the second tab you can arrange your *Contact* data. These are replicated from the option settings, if necessary you can modify these here. In the third tab your *Address* is located and in the fourth tab are the *Details* of the project. These details will appear also on the title page of the output.

Fig. 71 Insert project details

Since DIALux 4 the additional tab *Location* is included. This tab provides for the determination of the position of the sun with the daylight calculation (see chapter Daylight calculation in DIALux). You can insert here the location, provided that this is not selectable from the available list, as well as the longitude and latitude in degrees, time zone and summer time. A deactivated checkbox summertime is equal to the wintertime. You can save your inputs and remove any.

Fig. 72 Insert Project data – Location

Input data of location for the daylight calculation

Open a new project

An already existing project can be reopened at DIALux start, if you click in the start window on O*pen project*

Fig. 73 Open a project in the startup dialogue

or in the menu *File* → *Open* you can access the saved project by double-click on it.

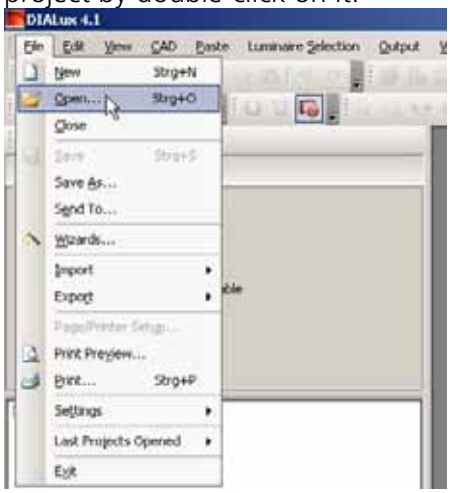


Fig. 74 Open a project in the menu

Project information in the file open dialog

The file open dialog has changed in the latest version of DIALux. While opening an existing project the user can see the most important information about the file.

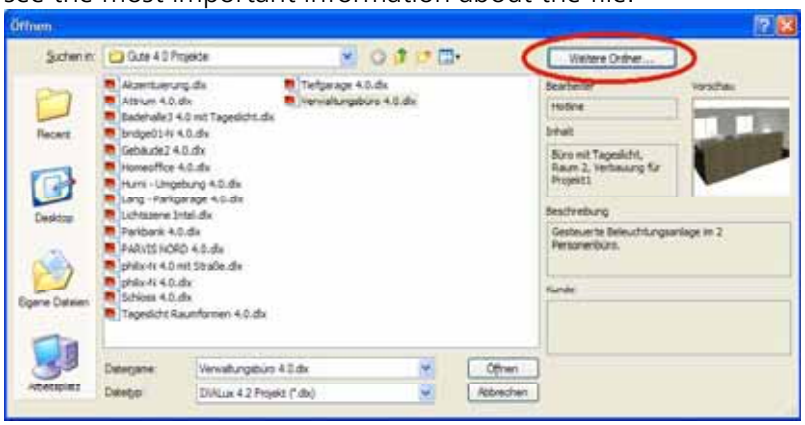


Fig. 75 Project preview

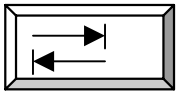
The information given in this dialog about the project is the 3D view of the first room or exterior scene, information about the designer, the description and the name of the customer. The button “other folders” opens a list of directories formerly used to store DIALux projects in.

Edit Rooms

In order to generate a room, click in *The Guide* on the *Insert New Room* button.

Fig. 76 Edit Rooms – Generate a new room

Edit Room Geometry



Afterwards the ground plan view appears on the right side within the CAD window and the room coordinates are displayed in the *Inspector*. Generally the coordinate origin of the room is down left (x=0, y=0). You can change the room geometry by moving the individual points via the mouse or you can insert points with the right mouse button. Alternatively you can edit the room coordinates in the *Inspector*.
DIALux transfers the values entered in the table after you have operated the tab key. After finishing editing the room data confirm with the *OK* button.

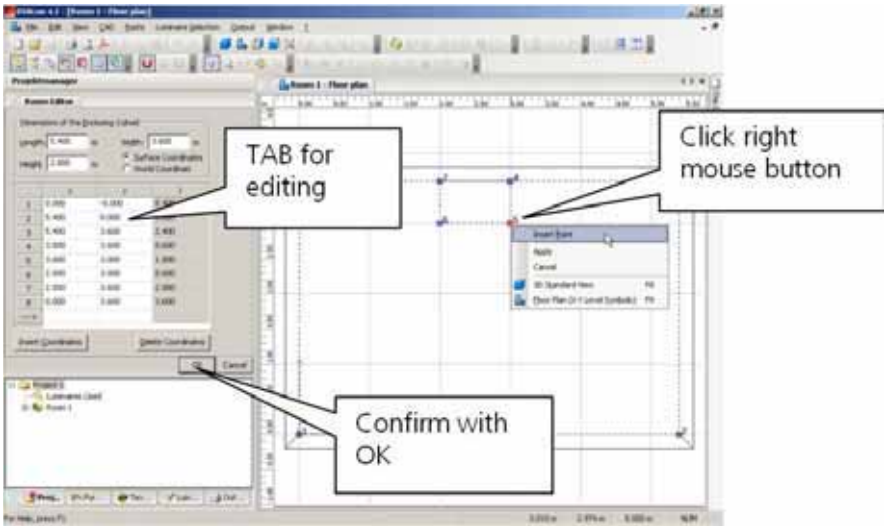


Fig. 77 Edit Rooms – Insert room coordinates

If you do not see all of your room, you can zoom out from the view by using the (Overall View of the Scene) *loupe* button for the complete room view.

Fig. 78 Edit Rooms – Zoom to the overall view of the scene

In order to see the 3D view you can use the right mouse button or click on the cube symbol (3D standard view). You can use the double arrow for the rotation of the 3D view. The button operations are: the *loupe* zooms, the

hand moves and with the *two feet* you can roam the scene. If you use a wheel mouse (see page 33), these functions are also available.

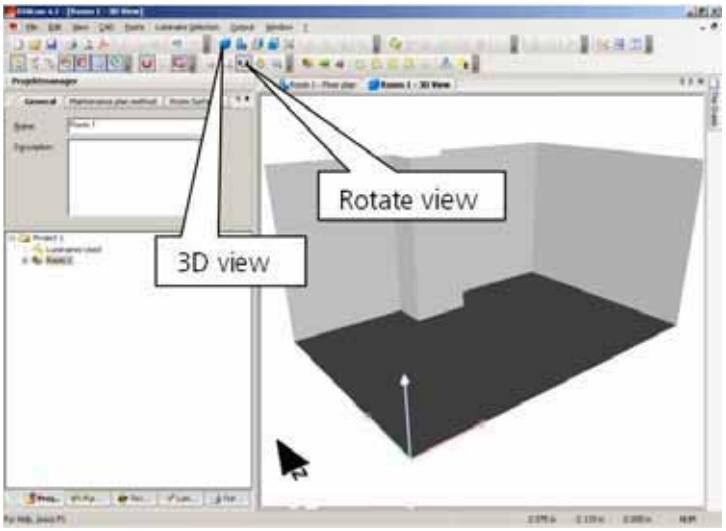


Fig. 79 Edit Rooms – 3D view

Edit Room Data

If you select a room in the *Project manager*, you can specify different properties via the *Inspector*. In the *General* tab you can define the room's *Name* and a *Description* text.

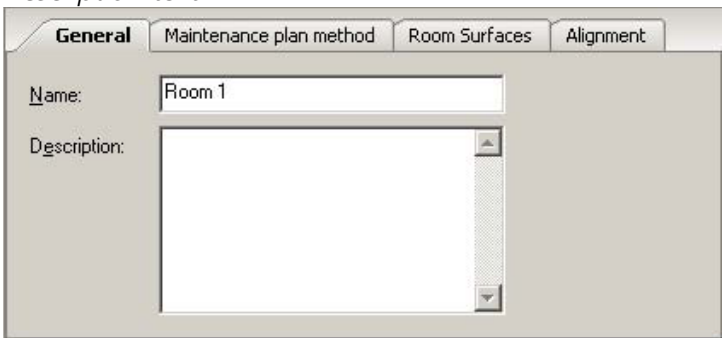


Fig. 80 Edit room data – General

New in DIALux 4 is the maintenance plan method tab. Here you can determine maintenance factors and set parameters for a maintenance plan, based on EN 12464-1 and CIE 97. The maintenance parameters of the inserted luminaire arrangements can be optimized to a target maintenance factor. It is possible for the user to use the maintenance factor as a consistent value for all luminaires in the room. The lighting designer is required, since the introduction of EN12464, to provide a maintenance plan for the lighting design. Now with DIALux 4 this is integrated into the lighting design workflow and is automatically provided.

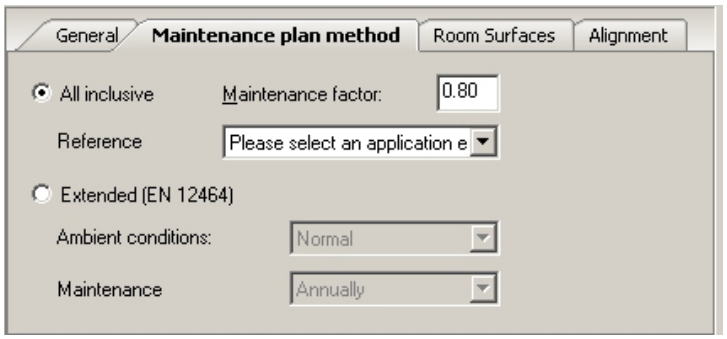


Fig. 81 Edit room data – Maintenance plan method

Maintenance plan method for determination of the maintenance factor

An easy method for determining maintenance factor

In DIALux the user is able to select whether he wants to have a global, all inclusive, maintenance factor for the whole room, or whether he wants to determine the respective maintenance factor for every luminaire / luminaire arrangement. The easiest way, which is the method used in early DIALux versions, is to use the classical method.

After a room or exterior scene was added to a project, the user can make the maintenance choice in the Property Page.

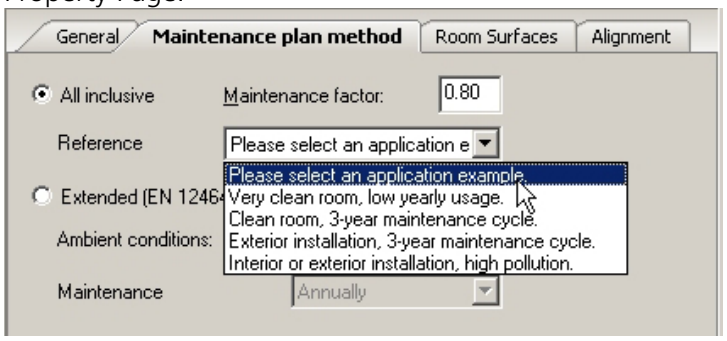


Fig. 82 Edit room data – Selection of a reference value for the maintenance factor

For the classical method the reference application examples are listed which appear in Mr. Stockmar article "Maintenance factor - theory and practise" in Licht 6-2003 from table 1. Of course the user can also enter any other value of maintenance factor in the maintenance factor field.

After choosing a luminaire, the user can place it in any arrangement. Also there is access to technical details of the luminaire.

Fig. 83 Technical data of the placed luminaire

Because the luminous flux and the correction factor have an influence on the number of luminaires required these values can be edited here.

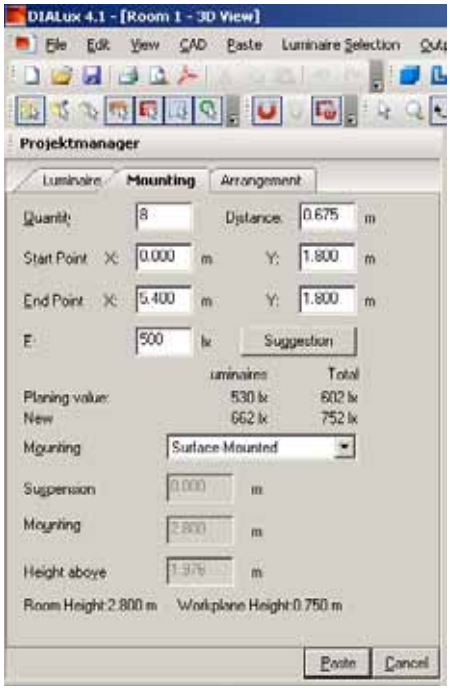


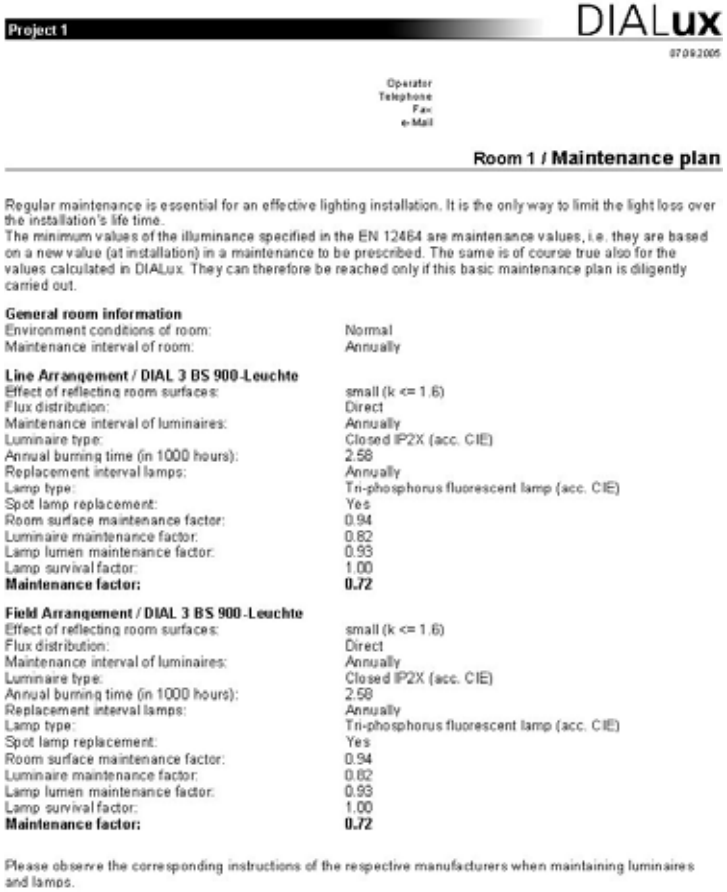
Fig. 84 Determination of the luminaire number of pieces

In DIALux the utilisation factor method is defined by the CIE to determine roughly the right number of luminaires for all luminaire arrangements. By using this method the expected initial illuminance as well as the maintained illuminance is indicated. Additionally, the initial and maintained value for the whole room is likewise indicated. The user can see immediately the contribution from this luminaire arrangement compared with the

whole layout of luminaires. In this case the values are different because other luminaires are in the room.

In the outputs the maintenance factor is shown as before on different output pages. For example, like here on the page "Maintenance plan".

The "classical" method is the default method when a new room is added.



Project 1 DIALux

07.09.2005

Operator
Telephone
Fax
e-Mail

Room 1 / Maintenance plan

Regular maintenance is essential for an effective lighting installation. It is the only way to limit the light loss over the installation's life time.
The minimum values of the illuminance specified in the EN 12464 are maintenance values, i.e. they are based on a new value (at installation) in a maintenance to be prescribed. The same is of course true also for the values calculated in DIALux. They can therefore be reached only if this basic maintenance plan is diligently carried out.

General room information

Environment conditions of room:	Normal
Maintenance interval of room:	Annually

Line Arrangement / DIAL 3 BS 900-Leuchte

Effect of reflecting room surfaces:	small (k <= 1.6)
Flux distribution:	Direct
Maintenance interval of luminaires:	Annually
Luminaire type:	Closed IP2X (acc. CIE)
Annual burning time (in 1000 hours):	2.58
Replacement interval lamps:	Annually
Lamp type:	Tri-phosphorus fluorescent lamp (acc. CIE)
Spot lamp replacement:	Yes
Room surface maintenance factor:	0.94
Luminaire maintenance factor:	0.82
Lamp lumen maintenance factor:	0.93
Lamp survival factor:	1.00
Maintenance factor:	**0.72**

Field Arrangement / DIAL 3 BS 900-Leuchte

Effect of reflecting room surfaces:	small (k <= 1.6)
Flux distribution:	Direct
Maintenance interval of luminaires:	Annually
Luminaire type:	Closed IP2X (acc. CIE)
Annual burning time (in 1000 hours):	2.58
Replacement interval lamps:	Annually
Lamp type:	Tri-phosphorus fluorescent lamp (acc. CIE)
Spot lamp replacement:	Yes
Room surface maintenance factor:	0.94
Luminaire maintenance factor:	0.82
Lamp lumen maintenance factor:	0.93
Lamp survival factor:	1.00
Maintenance factor:	**0.72**

Please observe the corresponding instructions of the respective manufacturers when maintaining luminaires and lamps.

Fig. 85 Output – Maintenance plan

Extended method for determining maintenance factor

The user can determine if required also the maintenance factor for a singly used luminaire (arrangement). The extended maintenance method must be selected from the room Property Page.

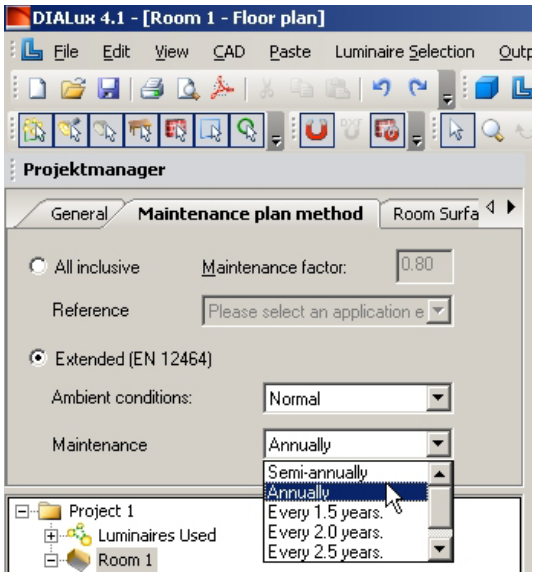


Fig. 86 Selection of the determination of the enlarged maintenance factor

For the room or the exterior scene the ambient condition is chosen. Here the user can select beside three given situations *clean*, *normal* and *polluted, very clean* which appears in the Trilux book "Planning help 12464". Next you pick the room maintenance interval.

After the selection of a luminaire, the user can place this in any arrangement. You also have access to technical details of the luminaire. This Property Page is identical with the one associated with the easy method.

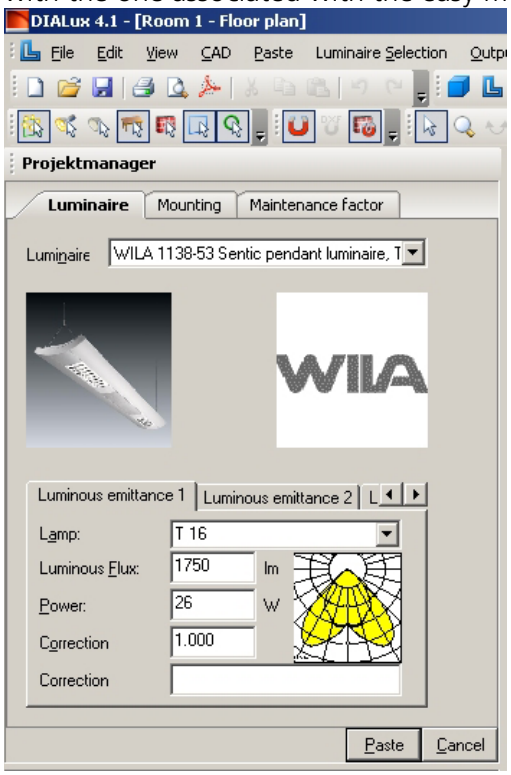


Fig. 87 Technical settings of luminaires with different luminous emittances

If you use a luminaire with several (different) luminaire emittances, (LEO, Light Emitting Object), you can set each LEO lamp choice and correction factor.

Both the initial illuminance and the maintained illuminance will be indicated as in the easy method. Also the initial and maintained illuminance of the whole room is shown. The user can see the contribution of this luminaire arrangement compared with the layout in the whole room. In this case the values are different because other luminaires are in the room.

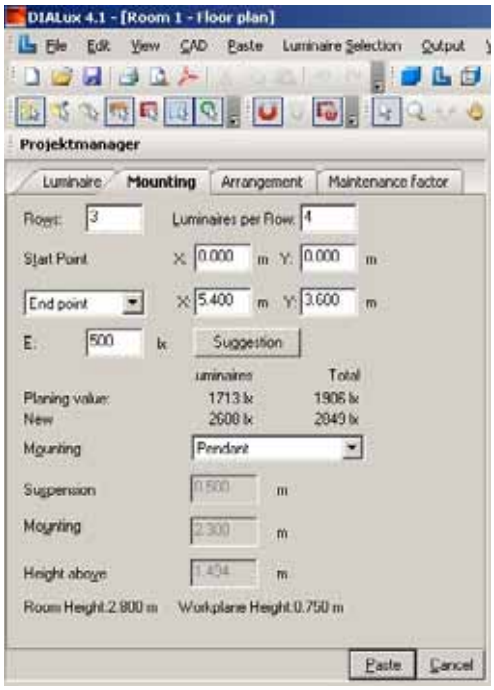


Fig. 88 Determination of the number of required luminaires

To access the Property Page *Maintenance factor* right click on an item below Luminaires in the *Inspector*, for example Field Arrangement or Individual Luminaire, then from the context menu select Edit maintenance Factor. All parameters can be edited associated with maintenance factor for this luminaire. If a luminaire has several LEOs, their parameters can likewise be individually edited.

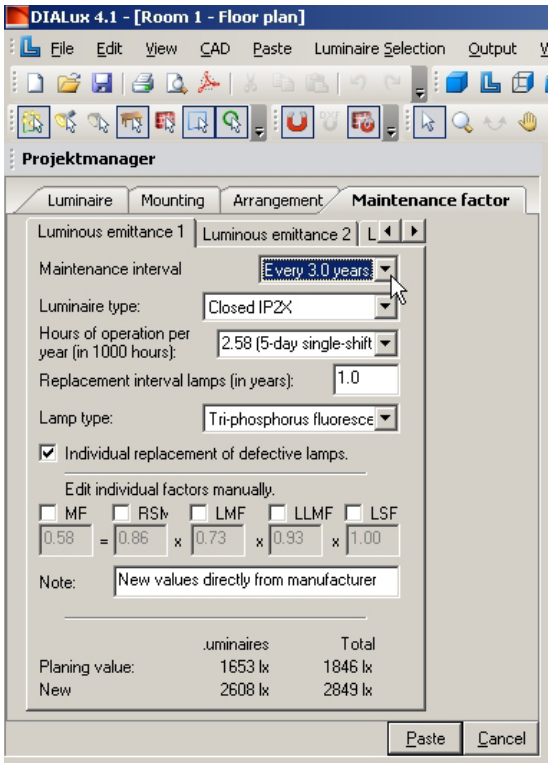


Fig. 89 Property Page Maintenance factor

On this Property Page the user can optimize the maintenance factor for the luminaire arrangement. If the luminaire manufacturer has defined maintenance parameters for this luminaire in his PlugIn or his ULD-file, this will be marked in the field *Luminaire type* and, also if it is available, under *Lamp type*. The maintenance factor depends on the ambient conditions (already defined in the Property Page of the room), the mounting height (because of room index k is defined using mounting height), the hours of operation (insert at this point) and the lamp and luminaires maintenance interval (define also at this point). If the luminaire manufacturer has defined no parameters, the user can choose under luminaire type and lamp type in the drop down lists from the CIE example data. If you want to use other factors for some reasons, you can mark the checkbox in the lower area above the individual factors.

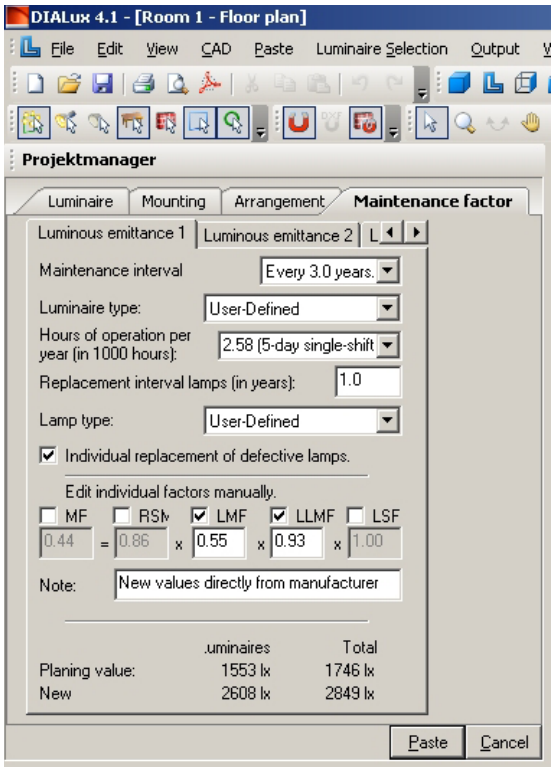


Fig. 90 User-defined maintenance factors

For those maintenance factors which you have selected (LMF or/and LLMF) the lamp type or luminaire type is selected on *User-defined*. Now you can insert directly the factors and a relevant remark.

On this Property Page you also have the overview for maintained and initial illuminance of the whole lighting system as well as this special arrangement. Therefore you are able to optimize the maintenance plan with regard to the number of luminaires and maintenance work.

With another arrangement in the same room the values of the whole illuminance and those of the respective arrangement of course vary.

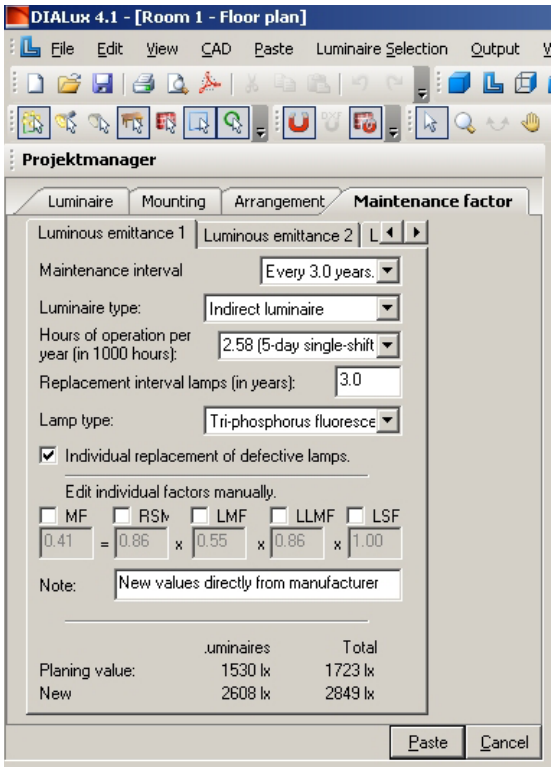


Fig. 91 Insert another arrangement in the same room

Now an optimum number of luminaires can be determined here for the project as a whole.

The maintenance factor also can be seen in the CAD view. Because luminaires in certain room zones can be subjected to different conditions, for example higher pollution or different operating hours, the maintenance factors of the individual luminaires can be shown in the CAD view. Local differences in maintenance factor consequently can be easily understood. You can display the maintenance plan factors either in the menu → *view* or in the menu bar in the CAD window.

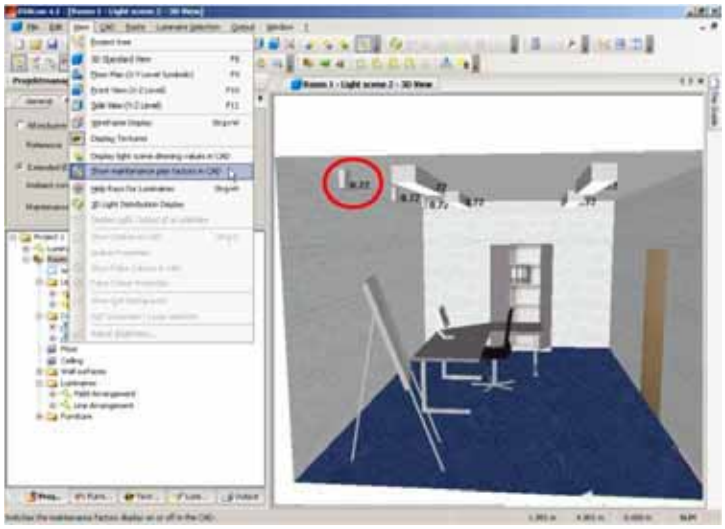


Fig. 92 Show maintenance factors in the CAD via menu

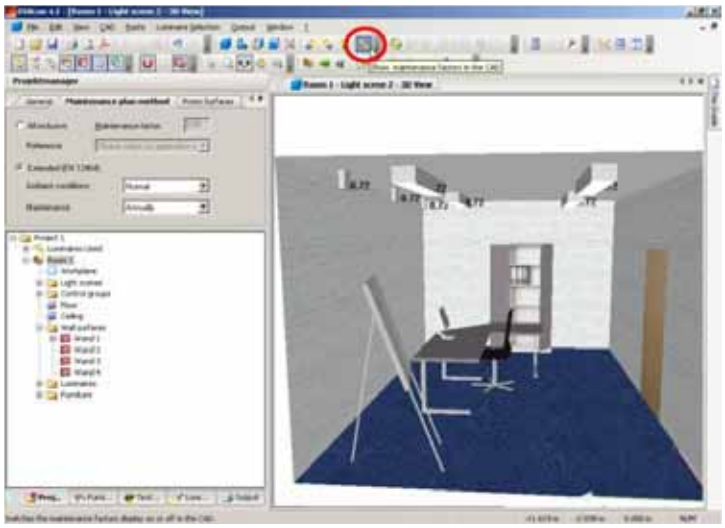


Fig. 93 Icon "Show maintenance factors in the CAD"

The user has the ability to edit the maintenance factors from the menu *Edit*

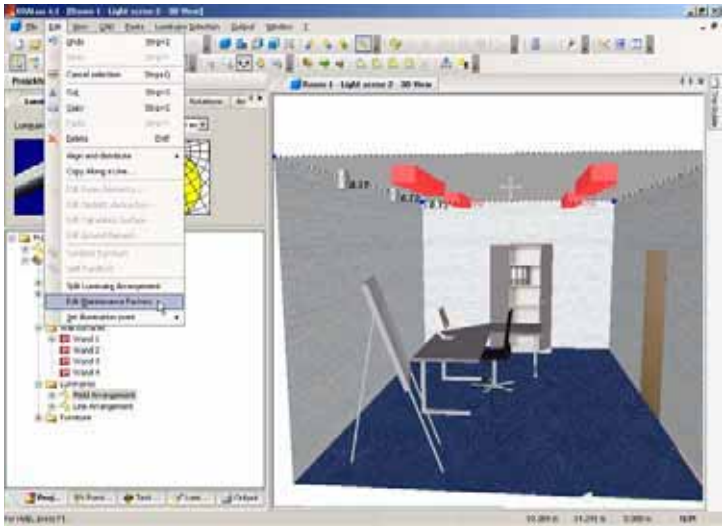


Fig. 94 Menu Edit – Edit Maintenance Factors

or in the context menu of the luminaire arrangement.

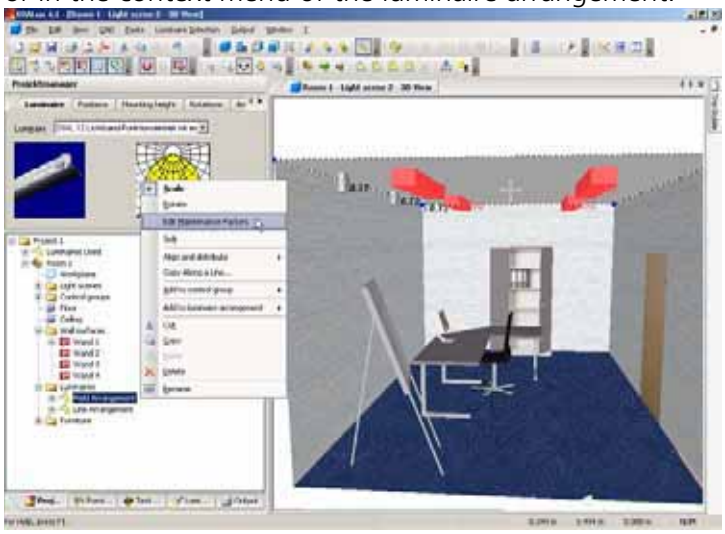


Fig. 95 Context menu of the luminaire arrangement - Edit Maintenance Factors

Also in the floor plan the ascertained maintenance factors can be shown. Perhaps more importantly the output *Maintenance Plan* is added as a new output in DIALux.

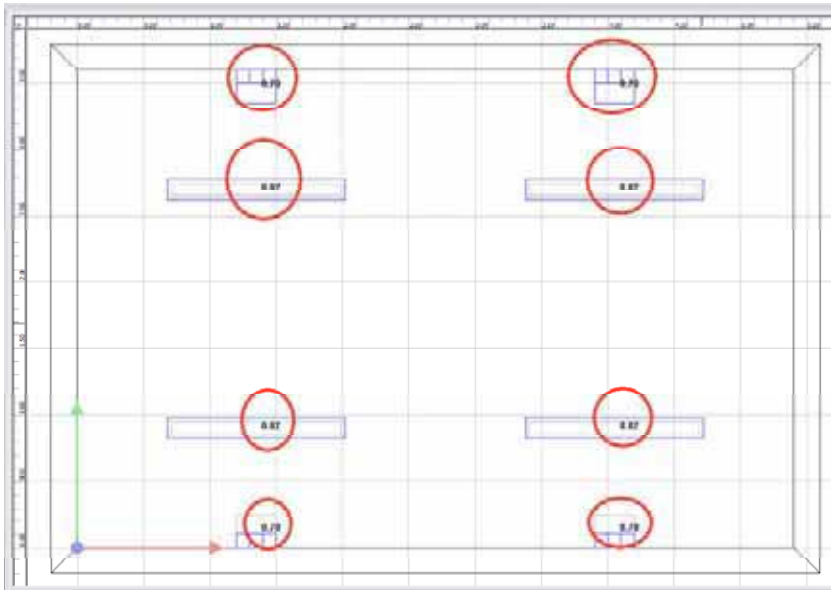


Fig. 96 View of the maintenance factors of individual luminaires in the CAD

With DIALux it is possible to save the maintenance plan as a *.RTF file.

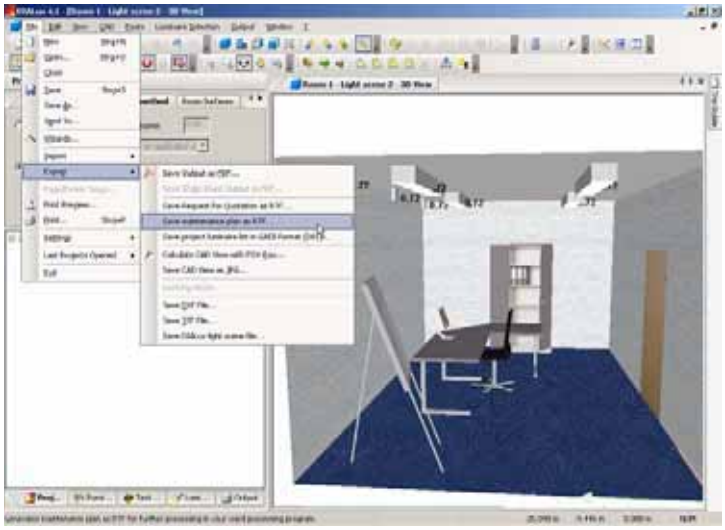


Fig. 97 Export of the maintenance plan

In the *Room Surfaces* tab you can specify the reflection properties for ceiling, walls and floor. If you change the reflection properties for the walls, you have to consider that always all walls of the room will be changed together.

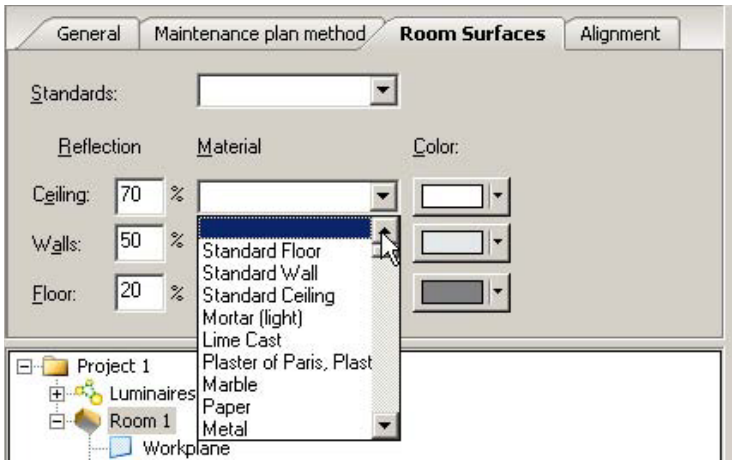


Fig. 98 Edit room data

Deviation of north from the Y-axis

The *Alignment* tab allows the setting of the north direction in relation to the Y-axis. For the room or the exterior scene the north direction can be set. To show this clearly, the north arrow is drawn near the coordinate origin.

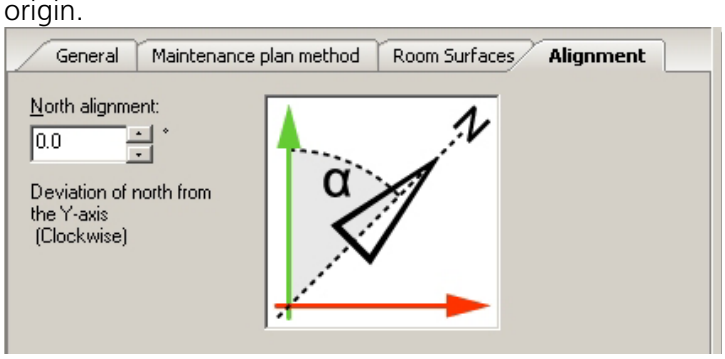


Fig. 99 Edit room data - Alignment

Modify Properties of Individual Walls

Select a wall in the 3D view, so that it is indicated in red. Alternatively in the *Project manager* you can select the corresponding wall and then similarly it is indicated in red. As soon as you marked an object, the properties of the wall selected will appear in the *Inspector*.
Here you can change the name of the wall and you can display the output results. If a shadow is displayed after the calculation, e.g. in the 3D rendering, you must define the calculation grid in the outputs. A better display will result from a smaller calculation grid (by increasing the number of points). Naturally the consequence of a smaller calculation grid is an increase in the calculation time for your computer.

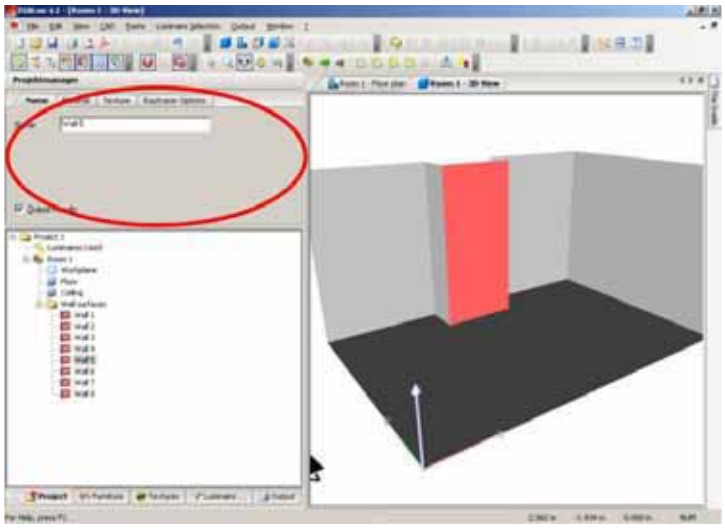


Fig. 100 Properties of a wall – Name

On the second tab –*Material*– you adjust the material properties for the wall. The *reflectance* value changes in response to new material choice. You can specify an alternative reflectance directly in the *reflectance* box.

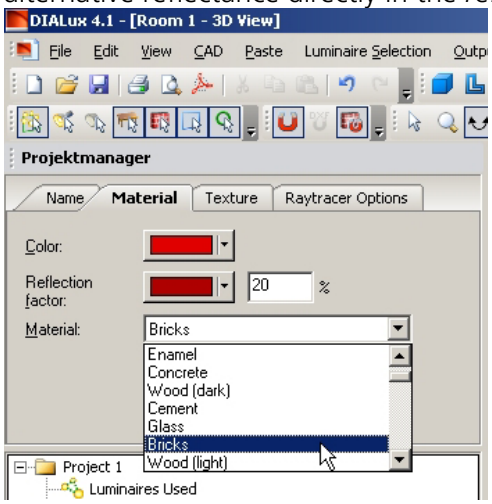


Fig. 101 Properties of a wall – Material

In the *Texture* tab you can adapt the texture properties, if you have placed a texture on the wall (see page 85). In the *Raytracer Options* tab you can adjust the properties, which the wall should have if you have started the Raytracer provided by DIALux.

Insert Room Elements

Modify a Room with Room Elements

With DIALux you have the possibility to modify the room with room elements. For example you can insert a *sloped ceiling* that cuts the existing wall surfaces and creates new surfaces called "ceiling 2". The other room elements like the flat ceiling become a part of the room as well and you can create new room surfaces at the same time.

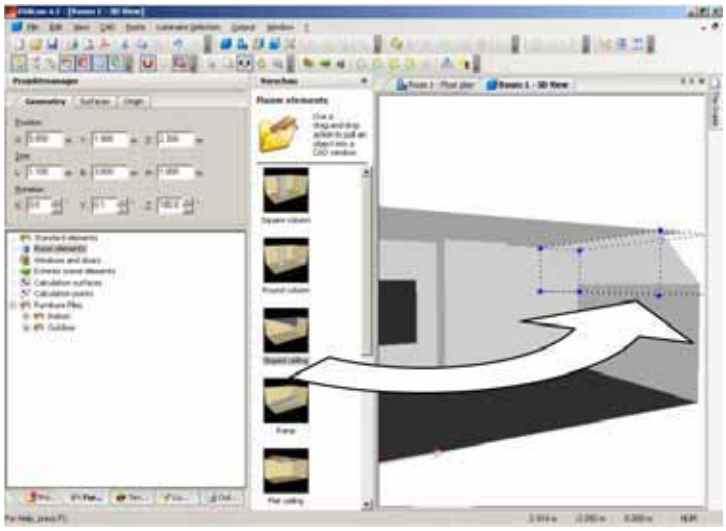


Fig. 102 Edit rooms – Insert room element

To insert room elements into a room, first of all you have to open the *Furniture tree*. Then select the file *Room Elements*. All room elements are displayed in the centre of the window. You can insert these simply by Drag & Drop into the 3D view or the ground plan view.

You can likewise create the room elements in the ground plan view. Particularly the scaling option of the room elements is easier in the ground plan view. You can scale and rotate the room element simply by using the mouse.

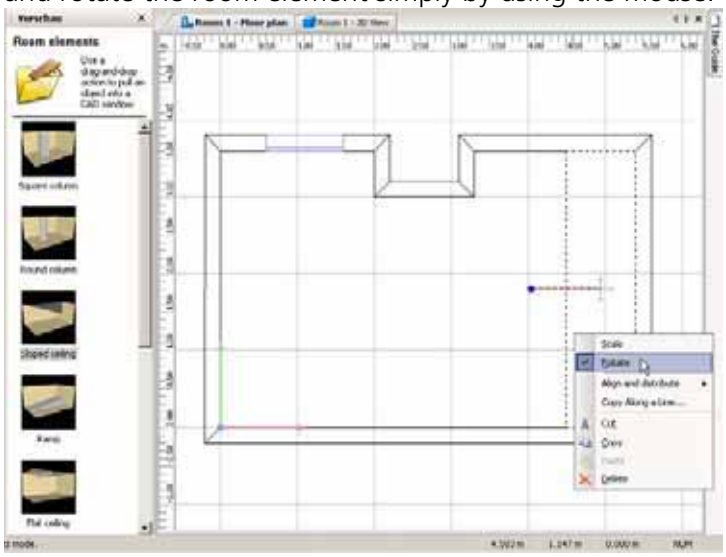


Fig. 103 Edit rooms – Edit room element

With DIALux it is possible to insert the following room elements. Naturally you can also combine these. As soon as a room element overlaps another, the invisible part is no longer considered in the calculation.

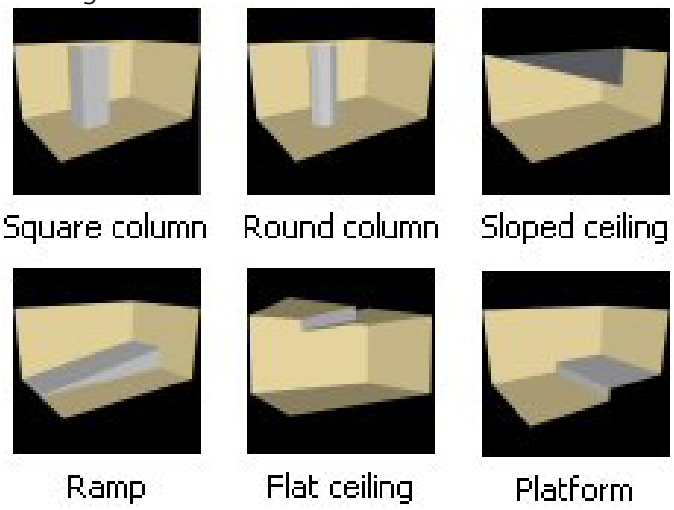


Fig. 104 Edit rooms – DIALux room elements

The room elements *vaults* are new in DIALux 4. Further possibilities for the construction of complicated ceiling forms have been improved. Now it is also possible to copy vault ceilings.

Fig. 105 DIALux room elements – Vault

The well known and well-tried room elements of DIALux are complemented with new objects, dome and half dome. These elements can be scaled or rotated just like any other room elements. They combine with the room. Their surfaces are automatically recognized as ceilings, so that ceiling mounted luminaires snap automatically to dome or half dome surfaces.

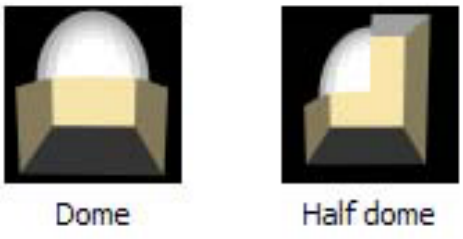


Fig. 106 DIALux room elements – Dome and half dome

Insert via Property Page

You can also insert objects numerically by entering coordinates in the furniture Property Page within the *Inspector*. Select the object in the furniture tree, enter the desired position in the *Inspector* and click on *Insert*.

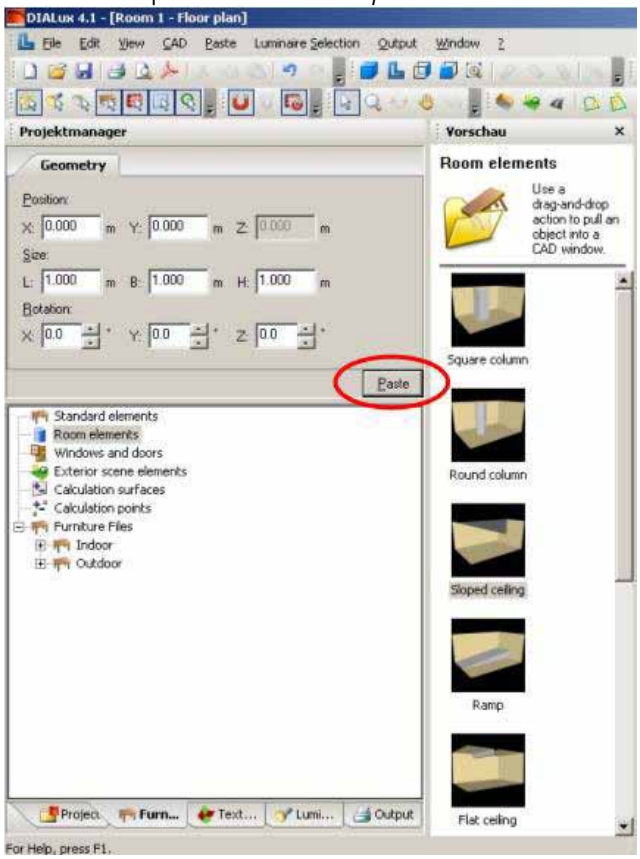


Fig. 107 Edit rooms – Insert room elements via Property Page

Insert Furniture

Insert Furniture

You can insert furniture into the project in the same way as room elements by using Drag & Drop or the Property Page.

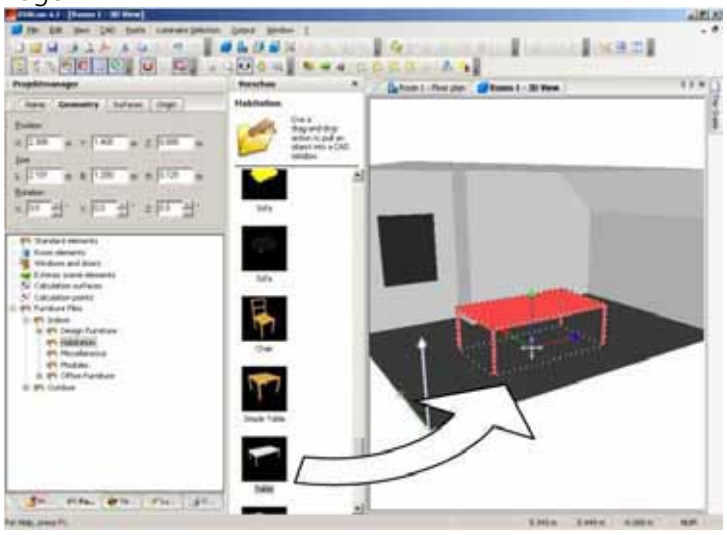


Fig. 108 Drag and Drop of furniture

Insert via Property Page

You can also insert objects numerically by entering coordinates in the furniture Property Page within the *Inspector*. Select the object in the furniture tree, enter the desired position in the *Inspector* and click on *Insert*.

Create Furniture

You can create your own furniture by combining standard bodies. The following example of a small shelf describes the procedure.

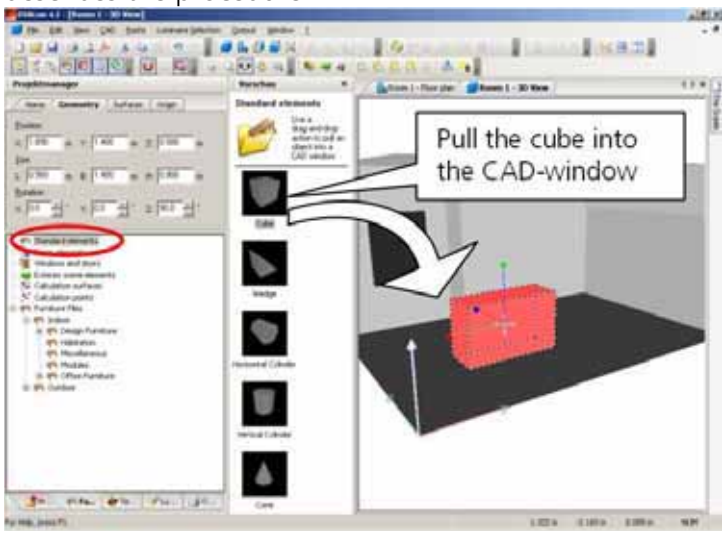


Fig. 109 Create furniture – Standard bodies

Modify the geometry of the cube in such a way that it corresponds to a bottom shelf by using the Property Page.

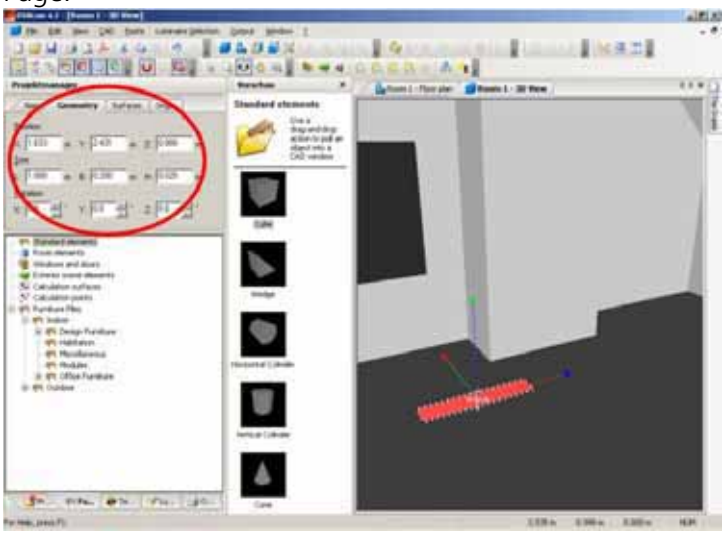


Fig. 110 Create furniture –Modify the dimensions

Subsequently you can copy the bottom shelf and move it to the desired position. Possibly the height (Z-axis) will need modifying.

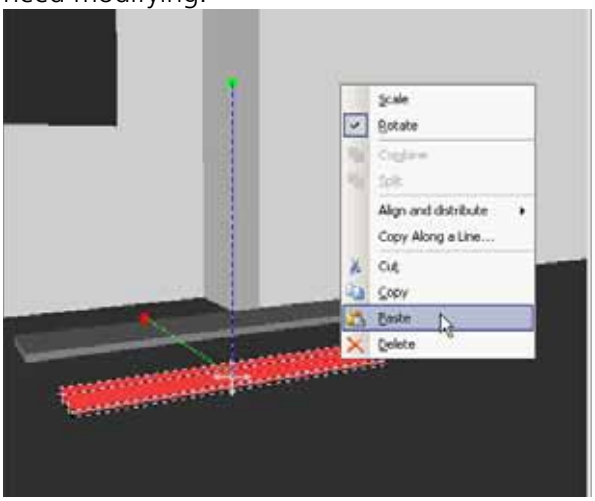


Fig. 111 Create furniture – Copy

Afterwards you can generate the side panels and position them correctly. Subsequently select all side panels and shelves and combine them via the right mouse button. Combining is very important particularly for the calculation. Otherwise DIALux will include each surface into the calculation, even those surfaces which are actually covered and no longer visible.

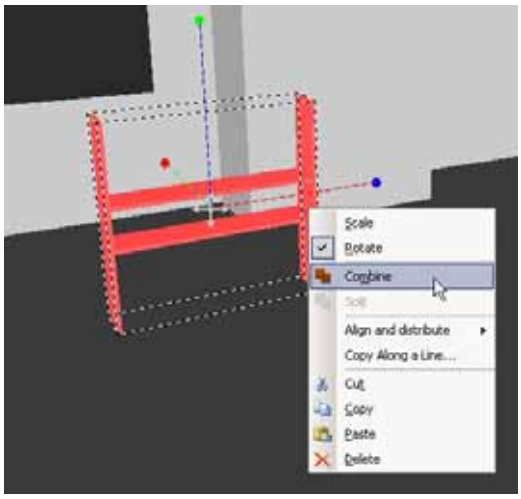


Fig. 112 Create furniture – Combine

You can save furniture by using the context menu *File* → *Export* function → *Save Furniture*. That way it is possible to use furniture in another project again.

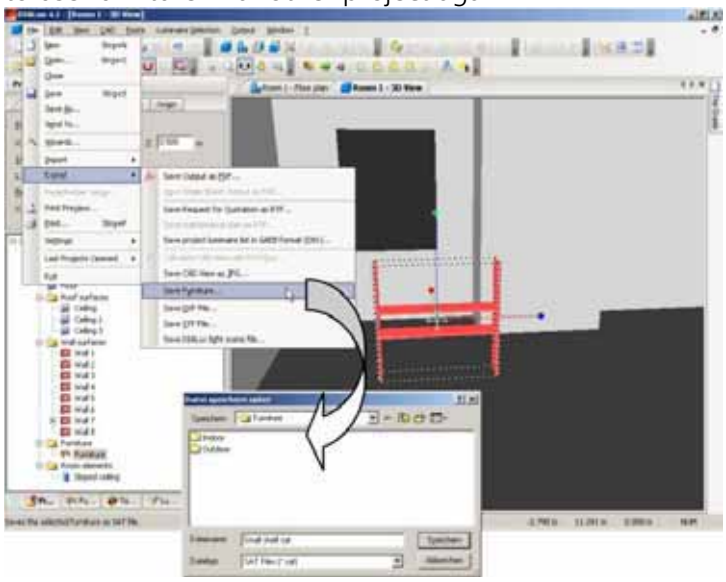


Fig. 113 Create furniture – Export furniture

Now you can see your saved furniture in the furniture tree (if necessary this must be updated once by changing into the *Project manager* and then back again into the furniture tree). From there you can move them at any time, like all other furniture, into a room or exterior scene via Drag & Drop into your CAD windows (see also page 157).

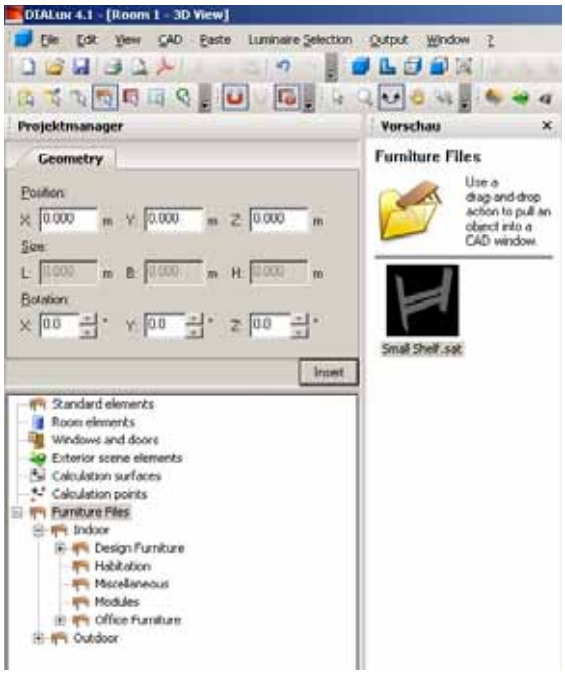


Fig. 114 Create furniture – Saved furniture

Import Furniture Files

You can import furniture files from other programs, e.g. Auto-CAD over the menu *File* → *Import* → *Furniture Files*. DIALux imports furniture files with the ending SAT (*.sat).

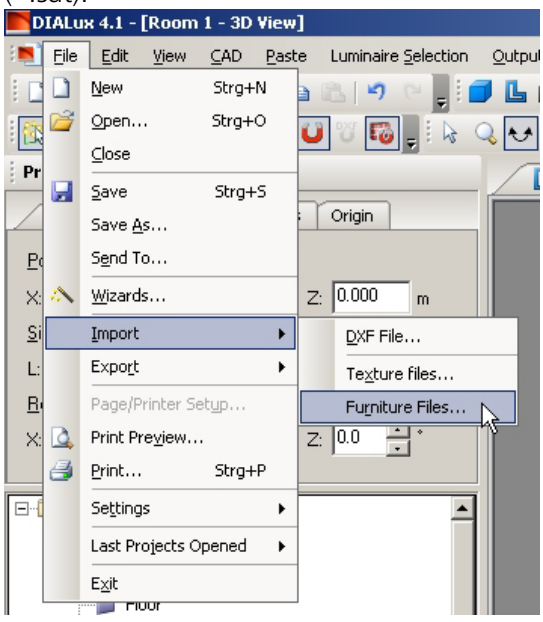


Fig. 115 Import furniture files

Extrusion Volumes

New to the standard elements is the furniture "Extrusion Volume". To create an extrusion volume, just drag and drop the object into a room or an exterior scene. A cube with edge lengths 1m x 1m x 1m is displayed. Simultaneously the familiar room editor is shown in the *Inspector*. With this editor you can assign the extrusion

volume any polygonal form you like, both numerically by inserting coordinates and graphically by dragging points or lines or by inserting coordinates with right clicks. After the extrusion volume's form is defined, any extrusion height can be selected.
An extrusion volume can be rotated, combined, subtracted or saved as new personal furniture. Of course, colours and textures can be assigned to the volume's surfaces.

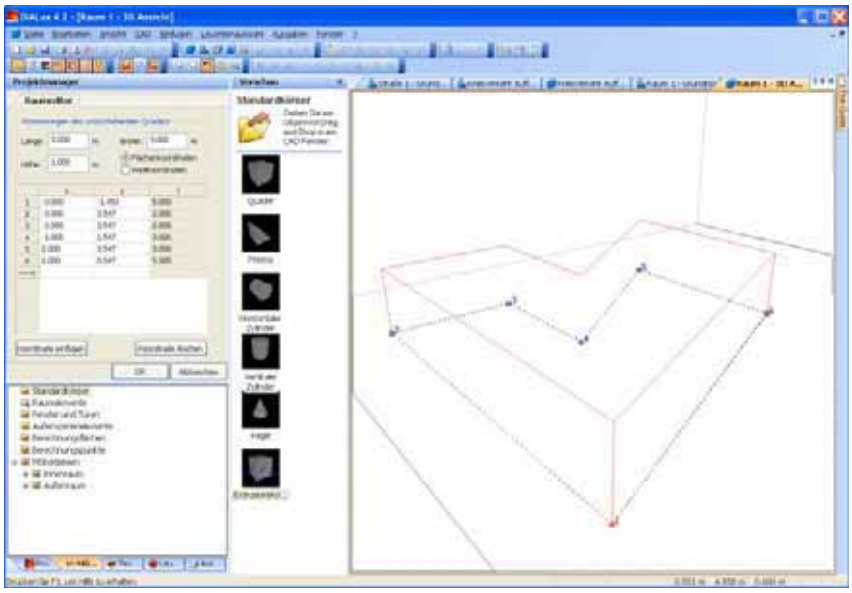


Fig. 116 Creating an extrusion volume

Subtraction of Objects

Subtraction of objects is a helpful tool to create complex furniture. Similar to room elements subtracting areas from a room, you can subtract one or more objects from one other object. Objects can be standard elements, extrusion volumes, furniture or imported SAT objects. The resulting object is what remains after the one object is subtracted from all other objects. The following example shows a polygonal extrusion volume with a cone sticking in it. The cone will create a depression in the volume. To achieve that, both objects are selected and the command "Subtract furniture" is executed. "Subtract furniture" can be found in menu "Edit" or in the context menu that is displayed after right clicking the selected objects. The command shows a Property Page, in which you can select the one object, all other objects are subtracted from. Pressing button "Subtract" executes the command. The CAD window afterwards displays what is left of the extrusion volume.

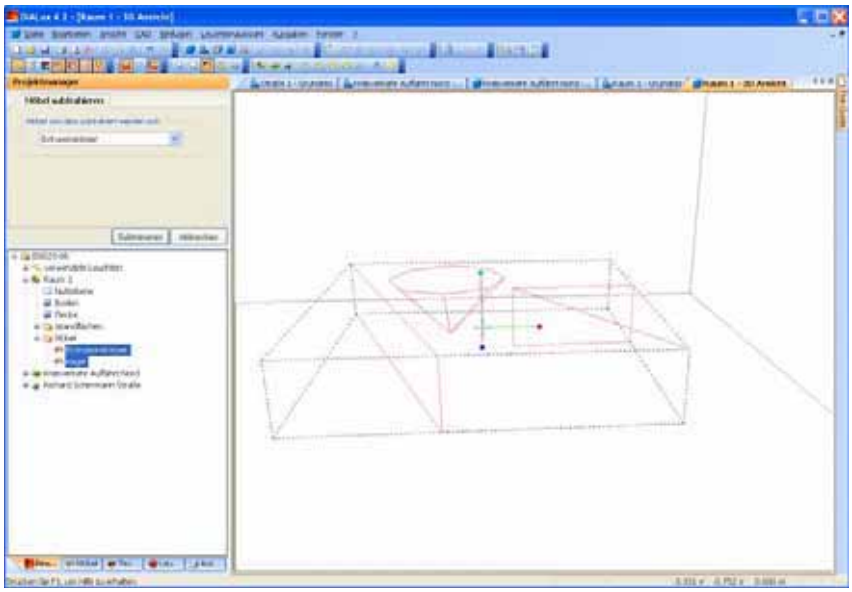


Fig. 117 Subtractions from a volume

If the cone goes completely through the extrusion volume, a hole is created. If the newly created furniture is split, all objects, even those which have been subtracted, are restored.

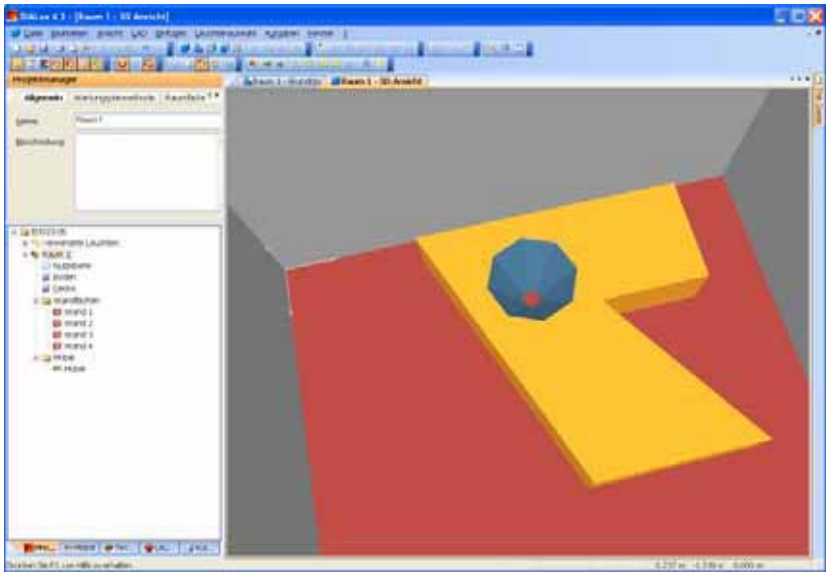


Fig. 118 Resulting volume

Selecting Single Surfaces

Time and again it is necessary to work on single surfaces of an object. With complex objects with very many surfaces, it may take a lot of time to find the desired surface in the surface list of the object's Property Page. To simplify this essentially, you can select a single surface now graphically. Just right click the object in the desired surface in the CAD and choose "Select this surface" from the context menu. The desired surface is selected in

the Property Page and can be assigned a colour, a texture, material and so on.

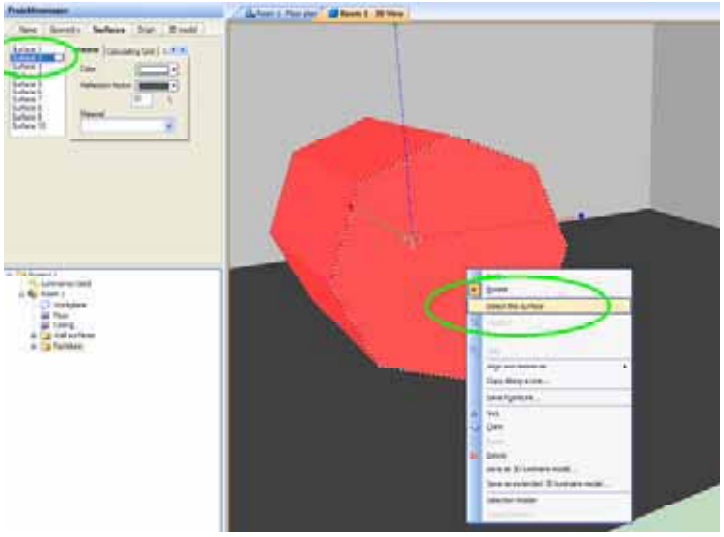


Fig. 119 Selecting specific surfaces from a volume

Windows and Doors

Windows and doors can also be inserted into the layout via "Drag & Drop". They can only be positioned in walls.

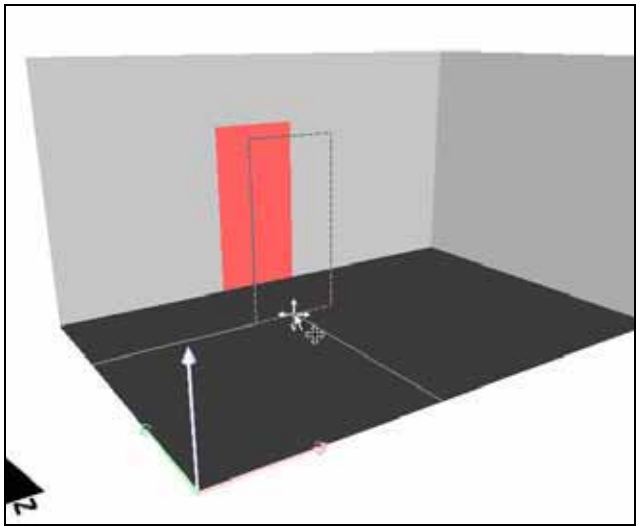


Fig. 120 Drag & drop for windows and doors

Since windows and doors can only be placed in walls, the door in this illustration is automatically placed vertically in the nearest wall. These objects automatically face the right way.

Insert Textures

Insert via Drag & Drop

You can insert textures into your project with Drag & Drop.

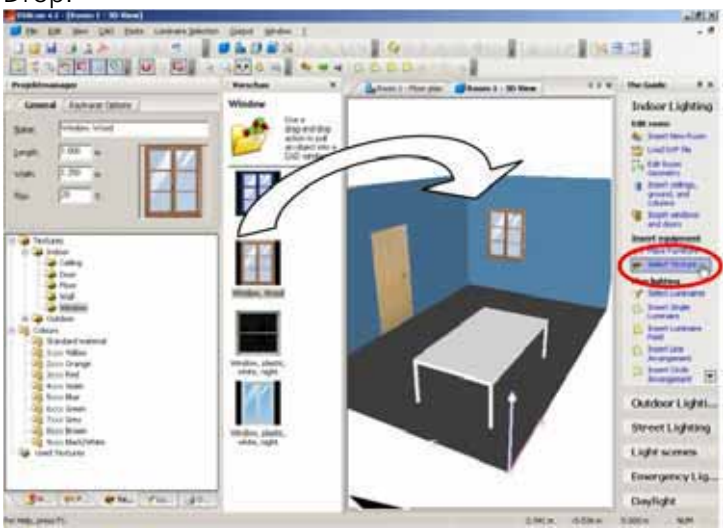


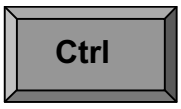
Fig. 121 Insert textures via Drag & Drop

If you want to assign a texture to a surface, you simply go to the colours tree, select the desired texture or colour, hold the left mouse button and drag it to the CAD and drop it onto correct surface. You can place textures and colours on every "real" surface (furniture, walls, windows, doors, …) but not on a "virtual" calculation surface. The light colours and colour filters can only be used on luminaires. Inside of an object (room or furniture) the texture is assigned to all surfaces with the same colour or texture. For example if the walls in a room have the same colour and you drag a masonry texture to one wall, the texture is assigned to all other walls at the same time.

In order to occupy only one surface of an object with the texture, hold the SHIFT key!

When you want to assign the texture only to one surface, you can hold the *Shift*-key while you drop the texture to the surface.

In order to occupy all surfaces of an object with the texture, hold the CTRL key!



