Guideline to building simulations with MicroShade® in ClimateStudio

This is a guideline to simulations with MicroShade® in ClimateStudio. ClimateStudio can be used for both daylight and thermal calculations. For daylight simulations ClimateStudio utilizes a progressive path tracing, thus making the software incredibly fast when doing daylight calculations. The thermal calculations are based on EnergyPlus. ClimateStudio is developed and distributed by Solemma LLC. For an easy start with ClimateStudio we recommend watching the tutorial videos here.

This guideline shows how to use MicroShade® in ClimateStudio. For further questions regarding ClimateStudio, please contact Solemma LLC. For questions regarding MicroShade®, please contact us on support@microshade.dk.

Simulation of MicroShade® in ClimateStudio

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[1] 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® please see our selection guidelines on 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 to confirm if rotation is beneficial.

[1] Facade application means glazing mounted in a near vertical position.

Daylight simulations in ClimateStudio

Daylight Metrics

ClimateStudio has a build-in workflow for LEED v4, which consist of Annual Sunlight Exposure, ASE, and Spatial Daylight Autonomy, sDA. Please note that LEED sDA is **not** similar to sDA in EN 17037. In order to calculate sDA in accordance with EN 17037 please use the EN 17037 workflow. Alternative workflows for BREEAM and daylight factor is also available.
For most situations the default radiance parameters, that control the quality of the calculation, can be left untouched. However, for special situations these may have to be changed, for further information on this topic click here.

MicroShade® properties description

The complex structure of MicroShade® can be described in several ways, depending on the type of simulation. For energy and thermal calculations, the .idf format should be used. For daylight calculations the BSDF files in .xml format is used for grid-based daylight simulations, while the .cal file can be used for both grid-based and image-based simulations.

MicroShade® IDF files

For energy calculations in ClimateStudio the .idf file format should be used to describe the properties of MicroShade®. IDF files of MicroShade® used in common window constructions are available for download below.

- 2-layer MS-F 60/14 for façade
- 3-layer MS-F 60/14 for façade
- 2-layer MS-F 60/14 for roof
- 3-layer MS-F 60/14 for roof

In case you cannot find the variation you are looking for, a custom IDF can be made following the Guideline to daylight simulations with MicroShade®, otherwise feel free to contact us at support@microshade.com

MicroShade® BSDF files

For daylight simulations in ClimateStudio the BSDF xml file format should be used to describe the performance of MicroShade®.
BSDF files of MicroShade® used in common window constructions are available for download below. These files can be used immediately in ClimateStudio.

- 2-layer MS-F 60/14 for façade
- 3-layer MS-F 60/14 for façade
- 2-layer MS-F 60/14 for roof
- 3-layer MS-F 60/14 for roof

In case you cannot find the variation you are looking for, a custom BSDF can be made following the Guideline to daylight simulations with MicroShade®, otherwise feel free to contact us at support@microshade.com

MicroShade® .cal files

For renderings and glare simulations the resolution of the BSDF files might become a limitation, thus we recommend you use our cal file for these simulations. Please note, that the cal file **only** represents the MicroShade® layer of the window and will have to be combined with an additional surface in Rhino, to account for the glazing in the window.

Microshade® is mounted on the glazing closest to the exterior inside the cavity (se figure 1, position 2). MicroShade® is always combined with either a low E or an extra low E coating, see position 3 and 5 on Figure 1. The coatings are always mounted inside the cavity facing the exterior. It should be mentioned that MicroShade® cannot be used in combination with solar control coatings.

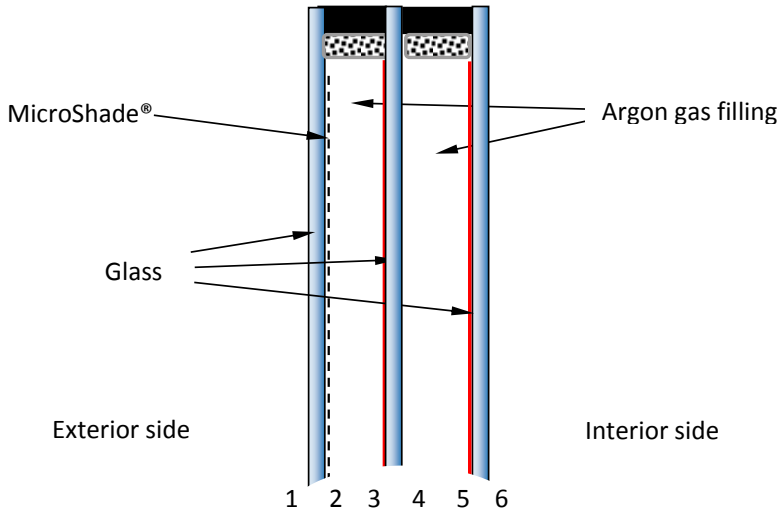

Figure 1. A glazing composition of a 3-layer LowE glazing with MicroShade®. The numbers indicate the indexing of the glazing surfaces.

