



# Tutorial to daylight simulations with DIVA

This is a tutorial to daylight simulations with MicroShade® in DIVA. DIVA is a daylighting analysis software that calculates the annual daylight availability in buildings based on the Radiance backwards raytracer and the DAYSIM daylighting analysis software. DIVA has been developed at the Graduate School of Design at Harvard University and is now distributed and developed by Solemma LLC. Please note, that DIVA is now replaced by ClimateStudio.

This guideline shows how to use MicroShade® in DIVA for simulation of daylight. For further questions regarding DIVA simulations, please contact Solemma LCC. For questions regarding MicroShade®, please contact us on [support@microshade.com](mailto:support@microshade.com)

## Daylight metrics

DIVA calculates a series of climate-based daylight metrics including daylight autonomy (DA), useful daylight illuminance (UDI), spatial daylight autonomy (sDA) and annual sun exposure (ASE). Furthermore DIVA can calculate the daylight glare probability (DGP) for glare assessments. DIVA can also calculate the simpler daylight factor (DF). DIVA can be integrated with Grasshopper for parametric optimizations and includes an energy simulation component as well.

## About MicroShade®

MicroShade® is a highly effective shading product consisting of an almost invisible film combining UV and IR coatings with a structured micro-lamella. The shading efficiency depends on the incidence angle of the sun on the lamellas. When the sun is high in the sky during the summer, MicroShade® provides the strongest shading and during winter when the sun is low more heat is allowed into the building.

## Selection of glazing with MicroShade®

For façade applications<sup>1</sup> MicroShade® is commonly combined with either a low energy coating or an extra low energy coating. An extra low energy coating provides a stronger shading, whilst a low energy coating allows more daylight inside. For roof applications an extra low energy coating is typically used, and for even stronger shading it is possible to combine MicroShade® with a hard coated solar control coating (SCH) on the front glass. For more information on selection of MicroShade® type please see our selection guidelines on [www.microshade.com](http://www.microshade.com)

## Rotation of MicroShade®

A rotation of MicroShade® can be done to optimize the g-value. For vertical facades MicroShade® are never rotated, while MicroShade® in roof windows can be rotated depending on the orientation and tilt of roof. Rotation should be considered for orientations between northeast (45°) and northwest (315°) for roof windows at tilts between 25° and 70°. The rotation angle is always 90°. Please contact MicroShade A/S at [support@microshade.com](mailto:support@microshade.com) to confirm if rotation is beneficial.

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<sup>1</sup>) Facade application means glazing mounted in a near vertical position.  
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## Usage

The MicroShade® model is a description of only the MicroShade® layer. In order to model MicroShade® in a window two polygons are needed; the outer polygon is the MicroShade® layer and the inner polygon is the glazing. The two polygons together model the MicroShade® window. The surface normal of the polygon representing MicroShade® should face the exterior, see Figure 1. In Rhino 6.0 this can be tested by selecting the relevant surface and using the command "dir". This will show the orientation of the surface. If the surface normal faces the interior, click on the surface to flip it.

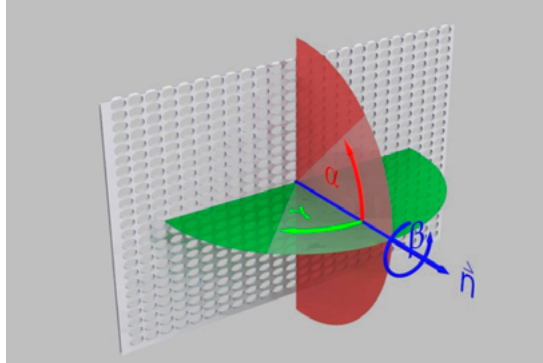


Figure 1. The surface normal should face the exterior.

The material description for the glazing is the same as without MicroShade®.

The material description for MicroShade® is enclosed in the following files:

- Microshade\_f.cal which should be stored in **C:\DIVA\Radiance\lib**
- Microshade\_mat.rad whose text has to be copied into the material.rad in **C:\DIVA\Daylight**

MicroShade\_mat.rad file contains the following:

```
void glass microshade_air
0
0
4 1 1 1 1

void plastic microshade_metal
0
0
5 0.1 0.1 0.1 0.017 0.005

void mixfunc microshade_f_mat

4 microshade_air microshade_metal trans microshade_f.cal 0

0
1 0 → Rotation angle  $\beta=0$  no rotation,  $90=90^\circ$  rotation anti clockwise seen from the exterior
```

A rotation of MicroShade® is normally done to optimize the g-value. For vertical facades MicroShade® is never rotated, while MicroShade® in roof windows can be rotated  $90^\circ$  depending on the orientation and tilt of roof. Rotation should be considered for orientations between northeast ( $45^\circ$ ) and northwest ( $315^\circ$ ) for all roof windows with inclinations between  $25^\circ$  and  $75^\circ$ . Please contact MicroShade A/S at [support@microshade.com](mailto:support@microshade.com) in these cases.

Simulation parameters should minimum be set to "**-ab 7 -ad 1500 -as 100 -ar 300 -aa 0.1**", as MicroShade® can be compared to venetian blinds in complexity.



## Simulations with DIVA

DIVA offers several kinds of daylight simulations: Useful Daylight Illuminance (UDI), Daylight Autonomy (DA), Continuous Daylight Autonomy (CDA), Annual Sun Exposure (ASE), Daylight Factor (DF) and Spatial Daylight Autonomy (sDA) according to LEED, which is based on occupied hours. In Europe it is recommended to use the spatial daylight autonomy based on daylit hours as described in EN 17037, which means further data processing is required.

The UDI, DA, CDA, sDA and ASE are calculated with the chosen weather data file, while the daylight factor (DF) is calculated with a CIE standard overcast sky as default.

The daylight factor is a very simple daylight assessment method and it is therefore recommended also to use the daylight autonomy and/or useful daylight illuminance as a supplement to the daylight factor assessment.

If you have any questions regarding daylight simulation with MicroShade® you are welcome to contact MicroShade A/S. If you are a first time user of DIVA please see our tutorial on daylight simulations in DIVA on our website [www.microshade.com](http://www.microshade.com) under downloads.

All information is intended as guidance. MicroShade A/S reserves the right to make amendments and changes to product specifications. MicroShade A/S cannot be held responsible for the correctness of the information provided in this document.