When you hold the *Ctrl*-key while you drop the texture onto a surface, all surfaces (e.g. the walls, the ceiling and the floor of a room) get the same texture.

Edit Placed Textures

When a texture is not placed properly on a surface, you can correct this afterwards.

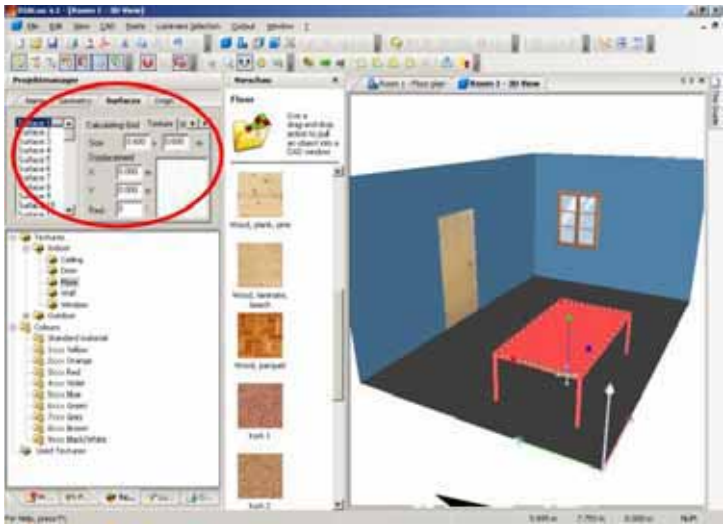


Fig. 122 Edit textures on an object

Select the object in the CAD view. The *Inspector* shows the Property Page *Surfaces* of the object with the additional information about the texture. If for example the texture has the wrong rotation, you can correct it on the Property Page *Texture,* similarly you can scale or move the texture.
If you want to mirror a texture, you can easily do it by entering a minus (-) symbol in front of the length or the width (or both) of a texture. You can use it only for the texture placed on a surface not for the texture itself.

Delete Textures

You can remove a texture from an object by using the *Eraser* from the texture tree on the corresponding object. Thereby the object gets assigned again the origin colour.

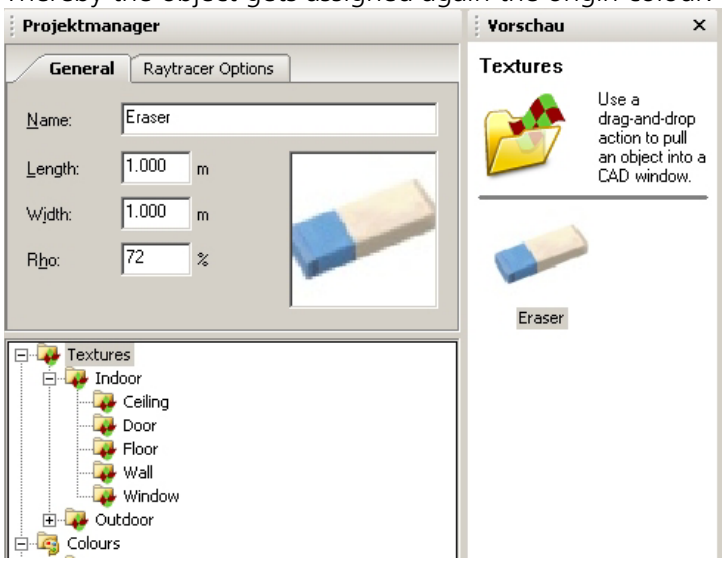


Fig. 123 Delete textures

Import Textures into the Texture Tree

You can insert your own textures or images into the texture tree. DIALux supports files in *.bmp, *.dib, *.jpg and *.gif-format.

Textures can be inserted via Drag & Drop into the texture tree. To import a new texture into the texture tree, open the texture tree and start the Windows Explorer.
Now you can drag the image file from the Windows Explorer into the wanted directory of the texture tree. DIALux automatically converts the image file into the needed format. The reflection factor is calculated using the RGB-values. The size defaults to 1m x 1m. You should check these values and correct them if necessary.

With the menu *File* → *Import* → *Texture Files* you can use a dialogue to copy the textures into a directory of the texture tree.

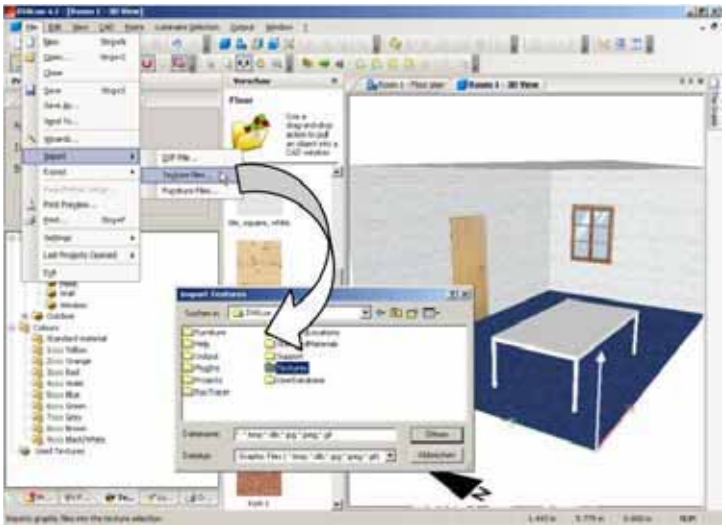


Fig. 124 Import textures into DIALux

Within the colour tree textures can be moved, copied or deleted. Also subfolders can be created or deleted. Just make a right click on the desired object.

Edit Room Geometry with DWG or DXF-File

Please read chapter *DWG and DXF import and export* starting from page 228.

Duplicate (Copy Rooms/Scenes/Streets)

Duplicate an Existing Room

An identical room can be created by clicking *Duplicate*. First select the original room in the tree, and then select the *Duplicate Room* command from the context menu.

Please note that the room information is duplicated (dimensions, materials etc.) together with the objects inside the room (luminaires and furniture).

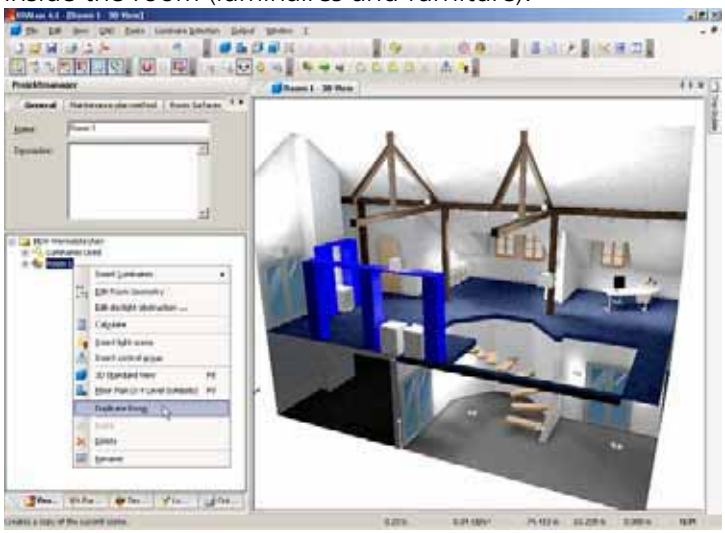


Fig. 125 Duplicate rooms

Insert and Edit Luminaires and Luminaire Arrangements

You can open the luminaire tree by clicking in *The Guide Select Luminaire*s. In the luminaire tree you will see *installed PlugIns* under DIALux catalogues. With one double-click on a name of a manufacturer you can open a PlugIn. Under *not installed PlugIns* you can find the DIALux project partners, whose PlugIns are not yet installed. A double-click on the corresponding names of the manufacturers opens its internet page. There you can download the DIALux PlugIn. Additionally telephone numbers and e-mail addresses are displayed.
At the bottom of the list the last used luminaires are always indicated. This can be up to 20 luminaires of different manufacturers.

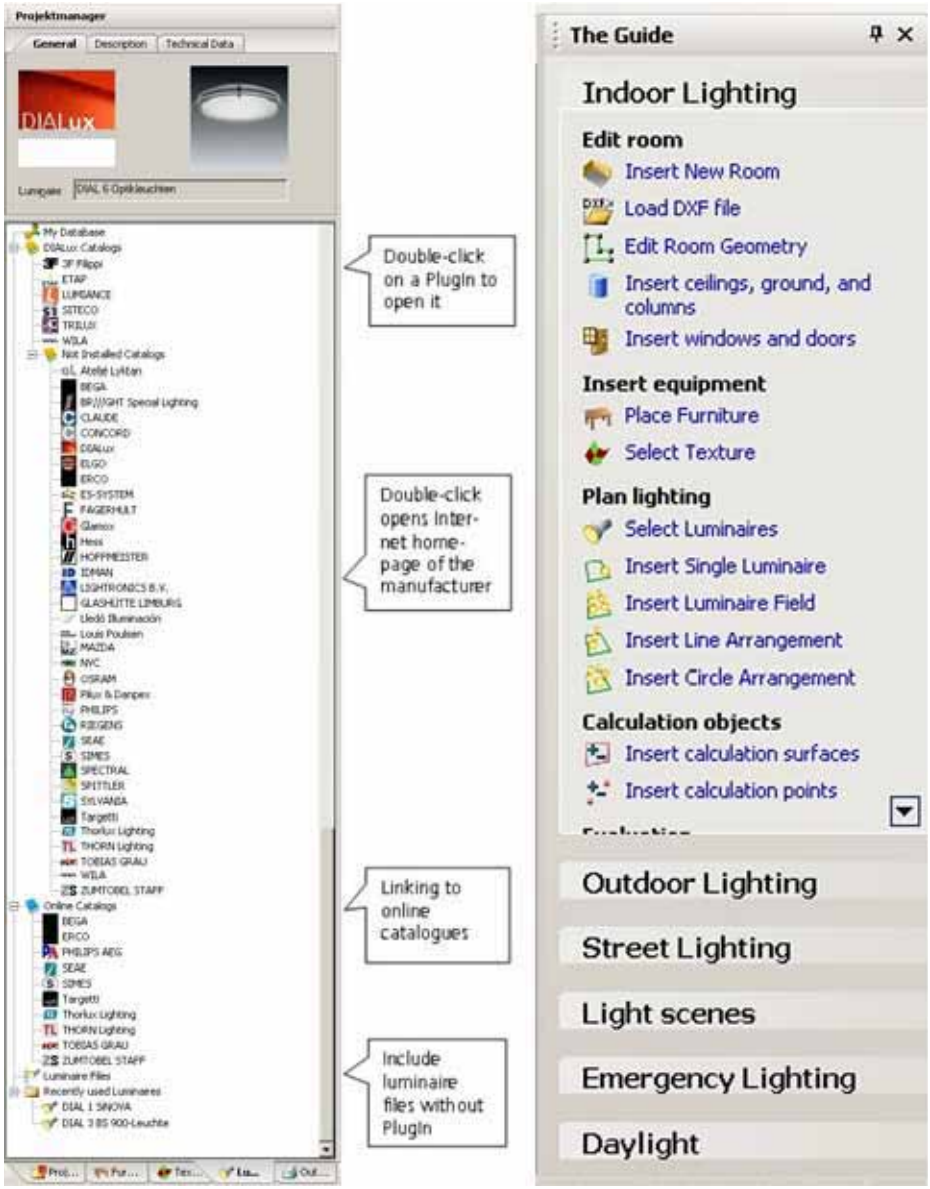


Fig. 126 Launch luminaire tree

Online Catalogues

In DIALux it is possible to insert luminaire files over so-called O*nline Catalogues*, functioning similarly as installed PlugIns.

You can open an online catalogue by double-clicking on the corresponding symbol in the luminaire tree. Afterwards the online catalogue opens and you can insert a luminaire from the internet page of your manufacturer directly into your DIALux project. In this way you can constantly access current files of your manufacturer.

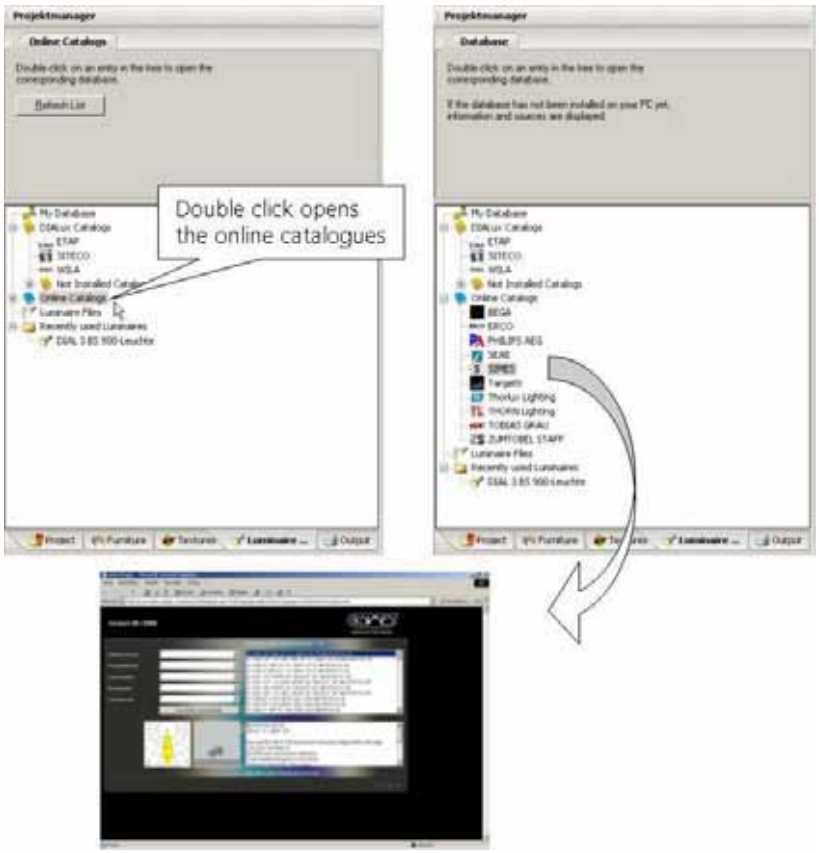


Fig. 127 Launch online catalogues

Hint: Inserting luminaires over the online catalogue works only if this service is offered by the corresponding manufacturer.

Individual Luminaires

Individual luminaires can be inserted into the room from the project or luminaire tree via Drag and Drop. Simply pull the luminaire from the tree to the room. The luminaire is inserted into the room at that position (X and Y coordinates) where you release the mouse button. The way it is inserted influences the arrangement type. Via Drag and Drop you can position luminaires only inside rooms.

In the future, some luminaire manufacturers will supply PlugIns from which luminaires can also be positioned via Drag and Drop.

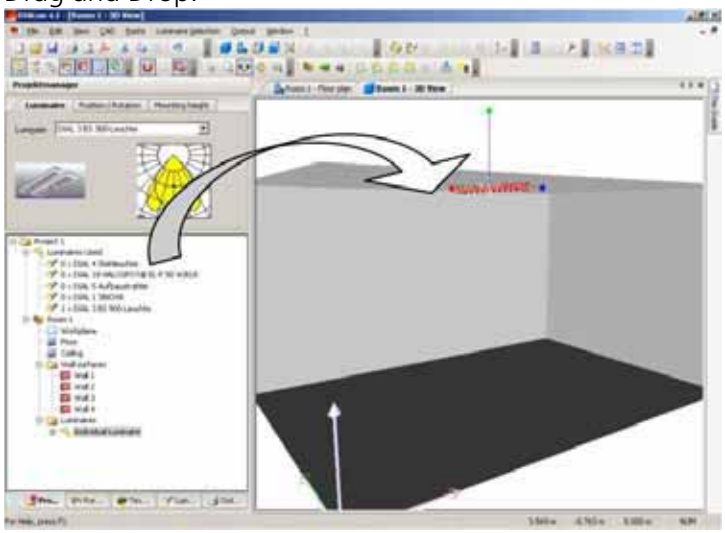


Fig. 128 Insert individual luminaires

If you click on *Insert Single Luminaire* in *The Guide*, a corresponding Property Page opens in the *Inspector*. In the CAD, the arrangement is highlighted by a rubber band lines, in the Property Page initial values are displayed and at the bottom of the Property Page the *Insert* and *Cancel* buttons are located.
Depending on the currently activated tab, you can adjust the *Position*, the *Rotation*, as well as the *Mounting height* of the arrangement. In the *Luminaire* Property Page you can select the luminaire to be positioned.

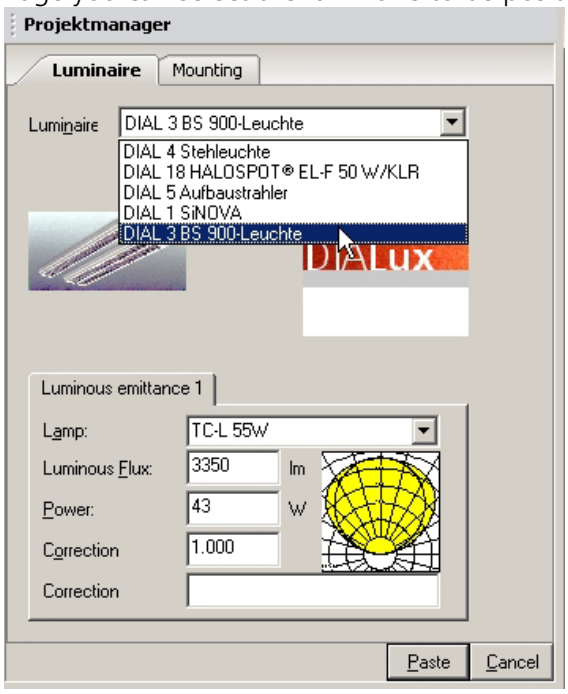


Fig. 129 Luminaire selection dropdown list

In the list displayed in the illustration, you can find the luminaires that you have inserted into the project, as well as the last luminaires you have used. According to the

Mounting tab you can make various settings for the mounting.

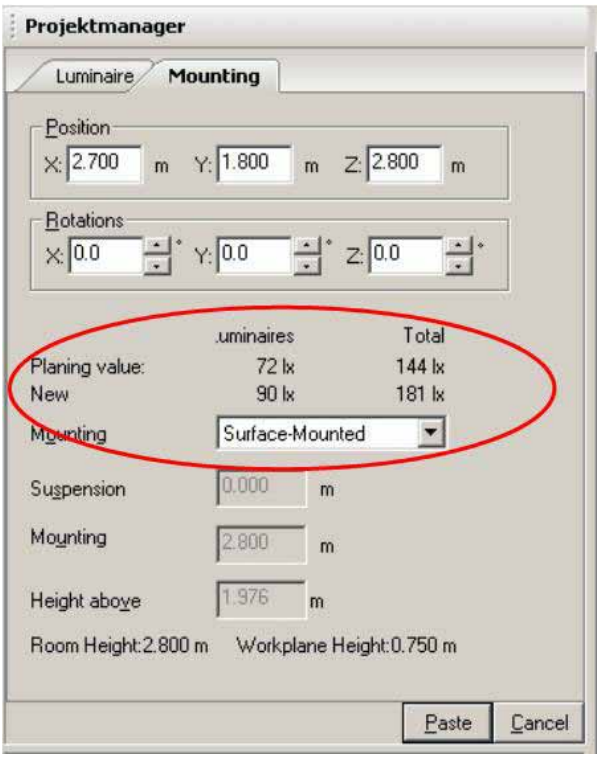


Fig. 130 Mounting tab

Additionally information is shown giving the maintained and initial illuminance due to these luminaires and due to the whole room.

Fig. 131 Modifying the technical data of luminaires

To modify the *Technical Data* of the luminaires, these must have been inserted into the room. In the *Project manager*, the luminaires contained in the arrangement are listed beneath the respective arrangement type (An individual luminaire arrangement in this case). If you

select one of these luminaires, you can modify its technical data. If you select multiple luminaires in the CAD, you can modify the values of all selected luminaires.

Aligning Luminaires

In DIALux you can switch on *Help rays* for the *luminaires*. In the menu *View* you can find the function *Help rays for Luminaires*.

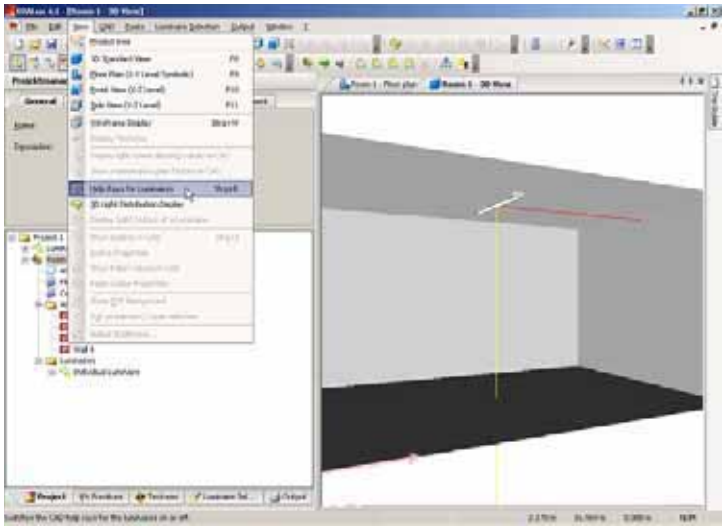


Fig. 132 Help rays for luminaires

The C0 level of luminaires with a rotation of 0° is directed lengthways in the positive X-axis. Gamma0 points vertically from the top to the bottom.

When you click on this icon, a C0 arrow (red line) – which indicates the direction of the C0 plane – and a yellow line –degree of light radiation gamma = 0° – appears at the inserted luminaires. The C0 planes of the luminaires always show towards the X axis, if it wasn't rotated.

With DIALux you can switch on the *3D Light distribution curve*, (LDC). This function is useful to check the correct placement of luminaires with asymmetrical distribution.

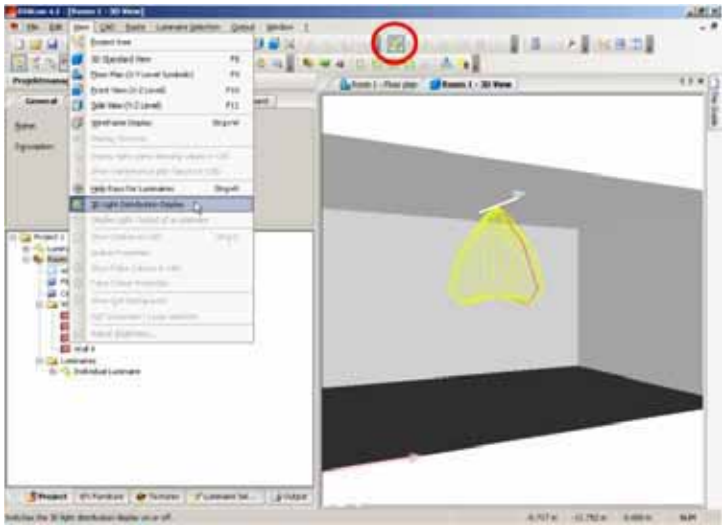


Fig. 133 Luminaire with 3D LDC

To show the LDC, click on the icon *3D Light Distribution Display* or select the menu *View* → *3D Light Distribution Display*.

In DIALux the alignment of luminaires is improved with the function *Set illumination point*, which allows you to align the yellow help ray (gamma = 0) with any point on a selected surface.

The alignment of luminaires has further been simplified in DIALux. Beside the function of the alignment of the luminaires to C0, Gamma0 and C90, Gamma 0 the illumination point can be also aligned optionally to the maximum luminous intensity ($I_{max.}$).

Set illumination point → align to $I_{max.}$

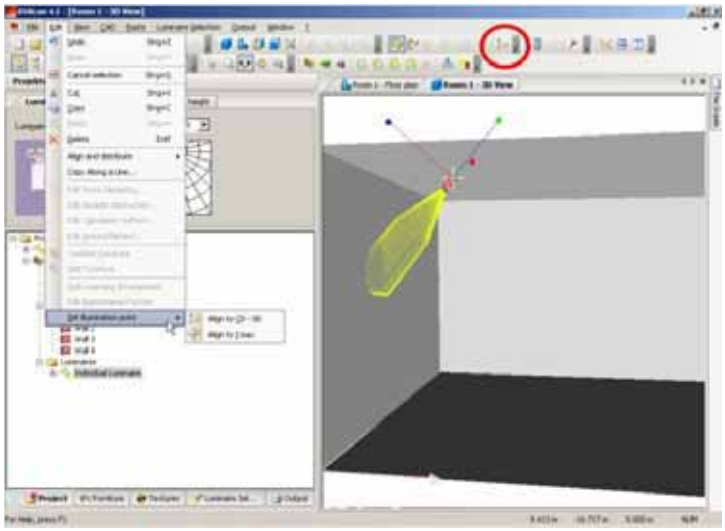


Fig. 134 Mouse mode to define illumination point

To set the illumination point, you have to select a *single luminaire* first. Maybe you even have to activate the single luminaire selection to select a luminaire inside of a luminaire arrangement.

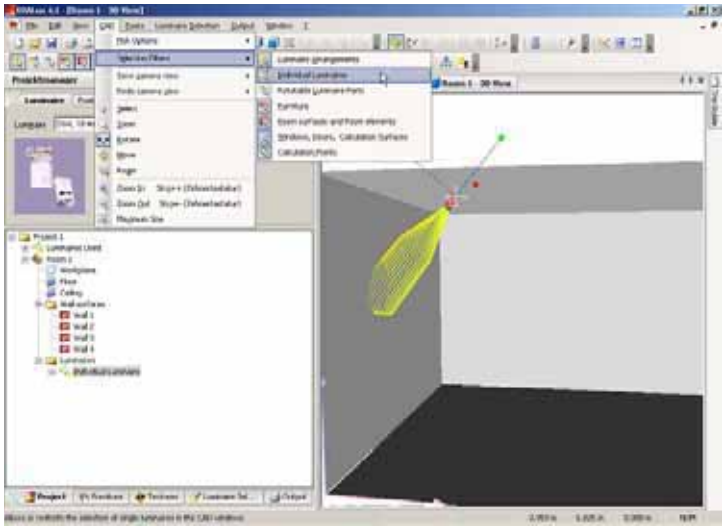


Fig. 135 Selection of individual luminaires

When you have selected the single luminaire, you can use the mouse mode *Set illumination point* and click on the position (surface or furniture) you want to illuminate.

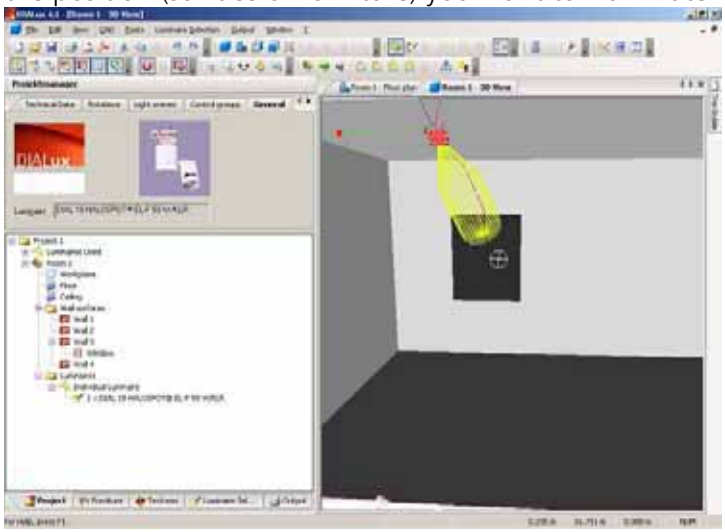


Fig. 136 Align a spotlight to a picture

Inserting Luminaire Fields

Luminaire fields can be positioned either by selecting the *Insert Luminaire Field* option in *The Guide* or the *Luminaire Arrangement Wizard* → *Field Arrangement* option. If you select a room and then perform a right-click, the context menu for that room opens. Here you can also select the *Insert* → *Field Arrangement* option. The Wizard sequentially queries all important parameters that must be entered.

If you use one of the options with which the luminaire field is entered manually, the *Inspector* displays, in addition to the luminaire field, a *Paste* and a *Cancel* button.

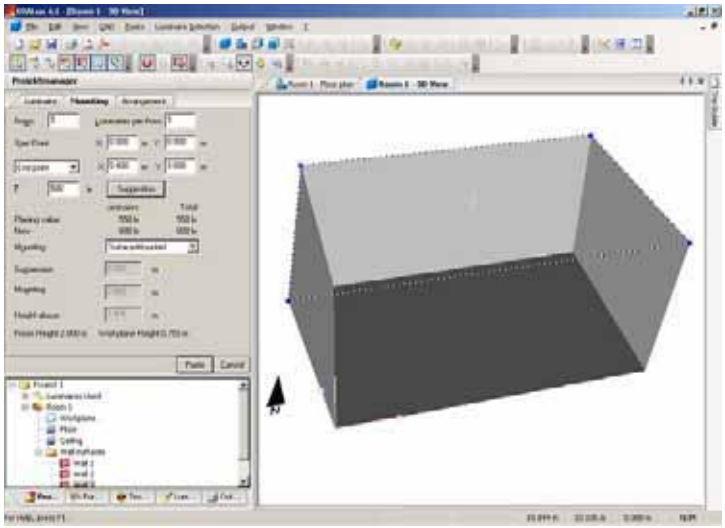


Fig. 137 Insert luminaire fields without wizard

Until you click *Paste*, only the rubber band indicating the field arrangement is visible. You can modify all parameters in the Property Pages before or after inserting the field.
To edit a luminaire field, select it in the tree or in the CAD view. If you click on a luminaire in the field, all luminaires in the field are selected by default. If you wish to edit individual luminaires, you first have to change the selection filter (see Fig. 135).

The following filters can be selected (from left):

New in DIALux 4.2: Selection of rotatable luminaire parts

- Allow or restrict the selection of luminaire arrangements
- Allow or restrict the selection of individual luminaires within an arrangement
- Allow or restrict the selection of rotatable luminaire parts
- Allow or restrict the selection of furniture
- Allow or restrict the selection of surfaces
- Allow or restrict the selection of windows, doors, calculation surfaces
- Allow or restrict the selection of calculation points

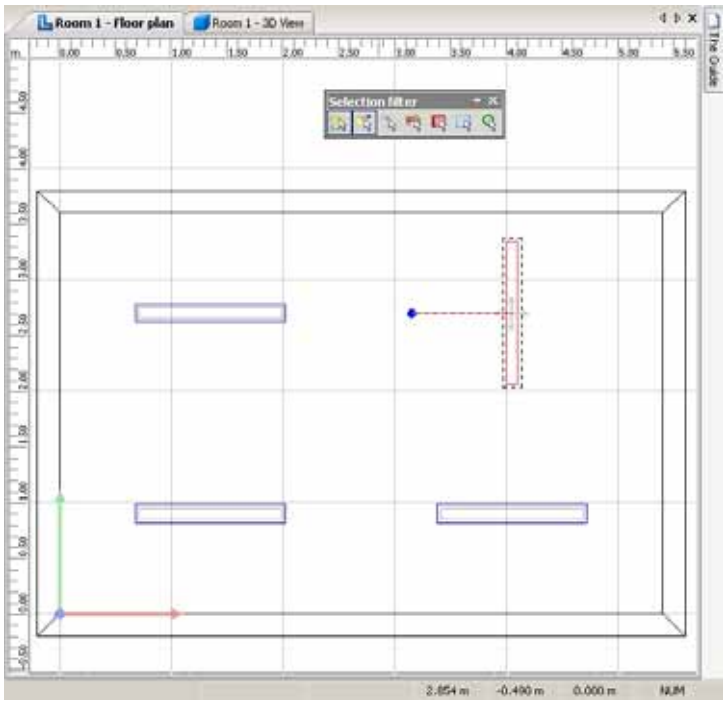


Fig. 138 Manipulating a luminaire within an arrangement

The figure above illustrates how individual luminaires within a field arrangement can be modified. The selection filter allows the selection of individual luminaires. The luminaire position is unchanged. This option, for example, can be useful when directing individual spotlights in a luminaire arrangement towards furniture pieces.

In the *Inspector* the luminaire properties can be changed. Here it is possible to select the arrangement type and the dimensioning type of luminaire fields.

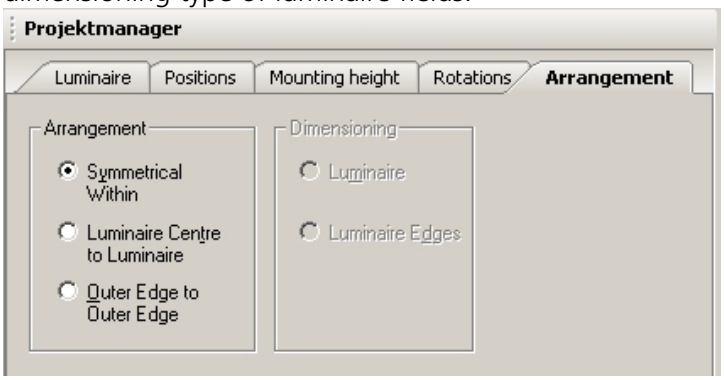


Fig. 139 Selecting the arrangement type of a luminaire field

The selected arrangement type, as well as the dimensioning, influences the field properties.

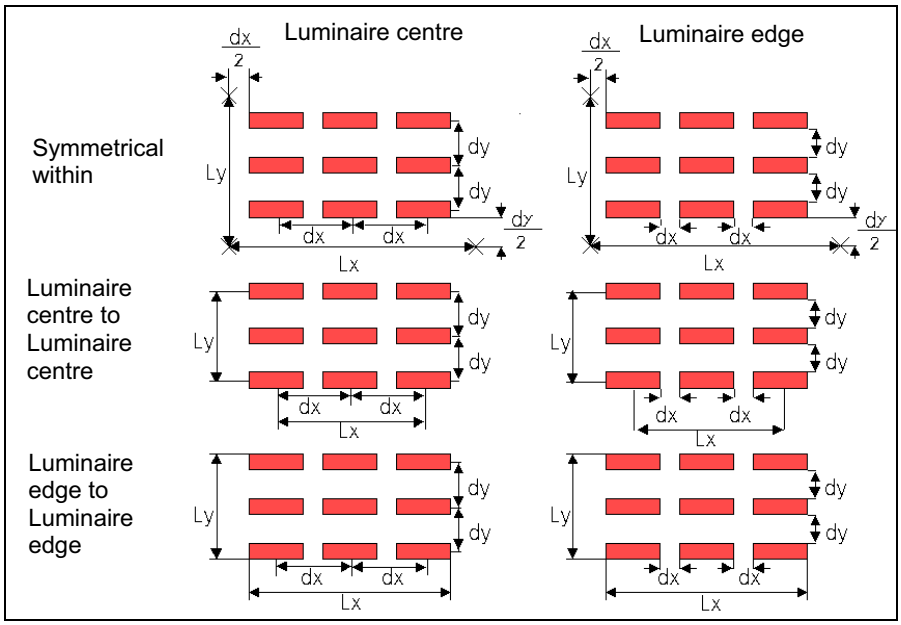


Fig. 140 Effect of arrangement type and dimensioning type on the luminaire field dimensions

The arrangement type is also taken into account when the luminaire fields are edited via CAD.

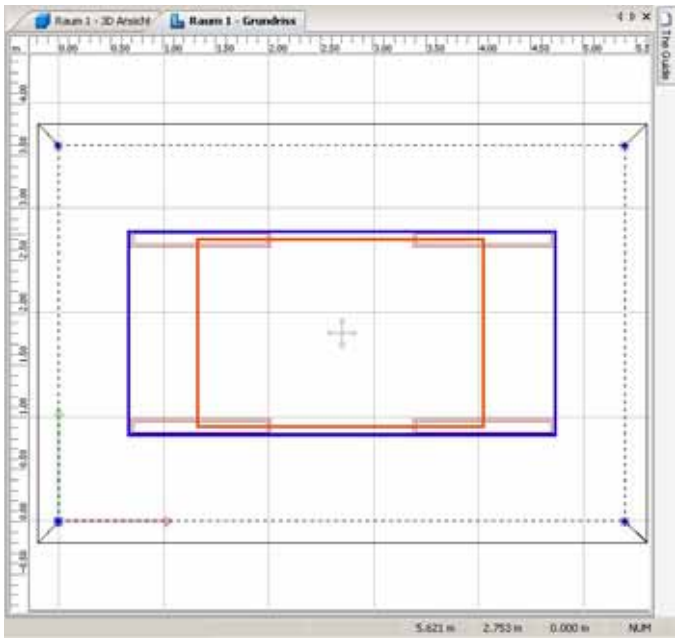


Fig. 141 Luminaire field insert frames depending on the arrangement type

In the CAD ground plan view, three possible edit or insert frames for the luminaire field are shown. When the *Symmetrical Within* arrangement type is selected, the outer blue broken line appears. The frame in the middle appears when *Outer Edge to Outer Edge* and the innermost red frame correspondingly appears with the *Luminaire Centre to Luminaire Centre* selection.
The dimensioning of the luminaires and of the start and end point of the field correspondingly changes. You can change the extent of the luminaire field via the mouse. To do this, right-click on the field (in the tree or in the CAD). By pulling on a line or on a corner coordinate, you can change the extent, just like you can do with the furniture. Please note that the amount and, of course, the size of the luminaires remain the same.

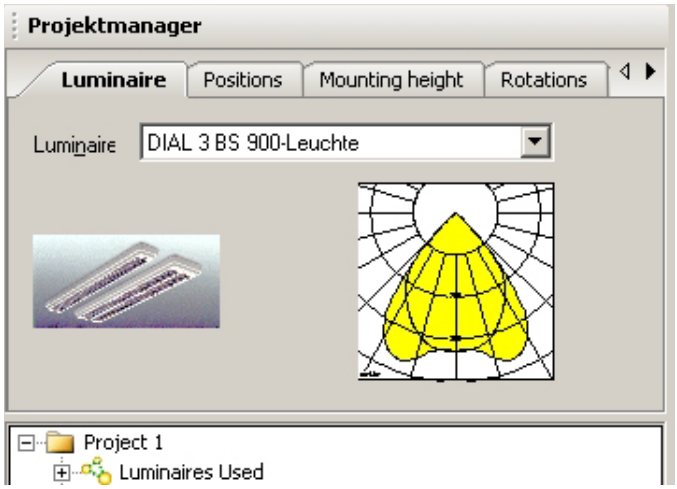


Fig. 142 Luminaires used in the arrangement

The luminaires in an arrangement can also be manipulated subsequently. As you can see in the

illustration above, the luminaires and the lamps used in the field can be modified without having to delete the field.

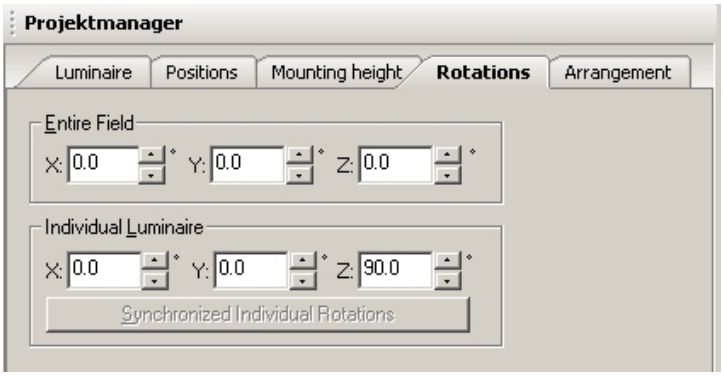


Fig. 143 Rotating the arrangement and the luminaires

Both the rotation of the entire field as well as the rotation of the luminaires within the field can be modified numerically or graphically. To rotate a single luminaire within a field, it must be selected individually. Additionally there is the possibility to synchronize individual rotations.

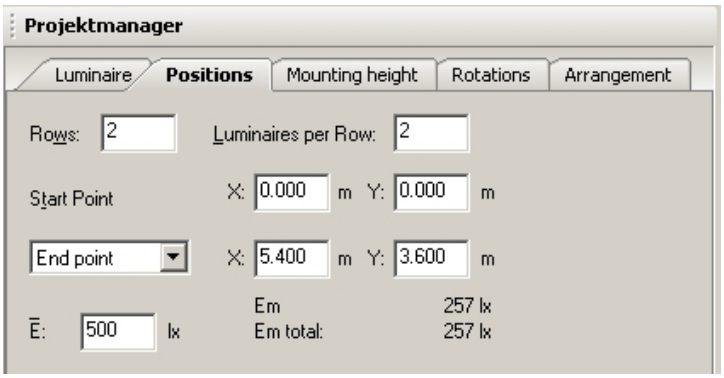


Fig. 144 Luminaire field position

The position of a luminaire field can also be modified numerically or graphically.

Inserting Luminaire Lines

Luminaire lines can also be positioned via the *Wizard* or manually. After a line has been inserted, the length, the position or the angle can be graphically modified.

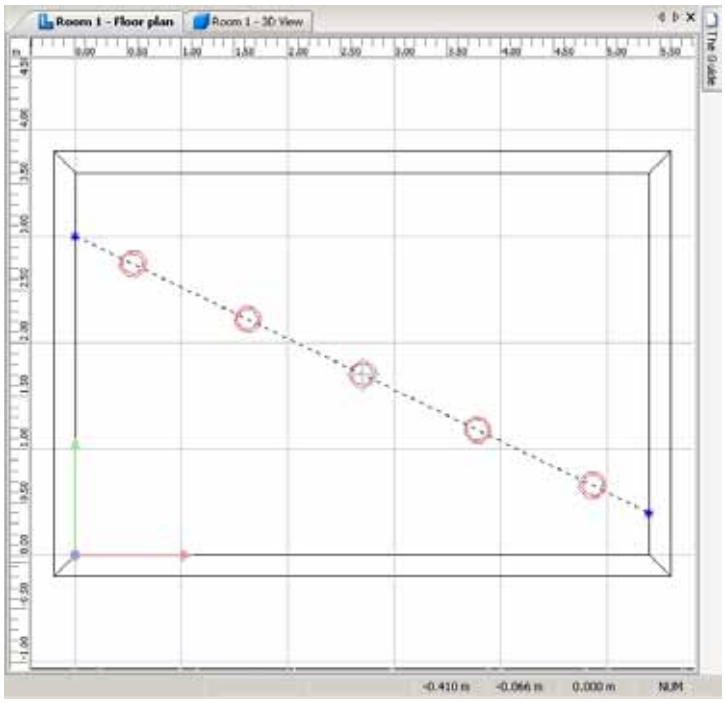


Fig. 145 Scale a luminaire line

If you pull the cross in the middle of the line with the mouse, you change the position. The angle and the length of the line remain constant. With the blue end points you can modify the length and the angle at the same time. It is not necessary to switch between *scale* mode and *rotate* mode.

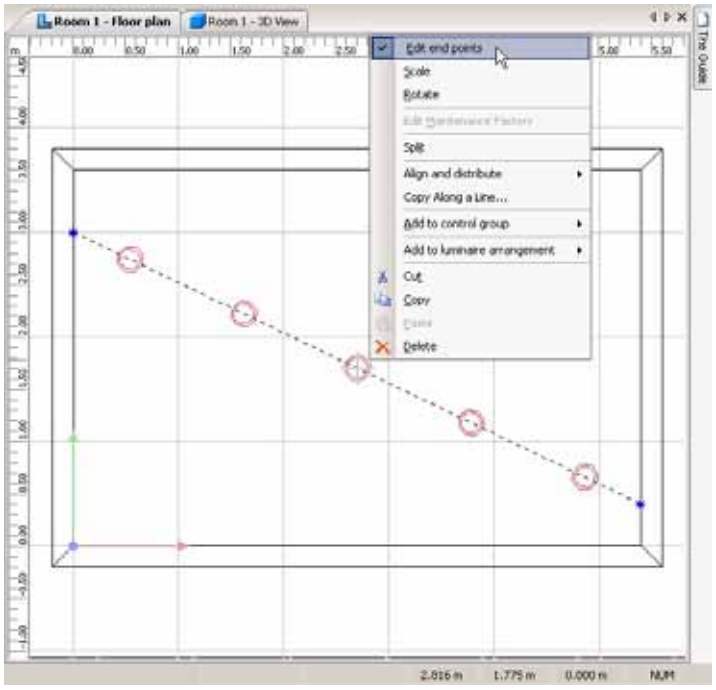


Fig. 146 Edit a luminaire line

If the luminaires within the arrangement have not been rotated, the C0 of the luminaires is directed towards the row axis (from the start point in the direction of the end point).

Aligning Lights

If you select individual luminaires in an arrangement via CAD, you can also modify their rotation within the arrangement. The position of the luminaires remains constant. You may also use the function set *illumination point*.

Alignment of lights on a track.
Alignment of luminaires within an arrangement.

Use this option to switch on the luminaire help rays and the C0 arrows. The help rays indicates Gamma=0°.

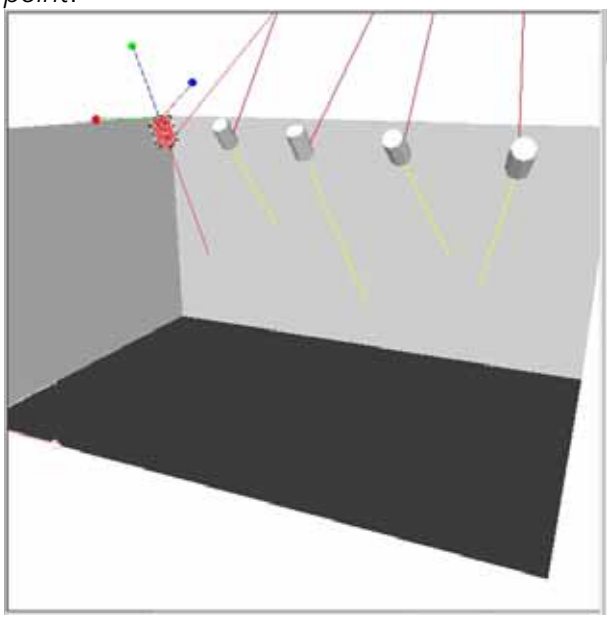


Fig. 147 Aligning individual luminaires within an arrangement

To be able to select individual luminaires within an arrangement, the selection filter must be set accordingly.

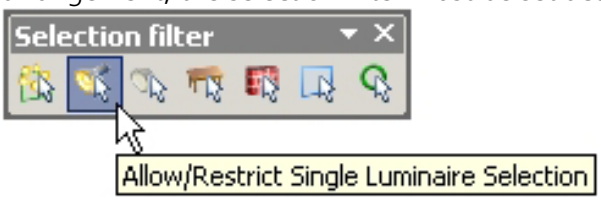


Fig. 148 Selection filter for CAD selection

The fourth icon from the right enables the selection of individual luminaires within an arrangement.
NOTE: A single luminaire is an *individual luminaire arrangement*.

Inserting Luminaire Circles

At the moment, no wizard for positioning luminaire circle arrangements is available. The options are very similar to those already described. Additionally we would like to point out the *Start Angle* and *End Angle* options.

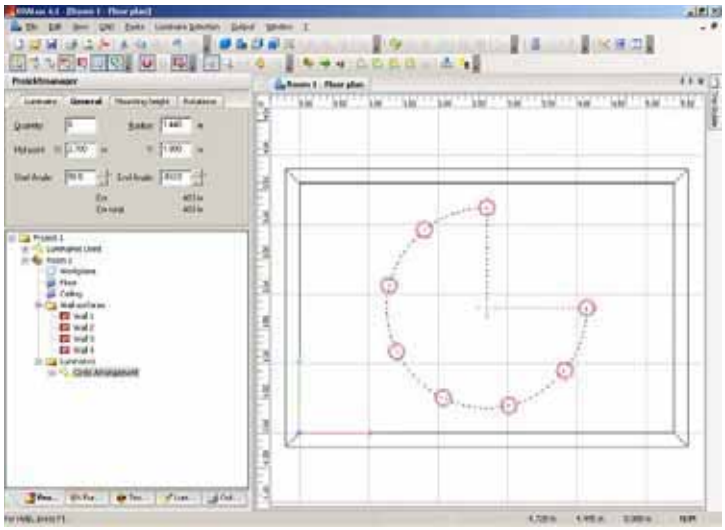


Fig. 149 Luminaire circle start and end angle

When the start angle is 0°, the first luminaire is positioned to the right of the mid-point at distance r on a straight line which is parallel to the X axis. Positive angles (> 0°) are created counter clockwise. If the individual luminaires are not rotated, the C0 level of each luminaire radiates outward.

Separating Luminaire Arrangements

An inserted luminaire arrangement can be separated into individual luminaires by right-clicking on the arrangement and selecting split. Subsequently the position of the individual luminaires can be modified. You can also separate a selected arrangement into individual luminaires via the *Edit* → *Split Luminaire Arrangement* menu option.

Modify the position of a Luminaire

To modify the position of a luminaire you can select the luminaire in the *Project manager*. Now you can use the Property Page with the coordinate fields.

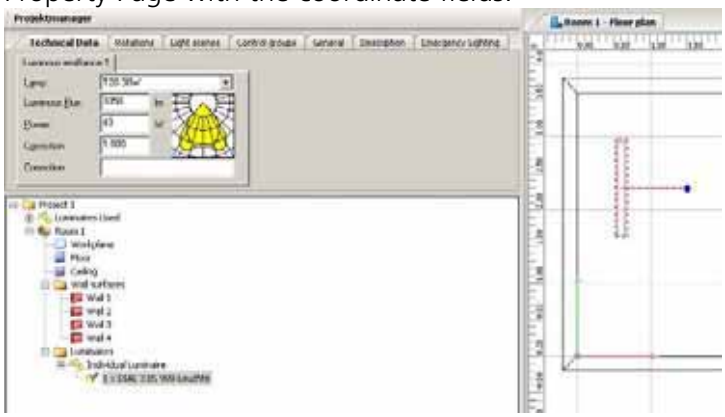


Fig. 150 Modify luminaire data – Corrections

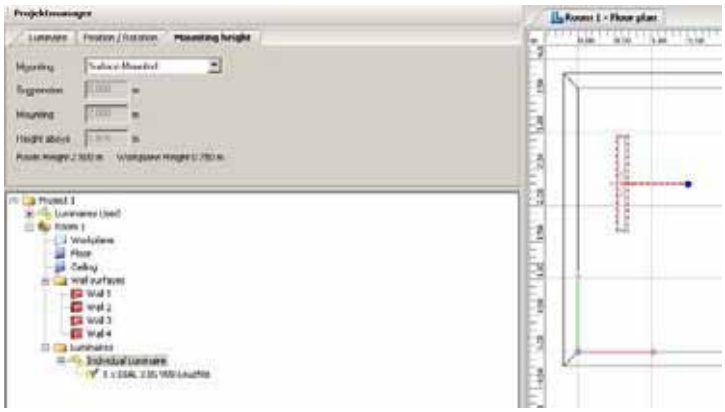


Fig. 151 Modify luminaire data – Mounting height

Luminaires with articulated joints

With DIALux it is possible in computer-aided lighting design to make use of all the mechanical properties of luminaires. In DIALux with 3D luminaire models it is possible, as in real life, to grasp the articulated joints and adjust them (spots, fully suspended systems, floodlights, street lighting). The manufacturer defines the articulated joints, the maximum rotation and even the increments of articulation. You simply click on the luminaire and turn it to where the light should be directed. Of course you can also do this numerically or graphically.

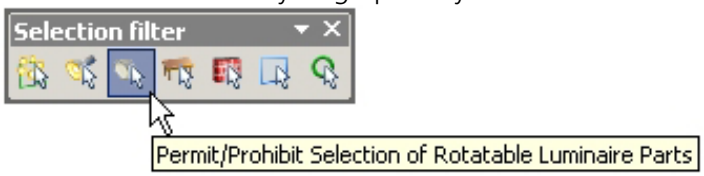


Fig. 152 Selection of rotatable luminaire parts

The third icon from left allows the selection of rotatable luminaire parts. If you have activated this icon, you can turn the luminaire with articulated joint to the desired position or you can specify the rotations in the appropriate Property Page.

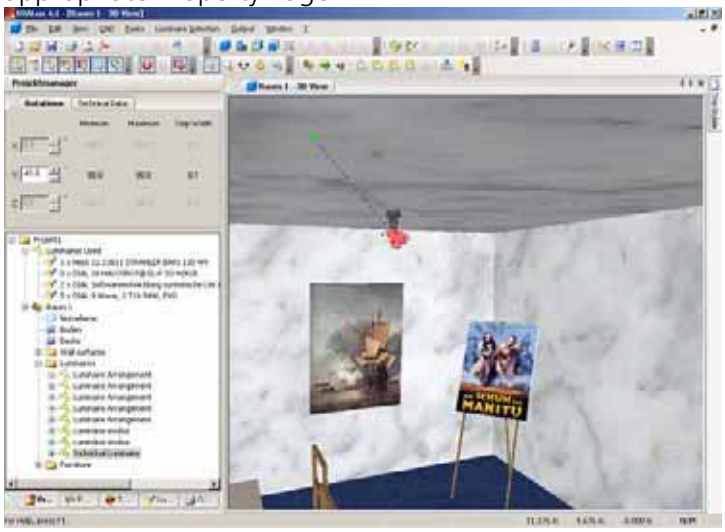


Fig. 153 Turn the rotatable luminaire part by mouse pointer

You can also align the luminaire with articulated joint to C0-G0, C90-G0 or Imax. (see similar chapter Aligning Luminaires).

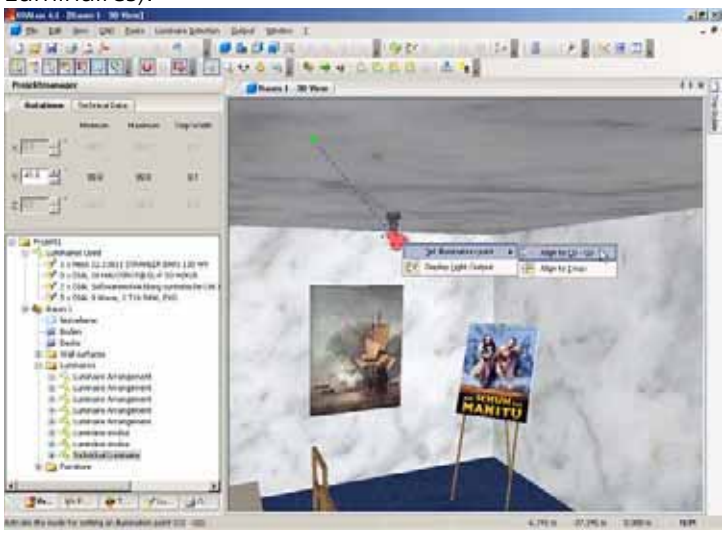


Fig. 154 Align the rotatable luminaire part

Unrestricted lighting arrangements

With DIALux you can position the luminaires individually, in a circle, in a line or in a field. You can then form them into groups to deal with them geometrically and/or as an electrical unit. Just add your desired luminaire arrangement to a new luminaire arrangement via context menu of the selected luminaire arrangement.

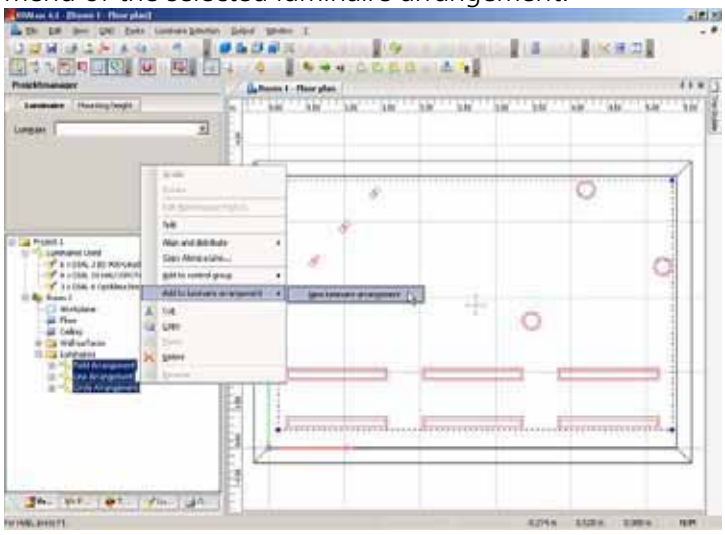


Fig. 155 Context menu of the unrestricted luminaire arrangement

You can modify these further by changing the name, position / rotate or modify the origin.

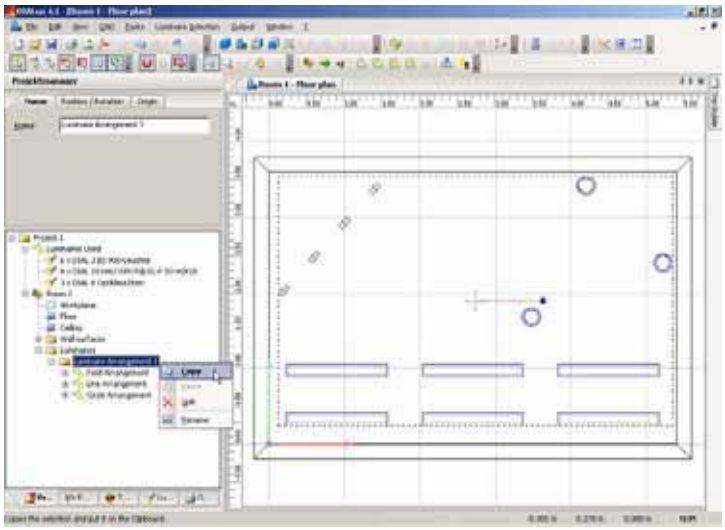


Fig. 156 Modify the new luminaire arrangement

You have the ability to copy and paste the whole luminaire arrangement in the context menu. If you want to take out individual luminaires of the new luminaire group, first of all you have to split the unrestricted luminaire arrangement. Then you can select the luminaire which should be removed from luminaire group and open the context menu. Now you can access the function *Remove from luminaire group*.

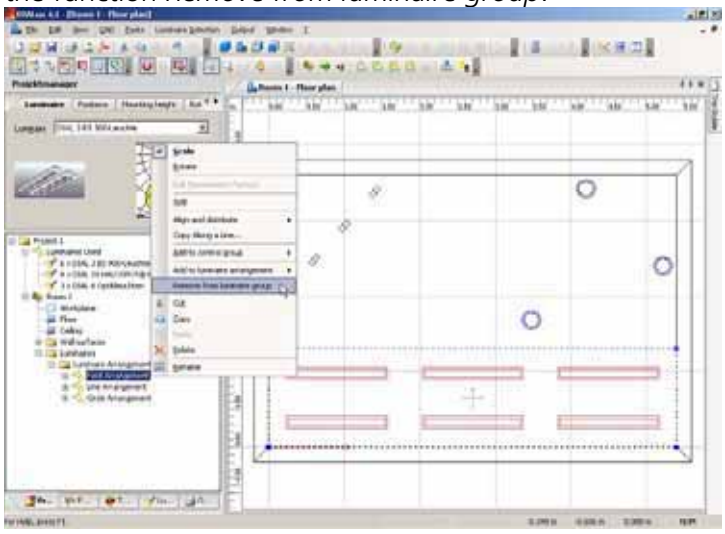


Fig. 157 Remove from luminaire group

Aligning luminaire arrangements

You can align to C0-G0, C90-G0 or Imax among individual luminaires also complete luminaire arrangements. To do this select the inserted luminaire arrangement (luminaire field, line or circle arrangement, unrestricted luminaire arrangement) and proceed with the context menu.

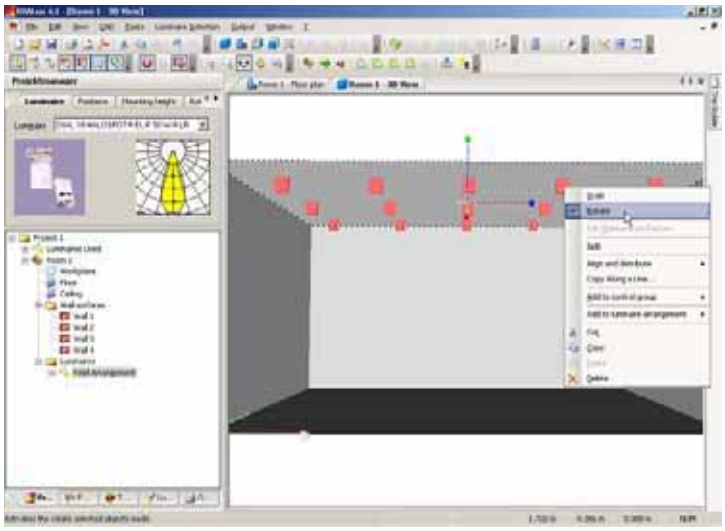


Fig. 158 Aligning luminaire arrangements – Context menu

Then the function *Set illumination point (to C0-G0 or C90 –G0 or Imax)* is activated and you can align the luminaire arrangements (see also chapter Aligning Luminaires).

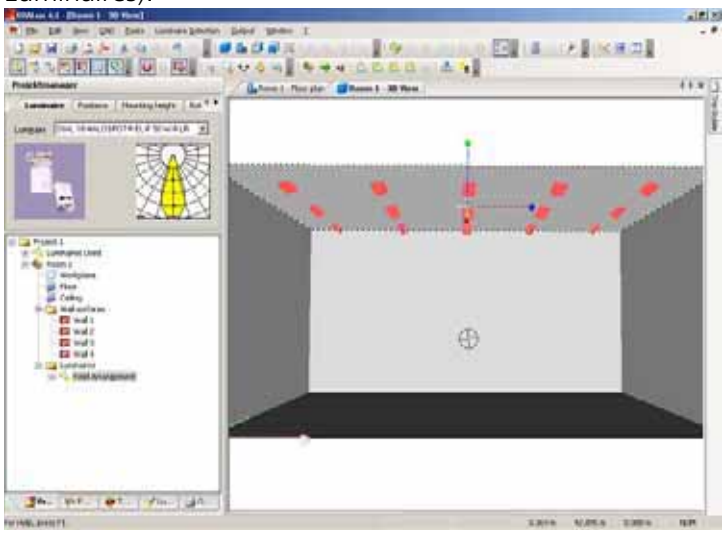


Fig. 159 Set illumination point – Aligned luminaire field

Calculation of luminaire geometry included

On request the user can now include luminaire geometry in the calculation. This is not necessary with normal surface-mounted or recessed luminaires. Extended pendant luminaires which emit light directly or indirectly may hang in their own shadow, perhaps making it necessary to consider the luminaire geometry.

Coloured light

Background information

Up to now DIALux only calculated "white" light. The amount of "light energy" distributed by the luminaire was defined by the luminous flux of the lamp(s) and the

light output ratio of the luminaire. The spectral distribution, the wavelengths of the distributed radiation was not taken into account. This approach is usually correct, because interior and exterior lighting design is mainly made with “white” light sources. Calculated values are totally correct, as long as only direct light is taken into account (without reflection). When reflected light has to be considered, the mistake made in the calculation can be serious. This depends on the spectral reflection of the material and the spectral distribution of the light sources.

Technical data of luminaires mainly describe the distribution of the light. Well known examples are the DIALux internal ULD format, CIBSE TM14, EULUMDAT, IES and others. The data describes the intensity of light from the light centre of the luminaire in defined directions . Unfortunately there is no information about the spectral distribution of the light from the light source given. Typically text informs the user which lamp is used e.g. T5 / 49W 830. The expert knows, that this is a triphosphor fluorescent lamp with a correlated colour temperature of 3000K and a colour rendering index greater than 80. The colour of light is now more or less described but not for a correct calculation. If light is to be calculated correctly including the colour information, it is absolutely necessary to know the spectral distribution.

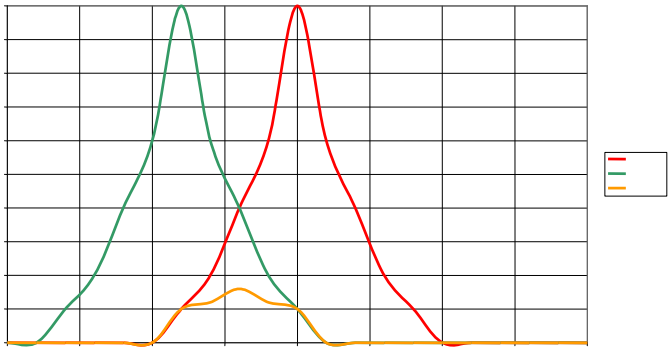


Fig. 160 spectral light calculation

In this diagram you can see the spectral distribution of the light source (green) and the spectral reflection factor of a material (red) in the visible spectrum. The reflected light from this surface would have the spectral distribution as shown by the orange line. Up to now, this effect was not taken into account by the calculation. For the light source the radiation was constant over the visible spectrum. The amount was defined by the luminous flux. For the material also the reflection factor was taken as constant over the visible spectrum.

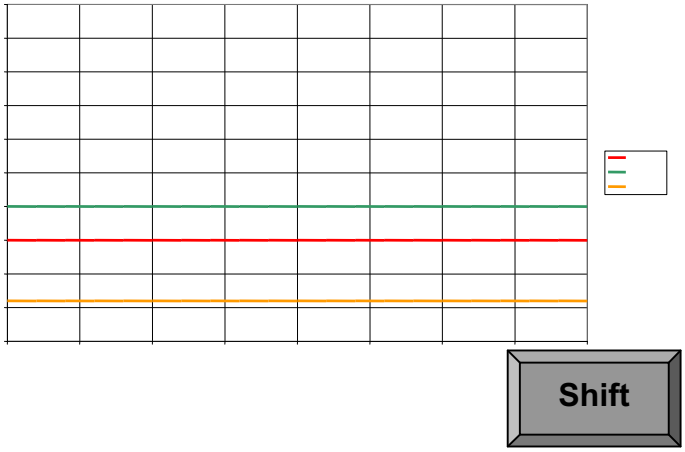


Fig. 161 non spectral light calculation

That this effect leads to serious errors calculating coloured light or coloured material is obvious.

DIALux can now take into account the spectra of light sources, the spectra of colour filters and materials. The luminous flux of the lamp is now distributed to the individual wavelengths according to the data given in the spectral distribution. Because of this the results are more accurate and the visualisation is improved. Now all colour effects can be displayed in the rendering.

Lamp spectrum / Light colours

Lamps can have a spectrum already defined in the luminaire PlugIn or in the lamp PlugIn. In that case, the user does not have to do any additional spectra selection to take colour into account in the light calculation. The luminaire manufacturers will add spectral distribution information to their products soon. Until that happens you can make use of the spectra included in the DIALux software.

In the colour tree of DIALux you can see the subfolder Textures, Colours, Light colours and Colour filter. While textures and colours are only for use with objects (room surfaces, furniture, …) the light colours and colour filters are for use with luminaires. The difference between light colour and colour filter is very important.

The light colour is the result of the spectral distribution of the luminous flux of the lamp. In the folder light colour there are three subfolders with specific spectral distributions for the black-body radiator, for standard

spectra and for common lamps. The common lamps are again divided into the incandescent lamps, fluorescent lamps and high pressure discharge lamps.

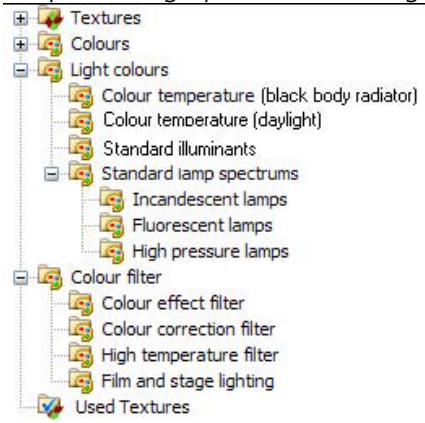


Fig. 162 Light colours in the DIALux colour tree

These spectra can be used for a lighting calculation. They can easily be dropped onto a luminaire. If a spectrum is selected, the inspector shows information regarding the correlated colour temperature, the spectral distribution and the colour rendering index.

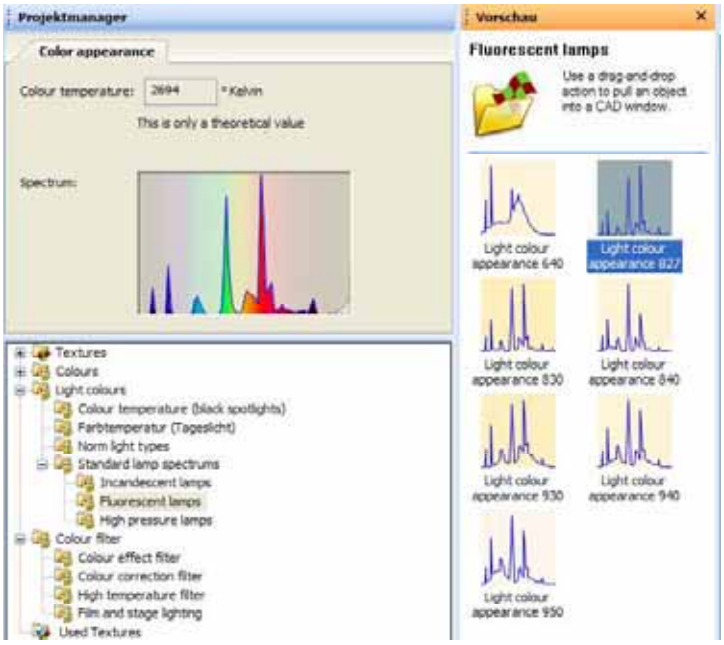


Fig. 163 Colour information for a selected spectrum

Selecting a spectrum in the colour tree, the inspector shows a graphical preview of the spectral distribution and a value for the correlating colour temperature. This value is only exact for a thermal radiator. The colour appearance of this spectrum is displayed as the background colour of the spectrum itself on the right hand side. A click on the lower right corner of the diagram in the inspector shows a preview of the CIE test colour samples illuminated with the spectral radiation of this light source. For each colour sample the colour rendering index is given and the Ra is also calculated.

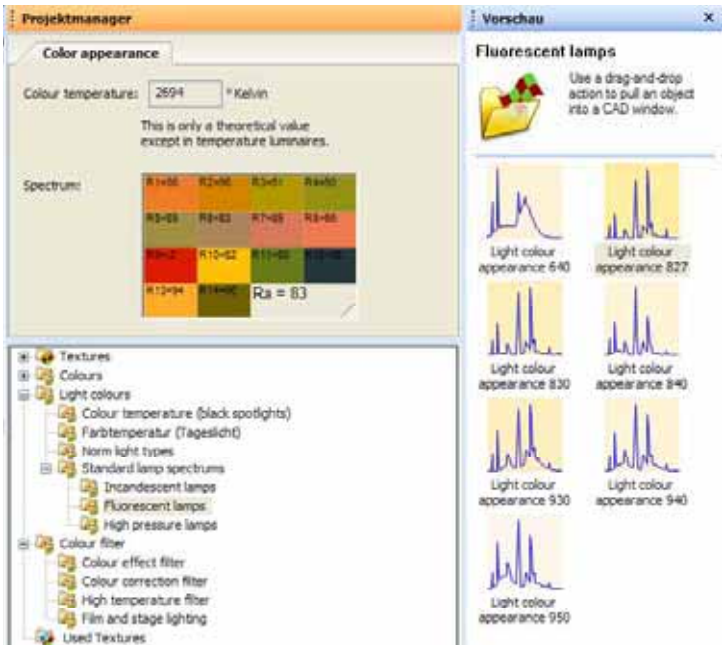


Fig. 164 Colour rendering indices of the CIE test colours (CIE 13.3)

The display is to specify the colour rendering and colour matching properties of light sources.