When preparing your model to be used with the .cal file it is therefore essential that you make one surface for the glazing plus one additional surface for MicroShade® located close to the exterior glazing surface but without the two intersecting.

Step 1 Download the .cal file here and place it in the folder "C:\Program Files\Solemma\Common\Radiance\lib\"

Step 2 Create a folder on your computer, which will become your local materials library.
Download the material file you assign the material here and put it in your custom material library folder.

Step 3 Assign the newly added material to the MicroShade® surface in your window and assign appropriate glass definitions for the glazing layer in the window.

Setting up an energy calculation in ClimateStudio with MicroShade®

When doing energy calculations with MicroShade® in ClimateStudio, you will need to have some experience working with Grasshopper for Rhino. If not, we recommend you watching the videos made available by Solemma on how to do energy calculations in grasshopper with ClimateStudio, and to try doing calculations in a shoebox before moving on to more complex geometries.

Step 1 Set up your model in Rhino/Grasshopper and assign boundary conditions etc.

Step 2 Set up you window: Assign the window geometry to a *brep* or similar in grasshopper and connect that to the "*CS Window*" component from the ClimateStudio tab in grasshopper (See figure 2).

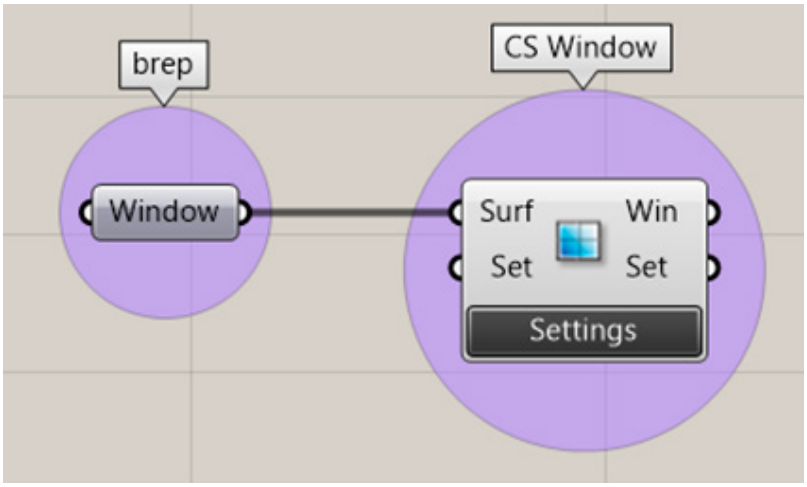

Figure 2 Connect "brep" containing window geometry to "CS Window" component

Step 3 Select the "*CS Window settings*" component from the ClimateStudio tab and drag it to the canvas. Zoom in on the component till you see a "+" in the bottom, click on it and then click on "*Glazing Construction [Glazing Name]*". A new input on the component should now appear called "Gcon" (see figure 3).

