

DIVA - User Guide

Taken from <http://diva4rhino.com/user-guide>

Setting Up a Rhino Model for Daylight Analysis

The following includes information about proper set-up of the Rhino model for use with the toolbar. To make sure that all geometry is being used in the analysis, it is a good idea to first run the “Visualization” Metric, and to examine the image for unexpected problems such as “holes” or gaps.

Units

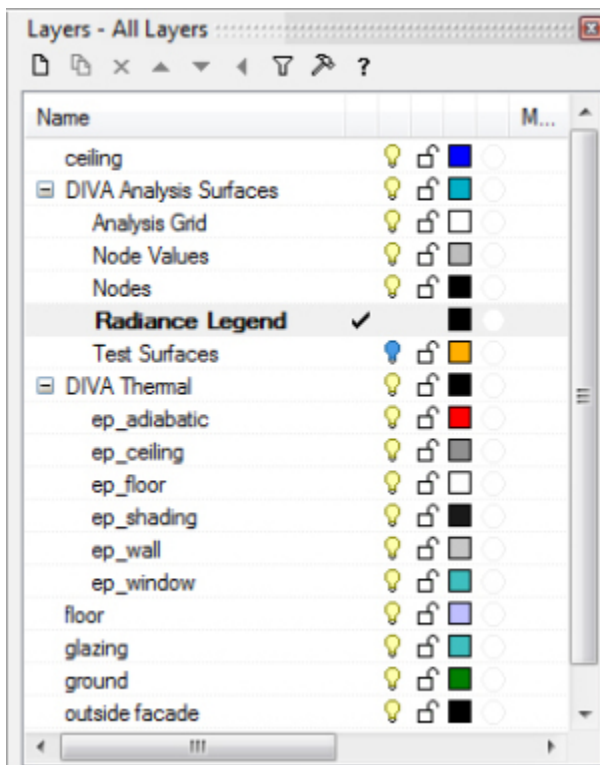
It does not matter what units are used for the Rhino modeling: meters, millimeters, inches, feet, parsecs, etc.

Orientation

It is important that your project is oriented properly within Rhino with regards to North. In Rhino, as most other software, North is the top of the screen when viewing the model in a “Top” or “Plan” view such that the positive Y-axis is North.

Layers

DIVA does not require any specific naming conventions for layers; however, materials will be associated by layer, so you can't keep geometry with different materials on the same layer.



Layer panel showing DIVA-Created Layers

DIVA Layers

When you run the DIVA **Location** button, several DIVA layers are created. These layers store the various nodes, node values, grid and legend information that DIVA generates.

Hidden Layers

Layers turned off will not be exported.

Locked Layers

Locked layers will not be exported.

Sublayers

There are no restrictions to using sublayers.

Ground Plane

A ground plane should always be modeled and assigned a DIVA material.

Geometry

Models can be built using surfaces, polysurfaces and/or meshes, although all geometry is "invisibly" converted to temporary meshes through the DIVA process. Complicated geometry can be "pre-meshed" before running the metrics.

Thickness

Glass should be modeled using single surfaces, as opposed to polysurfaces or solids.

Visibility, Locking and Hiding Layers





Only geometry on visible, unlocked layers will be exported to Radiance. Keep this in mind when running simulations.

Remember to always check that your geometry is being exported correctly by running the "Visualization" Metric and performing a visual check.

File Naming in DIVA

You are free to name your Rhino file whatever you like, and store it wherever you like on your computer. When you run DIVA, a results folder is created which stores all of your results files. This folder is created in the same folder that your Rhino file is stored, and is given the name of your Rhino file plus " - results". For example, say you name your file: **My House.3dm**, and you keep the file in **C:\Users\yourname\Documents\RhinoModels**.

When you run DIVA, a results file will be created in that folder called: **C:\Users\kera\Documents\RhinoModels\My House - DIVA**.

 Grid-Based	10/30/2013 9:09 AM	File folder
 Resources	10/30/2013 9:01 AM	File folder
 Thermal	10/30/2013 9:01 AM	File folder
 Visualizations	10/30/2013 9:01 AM	File folder

Contents of the results folder that DIVA creates for each Rhino file

As part of the process of using the toolbar, a folder is created in which necessary auxiliary files are kept. These supplemental files are located in, **C:\DIVA\Temp**. In this example, they would be stored in **C:\DIVA\Temp\My**

Important! Spaces in your file name

You will notice that in the Temp folder, the entire name of the example file is not preserved. This is because there is a **SPACE** in the Rhino file name. This does not affect anything EXCEPT, if you were to run DIVA on

another file (anywhere on your computer) called, say, **My Dogs House.3dm**, the original files in the Temp folder will be overwritten causing potential problems the next time you go to run a DIVA simulation in the My House.3dm file.

If you want to avoid any potential issues, simply do not use spaces when naming your Rhino files if you are going to use DIVA.

The DIVA User Interface

The Toolbar

After following the instructions in Installation, the DIVA toolbar will be visible within Rhinoceros. The toolbar contains four buttons: Location, Nodes, Materials, and Metrics.



The four buttons of the DIVA 2.0 toolbar

These buttons are primarily designed to be used in order from left to right to run daylight and energy simulations. Several of the DIVA toolbar buttons have two functions: one is accessed by a mouse left click and the other via a mouse right click. In essence, there is no “Undo” for the buttons. If you have made a mistake, or you wish to change any option, simply press the appropriate button and change the settings.

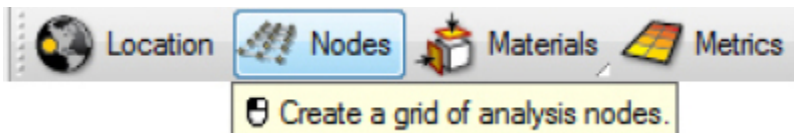
Location

The “Project Info” button has two functions. The first is similar to “New File” or “Save As” in other programs. It sets up a folder and a naming convention for results files. The second function is to establish the latitude, longitude and timezone of a project by associating it with a climate (.epw) file. For climate-based simulations and radiation maps, the hourly solar insolation is also read from the EPW file.

The Boston climate file is loaded with the DIVA plug-in into the folder C:\DIVA\WeatherData. There are a plentiful amount of free EPW files available for download from the US Department of Energy's Website. Save these files to the same C:\DIVA\WeatherData directory.

Nodes

The sensor nodes are the points at which the light levels are calculated.



Nodes button

Left-clicking on the button sets up an analysis grid for any nodes-based simulations in DIVA. The nodes array size, location and orientation are based on a piece of geometry from your model that you select. This can be a floor, wall, or any other surface, or multiple surfaces, and can be in any orientation (horizontal vertical, at an angle, etc.).

Surface Normals

The normal direction of the surface determines the orientation of the sensors. This is visualized by the direction the nodes are offset from the surface. If the point objects appear below the analysis surface, the normal of the surface should be flipped and the above process followed again. The 'Dir' command in Rhino can be used to visualize and flip surface normals.

Node Offset and Spacing

Typically, the sensor nodes are offset a specified distance off of the selected surface, and a specified distance apart. DIVA will prompt you to select these values, and suggests default values. Those values are always shown in the current model units. This can be feet, inches, meters, etc.

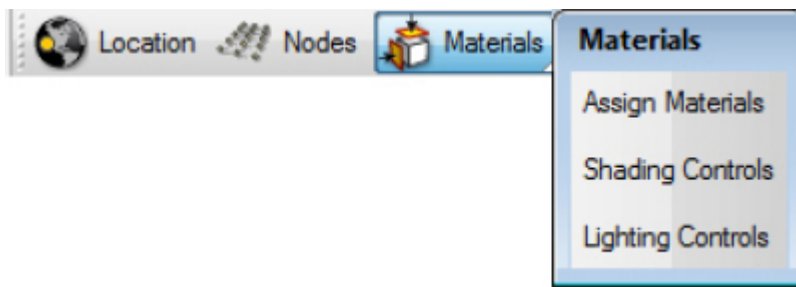
Tip: For typical workplane simulations, the sensor grid is set 30" off the floor and the nodes are no more than 36 " apart.

Nodes and the Test Surfaces layer

The "Test Surfaces" DIVA sublayer is a helpful place to store a reference surface if that surface does not exist as part of your built geometry. For instance, if you want to test only part of the floor or wall, you can make a surface on the "Test Surfaces" layer which is the size of the area you want to focus on.

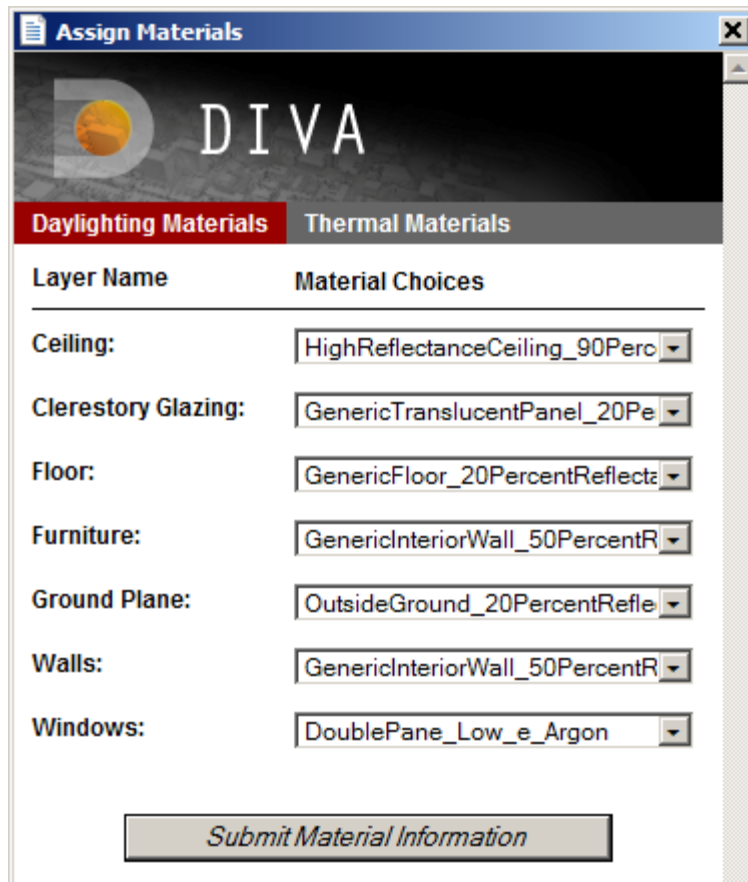
Materials

Materials must be assigned to the project geometry in order for it to be analyzed for daylight or energy performance.