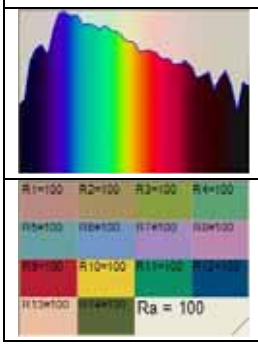
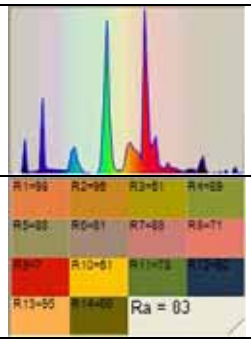
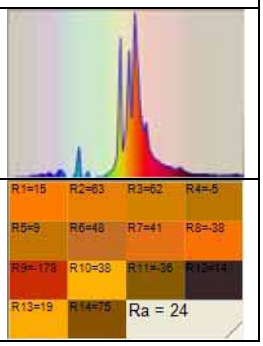
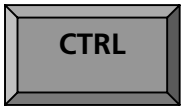
Standard illuminant D65 RA 100	Flourescent lamp warm white 830 RA 80	High pressure sodium RA 20
		

Fig. 165 Spectra and colour rendering properties of different light sources

The colour rendering index (CRI) (sometimes called Colour Rendition Index), is a measure of the ability of a light source to reproduce the colours of various objects being lit by the source. It is a method devised by the International Commission on Illumination (CIE). The best possible rendition of colours is specified by a CRI of one hundred, while the very poorest rendition is specified by a CRI of zero. The CRI is measured by comparing the colour rendering of the test source to that of a "perfect" source which is generally a black body radiator, except for sources with colour temperatures above 5000K, in which case a simulated daylight (e.g. D65) is used.

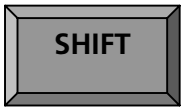
To add a light colour to all luminaires in a scene, hold down the CTRL key while drag and drop



To add a spectrum to a luminaire, just drag and drop it onto it. All luminaires within the arrangement (field, line, circle or single) get that spectrum. To add a spectrum just to a single luminaire within the arrangement, just

To add a light colour to just one luminaire in a scene,

hold down the SHIFT key while dragging and dropping it. The luminaires show the replacement of a spectrum with blinking for a short time and the light emitting surface will appear in the colour of the light source (if available including the colour filter). If you want to put a spectrum to all luminaires in the room or exterior scene, just hold down the CTRL key while you drop it on any luminaire.



Luminaires with rotatable elements can get a spectrum and filter for each light emitting object individually.

If you just drag and drop a filter onto a luminaire with adjustable elements, all the luminaires of the same arrangement and all light outputs will get the spectrum / filter.

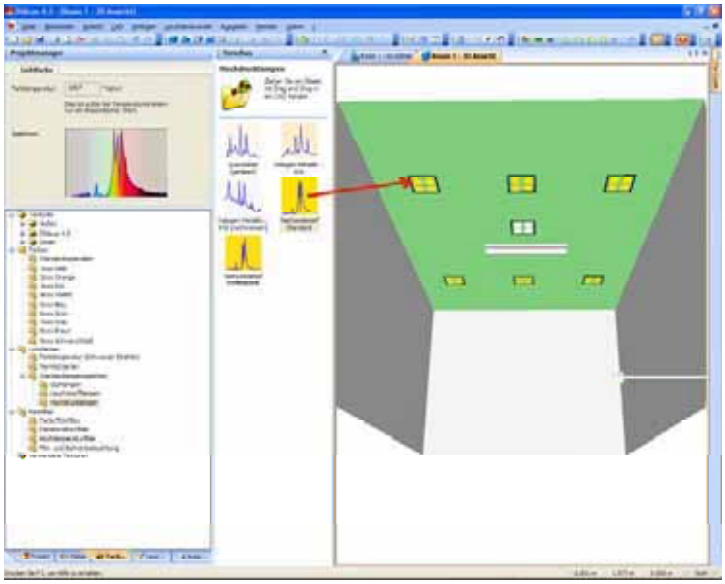


Fig. 166 Drag and Drop of a spectrum onto a luminaire with rotatable elements

The filter is not used on the luminaire of the same type which is in a single luminaire arrangement (in the middle) neither on the luminaire of a different type.

If you hold down the CTRL key while drag and drop the filter / spectrum, all luminaires and all light emitting elements get the spectrum. This includes those of a different type and in another arrangement.

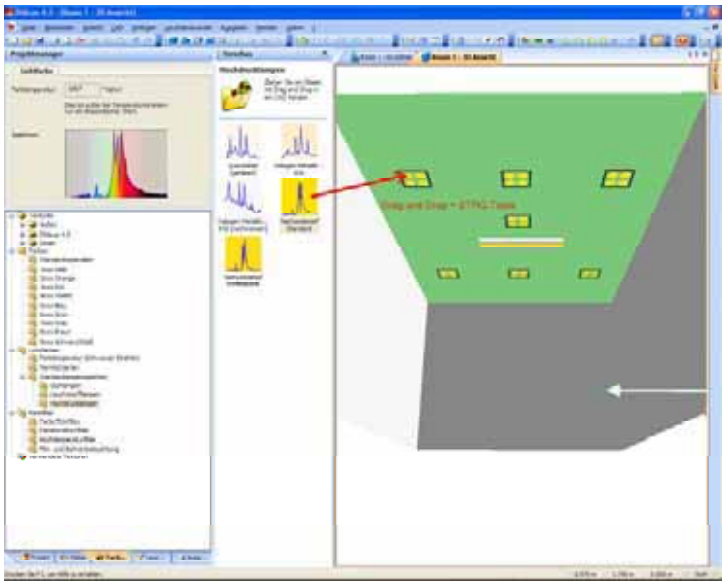


Fig. 167 Drag and drop of a filter / spectrum, while holding down the control key

IMPORTANT: Holding down the SHIFT key, makes only that light emitting element getting the filter that is picked by the mouse.

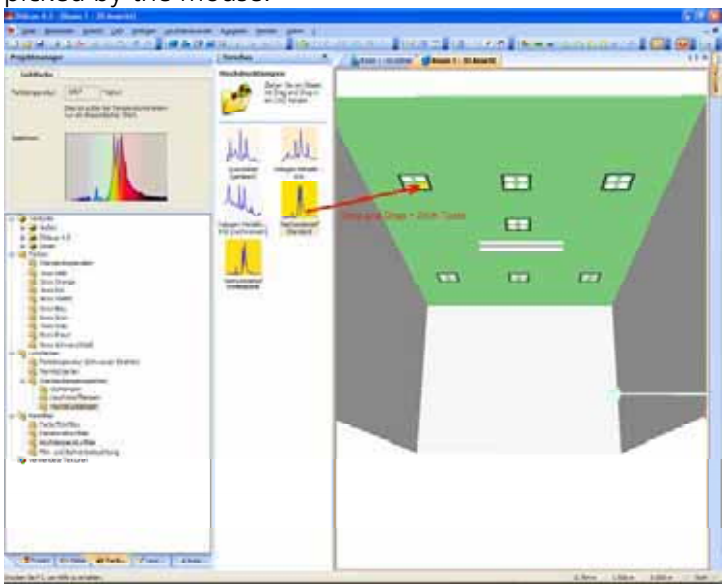


Fig. 168 Drag and drop of a spectrum / filter on a rotatable element of a luminaire while holding down the shift key

After a spectrum is added to a luminaire the Property Page "Colour appearance" tab displays the lamp spectrum, the filter spectrum and the resulting colour data. In the line "lamp colour" the name of the lamp spectrum is shown.

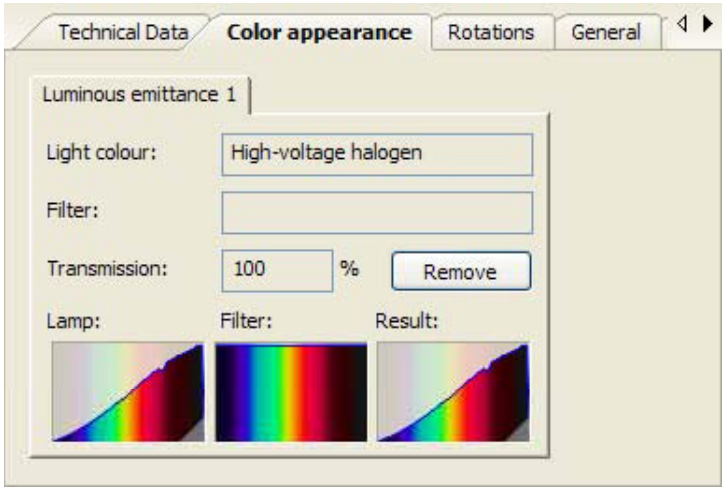


Fig. 169 Spectrum of the lamp, the filter and the resulting radiation. Click on the triangle on the bottom right to get the Ra values.

Colour filters

An optical filter is a device which selectively transmits light (often a particular range of wavelengths, representing a range of colours of light), while blocking the remainder. A filter can only block the specific unwanted range of wavelengths. The colour that the user wants to use has to be part of the spectral radiation of the light source. For example there is only a small amount of blue light in the spectral distribution of incandescent lamps. To get a high saturation of blue light another light source would be better.

In DIALux there are several hundred colour filters available. These are clear filters which had their spectral radiation measured in the photometric laboratory of DIAL. According to the usage of these filters they are stored in subfolders in the DIALux colour tree. The numbering is according to the numbering of the available product. In the preview you can see the colour appearance and the transmission factor when used with standard illuminant D65.

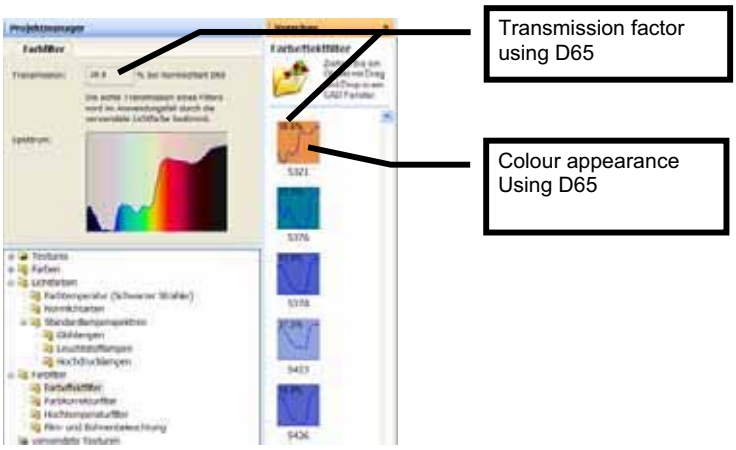


Fig. 170 Technical information of colour filter

To add a filter to a luminaire, just drag and drop it onto it. All luminaires within the arrangement (field, line, circle or single) get that filter. To add a filter just to a single luminaire within the arrangement, just hold down the SHIFT key while dragging and dropping it. The luminaires show the replacement of a filter with blinking for a short time and the light emitting surface will appear in the colour of the filter (if available including the colour of the light source). If you want to use a filter with all luminaires in the room or exterior scene, just hold down the CTRL key while you drop it on any luminaire.

Luminaires with rotatable elements can have a filter with each light emitting object individually.

Coaction of spectral distribution of the light source and colour filter

Most lighting calculation software has for each light source only one spectrum or even just a RGB value. But this is not enough for a professional lighting designer. The resulting colour is defined by the spectrum of the light source and the transmission spectrum of the filter.

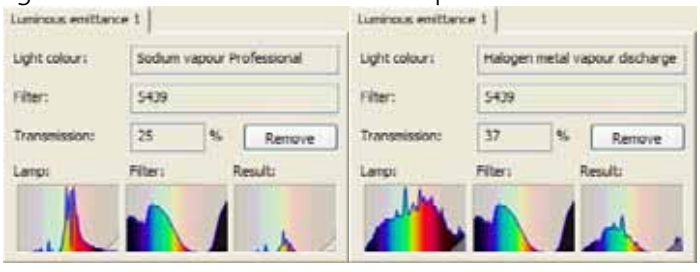


Fig. 171 Resulting spectrum of a luminaire with two times the same filter but different light sources

The two pictures above are from the Property Pages of two luminaires. In both cases the same colour filter was used. However the light sources are different, one is a high pressure sodium lamp and the other is a metal halide lamp. Of course the resulting spectrum is totally different. Also the transmission factor is different. The

transmission factor given for the filter at D65 is even higher at 41.6%.

Fig. 172 All the spots are using the same colour filter, but have different light sources. From the left: Incandescent, Flourescent 830, D65, high pressure sodium, metal halide ceramic and metal halide quartz

To get rid of a filter you can either click on the "Remove" button in the colour appearance Property Page or you drag and drop a "no filter" filter onto the luminaire. No filter is always in the top of the filter subfolders.

Light colours in the ray tracing

The used light colours and colour filters are automatically handed over to PovRay. There is no further setting necessary to use colours in the ray tracing visualisation.

White balance

The white balance is used to adjust the rendering on the monitor to the colour temperature of the lights in the scene. Digital and analogue recording of videos and pictures offer the option to use white balance to "correct" pictures. This imitates the ability of the human eye for chromatic adaptation.

Fig. 173 Four identical photos using different values for the white balance (Source: wikipedia, foto Thomas Steiner)

In the menu view you can select “Set white balance”. Selecting this function, you can choose different settings for using the white balance. Please keep in mind, that also your monitor has a setting for a white balance or at least for a colour temperature. These settings can counteract the software settings.

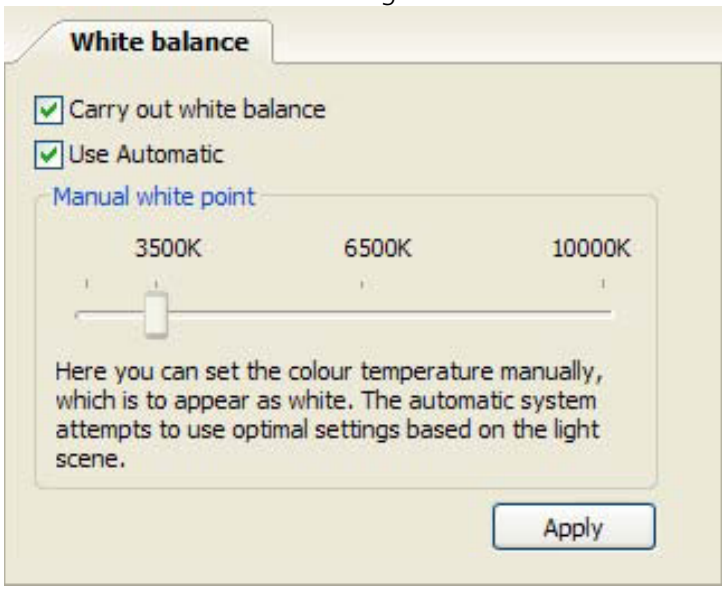


Fig. 174 Adjusting the white balance

Deselecting the checkbox “Carry out white balance” can make your rendering appear unrealistic and give a colour cast. We suggest using the automatic mode. If manual correction is necessary, switch of the automatic mode and adjust the slider to the colour temperature of the light in the rendering.

Light Scenes and Control Groups

Definition

DIALux supports the planning of dynamic light controls, e.g., on the base of DALI. There is the possibility to define luminaire groups, switch and dimming levels, to calculate light scenes, to visualize and to process the planning results for easy implementation. Light scenes define the changeable qualities of the contained control groups, as for example dimming levels, light colour, inclining and panning the luminaire and LDC. In light scenes groups of luminaire arrangements are called "control groups".

Requirements

Any luminaires can be added to control groups and also an individual luminaire can be included within an arrangement. Luminaires can exist in more than one control group. Light scenes can contain one or several control groups. Control groups cannot exist at the same time in the light scenes which contain the same luminaire. The complete light scene can be calculated as a whole or all necessary control groups of a light scene are calculated and the result can be changed afterwards interactively by changes in the light scene.

Generate a project with light scenes and control groups

Adding luminaire arrangement to control group

Insert a new room and adapt all settings in the accompanying Property Pages (see chapter Edit Room Data). Subsequent you can insert the luminaires which you would like to use in your project. Select those which you want to assign to a control group. If you have inserted a luminaire field, you should activate the function "Allow single luminaires selection", because the possibility exists to select single luminaires. DIALux offers the option to add your luminaire arrangement(s) to one or several control groups. In the menu → *Paste* → *Control group*, as well as in the context menu in the CAD window or in the *Project manager* you can add your selected luminaire(s) to a new or existing control group.

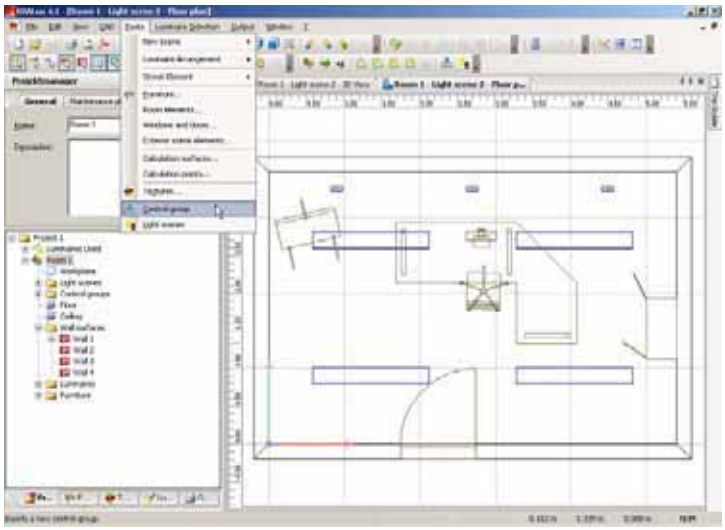


Fig. 175 Paste a control group via menu

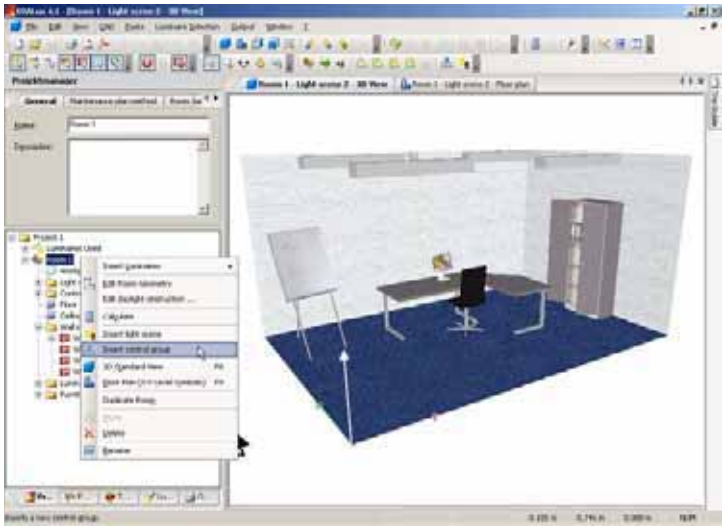


Fig. 176 Paste a control group – Context menu of the room

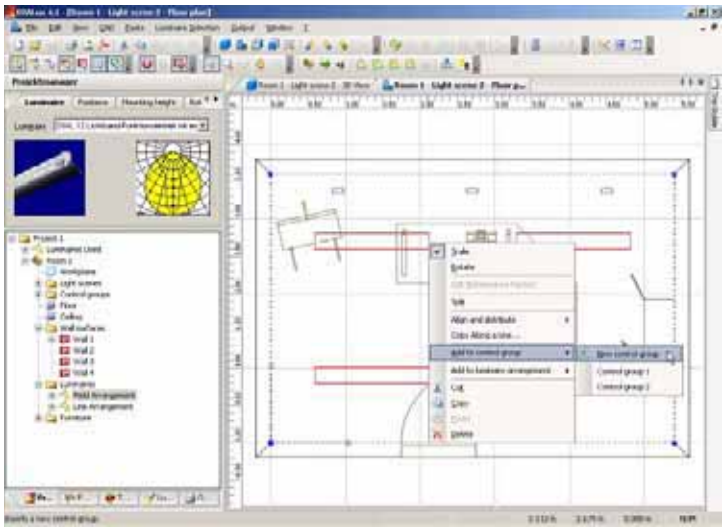


Fig. 177 Paste a control group – Context menu in the CAD view

Then in the *Project manager* the control group appears with a link to the luminaires. The control group has the Property Page *Name*.

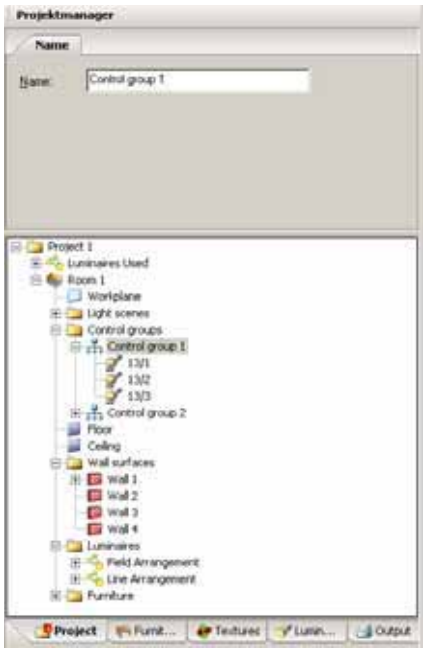


Fig. 178 Property Page of a control group

If luminaires are deleted, these are also removed at the same time from the appropriate control group, provided that these belong to a control group.

In the menu *Paste* you can insert a light scene in your project.

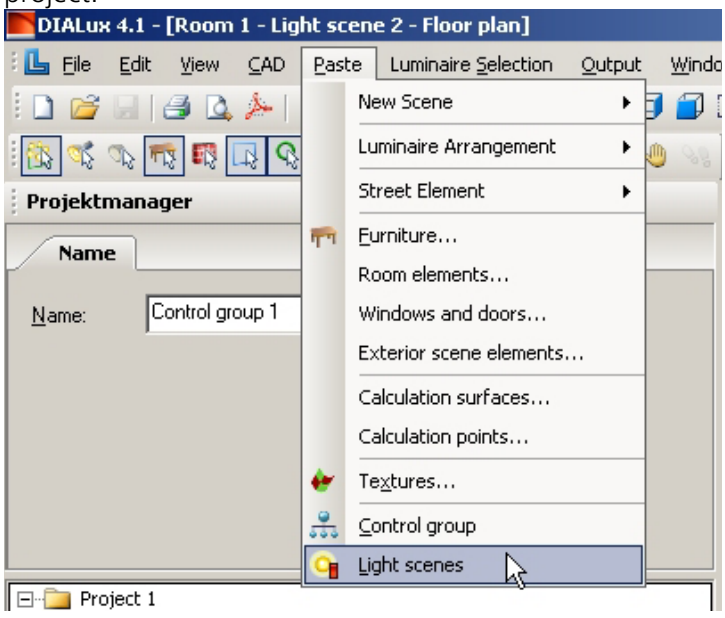


Fig. 179 Insert a light scene via menu

Alternatively you have the option to insert a light scene from the context menu of the room.

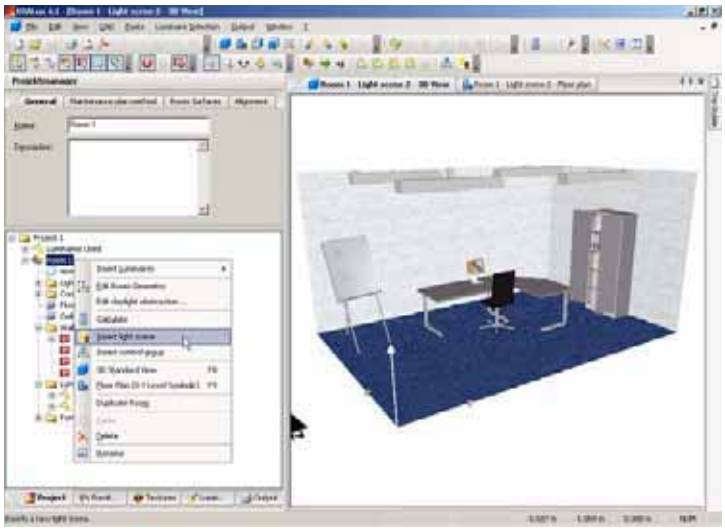


Fig. 180 Context menu of the room – Insert a light scene

If a control group was inserted already, you can access it by a right-click on the respective control group for the context menu and then add a new light scene. In fig 163 the suitable control group already exists.

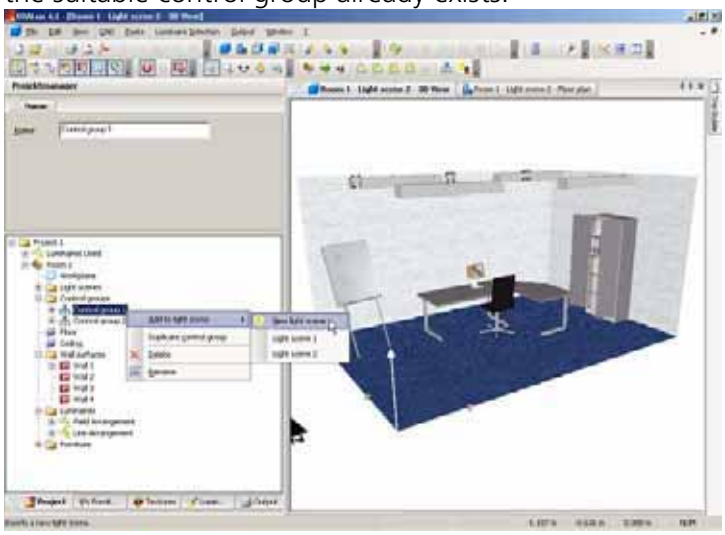


Fig. 181 Context menu control group – Add to light scene

If you select the light scene in the *Project manager*, the accompanying Property Pages open. The same happens to the control group available in the light scene. The Property Page *light scene* contains the name of the light scene which you can customise. DIALux has the option to define light scenes as an emergency light scene and to include the first reflection on the ceiling in the calculation (LG 12). You can make these adjustments in the checkboxes of the *light scene* Property Page.

Fig. 182 Property Page of a light scene – Light scene

The *Daylight factors* tab enables the determination of the position of the sun for the daylight calculation. You have the option to make various settings in the *Inspector* with respect to daylight. Activate the checkbox *Take daylight into account during calculation*, that way you include the daylight in your project. If the checkbox is deactivated, the room is calculated without daylight. Individual or all light scenes of a room can be calculated at the same time.

Fig. 183 Property Page of a light scene – Daylight factors

In the Property Page *Dimming values* the control groups with dimming levels are set in an editable list.

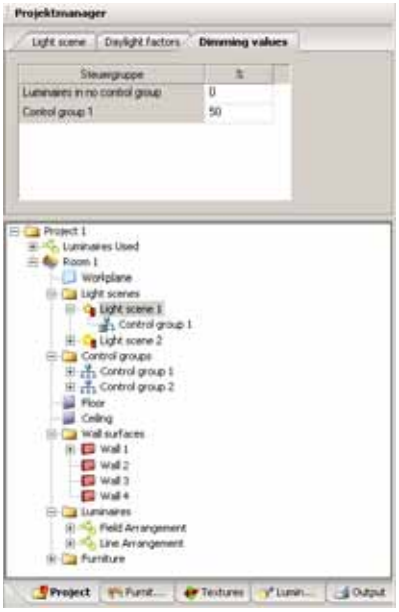


Fig. 184 Property Page of a light scene – Dimming values

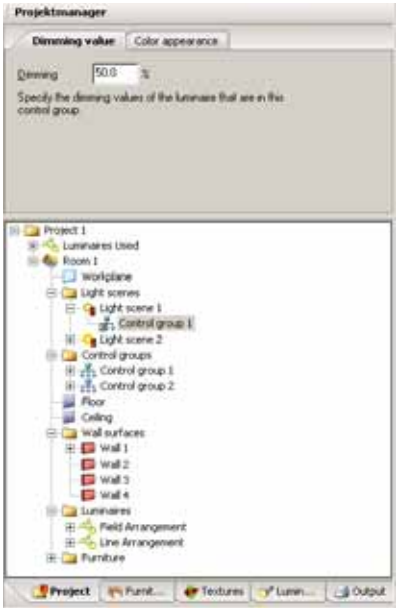


Fig. 185 Property Page of a control group – Dimming values

The user has the option to make set dimming levels of the used luminaires visible in the CAD view and to edit in the appropriate Property Pages. By means of the icons in the menu bar the dimming levels can be switched on and off. Also there is the option to change between individual light scenes with the arrows, provided that several light scenes exist.

Fig. 186 Icons for showing dimming values and light scenes in CAD

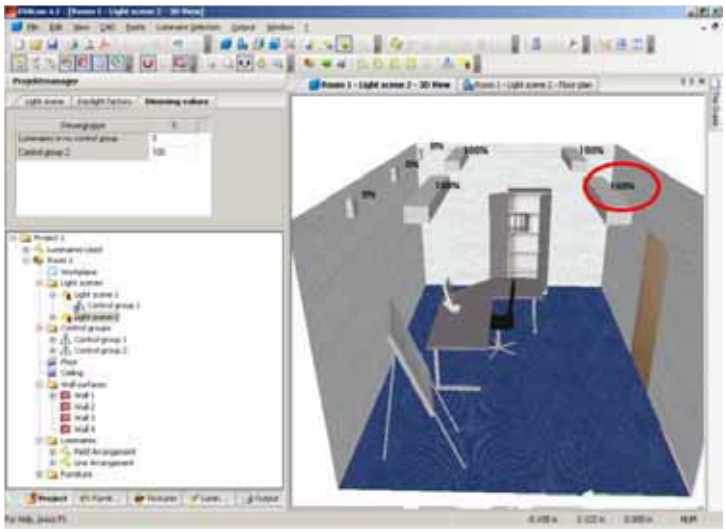


Fig. 187 Viewable dimming values in CAD

If luminaires with more than one light output are used, the dimming values for each light emitting object (LEO) can be adjusted separately. In the Property Page of the control group in the lighting scene, you can define the dimming values for each LEO. This dimming value will be multiplied with the dimming value of the control group.
Example:
The control group will be dimmed to 100%. In this control group there is a luminaire with independent direct and indirect light output. The direct light should be switched off, the indirect light should be completely on.
Settings:
Dimmingvalue of the control group: 100%

Light output direct: 0%
Total: 100% x 0% = 0%

Light output indirect: 100%
Total: 100% x 100%= 100%

If the indirect light should be dimmed to 50%, you can either dim the control group or the LEO.

Either:
Total: 50% x 100% = 50%
Or
Total: 100% x 50% = 50%

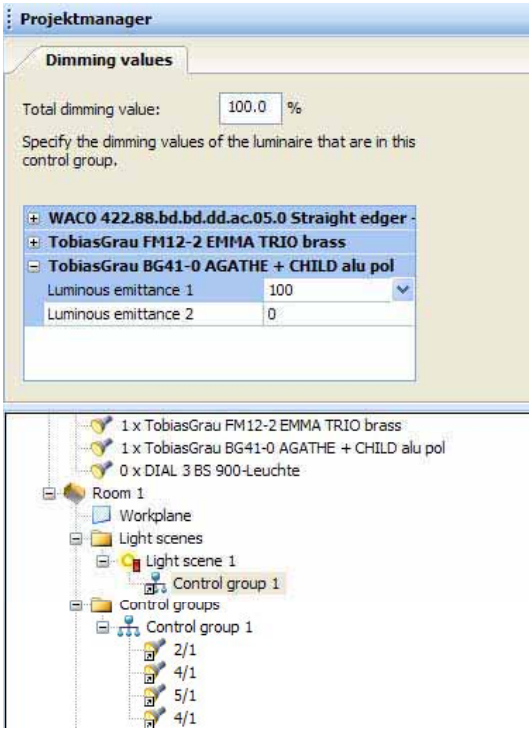


Fig. 188 Dimming individual light outputs separately

If no light scene is inserted in the room, only the room is calculated as before.

Modify light scenes and control groups

You have the potential to duplicate light scenes as well as control groups. In this manner the task is made easier for you if the same lights with different dimming levels are to be used. You can find this function in the context menu of the light scene or control group.

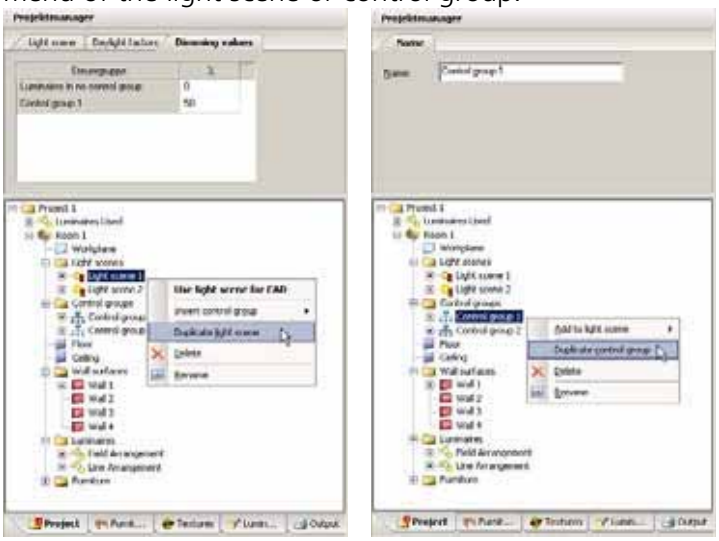


Fig. 189 Duplicate light scene or control group

The function of brightness distribution in the calculated room can be accessed in the menu *File* → *Settings* → *Adjust Brightness*

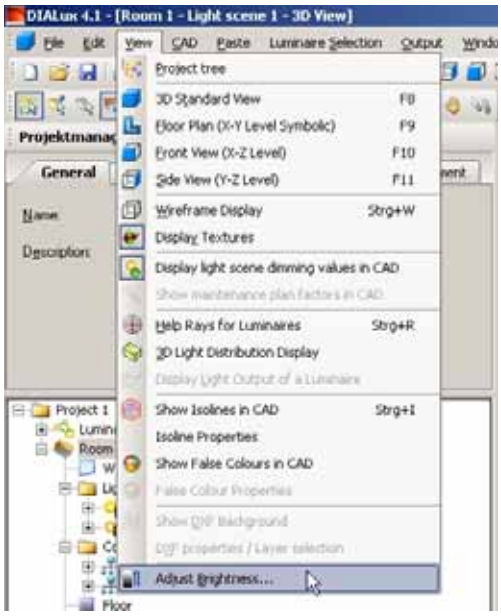


Fig. 190 Adjust brightness via menu

or in the context menu within the CAD window.

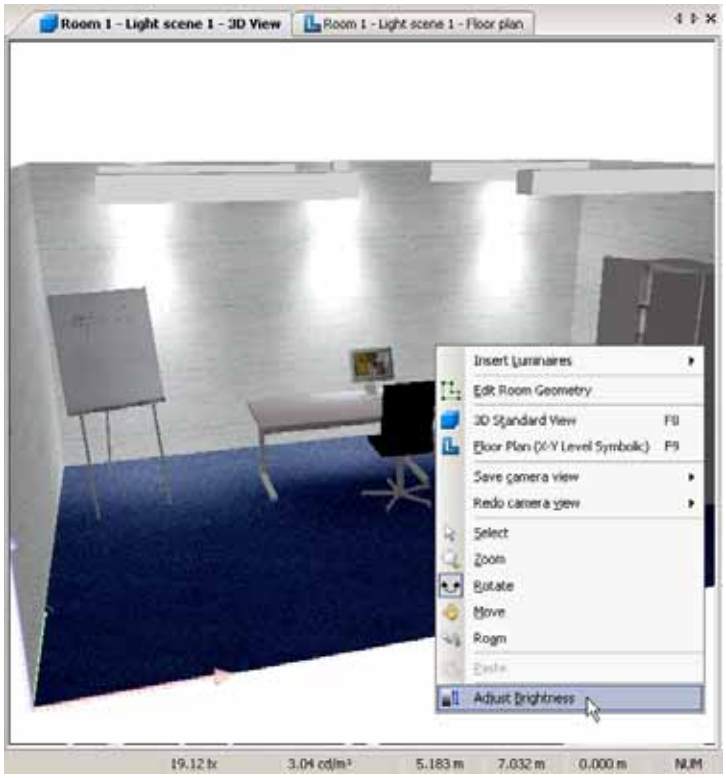


Fig. 191 Adjust brightness – CAD window

The Property Page *Brightness* allows the setting of the brightness distribution in the room. After you have shifted the brightness control in the desired position, click on the *Apply* button, so that the currently displayed window can be refreshed in your 3D Rendering.

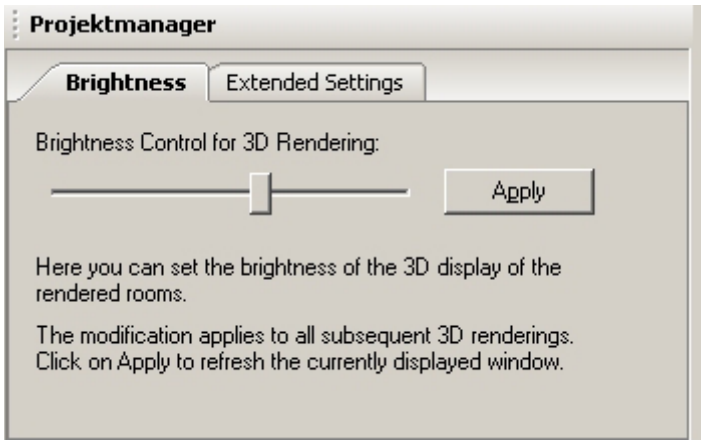


Fig. 192 Brightness control for 3D rendering

In the *Extended Settings* tab you can correct the exposure time of the CAD. Additionally you have the option to optimize light scenes together by means of the checkboxes.

Light scenes can be optimized together

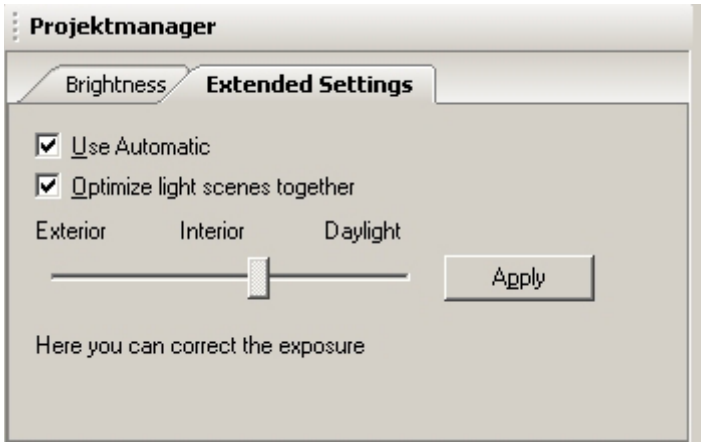


Fig. 193 Extended settings

Export of light scenes

Export light scenes in *.dlc format

Now DIALux offers the option to export light scenes in the *.dlc format (**D**IALux **L**ight **C**ontrol). You find this function in the menu *File* → *Export* → *Save DIALux light scene file*…

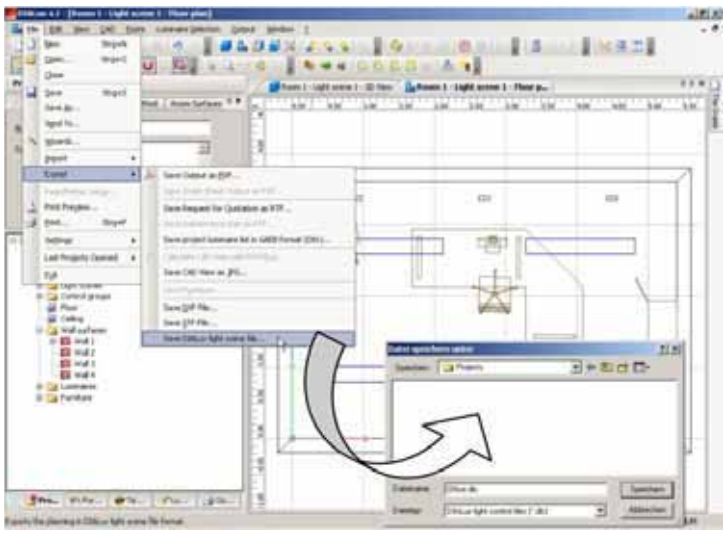


Fig. 194 Export of light scenes

Emergency lighting

Global

Emergency lighting can be calculated according to the European standard EN1838. In the introduction of the standard EN 1838 on page 2 it is stated that only the direct light has to be taken into account and not the reflected (indirect) component for the calculation of the emergency lighting scene. Also the special regulation of the Lighting Guide 12 (LG12) from the SLL in the UK, that the first reflection of direct light onto a ceiling is selectable for the calculation. In DIALux additional calculation methods are required for escape route lighting and open area lighting.

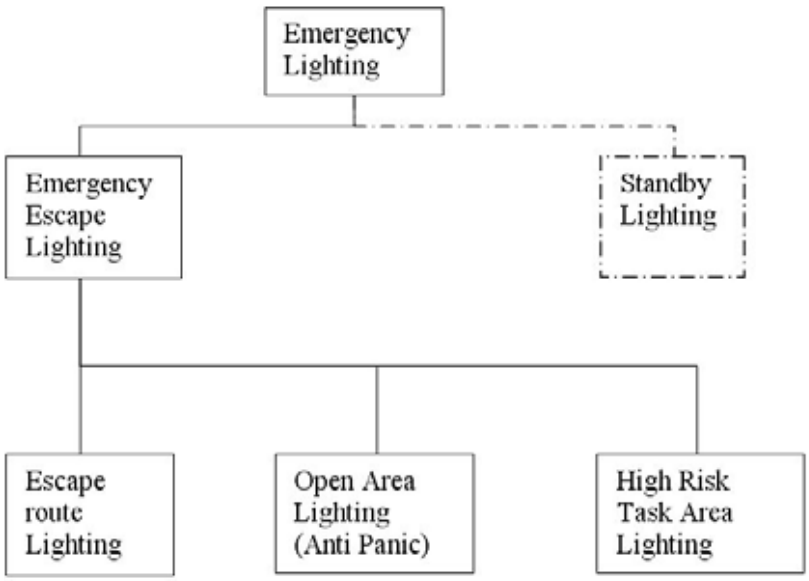


Fig. 195 Types of emergency lighting

Standby lighting is calculated like a regular lighting design. The option to do an emergency escape lighting design is available when a lighting scheme is inserted into a DIALux project and it is set to an emergency lighting scheme. Because the emergency situation and lighting is often integrated into a regular lighting design and realised with luminaires which are in use also for the regular lighting, this reduces the work the designer has to do. You are able to select those luminaires, which are used for emergency lighting from all the luminaires placed in a room and you can also place additional luminaires which are only used in an emergency. Such luminaires, which are only used in the emergency case, are not taken into account in the “regular” lighting calculation. But these luminaires are placed and they are listed for the outputs to locate them for the commissioning. You can select for each luminaire whether it is used in the regular lighting, in the

emergency lighting only or for both cases. The duration time and the luminous flux can be set for the emergency case. The dimming of luminaires and taking daylight into account in an emergency lighting scheme is of course not possible.

To create an emergency lighting scheme you just have to select the desired room and make a right click to add a lighting scheme.

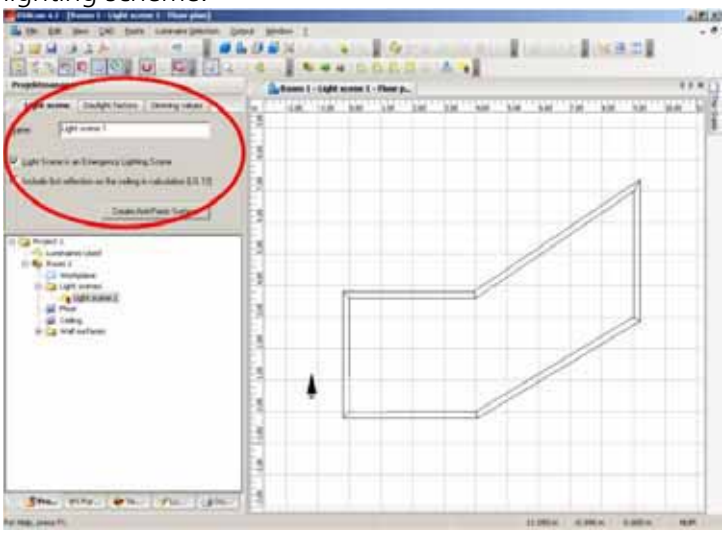


Fig. 196 Emergency lighting scene

If you want to design an emergency lighting project for the UK market, it will be possible to define here the calculation according to Lighting Guide 12, to take into account the first reflection of direct light on the ceiling(s). This, of course, will be automatically switched on if the user selected the standard settings according the UK market (global options, like UGR SHR and illuminance quotient).

You can define for each light emitting object whether it is used for emergency lighting.

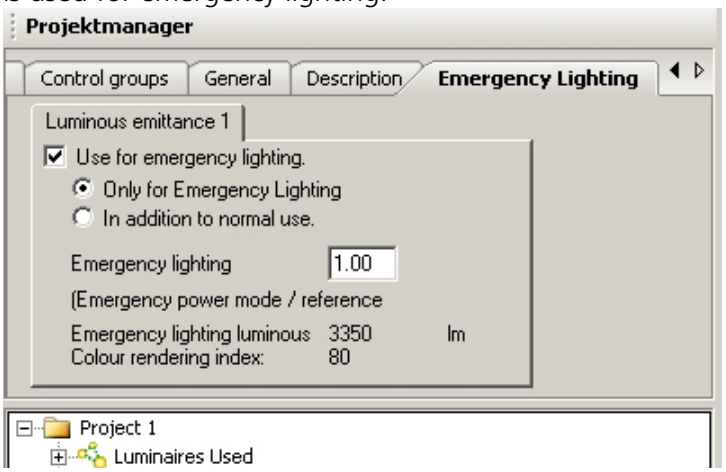


Fig. 197 Property Page of emergency lighting

For each luminaire and each LEO (Light emitting object, a luminaire may have more than one light output) of a

luminaire, there will be a luminaire data sheet for emergency lighting available. This datasheet offers important information about the LEO. The first one will be a graphic for the "Disability Glare Zone". In this graphic the maximum intensity values of EN1838, Table 1 will be listed and in two sketches the maximum intensity values of the LEO for the "flat floor" and for the "uneven floor" will be given. The second graphic / table will show the maximum distances for the mounting of the luminaire to achieve a desired illuminance (for example 1 lx). It will list several mounting heights (2m up to 5m) and the mounting options: wall to transverse, transverse to transverse, transverse to axial, axial to axial and axial to wall.

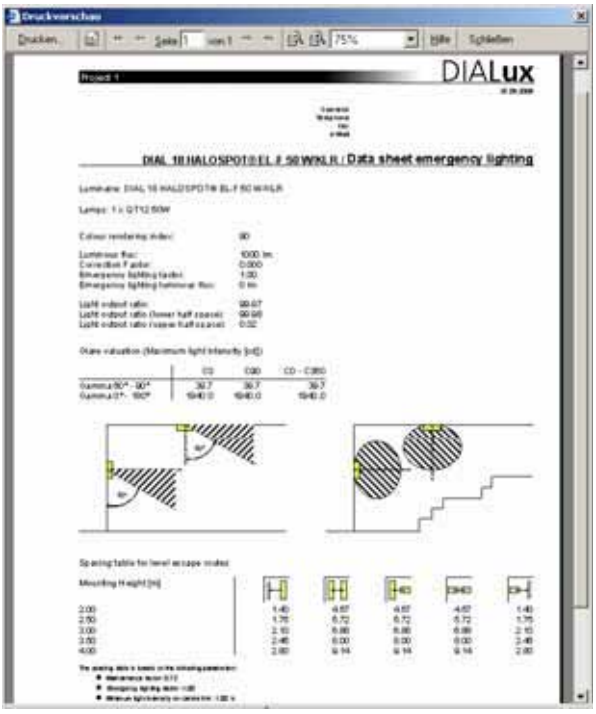


Fig. 198 Output – Emergency lighting data sheet

Escape route lighting

To do an escape route design, you have to insert one or more escape route calculation object(s). The escape route can be edited by entering the coordinates or by moving with the mouse. With a right click additional points can be inserted to add a kink to the escape route. The width can be set to a maximum of 2m.

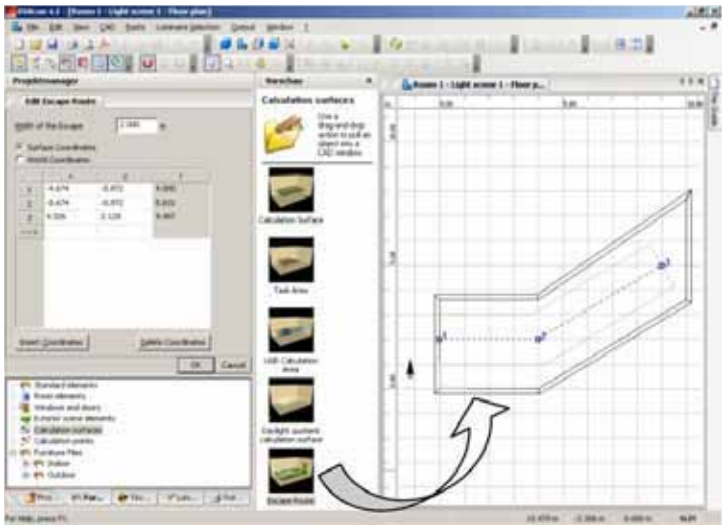


Fig. 199 Emergency lighting – Modify escape route

The surface is placed on the floor but you can move it around freely. After placing these escape route object(s) a luminaire has to be selected. With a right click on the escape route, a luminaire arrangement of single luminaires can be placed above the escape route.

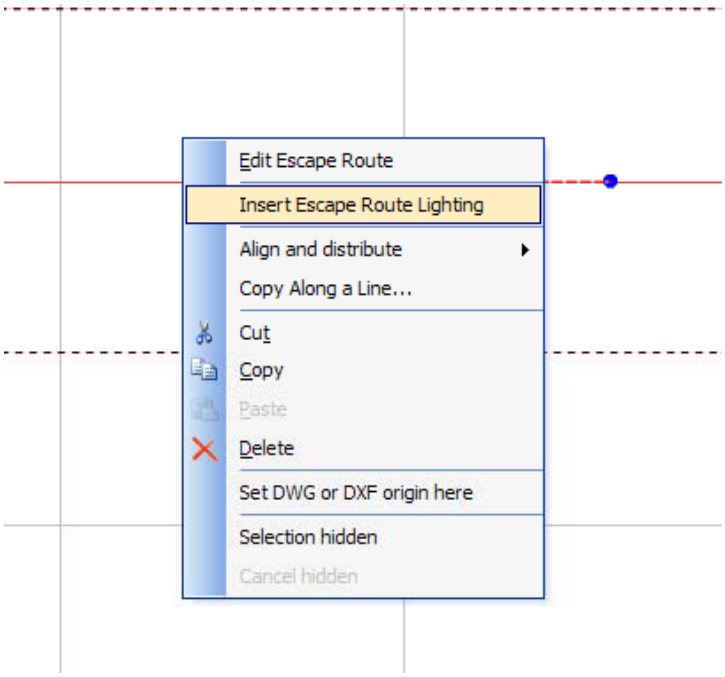


Fig. 200 Emergency lighting – Insert escape route lighting

You can select the luminaire you want to use, you can define the luminous flux, which LEO to be used (if there is more than one) and you can define a desired illuminance level to be reached on the escape route. The maximum distances for the first luminaire and between the luminaires are calculated and used for the positioning of the luminaires. Also you can select if there should be luminaires in the positions of the kinks of the

escape route. If necessary, there can be more than one escape route and luminaire arrangement in a room.

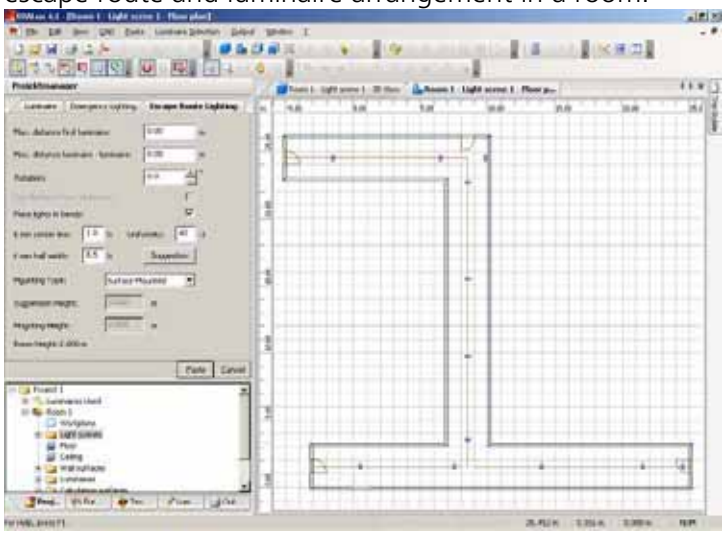


Fig. 201 Escape route lighting

Before the escape route with the escape route luminaries is planned, normally the positions of luminaires are also defined by the positions of "MANDATORY POINTS OF EMPHASIS". Initial design is conducted by situating luminaires to reveal specific hazards and highlight safety equipment and signs, in addition to providing illumination to assist safe travel along the escape route. This should be performed regardless of whether it is an emergency escape route or an open (anti-panic) area. As seen in this visualisation, the manufacturer can use real 3D models for the visualisation of its luminaires.

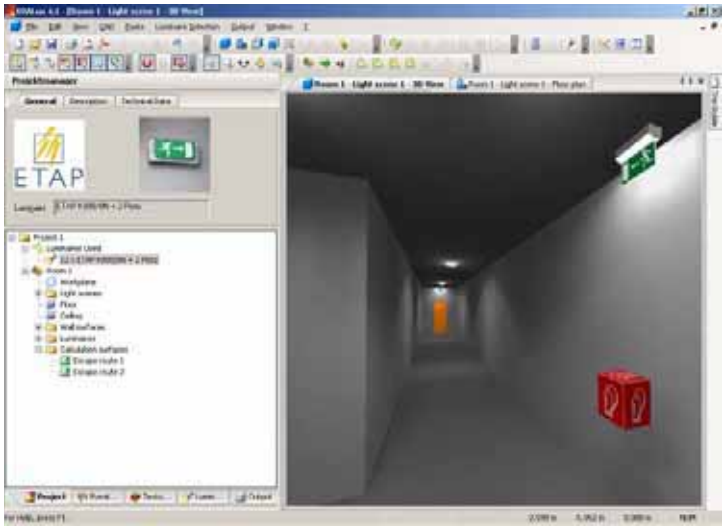


Fig. 202 Escape route lighting – Visualisation

Open area lighting (anti panic)

Open area lighting can be automatically prepared by inserting an emergency lighting scene. In the Property Page for the lighting scheme there is a button to insert "anti panic calculation surfaces" on each piece of floor in the room, even if the floor is tilted or consist of areas

in different heights. The geometry is copied from the floor minus 0.5m from the walls. It is also possible to edit the surfaces manually.

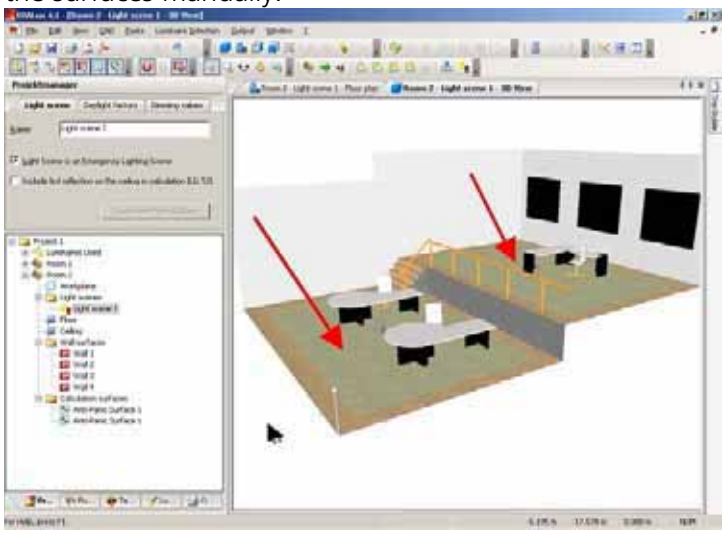


Fig. 203 Open area lighting

The way to insert an open area luminaire arrangement is similar to that in the escape route lighting. A right click on the open area calculation surface opens the Property Page for the luminaire arrangement.

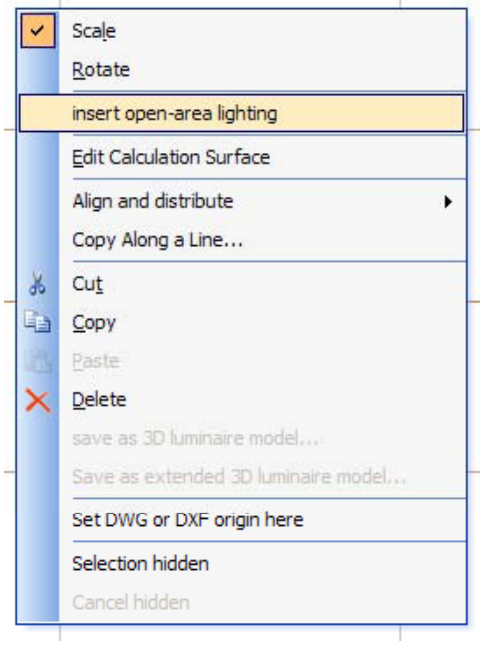


Fig. 204 Insert open area lighting

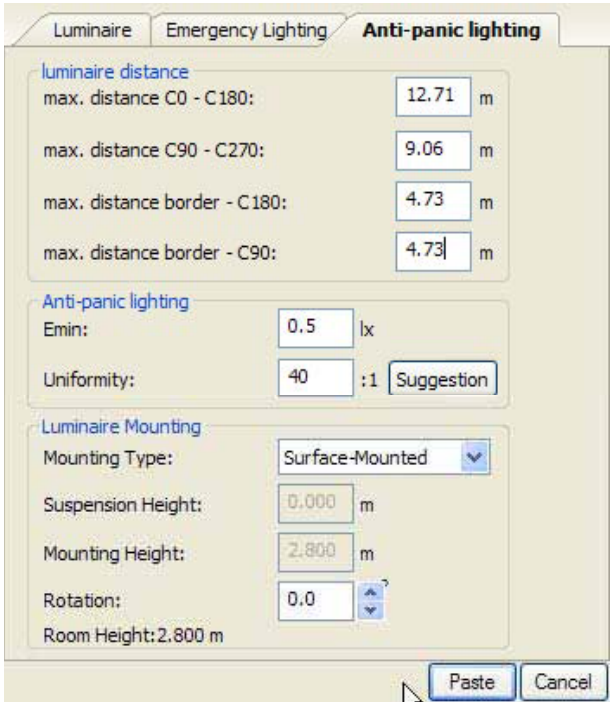


Fig. 205 Properties of the open area luminaire arrangement

This tool calculates the maximum distance for the selected fittings taking into account the desired minimum illuminance level and uniformity. You can see here the maximum distance lengthwise and crosswise between the luminaires and between luminaires and the border of the open area calculation surface. The arrangement will be placed symmetrically above the open area surface.

To calculate the “open area” which means the unobstructed floor, you have to select in the calculation setting not to take the furniture into account.

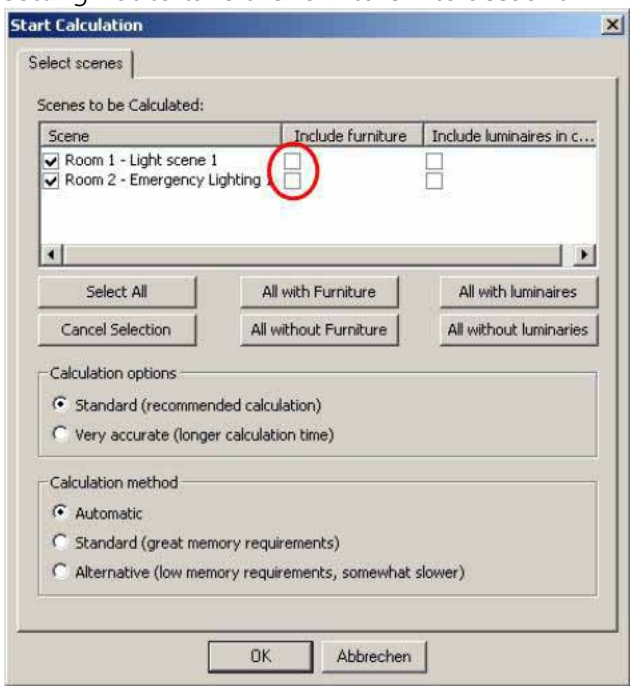


Fig. 206 Calculation dialogue – Without furniture

Those luminaires, which are in use for emergency lighting, are marked with the expression “emergency luminaire”.

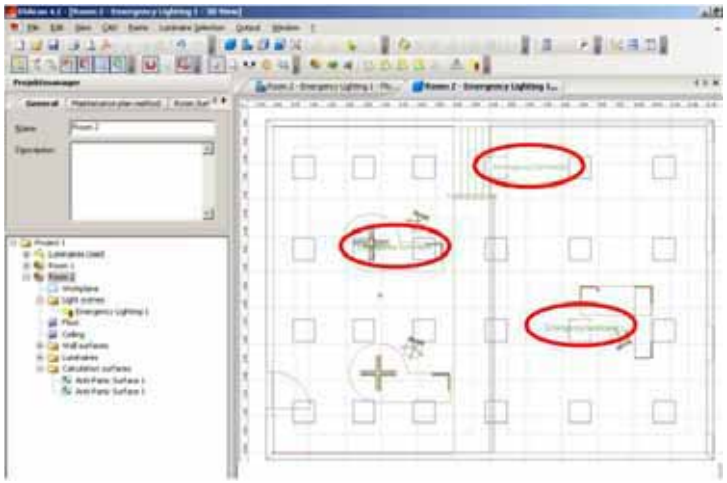


Fig. 207 Emergency luminaires in the CAD view

High risk task area lighting

For the high risk task area lighting, you can use the regular task area calculation surface of DIALux. It contains of the task area(s) and the surrounding area. The calculation surface will be calculated in the emergency lighting scheme as well as the other calculation surfaces.

Luminaires with emergency lights

A luminaire can transfer the information of several light emitting objects. These LEO can also be defined as “emergency LEO”. These emergency LEOs are only used for the emergency lighting calculation. From version 4.2 of DIALux these emergency LEOs will be used by DIALux for the emergency lighting calculation. A “regular” LEO can also be used for the emergency calculation. Often “normal luminaires are equipped with battery packs or they are connected to a central battery. So in the emergency case the “regular” light distribution curve is used for the calculation. Maybe the luminous flux is different. In DIALux a single luminaire can be picked and the settings to use it in the emergency lighting calculation can be defined.

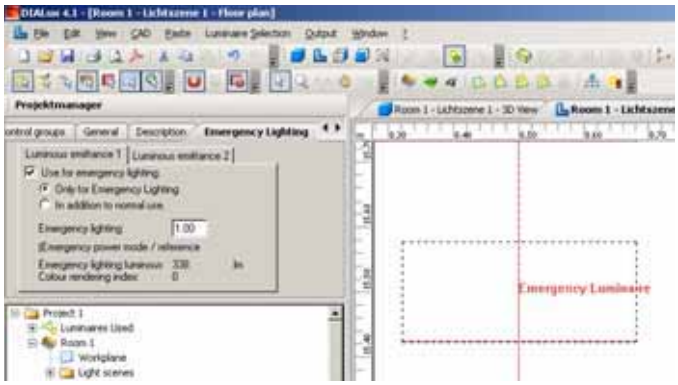


Fig. 208 Emergency lighting – Inspector

You can define here if the luminaire has to be used for the emergency calculation. Also you can define if it is used only in the emergency case or for the normal lighting. The luminous flux for the duration time can be edited here.

The emergency LEO is designed to handle a light distribution curve which is different from the regular LDC. There are for example fluorescent lamp luminaires on the market which have an incandescent lamp or a LED included for emergency lighting. In these cases it would be possible to use the fluorescent lamps LDC for the normal lighting situation and the incandescent lamp or LED LDC for the emergency lighting.

Emergency lighting data sheet

One element of good lighting design is of course complete lighting documentation. In accordance with prEN 13032-3 DIALux also provides evaluation of emergency luminaires with regard to glare and optimal positioning in the form of a data sheet.

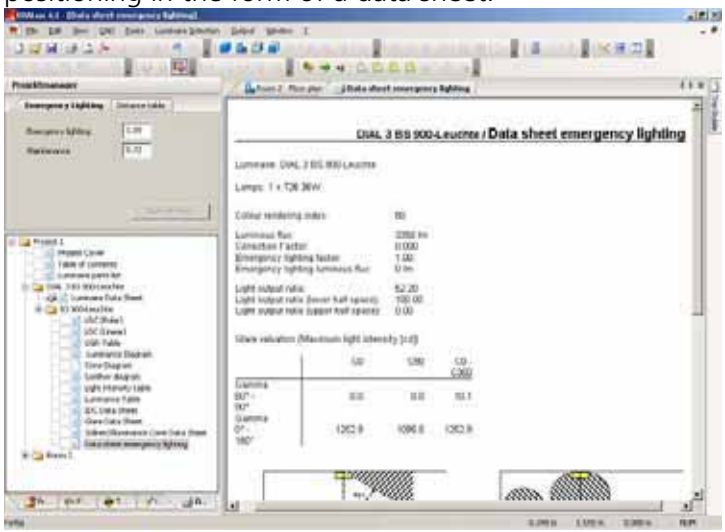


Fig. 209 Emergency lighting data sheet

Daylight calculation in DIALux

DIALux is complemented by the extensive support of daylight calculations. Now daylight scenes can be inserted in your project allowing the influence of daylight in the interior and exterior scenes to be simply calculated. The different sky models (clear, overcast, partially overcast), as well as the direct sunlight influences the calculation. Of course location, time and alignment, as well as the daylight obstruction are taken into consideration with the calculation.

Basics

Since the introduction of version 4 DIALux can calculate daylight. No special mode is necessary for this. In exterior scenes daylight can be calculated basically, and in interiors whenever windows or skylights exist in the room. As a base for the calculation the DIN 5034 and the CIE publication 110 were used. The sky dome is divided into parameterised luminous surfaces, which get a luminance depending on the sky model, location, date and time. By the option "use direct sunlight" it is also calculated with the sun as a light source. The calculation occurs in the following steps:

1. Calculation of the skylight on all surfaces (inside and outside)
2. Calculation of the direct sunlight on all surfaces
3. Calculation of the direct light of luminaires (if available)
4. Calculation of the indirect component

DIALux does not differentiate between inside and outside calculations, all surfaces are simply used for the radiative interchange. If you want to do a daylight calculation in DIALux, a suitable light scene must be inserted.

Sky types in DIALux

The sky types in DIALux correspond to the CIE 110-1994 "Spatial Distribution of Daylight - Luminance Distributions of Various Reference Skies". Thereby a luminance is assigned to every point of the sky. The luminance depends on the solar height, the solar azimuth, the sky point height and the sky point azimuth.

Tab. 1 Sky types according to CIE 110-1994

	Overcast Sky	Averaged Sky	Clear Sky
CIE-Name	Overcast Sky	Averaged Intermediate Sky Developed by Nakamura, Oki et al.	Clear Sky
Description	Complete Overcast Sky, rotationally symmetrical luminance distribution	Developed from a long period of measurements, described average weather conditions	Cloudless Sky
Direct sun possible	No	No	Yes
Number of possible zenith luminance	3	1	8
In DIALux used zenith luminance	Krochmann		Krochmann

Light Scenes

DIALux offers the possibility to define light scenes in a project. For this a light scene is inserted within the room or the exterior scene by right-click or insert-menu. In light scenes luminaires can be provided individually or as control groups with dimming levels. Likewise a daylight situation can be defined.

Fig. 210 Specify dimming values of the control group

To accomplish a daylight calculation, a light scene must exist in the room.

Daylight calculation

If a project is started, the global position must be defined first.

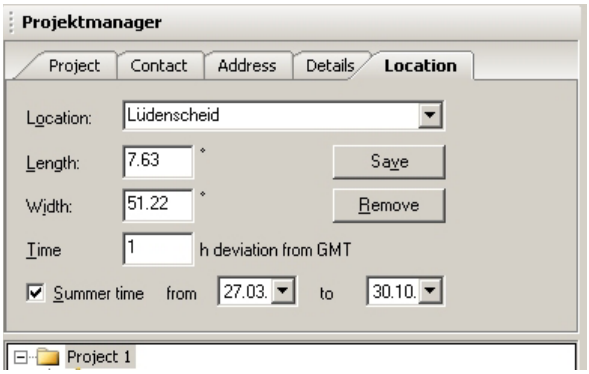


Fig. 211 Select the location

Here the user can select any location. DIALux offers a very long list of places on all continents, so that the inputs are already filled for longitude and latitude as well as time zone. Other places can be added arbitrarily.

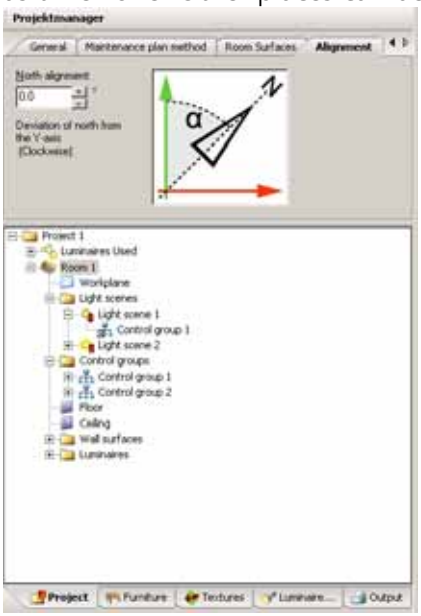


Fig. 212 North alignment

The north direction can be defined in each case for the room or the exterior scene. To recognize this easily, the north arrow is drawn near the coordinate origin.

In the room windows or skylights must be included in the plan as before. These can be easily placed as a line or field if one uses "Copy along a line" function.

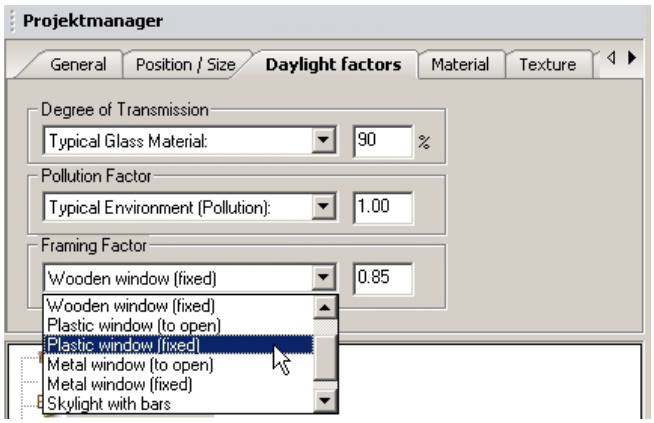


Fig. 213 Edit daylight factors

Of course all the important parameters can be defined for windows and skylights. As usual DIALux already includes a selection of the most current choices.

