Guideline to Daylight Simulations with MicroShade®

This is a guideline to daylight simulations with MicroShade®. The guideline describes how to use MicroShade® Radiance files and MicroShade® BSDF files. The guideline assumes that the user know which of the two methods could be used in their chosen daylight simulation software. The guideline is therefore not intended for any specific software. Please contact your program supplier for support on your program. For questions regarding daylight simulations with MicroShade® please contact us at support@microshade.com

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. Similarly, the shading efficiency also varies during the course of the day due to the different positions of the sun morning, noon and evening.

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® type 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 metrics

The different daylight simulation programs offer different daylight metrics for evaluation of the daylight conditions in a room or building. It is recommended to use a climate based metric when evaluating with MicroShade®. In Europe it is recommended to use the spatial daylight autonomy as described in EN 17037.

Most common is the Daylight Factor (DF), Daylight Autonomy (DA), Spatial Daylight Autonomy (sDA), Continuous Daylight Autonomy (cDA) and Useful Daylight Illuminance (UDI). Furthermore some programs can calculate the Daylight Glare Probability (DGP). All except the Daylight Factor are climate based metrics, where climate data are used to simulate every hour of a year.

The daylight factor (DF) is a very simple daylight assessment method performed at a CIE standard overcast sky. An one point in time measure at an artificial sky is a very coarse evaluation of the varying daylight conditions experienced in reality. Therefore it is **not** recommended to use the daylight factor for evaluation of the daylight conditions.

Daylight Autonomy (DA) and the two sister-metrics cDA and sDA all describes how many hours, workhours or percentage of the year where the daylight levels are above a certain (lower) limit, usually somewhere between 100- 500 lux. Spatial Daylight Autonomy (sDA) consider how many % of the floor area the desired level is obtained. The continous Daylight Autonomy (cDA) also take illuminance level below the treshold into account by weighting it.

Useful Daylight Illuminance (UDI) describes how many hours, workhours or percentage of the year where the daylight levels are within the desired interval, usually 100-3000 lux. Lower illuminance levels requires artificial ight and higher illuminance levels causes a risk of overheating and glare.

Daylight Glare Probability (DGP) is a meaure of the probability of glare from daylight during the year. Values below 0.35 is imperceptible glare, while values above 0.45 is intolerable glare.

MicroShade® Radiance model

The MicroShade® Radiance 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.

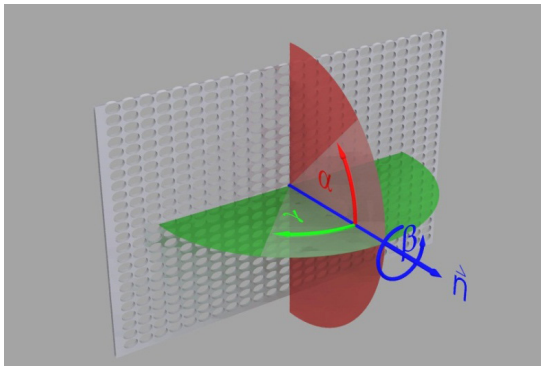

Figure 1. The surface normal should face the exterior.

The MicroShade® model has been validated against angle dependent transmittance measurements.

Since MicroShade® is a complex shading structure (as complex as venetian blinds) it is recommended to set simulation parameters to a high quality.

Usage of MicroShade® Radiance model

The material description for MicroShade® is enclosed in the following files. To download click on the link below. Remember to also download the material file (.rad).

- Microshade_f_6014.cal
- Microshade_mat.rad

The .cal file should be stored in the Radiance library "lib". The text in the MicroShade_mat.rad file should be copied into the material file in Radiance.

The letters behind underscore e.g. "MicroShade_f_6014" represent the MicroShade® type - in this case MS-F 60/14.