# Get started with DIVA

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In order to make daylight simulations with MicroShade® and DIVA you need to install the following programs:

- **Rhinoceros 6.0** - to prepare the 3D model
- **DIVA** - to make the daylight simulation

McNeel offers a 90 days trial for Rhinoceros 6.0

Solemnia LLC does no longer offer DIVA licenses.

The Grasshopper extension for Rhinoceros can also be used to create the model geometry and perform the DIVA simulations. However, it is not described in this guideline.

## The following tutorials will be good to read:

- Video tutorials for both Rhinoceros and Grasshopper:  
<http://web.mit.edu/sustainabledesignlab/projects/DIVATutorials/index.html>
- Radiance Tutorial by Axel Jacobs, 2010.  
[http://www.jaloxa.eu/resources/radiance/documentation/docs/radiance\\_tutorial.pdf](http://www.jaloxa.eu/resources/radiance/documentation/docs/radiance_tutorial.pdf)



# Preparation of the 3D model in Rhinoceros

The 3D model is drawn in Rhinoceros. The easiest way to build and analyse a simple model of a room is as follows:

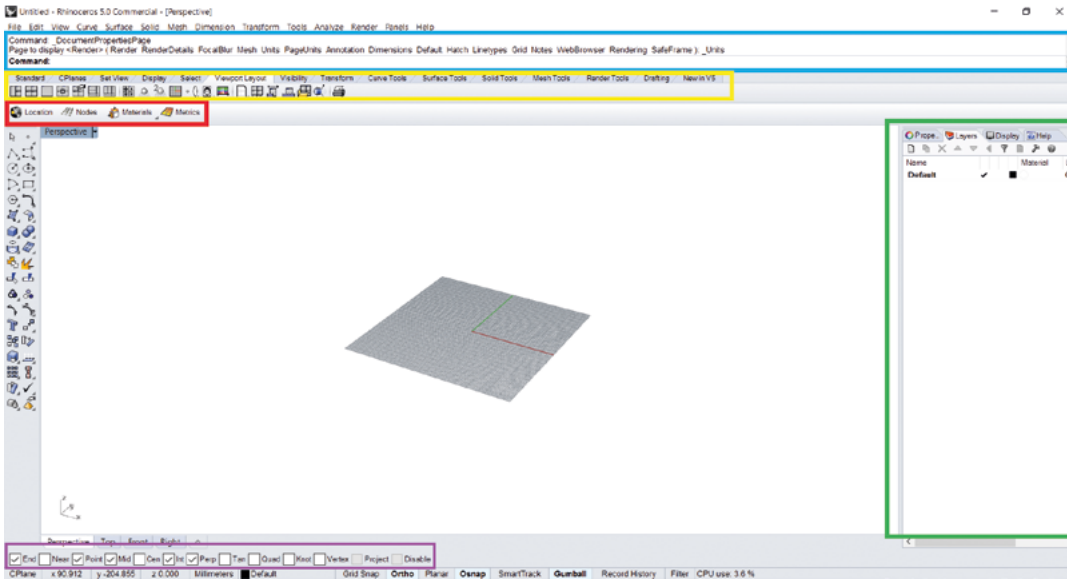


Figure 2: An empty Rhino workspace. The blue box marks the Rhino command line. The yellow box marks the Rhino toolbar. The red box marks the DIVA toolbar. The green box marks the layers and properties management toolbar. The purple box marks the snapping tick marks, which can make the cursor or lines snap certain ways.

## 1. Setting up Rhinoceros:

- Change view style. Go to "**View**" in the top-left corner to activate a drop-down menu. Left-click on "**Ghosted**". This view style has the transparency to look through geometry without getting too confused while maintaining colours for layer recognition.
- Check units. Type "**units**" in the command line and press enter. The "Document Properties" window will open at the unit configuration page. Go to "**Units and tolerances**" at "**Model units**" and choose "Millimeters", which is the unit this guide is using. Press "**OK**" when done.
- Look around. To swirl around a model in the Rhino viewport simply hold down the right mouse button and move around.
- Buttons. Hover the cursor over some of the buttons in the interface. Notice the small message popping up below showing the different function of that button when left or right mouse button is pressed. This can be useful.

## 2. Create the building model geometry:

- Draw room dimensions. Type "**box**" in the command line and press enter. Type "**p**" for "**3Point**" and Choose a press enter. Choose a starting point and draw (or type e.g. 0,0,0 for the origin) the width, length and height of the room. A box will begin to form.

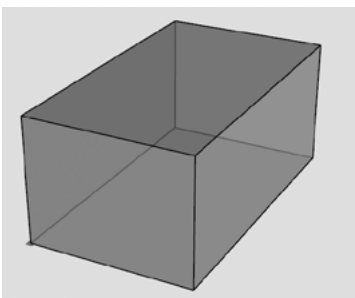


Figure 3: A box.



- b. Create room components. Select the box and type "**explode**" in the command line and press enter. The box will be divided into six surface planes.

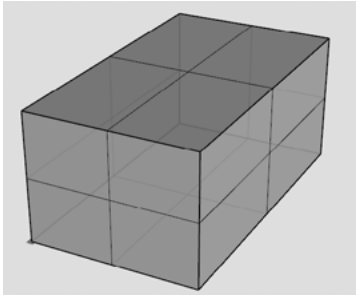


Figure 4: An "exploded" box.

- c. Create geometry layers. In the "**Layers**" management tab to the right of the screen create new layers by pressing this button. Name them "**Floor**", "**Ceiling**", "**Interior\_walls**" and "**Exterior\_walls**". Assign colours to the layers for better recognition in the model.

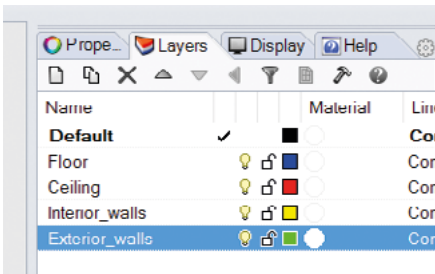


Figure 5: Layer management.

- d. Assign geometry to layers. Select a surface plane. In the "**Properties**" management tab (next to "**Layer**" management), click the drop-down menu next to "**Layer**" and choose the appropriate layer name for the surface. Do this for every surface.

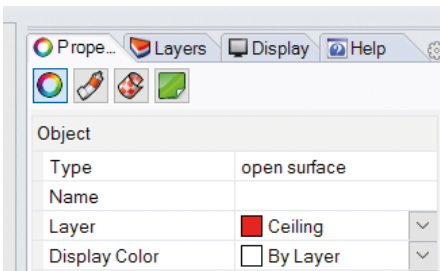


Figure 6: Properties management.