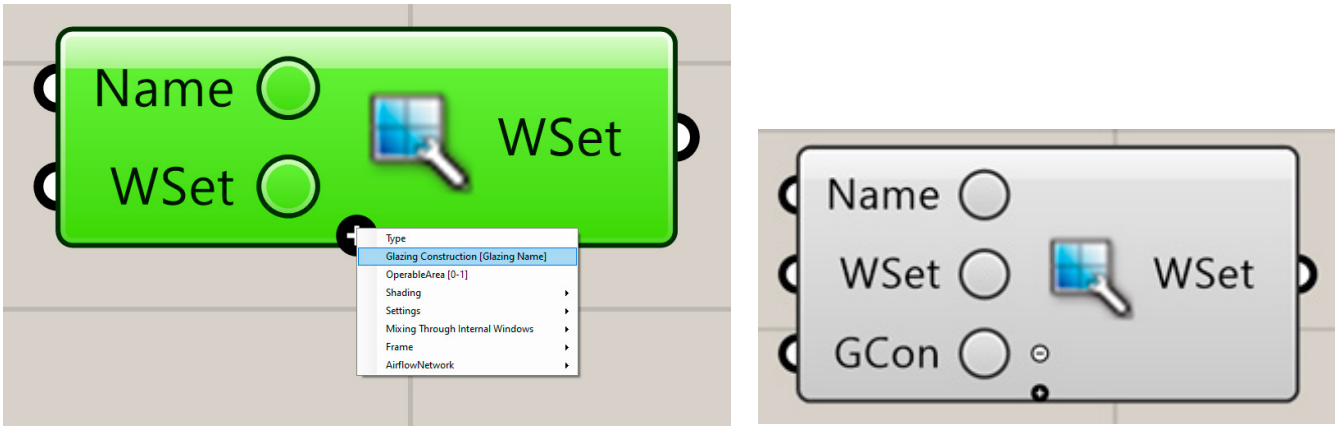

Figure 3 "CS Window settings" components, Left: Click on "+" sign and then on "Glazing Construction [Glazing Name]". Right: The input "GCon" will now appear

Step 4

Grasshopper needs to be able to recognize the input as a complex fenestration system, in BSDF format. Open the .idf file with MicroShade® you wish to use and scroll down till you see the header:

```
!-----------------------------------------------------------------------
!       Complex Fenestration State
!-----------------------------------------------------------------------
```

Bellow the header to the left of "!- name" you should find a name. In this example it is "CFS_Glz_132". Copy that name and paste it into a panel in grasshopper. Connect the panel to the "Gcon" input and connect the "WSet" output of the "*CS Window settings*" component to "Set" input in the "*CS Window*" component (See figure 4).

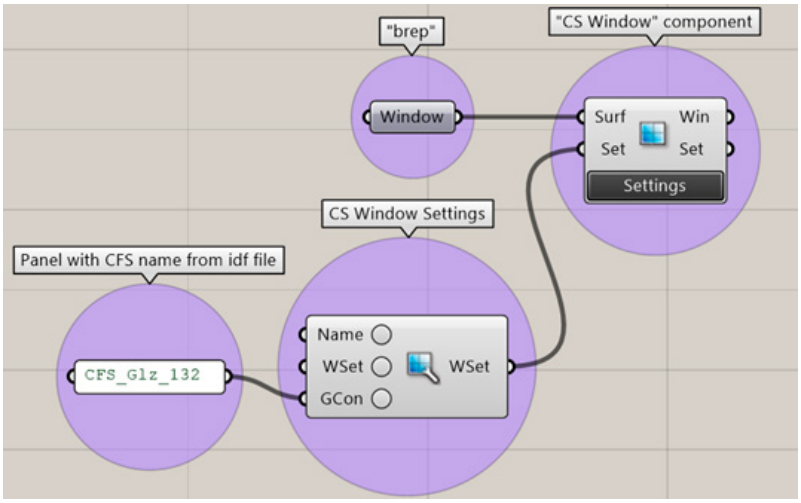

Figure 4 Connect the panel to "CS Window Settings" and then to "CS Window"

Step 5

Connect your zone and boundary conditions with the recently made "*CS Window*" to the component "*CS Model Maker*" (See figure 6). Add the two components "*File*" and "*Path*" to your canvas. Set the path to the idf file you wish to simulate (the same in which you found the CFS name) by right clicking on the component and selecting "Select one existing file" (See figure 5 left). Then right click on the "*File*" component and uncheck "Per line", the component should now write "Total File" below (See figure 5 right). It i**s important that you uncheck "Per line" before connecting it to anything, to avoid the script from crashing.** Connect the path to file and the file to the idf input in the "*CS Model Maker*" component (See figure 6).