Materials button sub-menu

Once your project location and sensor grid is established, Radiance materials must be applied to layers in the Rhino model. Each layer that the user wants to include in the simulation needs to have a material associated with it. To assign materials, use the Materials button and the "Assign Materials" option. A small library of useful materials is included with DIVA, and will show up as options in the pull-down menus.



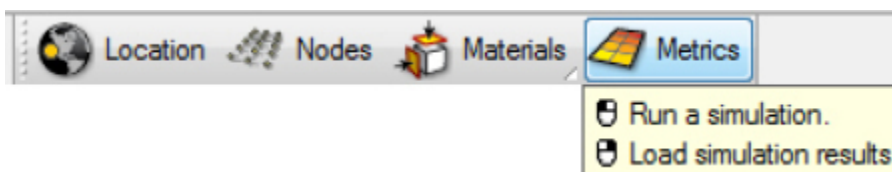
Materials Menu

Custom Materials

Note that customized Radiance materials can be added to the material choices. See the page, Custom Radiance Materials for more information. By default, DIVA instantiates each project with the default materials file, located in `C:\DIVA\Daylight\material.rad`. Project-specific materials can be defined in the `.\ProjectName - DIVA\Resources\material.rad` file. The `ProjectName - DIVA` directory is located in the same folder as your Rhino file.

The materials menu has two tabs: Daylight Materials and Thermal Materials. Use the one appropriate for the simulations you will be running, or both you are running both.

Metrics



Metrics button

The Metrics button has two functions. Left-clicking the button brings up the dialog box that allows the user to run the various simulations. Right-clicking on the button allows the user to load in previous simulation data. The dialog box displays different information for each simulation type, but generally allows you to set things like: simulation type, quality or "resolution" of simulation, sky condition, date and time or schedule, lighting

units, image size, image output and image viewer.

The Radiance parameters are automatically set, however, there is always a text-editable box where you can edit your own Radiance parameters. Before doing so however, you should read carefully the Radiance documentation to learn more about the commands and their values.

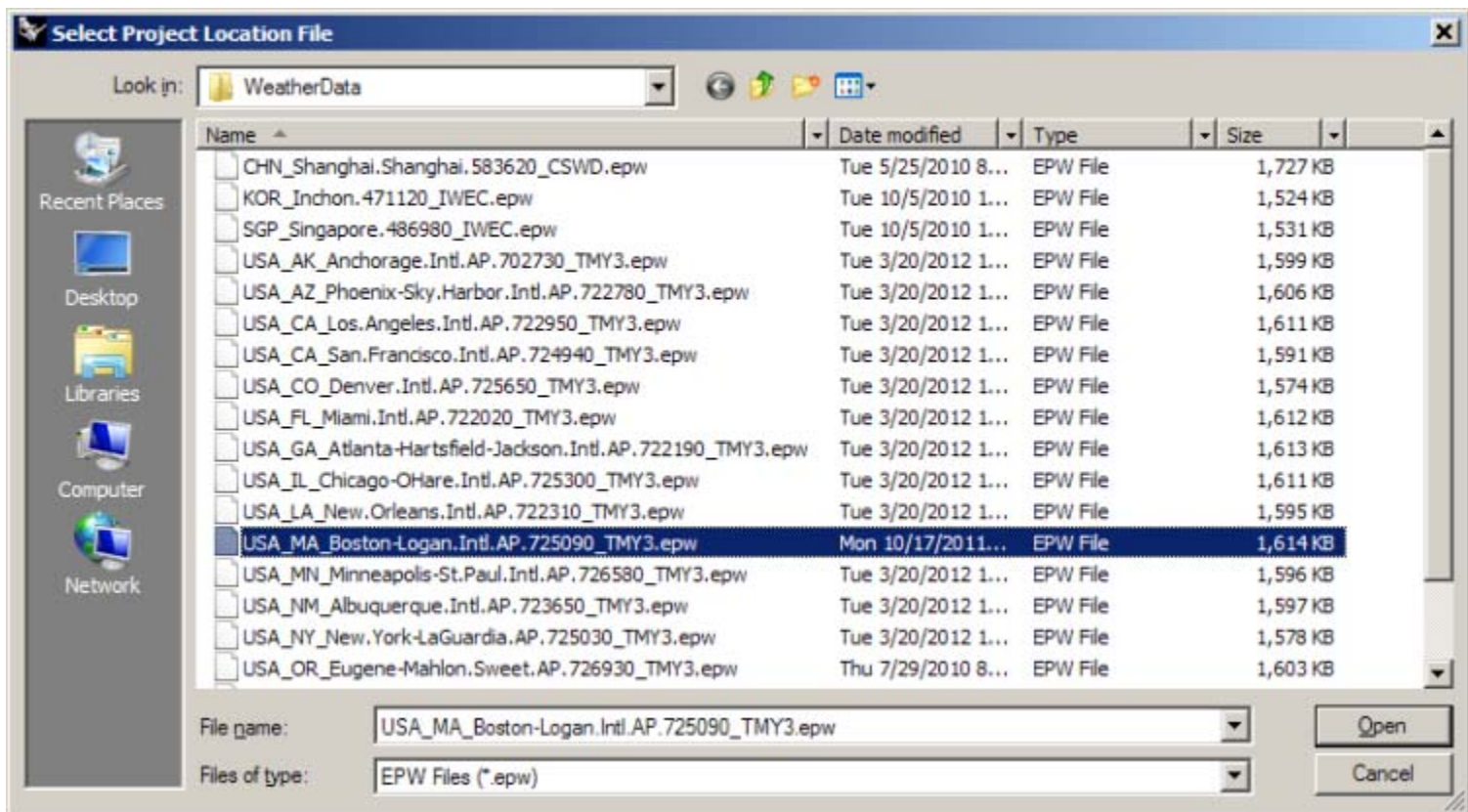
Your First Simulation

These steps will lead you through your first simulation. We will be running an illuminance test using a simple classroom model. You can download the example Rhino model [here](#). When you open the file, you will see a large building shell, with a single classroom modeled on the first floor. The file also contains several named views.

Step 1: Selecting the project location

The first step is to determine where the project is located using the **Location** button.

1. Left click on the **Location** button.
2. Follow the prompt and select the Boston climate file.



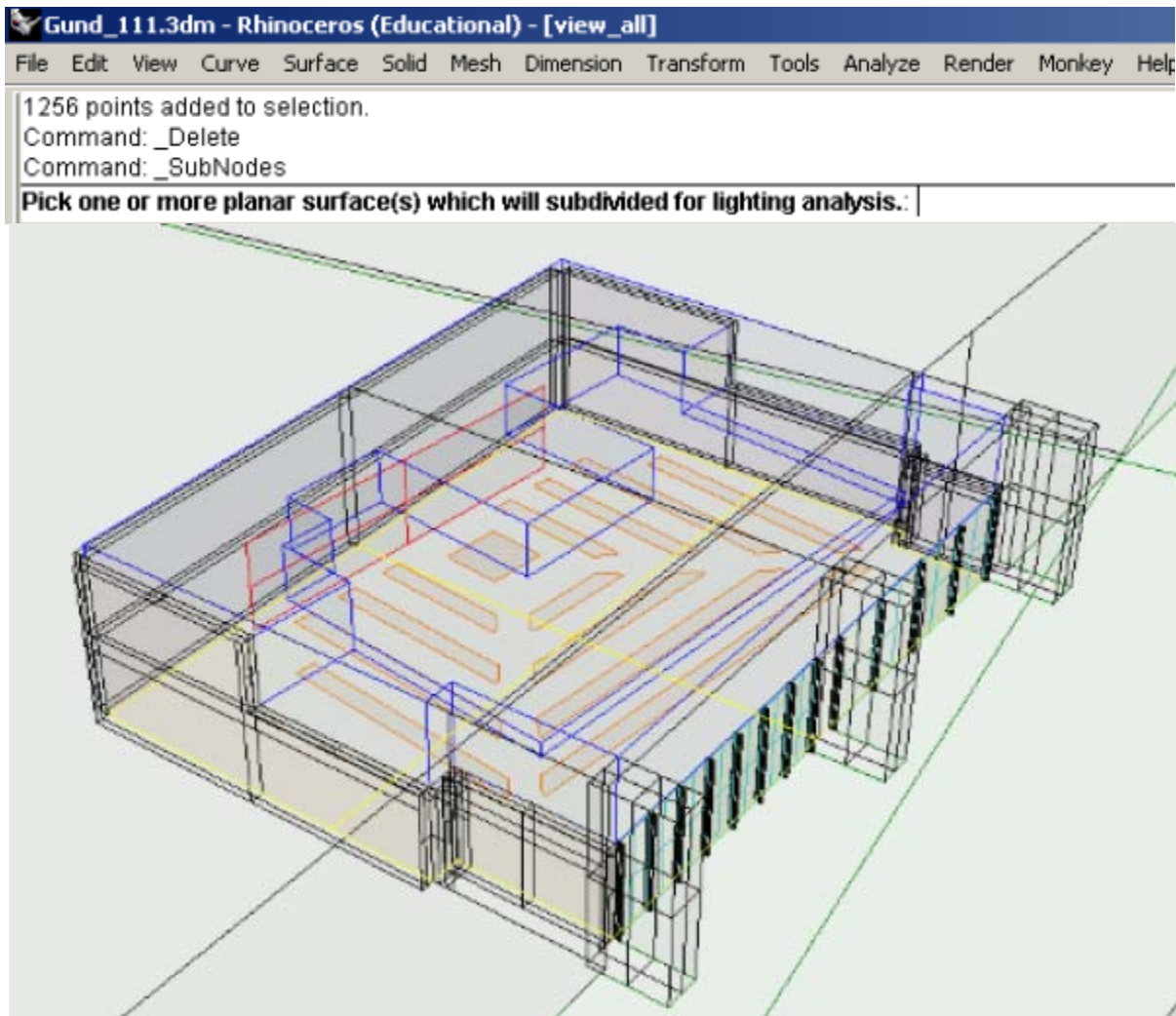
Select project location

Step 2: Setting up the sensor nodes

We are conducting a simple illuminance test at workplane height. The sensor nodes will be arrayed horizontally, with their orientation vector pointing up, so in this case we want to select the floor as the drive surface for the nodes.

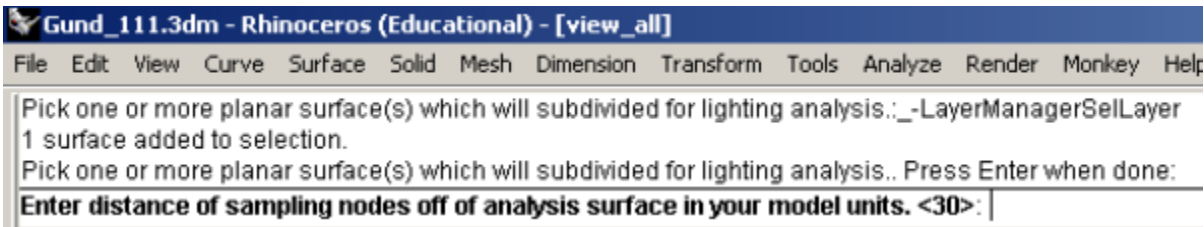
Nodes will be offset in the direction of the surface normal. To check this, in Rhino, type "Dir" for "Direction", and select the surfaces you will be applying nodes to. This command will allow you to view the normals of the selected surfaces. If any are oriented in the wrong direction, click on them while the command is still active in order to flip the normal.