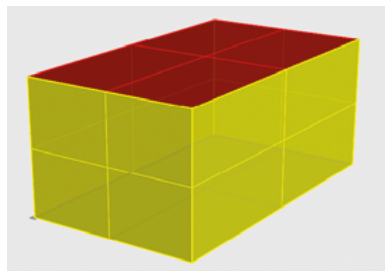


Figure 7: Layers assigned.



- e. Draw the window dimensions. Type "**plane**" in the command line and press enter. Type "**v**" for "**Vertical**" and press enter. Draw the size of the window(s). If it is difficult to draw the window plane on the front surface just draw it anywhere and move it later. When moving, type "**move**" in the command line and press enter. Follow the commands by selecting the surface, choose a point to move from (usually a corner) and move it onto the front surface. Sometimes it is beneficial to move objects in steps of three, one step for each coordinate component (X, Y, Z). The workflow for movement is: Type "**move**", select surface, press enter, select corner, type distance, press enter, and left-click in the direction of movement.

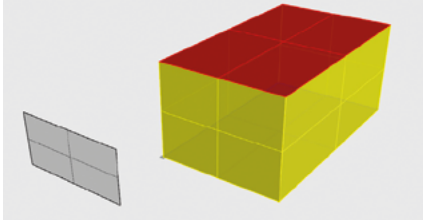


Figure 8: Window size plane...

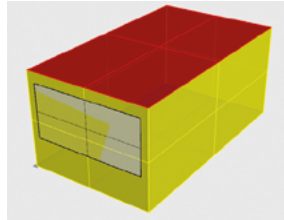


Figure 9: ...moved.

- f. Cut out the window hole in the façade. Type "**booleandifference**" in the command line and press enter. Select the façade surface and press enter. Then select the window plane and press enter. A window hole has now been cut through the façade.

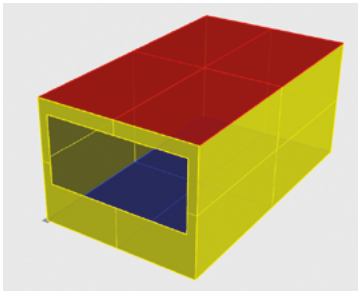


Figure 10: Window hole.

- g. Add thickness to the façade wall. Type "**extrudesrf**" and press enter. Select the façade surface. Type the thickness or drag and left-click to let go. The new box can be exploded (follow step b) to divide the exploded surfaces into exterior and interior walls. Assign the new façade geometry to layers (follow step d).

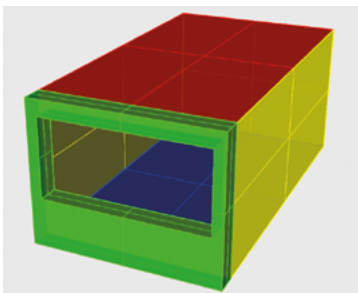


Figure 11: Exterior walls added.



- h. Insert MicroShade® into the window hole. Type "**plane**" and then "**v**" for "Vertical". Draw the MicroShade® surface at the front of the window hole. Remember to assign a layer named "**MicroShade**" to the geometry (follow step c and d).

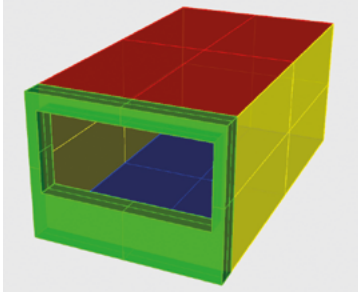


Figure 12: MicroShade layer.

- i. Insert glazing into window hole. Right-click the MicroShade® layer in the "Layer" management tab and choose "**Duplicate Layer and Objects**". Rename the new layer "**Window**". Turn off the MicroShade® layer (💡 = on, 🔌 = off) in order to move the glazing geometry. Type "**move**" and press enter. Select the glazing surface, press enter and choose a corner. Type "**1**" for 1 mm, press enter and make sure to move it straight back by aiming at a point, e.g. the back corner of the window hole. Left-click to leave it right behind the MicroShade® layer. Surfaces must not lie on top of other surfaces otherwise DIVA does not know which surface properties to prioritize.
- j. Check the surface normal of MicroShade® and floor. Select the floor and MicroShade® geometry. Type "**dir**" and press enter. The surface normal of the two planes will then be showed as arrows. If the surfaces are clicked upon the arrows will flip 180 degrees. It is very important to make sure the MicroShade® normal is pointing outwards from the room and the floor normal is pointing inwards to the room.

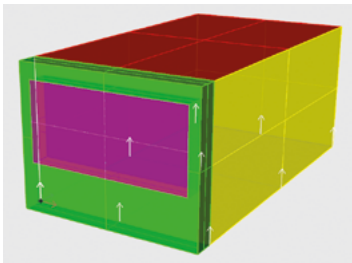


Figure 13: Floor normal has been flipped inwards.

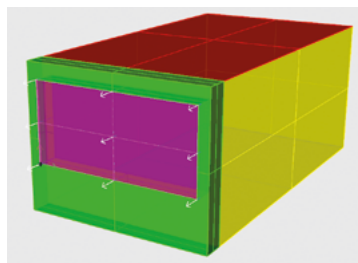


Figure 14: MicroShade normal has been flipped outwards. Colour is brighter.

- k. Create a ground surface. It is necessary to create a ground surface geometry for DIVA to take the ground reflectance into account. Type "**plane**" and then "**p**" for "**3Point**". Draw a relatively large plane under the building. Type "**move**", select the plane and type "**V**" for "**Vertical**". Select a point to move from and type "**-10**" and press enter. This will move the plane 10 mm below the building. This is necessary to keep floor and ground from lying on top of each other. Follow step c and d to create a "Ground" layer and assign the plane to it.

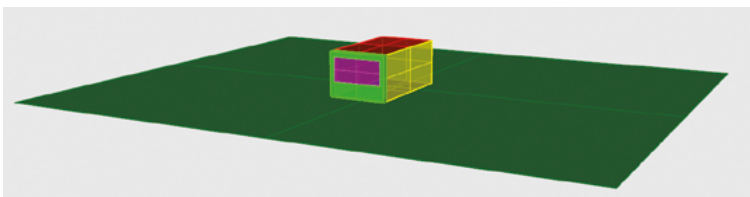


Figure 15: Ground plane.