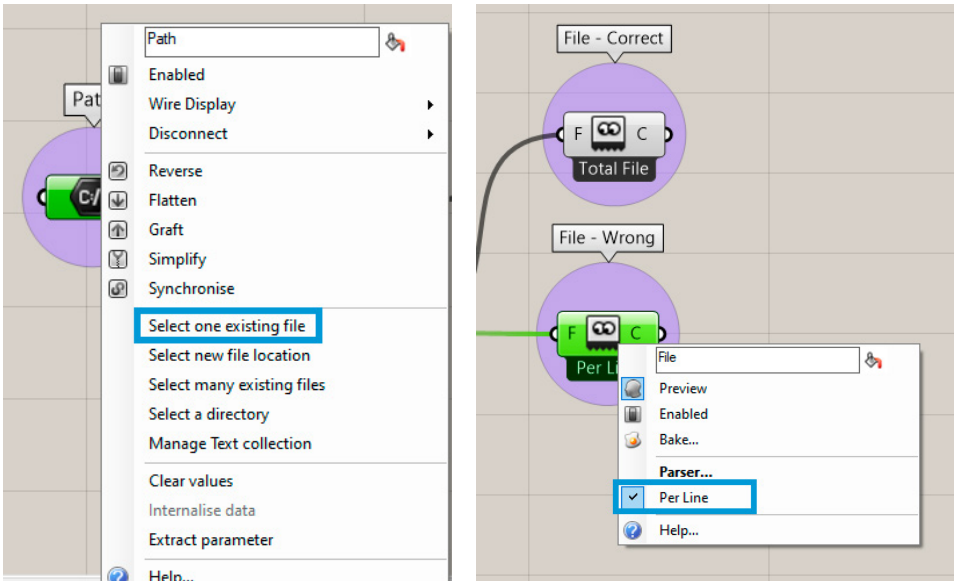

Figure 5 Left: Right click on "path" and select "Select one existing file".
Right: Right click on "file" and uncheck "Per line" so that it reads "Total file" below.

Step 6 You can now connect the “Model” output from “CS Model Maker” to the “Model” input in the component “Run CS Energy Model” and finalize your energy calculations.

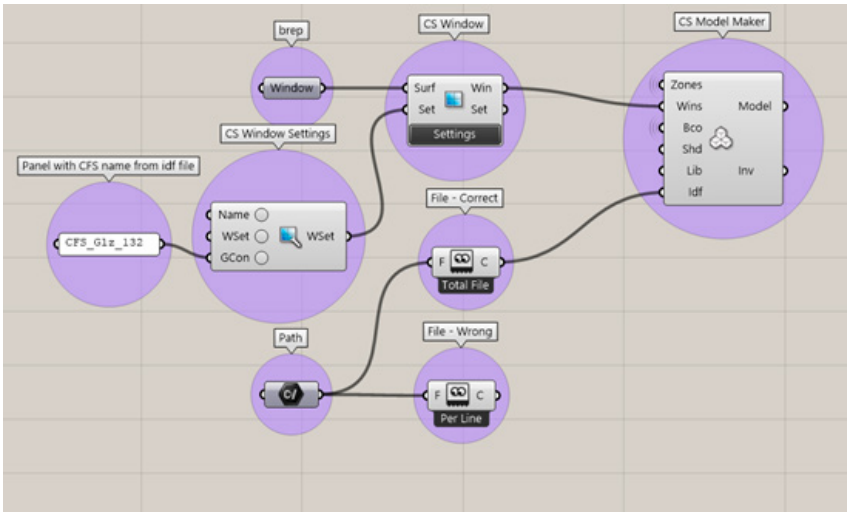

Figure 6 Connect window and .idf file to the "CS Model Maker" component

Setting up a daylight simulation in ClimateStudio with MicroShade®

Step 1 Create a folder on your computer, which will become your local materials library.

Step 2 Launch Rhino and create your geometry. In ClimateStudio materials are assigned to a layer. Thus, all objects in a layer will receive the same material. It is therefore important to keep objects with different material in different layers.
The whole window, including MicroShade®, is accounted for by a single BSDF file. It is therefore only necessary to model the window as a single surface if a BSDF is used.
If the .cal file is used, it is necessary to model two surfaces in the window, thus one surface is needed for MicroShade® and one for the glazing, the surfaces must not intersect.

Step 3 Select the desired workflow, in figure 7 "Daylight availability" is selected. Daylight availability comes with different predefined options, e.g. "*EN 17037*" or "*LEED v4.1 option 1*", you can read more about the options here.

Step 4 Now, go to the materials tab in ClimateStudio Workflows. Select a material by clicking in the right column named "material", next to the layer that you wish to assign a material (see the lower part of figure 7).

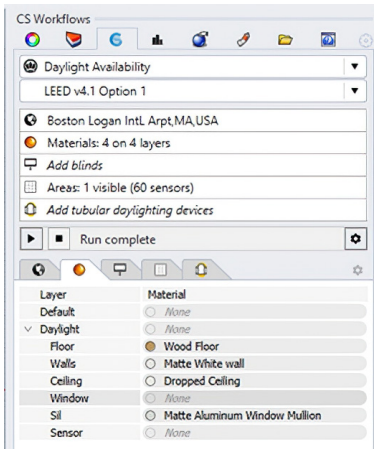

Figure 7 Materials tab

Step 5 To assign a window with MicroShade®, click on the material field next to the Window layer. A prompt will now open, where you click "*Manage Lighting Material Libraries*", marked with blue in figure 8