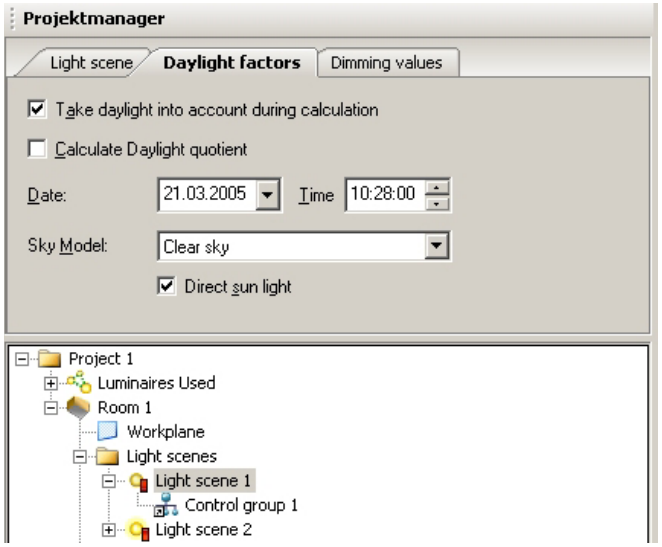


Fig. 214 Daylight factors

To calculate a light scene with daylight, the necessary calculation options must be put in the light scene. If the checkbox "Calculate Daylight quotient" is activated, the settings are made accordingly:

- Sky model of overcast sky
- No sun
- No consideration possibly of available luminaires

As a result you get as usual a calculation including visualization, and in this case, the output of the daylight quotient as a component of the work plane. If you want to know the daylight quotient at other positions, you can insert suitable calculation surfaces or calculation points.

In the following figure the value chart of the work plane is displayed. Currently (beta version) it doesn't show the daylight quotients, but just the illumination in the suitable positions. Also the outputs for D_{min}, D_{max} and D_m need to be shown as percentage values.

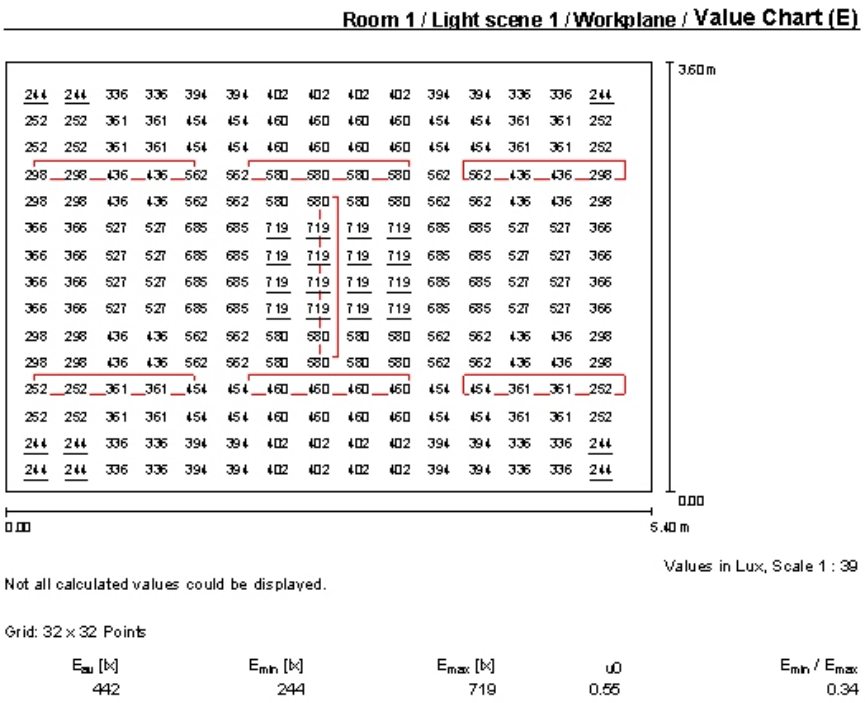


Fig. 215 Output – Value chart of the workplane

Obstruction

Of course the obstruction can be also taken into consideration in DIALux. For this it is also necessary to define this in the CAD. By the selection "Edit daylight obstruction" in the menu Edit or by right-click on the room the obstruction can be inserted. In the obstruction scene the room is shown in its exterior view. Now objects can be planned arbitrarily round the room. Also the room can be raised if it necessary, e.g., a room in a higher floor. The obstruction shades the direct light as well as the reflected light which hits the obstruction objects.

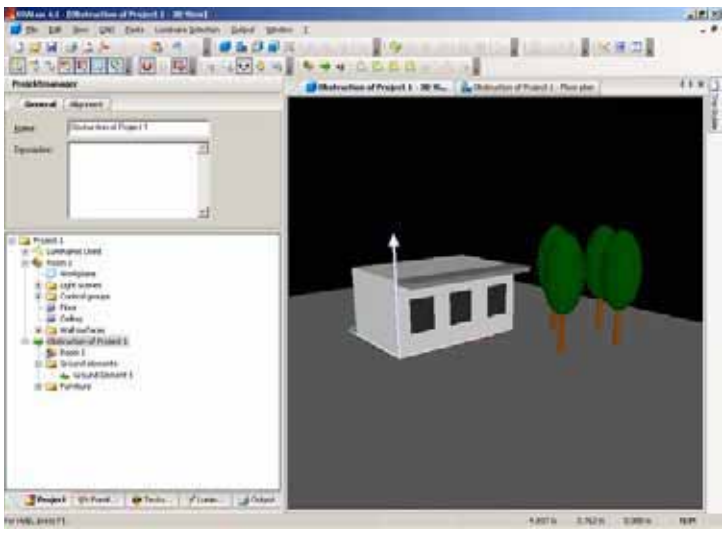


Fig. 216 Obstruction in CAD view

Sun and shadow visualisation

The direct incidence of sunlight in the room can be simulated on a real-time basis. For this an OpenGL compatible graphic card is necessary. The incidence of light by windows and/or skylights is calculated as a function of place, orientation, geometry and date and time.

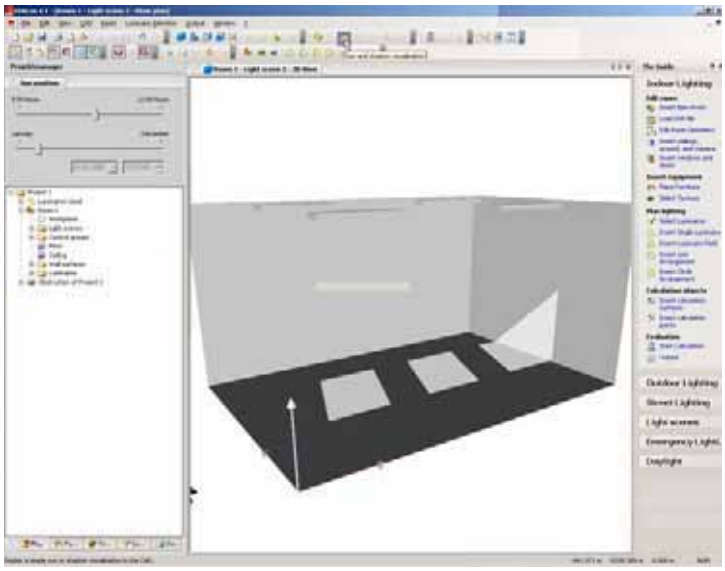


Fig. 217 Sun and shadow visualisation

At the top left of the *Inspector* there are two sliders. With these the date and time can be changed on a real-time basis and the path of the incidence light in the room can be simulated.

Settings in the calculation dialogue

Before starting the calculation you have the possibility to select the scenes to be calculated in the calculation window. Other settings are available. Thus you can select additional calculation options and operations.

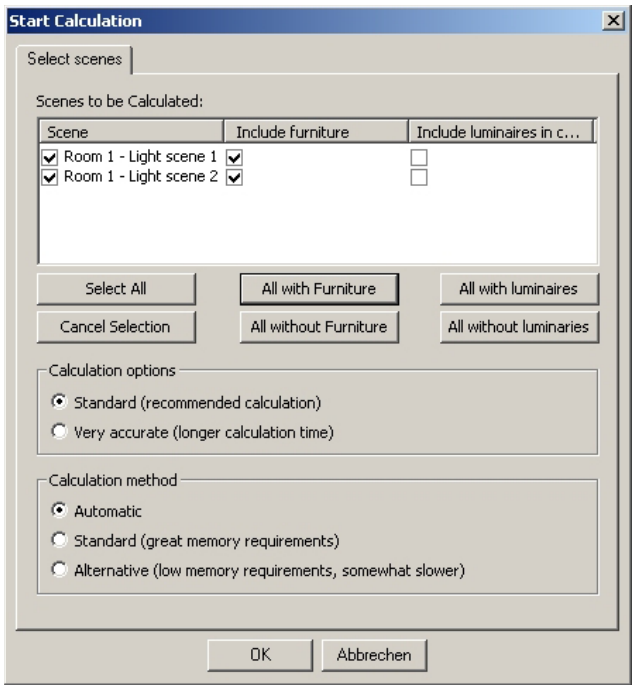


Fig. 218 Calculation dialogue

Working in the 3D View

Setup the 3D View

It is possible to roam through a planned scene to closely evaluate the results. The observer's position can also be inside a room. This is especially valuable when planning large rooms with a lot of furniture.

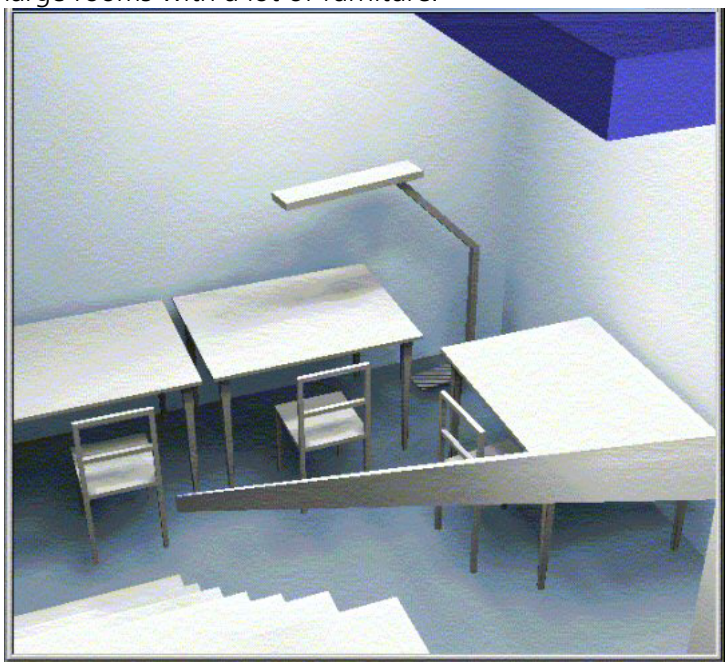


Fig. 219 Evaluating a staircase from the upper storey

If you have a "three-button mouse", the "*Move*" option is assigned to the mouse button in the middle. If you have a wheel mouse, you can "*Zoom*" by turning the wheel and "*Move*" by pressing it.

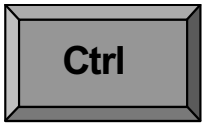
The following tools (from left) can be used to change the position in the 3D view:

Fig. 220 Toolbar for switching between modes

- Select Objects; when this mode is selected, objects (depending on the selection filter) can be selected by clicking on them.

- Increase/Decrease View Size; to increase or decrease the zoom factor, left-click in the CAD window and move the mouse up or down. With DIALux 4.2 you can increase or decrease the CAD view about 10% by using *CTRL* key + **+** or *CTRL* key + **-**.

Various options are available when roaming through a scene!



- Rotate 3D View; left-click and move the mouse while holding the mouse button pressed.

- Move; use this mode to move the area that is displayed in the window. If you have a "three-button mouse", this option is always assigned to

the mouse button in the middle.

- Roam Scene
  - Left-click and move the mouse to move forward, backward or to rotate on the spot.
  - Left-click holding the *CTRL* key ⇒ you can roam up, down, left or right, the viewing direction remains constant.
  - Left-click holding the *Shift* key ⇒ you remain on the spot and can look around you.

You can change the focal distance of the camera in the 3D view by selecting the mouse mode "zoom" (loupe symbol). While zooming (l*eft-click and move the mouse*) hold the *CTRL* key at the same time.

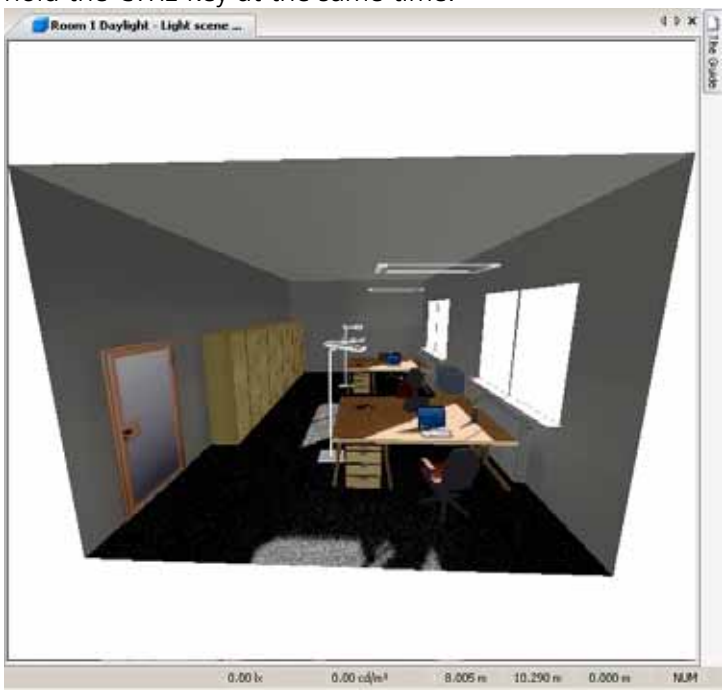


Fig. 221 Change perspective and focal distance of the camera

Check Calculation Values in the 3D View

With the help of the *Luxmeter* function you can see the calculated illuminance value of any selected point. To do this you should switch to the 3D view, enable the *Tool tips for calculation results* and select the *Rotate view* mouse mode. Move the mouse pointer to any position in the CAD window. The calculation results are displayed at the bottom of the figure. In order to indicate different points of calculation in your CAD window set your mouse function to *Rotate View*. This way you can quickly reach each point in the room.

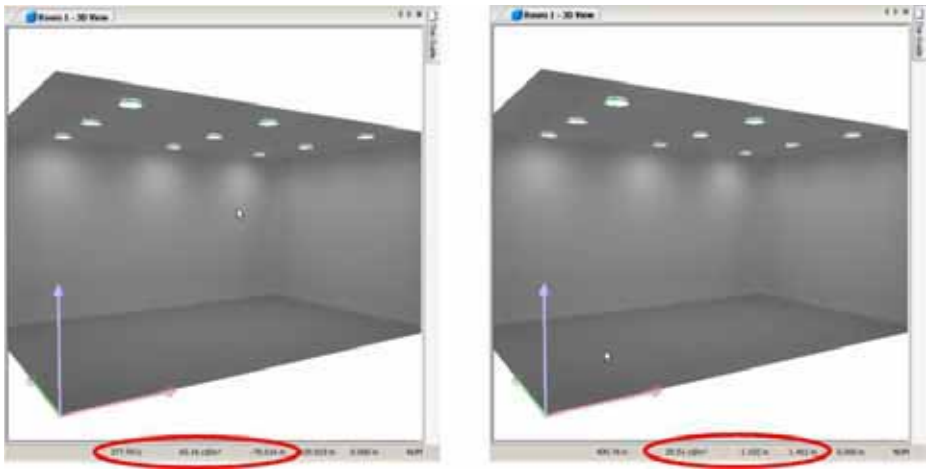


Fig. 222 Show calculation results in 3D view

Now you can click at any point that is of interest to you and the calculated illuminance is displayed in a small tool tip.

Save 3D View

DIALux offers two different ways to export the current 3D rendering into a graphics file. The easiest way to get a picture of the visualisation is to rotate or move the 3D view of a scene (interior room, exterior room or street) into the desired position and then use the menu → *Export* → *Save CAD view as JPG*… which opens a file selection dialogue.

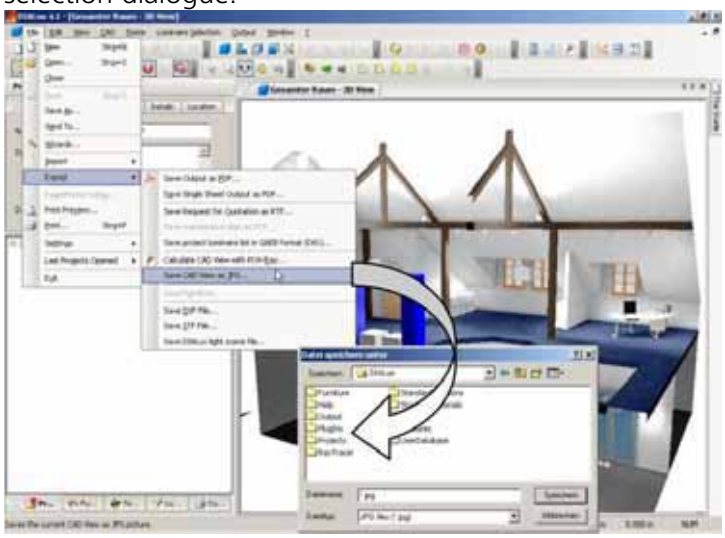


Fig. 223 Save a 3D view as *.jpg-file

Here you can enter the directory and the filename. The picture is stored as a *.jpg-file with a 1024 x 768 pixel image.

To get a picture with a higher resolution, proceed as follows:

- Make the planning as usual and adjust the perspective of the 3D CAD view.
- Change to the output and open the 3D rendering.

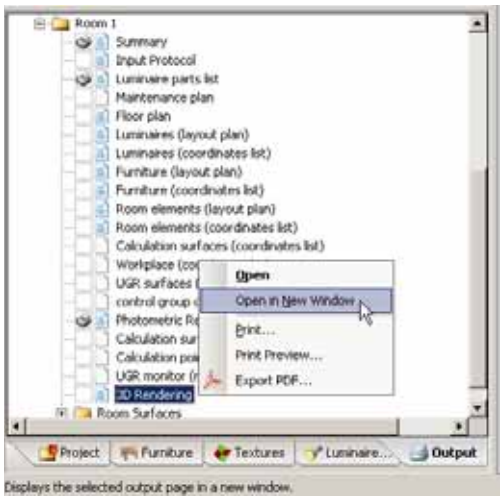


Fig. 224 Open the 3D rendering

- Start the software that should import the image. This might be Word, Excel or any image processing software.
- Click and hold the left mouse button on the 3D output and drag the image to the other program.

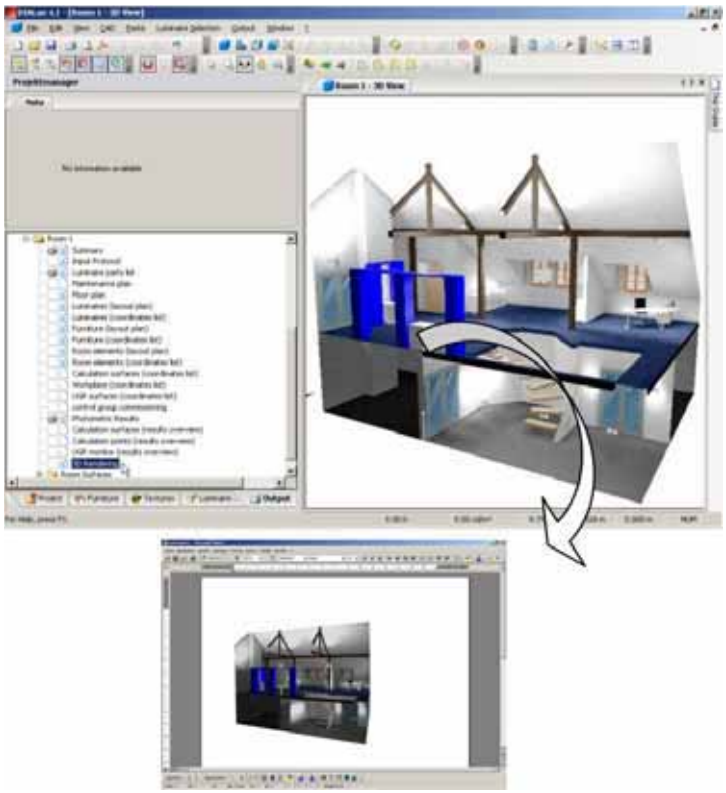


Fig. 225 Copy the 3D rendering into another software

- The image is copied into the other software with a resolution of 2000 x 2000 pixel.

Presentation of false colour rendering

With DIALux the user has the option to display the 3D rendering in a false colour rendering presentation. The presentation of illuminance and luminance with freely scaleable value ranges and definable colour gradients is now available.

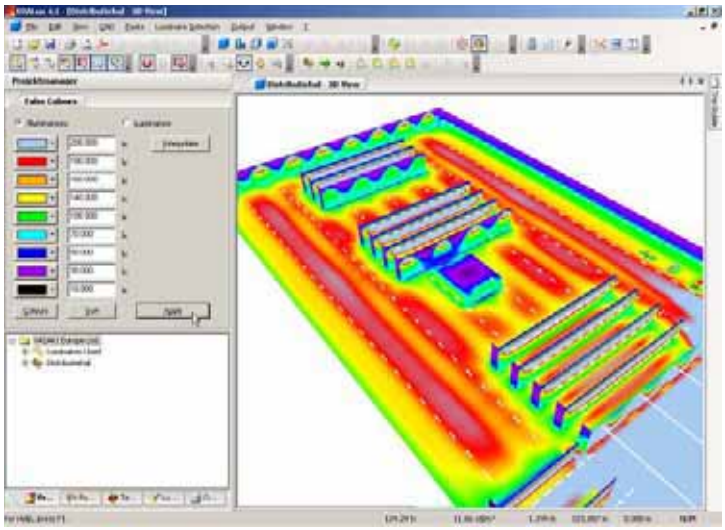


Fig. 226 False colour – Illuminances

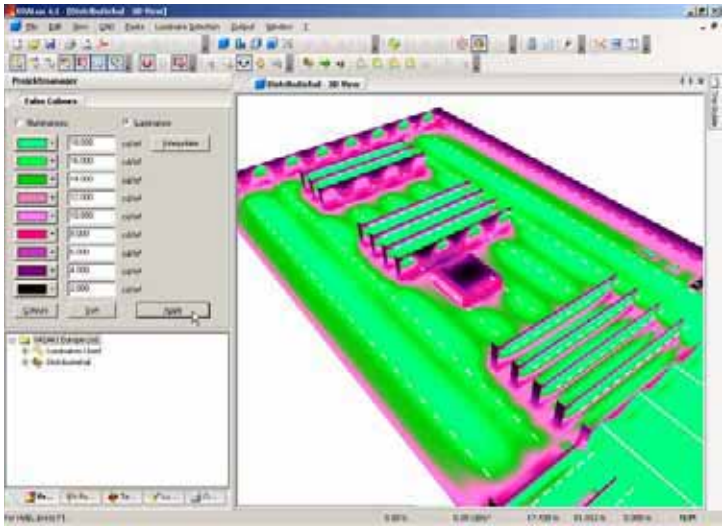


Fig. 227 False colour – Luminance

Working in Various Views

DIALux provides various views to assist you with your layout.

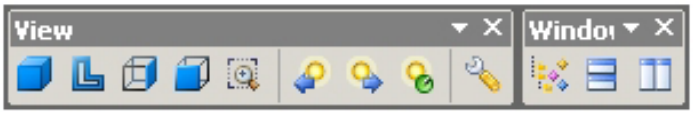


Fig. 228 Views toolbar

You can open the various views via the toolbar illustrated. The button functions are, from left to right:

- Open 3D view
- Open ground plan view
- Open side view
- Open front view
- Zoom to the overall view of the scene, for that DIALux zooms to the borderline of the room or exterior scene
- Show previous / next light scene
- Show dimming levels in CAD
- Show maintenance factors in the CAD
- Activate *Project manager*, DIALux shows the *Project manager* in addition to *The Guide*
- Tile windows horizontally
- Tile windows vertically

In the menu file *Settings* → *Customise Toolbars* you can activate more functions in the view's or window's toolbar (see page 52).

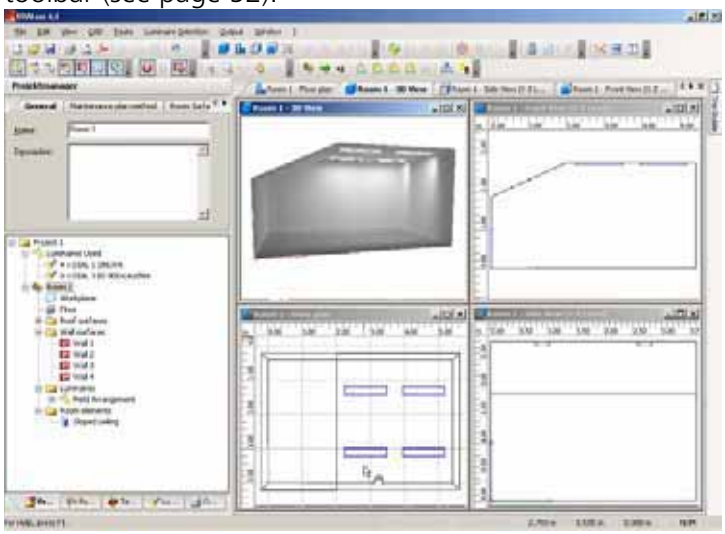


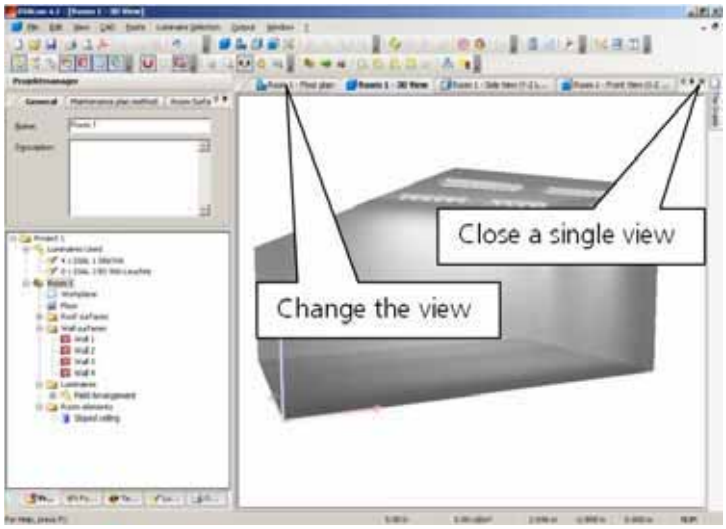
Fig. 229 Working in various views

If your monitor is big enough, it is advisable to keep several views open simultaneously

The display illustrated above can be achieved by first opening the four views and then arranging the windows, e.g. *Tile Horizontally*.

Fig. 230 Multiple view arrangement

Click on the X icon in the upper right corner to close the window.



Close views via the "X" icon

Fig. 231 Closing CAD windows

Save 3D CAD views

Saving of various CAD views (camera mode).

In the 3D view it is possible with versions from DIALux 4.0 onwards to save camera perspectives of 3D CAD displays with certain key combinations. Turn and zoom the CAD into the required position and then press *CTRL* + number. This view will be saved in the project. The view can be set again automatically by pressing *Alt* + number. The numbers 1 to 10 can be allocated as wished. You can also do this with a right click in the CAD or under the menu "CAD".

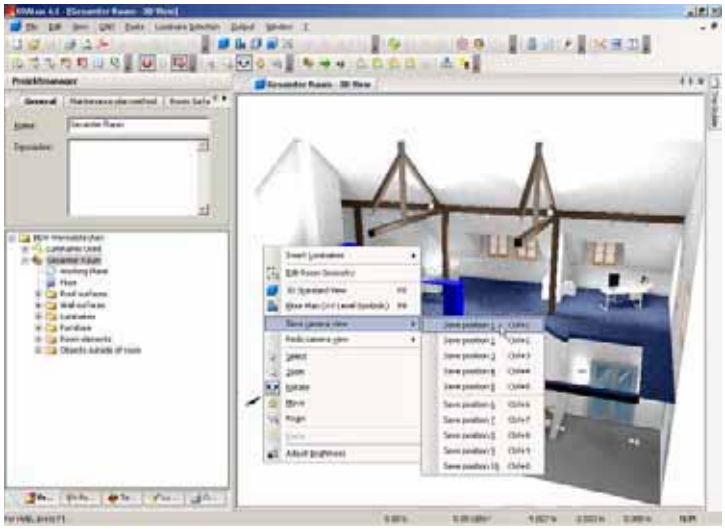


Fig. 232 Save camera view via context menu

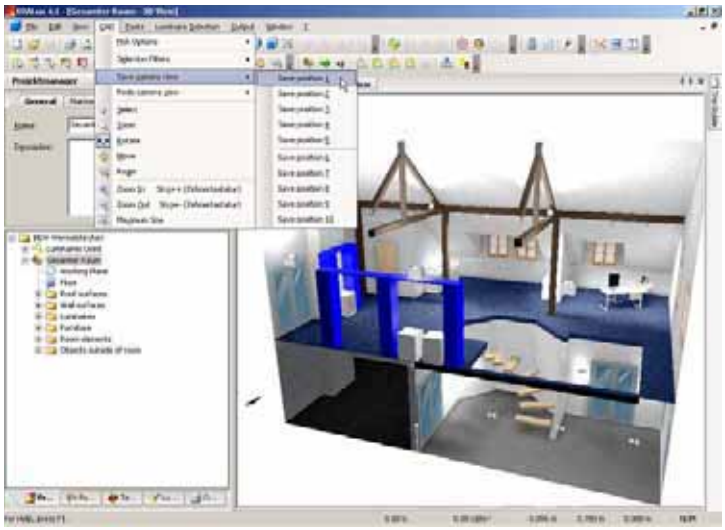


Fig. 233 Save camera view via menu

The function *redo camera view* accesses the saved views. You can proceed via the context menu within the CAD view or in the menu → *CAD*.

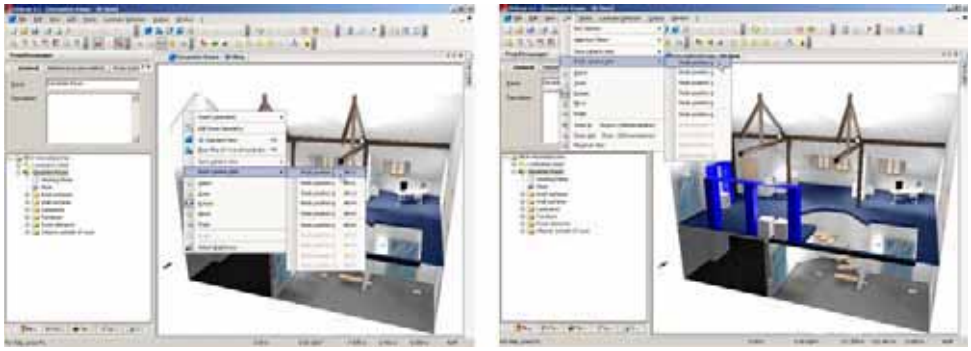


Fig. 234 Redo camera view – Redo positions

Wireframe Model

With DIALux there is the option to change into the wireframe mode. This is so that you can work on an "older" computer without judder when moving in the 3D view. You can find the function in the menu *View* → *Wireframe Display*. It is quicker to use the keyboard shortcut *Ctrl +W*.

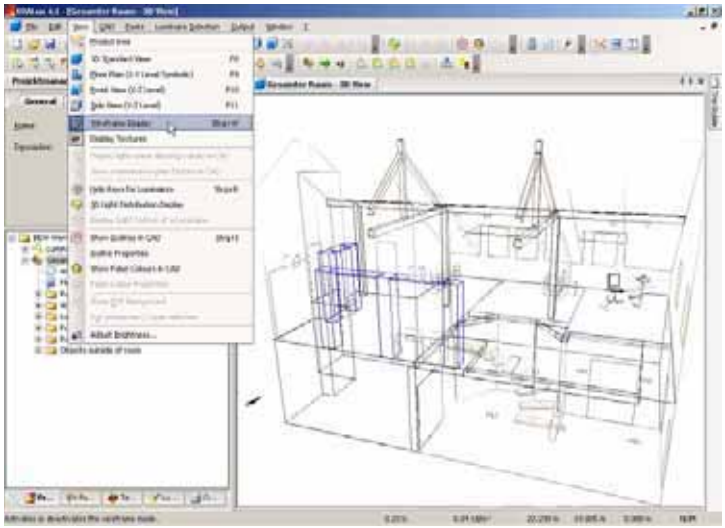


Fig. 235 Changing into the wireframe mode

Editing Inserted Objects

Moving Objects

After luminaires and furniture have been placed inside the room, they can be edited as desired. The *Inspector* displays all information relevant to the object which was selected in the *Project manager* or CAD view. This object can be modified by entering new values. If an object is modified in the CAD view (rotated, moved or scaled) the values in the *Inspector* are updated.

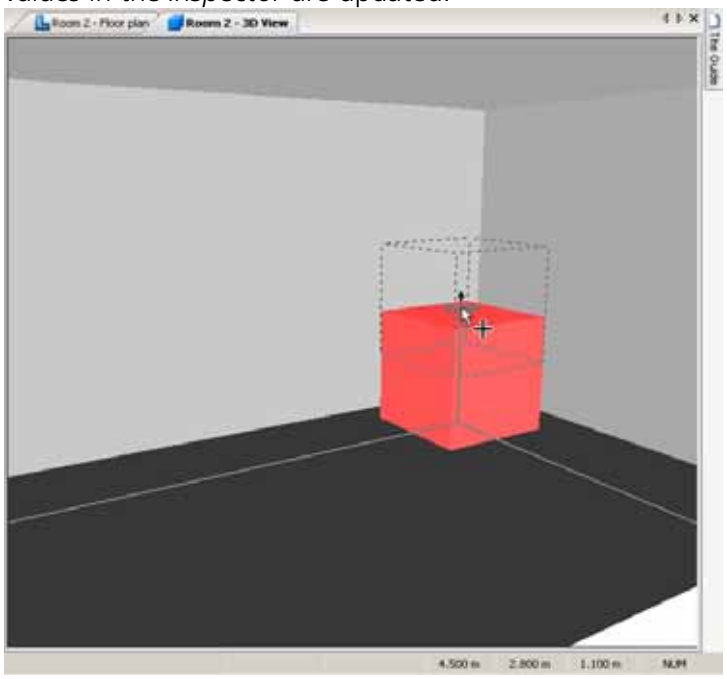
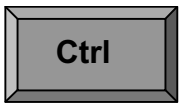


Fig. 236 Graphically modifying the object height

To change the height of an object via the mouse, keep the Ctrl button pressed!



To modify the position of a body along the Z-axis, press the control (Ctrl) key. Keep the button pressed while you click on the arrow cross within the body. As long as the left mouse button and the Ctrl key are pressed, only the height of the object can be modified. When you release the Ctrl key, you can modify the X and Y positions.

In the 3D view, the point of intersection of the three positioning lines shows the position of the cross, projected onto the floor surface.

Since DIALux 4.4 it is also possible to move an object not only by its insertion point but also by dragging the corners of the bounding box. The benefits are that it is now very easy to place one object directly next to another one and the object automatically rotates itself to get the same rotation as the object has where it is dragged to.

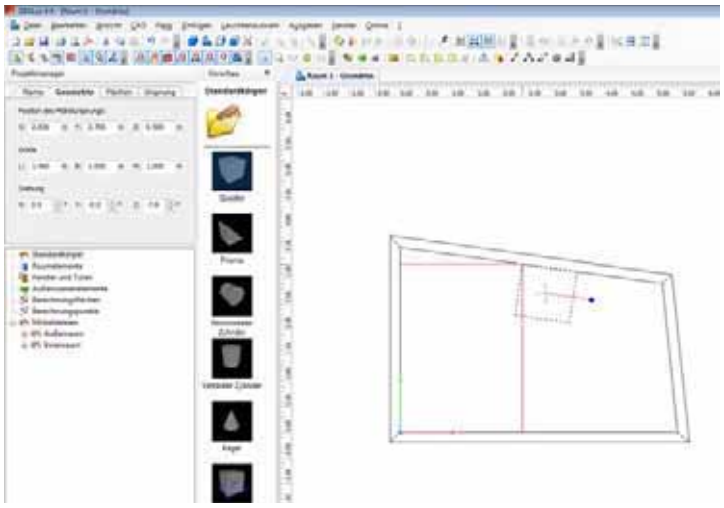


Fig. 237 Dragging an object by its corners and automatic rotation

To change the working area in the 3D view oppress the spacebar while the left mouse button is pressed and the mouse icon is above the area you would like the working area to be.

Using any surface as a working surface
In the 3D view an object can be moved by the mouse. The working surface is fixed as a parallel surface to the X-Y area (normally parallel to the floor). This can temporarily be changed if the SPACEBAR is hit while the mouse together with the object is in front of any other surface and the left mousebutton is pressed. Example: You click (left) on a cube and move it towards a wall. Make sure that the mouse icon is in front of the wall. Now hit the space bar on the keyboard. The wall will become the working area of the cube now. Instead of moving to the left and to the right (X-Y axis) you can now move up and down (axis of the wall). It can be any other surface as well (tilted floor, furniture,..). The working area is reset when the left mouse button is released and another object is selected.

To deactivate the preset pick grid, press the shift button!

Moving and Rotating Objects without Pick Grid

When you move the object via the mouse, it only moves within the preset pick grid. If you press the Shift key while you move the object, the pick grid is deactivated. The grid settings to be used when the pick is deactivated can also be preset. Select CAD → *Pick Options* → *Set Pick Grid*.

Fig. 238 Pick grid settings – Display Grid

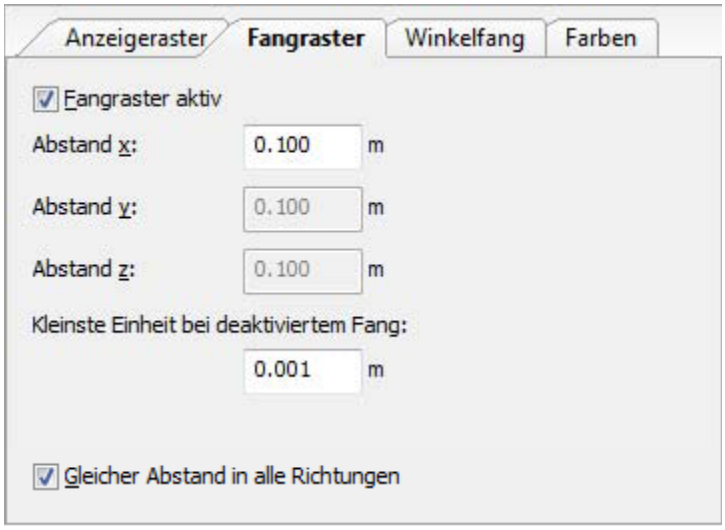


Fig. 239 Pick grid settings – Snap Grid

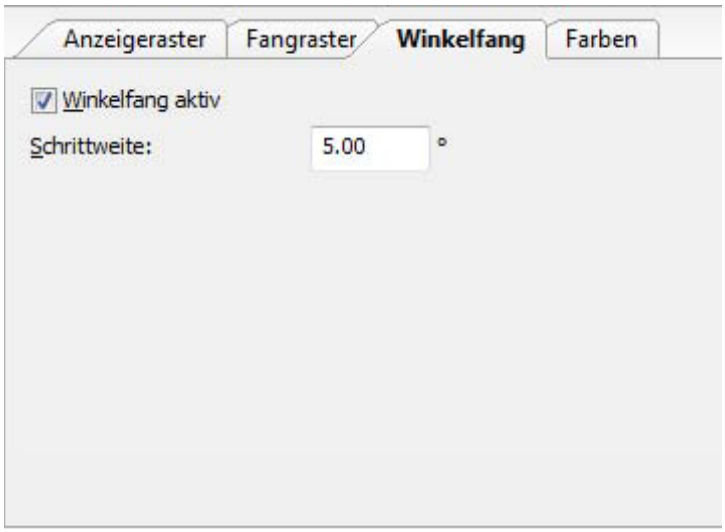


Fig. 240 Pick grid settings – Angle Pick

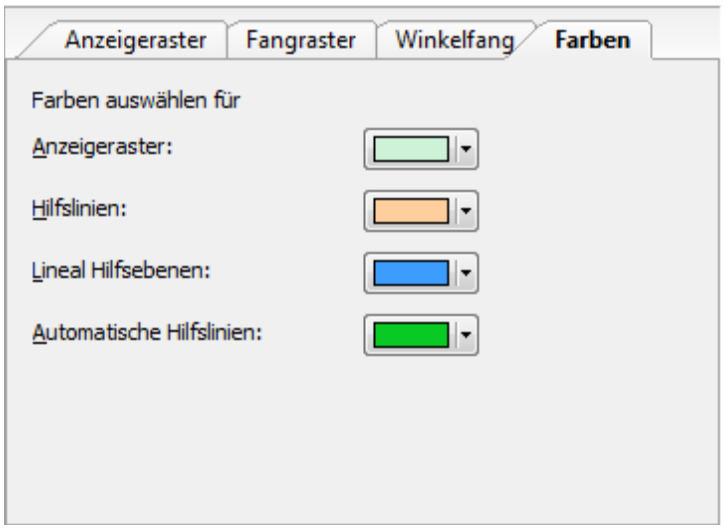


Fig. 241 Pick grid settings – Colours of the Pick grids

Scale or rotate

|<- Tabulator ->|

An object is either in scale or in rotate mode. After selecting an object it is initially in rotate mode. To change between the two modes you can either open the context menu by doing a right click or ,and this is new, you can hit the tabulator key to change between these modes.

Rotating Objects

If objects are to be rotated, they must be selected first. Then they can be modified numerically in the Property Page or graphically in the CAD view. Click on one of the three axes rotation points. There is a pick grid for rotations as well (Angle Pick).

Please note:
The red rotation point enables a rotation around the red axis, likewise the blue and the green rotation points enable rotations around the blue and green axes respectively.

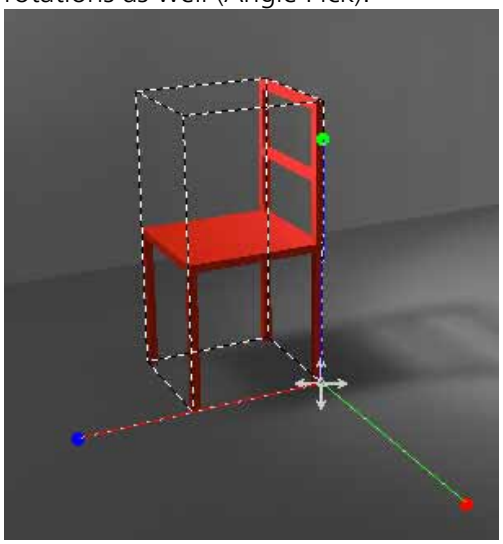


Fig. 242 Rotating objects

Objects are rotated around their own coordinate origin. This is indicated by the arrow cross and by the point of intersection of the three axes. If multiple objects are

selected to be rotated together, they are rotated around the centre of the encompassing cube.

Scaling Objects

Objects can be scaled along one, two or three axes. This can be done either in the Property Pages or in the CAD. To go to the scale mode in the CAD, open the object's context menu (right-click) and select the *Scale* option.

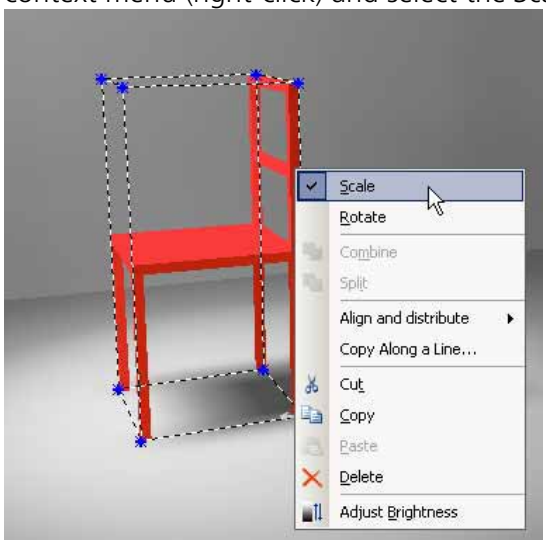


Fig. 243 Object context menu

In the 3D View:
Pull rubber band lines = Scale in one dimension

Pull rubber band corners = Scale in three dimensions

In the 3D view you can scale the object in the X, Y or Z direction by clicking and pulling one of the rubber band lines of the selected object. However, if you click on one of the selected corner points, you simultaneously scale in all directions.

In 2D views you can only scale in one dimension.

Combining and Saving Objects

If you have inserted multiple objects in the CAD which together you wish to treat as an arrangement or to save as a new custom piece of furniture, it is recommended to combine these objects in advance. Objects need not touch to be combined. They can also be positioned independently in the room.

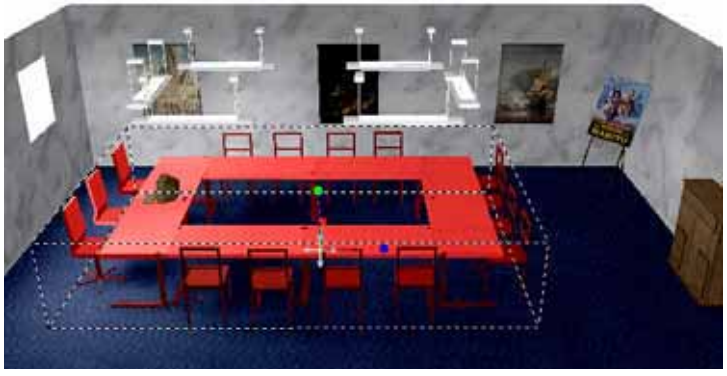


Fig. 244 Combining Objects

To combine objects, select them and select *Combine* from the context menu.
To save objects, select them and select *Save as…* from the context menu.

Important! DIALux only loads furniture saved in the …\DIALux\Furniture\…. directory into the furniture tree. The user can create subdirectories beneath the Furniture directory. If you have received furniture files in the SAT file format (*.SAT) from the manufacturers, you can save these in the Furniture directory and use them in DIALux.

(See also page 78)

Moving the Coordinate Origin of an Object

If you combine multiple objects, the centre of the encompassing cube automatically becomes the coordinate origin. This is not always the preferred position, because when you insert an object into your project via Drag & Drop, the origin is placed at the height Z = 0. Before you save a new object, you should check and position the origin. You can do this in the *Inspector* when you go to the Property Page *Origin*.

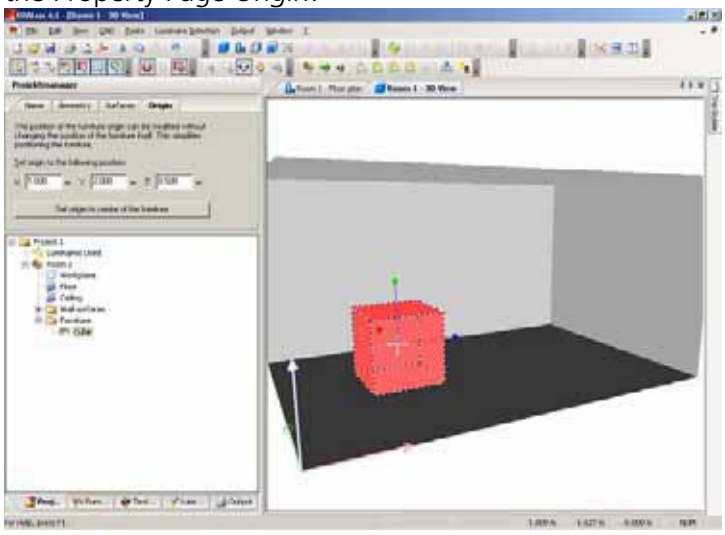


Fig. 245 Specify the coordinate origin

To move the coordinates system of an object, press the *Alt* button!

To define the origin visually, press the *Alt* button. When you now move the object's coordinate cross, the coordinate origin is moved instead of the object itself. To change the height or to deactivate the pick grid when movements are made, use the *Shift* and *Ctrl* buttons. If you now save the object, the new coordinate origin is also saved.

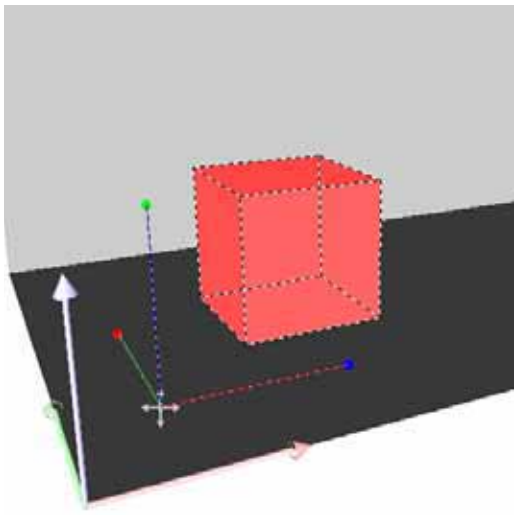


Fig. 246 Coordinate origin which was moved outside the cube

Resetting the rotation of the origin

To create complex models from several simple ones, sometimes it is necessary and useful to reset the rotation of an object. To achieve that, you have to click the "Reset rotation of origin" button in the Origin Property Page of the Object. The length, width and height of the object are taken from the rotated bounding box.

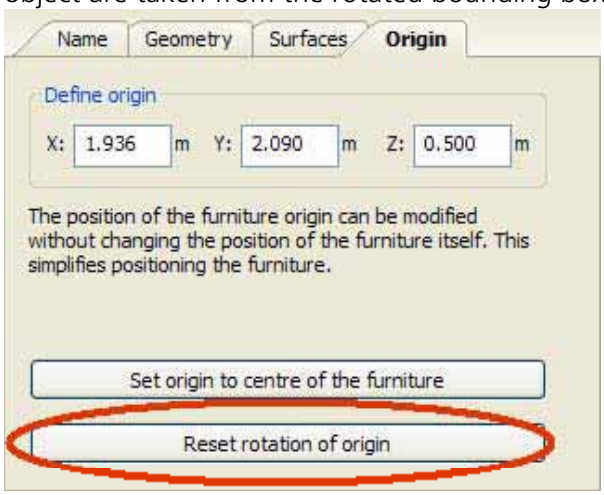


Fig. 247 Resetting the rotation of the origin of an object or futniture

Editing Object Surfaces

In DIALux you can assign any colour, reflectance, material and calculating grid and textures to any surface. To edit object surfaces, select the object and click the *Surfaces* tab.

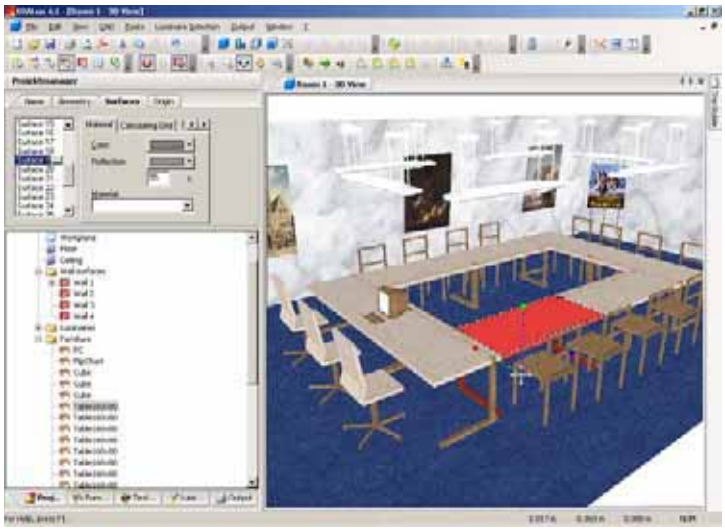


Fig. 248 Editing surfaces

In the *Inspector*, the Property Page with a list of existing surfaces appears. If you select a surface (surface 19 in this case), this is highlighted with a rubber band line in the CAD. In the right-hand side of the Property Page you can select a material, a reflectance or a colour. By clicking on the empty field "…" behind the name of the surface in the listbox on the left-hand side, the name can also be modified.

To receive output on furniture surfaces, check the *Result Output* checkbox.

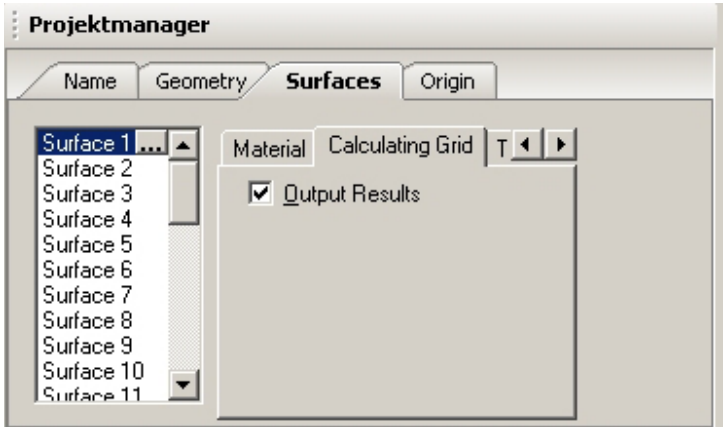


Fig. 249 Calculating grid and furniture surface output

To include the calculation results of a certain surface in the output, please check the *Result* Output checkbox in the *Calculating Grid* tab.

Time and again it is necessary to work on single surfaces of an object. With complex objects with very many surfaces, it may take a lot of time to find the required surface in the surface list of the object's Property Page. To make this simple you can now select a single surface graphically. Just right click the object on the required surface in the CAD and choose "Select this surface" from the context menu. The required surface is selected in the Property Page and it can be assigned a colour, a texture, material and so on.

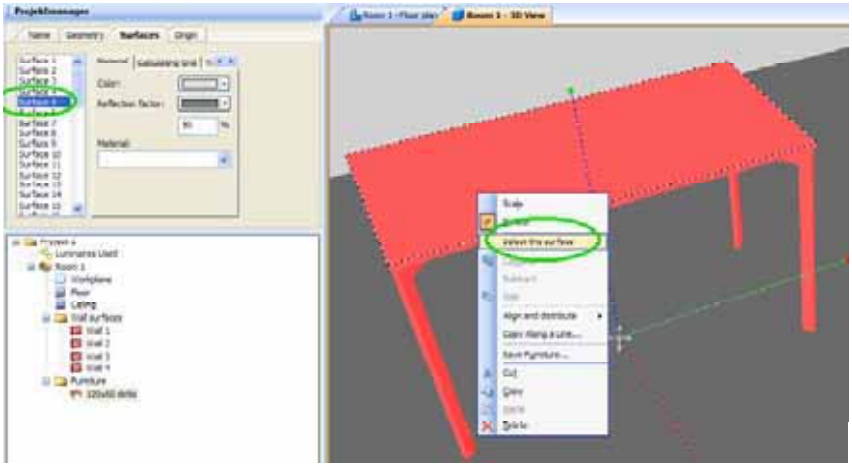


Fig. 250 Selecting a single surface with the mouse

Arrangement aids

Measurement of distances

Using the tape measure it is easily possible to find the exact distances between objects in 2D and 3D view. To start the tape measure just click on the icon or select the tape measure in the menu CAD.

Fig. 251 The tape measure icon

In the 2D view, the tape measure is placed by clicking on two points in the CAD window. The end points of the tape measure will snap to grids, help lines, insertion points of objects and to the bounding box of objects. If the snap is not to that point you like it to be, just zoom into the scene and the snap will be more accurate.

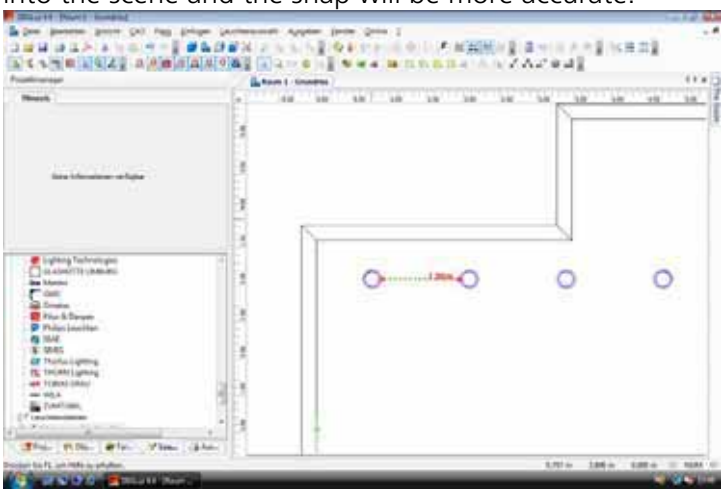


Fig. 252 The tape measure function in the ground plan view

In the 3D view, there are even more distances visible. There you can see the direct distance between two points as well as their heights above the floor and the distance on floor level.

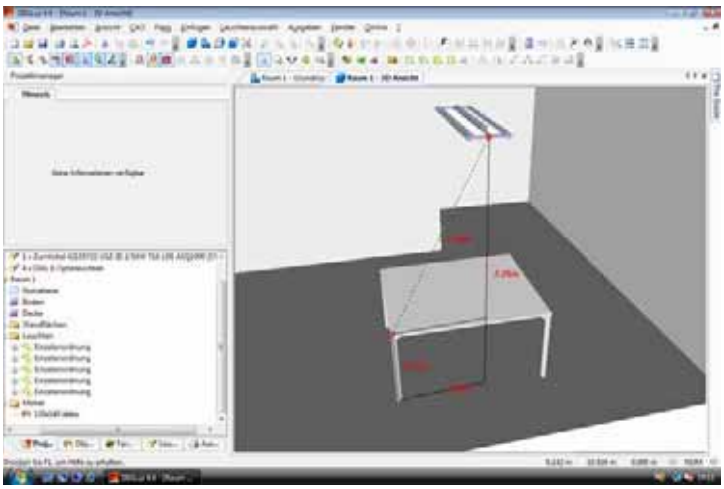
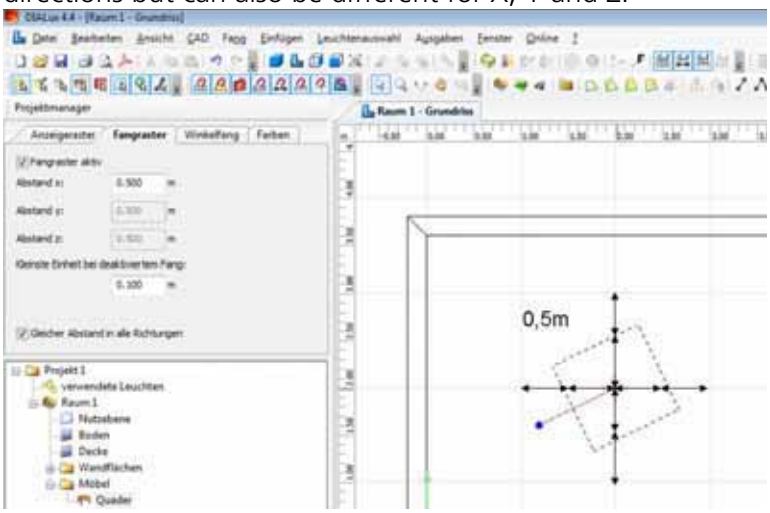


Fig. 253 The tape measure function in the 3D view

Working with the snap grid

The snap grid is a tool to simplify the handling and the movement of any object in the CAD views. The objects will step in the distance that's defined in the snap grid settings. The grid distances can be equal in all three directions but can also be different for X, Y and Z.



To switch of the snap temporarily just hold down the SHIFT key while you move the object.

Fig. 254 Fixed grid with a spacing of 0.5m in X and Y direction.

If you want to move an object for a short period without a grid, just hold down the SHIFT key while you place the object. This is valid for all grids and help lines.

To make the snap grid a visible tool as well, use the same settings for the display grid as you do it for the snap grid. The colour can also be changed to have a better contrast for example against a background DWG file.

Automatic help lines

Those objects which are already placed in a room or exterior scene can be used to align other objects. Moving an object you will recognize that in orthogonal direction there is a higher "gravity" than in any other direction. So moving along X, Y or Z axis is simple. Those objects (bounding boxes of furniture, walls, luminaires room elements), which are already in the scene can create automatically temporary help lines to align other objects to.

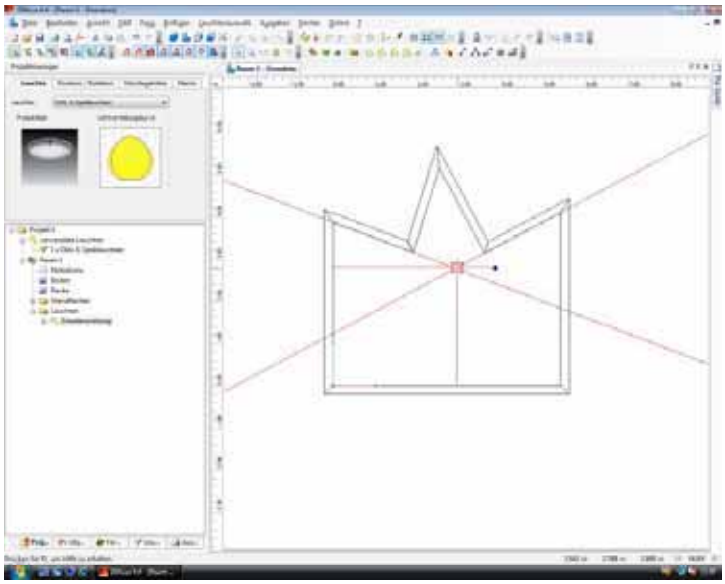


Fig. 255 Automatically by the walls generated temporary help lines.

In the screenshot you can see the red help lines which follow the direction of the tilted walls. These help lines are generated when you move with one object (e.g. luminaire) for a short while above any other object (e.g. wall). The help lines are visible until the left mouse button is released.

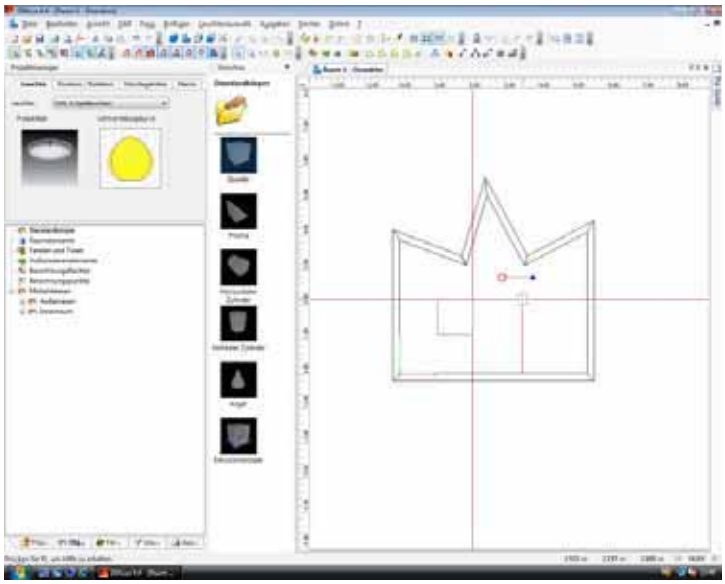


Fig. 256 Automatically by an object generated temporary help lines.

Here you can see help lines generated by the cube. Now it is pretty easy to align cube and luminaire.

Helping areas defined in the ruler

In ground plan, front and side view there are rulers located on the left and on the top of the CAD window. These ruler will show you the mouse position in X-Y, X-Z and Y-Z direction. From these ruler you can generate helping areas which are defined in a specific position and are useful to align objects to.

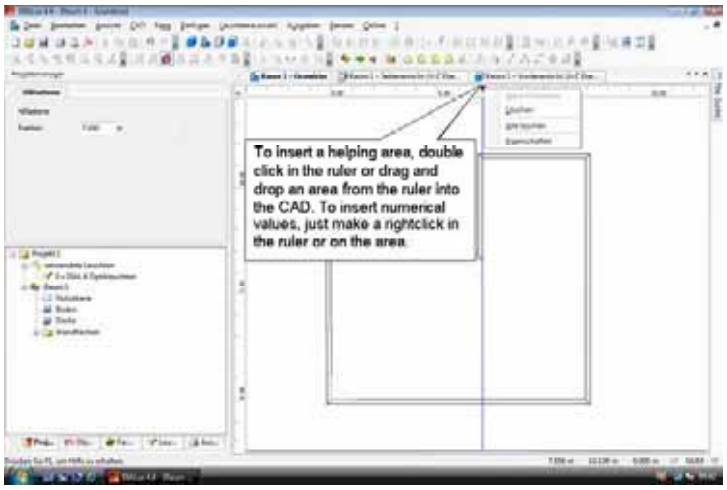


Fig. 257 Creating helping areas in the ruler

You can create those helping areas by double clicking in the position of the ruler or drag and drop the helping area from the ruler into the CAD. It is called helping area because it is active in two dimensions. If you place an helping area in the ground plan view parallel two the X-axis, it will be available in the side view as a parallel line facing from top to bottom as well. If you place an helping area parallel to the Y axis, it will be visible in the front view. Having them available in two views makes it easy to place objects not only in a desired position but also in a correct height.

If there are already objects in the CAD window available, the helping areas can be snapped to those objects as well.

Working with help lines

Help lines are objects which can be placed in any 2D view. When they are placed in the ground plan view, they are only visible in this view, not in any other 2D or 3D view.
They are meant to align objects to them or to place objects on them. Moving an object towards a help line, the snap will work on the bounding box and on the objects origin. If a object is moved wth the mouse on the bounding box dragger also the rotation of the object is align to follow the help line. This will not happen, if the object is dragged by its origin.

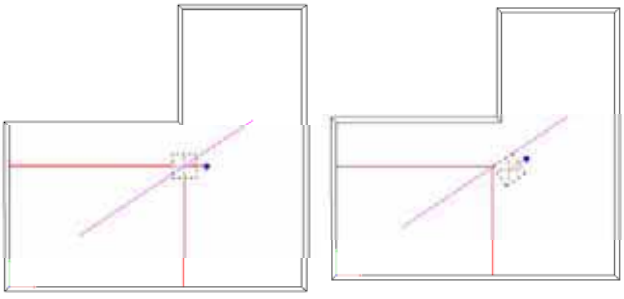


Fig. 258 In the left scetch the object is moved on its origin, on the right it is moved on the bounding box. In the second case the rotation is adjusted.

Help lines are not printed out. To insert a help line just press the icon or use the command “Insert” -> “Help lines”.

Fig. 259 Icons to insert help lines

Simple help lines

The simple help line is useful to align objects. Moving an object towards the help line it will be automatically snapped on the help line when a specific distance is reached. To avoid the snap temporarily just hold down the SHIFT key. To avoid the snap continuously, switch of the icon for the help line snap.

Fig. 260 Icons to switch on and off the snap to help lines

A help line is defined by clicking for the starting position and again clicking for the end position.

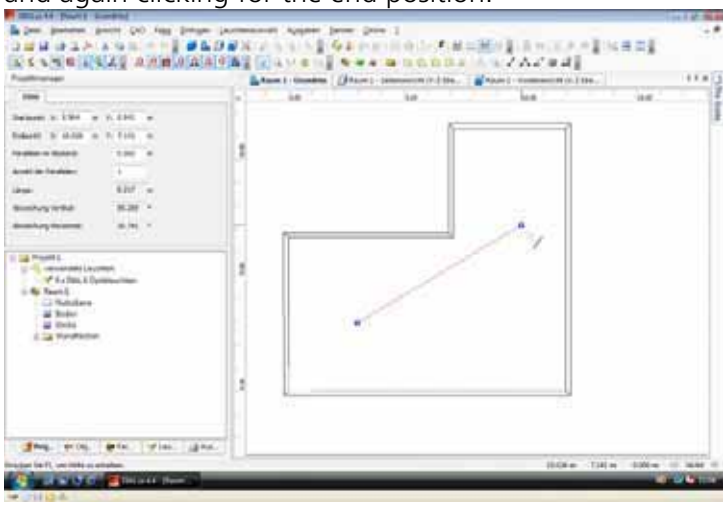


Fig. 261 Inserting a help line

In the inspector you can see the numeric values of start and end point. Further on you can see the angle the help line is rotated compared to the horizontal and the vertical axis of the 2D view. That’s way the axes changes from ground to side views.
The possibility to create parallel lines is also very useful. Just enter the number of parallel lines you need and the distance they should have.
To delete help lines just select and press the del(ete) key or select delete from the context menu. Help lines can be selected to be displayed or not. To switch between this modes press the glasses icon with the help line on it.

Fig. 262 Display help lines

Poly help lines

A poly line is working like a simple help line but instead of defining just a start and end point there can be any number of vertices in between. The line between vertices is always straight forward. Each left click defines a new vertex. To stop the poly line mode press the ESCAPE key or make a right click. In the context menu you can choose between closing the line between first and last point or just stop the mode at the last vertex.

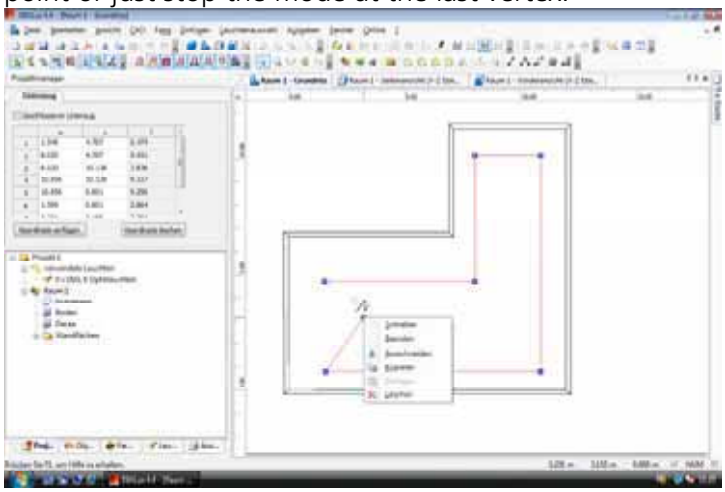


Fig. 263 Insert a poly line, stop the mode with a right click

In the inspector each vertex can be changed numerically and by ticking the checkbox the poly line can be closed.

To move the complete poly line after it is defined once, hold down the ALT key while the mouse is above one vertex and holding down the left mouse button.