### 3. Creating the interior geometry (only relevant when calculating DGP):

- a. Download the "Interior objects.3dm" geometry models from the MicroShade® webpage and copy the geometry and layers into the room. The file contains two occupants on chairs at desks with computers. It is important to copy the layer "View\_Points" as well. The models can be duplicated to get more than two occupants.

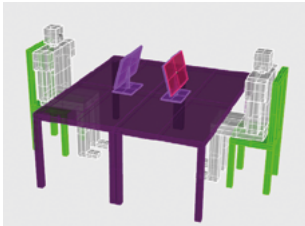


Figure 16: Interior objects..

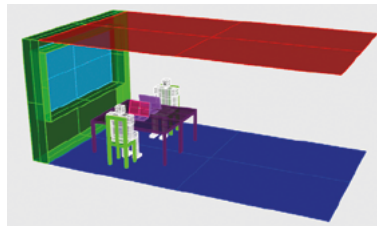


Figure 17: ...moved.

- b. In the Rhinoceros toolbar directly below the command line, go to the "Set View" tab.
- c. Right-click the "Place camera and target" button with this icon .
- d. Choose camera location. The command line will ask for a camera location. Select the point in the face of an occupant.
- e. Choose camera target. The command line will ask for a target location. Select the point in the computer screen in front of the same occupant. The view will then change to the view just set up, but it might be zoomed in too much.
- f. Zoom out. In the right side of the Rhinoceros interface, go from the "Layer" management tab to the "Properties" management tab. Look under the "Camera" section and find "Lens Length". The standard value tends to be "50", change it to "20". The view has now been zoomed out a bit.
- g. Again, go to the "Set View" tab in the Rhinoceros toolbar. Left-click the "Save view by name" button with this icon. Write the preferred name for the view, e.g. "Occupant\_1", and hit enter.
- h. More than one occupant? Repeat the process with the rest of the desired number of occupants.
- i. Check your work. To check if the process succeeded, left-click the "Edit named views..." button with this icon. Left-double-click on the views to change between them.
- j. Important notice! Saved views will not rotate around like geometry can, they have to be redone. The guiding points in faces and screens make this a quick task to do.

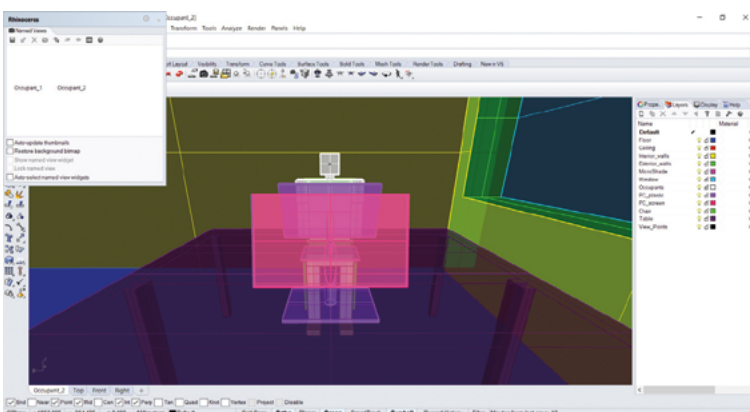


Figure 18: Two views are saved. The layer list has grown.

### 4. Changing the orientation of the model:

- a. Select all geometry. Turn on all layers by turning on the lightbulb (💡 = on, 🔌 = off) next to the layer names. Press CTRL+A to select all geometry in the scene.
- b. Type "rotate" in the command line and press enter.
- c. Select pivot point. The command line displays "Center of rotation (Copy=No):". Select a point as a pivot point, e.g. a corner of the building.



- d. Select an origin of rotation. The command line then displays "Angle of first reference point (Copy=No):". Select another point marking a line for the rotation to begin from. A line can also be selected, e.g. the edge of the building from the corner selected as a pivot point.
- e. Rotate the geometry. The command line then displays "Second reference point (Copy=No):". Rotate the geometry with the mouse and left-click to let go or type a value of degrees. If the button "Ortho" is on it is only possible to rotate in steps of 90°. Turning it off will allow free movement of degrees.

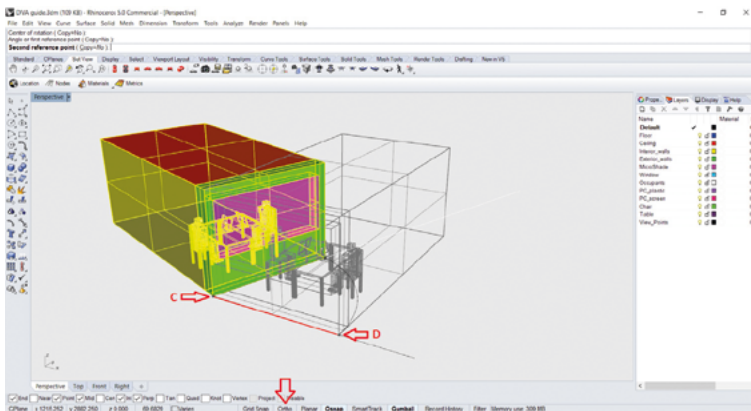


Figure 19: Rotating the model. Arrow C (pivot point) and D indicate step c and d. The last arrow points to the button "Ortho", which is off.

## Preparation of data sets for DIVA

A climate based daylight simulation with DIVA requires weather data, material description and occupancy schedule. The easiest and quickest way to set up the data sets for DIVA is as follows:

### 5. Set location/weather data:

- a. Locate weather data folder. DIVA stores its weather data for locations in **C:\DIVA\WeatherData**. By default it contains mostly (if not exclusively) American locations.
- b. Download weather data. If DIVA does not already have the weather data for a specific location, go to <https://energyplus.net/weather> and look for one. The .epw files are the ones DIVA needs.
- c. Save the (.epw) files in the weather data folder in **C:\DIVA\WeatherData**.

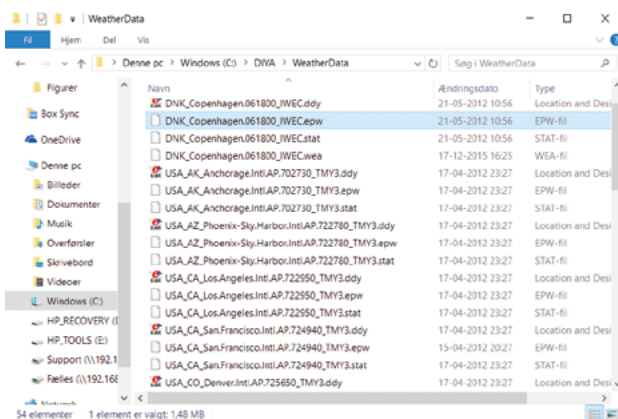


Figure 20: C:\DIVA\WeatherData where weather data is stored.