1. To start, left-click on the Nodes button.
2. Select one or more planar surfaces which will serve as the base planes for creating the sensor nodes. The surfaces do not have to be parallel and can be in any orientation (horizontal, vertical, etc.), but they must be planar (i.e. no curved surfaces). For this example, select the floor surface, and press Enter.

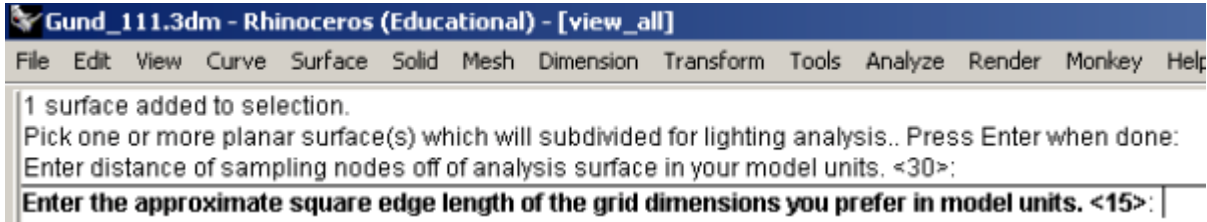


Setting up sensor nodes

3. The Rhino Command Line prompt will ask for the distance of sampling nodes off of analysis surfaces. Accept the default (30") by pressing Enter. This will put our sensor nodes 30" off of the floor, roughly at desk height. Enter distance of nodes off of that surface.

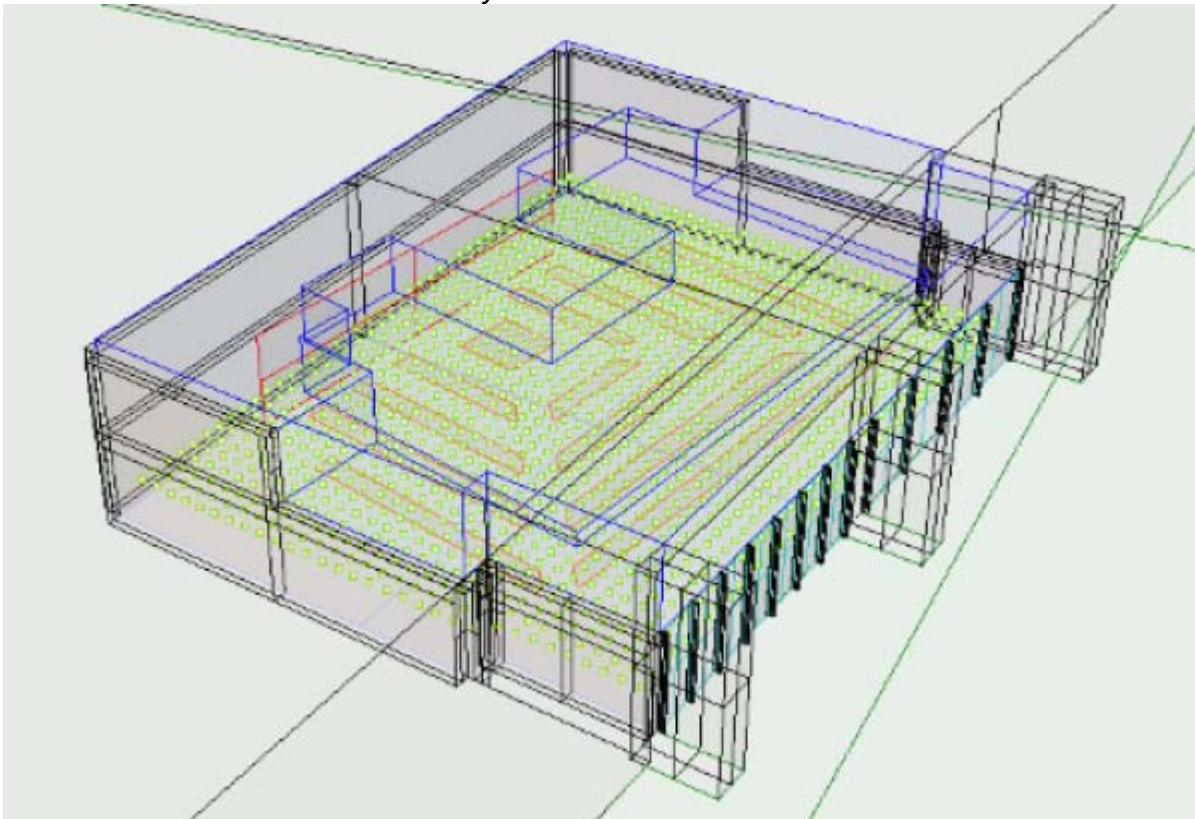


4. The Command Line prompt will ask you to enter the approximate square edge length of the grid dimensions. The edge length means the spacing between grid nodes. Accept the default (15"). This will set the nodes roughly 15" from each other in both directions.



Enter the grid

density as a distance between sensor nodes.



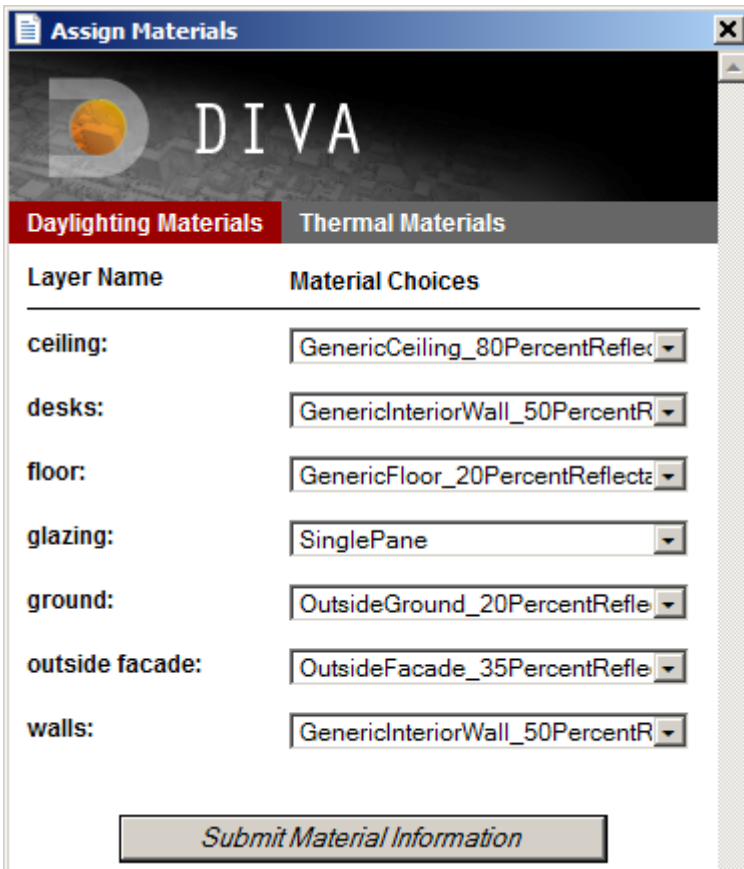
Check that the

*points are on the right side of the surface.
 Here the points are inside the space, so all is fine.*

Step 3: Setting Materials

Materials are associated with geometry by layer. It is important to note that any geometry on a layer **without** a material applied, will not be included in the analysis.

1. Left click on the Materials button. A dialog will pop up which reads all materials from the DIVA materials file.
2. Select the materials as shown below.
3. Click Submit Material Information.




An example of the materials window.

For more information on materials check out [custom materials](#).

Step 4: Running your first visualization

It is always a good idea to run a visualization first in order to verify that all of the geometry is being properly exported during the analysis.

1. In Rhino, set your viewport to the named view, "view_room".
2. Left click on the Metrics button
3. Select the Daylight Images Tab, then the Visualization Tab
4. Accept all of the other defaults, and click Run Simulation



DIVA

Daylight Images

Daylight Grid-Based

Thermal Single-Zone

Visualization

Timelapse

Radiation Map

Point-in-Time Glare

Annual Glare

Image Quality

Low Quality

?

Sky Condition

Clear Sky

?

Date and Time

09 21 09

?

Format: mm dd hr | (01-12) (01-31) (01-24)

Select Camera Views

Current Perspective View

?

Generate .tiff Image:

☐

?

Advanced Parameters

Radiance Parameters

-dp 128 -ar 23 -ds 0 -dt .2 -dc .25 -dr 0 -st .5 -ab 2 -aa .25 -ad 1024 -as 16 -av 0.01 0.01 0.01 -lr 6 -lw .01 -ps 8 -pt .16

?

Image Size [x,y]

800 600

?

Open With

wxfalsecolor

?

Hide Dynamic Shading

☒

?

Geometric Density

100

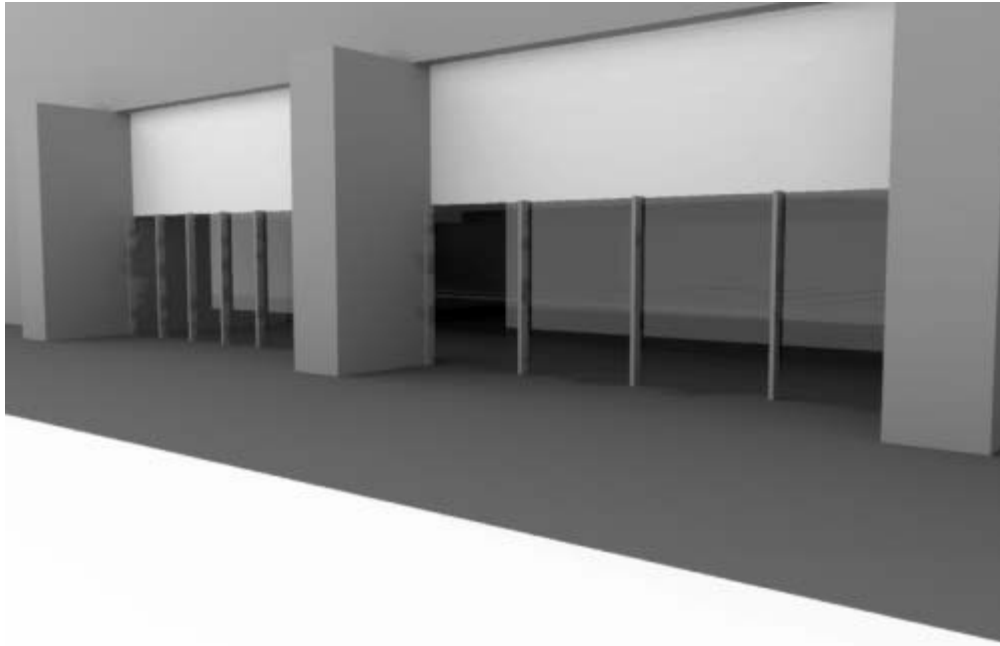
?