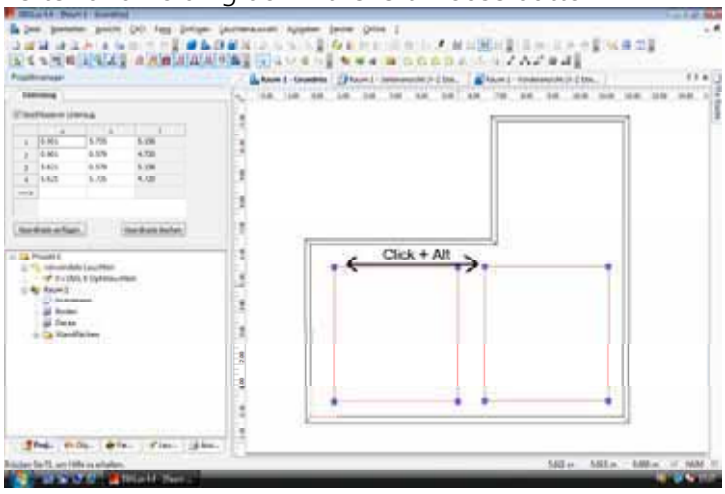


Fig. 264 Move the complete poly line by holding down the ALT key

Spline help line

The spline help line can be placed like the poly help line. The lines between the vertices are not straight but curved to follow a smooth line between the vertices. In the start and end point there are draggers which can be used to change the line towards the start and end point.

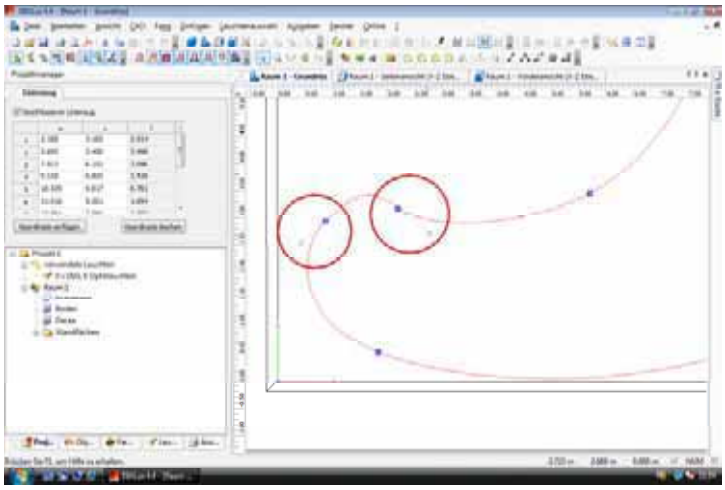


Fig. 265 A closed spline help line. In the start and end point are draggers to change the line

To move the complete spline help line after it is defined once, hold down the ALT key while the mouse is above one vertex and holding down the left mouse button.

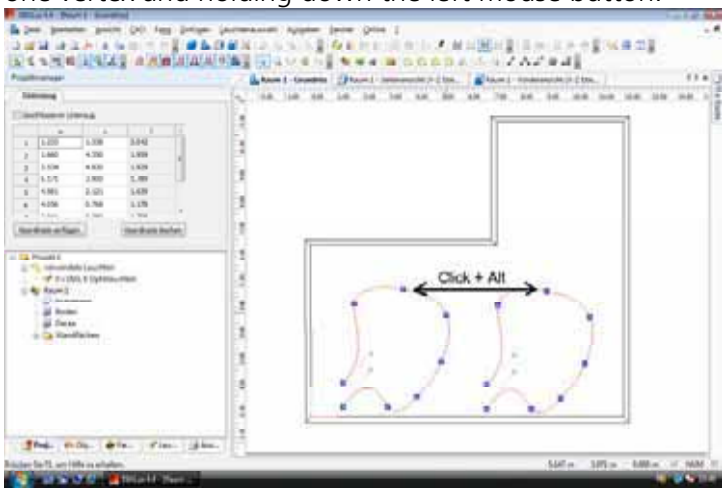


Fig. 266 Move the complete poly line by holding down the ALT key

Circular help line

The circular help line can be placed by first defining the mid point and then the radius.

Copy along a help line

Any help line can be used to be the copy and paste path of any object. Any object and any object combination can be copied along a help line, e.g. furniture, luminaires, Calc surface + furniture,… . To start that function, the help line has to be available in the scene. The object that has to be copied along a help line has to be in the scene as well. If you want to copy combined objects, you have to place them correctly next to each other first. The position in the room/exterior scene does not matter at all.

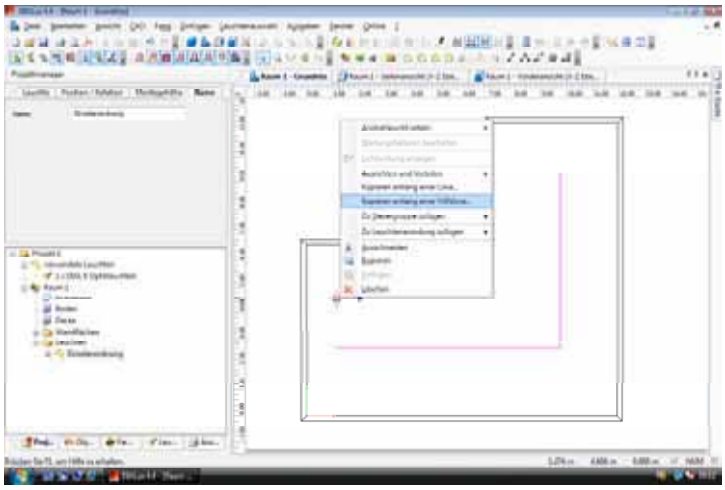


Fig. 267 Copy along a help ilne with the mouse

Start with selecting the object to be copied. Than make a right click and select “Copy along a help line” from the context menu. Now there is a symbol at the mouse to select the desired help line that should be used as a path where the object should be copied along. When the mouse is above a help line a small hook appears that tells you that this help line can be selected. The line is selected with a left click.

Fig. 268 Mouse symbol to select a help line for copying

Once the desired help line is selected, the inspector offers the possibility to define the desired number of copies and the distance between them.

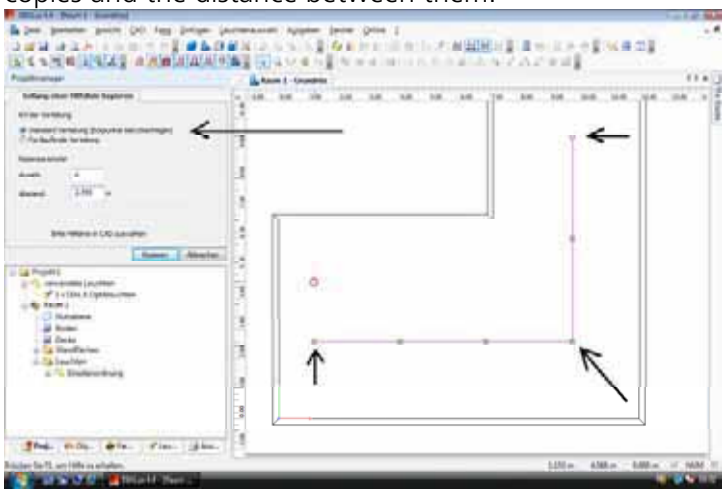


Fig. 269 Copying in the standard setting with placing objects in the vertex

If the standard setting is selected, DIALux places the first object in the start point, the last one in the end point and in every vertex also a copy. The distance between objects placed within two vertices will be averaged to keep the number of objects and the rsulting distance close to the desired values in the inspector.

If the second setting is selected, the distance between the objects is fixed. The first object is placed in the start point and every following one has the exact distance as defined. If the length of the help line is not integer literal of the distance, the complete length is not used and a rest of the line remains.

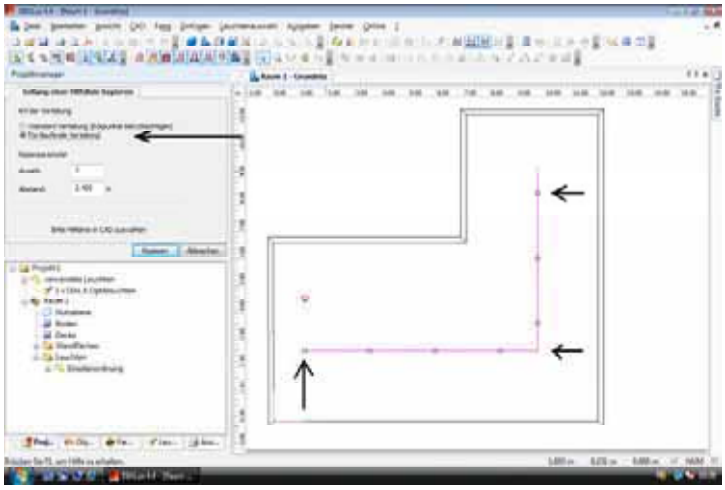


Fig. 270 Copying along a help line with fixed distance

In this way it is also possible to copy objects along spline help lines and circular help lines.

Help grids

In addition to the help lines it is also possible to insert help grids into the scene. To start this action, click on the insert help grid icon.

Fig. 271 Insert a help grid

In the inspector start and end point as well as the grid angle and the grid distance can be adjusted.In the graphical way, first the start point have to be defined with the first click. The second click defines the position of the end of the first axis of the grid. The third click have to be made in a distance perpendicular to the second point to define the width of the grid area. Initially the grid distance is set to 0.625m. This value can be changed in the inspector or graphically by moving the dragger next to the start point.

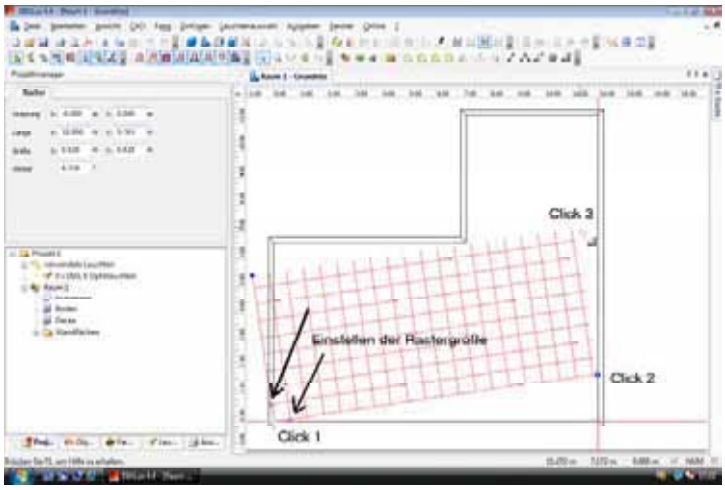


Fig. 272 Defining a help grid

The grid has snap points on each edge, on the lines in half the grid length and in the middle of each grid element.

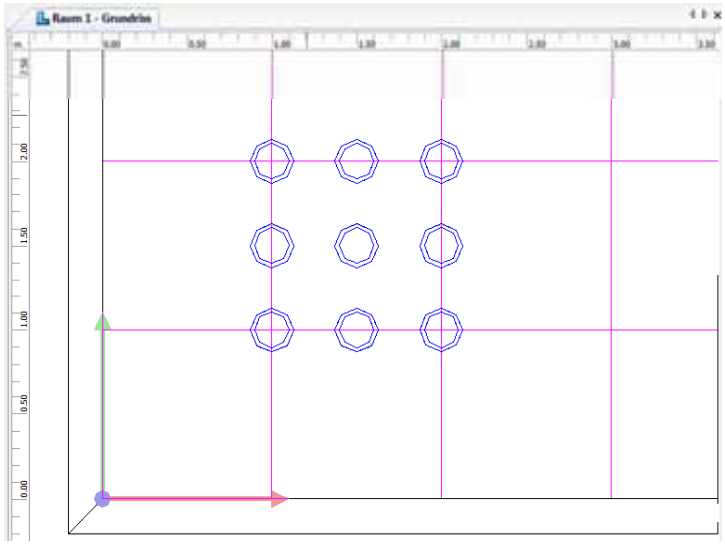


Fig. 273 Snap points on the help

Of course it is possible to place grids in other grids. This is useful if a luminare arrangement should be placed within one ceiling element.

Copy and paste with CTRL+C, CTRL+V and CTRL+H

With CTRL+C objects can be copied into the clipboard. This can be single objects or combined objects even those ones of different types. With CTRL+V the copied objects will be placed next to the original objects in a distance of 1m in X and 1m in Y direction. With the keyboard shortcut CTRL+H the object in the clipboard will be pasted next to the position of the mouse, taking into snap of any snap grid nearby. To copy luminaires into a ceiling grid just place the first fixture. Than move the mouse to the ceiling panels you need a luminaire in and press the CTRL+H keys. The luminaire is pasted and (if the mouse was close enough) the grid snap takes the luminaire in the correct position.

Copy Along a Line

DIALux offers the possibility to copy an object repeatedly one behind the other. This function *Copy Along a Line* is selected in the CAD window using the right mouse button or the menu *Edit*.

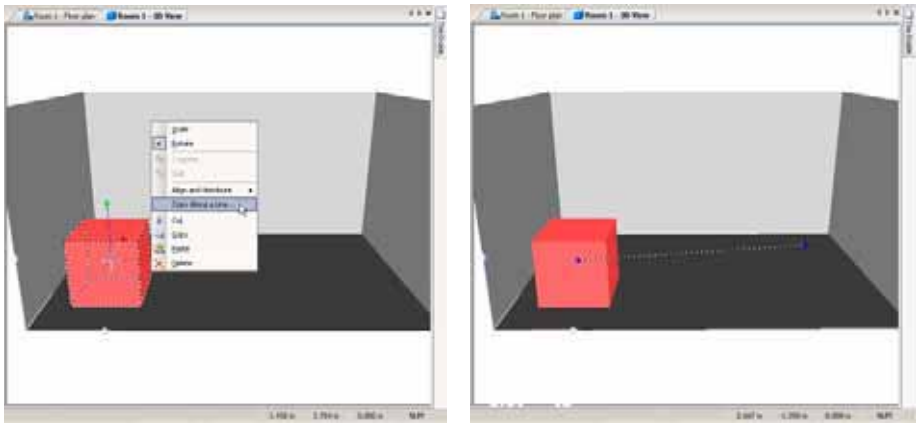


Fig. 274 Copy along a line with the mouse

In the *Inspector*, as an alternative or supplement to using the mouse you can edit the number of copies, align the line, the distance and the position of the last copy.

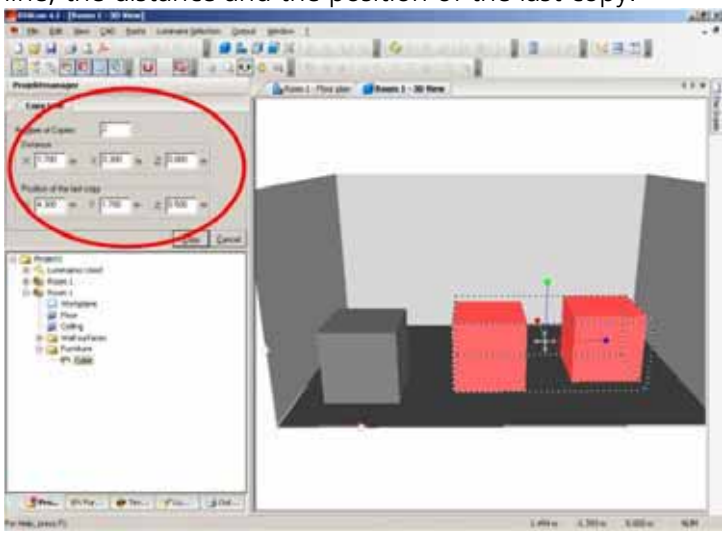


Fig. 275 Copy along a line with the inspector

Align and distribute

It is often necessary when planning and positioning several different objects to achieve a flush surface or to adjust them vertically and horizontally to achieve a regular arrangement or a neat appearance to the ceiling. In DIALux you can edit this in the context menu of the marked objects or in the menu *Edit* → *Align and distribute*.

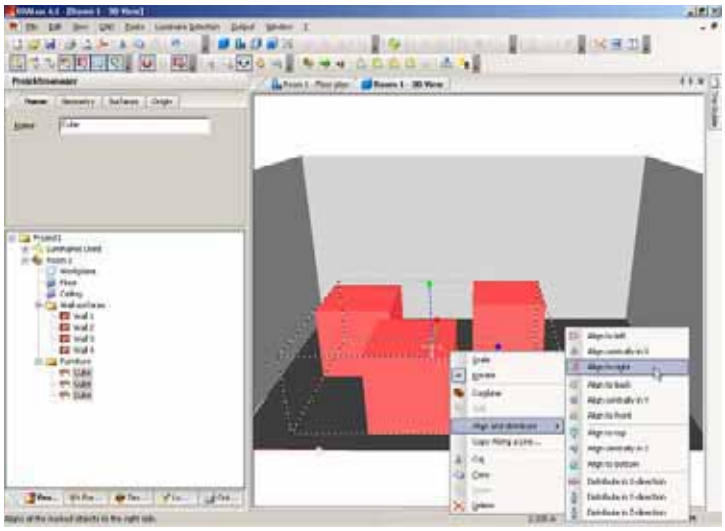


Fig. 276 Context menu CAD – Align and distribute

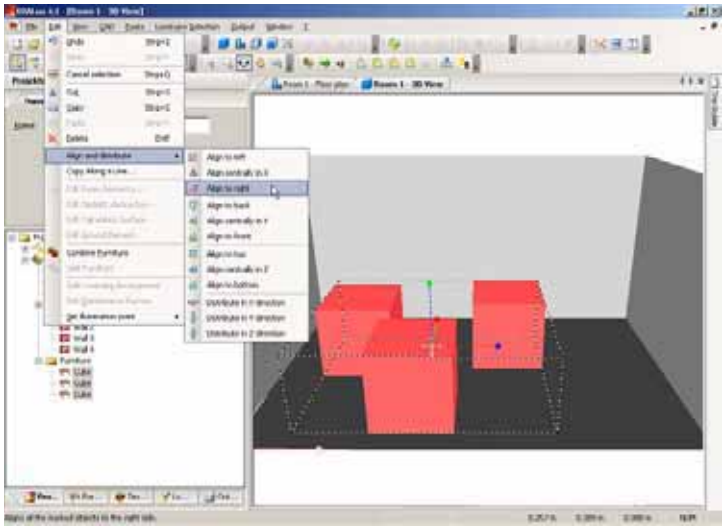


Fig. 277 Menu Edit – Align and distribute

Centre objects in the room

This is a very useful tool to centre luminaires separated by a modular spacing (for example a 600mm ceiling grid) in the middle of a room. The luminaire arrangement will be placed in the middle of the room after defining the number of luminaires and the distance between them.

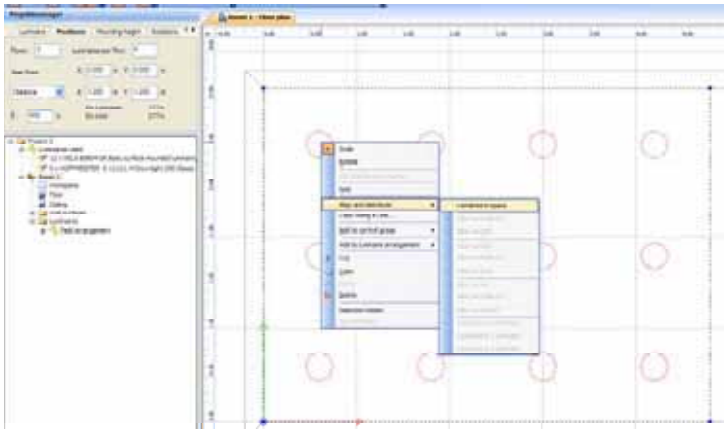


Fig. 278 Align and distribute – centred in space

Editing Calculation

In the furniture tree you can insert calculation surfaces or task area in DIALux. To do this simply select *Calculation surfaces* and move the appropriate object via Drag & Drop into a CAD window.

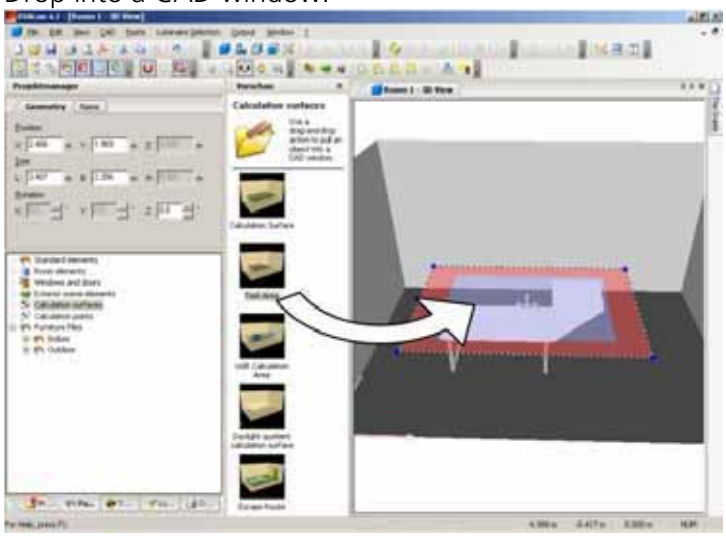


Fig. 279 Inserting calculation surfaces or task areas

Calculation Surfaces

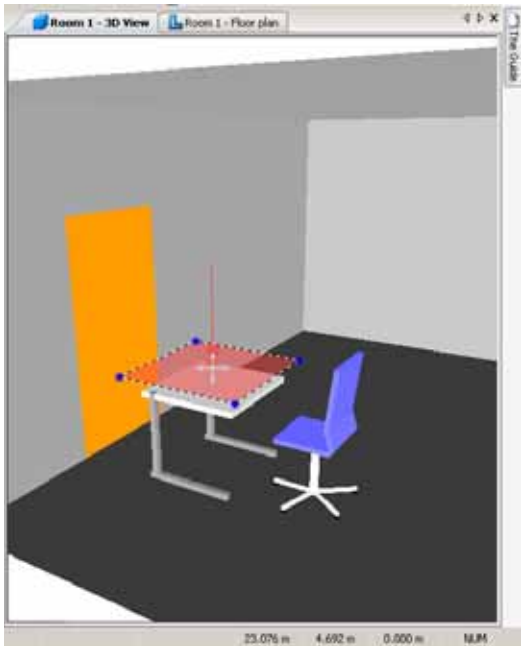


Fig. 280 Transparent calculation surfaces

A calculation surface is an area in which the illuminance can be "measured" without affecting the light distribution themselves. Various calculation surface norms exist, for instance the work plane, the correct reading level for hospitals etc.
A calculation surface is displayed as a transparent surface, as the example shows. The surface which appears transparent is the surface which provides the calculation results. The surface is invisible when viewed

from the other side. No results are calculated for the invisible side.
These objects can be scaled and rotated like all other furniture. Exception: windows and doors are always plane-parallel to the respective wall.

Calculation surfaces for different types of illuminance

The calculation surfaces in DIALux can now calculate different types of illuminance. As well as calculating the normal, namely the planar illuminance, perpendicular to the receiving plane, it is now possible to explicitly calculate vertical planar, horizontal planar and camera directed planar illuminance and also semi-cylindrical and cylindrical illuminance.

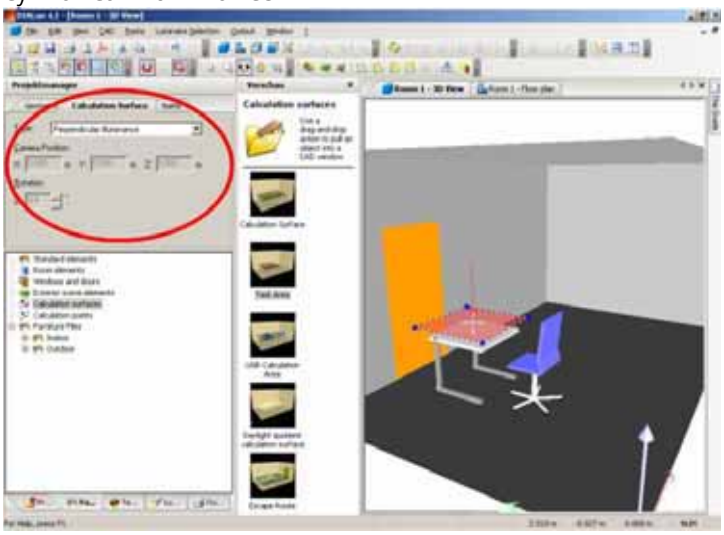


Fig. 281 Different types of illuminance

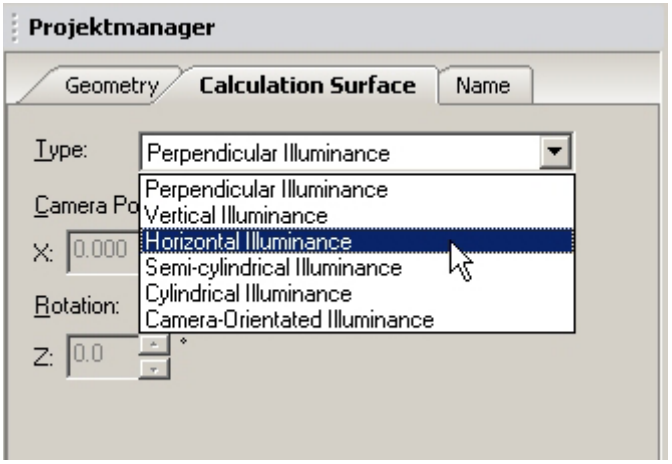


Fig. 282 Property Page of calculation surface – Selection of the types of illuminance

Penetration

If calculation areas are penetrated by furniture (e.g. cupboard and working surface) these are now automatically “cut out” of the virtual planes with

DIALux. It is not necessary for the user to make any special settings.

Task Areas

Task areas are calculation surfaces that consist of two parts. In DIN 5035 T7 and EN 12464 these two parts are defined. The two parts are the inner *Work Area* and the outer *Surrounding Area*. You can edit the polygonal shape of areas by clicking the right mouse button. The two parts are defined in the following way:

- Both areas are plane-parallel.
- The complete task area is positioned within the surrounding area.

The output shows isoline and greyscale diagram for both areas together. Value charts and value tables are listed separately for each area.

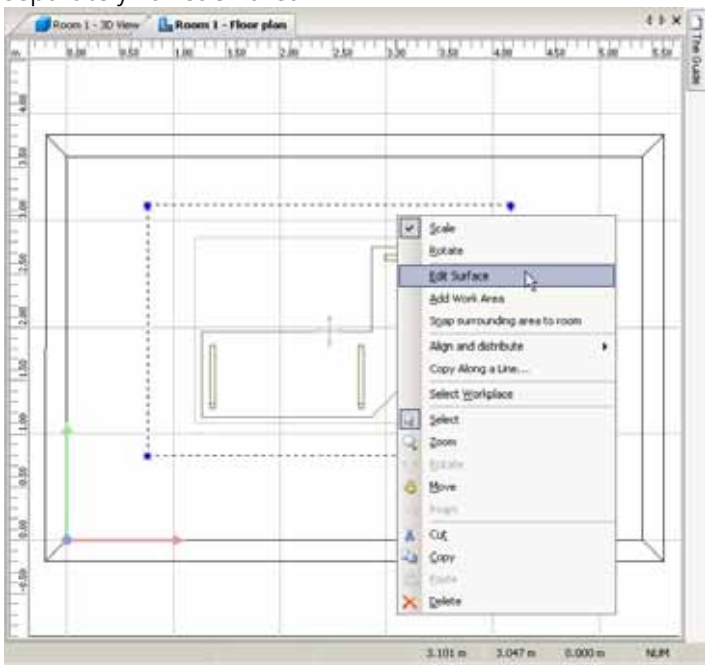


Fig. 283 Edit work area and surrounding area

Calculation Points

To get calculation results for a number of selected points. You can use horizontal calculation points, vertical calculation points and free calculation points.

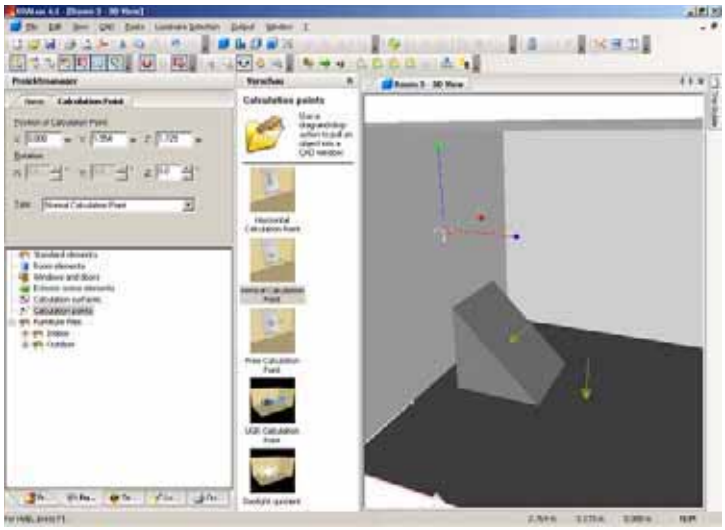


Fig. 284 Calculation points

Horizontal calculation points (shown at the right side of the figure above) cannot be rotated. They always "measure" the planar illuminance of the perpendicular incoming light.

Vertical calculation points (shown at the left side of the figure above) can be turned about the Z-axis. They can "measure" the planar ("normal") illuminance, the semi-cylindrical illuminance or the cylindrical of the incoming light. The type can be selected in the Property Page.

Free calculation points can be rotated about all axes. They "measure" the planar illuminance of the light incoming in the direction of the arrow.

The output lists of all calculation points are on one page ("Calculation Points List"). They are sorted according to their type (planar, semi-cylindrical, cylindrical) and their designation. The summary of the results shows maximum, minimum and average value.
Calculation points are a good tool to get the illuminance of stairs, blackboards, etc.

UGR Calculation

A major enhancement of DIALux affects the UGR calculation. It can produce the following UGR results:

1) The UGR table for all luminaires with direct lighting with a spacing to height ratio (SHR) of 0.25 or 1.
2) The single sheet output and the summary of "standard rooms" (rectangular, without furniture, only one type of luminaire) shows the four standard UGR values for the left wall and the lower wall viewing lengthways and across the

luminaire axis. This saves doing the manual calculation with the help of the standard table.

3) You can place UGR observers at workplaces to get UGR values with respect to
    a. position and viewing direction
    b. all used luminaires
    c. position and rotation of the luminaires
    d. shadowing and reflection
4) With UGR calculation areas you get the distribution of the UGR values on an area. The calculation is comparable to the calculation of UGR observers. The output lists information about local glare problems on arbitrary places in the room.

The output of part 1 is a table of the corresponding values. For part 2 and part 3 you get single UGR values. For part 4 you get isolines and greyscale diagram, a chart and a table of the values. Possible UGR values are between 10 and 30. Smaller values are shown as <10. Larger values are shown as >30.

Insert UGR Calculation Point and UGR Calculation Area

You can insert UGR calculation points and UGR calculation areas via Drag and Drop from the furniture tree into the CAD. NOTE: If you place these objects into the ground plan, they are inserted at a default height of 1.2 m. This is the standard value that is used for a sitting observer. If you place them into the 3D view, they are placed on the surface you "touch" with your mouse. For example if you place them into the 3D view of an empty room they are positioned on the floor at a height Z=0.

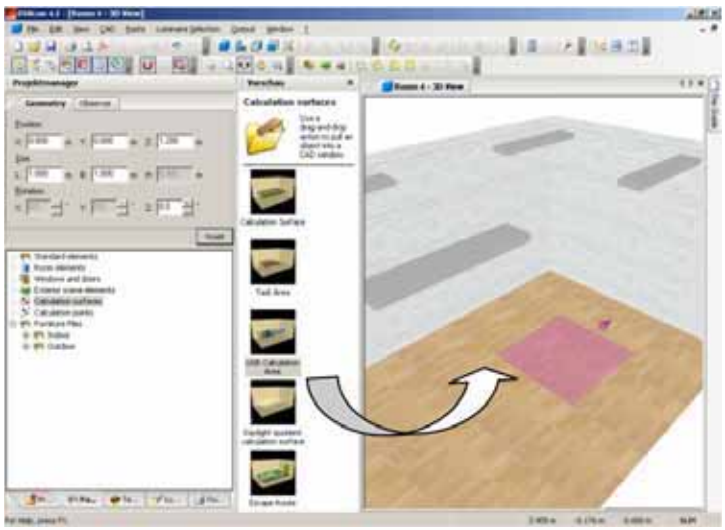


Fig. 285 Insert UGR objects into a room

A second way to insert these objects is to use the Property Page. You just enter the numerical values of the

position, the size and the rotation and click on *Insert*. It is the same Property Page that you can use to modify an existing object.

Adjust Viewing Direction of UGR Observer and UGR Area

To adjust the viewing direction, you can use the corresponding Property Page. A direction of 0° means that the observer looks lengthways, the X-axis. A positive angle means a counter clockwise rotation. An arrow shows the viewing direction.

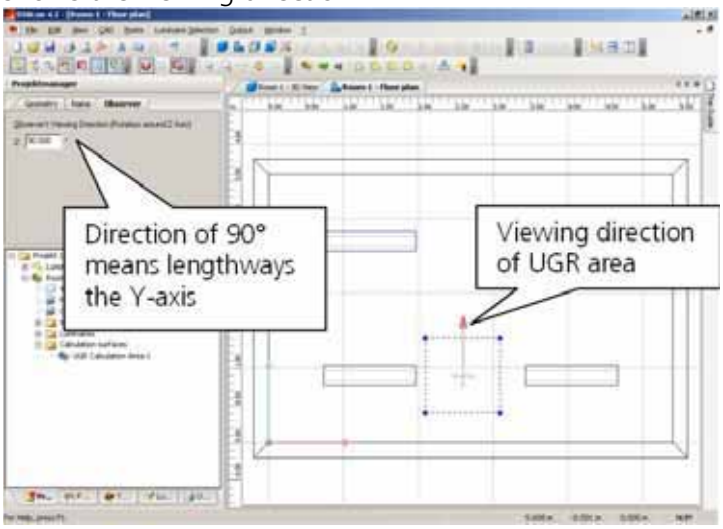


Fig. 286 Viewing direction of an UGR observer

Exterior Lighting

Exterior Scenes

You can use DIALux for planning of exterior scenes with almost the same steps you normally use in indoor lighting. After starting DIALux you will see a startup dialogue.

Fig. 287 Startup dialogue

In the startup dialogue you can choose *New exterior project* and DIALux starts with a new empty exterior scene. You can have rooms, exterior scenes and street scenes in one project.

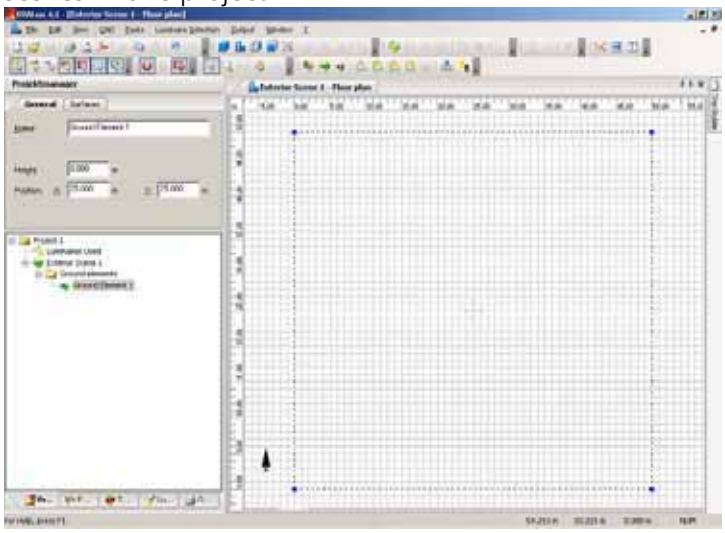


Fig. 288 Start DIALux 4.2 with a new exterior scene

In the *Project manager*, the exterior scene is quite comparable to a room. An exterior scene contains ground elements, furniture and luminaires. The room contains walls, floor and ceiling instead of the ground element.

Ground elements have their own photometric properties. The calculation results are limited to their surface. You can insert additional ground elements from the furniture tree.

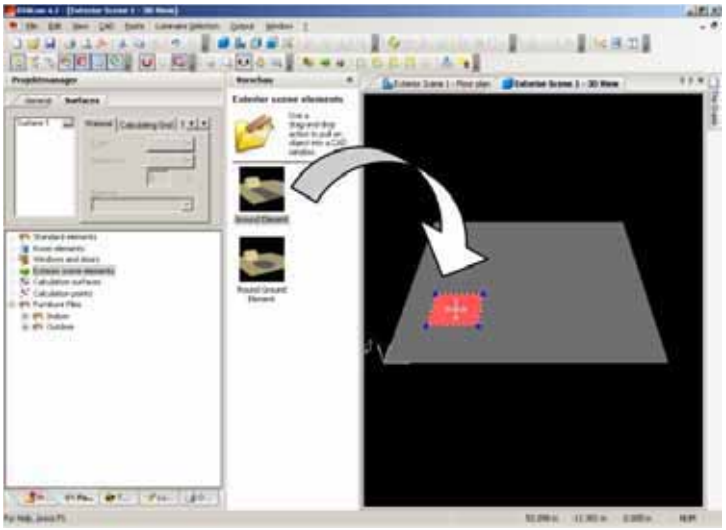


Fig. 289 Insert a ground element from the furniture tree via "Drag & Drop"

You can insert further ground elements from the furniture tree

You can edit a ground element similar to the rooms (see *Edit* mode). They can have any polygonal shape. When you enable the option *Result Output* in the Property Page *Calculation Grid*, DIALux will create the relevant output. You can place furniture and luminaires in the same way as in the rooms of an indoor project.

Ground Elements

A ground element can only be used in an exterior scene. It is an area with a defined shape and an arbitrary height that may for example differ from the rest of the scene only because of its function.

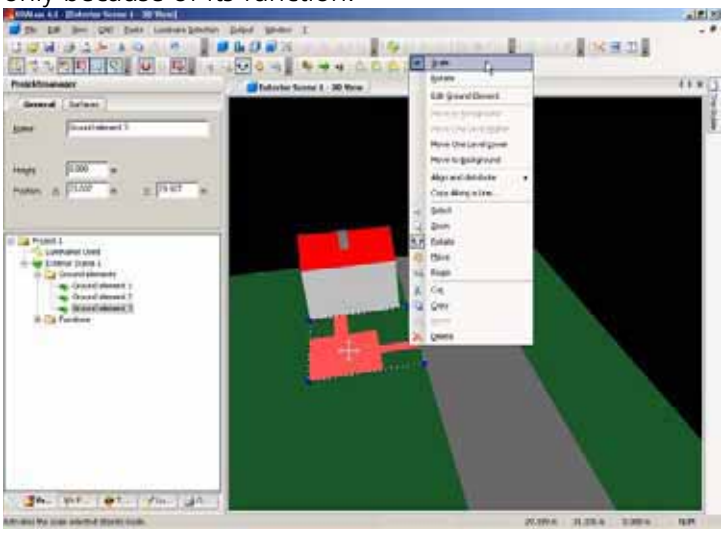


Fig. 290 A ground element

By default a ground element has a rectangular shape and a height of 0.0 m. If you modify the height, the ground element is extruded consists of a top surface and sides. If

you want to modify the shape of the ground element, you can switch to the *Edit* mode with a right click. The *Inspector* shows the different surfaces of the ground element. You can change their material independently and you can select if the different surfaces will be listed in the calculation output. A ground element can appear as a "hole" inside of another ground element. The grey ground element and the selected ground element in the figure above are such "holes" that are cut out of the green meadow. In this example DIALux will not create calculation results for these parts of the outer meadow.

Floodlight Illumination

To calculate the *floodlight illumination* of objects or buildings you start with an exterior scene. On top of the ground element, you place the object you want to illuminate. Now you can select a surface of the object and enable the option *Result Output*…

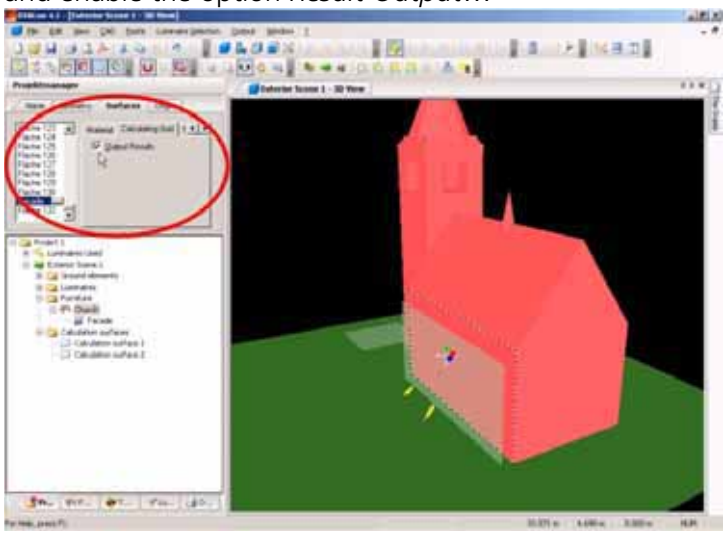


Fig. 291 Calculate results of a surface

… or you can place a calculation surface in front of the object.

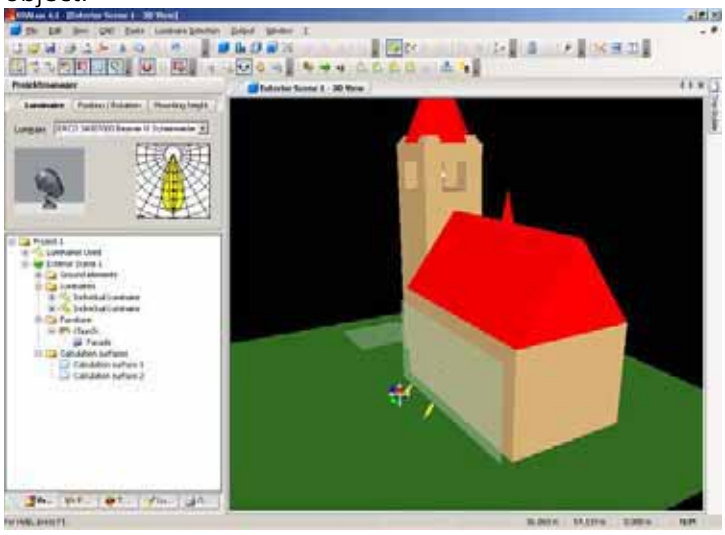


Fig. 292 Illumination of a facade with a calculation surface in front of it

Lighting Design according to prEN12464 Part 2 / EN8995-2

Glare Rating

The draft of EN 12464-2 / EN 8995-2 intends that glare has to be avoided for outdoor working places. To ensure this, glare limits for tasks and activities are prescribed. The glare rating system (GR) is defined in the CIE publication 112:1994. For glare evaluation, the veiling luminances produced by the luminaires and by the environment are the basic criteria. The latter is handled differently by EN 12464-2. In DIALux you can choose, whether you want to use the simplified method of EN or the complete method of CIE. The simplified method approximates the veiling luminance produced by the environment (Lve) with the formula L_{ve}=0.035 x ρ x E_{hav} x π, where ρ is the average reflection and E_{hav} the average illuminance of the "area". Unfortunately this "area" is not exactly defined. DIALux uses all ground elements as the "area".

The complete method of CIE 112:1994 uses the correct veiling luminance produced by the environment in front of an observer. Here the illuminated area is considered to consist of an infinite number of small light sources. The veiling luminance produced by the environment is defined by the formula $L_{ve} = 10\sum_{i=1}^{n} \frac{E_{eye\,i}}{\Theta_i^2}$ where n is the total number of small light sources. Of course, this calculation is more accurate but more time consuming too. The DIALux outputs state which method was used to calculate GR values.

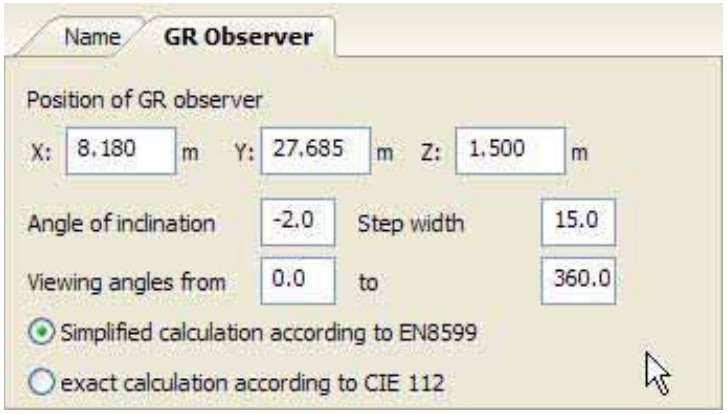


Fig. 293 Property page of the GR Observer

To calculate GR values, DIALux provides the GR observer tab. Any GR observer can be placed just like any other calculation point. There are some special properties, an

inclination angle, viewing angles from a start to an end angle and a step width. The inclination angle defines the observer's viewing direction towards the horizontal. Start and end angle define the observer's vertical viewing section. Here 0° is the direction along the positive X-axis, positive angles move counter clockwise. Step width defines the different viewing directions between start and end angle.

GR observers can easily be placed as a line or even as a field by using the function "Copy along a line".

Obtrusive Light / ULR Calculation

The ULR (Upward Light Ratio) value is the percentage of luminaire flux of a luminaire or a lighting installation that is emitted above the horizontal, where all luminaires are considered in their real position in the installation. Sky glow limitations depend on the environmental zone of the lighting installation. The standard defines four environmental zone categories from E_1 to E_4. E_1 category is used for intrinsically dark landscapes like national parks or areas of outstanding natural beauty. E_4 category is used for high district brightness areas like city centres. Sky glow limitations reach from 0% to 25%.

DIALux states the ULR value on the "Planning data" output page for exterior scenes. DIALux considers only luminaire flux that goes directly into the sky. Luminaire flux above the horizontal, that is both used for lighting of vertical structures such as facades, and is restricted to these structures, will not be considered.

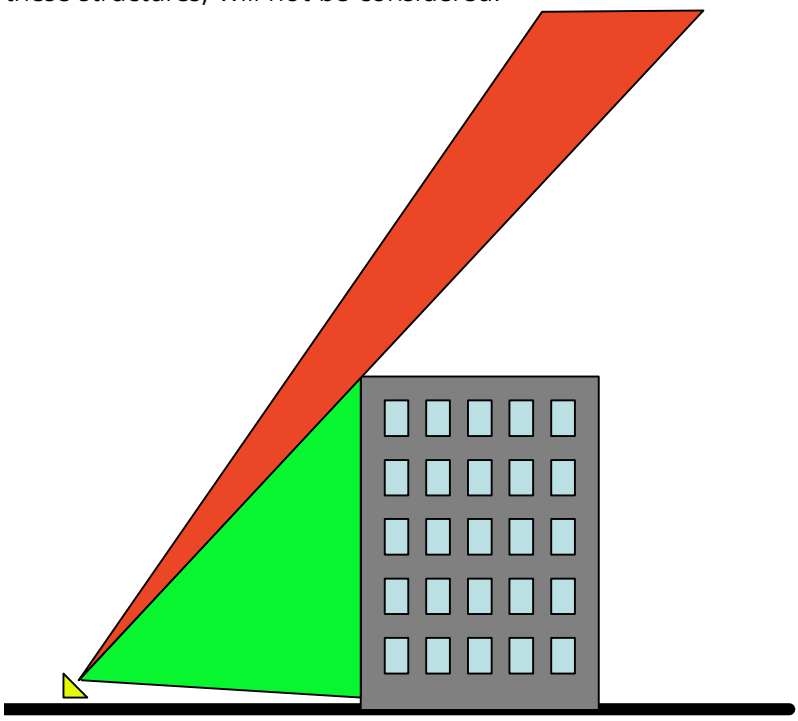


Fig. 294 Luminous flux that is taken into account for the ULR value

Obtrusive Light / Luminous Intensity Calculation Point

To minimize obtrusive light, EN 12464 not only gives limitations for ULR values but also for luminous intensity values in obtrusive directions and light trespass into windows. These limitations depend on the environmental zone category as well. Limitations for light trespass into windows are given in lux. Values can easily be calculated with calculation points and calculation surfaces. To calculate luminous intensity values in obtrusive directions DIALux offers Luminous Intensity Calculation Points. Such points can be placed just like any other calculation points. They consider all luminous intensities of all light emitting surfaces of all placed luminaires. So for a luminaire with two brackets two values are calculated. DIALux uses the luminaire's LDC in the installed position, the luminaire flux, the dimming level and the corrections factor, if applicable, for calculation. A Luminous Intensity Calculation Point can be placed for each potential obtrusive direction.

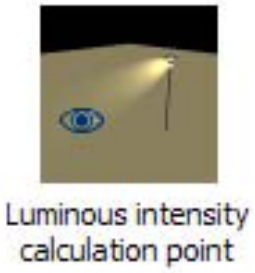


Fig. 295 Luminous intensity calculation point

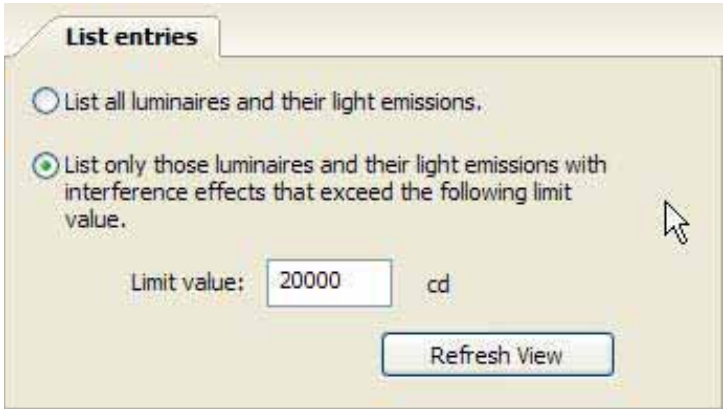


Fig. 296 Property page for the outputs of the luminous intensity calculation point

The luminous intensity calculation point output can be reduced to such luminaires and light emitting surfaces that do not hold a given limitation.

Street Valuation Fields in Exterior Scenes

DIALux users often expressed their wish to use "real" situations for street lighting planning. That is not possible

in a design according to EN 13201 or the obsolete DIN 5044. The "standard street" does not encompass curves or the possibility of changing single luminaire technical values or positions. So we added a new calculation surface for exterior scenes to DIALux, which calculates the luminance distribution on a roadway for an observer: the Street Valuation Field. This calculation considers exactly all luminaires and other objects placed in the exterior scene. Indirect light, e.g. reflections from facades, is not considered, shadowing through trees or buildings is. Because of the strict definitions of street lighting standards, the results of a Street Valuation Field should be used with extreme caution regarding the limitations of EN 13201. Whereas the "standard street" considers a certain amount of luminaires in a line in front and behind a single calculation point, the new calculation surface considers all luminaires in the exterior scene, even luminaires with other tasks.

Fig. 297 Calculation surface Street-valuation field

A Street Valuation Field consists of two parts: the calculation surface itself and a corresponding observer. The surface is visible in CAD windows and can be changed as needed. It can even be polygonal. The observer position and his viewing direction define the calculation grid of the surface. This grid is displayed by little crosses in the CAD. Grid point counts are able to be changed, initially there are 10 x 3 grid points. Initially the observer is placed 60 m to the left from the start of the surface. This is the observer position in a "standard street". The position can be changed as needed. His viewing direction is 0°, that is in direction of the positive X-axis. Therefore the grid points are initially parallel to the X-axis as well.

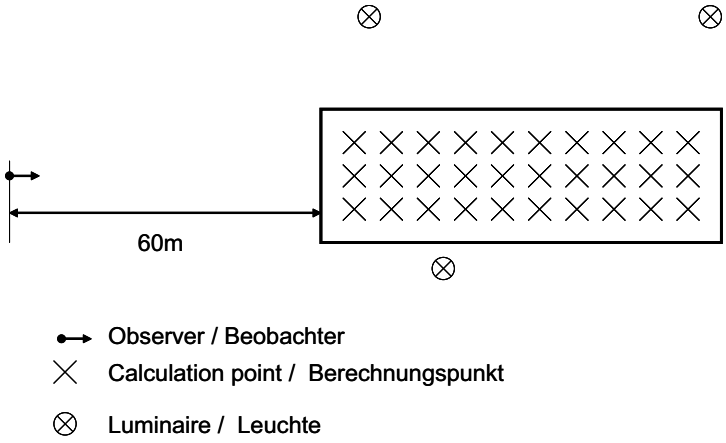


Fig. 298 Simple Street-valuation field in an exterior scene

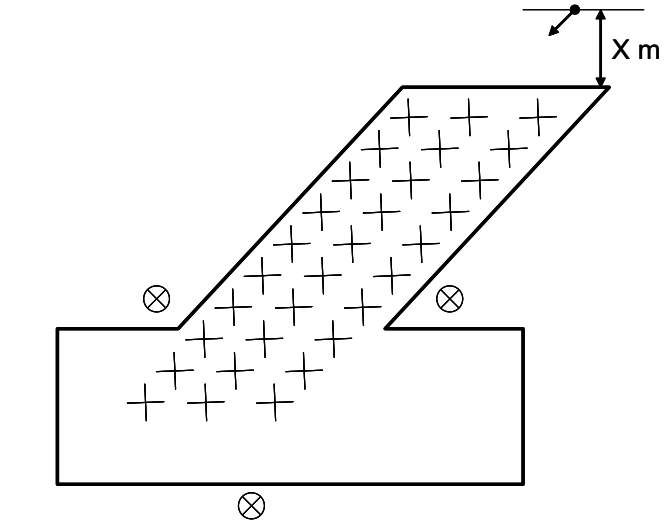


Fig. 299 Complex Street-valuation field in an exterior scene

The first graphic shows a simple example for Street Valuation Fields. It is very close to a "standard street" from EN 13201, only luminaire positions are different. The second graphic shows a more complex example. The observer is placed in the side street and views towards the crossing. His viewing direction (ca. 225°) defines the calculation grid's orientation.
Note: Reflection properties of tarmacs are only defined for close sectors. If the observer is placed too close to or too far away from the surface, no luminances can be calculated.

Road lighting

Standard Streets

You can use DIALux for planning *standard streets*. You may also use a calculation of streets together with rooms or exterior scenes in one project. To insert a street in your project you can select it from the DIALux welcome screen,

Fig. 300 Startup dialogue DIALux – New street project

from the menu *Insert* → *New Scene* → *Standard Street*

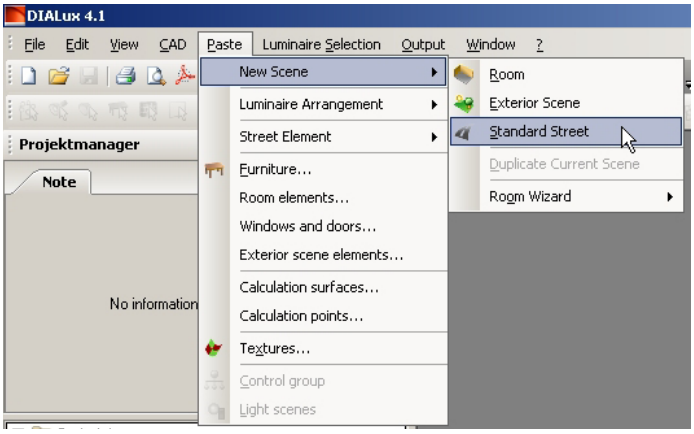


Fig. 301 Insert Standard Street via menu

or from *The Guide*.

Fig. 302 Insert Standard Street via "The Guide"

You can calculate your projects also by means of our quick street planning wizard (see also chapter *Working with Wizards*).

Quick Street Planning Wizard

To use this click with the left mouse button on DIALux *Wizards* in the WELCOME window.

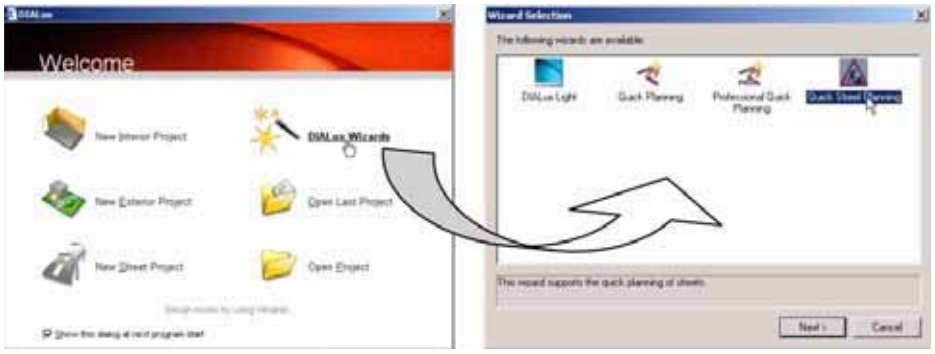


Fig. 303 DIALux wizards – Quick street-planning wizard

If you do not see the WELCOME dialogue any more, you will find the wizards in the menu *File* → *Wizard*.

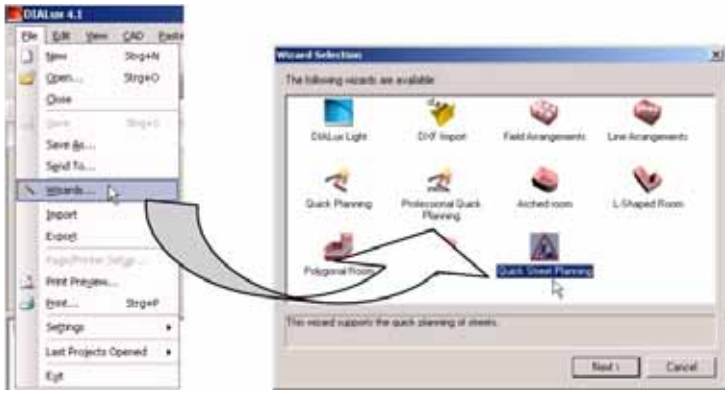


Fig. 304 Wizards via Menu

This wizard guides you through the quick planning for streets.

Fig. 305 Startup dialogue for street light wizard

Here you can specify the single elements for the street and their properties. Confirm each of your steps by clicking on *Next*.

Fig. 306 Street profile

Select those roadway elements which belong to the street profile of the project. The coating can be chosen for dry and wet surrounding conditions. This is necessary only for the calculation of the same uniformity "U0 wet". Street name and maintenance factor are likewise inserted on this page.

In the following window you can fix the individual or combined valuation fields for the street. In order to define photometric requirements for the street, select an illumination class for every valuation field. This is one of the essential innovations of the EN13201.

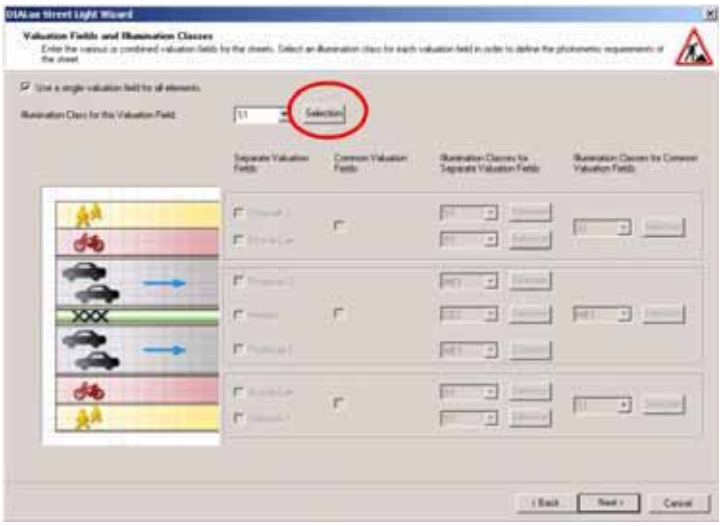


Fig. 307 Valuation Fields and Illumination Classes

By using the *Selection* button the illumination class wizard can be started. To understand this see also the section *Illumination class Wizard*.

You can also select single valuation fields and illumination classes for each element.

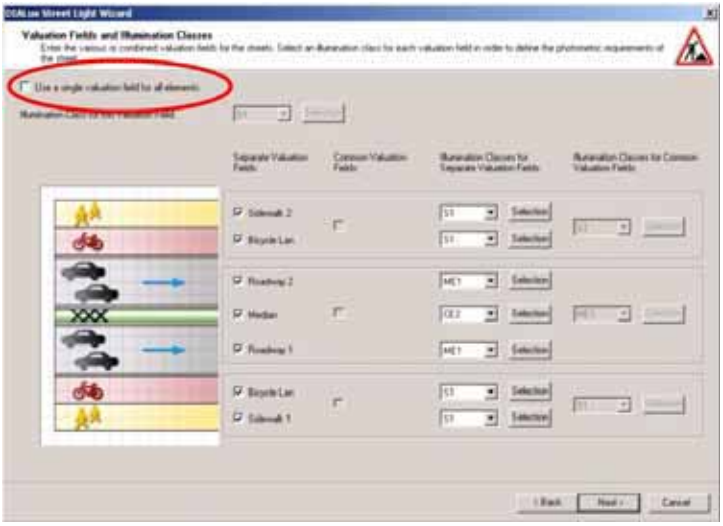


Fig. 308 Valuation Fields and Illumination Classes

In the window *Luminaire arrangement* you can select a luminaire and place this in an arrangement. You can optimise the arrangement parameters depending on the predefined photometric requirements. The illumination class and situation give the parameters to be optimized. Now you can decide which of the arrangement variables should be optimized. These are, e.g., pole distance, height above working plane, slope…. Several variables can be also optimized at the same time.

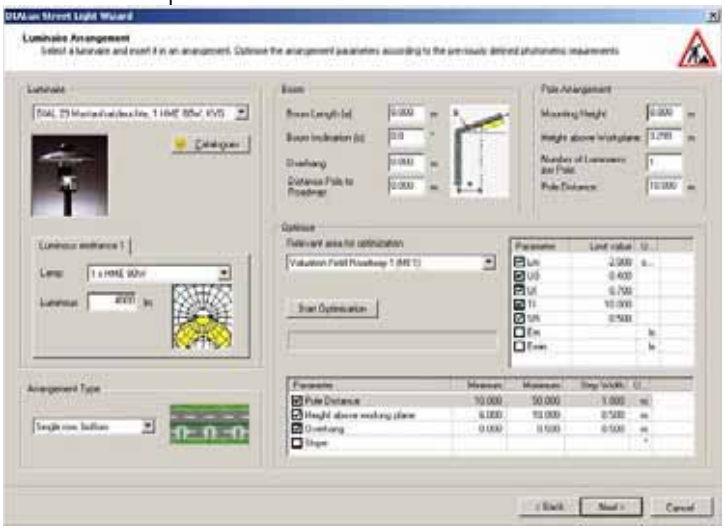


Fig. 309 Luminaire arrangement

Afterwards a final dialogue will appear automatically. If you activate the checkbox, the generated street will be calculated immediately.

Fig. 310 Final dialogue

Click on the *Finish* button and your street project will be displayed. You can do further work on this later.

Street Planning without Wizard

By default a street only consists of one roadway with a valuation field (at the beginning of a street planning).

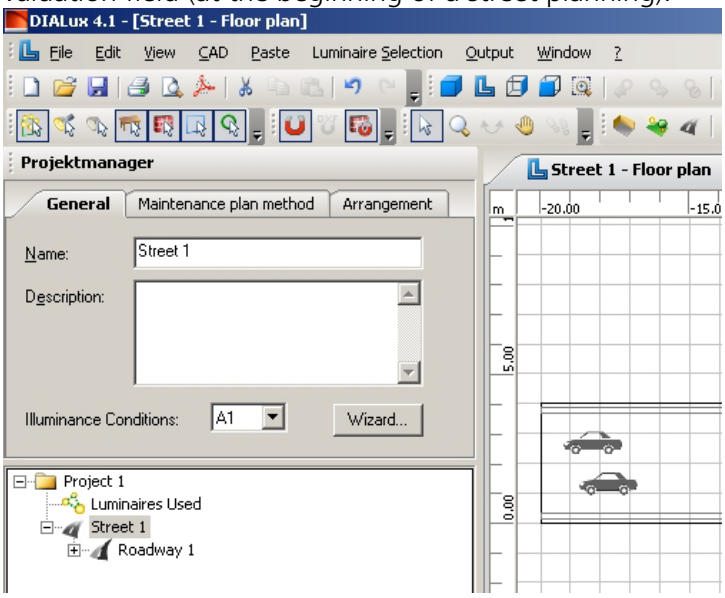


Fig. 311 Insert a new standard street

When you select the street in the *Project manager*, you can adjust some general settings. In the *Inspector* you will find options for the name, a detailed description, the maintenance factor or the design factor and you can fix the illuminance conditions.

The illuminance conditions can be entered manually or determined by means of the wizard. By default your street (project) always gets an illuminance condition with the designation A1.

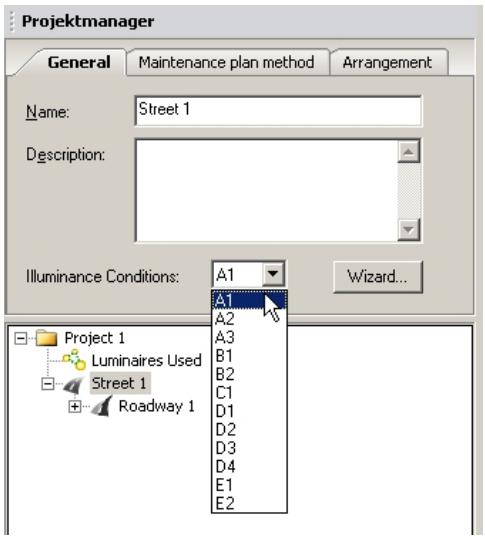


Fig. 312 Illuminance conditions

The illuminance condition is based on the Technical Report of the European committee for standardisation CEN/TR 13201-1. It serves as a basis for the definition of requirements for the street illumination. By means of a wizard the respective illuminance condition of the street can be determined systematically. The illumination condition wizard can be started using the *Wizard…* button (see Fig. 312).

Illumination Conditions Wizard

Fig. 313 Illumination Conditions Wizard – Welcome dialogue

You can set the typical speed of the main user by selecting from four options. Please confirm each of your steps by clicking on *Next*.

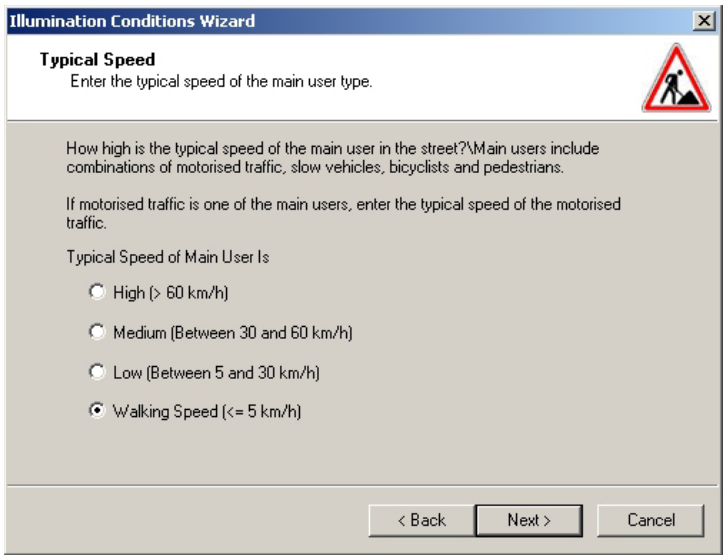


Fig. 314 Illumination Conditions Wizard – Typical Speed

Specify the permitted traffic participants in the window *Main Users and Other Users*.

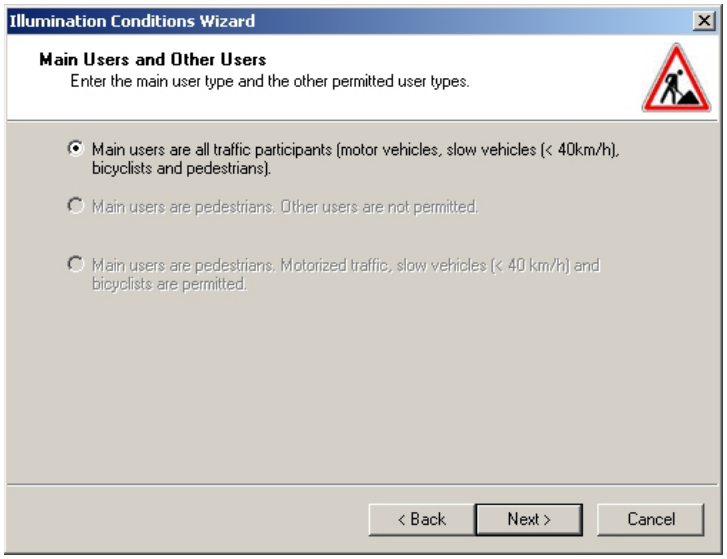


Fig. 315 Illumination Conditions Wizard – Main Users and Other Users

Afterwards a final dialogue appears with the information of the determined illuminance condition.

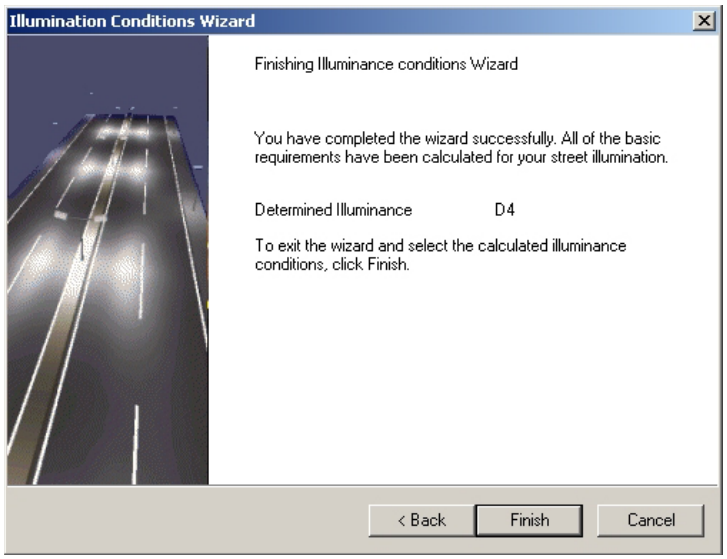


Fig. 316 Illumination Conditions Wizard – Final dialogue

After finishing the wizard DIALux incorporates directly the illuminance condition in your street project.

The wizard has already considered which kind of roadway element you have selected. For example, typical requirements of the roadway do not appear with a sidewalk.

The user has the option to determine the maintenance factor in the Property Page *maintenance plan method*.

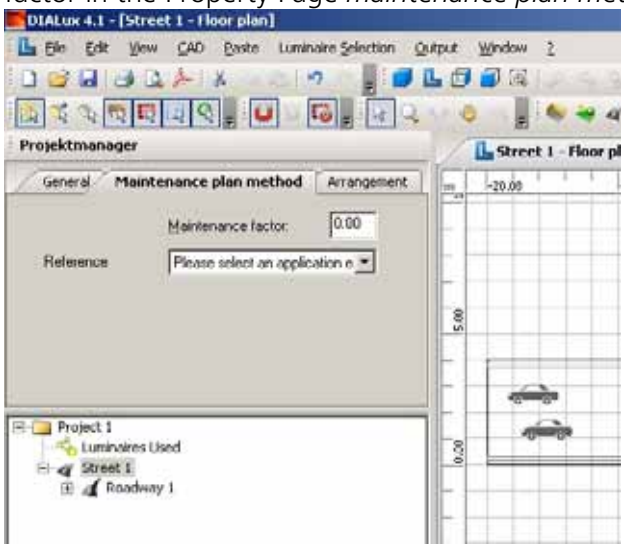


Fig. 317 Maintenance plan method

A standard street may contain certain street elements, which you can add, sort or delete in the Property Page *Arrangement*. To sort the street elements (e.g. sidewalk, bicycle lane, lay-by, …) you can select one of these and use the *Up* or *Down* buttons (see Fig. 318).