## 6. Define the materials:

- a. Materials definitions. DIVA stores its materials information in the "**material.rad**" file in **C:\DIVA\ Daylight**. Try and open the file to understand it a bit. By default the file contains some generic materials definitions. Material definitions can be fairly simple or rather complex depending on the user. For non-translucent surfaces, a plastic type material is often used defined by a reflection value from 0 to 1 in the red, green and blue spectrum (RGB). This could also be a metal type material. For translucent surfaces, a glass type material is often used defined by the transmissivity value from 0 to 1 (1 being no transmission) of the glazing in the RGB spectrum. To approximate the transmissivity, multiply the transmission value with 1.09 or calculate the values in the Excel sheet "[TransmittiontoTransmissivity.xlsx](#)" (source: DIVA forum) which can be downloaded from the MicroShade® webpage. For further information on Radiance materials look at this PDF of the Radiance Reference Manual: <http://radsite.lbl.gov/radiance/refer/refman.pdf>.
- b. Modify material.rad with MicroShade®. Copy the text from the "**MicroShade\_mat.rad**" file into the "**material.rad**" file:

```
void glass microshade_air
```

```
0
```

```
0
```

```
4 1 1 1 1
```

```
void plastic microshade_metal
```

```
0
```

```
0
```

```
5 0.1 0.1 0.1 0.017 0.005
```

```
void mixfunc microshade_f_mat
```

```
4 microshade_air microshade_metal trans microshade_f.cal
```

```
0
```

```
1 01
```

- c. Choose rotation of MicroShade®. A rotation of MicroShade® is normally done to optimize the g-value. For vertical facades MicroShade® is never rotated, while MicroShade® in roof windows can be rotated depending on the orientation and tilt of roof. Rotation should be considered for orientations between northeast (45°) and northwest (315°) for all roof windows at inclinations between 25° and 75°. Please contact MicroShade® at [support@microshade.com](mailto:support@microshade.com) in these cases to get the right rotation angle.

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<sup>1</sup>) Rotation angle : 0= no rotation, 90=90° rotation anticlockwise.



- d. Important notice! It is very important to use "\_" instead of spaces in names in the "material.rad" file to not confuse Radiance. In addition, everything written after a "#" is considered a comment and is left out during simulations.

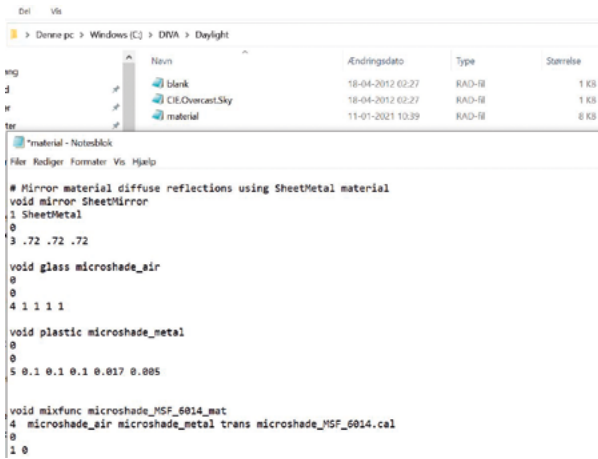


Figure 21: C:\DIVA\Daylight where the material.rad file is stored. The MicroShade® definition has been copied into the file.

## 7. Occupancy schedule:

- a. Schedule definitions. DIVA stores its occupancy schedules in C:\DIVA\Schedules. Schedules are basically Excel sheets with a value of 0 (empty) or 1 (occupied) for every hour of a year. DIVA has certain predefined schedules to choose from or it is possible to create a custom schedule, though the method will not be explained further.
- b. Optional. From the MicroShade webpage it is possible to download a custom schedule ("2013danishweekdays8to17noDST.60min.occ") with occupancy from 8.00 to 17.00 during weekdays and with no breaks, vacations or daylight saving time shift. Save the file in C:\DIVA\Schedules.

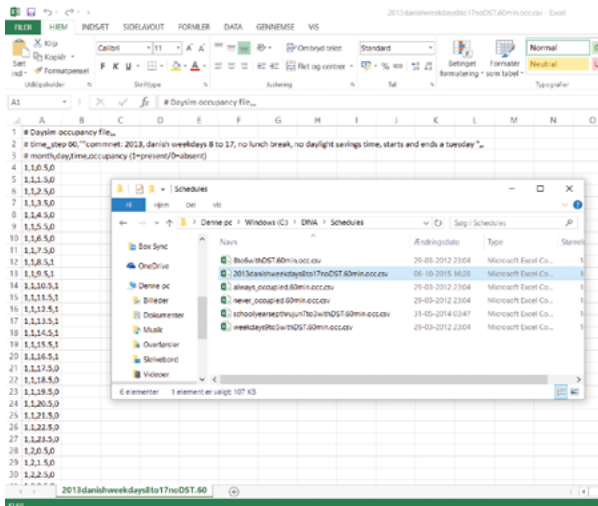


Figure 22: C:\DIVA\Schedules where the schedule is stored.



# Preparing the simulations with DIVA

With geometry and data sets complete, it is now time to set up the simulation:

## 8. Setting up the simulation:

- Open the Rhino geometry model.
- Left-click the **"Location"** button in the DIVA toolbar. A window opens to the folder **C:\DIVA\WeatherData** containing the .epw weather files.
- Select a weather file specific to the location where the simulation has to take place and press **"Open"**. DIVA creates a **"filename"**-folder in **C:\DIVA\Temp** to store the results files and temporary results files. DIVA also creates a **"filename – DIVA"** folder in the same place as the geometry file, which contains some the results files from the temporary folder. Additional auto generated layers have been created but are not relevant yet (just leave them turned on).

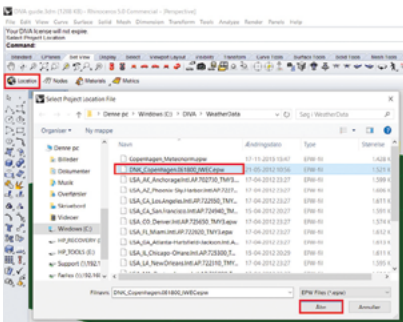


Figure 23: Choosing location/weather file.