Run Simulation

Restore Defaults

Daylight images - visualization menu

First, a DOS window will pop up, and after a short period of time, wxfalsecolor will launch and display the rendering of the model. Your visualization should look similarly to the following image.



For more information,

see [visualizations](#).

Step 5: Running your first metric

We are now ready to run the illuminance test.

1. Left click on the Metrics button
2. Select Daylight Grid Based
3. Select Point-in-Time Illuminance
4. Leave all of the defaults, and click Run Simulation

DIVA Simulation Options

DIVA

Daylight Images | **Daylight Grid-Based** | Thermal Single-Zone

Daylight Factor | **Point-in-Time Illuminance** | Climate-Based | Radiation Map

Metric: Illuminance ?

Sky Condition: Clear Sky ?

Date and Time: 09 21 09 ?
Format: mm dd hr | (01-12) (01-31) (01-24)

Units: Lux ?

Advanced Parameters

Radiance Parameters: -ab 2 -ad 1000 -as 20 -ar 300 -aa 0.1 ?

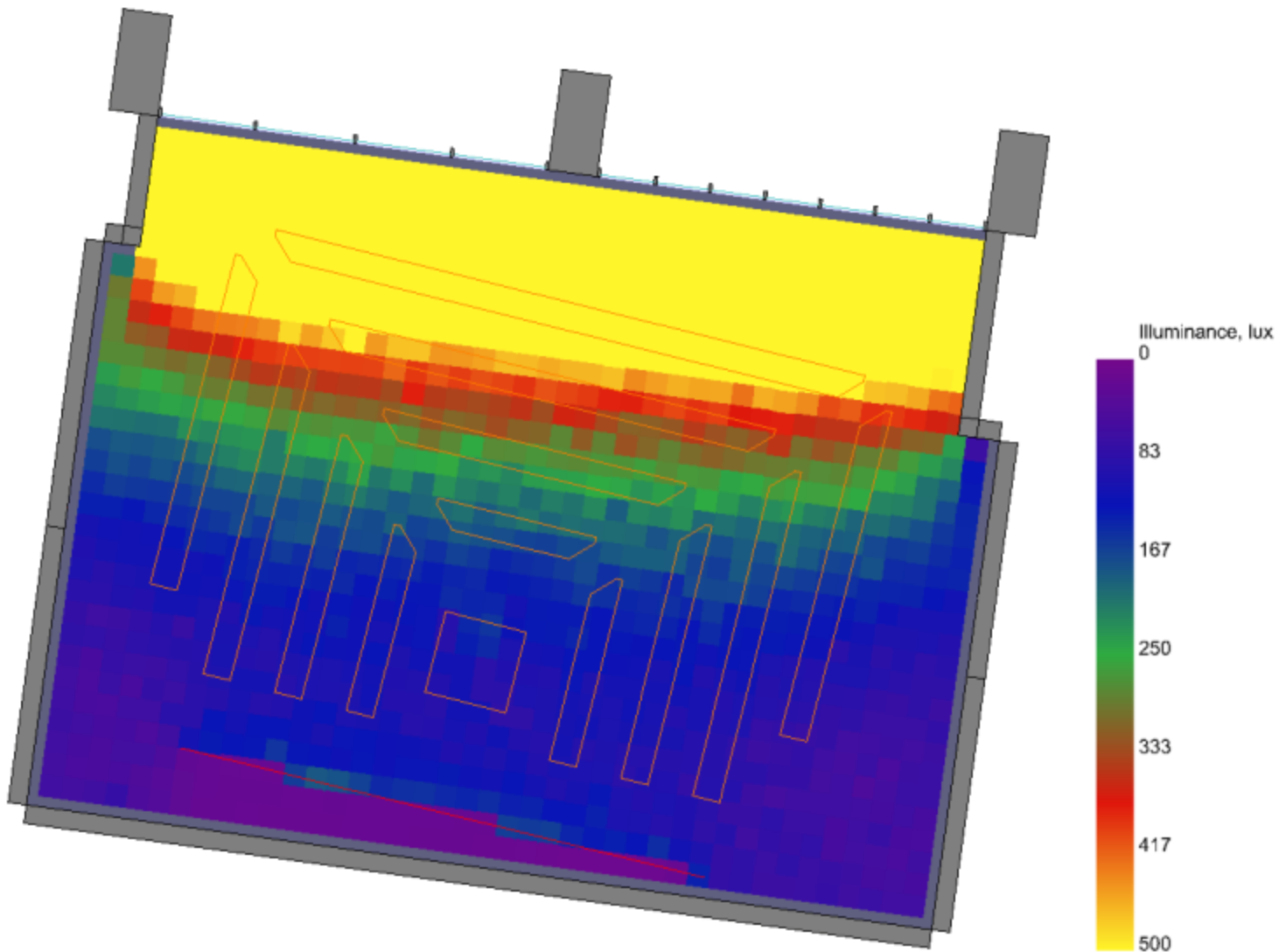
Hide Dynamic Shading: ☒ ?

Geometric Density: 100 ?

Run Simulation *Restore Defaults*

Point-in-Time Illuminance menu

5. Another DOS window will pop up, and this time, it may take slightly longer to run.
6. When the simulation is complete the "Load Metrics" dialog box will appear. Here is where you can select a variety of display options including the upper and lower bounds of the results, whether or not to display peak values or a variant label. You can also choose to change the display colors or node values. Don't worry if you change your mind about the options that you select. You can always change your options by **right clicking** on the Metrics button and reloading the data.
7. For now, Leave all of the defaults, and click Load Simulation Data.
8. Turn off the **ceiling** and **outside facade** layers, set your view to **Top** and for a sharper display, set your view to **Shaded**. Zoom out until you can see both the room and the legend. Your results should look something like below.



Congratulations! You have completed an analysis with DIVA.

Step 6: Results and Reports

Legend

The legend includes valuable information about the conditions under which the analysis was run, as well as important result statistics. The false-color grids are grouped into "panelgroups". There is one panelgroup per surface selected during the nodes creation step. If you aren't sure which panelgroup is which, in Rhino, use the "SelGroup" command, and enter "panelgroupXX" where "XX" represents the group number you are looking to identify. This will highlight the associated false-color grid.

False-color grid

The upper and lower bounds of the analysis are controlled by your selections in the "Load Metrics" dialog box. If you want to change the bounds, or any other aspect of the results display such as the display colors, whether node values are displayed, or other variants, simply right click on the Metrics button. You can load the analysis that you just performed and select the desired options, or you can load any other tests that were performed using this model.

Tips:

A. The legend scale and the false-color grid are both mesh geometries. In the "Options" menu of Rhino, you can change the way meshes, particularly mesh edges are displayed. Reducing the mesh edge thickness to "0" will eliminate the border on the meshes, creating a smoother look.

B. To create consistent reports, use the **Layout** and **Detail** commands in Rhino to create page layouts.

Step 7: Reloading Results

For practice, let's try changing the way our results are displayed. To do so, we will "reload" our results and change the display options.

1. Right click on the Metrics button to reload data from previous analysis runs
2. Select "Illuminance Values" from the "Lighting Test" drop down menu
3. Browse to the ".dat" file from the illuminance test we just ran. It will be located in the folder "Gund_111-Results" and will be named, "Gund_111.clsky092109.dat"
4. Change some of the display options in the **Load Metrics** dialog box
5. Click Load Simulation Data

Archiving Results

Keeping track of multiple tests

Let's say you want to run tests for the equinoxes and the solstices at 9am, 12pm and 3pm. DIVA will automatically track these options in the results file name, so you don't have to remember which file was run with which date, time or sky condition. In addition, say you ran one test, and wanted to run it again (for whatever reason). The files won't be overwritten. Instead, a new result file will be created with an appended index number: "01, 02, 03, etc.".

Suggested file organization methods

If you are testing out a single model with model-based variants such as materials or geometries, consider saving a separate Rhino file for each variant, with a name that identifies it by the variant. That way, when you run DIVA, a separate results folder will be created for each variant. If you don't do this, then all of the variants will be stored in the same results folder and it will be harder to tell which file contains the results from which variant.

On the other hand, if you are testing out times of day, or different metrics, or sky conditions, these can all be easily stored using the same results folder and file names since the automatically-generated DIVA extensions will keep track of that information.

Troubleshooting

If you are having problems with installation and you are working in a firewalled environment, see the [alternate installation](#) instructions.

1. Geometry does not appear to be included in the Radiance analysis

Possible reasons:

- If you are running Rhino 5, did you [adjust the default .obj export settings](#)?
- Is the missing geometry on a layer that is locked or off?
- Is the missing geometry is on a layer which does not have a material assigned?
- Is the geometry is complicated? Has the geometric density been set high enough? (in the Metrics dialog box)
- Are the surface normals oriented correctly? Check using the "Dir" command in Rhino.

Check if the geometry is exporting properly by running the Visualization/Image Metric and see whether the geometry appears properly in the rendering. It is generally a good idea to use a visualization to visually verify if your geometry is exporting properly before running any of the metrics.