The 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 GenericSingleGlazing90

4  microshade_air microshade_metal trans microshade_f.cal
0
1 0
```

Rotation angle ß=0 no rotation, 90=90° rotation anti clockwise seen from the exterior

In case of a horizontal window with MicroShade® it is important to notice that the structure is "open" towards negative x-direction and "closed" towards positive x-direction in the window coordination system as default.

MicroShade® BSDF files

BSDF (BI-directional-Scattering-Distribution-function) files of the first layer of glass including the UV and IR film and structured micro-lamella has been developed.

Usage of MicroShade® BSDF files

BSDF files of four variations of the first layer of glazing, containing the MicroShade® structure, has been made available in a range of glass thicknesses. First click on the link of the desired variation, from there you can select the appropriate glass thickness.

- MS-F 60/14
- MS-F 60/14 Rotated 90°
- MS-F 60/14 + Hard coated solar control (SCH)
- MS-F 60/14 + Hard coated solar control (SCH) Rotated 90°

In case you do not find the needed variation please contact us at support@microshade.com

In some simulation programs it is not possible to simulate MicroShade® as a separate layer. In these cases it is necessary to combine MicroShade® with a glazing. This can be done in e.g. Windows 7. Please see the section "Creating a BSDF file or a glazing with MicroShade® in Window 7".

As a supplement to constructing your own window using a BSDF of MicroShade® with the first layer of glazing, a selection of common window constructions are available for download. For roof applications, the link will take you to a list of glazings, where standard constructions together with variations of rotated MicroShade® structure and hard coated solar control (SCH) coating are available.

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

In case you do not find the needed variation please contact us at support@microshade.com

Creating a BSDF file for a glazing with MicroShade® in Window 7

About Window 7

Window 7 is a window program that calculates specifications (U-value, transmission, reflection etc.) for glazings and complex glazing systems with shadings. Window 7 is developed at Lawrence Berkeley National Laboratory (LBNL) in California, USA and contains the international glazing database (IGDB) with more than 3800 glazings.