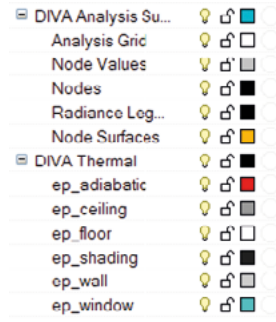


Figure 24: New auto generated layers.

- Left-click the **"Nodes"** button in the DIVA toolbar. The command line will now display: "Pick one or more planar surface(s) which will be subdivided for lighting analysis. Press Enter when done." Select the **"Floor"** layer geometry. Selection is indicated by the geometry getting yellow edges. Press enter when done.
- The command line now displays: **"Enter distance of sampling nodes off of analysis surface in your model units. <850>:"** Type the offset distance required.
- The command line now displays: **"Enter the distance between calculation nodes. (Actual distance between nodes will approximate.) <425>:"** It is not straight forward to hit a certain actual distance. In some way, DIVA tries to do as told but the division of space between nodes ends up being a matter of trial and error. Type a distance and press enter. Measure the distance to be sure that it is as close as possible.

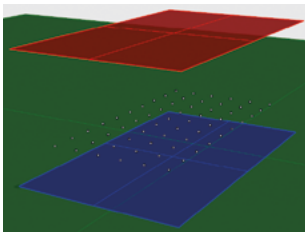


Figure 25: Nodes hovering over the floor.



- g. Left-click the **"Materials"** button in the DIVA toolbar. A drop-down menu appears. Left-click the "Assign materials" button. A window opens. Go to the **"Daylighting Materials"** tab. Each layer will be represented in the window by name and a drop-down menu. Choose the corresponding material to each layer in the drop-down menus. Do not assign materials to layers such as **"Default"** or **"View\_Points"** since they do not include geometry and will be left out in the simulation. If a layer does have geometry but is not assigned any material it will also be left out so watch out. Press **"Submit Material Information"** when done.

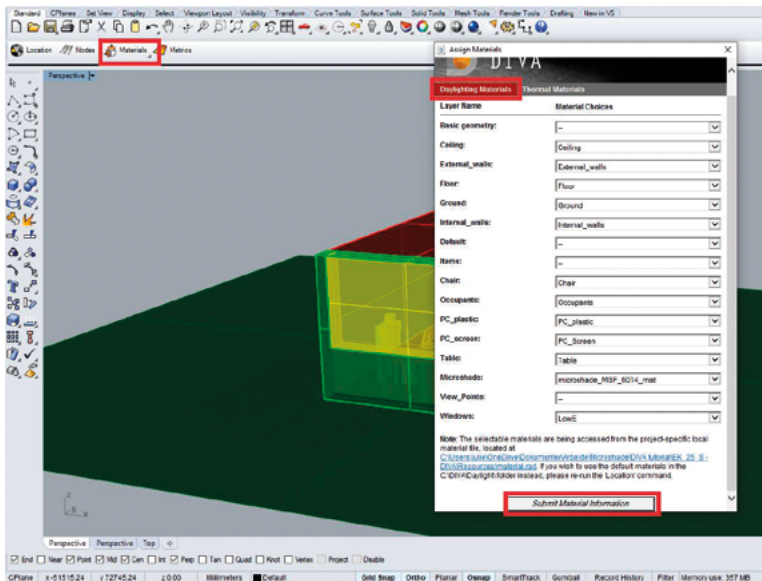


Figure 26: Assigning materials to each layer.

- h. Left-click the **"Materials"** button in the DIVA toolbar. A drop-down menu appears. Skip **"Load IES file"** and **"Set LM-83 sDA Controls"** and left-click **"Shading Controls"** button. Go to the **"No Dynamic Shading"** tab and click the **"Submit"** button.

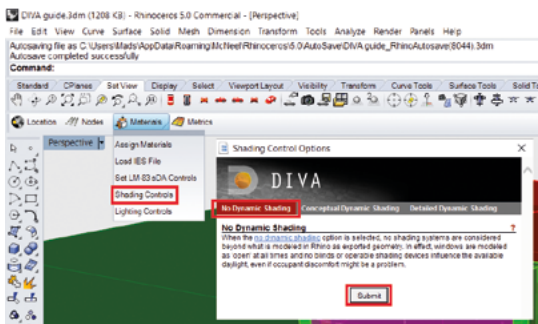


Figure 27: Choosing no dynamic shading.



- i. Left-click the **"Materials"** button in the DIVA toolbar. A drop-down menu appears. Left-click **"Lighting Controls"** button. Go to the **"Electric Lighting Off"** tab and click the **"Submit"** button to leave out electrical lighting in the simulation. Go to the **"Detailed Electric Lighting Controls"** tab if electrical lighting has to be simulated. Select the setpoint nodes for each lighting zone. It is possible to add different lighting groups with either manual or automated controls. It is possible to enter lighting power, setpoint, ballast loss factor and standby power for each group. Click the **"Submit"** button when finished.

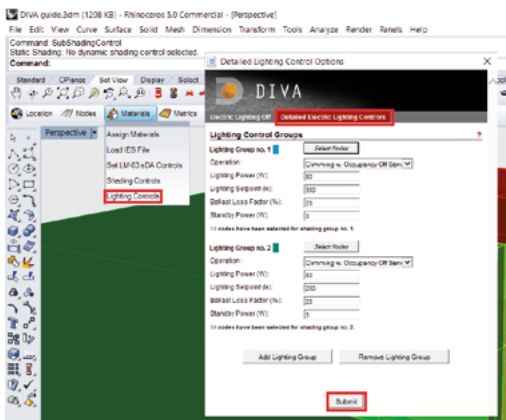


Figure 28: Setting the lighting controls for electrical lighting.

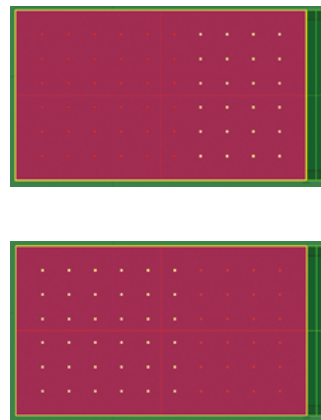


Figure 29: Two zones for electrical lighting.