2. Results seem incorrect

Possible reasons:

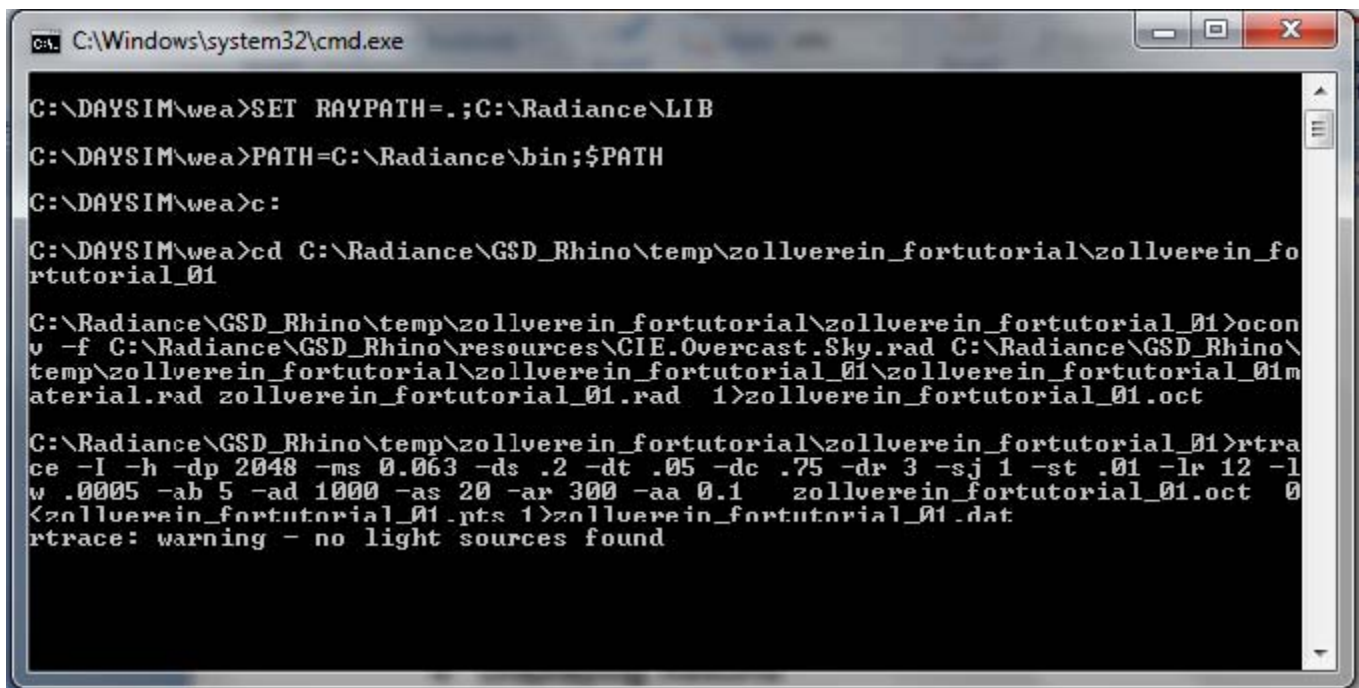
- Your geometry is not exporting properly. Run a Visualization Metric to verify.
- Your Radiance parameters are not set high enough. Try increasing them in the Metrics dialog box.
- Your sensor node normals are not oriented properly. Check them using the "Dir" command in Rhino.
- You have not created a ground plane and/or you have not assigned it a material. Ground planes should always be added into models, and be assigned a material.
- Results can be surprising, but always gauge them against what you would expect.

3. Nodes appear on the wrong side of the plane

The surface normal of the drive surface is reversed. Use the "Dir" command in Rhino to reverse the normals of the plane to which the nodes are associated.

4. "Rtrace – warning no lights found"

You can ignore this warning. It indicates that no sources other than the sun are found in the scene. Similarly, when running the "Radiation Maps" metric, there is a series of lines which say "ERROR!". This can be disregarded as well.



```
C:\Windows\system32\cmd.exe

C:\DAYSIM\wea>SET RAYPATH=.;C:\Radiance\LIB
C:\DAYSIM\wea>PATH=C:\Radiance\bin;$PATH
C:\DAYSIM\wea>c:
C:\DAYSIM\wea>cd C:\Radiance\GSD_Rhino\temp\zollverein_fortutorial\zollverein_fo
rtutorial_01
C:\Radiance\GSD_Rhino\temp\zollverein_fortutorial\zollverein_fortutorial_01>ocon
v -f C:\Radiance\GSD_Rhino\resources\CIE.Overcast.Sky.rad C:\Radiance\GSD_Rhino\
temp\zollverein_fortutorial\zollverein_fortutorial_01\zollverein_fortutorial_01m
aterial.rad zollverein_fortutorial_01.rad 1>zollverein_fortutorial_01.oct
C:\Radiance\GSD_Rhino\temp\zollverein_fortutorial\zollverein_fortutorial_01>rtra
ce -I -h -dp 2048 -ms 0.063 -ds .2 -dt .05 -dc .75 -dr 3 -sj 1 -st .01 -lr 12 -lw
.0005 -ab 5 -ad 1000 -as 20 -ar 300 -aa 0.1 zollverein_fortutorial_01.oct 0
<zollverein_fortutorial_01.pts 1>zollverein_fortutorial_01.dat
rtrace: warning - no light sources found
```

5. Various odd problems

Is your Rhino installed as a non-English localization? Unfortunately DIVA has some issues with non-English command parameters. You can add English by following the instructions at <http://wiki.mcneel.com/rhino/addlanguages>

You can then switch back and forth by going to Tools > Options :: Rhino Options > Appearance > Language

6. Error message in German when running a Visualization

It is likely that the view you are rendering is set to parallel projection. In order to produce an image, the projection must be set to perspective. Change it by going to the "Properties" panel and select "Perspective" from the Projection drop down menu.

Simulations in General

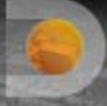
In the Metrics dialog box, there are many options which are common to two or more simulation types. Since these are common to several simulation types, we will review them all in one place (this page).

These options include:

- Quality Preset and Radiance Parameters
- Sky Condition
- Date and Time
- Hide Dynamic Shading
- Geometric Density

and for Image-based simulations:

- Camera Type
- Camera Views
- Generate .tiff
- Open With
- Image Size



DIVA

Daylight Images

Daylight Grid-Based

Thermal Single-Zone

Visualization

Timelapse

Radiation Map

Point-in-Time Glare

Annual Glare

Image Quality

Low Quality (quick render)

?

Sky Condition

Clear Sky with Sun

?

Date and Time

09 21 09

?

Camera Type

Perspective

?

Select Camera Views

Current Perspective View

?

Generate .tiff Image

☐

?

Advanced Parameters

Radiance Parameters

?

Image Size [x y]

800 600

?

Open With

wxfalsecolor

?

Hide Dynamic Shading

☒

?

Geometric Density

100

?

Cleanup Temporary Directory

☒

?

Run Simulation

Restore Defaults

- *DIVA Simulation Menu*

Image Quality and Radiance Parameters

(Low, Medium, High (Long Render Times))

Each quality preset relates to a set of Radiance parameters which can be seen and edited in the "Advanced Parameters" section of the dialog box. These settings set things like the number bounces and the number of rays that the Radiance engine will calculate for the simulation. It is not advisable to manually change these settings unless you have first understood the various Radiance commands and their respective values. For more information, see: Radiance Manual

Make sure that you follow the conventions for specifying variables (e.g. "-ab", not "ab").

For quick tests, the Low preset is fine, but for good, reliable results the High Preset is recommended. The Medium setting can be a good option for simulations that could possibly run extremely long if set to "High". Since many Radiance simulations involve a stochastic process, re-running the exact same simulation can produce slightly different results each time. Higher resolution settings will reduce the variability in results, but at the expense of longer simulation times.

Sky Condition

(Clear Sky, Overcast Sky, Custom Sky, Clear sky without sun, Uniform

You can specify a number of different sky conditions for your scene as explained below. The most common options typically used are Sunny or Cloudy.

- *Sunny Sky:* Uses the Radiance program *gensky* to model a CIE clear sky. This is a standard file defined by the International Commission on Lighting (CIE).
- *Cloudy Sky:* Uses the Radiance program *gensky* to model a CIE overcast sky. This is a standard file defined by the International Commission on Lighting (CIE). It is bright near the zenith and rotationally invariant, meaning that it looks the same in all orientations. This is the reference sky for the daylight factor.
- *Custom Sky:* In case you are interested in modeling a particular sky, for example when you have taking illuminance measurements of a space and you would like to model the space now under the same daylighting conditions. you can use the Perez sky model (Radiance program *gendaylit*) which requires as input date and time as well as measured direct and diffuse horizontal irradiances.
- *Clear sky without sun:* Same as clear sky but without the solar disk. Some designers like using this theoretical (non physical) sky to distinguish between lighting contributions from the celestial hemisphere and from direct sunlight.
- *Uniform:* Uses the Radiance program *gensky* to model a completely uniform sky. The underlying uniform sky model was used before the CIE overcast and other sky models were introduced.

Date and Time

(mm dd hr)

The solar date and time are set by specifying month, day and hour in the format: mm dd hr (a single space between each entry). For instance: December 10 at 3:15pm would be: 12 10 15.25.

Solar Date and Time mean that the sun position is calculate taking the Equation of Time into account, and WITHOUT daylight savings time.

Hide Dynamic Shading

(checkbox)

If selected any Rhino layer that is modeled as a dynamic shading systems such as a lowered venetian blind is excluded from all calculations except for climate-based metrics and electric lighting simulations.

Geometric Density

(0-100)

To use a finer mesh resolution when running any of the Metrics, adjust the "Geometric Density" option. Values

range between 0 and 100. "0" represents the crudest resolution of curves and complicated surfaces, where as "100" produces the most refined resolution.

Camera Type

(Perspective, 180 degree fisheye)

DIVA Image simulations will only successfully run when the projection of the view you want to run is set to "Perspective Projection" in Rhino. If your view is set to an Orthographic Projection, an error will appear. To change the projection of your view in Rhino. Make sure that nothing is selected, and navigate to the "Properties" menu. Under "Viewport", there is an option which says "Projection". You can change the setting there.

The 180 degree fisheye automatically set when the Run Evalglare check box is checked.

Camera Views

(Current Perspective View, Saved views only)

By default, when running an Image simulation, DIVA will render the current view in Rhino. The "Saved Views Only" option allows you to run only the views you have saved under "Named Views" in Rhino. With either choice, remember to make sure they have a Perspective projection.

Generate .tiff

(checkbox)

Image simulations automatically create a *.pic file which is effectively, an *.hdr (high-dynamic range) image. Unfortunately, these images cannot be opened by most photo previewers and NOT by Photoshop. In the wxfalsecolor window, you have the option to save the file that is generated as several file types, including a jpeg, but checking the "Generate .tiff" dialog box will save you the extra step of saving the image and will automatically generate and store the image as both a *.pic and *.tif in your results folder.

Open With

(wxfalsecolor, Radiance IV, Do Not Open)

wxfalsecolor is a program developed by Thomas Bleicher and is automatically installed with DIVA. In order to use the Radiance IV option, you must have the Radiance Image Viewer installed on your computer.

Image Size

(integer integer)

The dimensions of your output image can be set here. Values are entered in pixels x pixels in the format: integer integer. For instance 640 x 480 would be entered as: 640 480.