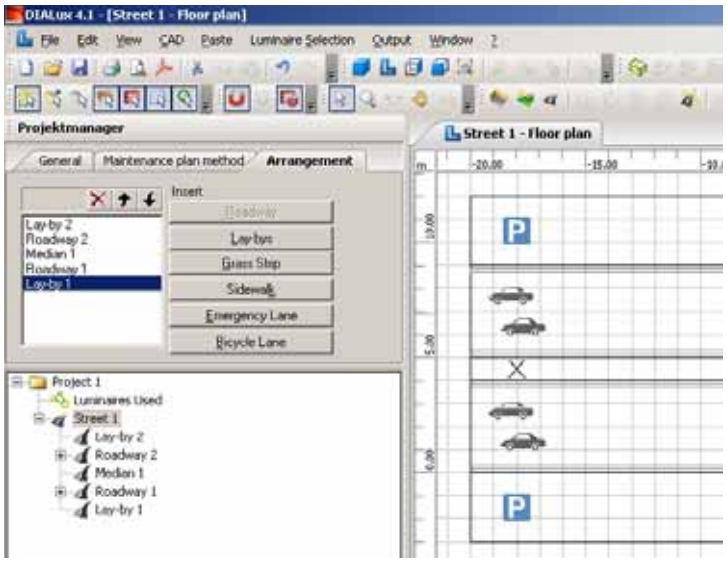


Fig. 318 Insert and arrange the street elements

Optionally you can insert street elements in the menu *Paste → Street Element*

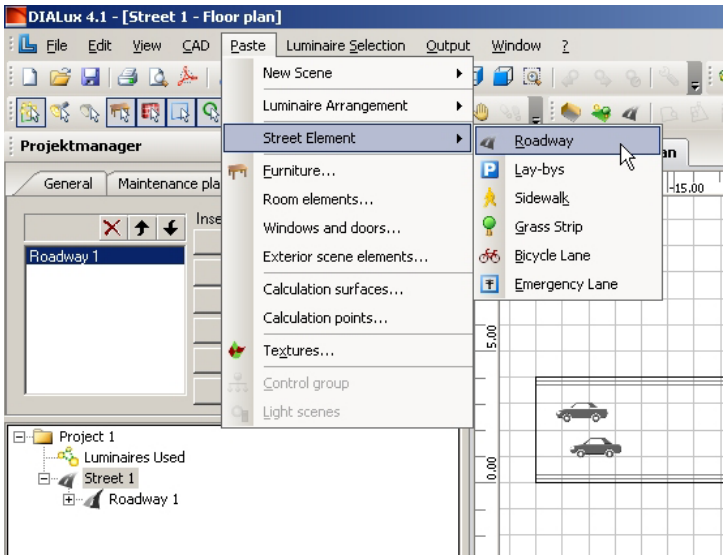


Fig. 319 Insert street elements via menu

or by means of the right mouse in the context menu of the street.

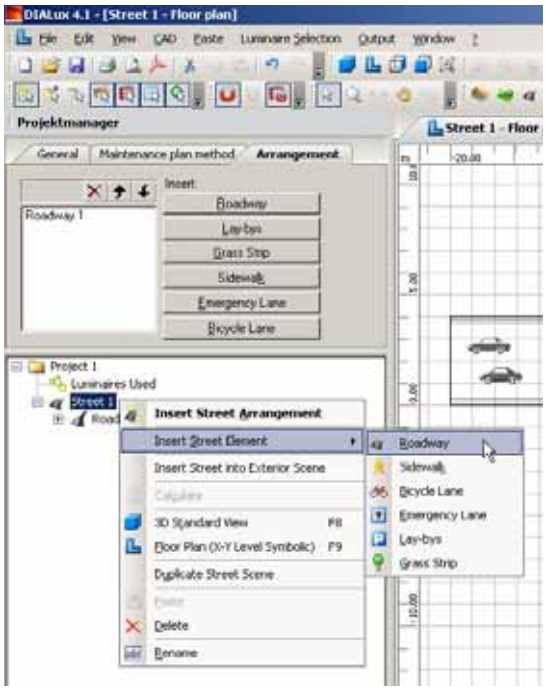


Fig. 320 Insert street elements via context menu

When you select a single street element in the *Project manager* or in the CAD view, you can see and modify the properties in the *Inspector*.

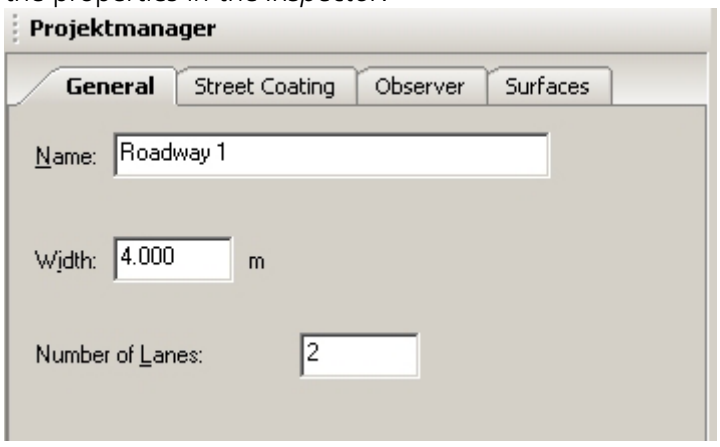


Fig. 321 Properties of a roadway – General

For example the properties of the roadway can look like:

- Width: 4.000m
- Number of lanes: 2
- resulting width of a lane: 2.000m

The tarmac and the luminance coefficient can be modified in the Property Page *Street Coating.*

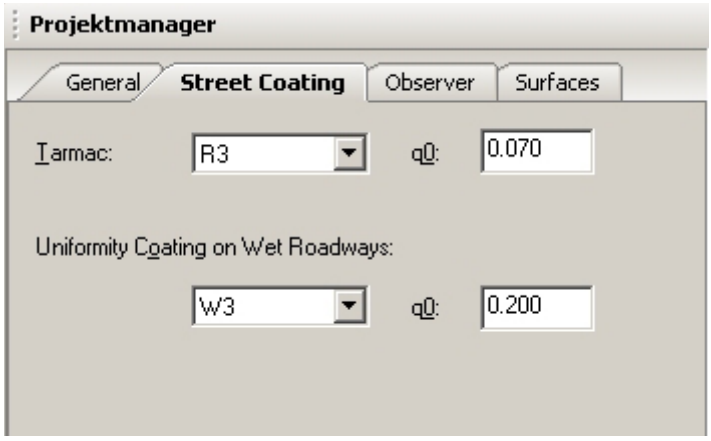


Fig. 322 Properties of a roadway – Street coating

Each street has an observer whose average age can be varied individually for the calculation of TI.

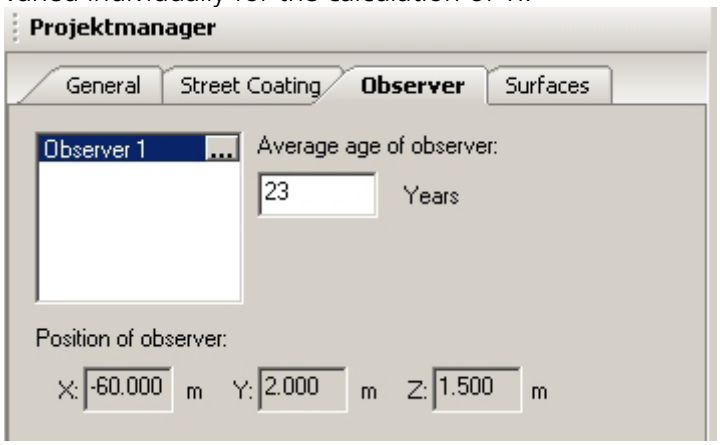


Fig. 323 Properties of a roadway – Observer

DIALux positions the observers automatically according to the default of the EN. The observer is always 60m in front of the valuation field in the middle of the respective roadway, at a height of 1.5m above the ground. Normally every roadway has an observer who looks in the direction of the driving direction. On the basis of the resulting symmetries a rotation of the observation direction is not necessary.

The Property Page *Surfaces* offers the possibility to set *material*, t*exture* and *Raytracer Options*. All settings only have an effect on the visualisation, but not on the calculation results.

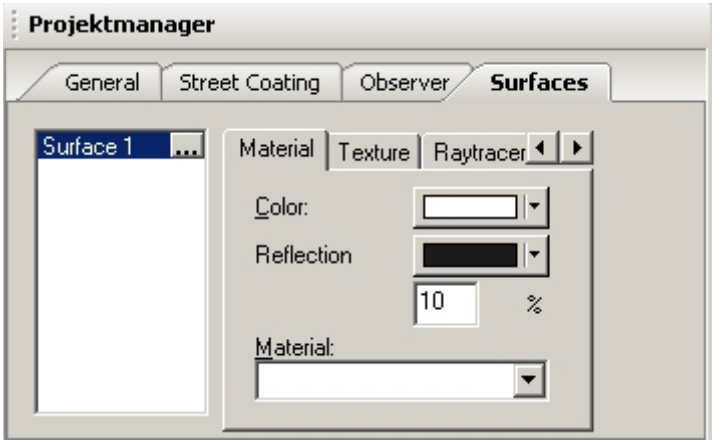


Fig. 324 Properties of a roadway – Surfaces

In the default setting median, parking lane and grass strip have no valuation field. Nevertheless, this can be inserted, while the respective street element is marked in the *Project manager* and with the right mouse button the option *Insert Valuation Field* is chosen.

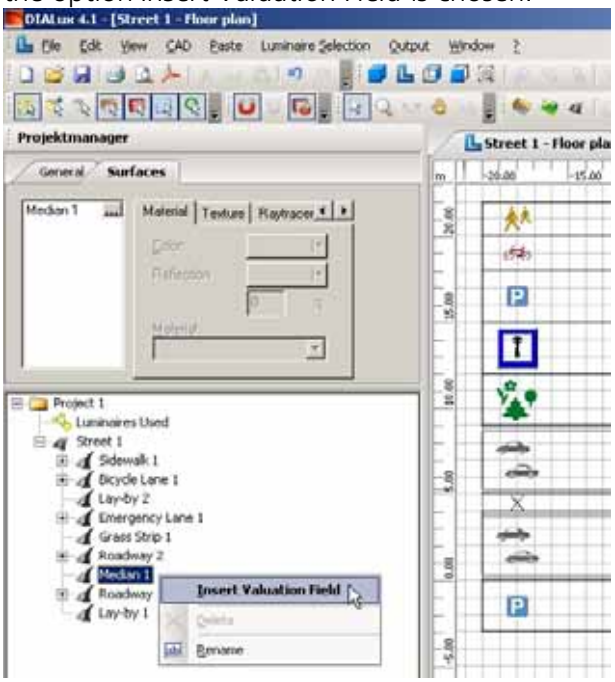


Fig. 325 Insert valuation field via context menu

Similarly a valuation field can be deleted or renamed by means of right mouse button.

The new EN allows the use of common valuation fields for different roadway elements. In the wizard this is possible by choosing the suitable checkbox. If additional validation fields are selected several more steps are necessary. DIALux defines for every surface (except median, parking lane and grass strip) a valuation field. Now if you want to have, for example, a bicycle lane and a sidewalk with a common valuation field, you must first cancel the existing valuation fields. Then select both roadway elements for which you would like to have a

common valuation field by pressing the shift key and clicking those roadway elements. Then do a right-click on the marked objects and choose *Insert Valuation Field*. Now you will get a common valuation field for both roadway elements.

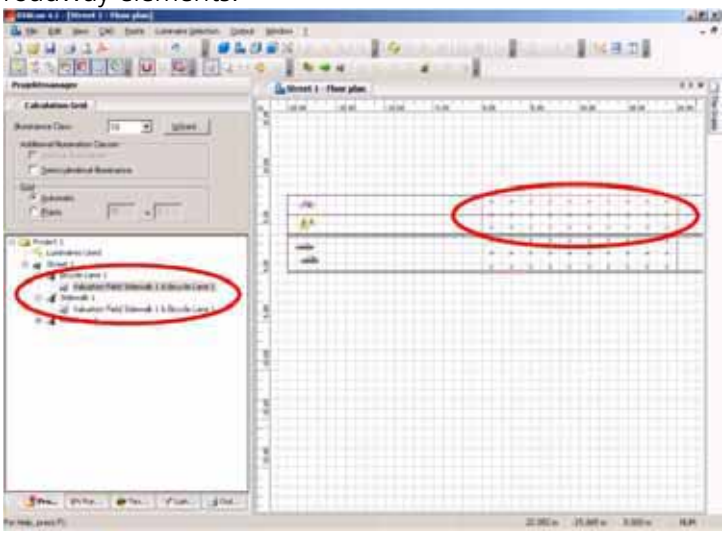


Fig. 326 common valuation field

If you mark a *valuation field* in the *Project manager*, the Property Page *calculation grid* opens in the *Inspector*.

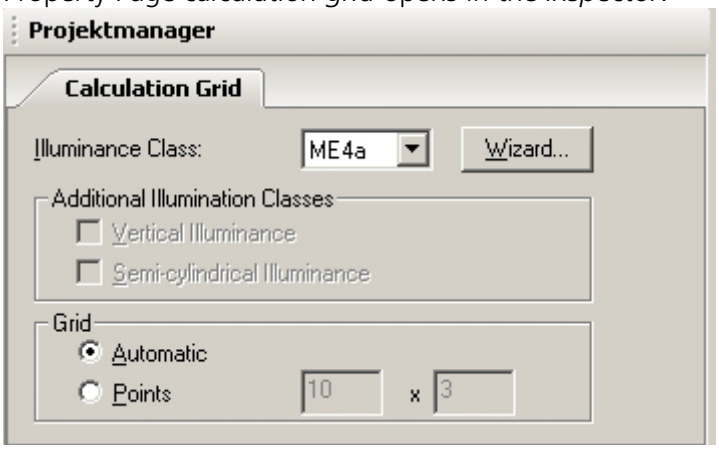


Fig. 327 Calculation Grid

The grid is generated automatically according to the EN13201. If the checkbox "*Automatic*" is chosen, the right number of calculation points is always chosen. If you want a grid different to the standard, here you can give the number of the calculation points in the X direction (longitudinal direction of a roadway) and the Y direction (width of a lane), after you have activated the checkbox "*Points*".

NOTE: Then the results are no longer according to the standard EN13201.

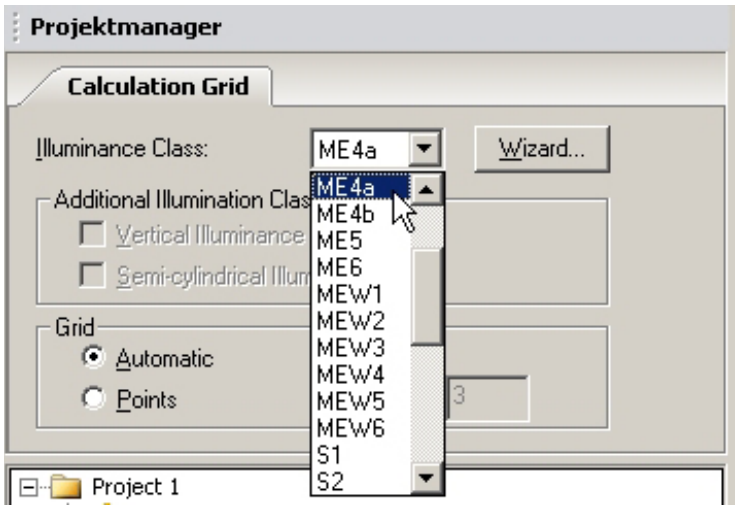


Fig. 328 Calculation Grid – Illuminance Class

Here you have the option to specify the *illuminance class*. Either the given illuminance class is selected manually from the available list, or by using the wizard to determine the illuminance class in according to the European Standard CEN/TR 13201-1. The illuminance class contains a summary of the photometric requirements for your project which depends on the visual needs of specific street users using different kinds of traffic surfaces and their environment. Additional *illuminance classes* can be chosen according to street situation for *vertical* and *semicylindrical* illuminances (q.v. EN13201 – 1, chapter 6.4).

For valuation fields requiring illuminances rather than luminances it can be necessary within the scope of the norm to calculate each of four illuminances dimensions dependent on the interpretation criteria according to EN13201-2. These are:

- horizontal illuminance;
- hemispherical illuminance;
- semicylindrical illuminance;
- vertical illuminance.

Horizontal illuminance is always calculated. However, in some countries hemispherical illuminance is needed instead of horizontal illuminance.
Similarly this is always calculated and can be selected in the output for the printout. In table 4 of the CEN/TR 13201-1 the alternative A-classes are specified for the S-classes. Accordingly DIALux changes the necessary illuminance dimensions in the outputs.

Horizontal illuminance:
Calculation points shall be located in a plane at ground level in the relevant area.

Hemispherical illuminance:
Calculation points shall be located in a plane at ground level in the relevant area.

Semicylindrical illuminance:
Calculation points shall be located in a plane 1.5m above the surface in the relevant area. Semicylindrical illuminance varies with the direction of interest. The vertical plane at right angles to the rear flat surface, shall be oriented parallel to the main directions of pedestrian movement, which for a road is usually longitudinal.

Vertical illuminance:
Calculation points shall be located in a plane 1.5m above the surface in the relevant area. Vertical illuminance varies with the direction of interest. The vertical illumination plane shall be oriented at right-angles to the main directions of pedestrian movement, which for a road are usually up and down the road.
You can activate the wizard for the determination of an illumination class via the wizard... button (see figure 178). After starting it you are welcomed by a welcome screen.

NOTE:
The single steps to the calculation of an illuminance class by means of the wizard depend in each case on the kind of marked street element. The specific requirements for the illumination class are influenced by the kind of street user or the kind of street.

With the help of the following example we would like to explain to you the functionality of the wizard for the determination of the illuminance class of a street.

Illumination Class Wizard

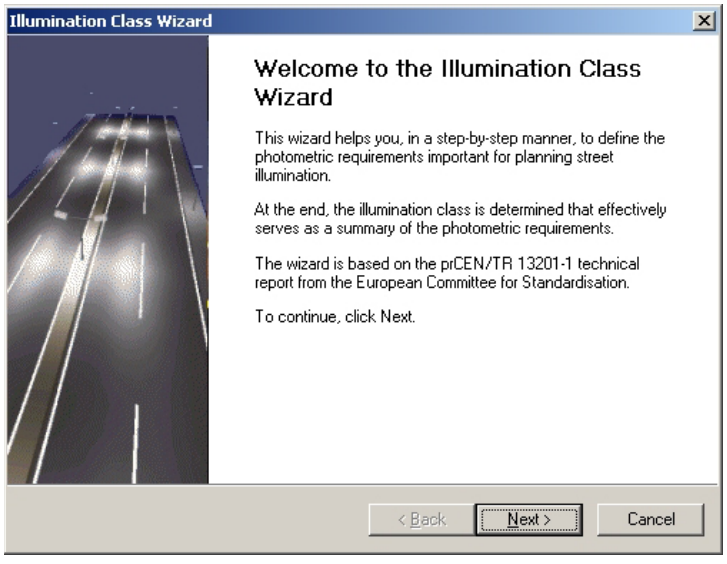


Fig. 329 Illumination Class Wizard – Welcome dialogue

After activating the *Next* button you are called on to specify the typical speed of the main user.

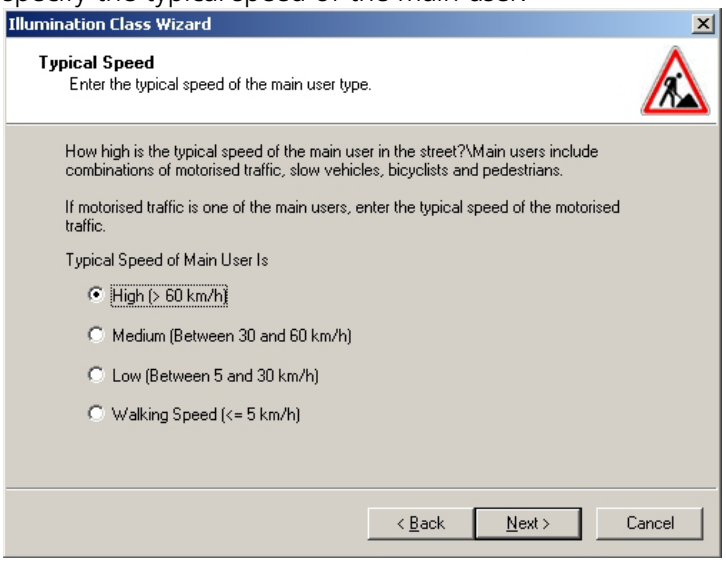


Fig. 330 Illumination Class Wizard – Typical Speed

You can define the admitted main user in the street in the window *Main Users and Other Users*. Confirm each of your steps by clicking on *Next*.

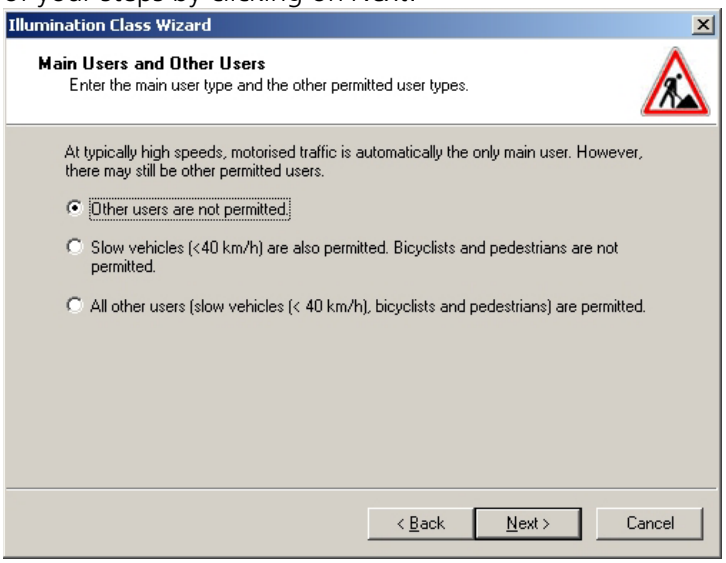


Fig. 331 Illumination Class Wizard – Main Users and Other Users

Afterwards you enter the typical weather.

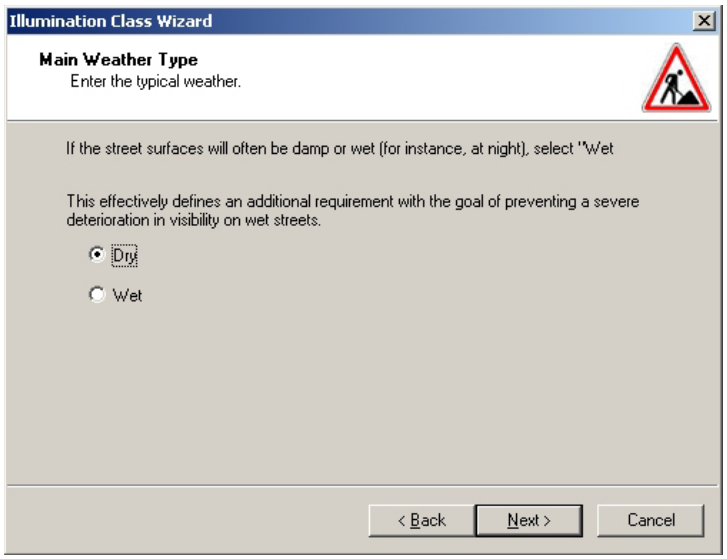


Fig. 332 Illumination Class Wizard – Main Weather Type

In the window *Interchanges* you choose the kind and frequency of the interchanges.

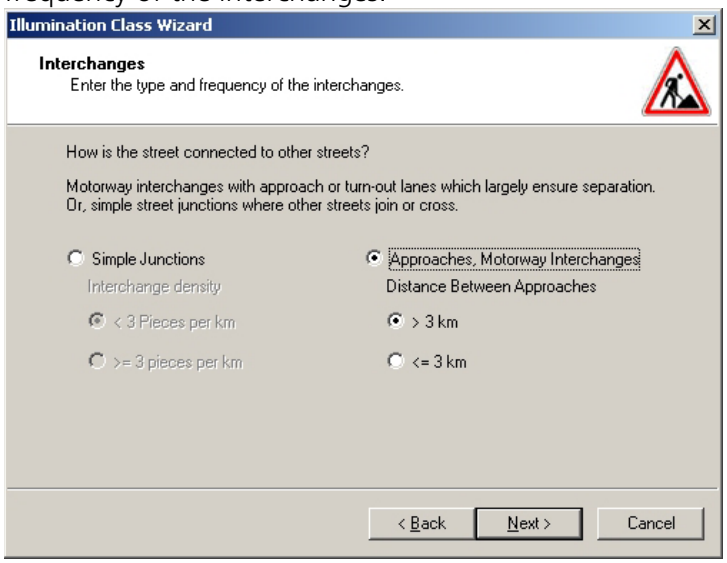


Fig. 333 Illumination Class Wizard – Interchanges

Specify the *traffic flow of motorised vehicles*, if it concerns vehicles for motorised traffic.

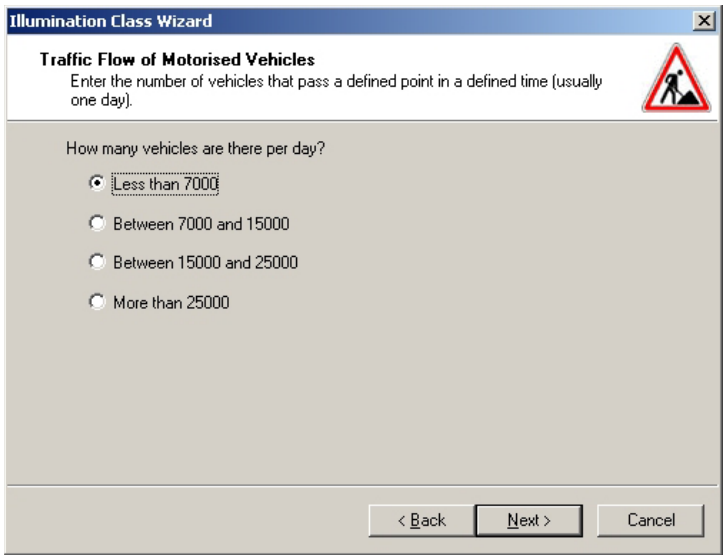


Fig. 334 Illumination Class Wizard – Traffic Flow of Motorised Vehicles

In the window *Conflict Zone* select whether a conflict zone exists or not.

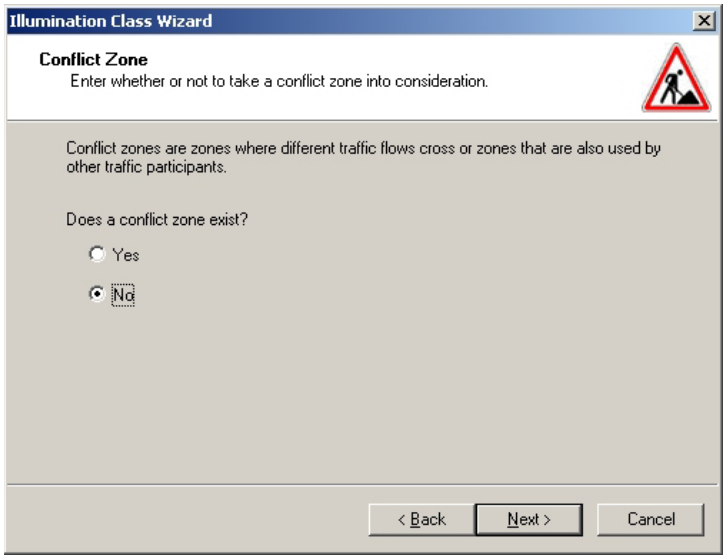


Fig. 335 Illumination Class Wizard – Conflict Zone

Specify the *Complexity of Field of Vision*.

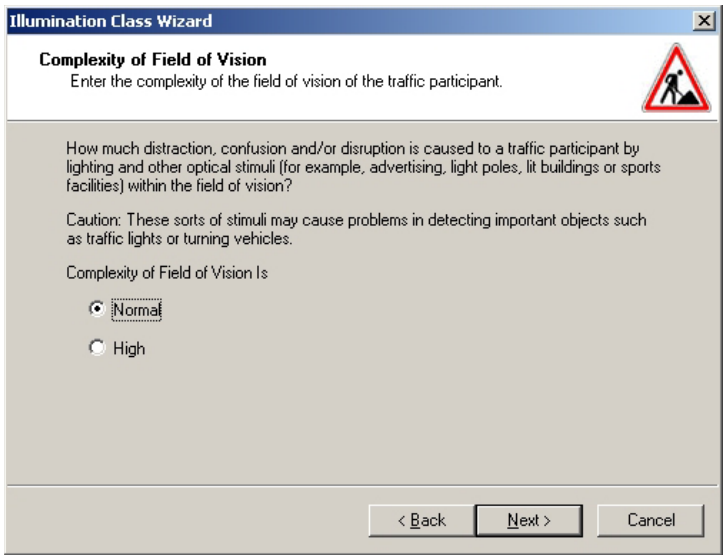


Fig. 336 Illumination Class Wizard – Complexity of Field of Vision

You define the *Degree of Navigational Difficulty* of the traffic participant in the associated window.

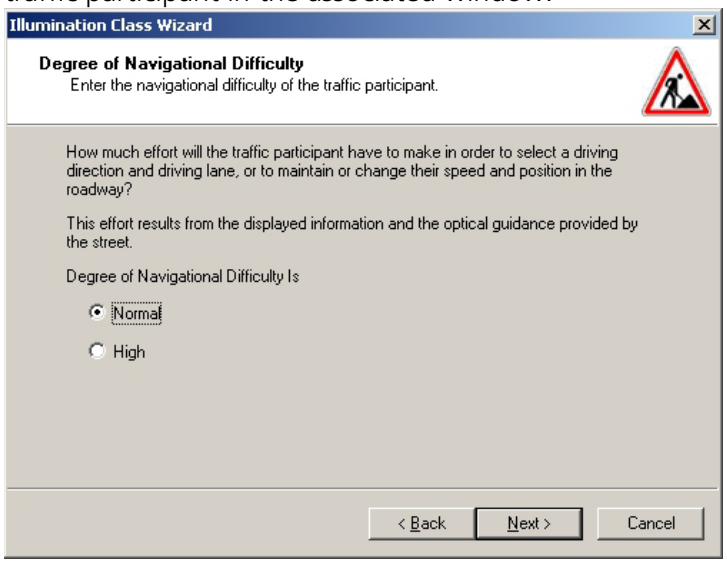


Fig. 337 Illumination Class Wizard – Degree of Navigational Difficulty

Afterwards you can select the estimated *Brightness of Surroundings.*

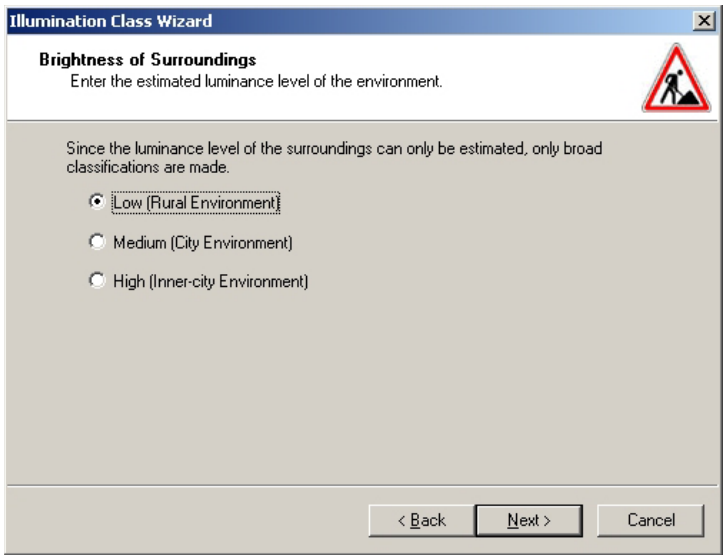


Fig. 338 Illumination Class Wizard – Brightness of Surroundings

The wizard indicates to you the determined illumination class in the final dialogue. Upon completion of the wizard the illumination class is automatically taken over in your calculation grid in DIALux.

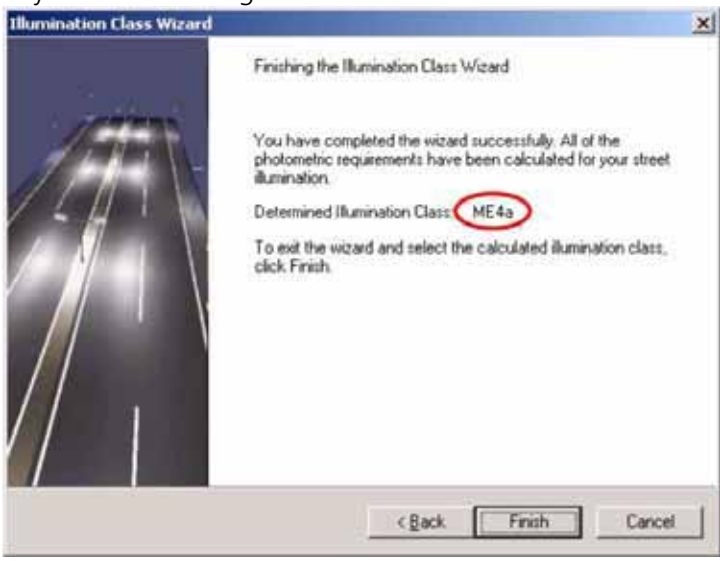


Fig. 339 Illumination Class Wizard – Final dialogue

Street Illumination

A standard street can contain several *street arrangements* of luminaires but no other luminaire arrangements or furniture. The v*aluation field* is defined with the first street arrangement.

To insert the street arrangement you can use *The Guide*

Fig. 340 Insert street arrangement via "The Guide"

or the menu *Insert* → *Luminaire Arrangement* → *Street Arrangement* when you have selected the street in the *Project manager*

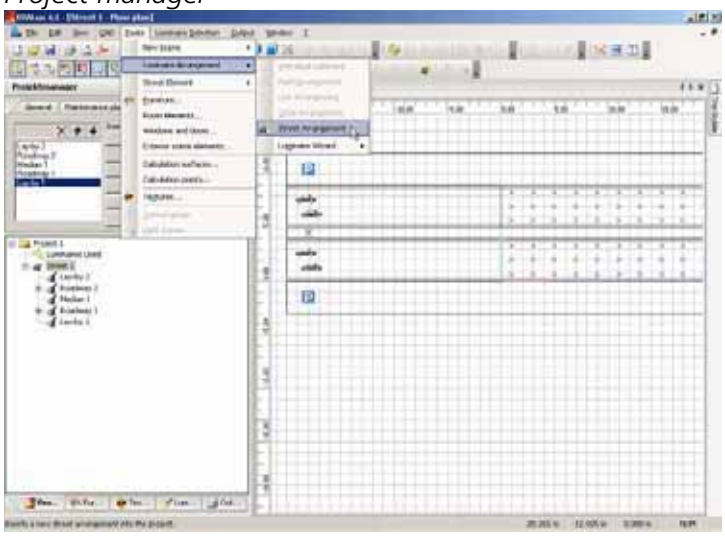


Fig. 341 Insert street arrangement via menu

or by means of right mouse button, after you have picked the street in the *Project manager*.

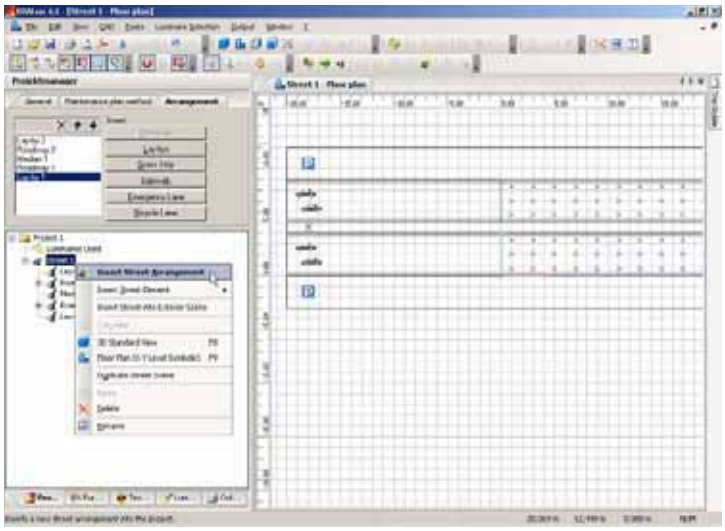


Fig. 342 Insert street arrangement via right mouse button

DIALux offers all the key parameters for positioning street luminaires.
To position luminaires first you select the type of luminaire in the manufacturers PlugIn. Now you use the option *Insert Street Arrangement* and choose the product from the luminaire list.

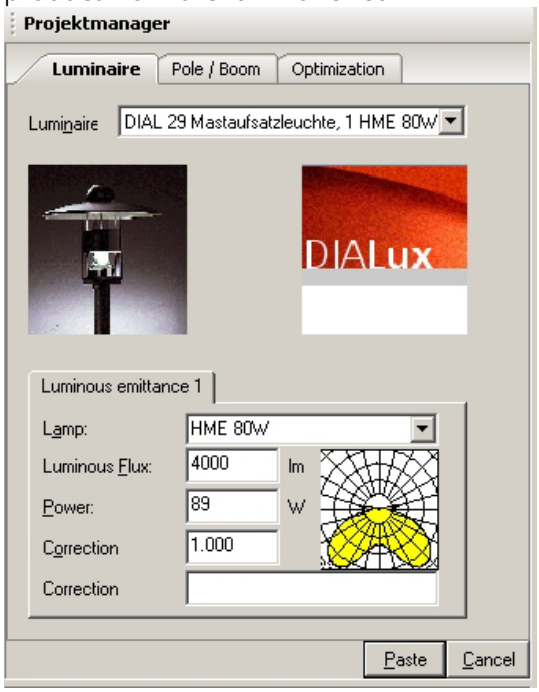


Fig. 343 Insert Street Arrangement – Luminaire

The Property Page *Luminaire* allows you a choice of luminaires, as well as the entry of technical data for the luminous emittance.

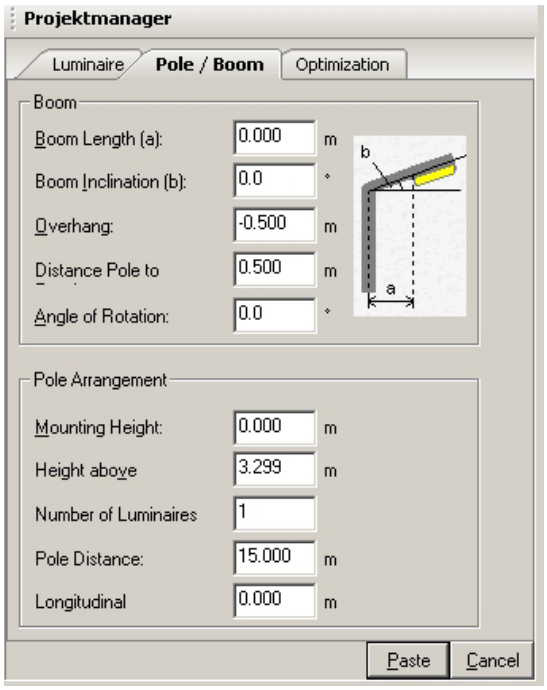


Fig. 344 Insert Street Arrangement – Boom properties and pole arrangement

In the Property Page *Pole / Boom* you can define specific properties of the boom as well as the pole arrangement.

The drawing in Fig. 344 illustrates the *Boom Length* and *Boom Inclination*. The *Overhang* defines how far the middle of the luminaire plane (centre of gravity of the luminaire) overlaps the roadway. The *Distance Pole to Roadway* is measured between the root point of the pole and the border of the roadway. Additionally you can specify the *Pole Arrangement* here.

A good way to get the optimal distance between the luminaires is to use the Property Page *Optimisation*. Under *Arrangement Type* you can define the place along the street where you want to install the luminaires. A list of arrangement types are available to you.

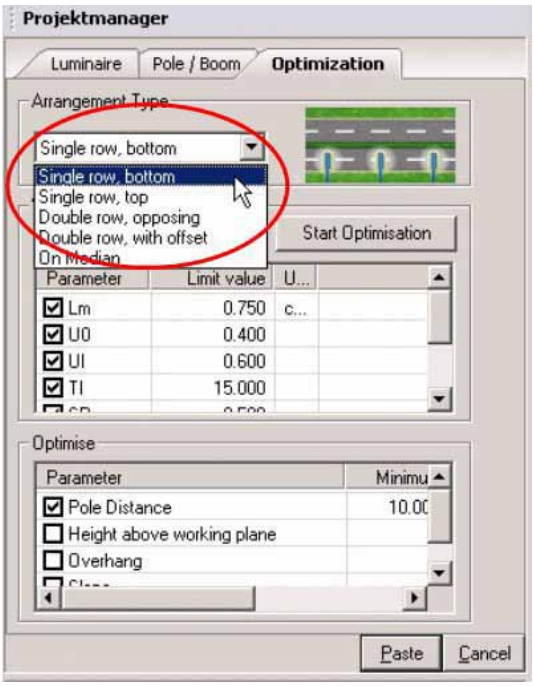


Fig. 345 Insert Street Arrangement – Select the arrangement type

In the *valuation field* you can specify the photometric values of the roadway (illumination class and condition). In this Property Page the minimum values to be reached for the illumination class are already entered. If you wanted to optimise on other values, enter here the desired limit values. You activate the optimisation via the *Start Optimisation* button. Be aware that if you optimise many parameters at the same time, the calculation time can take several minutes.

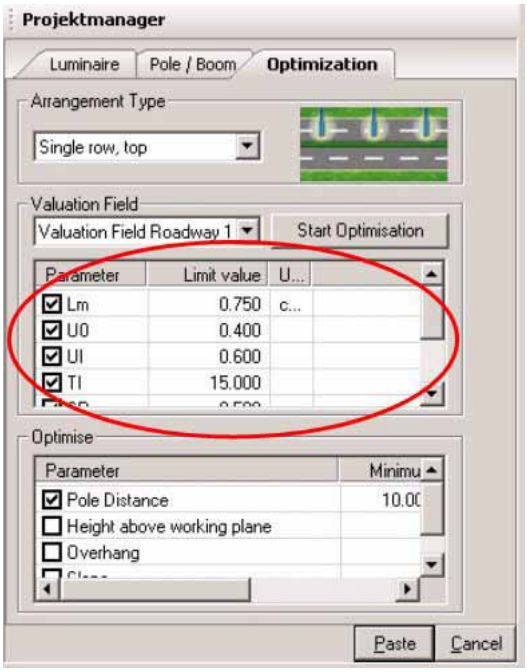


Fig. 346 Insert Street Arrangement – Optimisation / Valuation Field

Then DIALux calculates according to the choice and weighting of the parameters, the optimal pole distance,

the height above working plane, the overhang and the slope. The checkbox provides for the activation or deactivation of the parameters to be optimised. The purpose of the optimization is to find the maximum pole distance, the minimum height above the work plane, the minimum overhang and/or the minimum inclination slope.

The optimisation is carried out before the arrangement is placed; however it can be accomplished after the insertion.

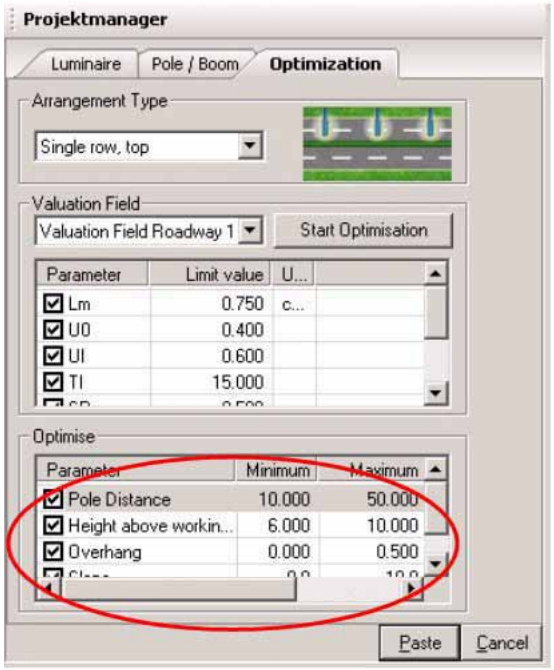


Fig. 347 Insert Street Arrangement – Optimise

Alternatively you can enter the values numerically, in order to fix the *minimum*, *maximum* or the *step width* of the respective parameters. To insert the luminaire arrangement in your street project, please, click on the *Paste* button.

In the context menu of the street arrangement you can optimise individually the arrangement of your luminaires. To do this select with the right mouse button the *street arrangement* in the *Project manager*.

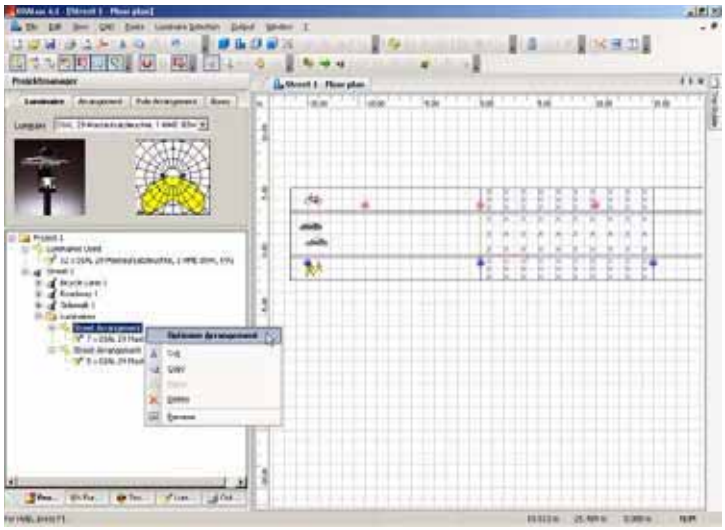


Fig. 348 Street arrangement – Optimise arrangement

The luminaire arrangement always defines the valuation field. If you insert several luminaire arrangements, the resulting valuation field depends on each case of the maximum (pole) distance between two luminaires, shown in the following example (see Fig. 349).
The luminaires of the lower arrangement therefore specify the calculation field.

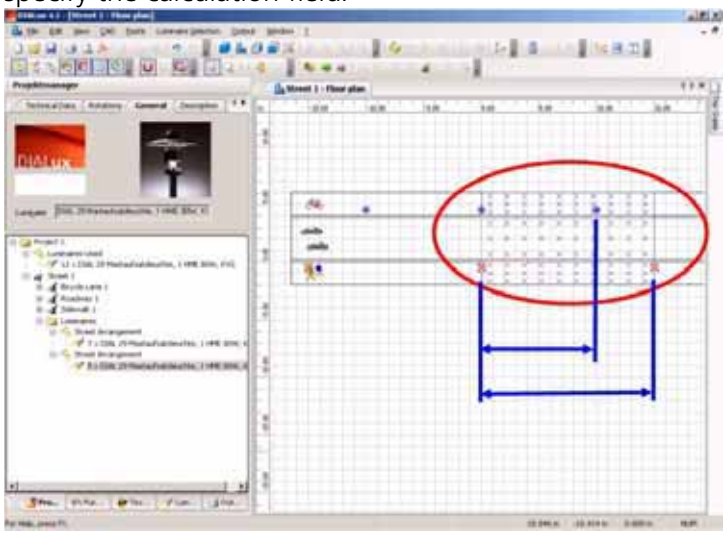


Fig. 349 Calculation field in the ground plan view

The starting point of the arrangement, relatively to the calculation field can be changed under *Pole Arrangement* → *Longitudinal*.

The *Inspector* provides technical data on the inserted luminaire arrangement (see chapter *Luminaire Arrangement*).

DIALux displays the street in 2D and in 3D view just like rooms and exterior scenes.

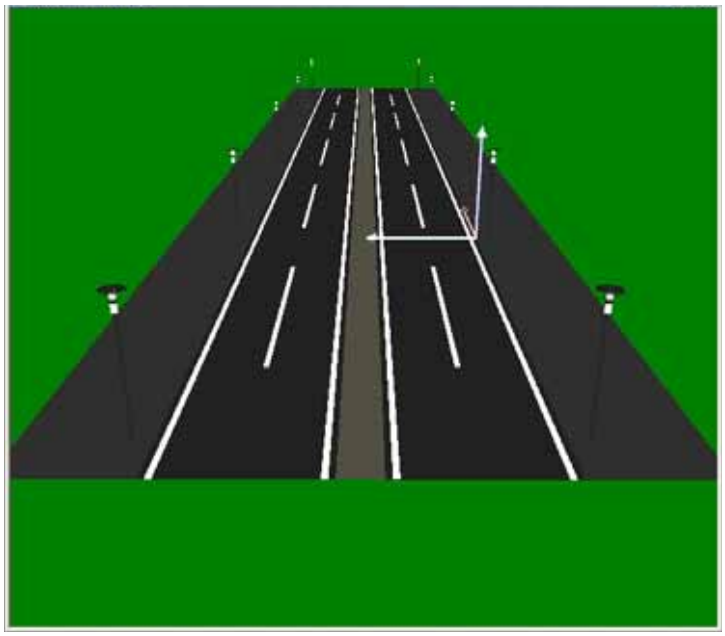


Fig. 350 3D visualisation of the street

You can rotate, zoom and roam the 3D view and export it as *.jpg like all other scenes.
NOTE: The rendering shows the distribution of the illuminance but not the luminance.

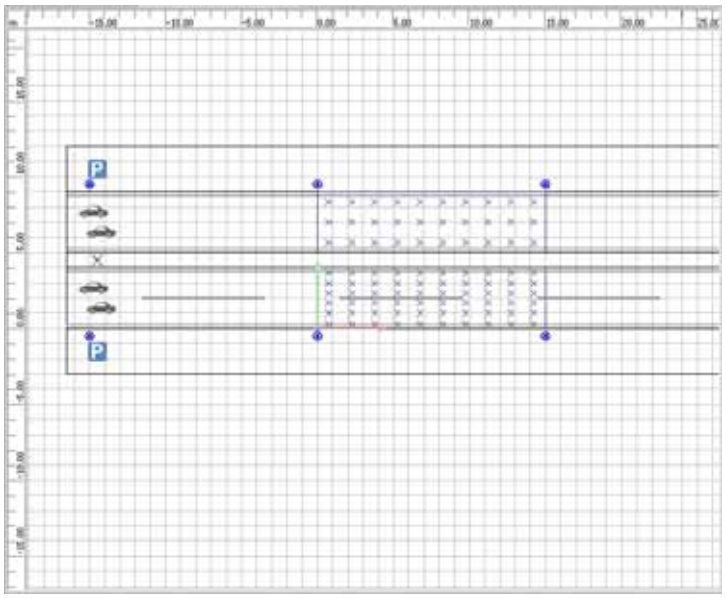


Fig. 351 2D visualisation of the street

In the floor plan view DIALux also shows the valuation field / calculation grid together with the street elements and luminaires.

DIALux offers the option to insert streets into exterior scenes.

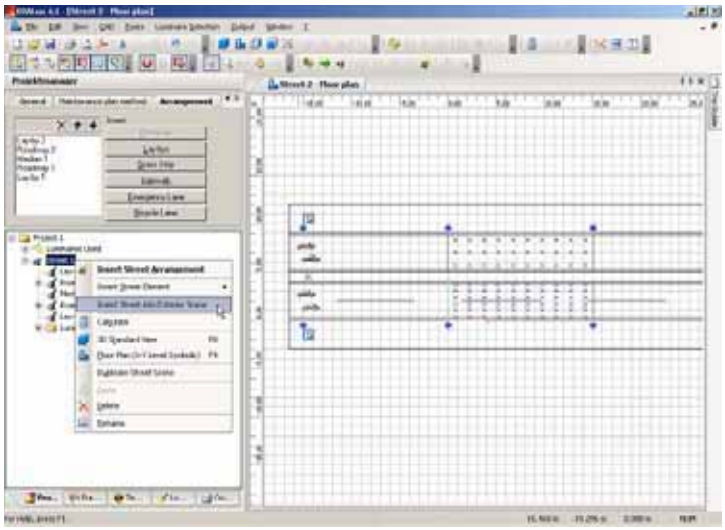


Fig. 352 Insert street into exterior scene

Insert a street into exterior scene

You can work on the individual street elements and luminaire arrangements in the same way as you did in your street project. All street elements are shown in the exterior scene as ground elements.

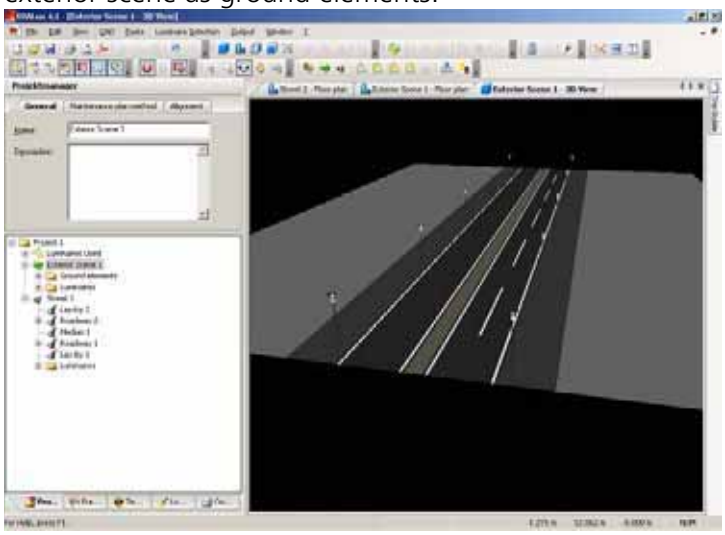


Fig. 353 Street in an exterior scene

Luminance Calculation according to DIN 5044

In 2005 EN 13201 was established for street lighting planning. DIALux users can do street lighting planning according to that standard from version 3.1.5. But sometimes it is necessary to do planning with obsolete DIN 5044, for example for checking old street luminaire arrangements. For such circumstances, DIALux allows street light planning according to DIN 5044. In a street's Property Page "General" you can select "DIN 5044" from the "Illuminance Conditions" selection.

Fig. 354 DIN 5044 for the road lighting calculation

Global Output Settings

User Data and Project Data

In the menu *Settings* → *General Options* → *Output* you can define user and project data that are stored as default values. These are used when you create a new project (see also page 52).

In the Property Page *Output* you can specify a *.bmp file as a logo. The footer line is used for page 2 and the following pages. Furthermore you can specify the names of five edit fields that are used later for information on the cover page.

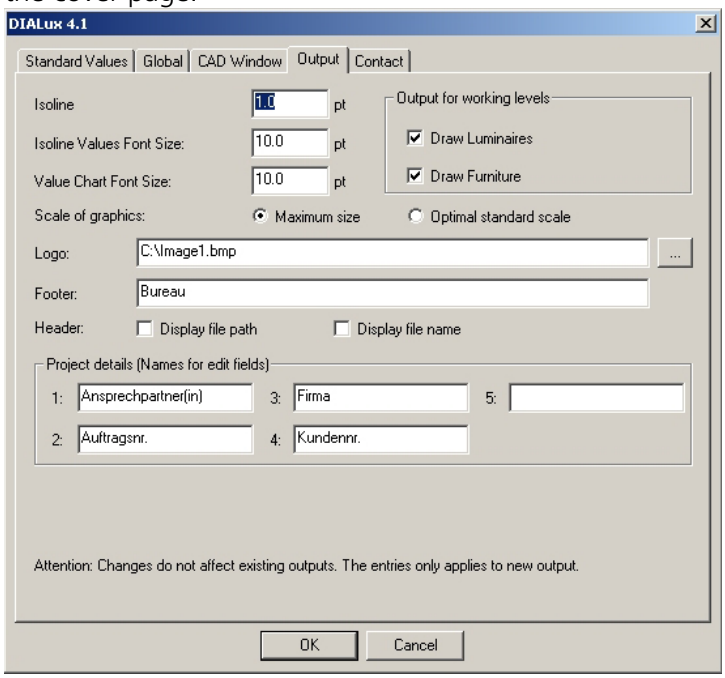


Fig. 355 Output settings

The logo and your user data are shown together on all pages after the cover page.

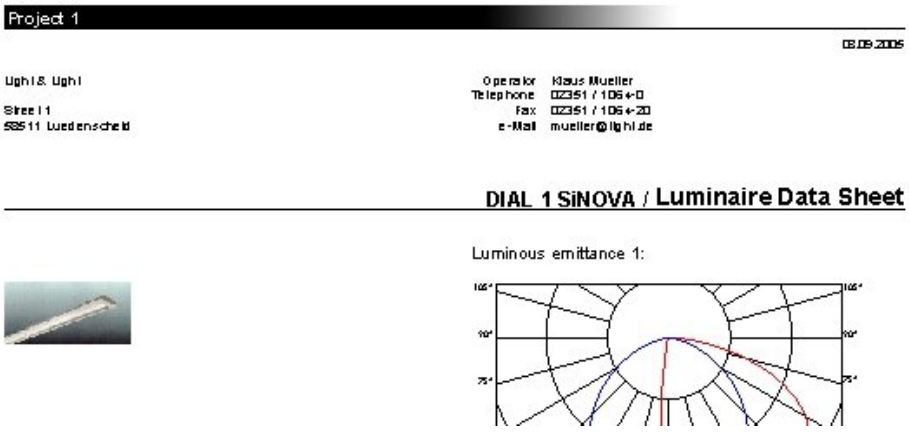


Fig. 356 Output header line

Global Settings

The Property Page *Global* is used to specify whether you want to use European or American units in your projects.

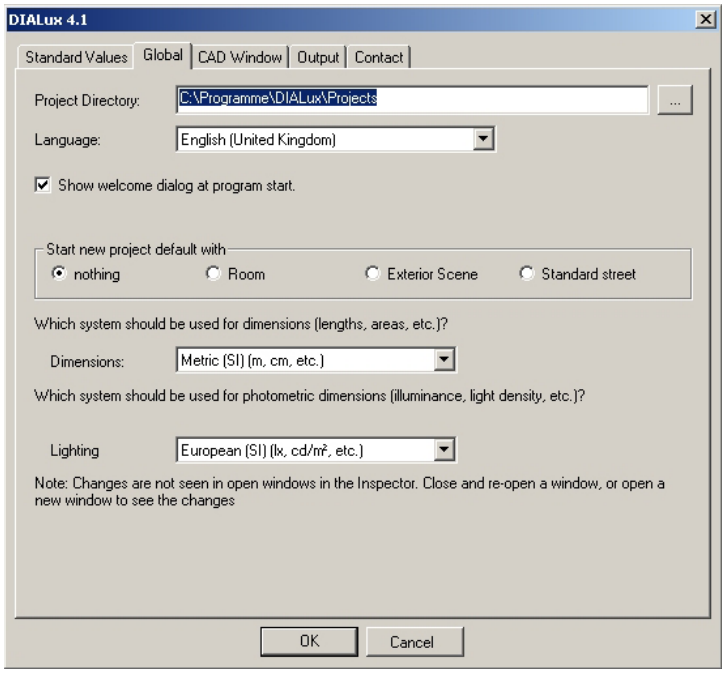


Fig. 357 Global settings

Output

Viewing Calculation Results

After a calculation has been completed, DIALux shows the 3D display of the room.

Project output can be viewed before or after a calculation. The output types which are not affected by the calculation results can be viewed at any time, for example the project cover sheet, luminaire parts lists, luminaire coordinates, room coordinates etc.

Most output types need to be calculated first. If one of these output types is opened when there are no results yet, DIALux enquires whether the calculation should be performed.

When you double-click on the desired page in the *Project manager*, it is displayed in the CAD window. DIALux differentiates between print output and monitor output. The monitor output enables experts to easily evaluate only the required information, without being limited by layout and page size. Big tables are displayed completely and can be viewed by scrolling. Here it is handy to use the middle mouse button.

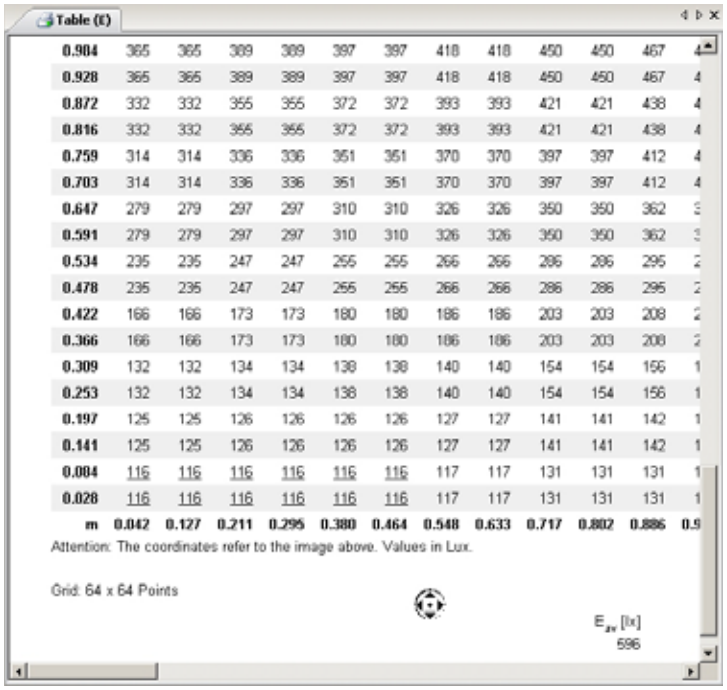


Fig. 358 Monitor output of a big table

Scroll bars are located at the window edges. If you use the middle mouse button, the scroll icon appears and you can navigate by moving the mouse.

You can use the print preview to view the printout on the monitor before it is printed. DIALux supports

"WYSIWYG, What you see is what you get". To go to the print preview, use the *File* → *Print Preview* option. Please keep in mind that only the output types that were selected with a black checkmark are included in the print preview and in the printout. Depending on the size of the report, generating the output can take some time. An information window displays the current status.

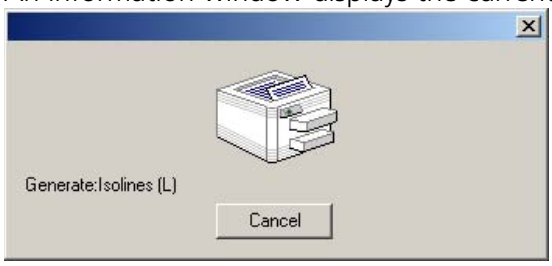


Fig. 359 Print preview generation status

The print preview supplies you with an overview of the chosen output.

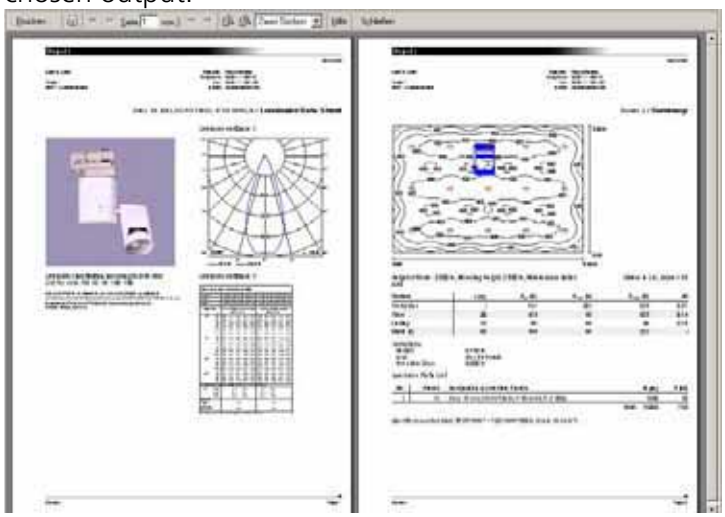


Fig. 360 Print preview

Here you can also specify further print settings, depending on your printer.

For larger print jobs it is advised that you send multiple print jobs consecutively (e.g. Page 1– 30, Page 31- 55). If the RAM is quite large (>128 MB), this is not required.

Limit Result Output

In the *Project manager* you can limit the amount of the output. For example with sloped ceilings there may be results for a number of surfaces that you are not interested in. For all these surfaces you can disable the checkbox *Result Output* so that they will not appear in the output tree.

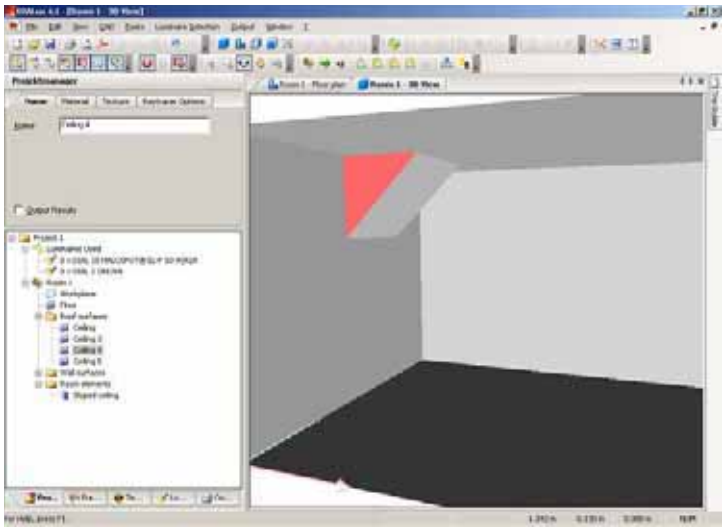


Fig. 361 Limit result output

Output Settings

For many output types further settings can be specified. Select the respective output in the output tree and change the settings in the corresponding Property Page in the *Inspector*.

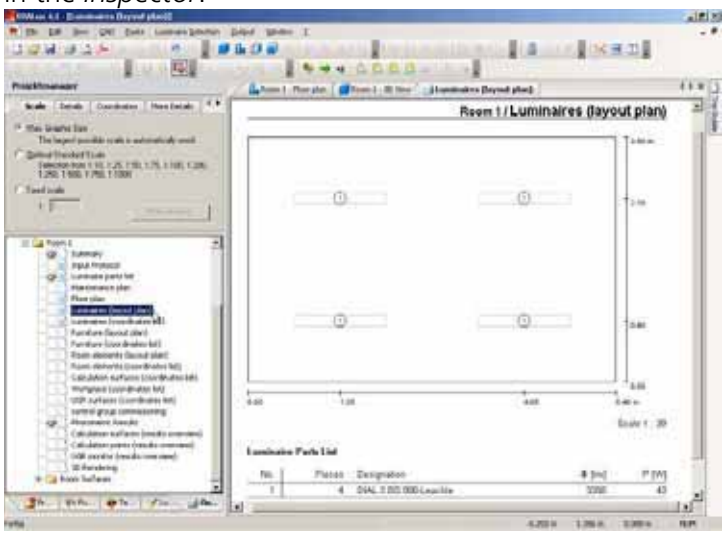


Fig. 362 Output settings

If you change the settings, the *Refresh View* button is activated. If you use this button, the changes entered are applied in the output window.

The 3D rendering is generated using the observer position set in the CAD.

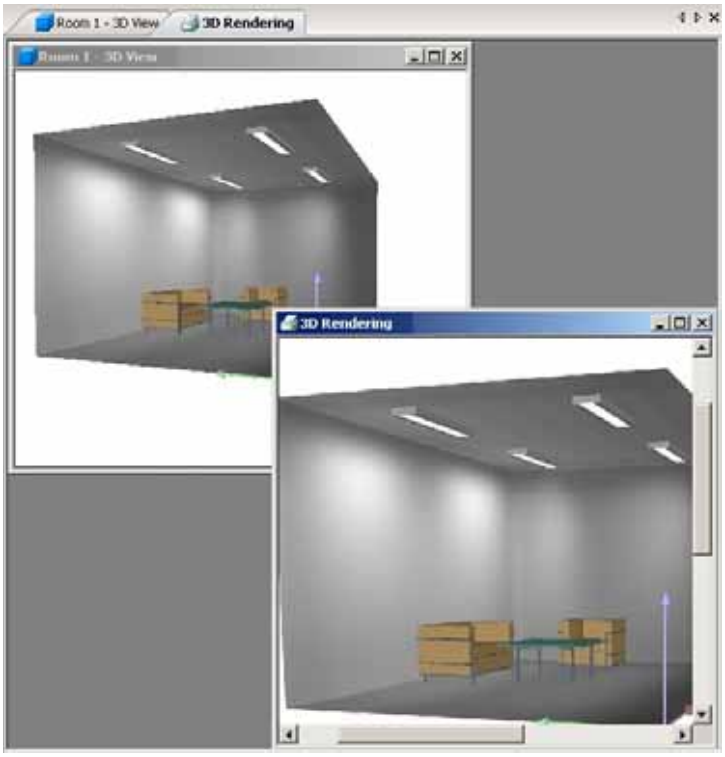


Fig. 363 3D CAD at the top left (for editing purposes) and 3D rendering (as output) at the bottom right

New Output in DIALux

DIALux offers several new or enhanced output types since DIALux 4. Most of them refer to the new light controls. Thus there are suitable outputs for control groups and light scenes. These outputs are similar to the present outputs of other rooms.

Fixing the calculation grid in the output

The calculation grid is fixed in DIALux in the outputs. Open in the output tree the summary of a light scene and select the settings of your output grid. If you click on the "Refresh View" button DIALux determines the current calculation grid and displays the results in the output window.

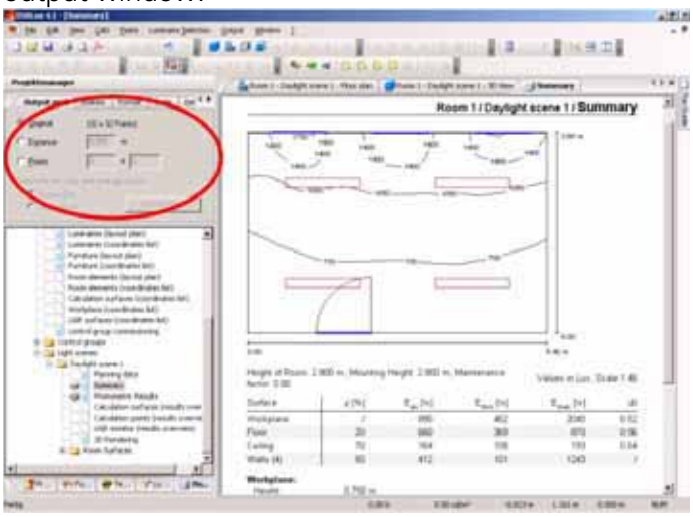


Fig. 364 Output of a light scene

The documentation of the used luminaires is modified in DIALux too.

Luminaire Data Sheet

The design is completely changed. Besides the picture and the text two customisable diagrams are created. When you use luminaires with several light outlets you can select which diagram is used for which outlet. The luminaire can be classified according to numerous regulations (DIN, BZ, UTE, CIE, NBN).