## Running the simulations

There are different types of simulations in DIVA. This guide will show three different kinds:

### g. The DA, CDA, UDI simulations:

- a. Left-click the **"Metrics"** button in the DIVA toolbar. Go to the **"Daylight Grid-Based"** tab and on to the **"Climate-Based"** tab.
- b. In the drop-down menu at **"Metric"**, choose **"All (DAutonomy, CDA, DAvailability, UDI)"**.
- c. In the drop-down menu at **"Occupancy Schedule"**, choose the preferred occupancy schedule e.g. **"2013danishweekdays8to17noDST.60min.occ"**.
- d. At **"Target Illuminance"** type the preferred target illuminance which is often 300 lux.
- e. At **"Units"**, choose **"Lux"**.
- f. The tick at **"Show Daysim Report"** will determine whether DIVA will show a report in the browser when the simulation is done.
- g. The tick at **"Use DGP Schedules"** will determine how DIVA simulates a manually controlled dynamic shading system. In this guide, the tick is removed since MicroShade® will be the only shading in the scenario.
- h. Under **"Advanced Parameters"** go to **"Radiance Parameters"**. This determines how complex a simulation DIVA will run and how accurate results are calculated. These parameters are complicated to adjust right and usually varying between two sets of parameters are enough. These are **"-ab 5 -ad 1000 -as 20 -ar 300 -aa 0.1"** (scene I) and **"-ab 7 -ad 1500 -as 100 -ar 300 -aa 0.1"** (scene II). It is required to use scene II parameters to simulate MicroShade® since it is quite complex in its definition.
- i. In the drop-down menu at **"Adaptive Visual Comfort"** choose **"User(s) cannot adapt. Simulation uses viewpoint with worst glare condition"**. No annual glare calculation has yet been made so it is not that relevant yet.
- j. At **"Geometric Density"** leave the default value of **"100"**.



- k. Remove the tick at "Cleanup Temporary Directory" to keep all the temporary files for data processing.
- l. Click the "Run Simulation button".



Figure 30: "All" simulation settings.

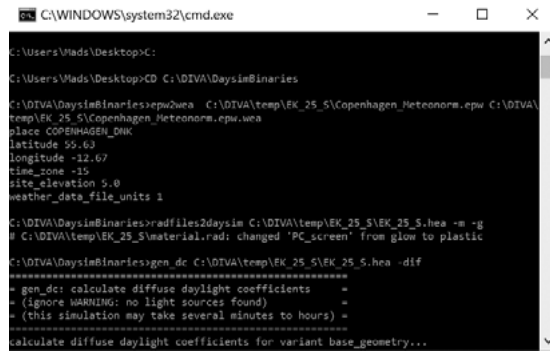


Figure 31: Example of simulation in progress.

## 10. The DF simulation:

- a. Left-click the "Metrics" button in the DIVA toolbar. Go to the "Daylight Grid-Based" tab and on to the "Daylight Factor" tab.
- b. At "Radiance Parameters" type the scene II parameters "-ab 7 -ad 1500 -as 100 -ar 300 -aa 0.1". If another simulation has been run with these parameters they will probably already be set correctly.
- c. Leave the tick on at "Hide Dynamic Shading" since dynamic shading is not taken into account in the DF metric.
- d. At "Geometric Density" leave the default value of "100".
- e. Remove the tick at "Cleanup Temporary Directory" to keep all the temporary files for data processing.
- f. Click the "Run Simulation button".

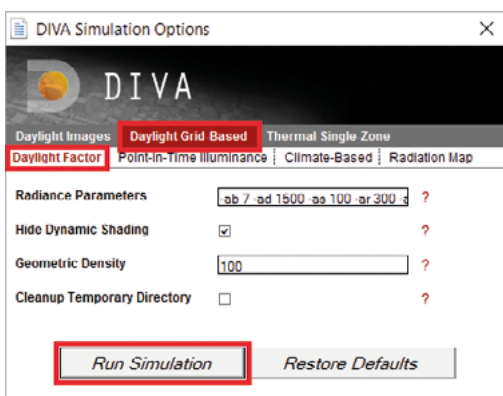


Figure 32: "DF" simulation settings.



## 11. The DGP simulation:

- a. Left-click the **"Metrics"** button in the DIVA toolbar. Go to the **"Daylight Images"** tab and on to the **"Annual Glare"** tab.
- b. In the drop-down menu at **"Select Camera Views"**, choose **"Saved Rhinoceros Views"**.
- c. In the drop-down menu at **"Occupancy Schedule"**, choose the preferred occupancy schedule e.g. **"2013danishweekdays8to17noDST.60min.occ"**.
- d. Under **"Advanced Parameters"** and **"Radiance Parameters"** type the scene II parameters **"-ab 7 -ad 1500 -as 100 -ar 300 -aa 0.1"**.
- e. In the drop-down menu at **"Adaptive Visual Comfort"** it is possible to choose whether or not the occupants are allowed to move between the predefined views to get the least glare. If users can adapt, DIVA will **"weave"** one annual glare analysis diagram based on the different views. If users cannot adapt, DIVA will show the annual glare analysis for every shading state for every defined view. Select **"User(s) cannot adapt"** to get the best analytical view of the glare risk for several occupants or select **"User(s) can adapt"** if focused on the visual comfort of one occupant. The choice depends on the amount of data processing to be done afterwards or if the diagrams presented by DIVA is enough.
- f. At **"Geometric Density"** leave the default value of **"100"**.
- g. Remove the tick at **"Cleanup Temporary Directory"** to keep all the temporary files for data processing.
- h. Click the **"Run Simulation button"**

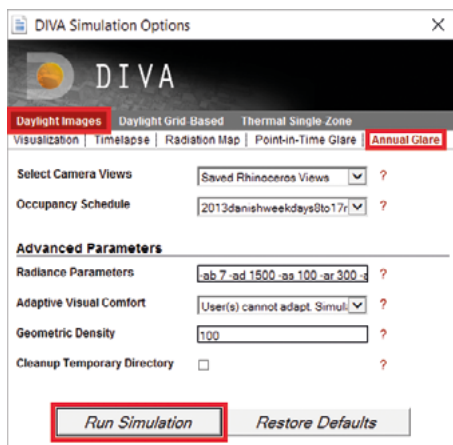


Figure 33: "DGP" simulation settings.



# Results

There are different ways to show the results from DIVA. The easiest way is to use DIVA to import the results into the Rhino viewport in a graphical way.