Window 7 can be used to build-up any glazing including shading systems to be used for energy or daylight analysis in other programs like e.g. Radiance or IESVE. For complex fenestration systems like MicroShade® the output is a XML BSDF file containing the angular depended transmittance and reflectance of the glazing including MicroShade®. Programs that can read XML BSDF files can also use the files created in Window 7.

Glazing build up with MicroShade®

To implement MicroShade® in a window, the coatings of the glazing need to be placed on the correct surfaces in the glazing. The BSDF files provided contains the first pane of the glazing, where MicroShade® is installed on the interior surface referenced to as surface "2" in Fig. 2. Low-E coatings should be places on surface 3 and 5.

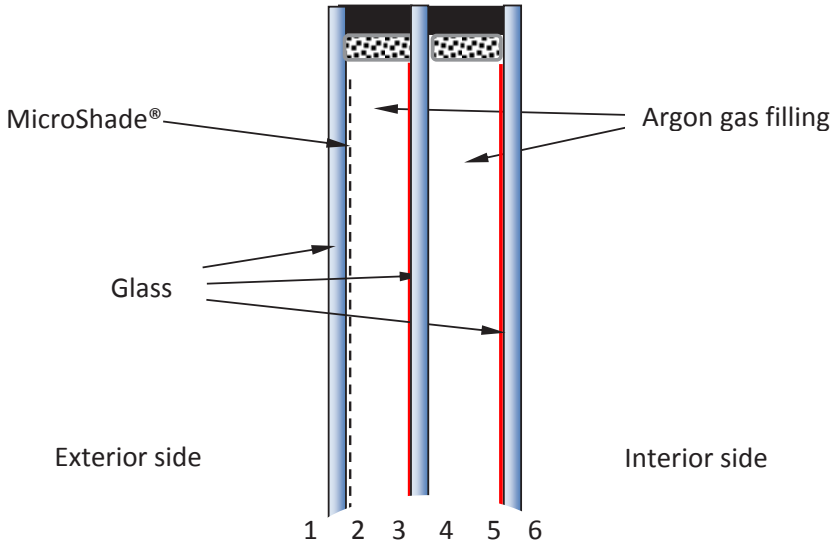

Figure 2. A glazing composition of a 3-layer LowE glazing with MicroShade®. The numbers indicate the indexing of the glazing surfaces.

Import the MicroShade® BSDF o Window 7

1. Go to the shading layer Library; "Libraries" > "Shading Layer" or click on the Shading Layer Library icon in the menu bar.

2. In the left menu bar click on "New". A new window will open up and prompt for an ID number for the new record. Just use the number suggested and press "OK".

3. The new record you just created will show on the last line in the list. Double click on it and a new window will open up. See figure 3

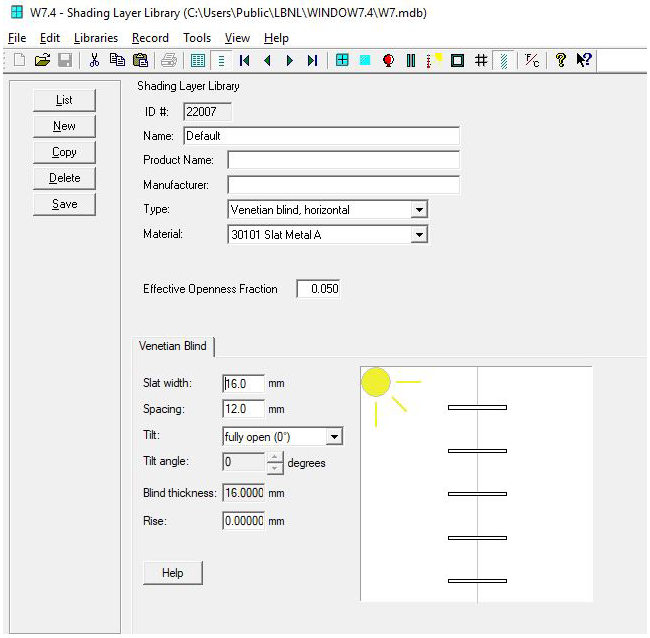

Figure 3: New Shading Layer Record.

4. In the “Type” drop-down menu choose the “Shade with XML data”.

5. Click “Browse” and choose the MicroShade® BSDF file you want to import. Values will now appear in the table. See figure 4

Please note: The thickness is allways 0.05 greather than the selected pane size, which accounts for the MicroShade® product installed.

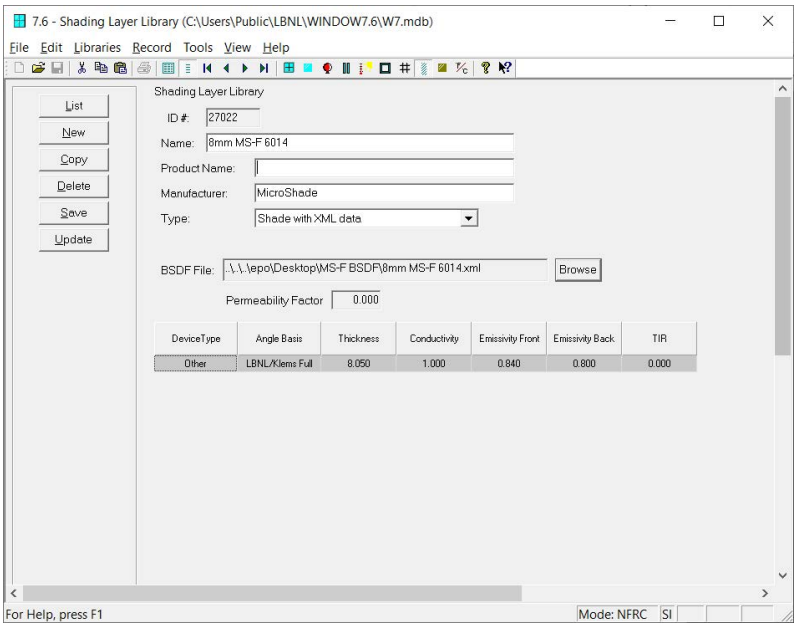

Figure 4: MicroShade® BSDF file has been imported.

6. Save the new shading layer you just created.

Create a glazing with MicroShade® BSDF

1. To get LBNL Window to produce .xml files the following preferences must be set in File/Preferences/Optical Calcs:

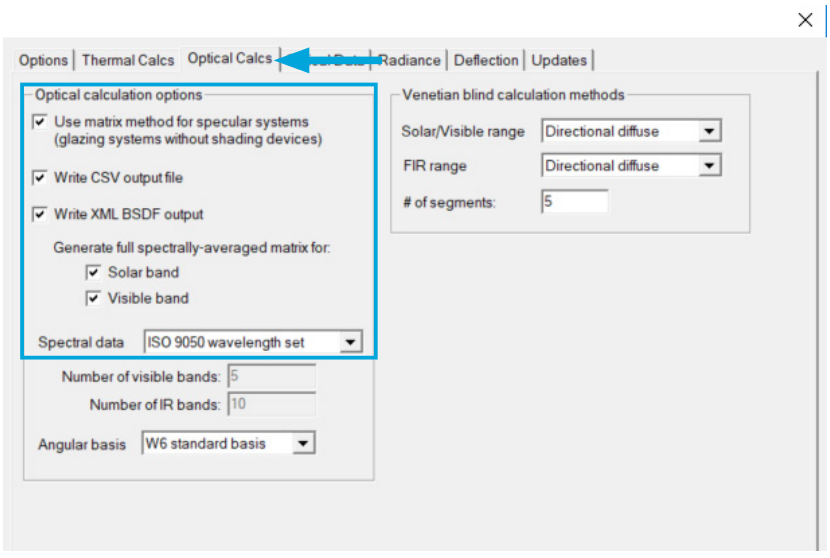