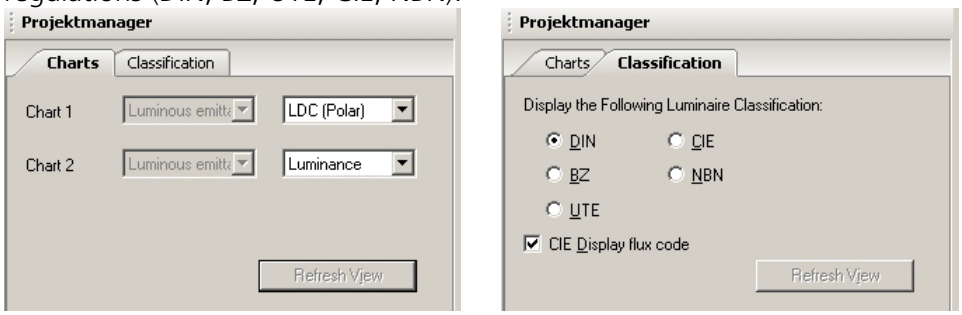


Fig. 365 Settings of luminaire data sheet

Luminance Diagram

The luminance diagram is a new development that allows the evaluation of the luminance with regard to different angles of radiation (omni directional glare control).

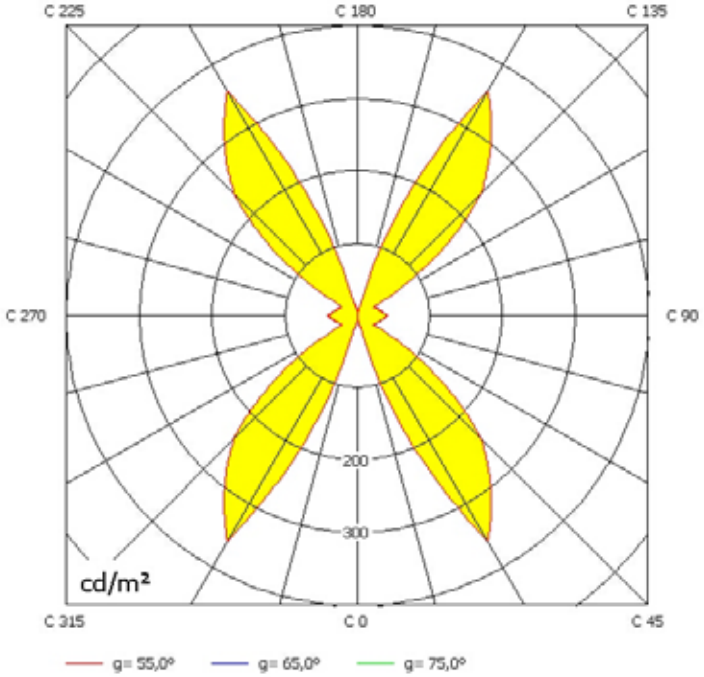


Fig. 366 Luminance diagram for evaluation of omni directional glare control

Tabular Presentation of Photometric Data of Luminaires

The light intensity and the luminance are also presented in tabular form. The steps C-levels and Gamma angles can be adjusted in the Property Page.

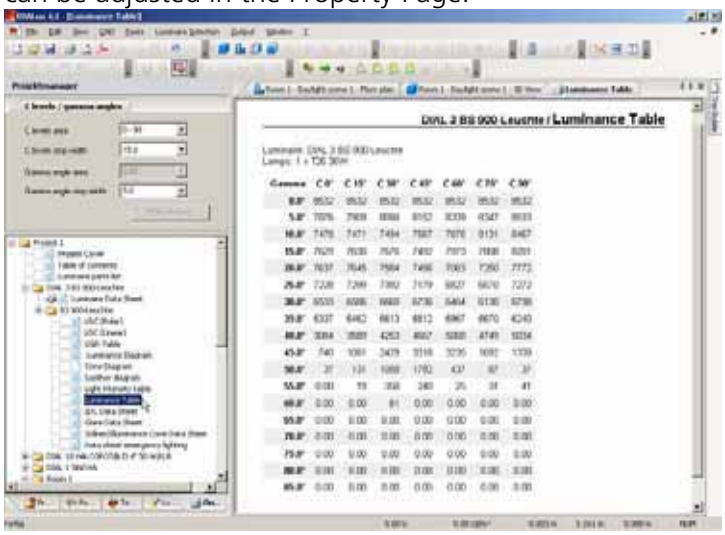


Fig. 367 Light intensity table

Tabular Presentation of Exterior Scenes

DIALux can create a summary which contains a ground plan with luminaires and furniture and their coordinates. With the Property Page you can adjust the scale, details and coordinates.

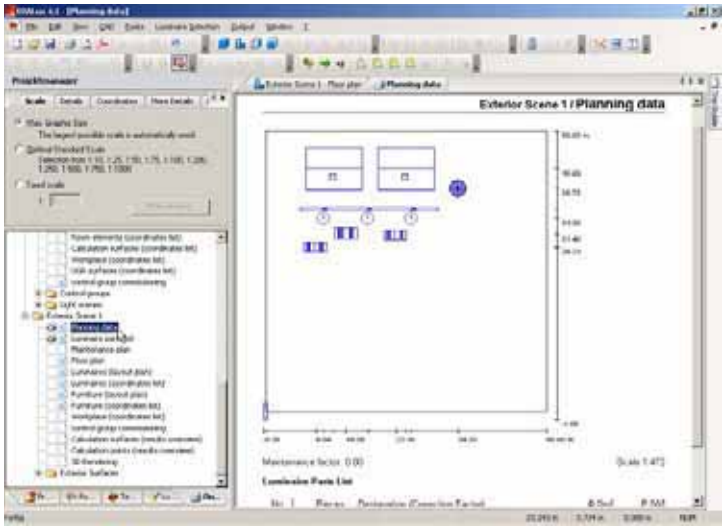


Fig. 368 Property page output exterior scene

Creating User-Defined Standard Output

The user can generate and save frequently-used combinations of output types in DIALux. To do this, a folder that contains output must be selected in the output tree.

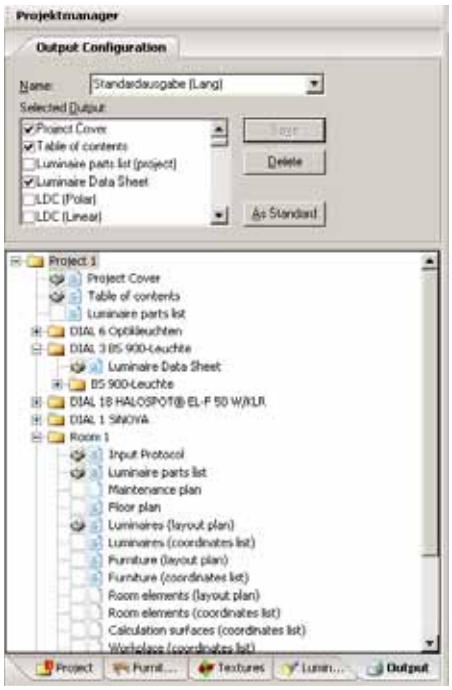


Fig. 369 Creating standard outputs

Start on the highest hierarchy level, i.e. the project. Select the project in the output tree, in this case project 1. If you wish to use a preset standard, select it from the *Name* listbox. To generate a standard, check the output types which should be included in your standard. Please keep in mind that the list contains all output types, including those of lower hierarchy levels. For example, if you check the Isolines (E) output type in this hierarchy level, it is also checked in all lower hierarchical levels.

You can now select lower hierarchical levels and use a different output standard here. For example you can select Room 1 and select the *Complete Documentation* standard, which in this example describes a very extensive documentation. The other rooms are not affected by this change, as these still use the *Short Documentation* output standard which has previously been assigned to the project.

Thus you can influence the individual output subdirectories – thereby deviating from the global standard. Of course you additionally have the option of selecting the output types individually for every object in the output tree.

To use a user-defined output standard as default setting, select it from the *Name* listbox and click on the *As Standard* button. In the listbox the phrase Standard appears in brackets behind the corresponding name. To delete a user-defined standard, select it and click on *Delete*. After another standard has been selected from the listbox the one deleted previously is not available anymore.

Save Output as PDF-File

Similar to the printing you also can export the output to a PDF-file. After you selected all desired information with the small printer symbol you select the menu File → *Export* → *Save Output as PDF*.

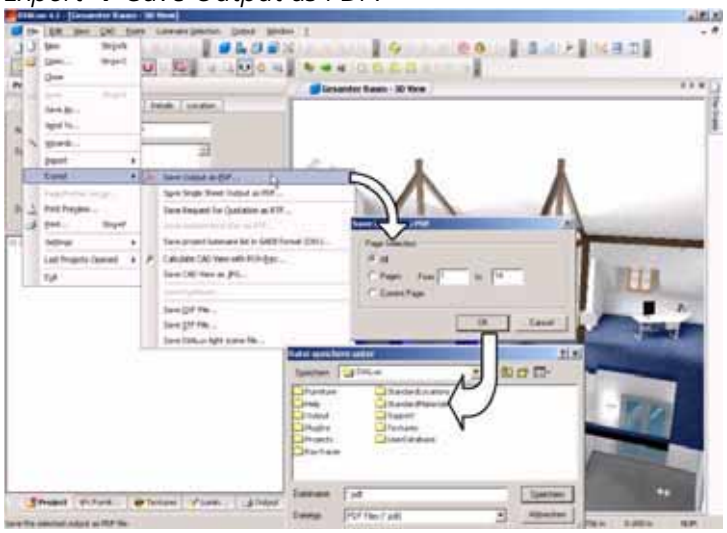


Fig. 370 Export the output to a PDF-file

This menu is only available if one output window is active. Then you are asked to specify the directory and the name of the PDF-file. Exporting to PDF can take some time if you have a large project but usually it is twice as fast as printing the output. Once you have the PDF-file you can send it to your customer. The PDF-file cannot be modified.

Export Output Graphics, tables, text and graphic

When the output in DIALux is opend (doubleclick on the desired output sheet) any type of output can be selected for copy and paste by a right click on it. Further on tables, graphics and text can be saved in a file.

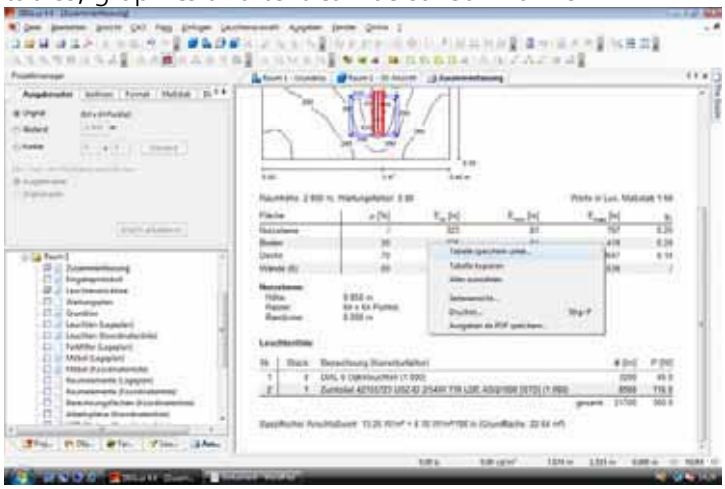


Fig. 371 Export the output table to a file or copy it into the clipboard

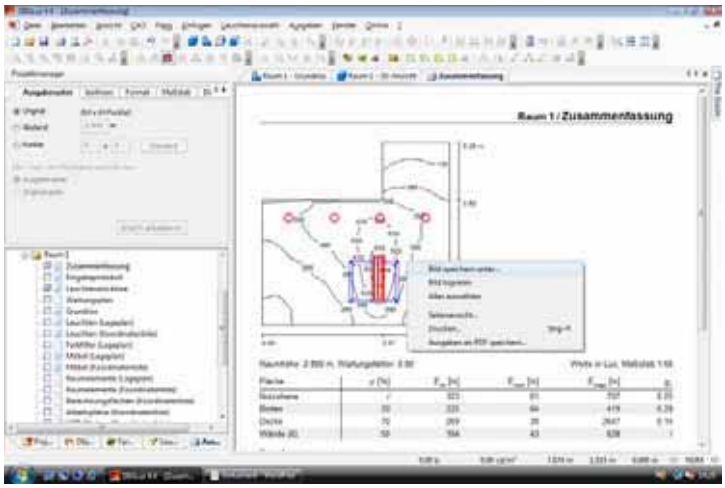


Fig. 372 Export the output graphic to a file or copy it into the clipboard

You can export the graphical output DIALux created to almost all other Windows software like Word or image processing software. To do this open the according output in the output tree and adjust the settings (e.g. steps, colours, font size,…). Now click and hold the left mouse button in the output window and drag the output image to the other program. The image is copied to this program as a wmf-image.

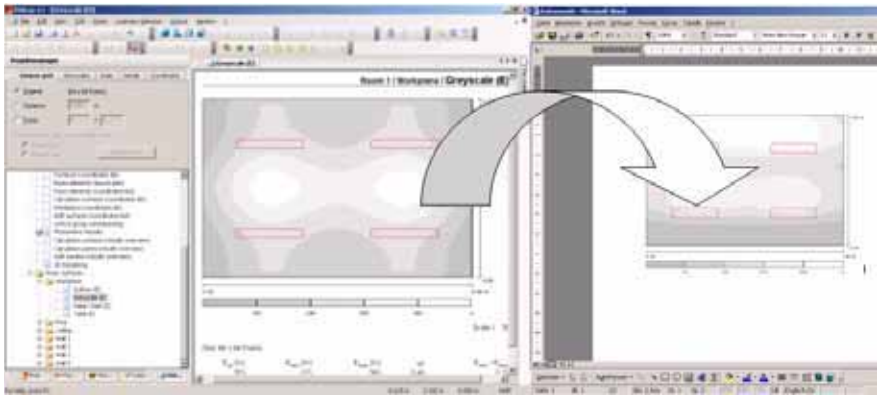


Fig. 373 Export of output graphics to other programmes

Of course you can also copy text and tables to other programs with *Copy* and *Paste*.

DWG and DXF Import and Export

With DIALux you may import DWG and DXF drawings and use them for your work. After you finished your planning you can export the room geometry, the room elements, the luminaires and the furniture into your CAD-drawing.

DWG / DXF-Import

- Create an empty rectangular room (If you work on an exterior scene create that)
- Go to the ground plan view
- From the menu File *Import* use the option DWG or *DXF File*. The wizard asks you to select the dwg or dxf-file.

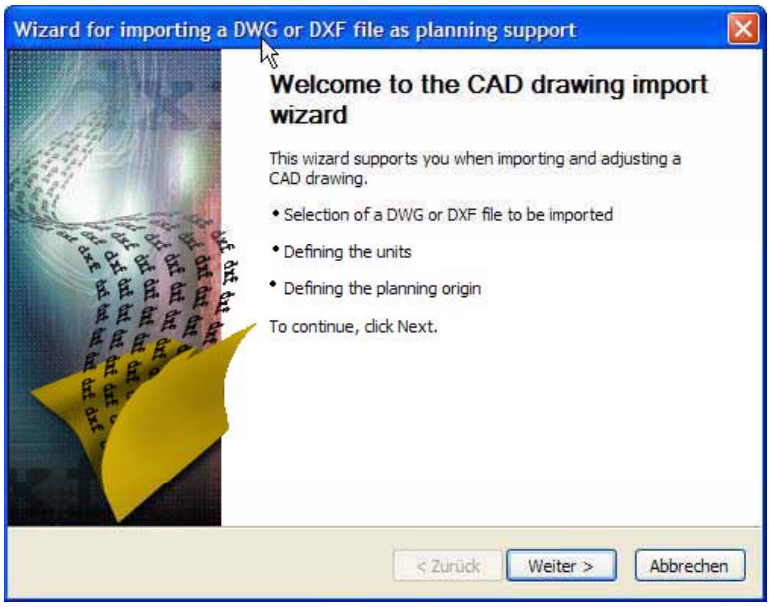


Fig. 374 DWG / DXF Import options

- Let the wizard read the dxf-file.
- The units used in the dwg / dxf-file are not yet defined. When you select the probable unit, the size of the drawing is listed in two fields.
- You can place the origin of the planning at the origin of the global coordinates system (0.00/0.00/0.00) or you can choose a point defined in the dxf-file or you can place the origin at the gravity centre of the used area (the middle of the drawing).

Basic DWG / DXF Settings and Layer Selection

With the menu *CAD* you can change the properties of the dwg / dxf-file and of the layers similar to the CAD program. You can decide to show or hide single layers and to set the layer colour. If a layer of the dxf-file uses a certain colour you may overwrite this colour.

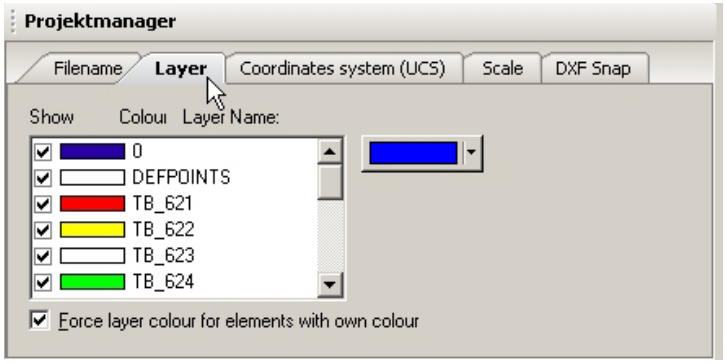


Fig. 375 DWG / DXF settings

Edit a Room based on the DWG / DXF-Ground Plan

To move the room to a certain position of the dwg / dxf-ground plan, just click on this point with the right mouse button, and use the option *Set DWG or DXF-origin here*.

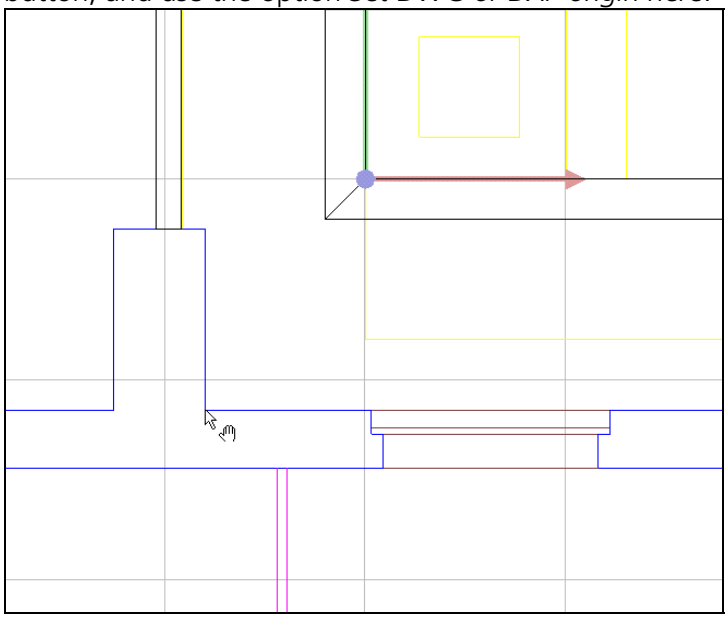


Fig. 376 Move the dwg / dxf-origin with mouse and context menu

After you moved one corner of the room to the origin of the dwg / dxf-drawing, you can adjust the room geometry. The easiest way is to drag the corners of your room after selecting *Edit room geometry* from *The Guide*.

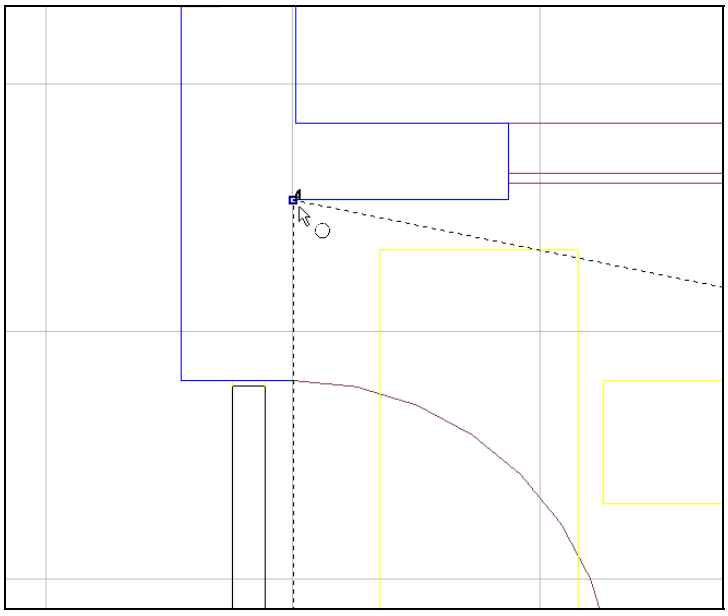


Fig. 377 Drag the corners to align the room with the drawing

Now you can insert further elements like doors and windows based on the drawing.

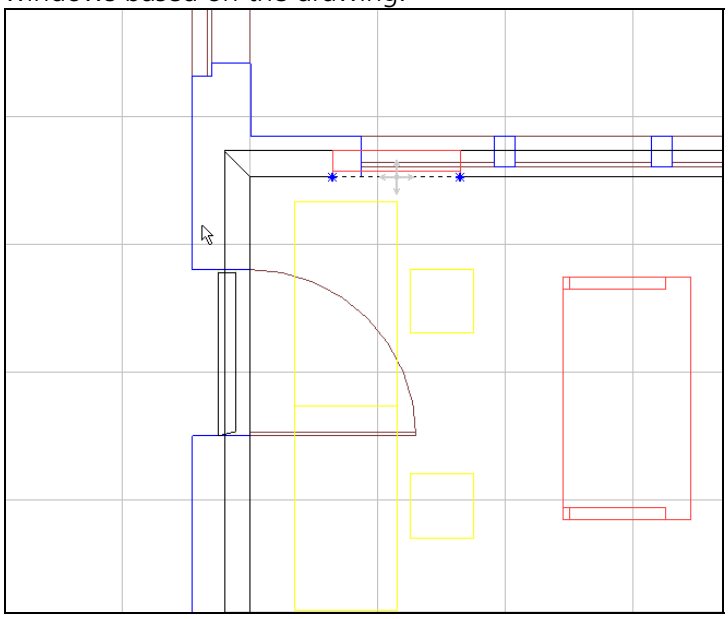


Fig. 378 Insert doors, windows, furniture

Working with the DWG / DXF Background in the 3D View

You can use the CAD-drawing as a background image in the 3D view. Usually it is recommended to use the option *Represent 2D projection of dwg / dxf in 3D view* from the Property Page.

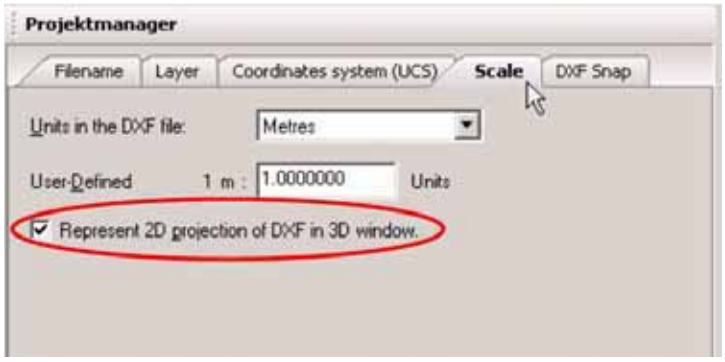


Fig. 379 Using 2D projection of dwg / dxf in 3D view

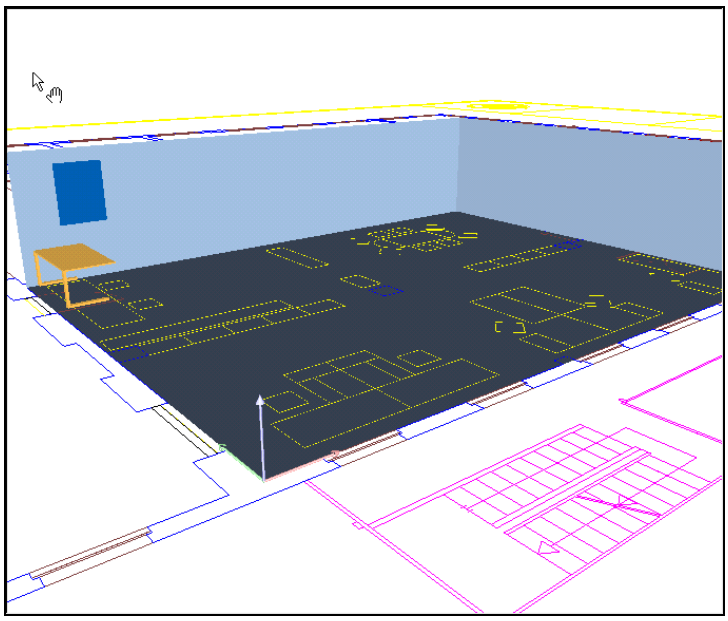


Fig. 380 3D view with DXF background

You can display or hide the dwg / dxf background from the *Window* toolbar.

DWG / DXF-Export

You can export the result of your planning in dwg or dxf-format.

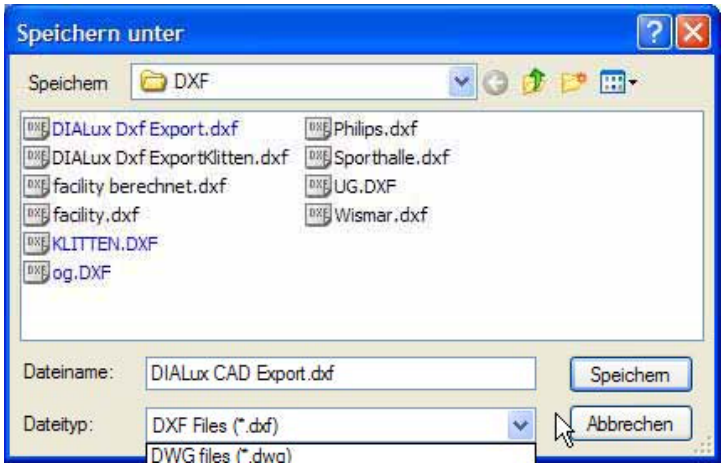


Fig. 381 Save as dialog with DWG or DXF selection

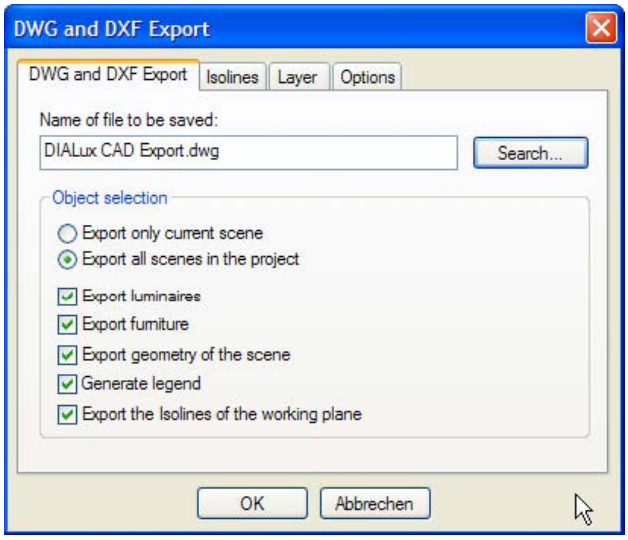


Fig. 382 DWG / DXF-Export dialogue – DWG / DXF Export

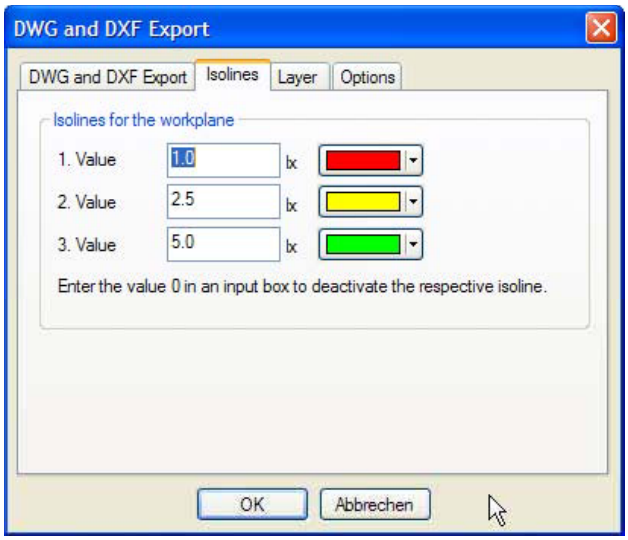


Fig. 383 DWG / DXF-Export dialogue – Isolines

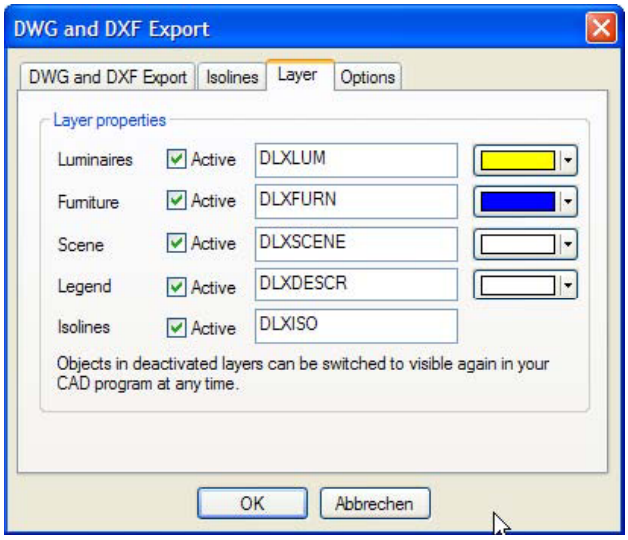


Fig. 384 DWG / DXF-Export dialogue – Layer

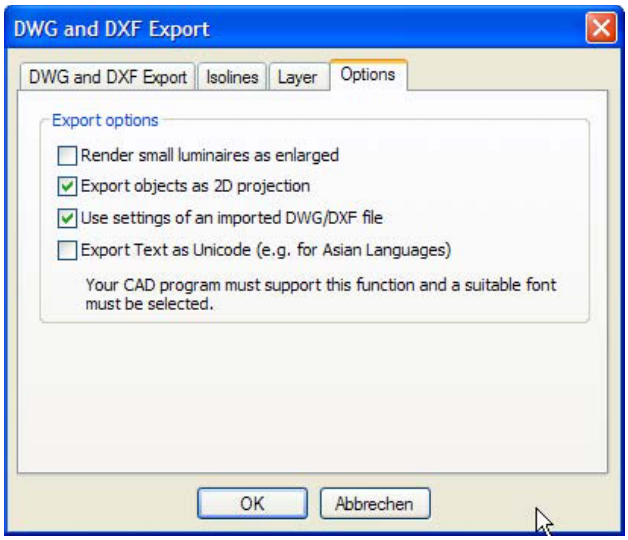


Fig. 385 DWG / DXF-Export dialogue – Options

In the DWG / *DXF Export* dialogue you can specify which information should be exported. When you want to import your DIALux planning into the original drawing, it is useful to use the settings of the imported drawing.

Optionally DIALux can create a legend that is embedded into the CAD drawing which contains a part list of the used luminaires.

Energy Performance of Buildings

Background information

Under the Kyoto protocol, Europe is committed to reduce CO_2 emissions seriously. One instrument to achive this is the directive 2002/91/EC „Energy Performance of Buildings Directive"of the European Parliament and Council. The directive's requirements hold for both new and to be renovated buildings and for both residential and non-residential buildings.

Member states of the EU were committed to implement this directive into national right. As a guideline the EU created a general framework for the calculation of energy performances of buildings, which stated which aspects the calculation methodology must include at least. These aspects particularly are heating, ventilation, air-conditioning, hot water supply and lighting.

To support the implementation of the directive in the EU member states, the european committee for standardization CEN created a set of CEN standards. This set consist of more than 30 parts, includes more than 40 standards and drafts and covers 5 CEN technical committees. A good overview can be found in http://www.buildingsplatform.eu/epbd_publication/doc/P02_EPBD_CEN_Standards_p2370.pdf.

The part concerning lighting is EN 15193: „Energy performance of buildings – Energy requirements for lighting“.

Besides the european implementation there are national implementations, for example in germany the DIN 18599: “Energy efficiency of buildings”. This standard uses an integral approach for the calculation of the energy balance. That is a joint evaluation of energy demands for all parts of the building (heating, ventilation, air conditioning, cooling, humidification, domestic hot water and lighting), taking into account interactions between them and impacts on others.
For example, the energy consumption for lighting is not only part of the energy balance for lighting, but also an inner heating source and so an important part of heating and cooling.

For more information about the directive please visit site www.buildingsplatform.eu. This site really covers everything about the directive, that is worth knowing.

Why energy evaluation in DIALux?

In medium terms, the energy performance for buildings directive causes increased efforts for light planners. Besides the well known lighting data characteristics, they will also have to pay attention to new energy performance characteristics.

Fortunately, a common light planning already contains a great deal of the needed information for an energy evaluation. These informations can be analysed and recycled for the energy evaluation. So if the energy evaluation is integrated into the light planning process as efficient as possible, the additional expenses for this evaluation can be reduced significantly. That’s why DIALux 4.4 offers the possibility to include an energy evaluation according to EN 15193 or DIN 18599.

A DIALux user can include an energy evaluation project into a DIALux project with only two mouse clicks.

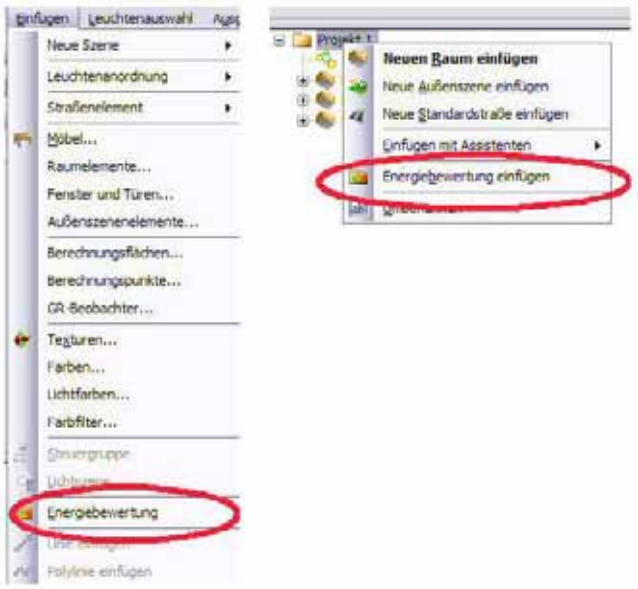


Fig. 386 Insertion of an energy evaluation project into a DIALux project via menu „Paste“ and via the context menu of the DIALux project.

The rooms for light planning can be transfered to the energy evaluation all together or only in part.
Caution: Energy evaluation is only defined for inner rooms! Outdoor scenes and streets are not part of the evaluation.

Properties of the room and the project (geometry, obstruction, location and north alignment) are automatically identified, analysed and recycled for energy evaluation by DIALux. The same holds for windows and roof lights. Particularly daylight supplied and not daylight supplied assessment zones are determined automatically. The specific connected load is no problem for the user too, it is taken directly from the planned luminaires in the room.

DIALux 4.4 is designed in such a manner, that a light planner is able to do a light planning under optimal lighting data aspects, that fulfills energetic requirements at the same time, with as little additional expenses as possible. Ideally the additional energy evaluation needs only a few mouse clicks.

Structure of an energy evaluation project

Once an energy evaluation is part of a DIALux project, there is an energy evaluation project beneath the DIALux project.

Fig. 387 Energy evaluation project in project tree

For this energy evaluation project a standard, according to which the evaluation will be done, can be selected. Currently EN 15193 and DIN 18599 are possible. Multiple simultaneous energy evaluation projects are not allowed.

An energy evaluation project is animated by adding energy evaluation rooms to it. This can be done either via the context menu of the energy evaluation project or via the context menu of a DIALux-room.

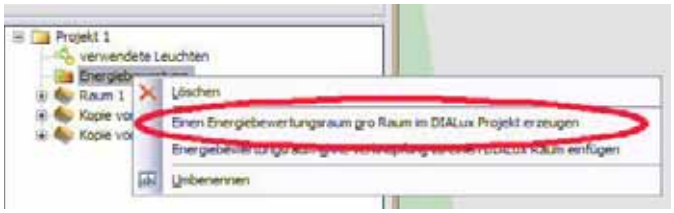
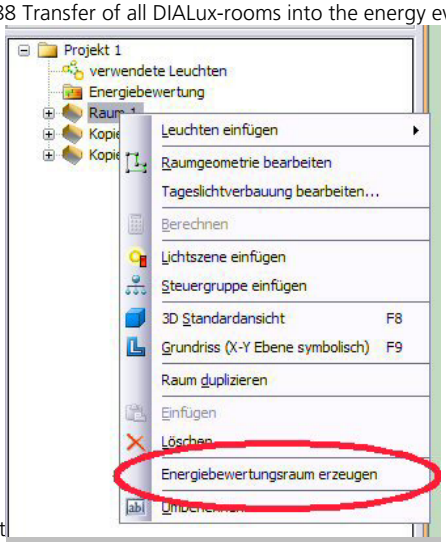


Fig. 388 Transfer of all DIALux-rooms into the energy evaluation



project

Fig. 389 Transfer of one single DIALux-room into the energy evaluation project

With the first method all rooms of a DIALux project can rapidly be transfered to the energy evaluation project, so that they are part of the energy evaluation.
Besides you can create energy evaluation rooms without links to DIALux rooms in this context menu. Thus, you

can evaluate energy demands for rooms, without doing any lighting planning for them. More about that later on.

The second method via the conext menu of one or even multiple DIALux rooms is best, if you do not want all rooms of a DIALux project to be part of the energy evaluation.

Caution: Each DIALux room can only be linked with one single energy evaluation room. Links with multiple energy evaluation rooms do not make sense, since each energy evaluation room can be taken into account multiple times during the energy evaluation.

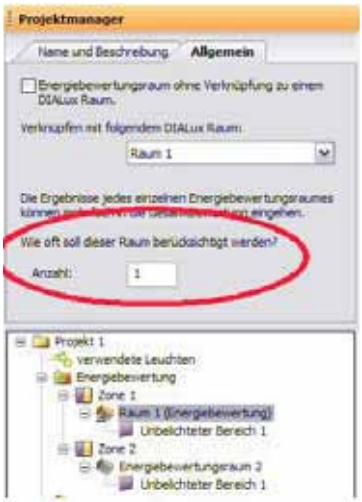
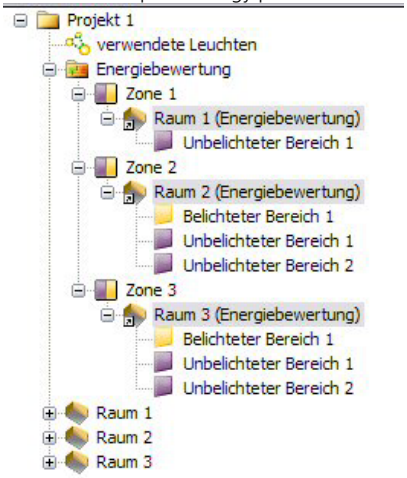


Fig. 390 Multi-consideration of one energy evaluation room during the evaluation of the complete energy performance



project

Fig. 391 Multiple energy evaluation rooms and there utilisation zones

Each energy evaluation room belongs to exactly one utilisation zone. It is initially created in its own utilisation zone, but can be moved to any other utilisation zone.

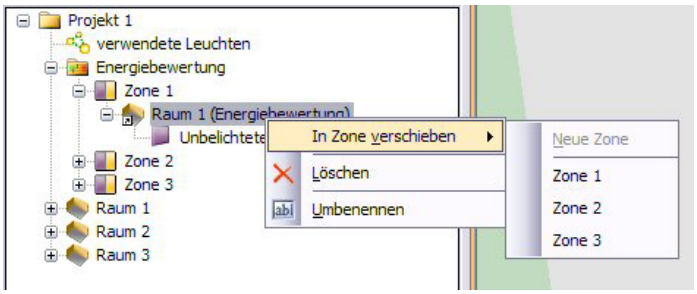


Fig. 392 An energy evaluation room with a selection of utilisation zones, to which it can be moved

Utilisation zones are a main issue in DIN 18599, where they are used to collect energy evaluation rooms with the same utilisation conditions to provide them with a common utilisation profile.

Anyway utilisation zones are a good instrument to group energy evaluation rooms.

Caution: Utilisation zones can not be created explicitely, they are only generated during the creation of energy evaluation rooms.

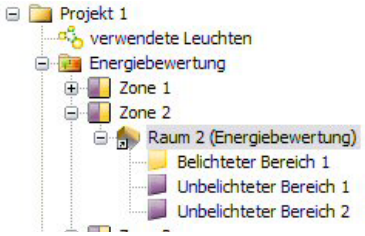


Fig. 393 Energy evaluation room in project tree with its assessment zones

Each energy evaluation room has one or more assessment zones. Each assessment zone is either completely supplied with daylight or not. Assessment zones can not be explicitely created, removed or changed in any way. They are exclusively created respectively adjusted to geometric and daylight depending conditions.

Each energy evaluation room is divided into assessment zones, that do not intersect one another and that build up the complete area of the room.

These assessment zones can be displayed in 2D- and 3D-views of the associated DIALux room. Daylight supplied and not daylight supplied zones are distinguished by colour.

Fig. 394 Display of assessment zones in CAD-windows (second icon from the left)

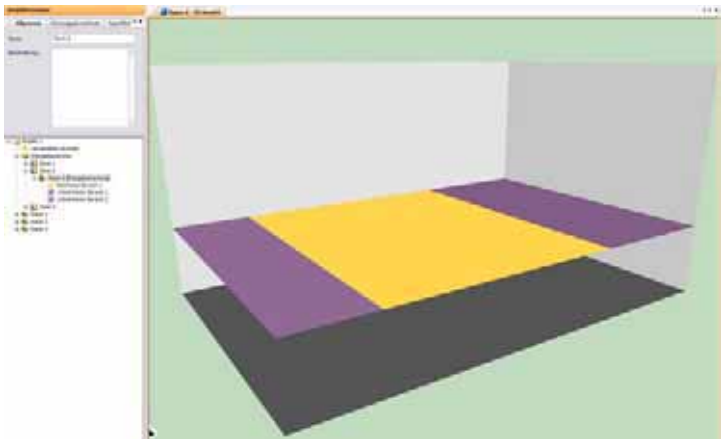


Fig. 395 Display of assessment zones of an energy evaluation room in 3D-view

Assessment zones are both the bottom and the most important level of the energy evalution. The actual evaluation is done on this level, all needed parameters are determined here. Energy demands are explicitely calculated only for assessment zones, all other results for energy evaluation rooms, utilisation zones or the complete energy performance project arise from summing up results of involved assessment zones.

Of course, you can also use „The Guide“ to navigate through the complete energy evaluation process.

Fig. 396 Energy evaluation in The Guide

Energy evaluation rooms with links to DIALux rooms and without

As mentioned before, you can create energy evaluation rooms with a link to a DIALux room, but also without such a link.

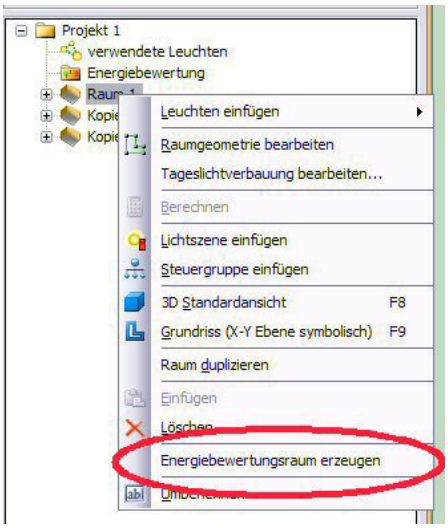


Fig. 397 Create an energy evaluation room with a link to a DIALux room.

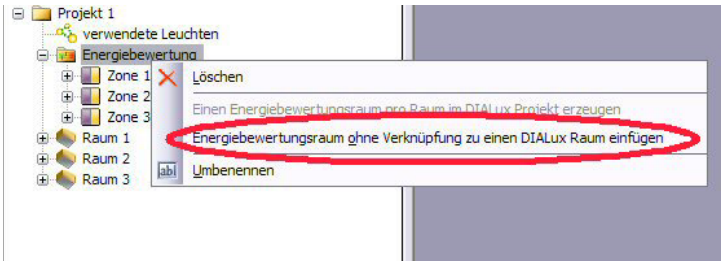


Fig. 398 Create an energy evaluation room without a link to a DIALux room

In the first case, an energy evaluation room is created that is linked to the corresponding DIALux room. In the second case, an energy evaluation room is created that is not linked to any DIALux room.

Fig. 399 Energy evaluation rooms with and without link to DIALux rooms

The linking of energy evaluation rooms and DIALux rooms has many advantages. Many aspects of the started or even completed light planning can be automatically transfered to the energy evaluation with such links.
The complete geometry of the DIALux room is analysed for the energy evaluation, and this does not only mean the ground area and height, but even the daylight relevant informations like position and properties of windows and roof lights, the orientation (north alignment) and obstruction, etc. One of the most important steps during energy evaluation, the determination of daylight supplied assessment zones, happens completely automatically.
All technical informations about luminaires and lamps are transfered as well. You do not need to think about mapping of total power values of luminaires and associated parasitic power values to assessment zones or even use some table or rough calculation methods to get such power values. All lighting data is determined from the light planning and assigned to the energy evaluation.

And the advantages are not limited to the creation of energy evaluation rooms and their assessment zones. A

comprehensive update mechanism makes sure that changes to all relevant data of the light planning will be passed on to the energy evaluation as well. So the energy evaluation is always up to date and a simultaneous planning is possible.

Nevertheless, for a lot of details it makes sense, to have them well designed before a link is created. That's because DIALux tries to initialise all of the parameters of the energy evaluation room and its assessment zones as good as possible, so that the user has to do as little adjustments as possible. And the better the starting position the better the initialisations.

Furthermore, there is another important reason, to do as much preliminary work as possible. As said before there is an update mechanism between light planning and energy evaluation, that reacts on subsequent changes. This update mechanism not only changes properties of assessment zones, it also may create new assessment zones and delete old ones. The new zones are once again initialised as good as possible by DIALux, but must again be checked and adjusted where applicable by the user. The old zones are deleted, the invested time to check and adjust their properties is lost.

Fig. 400 Possibility to change the linked DIALux room for an energy evaluation room

Links between energy evaluation rooms and DIALux rooms can also be changed respectively canceled.

Fig. 401 Possibility to cancel the link of an energy evaluation room to a DIALux room

Caution: Each DIALux room can only be linked with one single energy evaluation room. As soon as there is a link between a DIALux room and an energy evaluation room, there can not be more. Therefore, there are only rooms in the selection list, that are not linked to energy evaluation rooms.

And what is so different in energy evaluation rooms without a link to a DIALux room?
Because of lack of both geometric and lighting data informations DIALux can't do any automatic subdivisions into assessment zones for such energy evaluation rooms, no statements concerning daylight are possible and there are absolutely no informations about luminaires and lamps. All parameters for the energy evaluation have to be set manually by the user himself. In this process, the user can restrict himself by just editing the consumption values of the energy evaluation room directly or work on lots of parameters to calculate such consumption values.

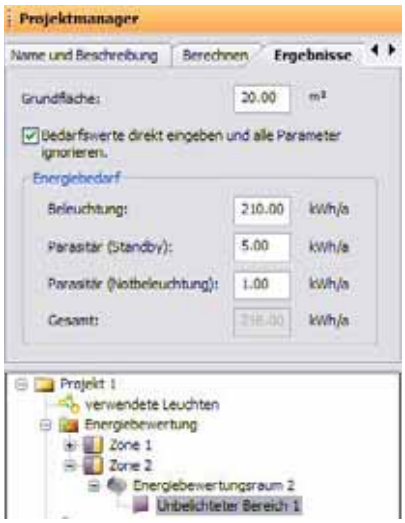


Fig. 402 Working on the assessment zone of an unlinked energy evaluation room

The possibilities of working with unlinked energy evaluation rooms in DIALux are relatively rudimental right now. Each such room has exactly one assessment zone without daylight supply. More assessment zones can't be created, daylight supply can't be added. However, their main purpose is only to include rooms in the whole energy performance evaluation process, which have no light planning and whose energy consumption values are known from other sources.

In fact, you could do an energy performance evaluation in DIALux completely without linked rooms. But by doing so, you would abandon all advantages DIALux is offering for simultaneous light planning and energy evaluation. You would have to define and work on a lot of aspects, that would be in place automatically for linked rooms. So our recommendation is to work with linked energy evaluation and DIALux rooms as far as possible.

Working on parameters

For each assessment zone you can (have to) adjust a lot of parameters, influencing the energy demands of that assessment zone. There are partly different parameters for the EN 15193 and the DIN 18599.

When using the DIN 18599, there are some parameters taken from the so called utilisation profile of the superordinate utilisation zone. That can't be done in EN 15193, since there is no such profile.

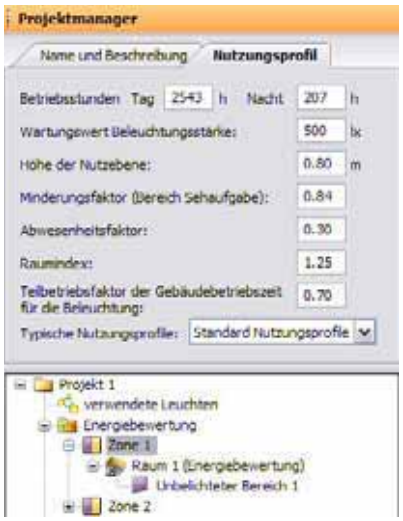


Fig. 403 Utilisation profile of an utilisation zone in a planning according to DIN 18599

Furthermore, there are some parameters only for daylight supplied assessment zones.

Fig. 404 One property page of a daylight supplied assessment zone

Some only for special daylight sources.

Fig. 405 Property pages for assessment zones, that are daylight supplied by windows respectively roof lights

Assessment zones of unlinked energy evaluation rooms have additional parameters, since direct input of energy consumption is possible.

Fig. 406 Direct input of energy consumption values in unlinked energy evaluation rooms

Most parameters can be edited in the common manner, others can only be read and some others can be edited normally and are resettable to an internally calculated value in addition.

Fig. 407 Occupancy parameters of an assessment zone in EN 15193 (left) and in DIN 18599 (right)

Within a EN planning the parameters “Absence Factor” and “Factor for Occupancy Control” can both be edited in the common way. Both have even a supporting functionality to set them to typical values. The parameter “Occupancy Dependency Factor” results from these two parameters by expressions and formulars from the EN 15193. One can easily understand that by changing one of the first two parameters and watch the changes of the third one. There is exactly one calculated value of the third parameter, that results from the other ones. Nevertheless, the third parameter can be edited in the common way. There may be special cirumstances or informations, that define this parameter differently. So when you edit such a parameter, this will be stated in the output. The documentation will include not only the edited value, used for the energy evaluation, but also the initially calculated value, resulting from the other parameters. In such cases, you are well advised, to state why you changed the calculated value in the description of the assessment zone. If you want to return to the calculated value, you can easily reset it by pressing the “Reset” button.

Within a DIN planning the “Absence Factor” is only readable, because it belongs to an utilisation profile. The “Factor for Occupancy Control” is only readable as well, because it is only changed by the selection of “With

Occupancy Sensor" yes or no. For the "Occupancy Dependency Factor" the same holds as with EN 15193.

There are a lot of relations and dependencies between parameters. They all have one thing in common: the duty of documentation, to explain and circumstantiate calculated energy demands.

Calculation and results

When the complete building is subdivided into utilisation zones, all energy evaluation rooms are created, all assessment zones are determined and all parameters are adjusted, then it's time to calculate the energy demands and other energetic characteristics. That's the moment, when the real energy evaluation is done.

Fig. 408 Start of an energy evaluation in menu „Output"

You can start the energy evaluation either with "Conduct energy evaluation" in menu "Output" or with the icon of the same name.

Fig. 409 Start of an energy evaluation with the icon of the same name (second from left)

In both cases a complete energy evaluation for the whole energy evaluation project is done. There's no selection of utilisation zones, energy evaluation rooms or assessment zones, as known from light planning calculations. That is because energy evaluation is very quick. It needs a lot less time than the user reading and editing a selection dialogue.

As mentioned before, the real energy evaluation is done at the level of assessment zones. So when an evaluation is started, the energy demands for each assessment zone is calculated. Depending on the selected standard this may be "only" the total energy used for lighting or additionally the energy consumption used for illumination and the luminaire parasitic energy consumption. In each case annual consumption values are calculated. And that's it, almost.

All other characteristics can be derived from these values. Monthly values can be obtained with the help of redistribution factors, values for energy evaluation rooms are nothing else than sums of values of their contained assessment zones, values for utilisation zones nothing else than sums of values of their contained energy

evaluation rooms, and so on. Even the Lighting Energy Numeric Indicator (LENI) from EN 15193 is nothing else than an area weighted value.

For assessment zones that are add to another assessment zone or to the superordinate utilisation zone, things are different. Such zones are not calculated independently.

Fig. 410 An assessement zone, that is added to another assessement zone

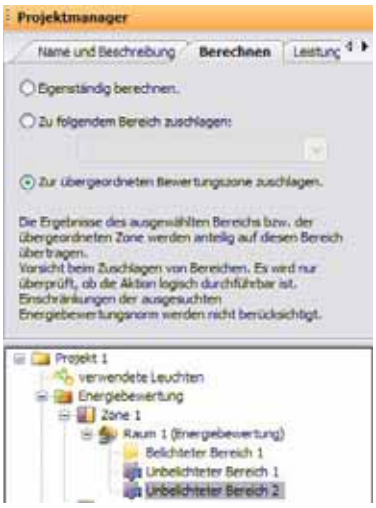


Fig. 411 An assessment zone, that is added to the superordinate utilisation zone

When an assessment zone is added to another zone or to the superordinate utilisation zone, then this zone is no longer calculated independently, that is on the basis of its parameters. Instead, the results of the other assessment zone respectively the results of the superordinate utilisation zone are allocated to the dependent assessment zone.

Such dependent assessment zones get their results, as soon as the independent assessment zones are calculated. Results are simply allocated area weighted.

There are two main constraints concerning adding of assessment zones to others: First, you can only add to

such assessment zones that are independently calculated. Second, each utilisation zone needs at least one assessment zone that is independently calculated.

Documentation of energy evaluation results

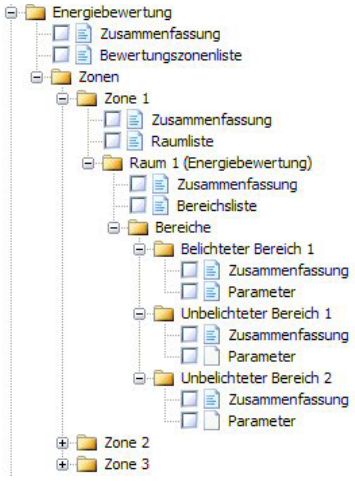
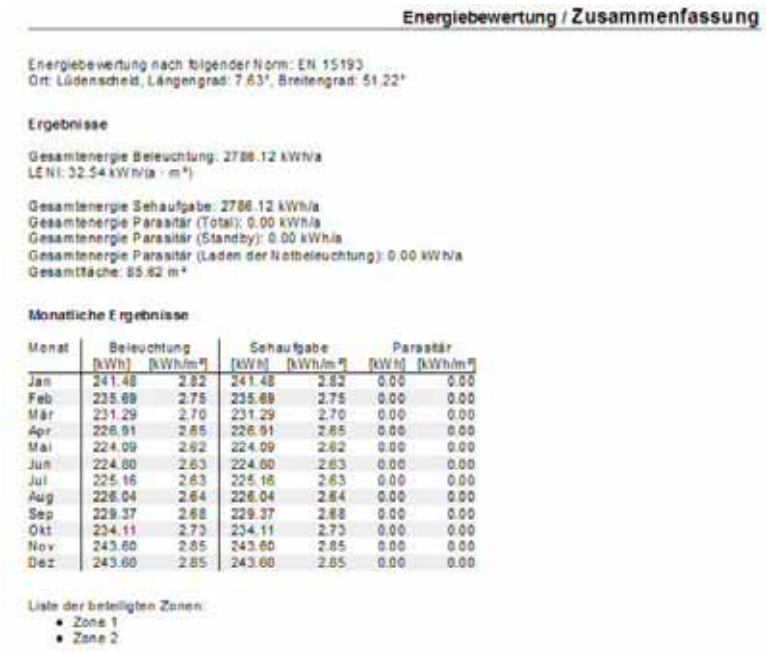


Fig. 412 Outputs for an energy evaluation

There are several outputs for an energy evaluation, to show the calculated energy demands for different objects.

The calculated total energy demands for lighting and other energetic characteristics can be shown for the complete energy evaluation project, for each contained utilisation zone, each energy evaluation room and for each assessment zone. A subdivision in monthly values is also possible for each object.



Energiebewertung / Zusammenfassung

Energiebewertung nach folgender Norm: EN 15193
Ort: Lüdenscheid, Längengrad: 7.63°, Breitengrad: 51.22°

Ergebnisse

Gesamtenergie Beleuchtung: 2786.12 kWh/a
LENI: 32.54 kWh/(a · m²)

Gesamtenergie Sehaufgabe: 2786.12 kWh/a
Gesamtenergie Parasitär (Total): 0.00 kWh/a
Gesamtenergie Parasitär (Standby): 0.00 kWh/a
Gesamtenergie Parasitär (Laden der Notbeleuchtung): 0.00 kWh/a
Gesamtfläche: 85.62 m²

Monatliche Ergebnisse

Monat	Beleuchtung		Sehaufgabe		Parasitär	
	[kWh]	[kWh/m²]	[kWh]	[kWh/m²]	[kWh]	[kWh/m²]
Jan	241.48	2.82	241.48	2.82	0.00	0.00
Feb	235.69	2.75	235.69	2.75	0.00	0.00
Mär	231.29	2.70	231.29	2.70	0.00	0.00
Apr	226.91	2.65	226.91	2.65	0.00	0.00
Mai	224.09	2.62	224.09	2.62	0.00	0.00
Jun	224.80	2.63	224.80	2.63	0.00	0.00
Jul	225.16	2.63	225.16	2.63	0.00	0.00
Aug	226.04	2.64	226.04	2.64	0.00	0.00
Sep	229.37	2.68	229.37	2.68	0.00	0.00
Okt	234.11	2.73	234.11	2.73	0.00	0.00
Nov	243.60	2.85	243.60	2.85	0.00	0.00
Dez	243.60	2.85	243.60	2.85	0.00	0.00

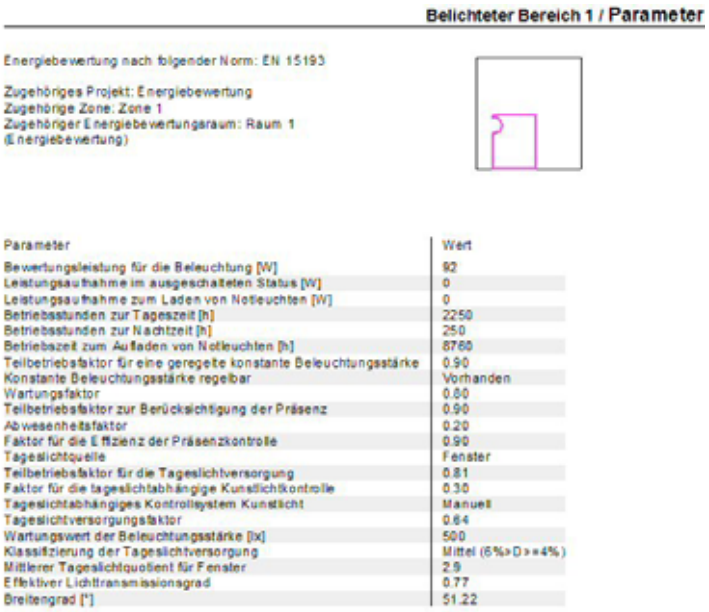
Liste der beteiligten Zonen:
- Zone 1
- Zone 2

Fig. 413 Output for the complete energy evaluation project with all important characteristics

Of course, the user has the possibility to select which details are shown on each output page.

Fig. 414 Property page of the above output page

The output of all involved parameters is most important, because all energy performance standards demand such documentations.



Belichteter Bereich 1 / Parameter

Energiebewertung nach folgender Norm: EN 15193

Zugehöriges Projekt: Energiebewertung
Zugehörige Zone: Zone 1
Zugehöriger Energiebewertungsraum: Raum 1 (Energiebewertung)

Parameter	Wert
Bewertungsleistung für die Beleuchtung [W]	92
Leistungsaufnahme im ausgeschalteten Status [W]	0
Leistungsaufnahme zum Laden von Notleuchten [W]	0
Betriebsstunden zur Tageszeit [h]	2250
Betriebsstunden zur Nachtzeit [h]	250
Betriebszeit zum Aufladen von Notleuchten [h]	8760
Teilbetriebsfaktor für eine geregelte konstante Beleuchtungsstärke	0.90
Konstante Beleuchtungsstärke regelbar	Vorhanden
Wartungsfaktor	0.80
Teilbetriebsfaktor zur Berücksichtigung der Präsenz	0.90
Abwesenheitsfaktor	0.20
Faktor für die Effizienz der Präsenzkontrolle	0.90
Tageslichtquelle	Fenster
Teilbetriebsfaktor für die Tageslichtversorgung	0.81
Faktor für die tageslichtabhängige Kunstlichtkontrolle	0.30
Tageslichtabhängiges Kontrollsystem Kunstlicht	Manuell
Tageslichtversorgungsfaktor	0.64
Wartungswert der Beleuchtungsstärke [lx]	500
Klassifizierung der Tageslichtversorgung	Mittel (6%>D>=4%)
Mittlerer Tageslichtquotient für Fenster	2.9
Effektiver Lichttransmissionsgrad	0.77
Breitengrad [°]	51.22

Fig. 415 Parameter output for an assessment zone

Attention should be paid to the possibility of using descriptions for assessment zones and other energy evaluation objects. These descriptions should not be too long, but should frequently be used.
With short, precise comments you can explain the selection of one or more parameter. Particularly with regard to manually adjustments to automatically calculated values such explanations are in fact mandatory.

Fig. 416 : Input of a description for an assessment zone

STF Interface

The STF interface is supported by DIALux since version 1.0. The interface is continuously extended and improved. Via STF CAD programs can exchange their planning data with DIALux. The workflow is normally as follows:

Design in the CAD application by the architect / engineer.

Design of the building, the storey or the room(s). If necessary the luminaire positions can be defined in the CAD application as well, for example in the case of a redevelopment or if the luminaires have to be placed in certain positions.

Export of the information via STF file to DIALux.

Import of the STF file into DIALux. All the rooms defined in the CAD will appear in the DIALux project, including additional information like the position of doors, windows, degree of reflection, room information,… . The user can now do the lighting design in DIALux. The correct fittings can be placed; additional calculation objects can be defined. The calculation will be done and the documentation of the design can be made in DIALux.

Export of the revised STF file from DIALux to the CAD application.

Depending on the CAD software used, a different level of information from the DIALux STF file is read in. The information exported by DIALux is for example the luminaire name, article number, description, electrical and light technical parameter, pictures, 3D model, isoline diagram and so on.

Further information about the STF interface can be obtained from dialog@dial.de or hotline@dialux.com

Making videos in DIALux

To create a video with DIALux you have to define the camera path. First open the lighting design in the 3D window then use the command “File -> Export -> Save 3D video…”. Now a camera path appears in the CAD window.

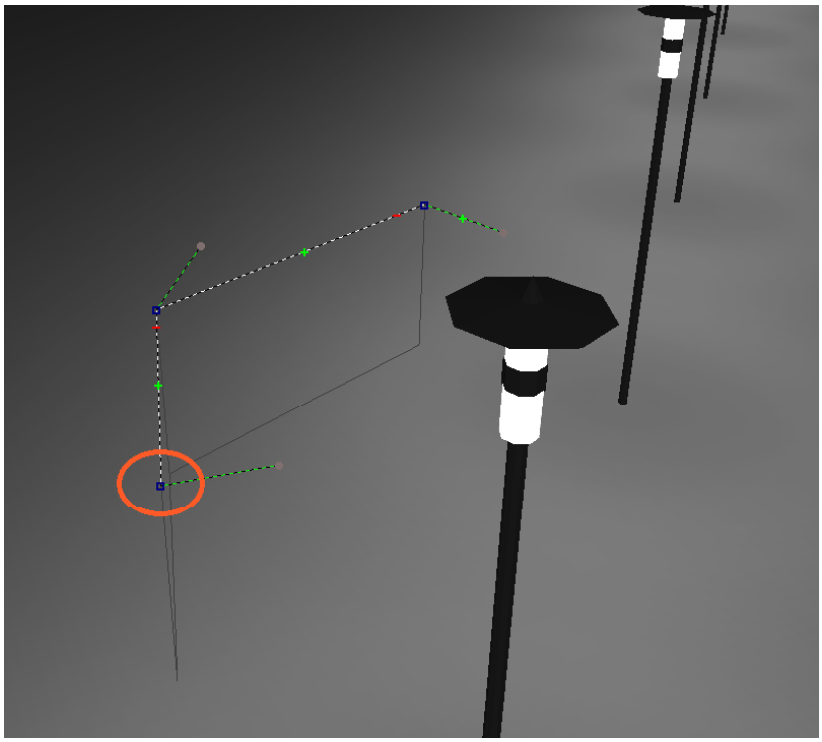


Fig. 417 Inserting a camera path in the 3D view

At the beginning, the end and at all inserted points of the path, the camera position in X and Y direction can be defined by left click and moving the mouse. The Z position can be changed by left click and holding down the control (CTRL) key.

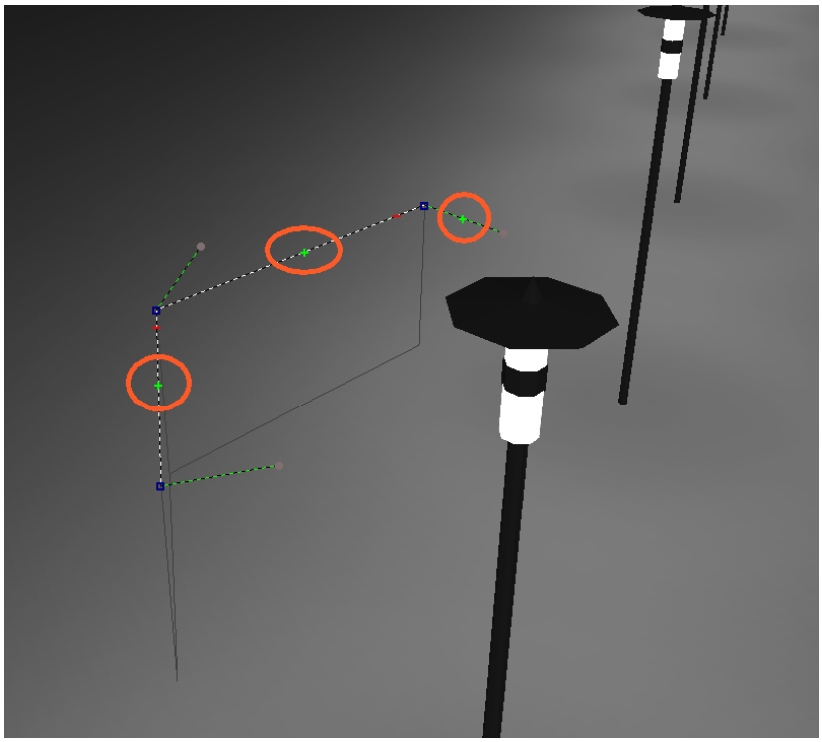


Fig. 418 Inserting additional camera positions along the path

Near to the end points and in the middle between two points there are green “+” symbols. By clicking on these symbols, a new point is inserted into the camera path. If the red “-” symbol is clicked, the associated point is deleted.

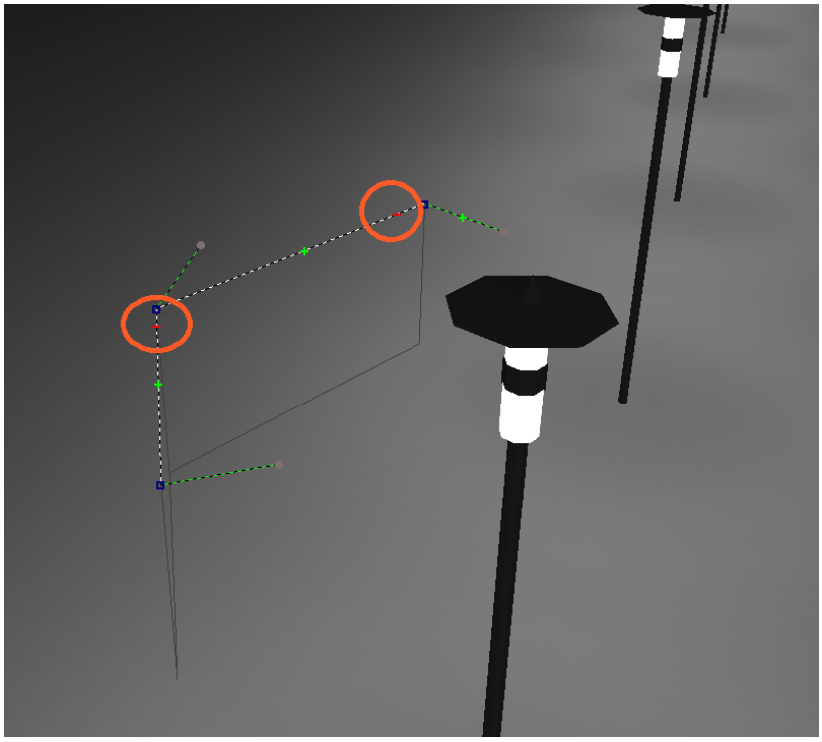


Fig. 419 Deleting camera positions

At all the points there are thin green lines drawn. These lines are defining the “viewing direction” of the camera. The small ball at the end of these lines can be moved with the mouse. To move into the Z direction hold down the control key.