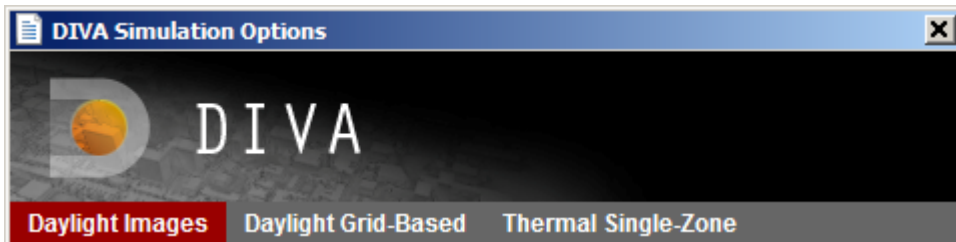
Cleanup Temporary Directory

(checkbox)

Selecting this option will automatically clean up unnecessary files from the C:\DIVA\Temp\[RhinoFilename] directory.

Simulation Categories

When you click on the Metrics button, at the top of the menu that pops up are tabs with the 3 simulation category types. The tab names are: Daylight Images, Daylight Grid-Based and Thermal Single-Zone. These are described below.



Simulation Categories: DIVA

Metrics Menu Tabs

Daylight Images

(Visualization, Timelapse, Radiation Map, Point-in-Time Glare, Annual Glare)

This category contains all metrics for which the output is an image in the format of *.pic which can also be saved as a .tif or various other image types, and can be viewed in an image viewer like wxfalsecolor. The images do not depend on nodes, and do not output to a falsecolor grid.

Daylight Grid-Based

(Daylight Factor, Point-in-Time Illuminance, Climate-Based, Radiation Map)

These simulations depend on the setting up of the sensor node grid, using the Nodes button. The output of these simulations is a falsecolor grid which shows up directly in the Rhino, and can be exported in the ways that other Rhino views can be rendered, printed or exported.

Thermal Single-Zone

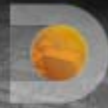
Visualization

Metrics >> Daylight Images >> Visualization

The Visualization simulation creates a Radiance rendering (*.pic) of the selected Rhino view of your model. This is a useful simulation to run **before all other simulations**, because it provides very useful information as to whether your model geometry is defined correctly and properly exporting. Sometimes surface normals are flipped, geometry is turned off or has not been defined a material, or other inconsistencies occur. The visual check allows you to preview the model the way Radiance sees it before running your simulation. Make sure your selected viewport is a perspective view and **not an orthographic projection**(Front, Top, etc...).



DIVA Simulation Options



DIVA

Daylight Images

Daylight Grid-Based

Thermal Single-Zone

Visualization

Timelapse

Radiation Map

Point-in-Time Glare

Annual Glare

Image Quality

Low Quality (quick render) ▼



Sky Condition

Clear Sky with Sun ▼



Date and Time

09 21 09



Camera Type

Perspective ▼



Select Camera Views

Current Perspective View ▼



Generate .tiff Image

☐

Advanced Parameters

Radiance Parameters

-ps 8 -pt .15 -pj .6 -dj 0 -ds .5 -dt .5 -dc .25 -dr 0 -dp 128 -
st .85 -ab 2 -aa .25 -ar 128 -ad 1024 -as 1024 -lr 4 -
lw .05



Image Size [x y]

800 600



Open With

wxfalsecolor ▼



Hide Dynamic Shading

☒

Geometric Density

100



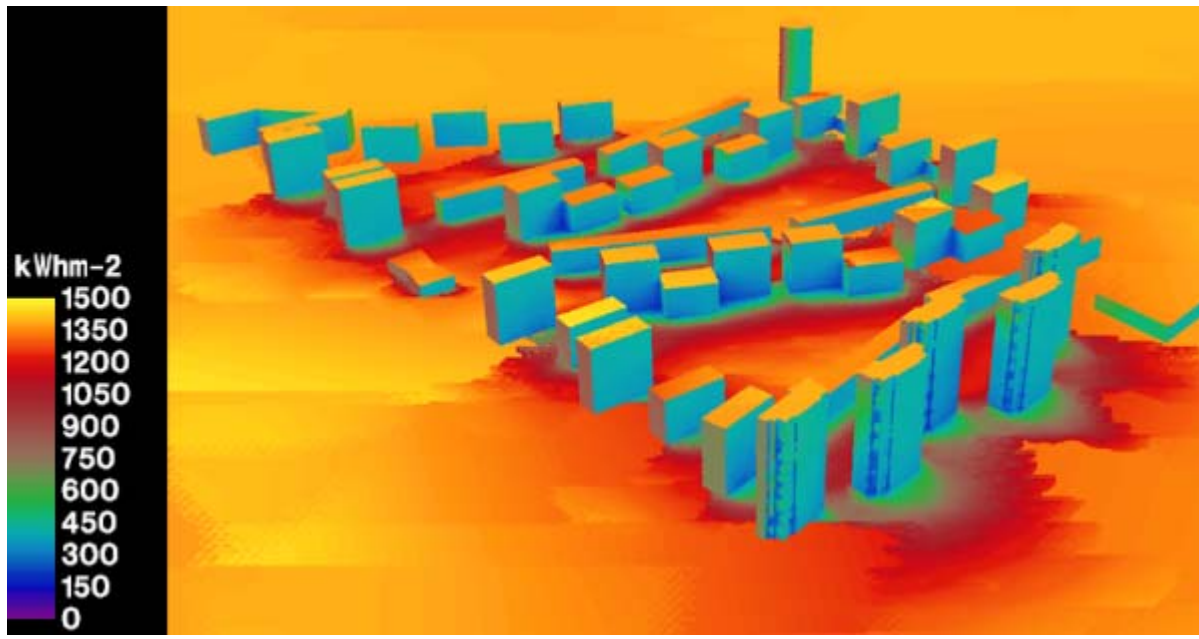
Cleanup Temporary Directory

☒

Run Simulation

Restore Defaults

Radiation Maps



Example of a

radiation map generated in DIVA using rpict and gencumulativesky

DIVA-for-Rhino can generate climate-specific annual surface irradiation images or calculate annual irradiation at node locations. This is a powerful tool that can be used on an urban or building scale to identify locations with solar energy conversion potential or areas in need of shading due to excessive solar exposure. Comparing summer and winter period irradiation results could help optimize shading devices to maximize winter gain while minimizing summer exposure.

The analysis uses a method described by Robinson and Stone which harnesses a Radiance module called GenCumulativeSky to create a continuous cumulative sky radiance distribution. This cumulative sky is then used in a Radiance backwards ray-trace simulation. Compared to other approaches which use hourly calculations, this approach is significantly faster with a minimal sacrifice in accuracy.

Daylight Factor and Illuminance

Daylight Factor

Metrics >> Daylight Grid Based >> Daylight Factor

A daylight factor is the ratio between exterior sky illuminance on an overcast day and illuminance inside a building. To run the metric, you must have first set up a sensor node grid using the **Nodes** button.

Daylight Images		Daylight Grid-Based		Thermal Single-Zone	
Daylight Factor		Point-in-Time Illuminance		Climate-Based	
Radiance Parameters		<input type="text" value="-ab 6 -ad 500 -as 16 -ar 300 -aa 0.1"/>		?	
Hide Dynamic Shading		<input checked="" type="checkbox"/>		?	
Geometric Density		<input type="text" value="100"/>		?	
<input type="button" value="Run Simulation"/>		<input type="button" value="Restore Defaults"/>			

Metrics Menu: Daylight Factor

Since the sky condition is overcast, neither a sky condition nor a date and time for the calculation are needed. You have the option to manually change your Radiance parameters and the geometric density of your geometry.

Illuminance

Metrics >> Daylight Grid Based >> Point-in-Time Illuminance

Illuminance calculations are also called "point-in-time" calculations because unlike the annual, or climate-based metrics, illuminance calculations measure light levels at a specific date and time. Like Daylight Factor, you will need to set up the sensor node grid, using the **Nodes** button before you run this metric.

Daylight Images		Daylight Grid-Based		Thermal Single-Zone	
Daylight Factor		Point-in-Time Illuminance		Climate-Based	
Radiation Map					
Metric	Illuminance				?
Sky Condition	Clear Sky				?
Date and Time	09 21 09				?
Format: mm dd hr (01-12) (01-31) (01-24)					
Units	Lux				?
Advanced Parameters					
Radiance Parameters	ab 6 -ad 500 -as 16 -ar 300 -aa 0.10				?
Hide Dynamic Shading	<input checked="" type="checkbox"/>				?
Geometric Density	100				?
Run Simulation		Restore Defaults			

Metrics Menu: Point-in-Time

Illuminance

Units

(Lux, Footcandles)

Select your preferred lighting units

Solar Date and Time

(mm dd tt)

Enter a date and time for the calculation. To enter minutes use an integer followed by a decimal point. For example, if you want to run a test on September 21 at 9:15am. Enter "09 21 9.25".

Climate Based Metrics

Daylight Autonomy, Continuous Daylight Autonomy, Daylight Availability, Useful Daylight Illuminance Metrics >> Daylight Grid Based >> Climate-Based

Climate-Based Metrics use recorded climate data in the form of *.epw files to simulate the sun and sky conditions for various simulations including Daylight Autonomy, Daylight Availability, Continuous Daylight Autonomy and Useful Daylight Illuminance. The second important aspect of Climate-Based Metrics is that they are **annual** calculations which means they take the entire year into account. The metrics use Radiance and Daysim as their calculation engines.

Daylight Images		Daylight Grid-Based		Thermal Single-Zone	
Daylight Factor		Point-in-Time Illuminance		Climate-Based	
Metric	Daylight Autonomy				?
Occupancy Schedule	weekdays9to5withDST.60min.oc				?
Target Illuminance	300				?
Units	Lux				?
Show Daysim Report	<input checked="" type="checkbox"/>				?
Advanced Parameters					
Radiance Parameters	-ab 6 -ad 1500 -as 32 -ar 300 -aa 0.1				?
Adaptive Visual Comfort	User(s) cannot adapt. Simulation				?
Geometric Density	100				?
		Run Simulation		Restore Defaults	

Metrics Menu: Climate-Based

Units

(Lux, Footcandles)

Although Radiance and Daysim only use lux as a unit of illuminance, if you are working in an environment which reference footcandles, you select "Footcandles" as a unit here. The values will be converted over to lux in the simulation process and then back to footcandles for the display output.

Occupancy Schedule

(always_occupied.60min.occ.csv, never_occupied.60min.occ.csv, weekdays9to5withDST.60min.csv)

In this dialogue annual hourly occupancy schedules can be selected. These occupancy schedules are used to determine when a lighting or shading group is occupied. These files are stored in csv (comma separated value) format under c:\DIVA\Schedules.

Target Illuminance

(integer)

Select a target illuminance level for your space. This level should depend on space type for example 500 lux of an office. For predominantly daylighted spaces it has become customary to assume a target illuminance of 300 lux.

Show Daysim Report

(checkbox)

If selected a detailed Daysim report will be displayed in your browser.