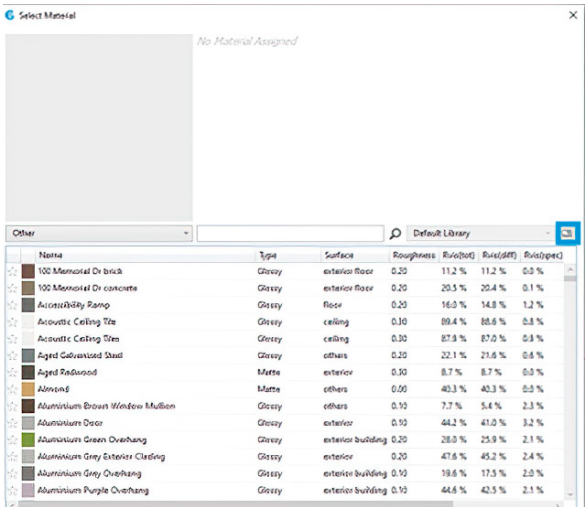

Figure 8 Select material prompt, "Manage Lighting Material

Step 6 Click the "+" sign and select the previously created folder containing the MicroShade® BSDFs or .cal file. See figure 9.

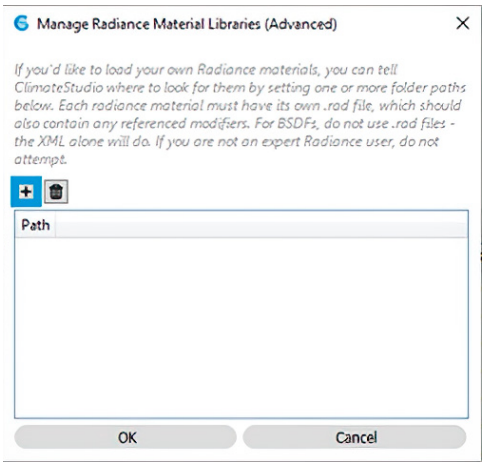

Figure 9 Click on "+", marked with blue and select the folder containing your custom materials library

Step 7 Click on the dropdown menu displaying "Default Library" and select the newly added custom library. See figure 10. If materials are added while working, click the refresh button, , to be able to see the newly added materials. Click on the material you want to use, and click "Select", see figure 11.

Step 8 You can now select your location under the location tab and set up the work planes.
Click run to start the simulation.

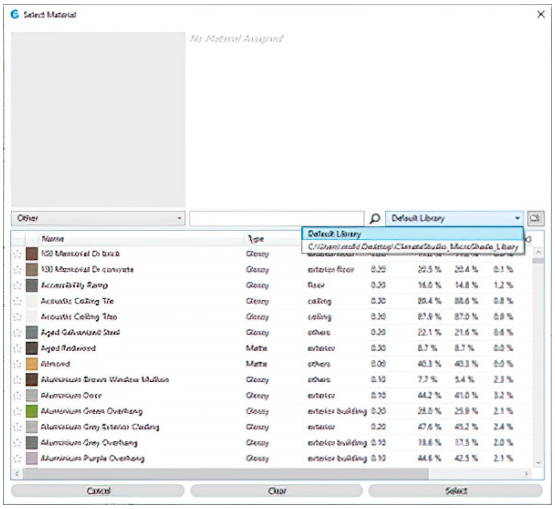

Figure 10 Select your newly added Custom Library

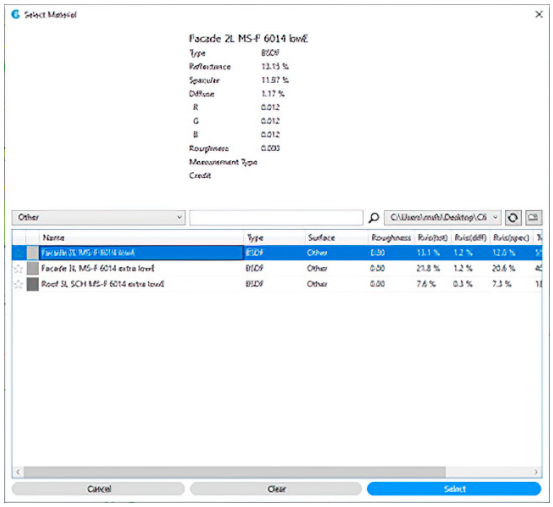

Figure 11 Click on the BSDF you want to use, if multiple is added to your library, and click "Select".