## 12. Results:

- a. Right-click the "Metrics" button.
- b. A small window opens. Here it is possible to choose which metric should import. Choosing one of the options in the drop-down menu will open a path to the "filename - DIVA" folder requesting the user to find the right file. Most of the file types are specific to the metric, so it is not difficult to find the right one.

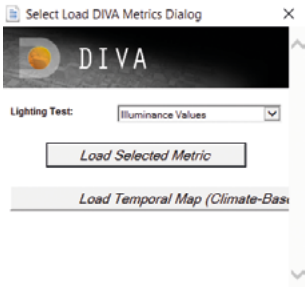


Figure 34: Loading results.

- c. Selecting a file open another window. Here it is possible to adjust the graphical presentation with different min/max values and colour schemes. When done press "Load Simulation Data".

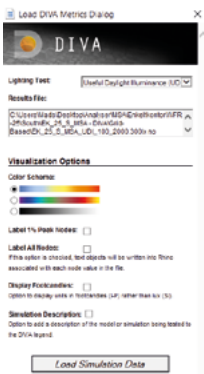


Figure 35: Adjustment of the graphical presentation.

- d. Turn off geometry until there is a clear view of the graphical presentation. For every node there is a coloured square representing the value with respect to the metric. A coloured scale is also shown with some text explaining the results a bit.

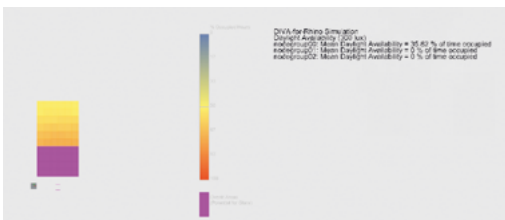


Figure 36: Graphical presentation.



Results such as DGP, occupancy schedule and lighting dimming schedule are presented in form of diagrams. They can be found in the "filename – DIVA" folder -> "Grid-Based" -> "filename\_ electriclighting.300lx no dynamic shading.htm" and in the "filename – DIVA" folder -> "Visualizations" -> "annual\_glare.htm" as an example.

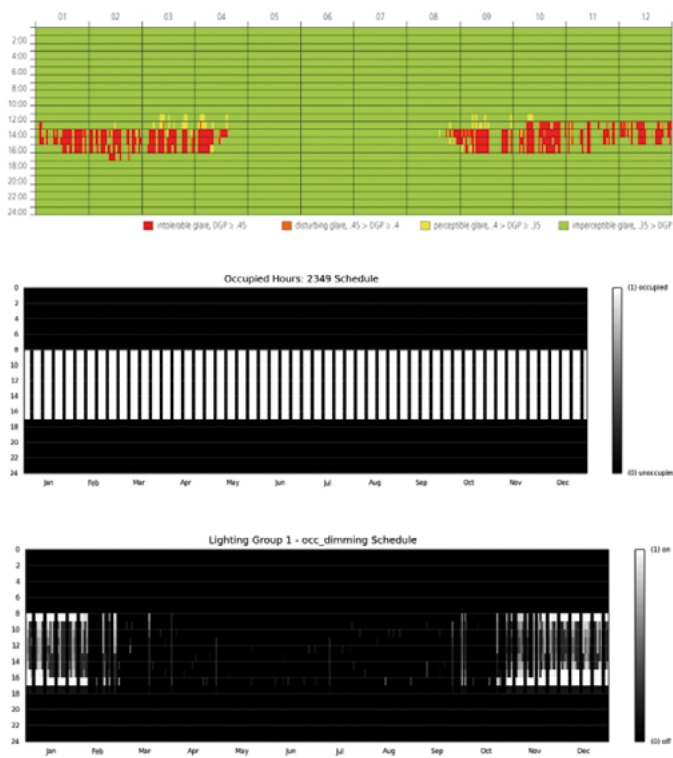


Figure 37: Top is a graphical presentation of annual DGP results for one occupant. Middle is a graphical presentation of the annual occupancy schedule. Bottom is a graphical presentation of the dimming of electrical lighting during a year.

The last option to study the results is to look in the files themselves and sorting out the data with any data analysis tool such as Microsoft Excel or Matlab. This will not be explained any further. The table below is a guide to where these files can be found and what data they hold.



Filename	Path	Application
Filename.300lx no dynamic shading.ill	C:\...\filename - DIVA\Grid-Based	Illuminances for shading state 1 + Sensor node coordinates
Filename.df.dat	C:\...\filename - DIVA\Grid-Based	Daylight Factor
Filename_availability.300lx detailed dynamic shading.DA	C:\...\filename - DIVA\Grid-Based	Daylight Availability
Filename_autonomy.300lx detailed dynamic shading.DA	C:\...\filename - DIVA\Grid-Based	Daylight Autonomy
Filename.300lx detailed dynamic shading.CDA	C:\...\filename - DIVA\Grid-Based	Continuous Daylight Autonomy
Filename.ASE	C:\...\filename - DIVA\Grid-Based	Annual Sun Exposure
Filename.300lx.IES-LM-83 sDA control.sDA	C:\...\filename - DIVA\Grid-Based	Spatial Daylight Autonomy
Filename_electriclighting.300lx detailed dynamic shading.htm	C:\...\filename - DIVA\Grid-Based	Energy consumption of electrical lighting
Filename_electriclighting.300lx detailed dynamic shading.htm	C:\...\filename - DIVA\Grid-Based	Dimming control of electrical light + Control strategy for shading activation
Filename.dgp	C:\...\filename - DIVA\Visualizations	Discomfort Glare Probability for shading state 1
SGoBS0.dgp	C:\...\filename - DIVA\Visualizations	Discomfort Glare Probability for shading state 2
SGoBS1.dgp	C:\...\filename - DIVA\Visualizations	Discomfort Glare Probability for shading state 3
SGoBS2.dgp	C:\...\filename - DIVA\Visualizations	Discomfort Glare Probability for shading state 4
SGoBS0.ill	C:\DIVA\Temp (only for dynamic)	Illuminances for shading state 2
SGoBS0.ill	C:\DIVA\Temp (only for dynamic)	Illuminances for shading state 3
SGoBS2.ill	C:\DIVA\Temp (only for dynamic)	Illuminances for shading state 4

Figure 38: Overview of DIVA files. "C:\...\\" is where the model file is saved. DIVA creates the "filename - DIVA" folder at the same path.



If you have any questions regarding daylight simulation with MicroShade® you are welcome to contact MicroShade A/S.

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