Figure 5: This tells the program to create XML outputs for solar and visible wavelengths. The BSDF in XML format is necessary for using BSDF files in Radiance.

2. Go to the Glazing System Library; “Libraries” > “Glazing System” or click on the Glazing System icon in the menu bar.

3. In the left menu click on “New”. A new window will open up and prompt for an ID number for the new record. Just use the number suggested and press “OK”. The new record you just created will show in a pop-up window.

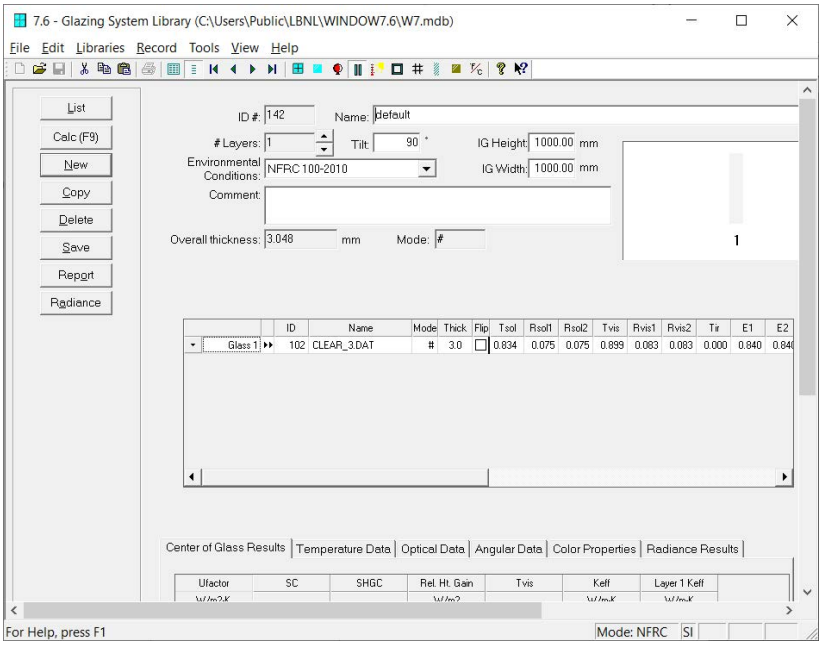

Figure 6: New Glazing System record.

4. Type in the name of your new glazing and choose the number of layers. The MicroShade® layer is incorporated with the first pane of glazing in the BSDF files, thus no extra layer should be added to account for the MicroShade®.

5. Each layer can now be modified to the desired glazing build up. The first layer should be changed to a *"Shade or frit"*, after that the newly created shading layer can be selected by double clicking on the name of the layer.

Please note: Remember to place the low-e coating on side 3 (and 5) in the MicroShade® glazing.

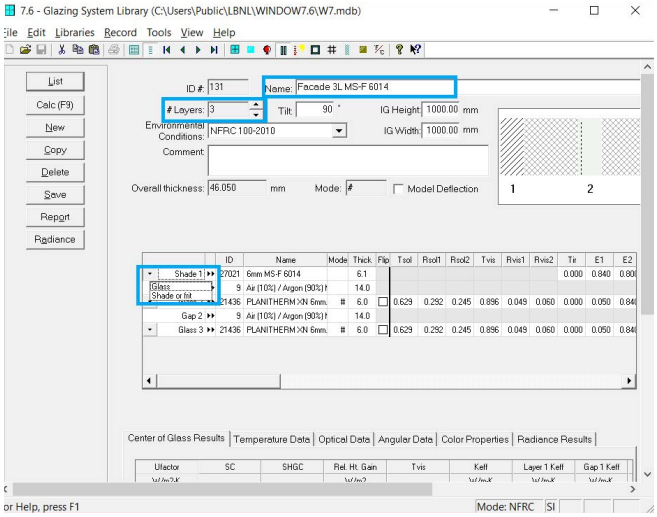

Figure 7: Example of a 3-layer MicroShade® glazing. Please note the position of the low-e coating on side 3 and 5. The blue areas indicate where to change the name, the amount of layers and the first layer to a "Shade or frit".

6. Once you have build-up your glazing, you are ready to calculate the value for the glazing including MicroShade®. As default boundary conditions the standard NFRC 100-2010 is used. The boundary conditions are only relevant for U- and g-value calculations and are not important for generation of the new BSDF file

7. Go to the left menu bar and click “Calc”. A pop up window will show up while the values are being calculated.

8. Save the record, when the values have been calculated.

9. To generate the new BSDF file with MicroShade® included in the glazing go to the left menu and press “Report”. Chose “Energy Plus BSDF IDF File” in the drop down menu and save the file on your desired location. The file format is “.IDF” and can be used directly in EnergyPlus.

10. If your preferences are set as described above, the XML file will be located here: C:\Users\Public\LBNL\WINDOW7.6\BSDFs.The XML file can be viewed in a text editor.