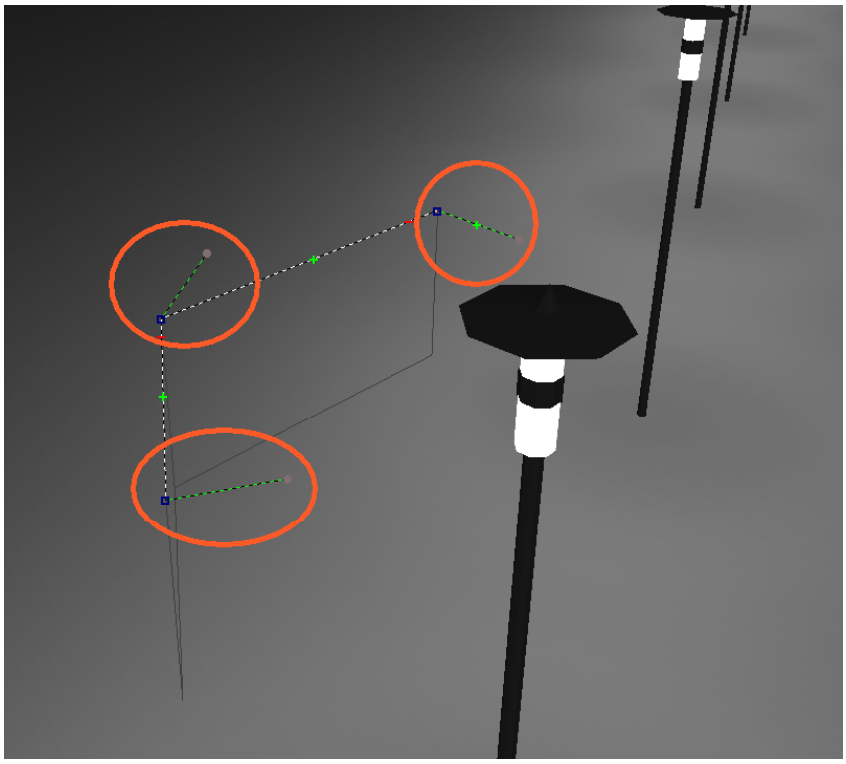


Fig. 420 Defining the camera viewing direction

The camera is moving along the path from point one to point two. It is turned during the movement according to the viewing directions in point one and two. If you want to have more rotations on the way from point one to point two, you have to insert more points directly on the path only changing the viewing direction and not the position of the path.

The camera is not following strictly the path. The path is converged to the edges. That makes the video smoother and there is no judder effect.

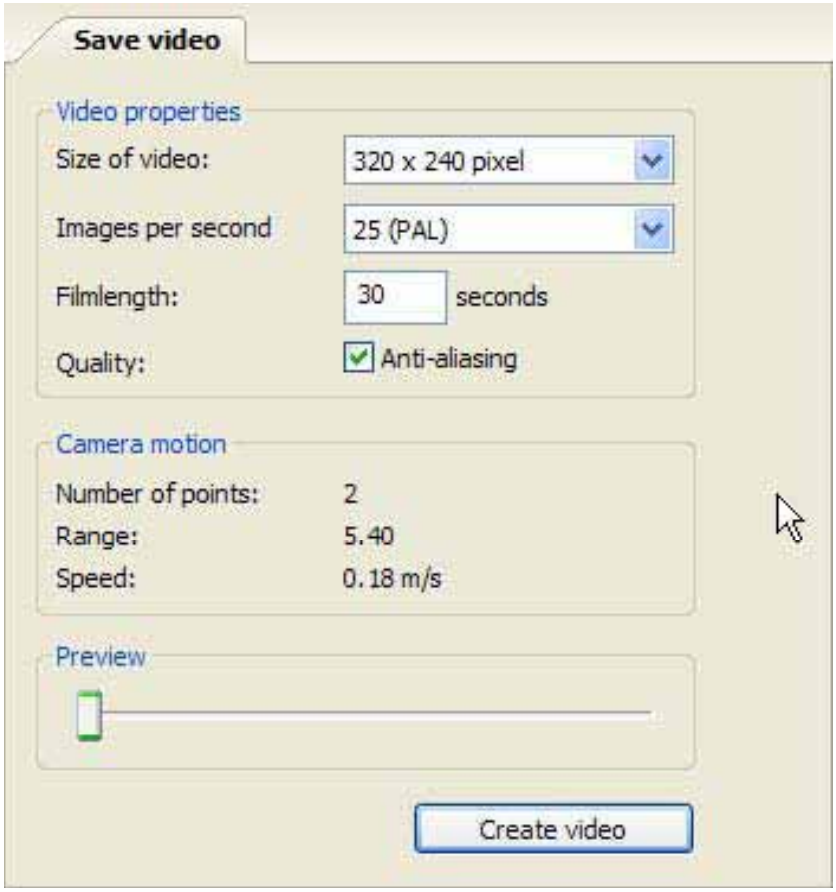


Fig. 421 Settings of the video

Besides the camera path and the camera viewing direction, also the video size the number of frames per second and the duration can be defined. The size defines the number of pixels in the X and Y direction on the screen. The higher the resolution, the more space is required to save the video. If you want to prepare a presentation for a TV (DVD or S-VCD) you should select a standard resolution. In Europe the PAL format is common, in the US the NTSC format is used normally. Also the frame rate is defined in the standard format. The camera speed is defined by the film length, the frame rate and the length of the camera path. The speed along the camera path is constant. If anti-aliasing is selected, the quality of the video will be better but this function needs also some calculation time. In the field "camera motion" you can see a summary of the camera path and speed.

Moving the slider "Preview" brings the 3D CAD view into the position of the camera along the path. So you can check the resulting video before you have created it. If the DIALux project becomes bigger a good graphic card is absolutely necessary. We recommend a Nvidia graphic card with a memory of at least 128MB. If you are working in MESA mode and the DIALux project is

complex (a lot of objects, a large area, …) the 3D CAD will soon start to judder.

Clicking on "Create video" will open a Save As dialog. The location and the filename have to be selected here. After that a standard windows dialog appears where the user can select the video codec to compress the movie.

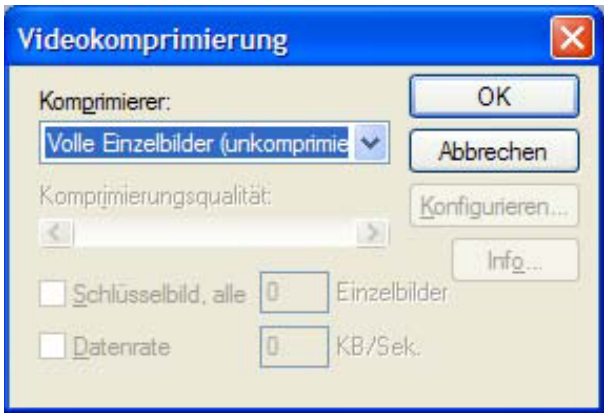


Fig. 422 Windows dialog for the video compression settings

In the drop down list all the codecs installed on the computer will be listed. These codecs are not installed by DIALux. The quality of the codec is responsible for the quality of the video. The better a codec is, the smaller the size of the file will be and the higher the quality of the video will be. Some of the codecs are free of charge. The codec has to be installed on the computer that creates the movie and on the computer that plays the movie. Microsoft XP already includes several codecs. These are available on all the XP machines if they were not deselected during the installation of the operating system. Some codecs are available from the internet. For example from here: www.divx.com or here: http://www.divx-digest.com/software/xvid.html . The last link leads to an open source project. The official site is here: http://www.xvid.org . Some of the codecs are offering a wide range of settings. Please click on settings to define the settings for the creation of the video. DIAL can not offer any support for the usage of a codec. NOTE a wrong codec or the selection of "uncompressed" full pictures will create a very large file size for the video. Start to test your codecs with small videos to find out which one and which settings are the best.

Raytracer

Important:
You can open the separate POV-Ray help with "F1" while POV-Ray is running.

For raytracing DIALux uses the external programme *POV-Ray*. If you want to have more detailed information about POV-Ray and the possible settings you can use the "*F1*"-key to open the POV-Ray help.

Background

DIALux automatically copies POV-Ray onto the PC. The software will be installed when the user for the first time starts to calculate a photorealistic image. The setup installs the standard version of POV-Ray 3.6. This software is freeware and available at www.povray.org . Additionally DIALux installs an adapted version of the povengine.exe into the DIALux directory. The major difference between the DIALux version and the original version of POV-Ray is that the DIALux version can handle real photometry of luminaires. The measured light distribution of a luminaire is used to define the distribution of light. The original version can only handle ideal light sources like spot and ambient light. Whenever the DIALux user wants to edit the POV-Ray files, it is important to use the pvengine.exe in the DIALux directory e.g.
"C:\Program Files\DIALux\pvengine.exe". Otherwise the *.pov file can not be interpreted. You can continue to work with POV-Ray to edit the scene generated with DIALux. All functions of POV-Ray are available. For further editing you must use the program "pvengine.exe" that is stored in the directory "C:\Programs Files\DIALux\". You cannot use the original POV-Ray software.

POV-Ray Settings within DIALux

The most important settings for the raytracing with POV-Ray can be made in DIALux. For the standard use of the photorealistic visualisation these settings are adequate. Expert users can use all the features of POV-Ray by loading the *.pov file made with DIALux into the editor of POV-Ray.

Photo Realistic Images with Raytracing

Raytracing means that the light beams from your own point of view with respect to mirroring, transparency and roughness of surfaces are followed.

Basic Settings

The newest version of the Raytracer POV-Ray (3.6) is integrated in DIALux. This is substantially quicker and can choose the right brightness settings independently. For the visualizations with POV-Ray the spectral distributions of the lamps and the colour filter as well as the dimming level for the control groups are handed over

automatically. In the menu file *Export* you find the option *Raytracing with POV-Ray* which opens a dialogue where the usually recommended settings are selected. In the quick preference tab you can define the basic settings for your first applications. Experienced users might change options for *Indirect Calculation*, *Brightness Preferences* and *Image Preferences*.

Quick preferences

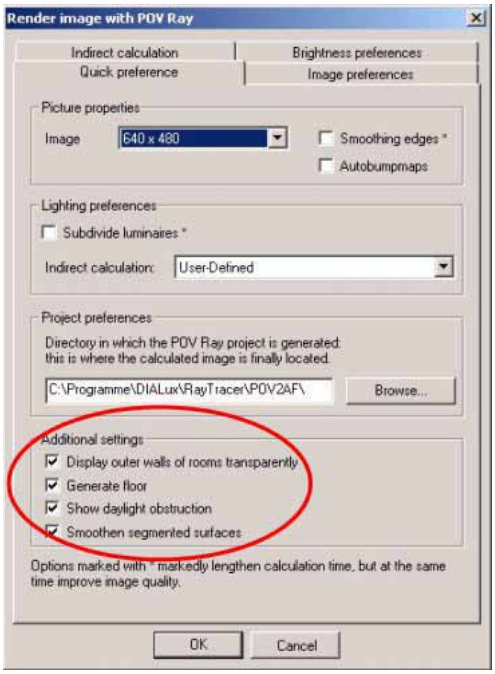


Fig. 423 Basic settings for Raytracing

Additional settings are possible in the *Quick preference* tab

In the *quick preferences* tab there are the following settings:

- *Picture properties*:
  Here you can define the size of the generated picture in pixels (length × height). The larger the number of pixels, the larger is the final result. In addition, a large picture extends the calculation time.
- *Smoothing edges (Anti-aliasing)*:
  This feature improves the transitions at edges, e.g. from walls. This should be activated if textures with lines are used, like tiles, bricks or pavement. This setting uses a lot of calculation power so it should not be used for preview pictures. Not only textures are smoothed, also the edges of the geometry will be straightened. A higher degree of Anti-aliasing can be selected in the POV-Ray editor. See advanced settings.

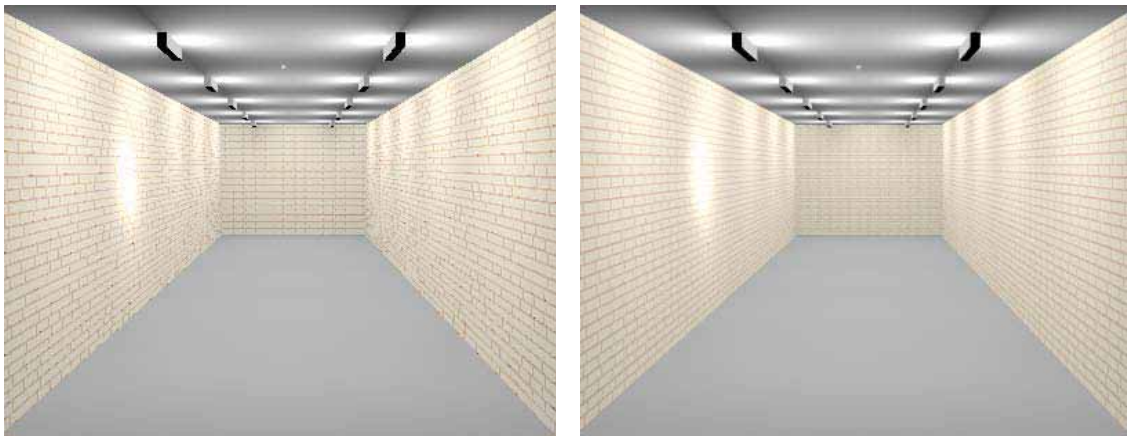


Fig. 424 Smoothing edges with POV-Ray

- *Autobumpmaps*:
  If textures are used which have a surface texture, e.g. wood or tiles, you can produce a better 3D view with the activation *Autobumpmaps*. They should be activated, if the light-dark information of the texture is identically with the high-low structure. E.g. water, bricks, wood. The bump map texture will be calculated from the grey values of the image. Within POV-Ray also there are independent bump maps that can be placed.
- *Lighting preferences*:
  With *Subdivide luminaires* you can specify whether the influence of each individual luminaire or all luminaires should be calculated together. The *Subdivide luminaires* setting generates a better result, however the calculation time extends. Without this option, the light rays are starting only in the middle of the light emitting surface. If a long luminaire is placed near to surface, the resulting image seems unrealistic. If this option is switched on, for each pixel, depending on the distance to the light source, the luminaire is subdivided into small luminous parts. Of course, this increases the calculation time.
  With *Indirect calculation* you can specify the influence of the indirect lighting on the result. The higher you select the part that indirect lighting plays, the longer the calculation time becomes. This option starts an elementary radiosity. Without this option, those objects which are not directly hit by rays are invisible. The higher the accuracy that is chosen, the longer the calculation takes but the quality increases. For exterior scenes sometimes it could be better to skip the indirect calculation. For a first preview, the indirect calculation should be switched off or "standard" should be selected. If directional lighting (mainly spots) is used, high to very high indirect calculation should be selected. For

diffuse, uniform illumination standard settings are adequate. This setting defines the number of rays used, for the calculation of the indirect light on each pixel. The more rays there are, the more correct the results are.

- *Project preferences*:
  After POV-Ray completed its work, by default the rendered image (bitmap *.bmp) is stored in the directory - as standard preference in:
  "C:\Program Files\DIALux\Raytracer\Room 1\…bmp".
- Additional preferences are possible. You can display outer walls of rooms transparently or daylight obstruction by using the checkboxes.

Image preferences

This defines the size of the picture in pixel. Any size can be selected. The aspect ratio is 4:3. This ratio is correct for projectors, most monitors and TV screens. Modern TVs and laptops can have ratios of 16:9 or 16:10. To define such a ratio see advanced settings. For a first picture you should always start with a small picture like 640 x 480.

Fig. 425 POV Ray – Image preferences

Indirect calculation

In addition to the settings of "indirect calculation" of the quick preferences, in this dialog the indirect calculation can be defined in a more detailed way.

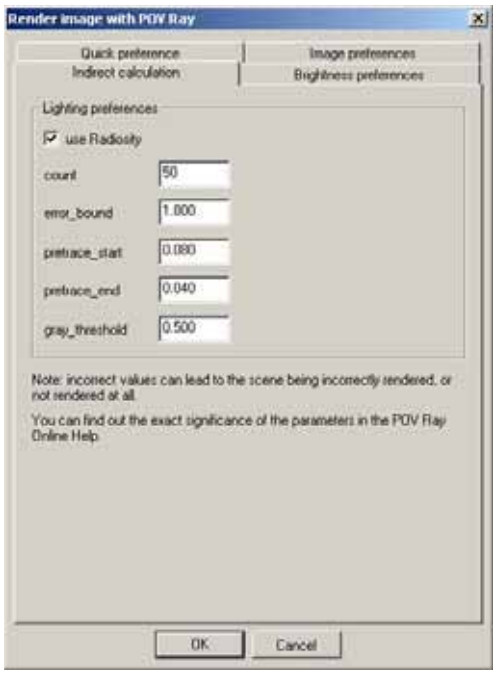


Fig. 426 POV Ray – Indirect calculation

The checkbox *Use Radiosity* switches the indirect calculation on and off.

- *Count*
  The integer number of rays that are sent out whenever a new radiosity value has to be calculated is given by count. A value of 35 is the default, the maximum is 1600. When this value is too low, the light level will tend to look a little bit blotchy, as if the surfaces you're looking at were slightly warped. If this is not important to your scene (as in the case that you have a bump map or if you have a strong texture) then by all means use a lower number.
- *Error bound*
  The error bound float value is one of the two main speed/quality tuning values (the other is of course the number of rays shot). In an ideal world, this would be the only value needed. It is intended to mean the fraction of errors tolerated. For example, if it were set to 1 the algorithm would not calculate a new value until the error on the last one was estimated at as high as 100%. Ignoring the error introduced by rotation for the moment, on flat surfaces this is equal to the fraction of the reuse distance, which in turn is the distance to the closest item hit. If you have an old sample on the floor 10 inches from a wall, an error bound of 0.5 will get you a new sample at a distance of about 5 inches from the wall. The default value of 1.8 is good for a smooth general lighting effect. Using lower values is more accurate, but requires a higher count. You can

use values even lower than 0.1 but both render time and memory use can become extremely high then.

- *Pretrace*
  To control the radiosity pre-trace gathering step, use the keywords pretrace_start and pretrace_end. Each of these is followed by a decimal value between 0.0 and 1.0 which specifies the size of the blocks in the mosaic preview as a percentage of the image size. The defaults are 0.08 for pretrace_start and 0.04 for pretrace_end.
- *Gray threshold*
  Diffusely interreflected light is a function of the objects around the point in question. Since this is recursively defined to millions of levels of recursion, in any real life scene, every point is illuminated at least in part by every other part of the scene. Since we can't afford to compute this, if we only do one bounce, the calculated ambient light is very strongly affected by the colours of the objects near it. This is known as colour bleed and it really happens but not as much as this calculation method would have you believe. The gray_threshold float value grays it down a little, to make your scene more believable. A value of 6 means: calculate the ambient value as 60% of the equivalent gray value calculated, plus 40% of the actual value calculated. At 0%, this feature does nothing. At 100%, you always get white/ gray ambient light, with no hue. The following pictures show a spot light (white) directed to a green wall. The first picture has a gray threshold value of 0, the second of 0.5 and the last a value of 1.

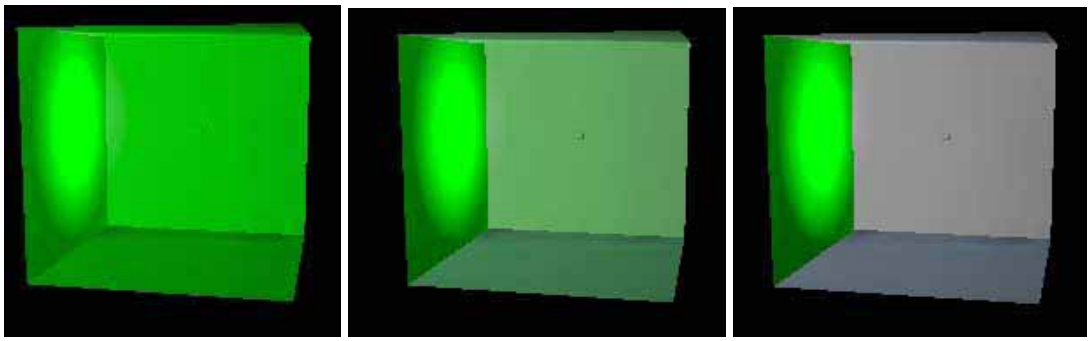


Fig. 427 Indirect calculation

Brightness preferences

In the *Brightness preferences* tab you can define, whether the scene tends to be rather dark or bright. Rule of thumb: the more luminaires that exist in the project, the brighter they becomes as does the scene. It would help to test it. In addition to the quick settings, the

brightness of the picture can be manipulated freely. If there are too dark areas in an image, decrease the low_value slightly downwards. This will make more details visible were it has been too dark. If parts of the image seems to be overexposed (the ceiling in a room with only indirect light), modify this value upwards, to make more details visible.

Fig. 428 POV Ray – Brightness preferences

Now the new version of the Raytracers (POV-Ray 3.6) allows the conversion of the light colours from the control groups, so that the rendered image is shown in colour.

Raytracing-Options for Surfaces

You can assign certain options to all surfaces of the room, the room elements or the furniture. Just select the surfaces and use the Property Page to adjust the values. You may select several surfaces using the *Shift*-key or the *Ctrl*-key. The option Autobumbmaps assigns an additional structure like for example some ripple to the texture.

Glass surfaces should have 15% reflection and 30% transparency

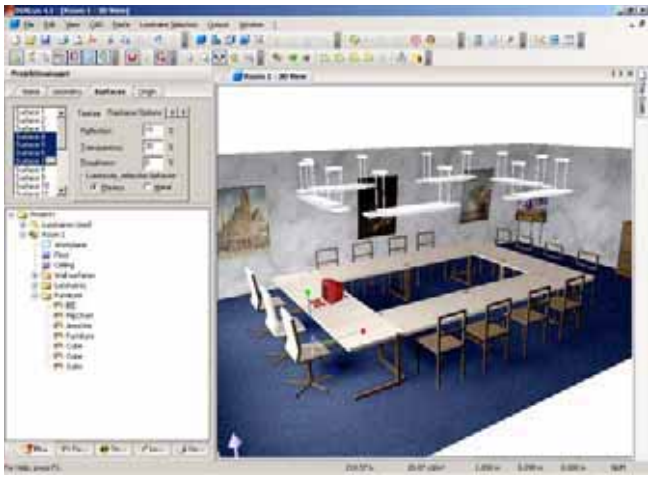


Fig. 429 Raytracing options modify the surfaces

The amount of reflection should be 5 – 10 % for floors and 10 – 15 % for glass. The transparency of glass should be around 30 %.

3-D Standard View for Raytracing

The Raytracing is based on the 3D view of your room or scene, where you can define the point of view, the perspective and the display window of the image.

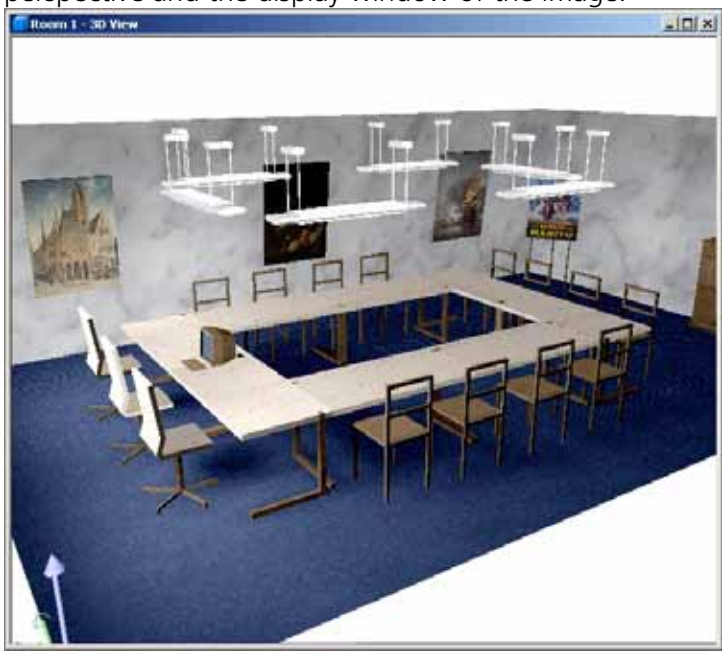


Fig. 430 3D view for the rendering

Starting POV-Ray

After you have adjusted the 3D view you can start POV-Ray from the menu *File* → *Export* → Calculate CAD view with POV-Ray or via Raytracer icon.

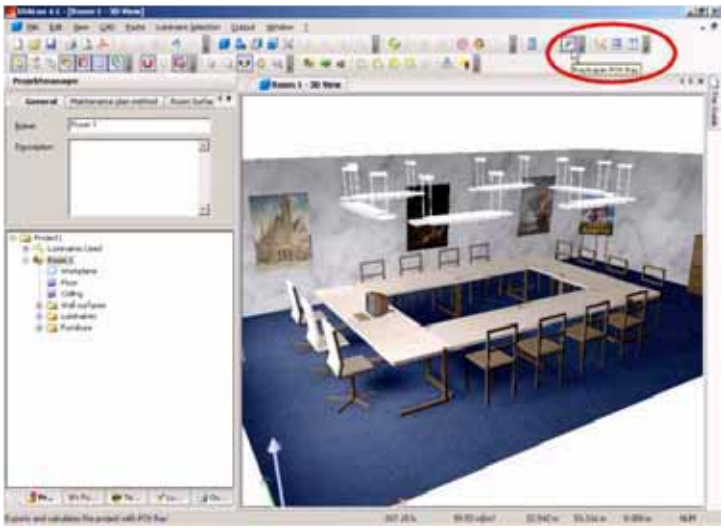


Fig. 431 Start the rendering

If the POV-Ray software is not yet installed, the installation is initiated now. The necessary files have been copied during the installation of DIALux .

If you have further questions you can use the POV-Ray help program, you can find it in the folder at "C:\Program Files\POV-Ray for Windows v3.6" or you can find the information at "http://www.povray.org".

Fig. 432 The rendered image

The output of the rendering is a bmp-file that you can print, import into other software or use with an image processing program.

Manipulation of the POV file and editing in POV-Ray

Start of the adapted POV-Ray Version

POV-Ray is freeware, available at www.povray.org. DIAL changed POV-Ray to adapt it to the needs of calculation with "real" luminaires. The POV files created by DIALux can only be modified by the POV-Ray version installed by DIALux. If the user tries to open these files with the regular POV-Ray, an error message will occur. To start the DIAL POV-Ray version, open the PVENGINE.EXE file in your DIALux directory e.g. C:\Program Files\DIALux\ and by a double click.

Smoothing edges

The Anti-aliasing function can be set in DIALux and with more parameters in POV-Ray. To edit a POV file you have to start the POV-Ray program first and then load the *.pov file created by DIALux. The following pictures are showing the same scene without smoothing edges, with the setting switched on in DIALux and with a higher level defined in POV-Ray. This is normally only necessary for small, detailed textures in big distances. Calculation time increases with the level of Anti-aliasing.

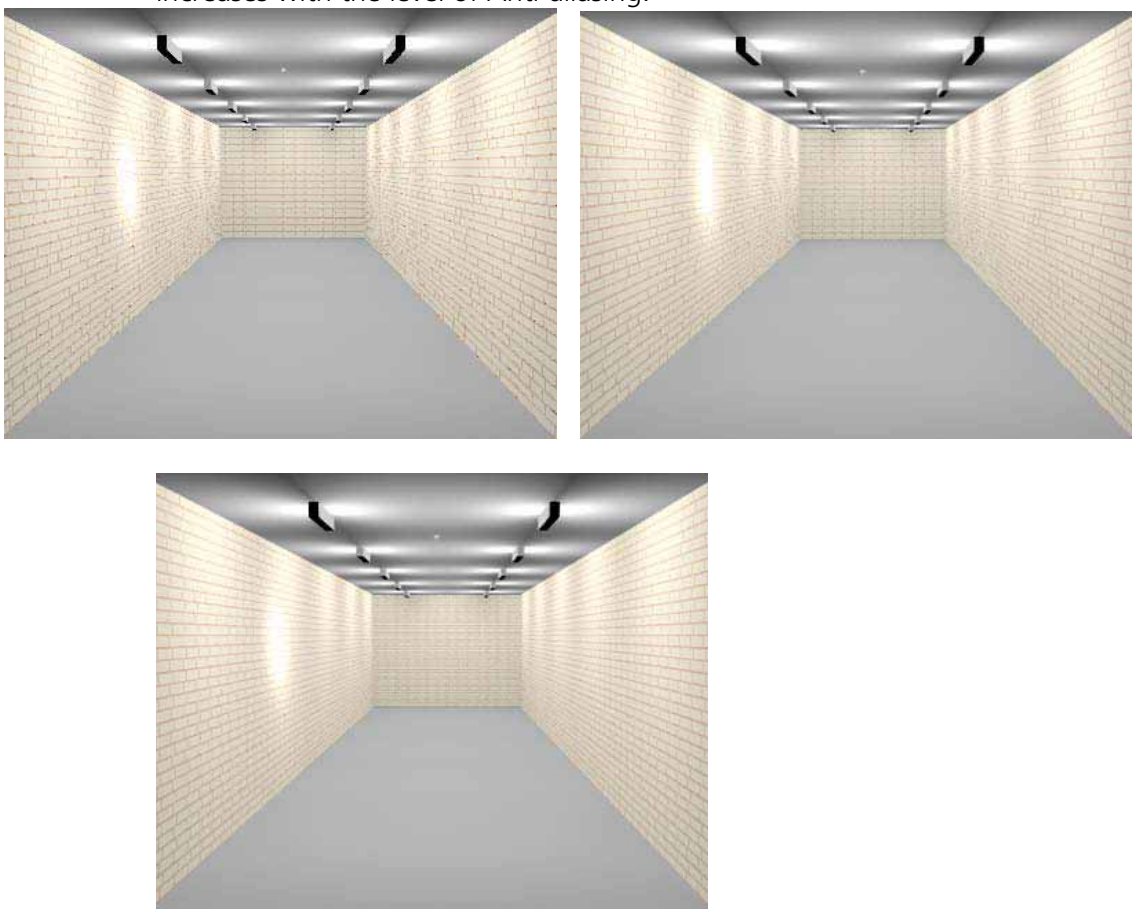


Fig. 433 Smoothing edges

After loading the POV file into the editor, the user can enter additional values for different parameters directly

into the edit field in the top middle of the screen. The command for Anti-aliasing is +a followed by a number without a blank e.g. “+a0.001”. The lower this value is, the higher the smoothing is.

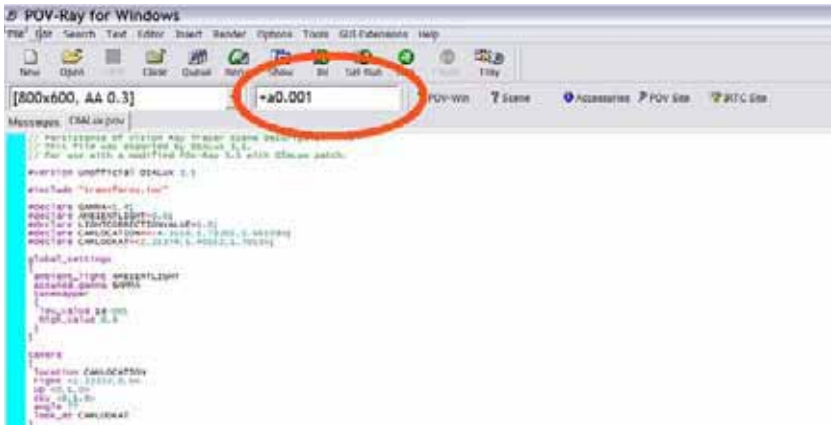


Fig. 434 POV-Ray for Windows

When the POV-Ray editor is started the user can always open the help by pressing F1 to get information for any command.

Picture ratio

Images created by DIALux are always in a ratio of 4:3. This is for the most presentation techniques a good value (TV, projector, monitor,…). Modern laptops or TVs have another ratio e.g. 16:9 and 16:10. After loading the POV file the user can search for the camera command in the text. The search command is one of the drop down menus at the top of the window. In the menu “search” you can select “find” and enter “camera”. Below “camera” there is a command for the “right vector” of the used camera. There is written: <1.3333,0,0>. 1.333 is the ratio 4:3. To achieve a ratio of 16:9 enter there <1.7777> or 16/9 (E.g. right <16/9,0,0>). It is important to define a correct picture size with the same ratio. The following pictures of the same scene are made in 4:3 and 16:9 ratio. The 4:3 picture has a resolution of 800 by 600 pixel. If you want to keep the height of 600 pixel, you have to multiply the width with the desired ratio. In our example 600 x 16/9 = 600 x 1,7777 = 1066.

Fig. 435 Picture ratio

Fig. 436 Manipulated picture size

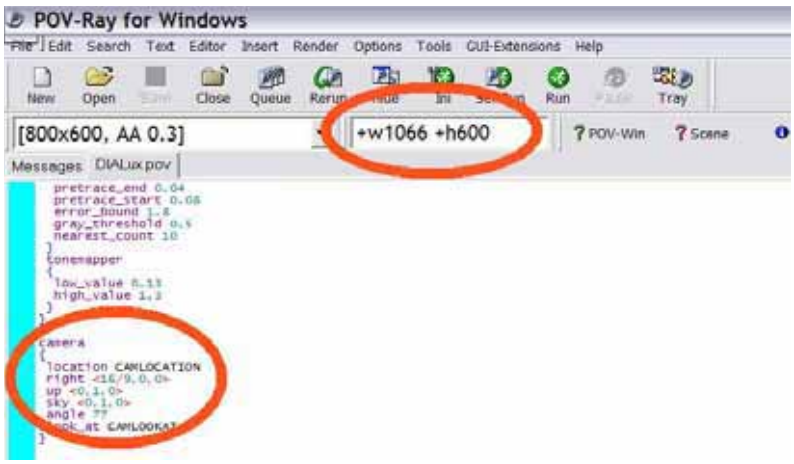


Fig. 437 Change picture size

You can manipulate the picture size by entering the desired size into the edit field with +w and +h directly followed by the numbers. w means width, h means height.

Camera

The camera definition describes the position, projection type and properties of the camera viewing the scene.

Interesting types are spherical, cylinder and panoramic. In the POV-Ray help a number of camera types are explained. If none is specified, the perspective camera is the default. The perspective keyword specifies the default perspective camera which simulates the classic pinhole camera. The (horizontal) viewing angle is either determined by the ratio between the length of the direction vector and the length of the right vector or by the optional keyword angle, which is the preferred way. The viewing angle has to be larger than 0 degrees and smaller than 180 degrees. In the "camera" area of the POV file the settings for the camera can be changed.

```
camera
{
 location CAMLOCATION      // parameter for the
                           position, is defined in the
                           beginning of the file
 right <16/9,0,0>          // right vector of the
camera
 up <0,1,0>                // up vector of the camera
 sky <0,1,0>               // Vector for the sky
 angle 77                  // viewing angle
 look_at CAMLOOKAT         // viewing direction of the
                           camera
}
```

The primary purpose of the up and right vectors is to tell POV-Ray the relative height and width of the view screen. In the default perspective camera, these two vectors also define the initial plane of the view screen before moving it with the look_at or rotate vectors. The length of the right vector (together with the direction vector) may also be used to control the (horizontal) field of view with some types of projection. The look_at modifier changes both the up and right vectors. The angle calculation depends on the right vector.

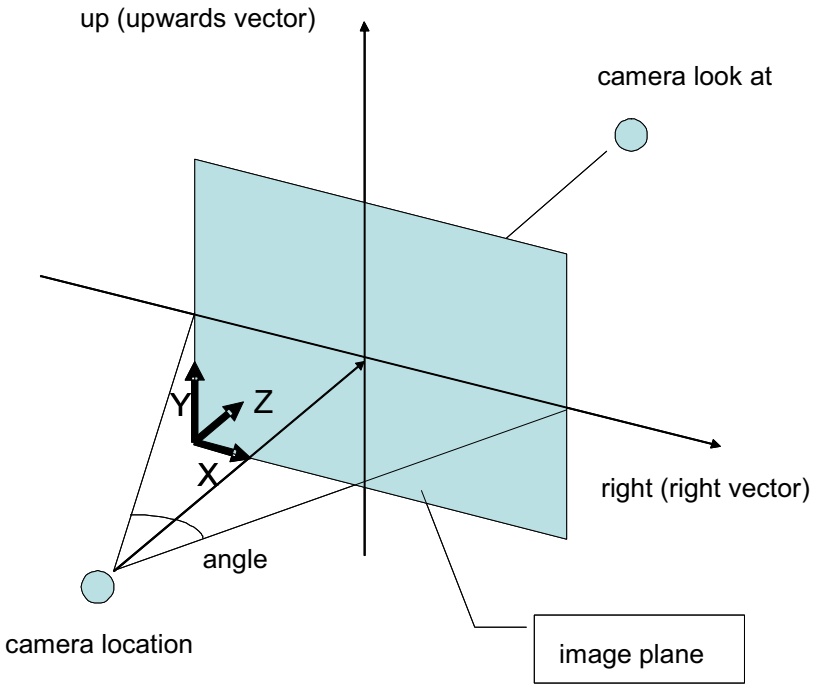


Fig. 438 Camera look and location

This picture shows the definition of the field of view. The blue plane is the image plane. DIALux exports those values as they are defined in the 3D view of the CAD. Depending on the camera type used, those values can differ. See POV-Ray help for more details.
To create a "round view" the camera type "cylinder" is useful. Especially in exterior scenes interesting views can be created. To define such a view the user has to enter the command "cylinder 1" in the area of camera. Use 180° for the angle. It is important to select a correct image size. If you want to have a picture of 500 to 120 the picture ratio has to be 4.2666. The following image is calculated with a 180 degree viewing angle and a cylindrical camera.

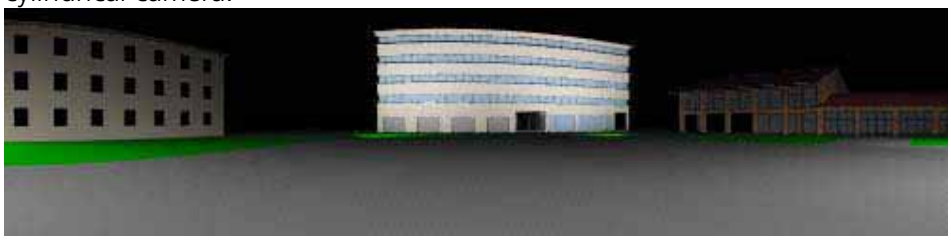


Fig. 439 Exterior scene visualisation

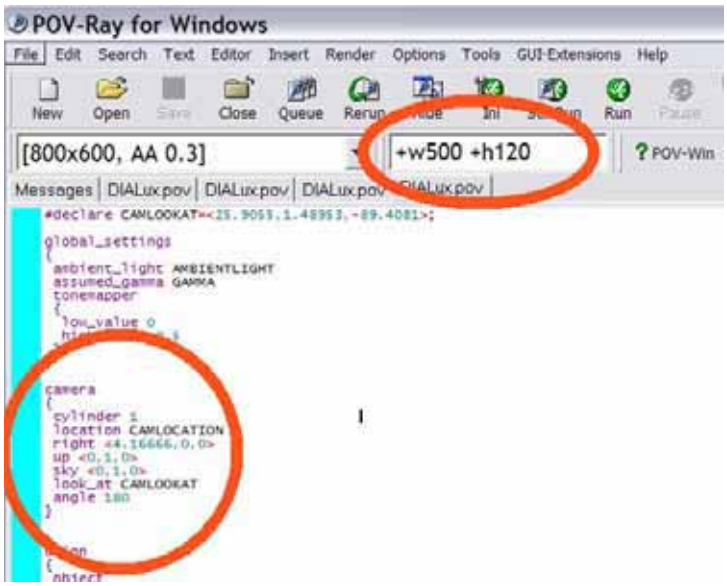


Fig. 440 Settings camera location

Animation

Animation with Keyframes

You can create videos in DIALux with selecting Menu -> File -> Export -> Save 3D Video". You have to define a camera path and several other parameter (see Making videos in DIALux). If you create a PovRay visualisation after defining the camera path, most of the work for making a PovRay video is done. Load the created *.pov file into the PovRay editor. Make sure, that you use the pvengine.exe in the DIALux subfolder. Look for the green lines in the pov file:

// Right click on next line and select "Copy xxx to Command-Line" to render animation
// +KFI0 +KFF249

As written in the first line, please make a right click on the line // +KFI0 +KFF249. Depending on the setting of your animation the values for KFI and KFF can differ.

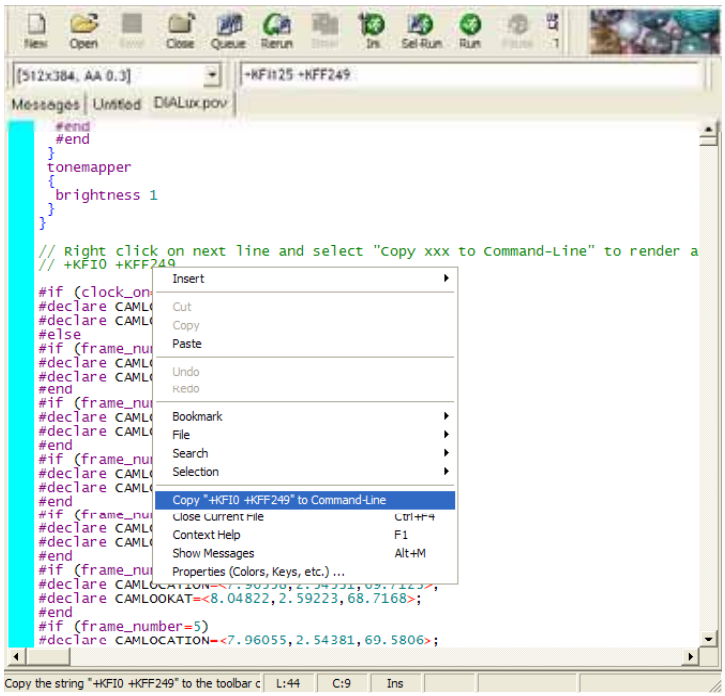


Fig. 441 Starting an anmation in PovRay using key frames

Making a right click a context menu appears. Select the "Copy xxx to Command Line" command. This is now written into the command line in the top of the PovRay editor. Clicking on run starts the PovRay raytracing. PLEASE KEEP IN MIND: a 10 second movie with 25 FPS (frames per second) has 250 pictures to be calculated. If one picture takes a minute, you will wait 250 minutes or 4 hours and ten minutes

Animation with the clock parameter
With POV-Ray also animation of scenes can be created. Up to now only static images with fixed camera position and viewing direction have been made. The following settings are defining camera position and viewing direction:
#declare CAMLOCATION=<1.5,1.7,2.6>;
#declare CAMLOOKAT=<6.4,1.7,-7.6>;

It is important to know, that X, Y and Z are not the same directions as they are in DIALux. Y and Z are changed, compared with DIALux. With the following command lines you can prepare POV-Ray for creating animations.

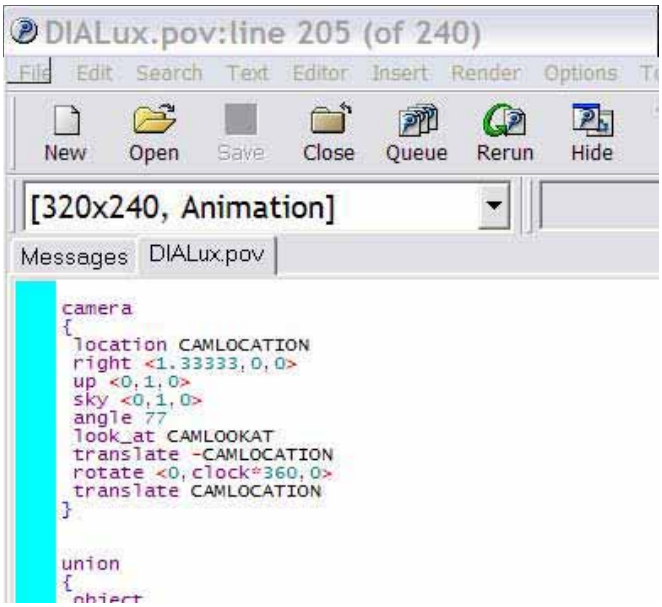


Fig. 442 Animation settings

The camera will be rotated around the upwards axis. Because of that, we will have a look around the room. Rotate <0,clock*360,0> defines the rotation around the up axis. Remember, Y and Z are exchanged, compared with DIALux. Clock is a counter which is going upwards from 0 to 1. The definition of the clock has to be done in the Ini file of POV-Ray. To do this open the Ini file by clicking on the icon. In this Ini file a section with the correct resolution, anti-aliasing and step width of the clock has to be added. Example:

[320x240, Animation]	Name
Width=320	resolution width
Height=240	resolution height
Antialias=Off	anti-alias switched off
Initial_Frame=1	Image to start with
Final_Frame=25	Image to stop with, defines the number of images
Initial_Clock=0.0	start value of clock
Final_Clock=1.0	stop value of clock

After changing the Ini file, POV-Ray has to be closed and restarted. After the restart of POV-Ray this section can be selected in the top left area of the editor.

Initial_Frame and Final_Frame define the number of pictures to be rendered. In our example there are 25 pictures. Initial_Clock and Final_Clock should be taken without changing. In Europe there are 25 frames per second in PAL format commonly. A 10 seconds lasting film needs 250 pictures (frames). In our example we create 25 pictures, coded as a PAL movie, it will last 1 second. In the POV file we have added the line rotate <0,clock*360,0>. From “Initial_clock=0” up to

“Initial_clock=1” the camera is turned around 360°. POV-Ray creates every 360/25= 14.4 degree a picture. The camera should be turned around its own centre. Therefore it is necessary to translate it into the origin before rotating, otherwise the camera will be rotated around the origin on a circular path. To achieve this you have to enter <translate –camlocation> then <rotate <0,clock*360,0>> then again <translate camlocation> .

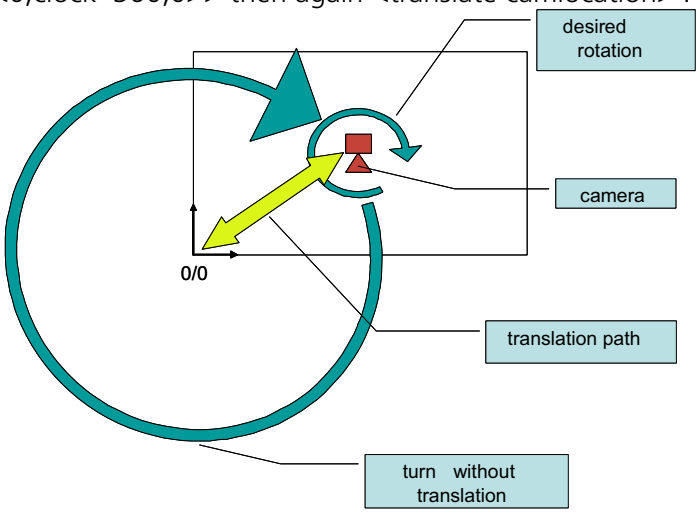


Fig. 443 Camera – Rotation and translation

Each picture will be calculated one after another after clicking on the “Run” icon. Each picture will be saved into the work directory with consecutive numbering. With any animation tool, pictures can be combined to a movie (*.avi, *.mpeg,…) The freeware tool VirtualDub can create such movies in a short time in high quality. http://www.virtualdub.org/index

Translation animation

You can define a camera path using clock. To do so, the Ini file and the POV file have to be changed. Instead of the camera rotation you can change the camera location using the clock parameter. In the following example we change the POV file of the first example. The Ini is already changed. The POV file will be changed by adding the clock variable to the X position of the camera location.

```
#declare GAMMA=1.4;
#declare AMBIENTLIGHT=0.0;
#declare LIGHTCORRECTIONVALUE=1.0;
#declare CAMLOCATION=<1.23+clock*11,1.15,3.11>;
#declare CAMLOOKAT=<12.4,1.5,-1.0>;
```

In DIALux the 3D view was turned in that way to enable the camera path to go through the whole room. In the beginning clock=0, that means the position X is 1.23m. Clock will be counted up in 25 steps from 0 to 1(value from the Ini file). The X position of the camera changes

from 1.23m in the first step to 1.23m + 1/25 x 11m = 1.67m in the second step. The last X position is 1.23m + 25/25 x 11m = 12.23m.

The clock variable can be used a number of times in one file. It can be used for translation and rotation in the same animation. So the camera moves along a path turning the viewing direction around its up axis.
For example:

```
#declare GAMMA=1.4;
#declare AMBIENTLIGHT=0.0;
#declare LIGHTCORRECTIONVALUE=1.0;
#declare CAMLOCATION=<1.18+clock*11,1.15,3.13>;
#declare CAMLOOKAT=<12.4,1.56,-1.02>;

global_settings
{
 ambient_light AMBIENTLIGHT
 assumed_gamma GAMMA

 tonemapper
 {
  low_value 1e-005
  high_value 0.8
 }
}

camera
{
 location CAMLOCATION
 right <1.33333,0,0>
 up <0,1,0>
 sky <0,1,0>
 angle 77
 look_at CAMLOOKAT
 translate -CAMLOCATION
 rotate<0,180*clock,0>
 translate CAMLOCATION
}
```

In this example the rotation is reduced to 180 degree and it is added to the POV file which already includes the movement of the camera.

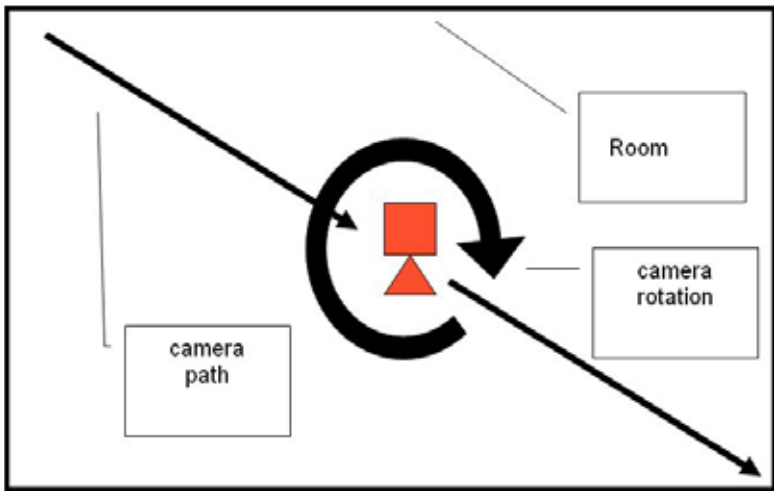


Fig. 444 Movement of the camera

Colour

POV-Ray can calculate coloured light. DIALux will export light colour information of a lightsource in version 3.2. Up to that time, you can create coloured light either by using a transparent, coloured filter glass in front of a luminaire or you can edit the RGB value of a luminaire in the POV file.

To add a "filter glass" in DIALux you have to place a small cube in front of the lightoutput of a luminaire. In the "Raytrace settings" of the geometry you have to define the transparency and the colour of the "filter". It is necessary to remove these filters before calculating with DIALux. DIALux does not yet calculate transparency.

To change the RGB value in the POV file you have to open the file and to find (menu search -> find) ldt_data. The underscore is important!

```
light_source
{
  <0,0,0>
 color <1,1,1>
 ldt_data
 {
  72, 72, 1 * LIGHTCORRECTIONVALUE,
```

color<1,1,1> means the RGB values for the light source are all 100%, means white light. If you change any of these parameters, (e.g. <1,0,1>) the resulting color will be according to the RGB values. This has to be done for each luminaire. It could be helpful to use the replace function (menu search -> replace…)

Further functions of POV-Ray

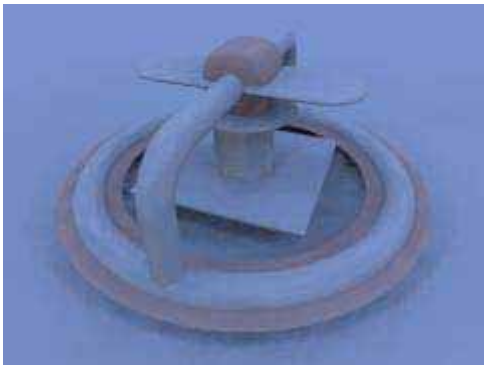
The following information is an excerpt from the POV-Ray online help you get when you press "*F1*" after POV-Ray is started. Furthermore you will find additional information under www.povray.org. Here follows an abstract of the POV-Ray help.

4.2.3 Radiosity without conventional lighting

You can also leave out all light sources and have pure radiosity lighting. The situation then is similar to a cloudy day outside, when the light comes from no specific direction but from the whole sky.

The following 2 pictures show what changes with the scene used in part 1, when the light source is removed. (default radiosity, but `recursion_limit 1` and `error_bound 0.2`)

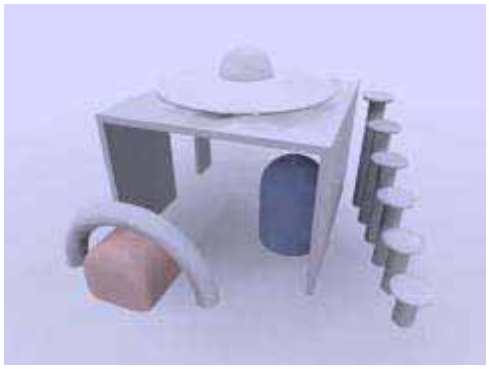
with light source



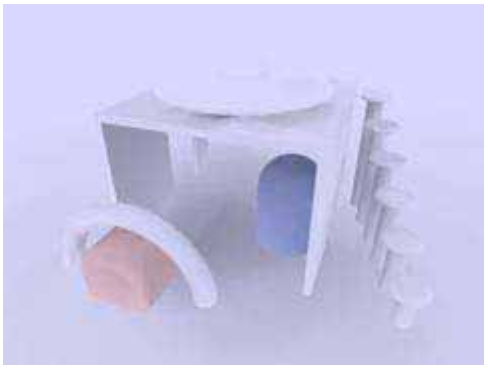
without light source

You can see that when the light source is removed the whole picture becomes very blue, because the scene is illuminated by a blue sky, while on a cloudy day, the colour of the sky should be somewhere between gray and white.

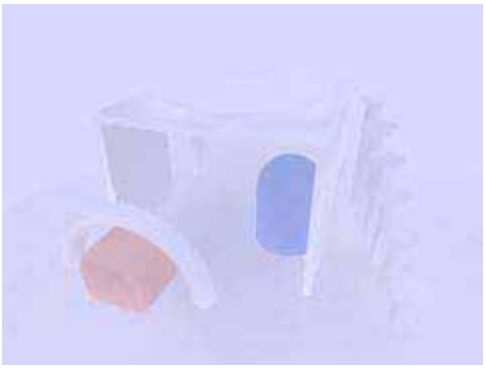
The following pictures show the sample scene used in this part with different settings for `recursion_limit` (everything else default settings).



recursion_limit 1



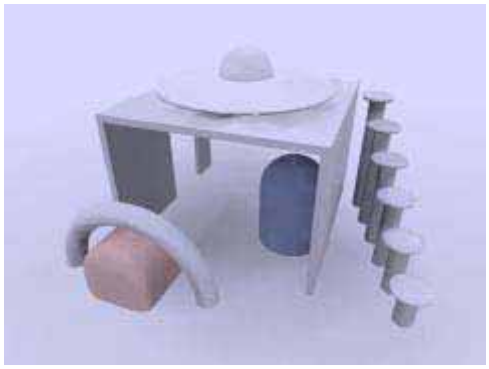
recursion_limit 2



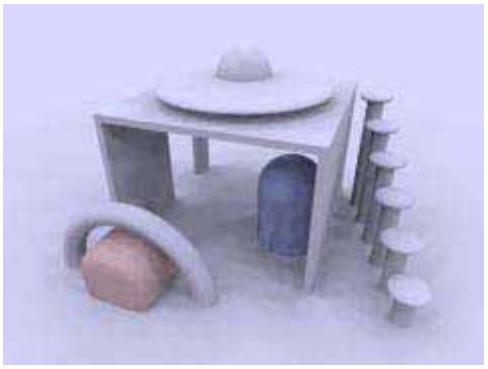
recursion_limit 3

This looks much worse than in the first part, because the default settings are mainly selected for use with conventional light sources.

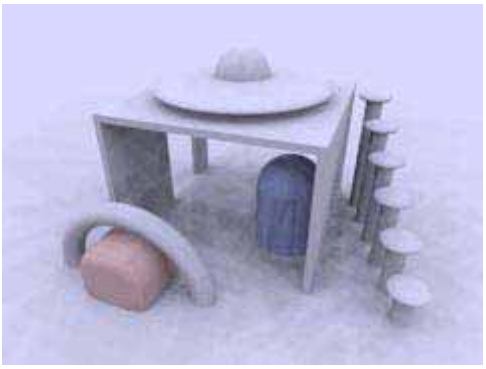
The next three pictures show the effect of `error_bound`. (`recursion_limit` is 1 here) Without light sources, this is even more important than with good values, much depends on the scenery and the other settings, lower values do not necessarily lead to better results.



error_bound 1.8

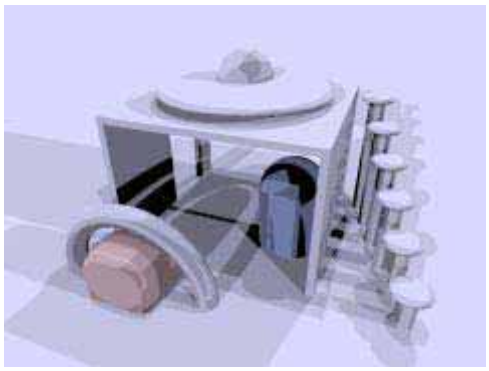


error_bound 0.4

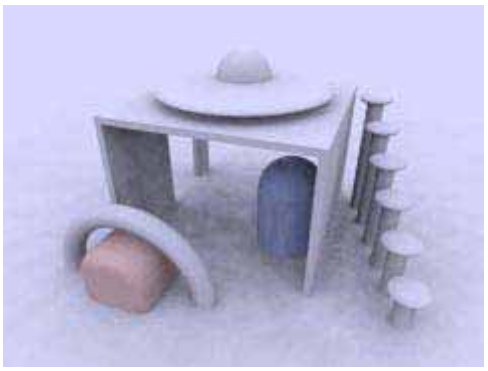


error_bound 0.02

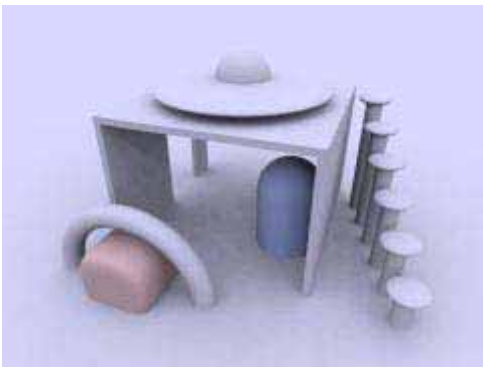
If there are artefacts it often helps to increase `count`, it does affect quality in general and often helps in removing them (the following three pictures use `error_bound 0.02`).



count 2

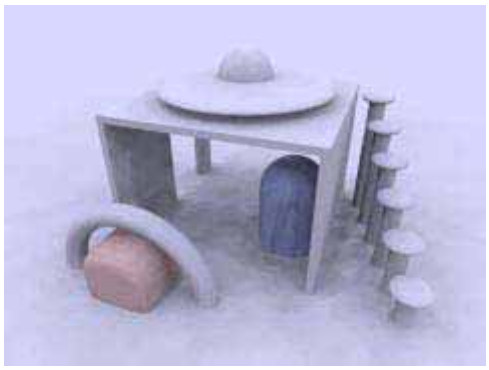


count 50

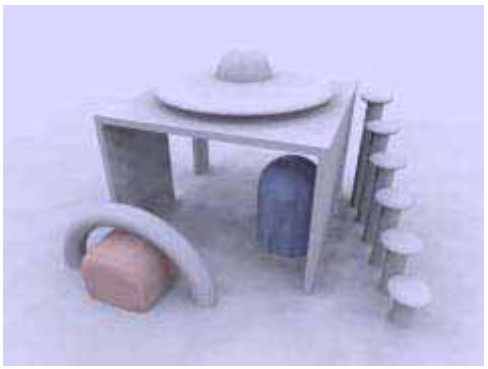


count 200

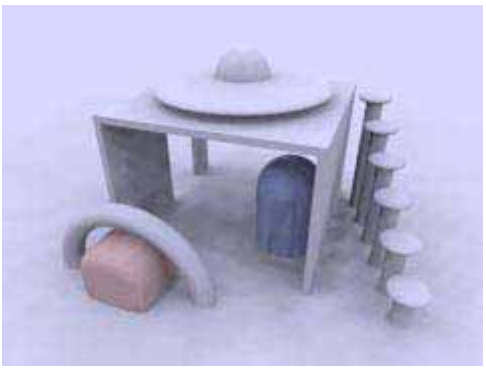
The next sequence shows the effect of `nearest_count`, the difference is not very strong, but larger values always lead to better results (maximum is 20). From now on all the pictures use `error_bound 0.2`



nearest_count 2



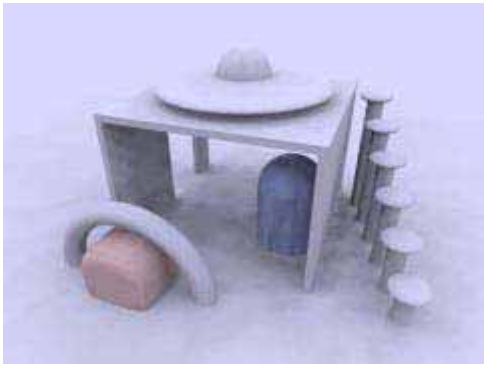
nearest_count 5 (default)



nearest_count 10

The `minimum_reuse` is a geometric value related to the size of the render in pixel and affects whether previous radiosity calculations are reused at a new point. Lower values lead to more often and therefore more accurate calculations.

minimum_reuse 0.001

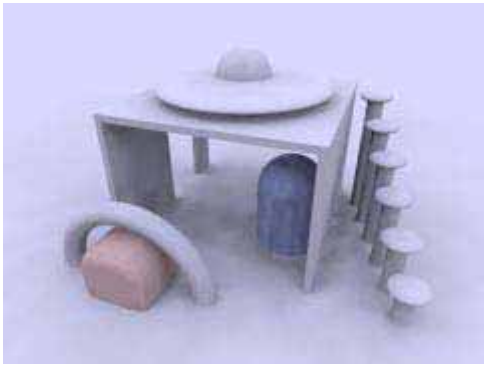


minimum_reuse 0.015 (default)

minimum_reuse 0.1

In most cases it is not necessary to change the `low_error_factor`. This factor reduces the error_bound value during the final pretrace step. `pretrace_end` was lowered to `0.01` in these pictures, the second line shows the difference to default. Changing this value can sometimes help to remove persistent artefacts.

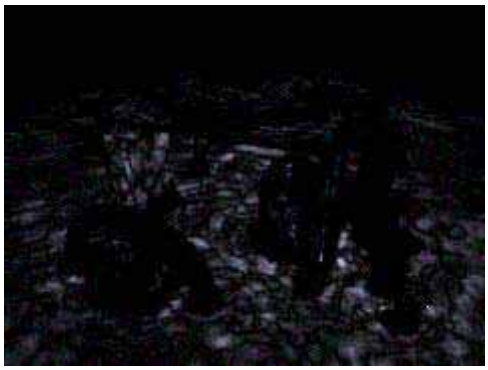
low_error_factor 0.01



low_error_factor 0.5 (default)

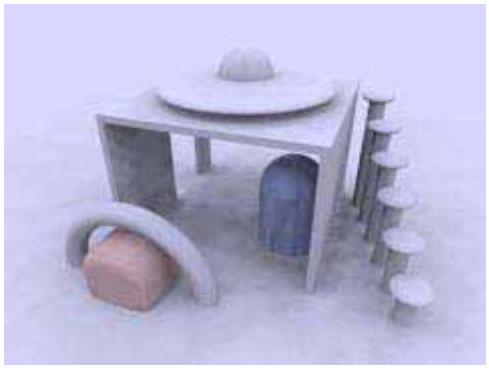
low_error_factor 1.0

low_error_factor 0.01

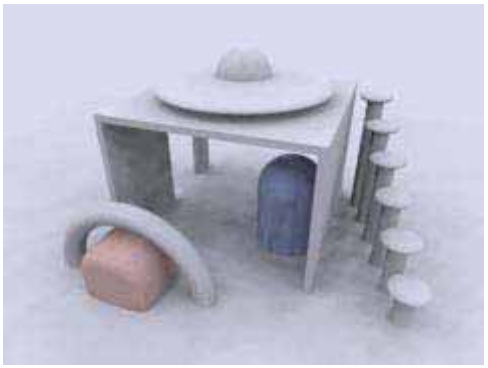


low_error_factor 1.0

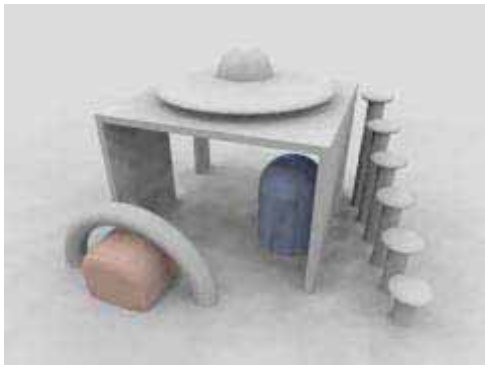
`gray_threshold` reduces the colour in the radiosity calculations. As mentioned above the blue sky affects the colour of the whole scene when radiosity is calculated. To reduce this colouring effect without affecting radiosity in general you can increase `gray_threshold`. 1.0 means no colour in radiosity at all.



gray_threshold 0.0 (default)

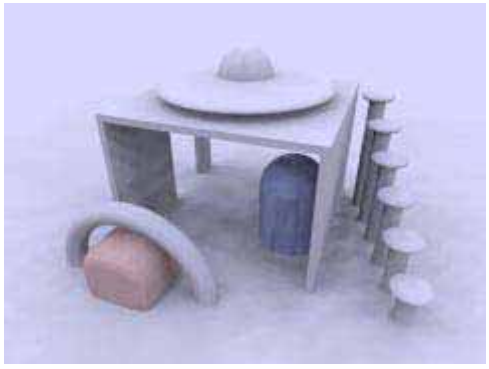


gray_threshold 0.5



gray_threshold 1.0

Another important parameter is `pretrace_end`. Together with pretrace_start it specifies the pretrace steps that are done. Lower values lead to more pretrace steps and more accurate results but also to significantly slower rendering.

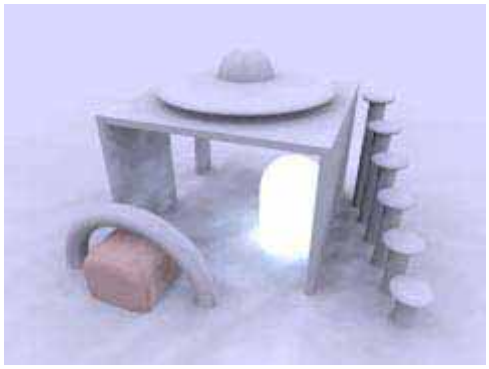


pretrace_end 0.2

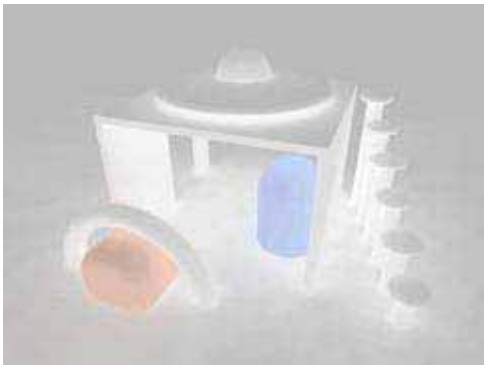
pretrace_end 0.02

pretrace_end 0.004

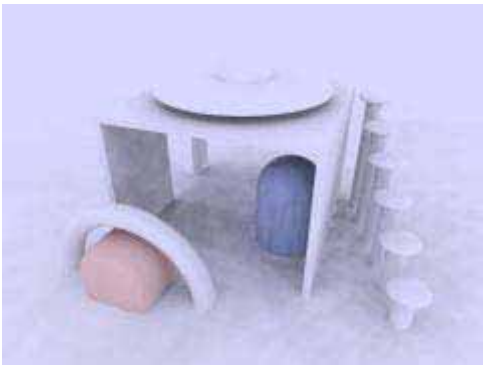
It's worth experimenting with the things affecting radiosity to get some feeling for how things work. The next 3 images show some more experiments.



ambient 3 instead of ambient 0 for one object



ambient 0.5 instead of ambient 0 for all objects sky: ambient 0

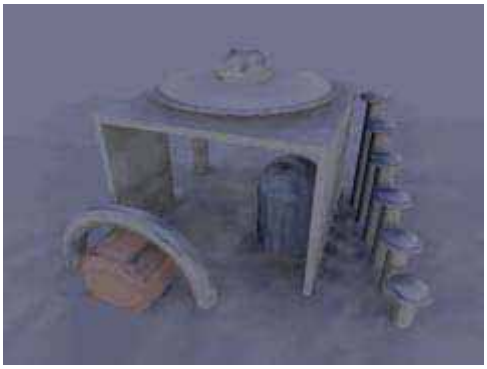


error_bound 0.04 recursion_limit 2

Finally you can strongly change the appearance of the whole scene with the sky's texture. The following pictures give some example.

yellow-blue gradient from left to right

light-dark gradient from left to right



light-dark gradient from bottom to top

Really good results depend a lot on the unique situation and how the scene is meant to look. Here is a “higher quality” rendering of this particular scene, but the requirements can be considerably different in other situations.

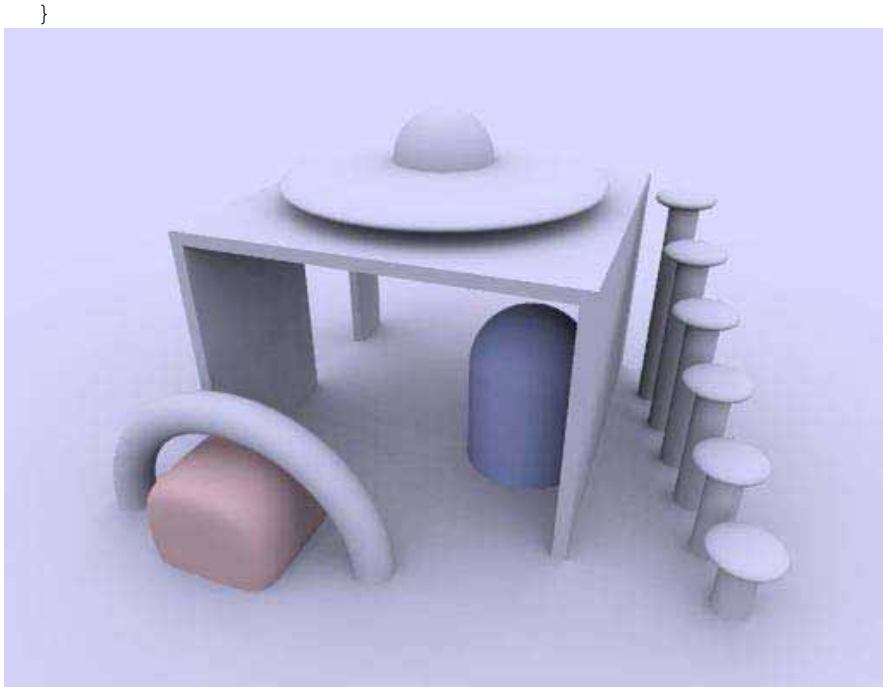
```
global_settings {
  radiosity {
    pretrace_start 0.08
    pretrace_end   0.01
    count 500

    nearest_count 10
    error_bound 0.02
    recursion_limit 1

    low_error_factor 0.2
    gray_threshold 0.0
    minimum_reuse 0.015
    brightness 1

    adc_bailout 0.01/2
  }
```

}



higher quality

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