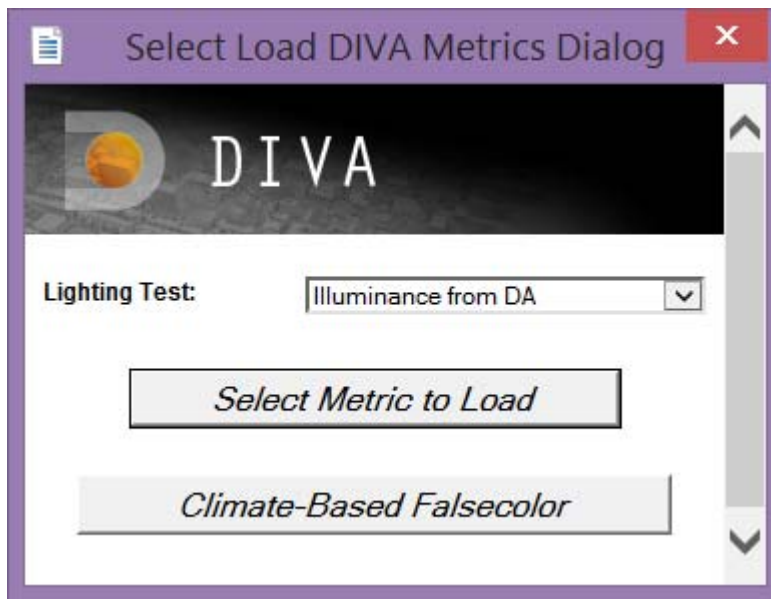
Adaptive Comfort

(User(s) cannot adapt. Simulation uses viewpoint with worst glare condition., User can adapt. Simulation uses least glary viewpoint.)

This parameter determines how annual glare simulations inform the use of a dynamic shading system. If the shading system is manual controlled and more than one view point was provided for the annual glare calculation, then the former selection assumes that a user can *adapt* to the space and pick the position with the least amount of glare. In the latter case several occupants are in the space and the occupant with the worst glare condition determines whether the shading device needs to be readjusted.

Load Metrics

To load previous results into your model, you right-click on the **Metrics** button. The **Choose** and **Load Metrics** boxes are displayed. The Load Metrics box is also displayed when any of the node-based metrics are finished running. The boxes provide options for how the results are displayed, and depend on which metric you are loading.

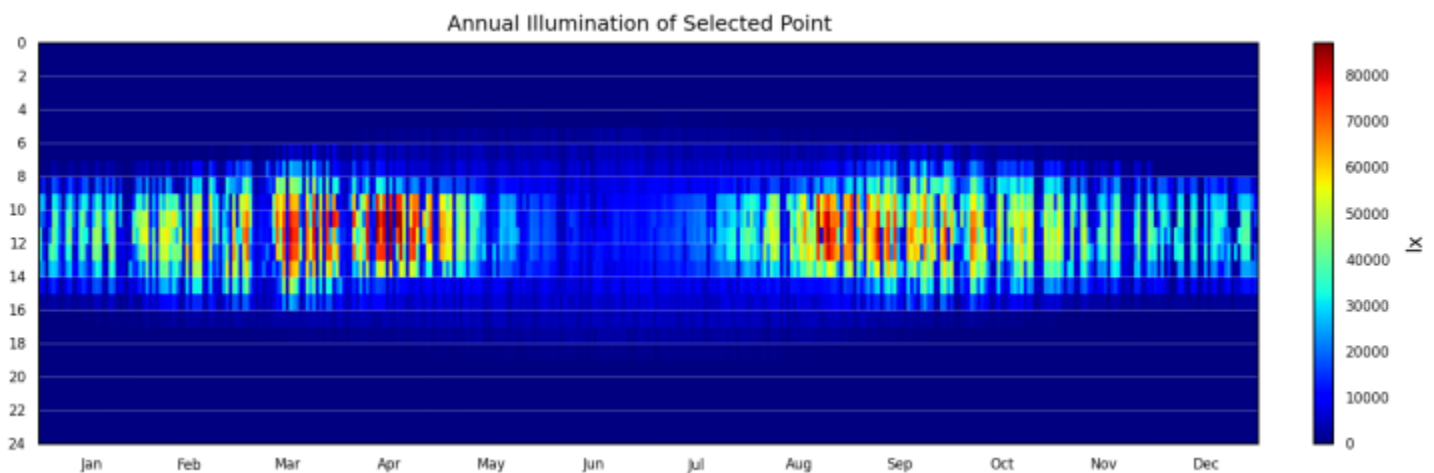


Choose metrics dialog


Lighting Test prompts you to choose which metric to load. Most of these are self-explanatory; however, 'Illuminance from DA' is a new feature which allows visualization of the hourly illuminance results from Daysim / Climate-based metrics.

Choose **Select Metric to Load** if loading a grid-based result.

Choosing **Climate-Based Falsecolor** will allow an hourly temporal map of climate-based simulation results for a selected point.



A result of the climate-based falsecolor option



Load DIVA Metrics Dialog

×

Lighting Test:

Illuminance Values

▼

Results File:

C:\Users\John\Desktop\diva21testr4 - DIVA\Grid-Based\diva21testr4.df.dat

⬆

⬇

⬇

⬆

Min. Illuminance:

300

Max. Illuminance:


2000


Real number values in lux or footcandles (only if selected).


Results fall in the range between 0 and 716.

Visualization Options

Color Scheme:

☒


☐


☐


Label 1% Peak Nodes:

☐

Label All Nodes:

☐

If this option is checked, text objects will be written into Rhino associated with each node value in the file.

Color Extreme Values:

☐

Color panels below the scale range a blue or black color and those above the scale range bright pink.

Display Footcandles:

☐

Option to display units in footcandles (I-P) rather than lux (SI).

Simulation Description:

☐

Option to add a description of the model or simulation being tested to the DIVA legend.

Load Simulation Data

⬇

Load metrics dialog

Min/Max Illuminance (Illuminance and Continuous Daylight Autonomy)
(integer, integer)

The user can set the lower and upper bounds which correspond to the colors displayed on the false-color node grid.

Min/Max Irradiance (Radiation Nodes)

(integer, integer)

The user can set the lower and upper bounds which correspond to the colors displayed on the false-color node grid.

Min/Max Daylight Factor (Daylight Factor)

(integer, integer)

The user can set the lower and upper bounds which correspond to the colors displayed on the false-color node grid.

Color Scheme (All Metrics)

(3 gradient options)

This option lets the user select which color scheme to use for the false-color node grid.

Label 1% Peak Nodes (All Metrics)

(checkbox)

By checking this box, the 1% peak nodes will be highlighted.

Label All Nodes (All Metrics)

(checkbox)

Checking this box will display the numeric result value at each node. These node labels are stored on their own DIVA sublayer called, "Node Values".

Color Extreme Values (Daylight Factor, Illuminance, Radiation Nodes, Continuous Daylight Autonomy)

(checkbox)

Panels whose values fall below the set range are shaded black and those that fall above are shaded bright pink.

Display Footcandles (Illuminance, Continuous Daylight Autonomy, Useful Daylight Illuminance, Daylight Autonomy, Daylight Availability)

(checkbox)

This should be checked if the user selected "footcandles" as the "Lighting Units" in the Metrics dialog box before running the metric.

Create Variant Label (All metrics)

(text)

In this space the user can enter a "variant" label (or title) for the calculation. This helps in remembering key options that were being tested during the metric.

Understanding DIVA Results Files

DIVA Grid-Based Results

When you run a DIVA simulation, a directory of files is created for you, and depending on the metric you run, different file types will be created. For Daylight Grid-Based Simulations these files are basic text files with different file extensions. In this tutorial, we are going to take a look at the results files for Daylight Factor,

Point-in-Time Illuminance, Climate-Based Metrics and Radiation Maps and learn what information they contain and how to use them to learn more about your analysis.

The two basic file types (file extensions) for the Daylight Grid-Based simulations are *.dat and *.da:

.dat files

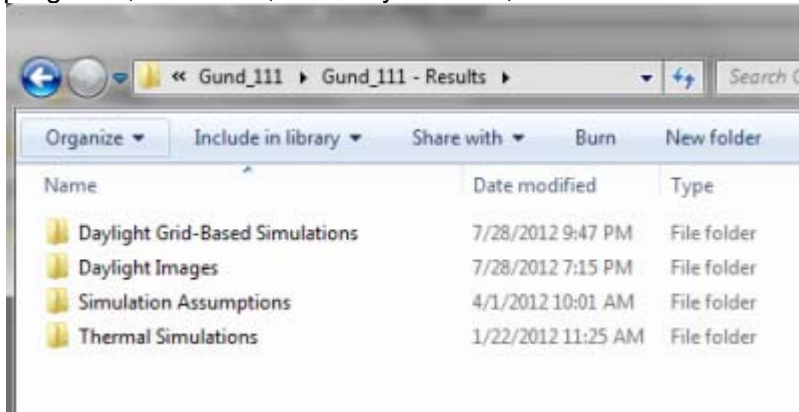
Daylight Factor	*.df.dat
Radiation Maps	*_ radmap. *.dat
Point-in-Time Illuminance	*.dat

.da files

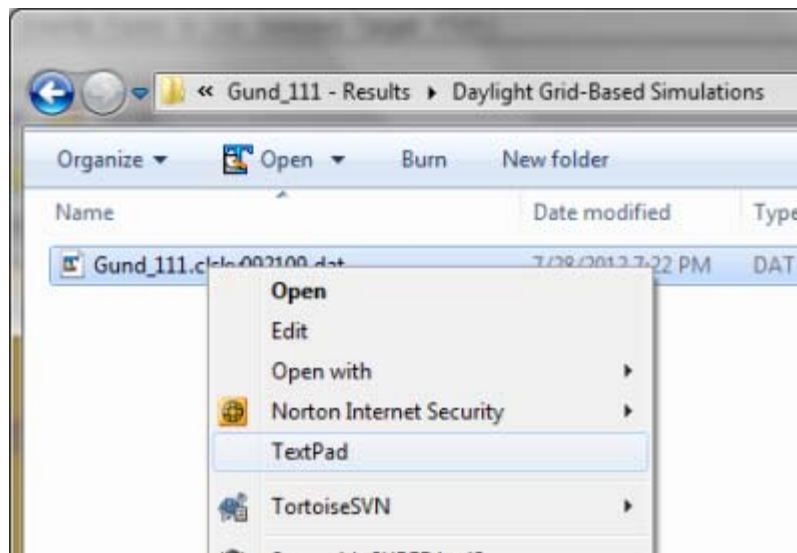
Daylight Autonomy	*_autonomy.shading.da
Daylight Availability	*_availability.shading.da
Continuous Daylight Autonomy	*.shading.cda
Useful Daylight Illuminance	*_UDI_100.shading.da, *_UDI_100_2000.da, *_UDI_2000.da

Viewing Grid-Based Results

These files can be easily viewed in any basic text editor, such as Text Pad, or they can be imported into spreadsheet programs, like Excel, for analysis. First, let's look at how we would import a .dat file into Excel.

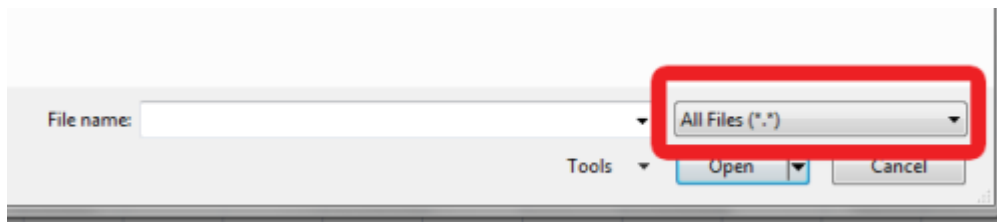


DIVA Results Directory



Opening files with Text Pad

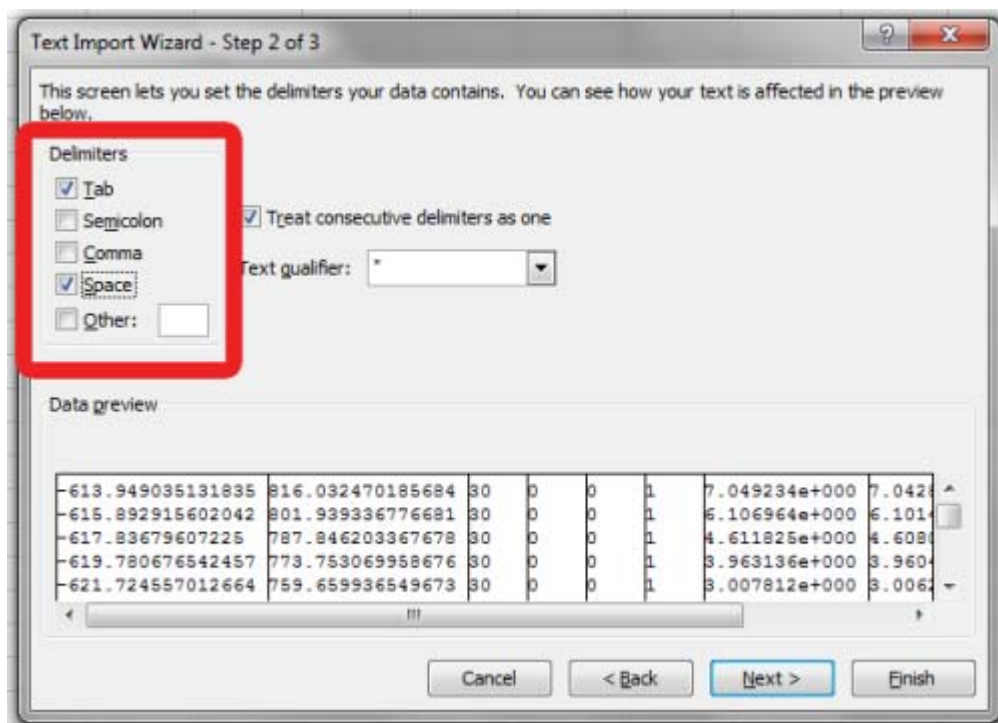
- Step 1 Run a Point-in-Time Illuminance metric and locate the results file
- Step 2 Click FileàOpen
- Step 3 Change "File Type" to "All Files"
- Step 4 Browse to your results folder
- Step 5 Select the .da or .dat file that you want to open
- Step 6 Use the screen shots below to guide the rest of the import



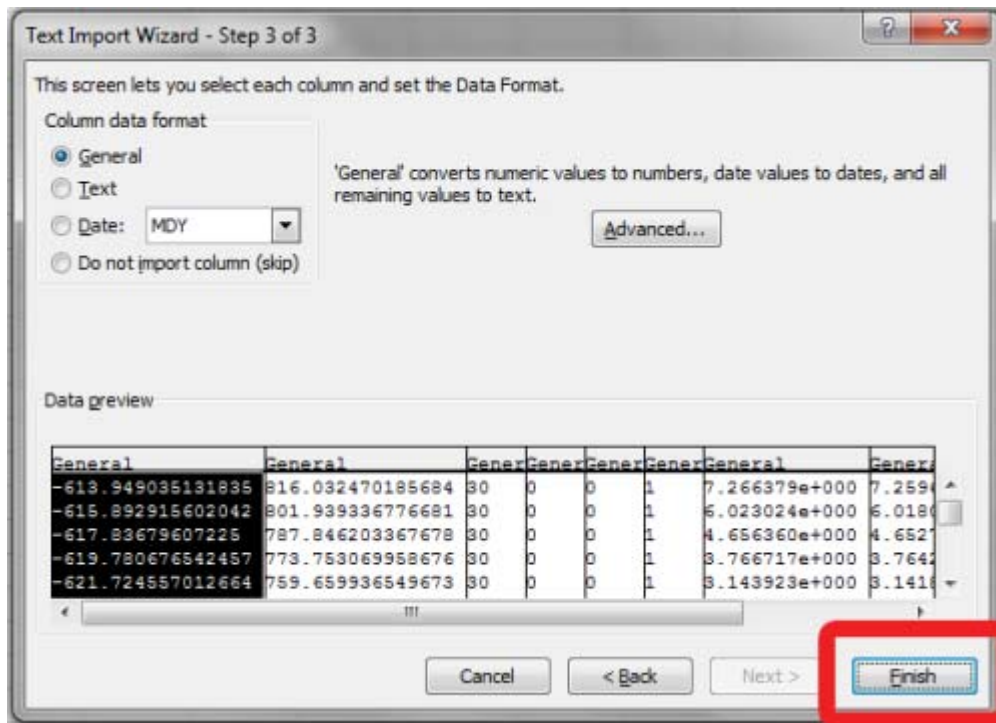
Step 3 Select "All Files" as the file type



Step 5 Select a .dat file to open



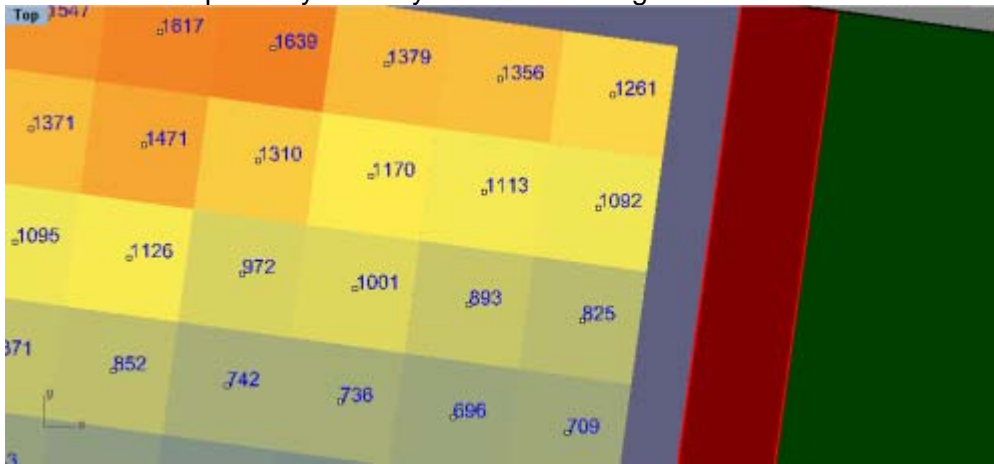
Step 6a Select "Tab" and "Space as delimiters



Step 6b Click "Finish"

Understanding Grid-Based Results

When you open any of these files, some parts are the same regardless of which file you look at. All .DA files will have some basic information at the top which identify the name of the metric, and some basic information such as the design illuminance threshold. The other information common to all files is a series of lines at the end of the file, all preceded by "#". There is one set of these lines for each set of nodes in your model (a nodegroup is the group of nodes associated with one surface in your model). For the most part, you don't need this information. It is primarily used by DIVA for loading in files.



Node Values Displayed

Sensor Node Coordinates			Sensor Node Vector (Orientation)			Results Values			
X	Y	Z	vX	vY	vZ	R	G	B	
A	B	C	D	E	F	G	H	I	
4	-617.837	787.8462	30	0	0	1	4.61E+00	4.61E+00	4.60E+00
5	-619.781	773.7531	30	0	0	1	3.96E+00	3.96E+00	3.96E+00
6	-621.725	759.6599	30	0	0	1	3.01E+00	3.01E+00	3.00E+00
7	-623.668	745.5668	30	0	0	1	2.53E+00	2.53E+00	2.53E+00
8	-625.612	731.4737	30	0	0	1	2.15E+00	2.15E+00	2.15E+00
9	-627.556	717.3805	30	0	0	1	1.59E+00	1.59E+00	1.59E+00
10	-629.5	703.2874	30	0	0	1	1.47E+00	1.46E+00	1.46E+00
11	-631.444	689.1943	30	0	0	1	1.11E+00	1.11E+00	1.11E+00
12	-633.388	675.1011	30	0	0	1	7.42E-01	7.41E-01	7.40E-01
13	-635.332	661.008	30	0	0	1	7.11E-01	7.10E-01	7.10E-01

.dat file data

The important part of the files is the middle section. Regardless of the results file, each line contains information for one of the sensor nodes in your model. The first three numbers of each line are the x, y and z coordinates of a given sensor node. For all of the .dat files, there are a second set of three numbers which are the x, y, and z components of the node vector (this gives the node orientation).

The last numbers are the metric value for the associated node. For the .dat files there are three numbers which are the R, G and B components of the Daylight Factor, Irradiation, and Illuminance. In the file they are in this order: R-value, G-value, B-value. You may notice that none of the columns contain values that equal the node values displayed by the same file in the model. These three values represent a weighted contribution to the final Daylight Factor, Irradiation or Illuminance value. To derive that result, a factor is placed on each component and the weighted values are summed.

For the Daylight Factor and Radiation Maps metrics, this equation is: $R*0.265 + G*0.67 + B*0.065$, where R, G and B are the R, G, B values from the last three columns of the results file. For the Illuminance metrics, the equation remains the same, but the entire sum is multiplied by 179: $(R*0.265 + G*0.67 + B*0.065)*179$. For the .da files, there is just one number after the sensor node coordinates which is the DA value. No additional steps are necessary to derive a final answer.

Once you have your values in place, you can Excel's functions and graphing capability to analyze your results in hundreds of ways.