Guideline to thermal simulations with MicroShade® in IES VE

This is a guideline to dynamic thermal simulations with MicroShade® in IES VE version 2019 or later. IES VE is a building simulation software developed and licensed by Integrated Environmental Solutions Limited. IES VE is a suite of integrated analysis tools for buildings and amongst its capabilities it carries out whole building energy simulations and indoor climate analysis. IES VE also has a daylight calculation tool based on Radiance. This is an accompanying guide to simulations of indoor climate and energy consumption with MicroShade® in IES VE using the readily available MicroShade® constructions that can be found in the IES Navigator for import.

For guidance on carrying out daylight simulations with MicroShade® in IES VE please use the **Guideline to daylight simulations in IES-VE with MicroShade®**. For further questions regarding IES VE simulations, please contact IES Ltd. For questions regarding MicroShade®, please contact us on **support@microshade.com**.

Simulation of MicroShade® with IES Navigator

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.

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

About IES Navigator

Dynamic thermal modelling of MicroShade® with IES Navigator
The IES Navigator includes a set of readily available Apache Construction Database (ApCDB) constructions that replicate the performance of the MicroShade® products. The constructions consist of either a two-layer glazing or three-layer glazing construction that is typically combined with MicroShade® both for façade and roof applications. Please refer to table 1 for the IES navigator standard glazing composition and table 2 for the IES navigator standard glazing properties.

Table 1: IES Navigator standard glazing composition.

Standard glazing	Glazing build-up
Façade 2-Layer Glazing (6-16-6)	6 mm Paniclear + MS-F 60/14 - 16 mm argon - 6mm Planitherm XN
Façade 3-Layer Glazing (6-14-6-14-6)	6 mm Planiclear + MS-F 60/14 - 14 mm argon - 6 mm Planitherm XN - 14 mm argon - 6 mm Planitherm XN
Roof 2-Layer Glazing (8-16-8)	8 mm Planiclear + MS-F 60/14 - 16 mm argon - 8 mm laminated Planitherm XN
Roof 2-Layer SCH Glazing (8-16-8)	8 mm Planiclear w/ Stopsol Supersilver + MS-F 60/14 - 16 mm argon - 8 mm laminated Planitherm XN
Roof 3-Layer Glazing (8-14-8-14-8)	8 mm Planiclear + MS-F 60/14 - 14 mm argon - 8 mm Planitherm XN - 14 mm argon - 8 mm laminated Planitherm XN
Roof 3-Layer SCH Glazing (8-14-8-14-8)	8 mm Planiclear w/ Stopsol Supersilver + MS-F 60/14 - 14 mm argon - 8 mm Planitherm XN - 14 mm argon - 8 mm laminated Planitherm XN

*Table 2: IES Navigator standard glazing properties.*U-value is given for 90° installation.*

Standard glazing	g_o-value	U-value (W/m² K)	Direct solar transmission	Solar reflectance	Light transmission
Façade 2-Layer Glazing (6-16-6)	0.45	1.12	0.39	0.10	0.69
Façade 3-Layer Glazing (6-14-6-14-6)	0.40	0.64	0.33	0.11	0.63
Roof 2-Layer Glazing (8-16-8)	0.45	1.11	0.38	0.09	0.69
Roof 2-Layer SCH Glazing (8-16-8)	0.27	1.11	0.21	0.06	0.35
Roof 3-Layer Glazing (8-14-8-14-8)	0.40	0.63	0.32	0.10	0.62
Roof 3-Layer SCH Glazing (8-14-8-14-8)	0.23	0.63	0.17	0.06	0.35

Each MicroShade® construction has been set up using each of the standard glazing options as a basis and adding its shading effect using the "Local shade" and/or the "External shade" elements under "Shading Device" in ApCDM, as well as a g-value reduction.

Please refer to table 3 for the naming convention used to identify each MicroShade® case found in the IES Navigator.

Table 3: IES Navigator MicroShade® constructions naming convention

Naming convention	Façade glazing	
Façade glazing	**Facade 2L glazing (6-16-6)**	**Facade 3L glazing (6-14-6-14-6)**
Vertical façade (90˚)	MS-F_6014_2L_90	MS-F_6014_3L_90
	Roof glazing	
Rooflight glazing	**Roof 2L (8-16-8)**	**Roof 3L glazing (8-14-8-14-8)**
Roof (0˚-30˚)	MS-F_6014_2L_0	MS-F_6014_3L_0
Tilted façade (30˚-60˚)	MS-F_6014_2L_30	MS-F_6014_3L_30
	MS-F_6014_2L_30 - Rotated	MS-F_6014_3L_30 - Rotated
Tilted façade (60˚-90˚)	MS-F_6014_2L_60	MS-F_6014_3L_60
	MS-F_6014_2L_60 - Rotated	MS-F_6014_3L_60 - Rotated
Hard coated solar control rooflight glazing	**Roof 2L SCH glazing (8-16-8)**	**Roof 3L SCH glazing (8-14-8-14-8)**
Roof (0˚-30˚) (SCH)	MS-F_6014_2L_SCH_0	MS-F_6014_3L_SCH_0
Tilted façade (30˚-60˚) (SCH)	MS-F_6014_2L_SCH_30	MS-F_6014_3L_SCH_30
	MS-F_6014_2L_SCH_30 - Rotated	MS-F_6014_3L_SCH_30 - Rotated
Tilted façade (60˚-90˚) (SCH)	MS-F_6014_2L_SCH_60	MS-F_6014_3L_SCH_60
	MS-F_6014_2L_SCH_60 - Rotated	MS-F_6014_3L_SCH_60 - Rotated

The IES VE modules required for carrying out dynamic thermal simulations with MicroShade® are ModelIT (for geometry/import), ApacheSim (for window configuration and dynamic thermal simulation) and Vista (for results). Suncast is recommended to track direct beam radiation according to the specific model geometry.

Setting up a thermal simulation in IES VE with MicroShade®

Route 1 – Using the standard base glazing included in the IES Navigator

1. Open IES VE and create a new project or open an existing project. IES supports interoperability so you can also import geometry from BIM software. Set up your model as you normally would, defining the location, climate, other building fabric, thermal templates and energy systems.
2. Once your model is defined and you are ready to implement MicroShade®, go to the "Navigators" interface of IES and select the MicroShade Importer from VE Python Scripts to load the navigator.
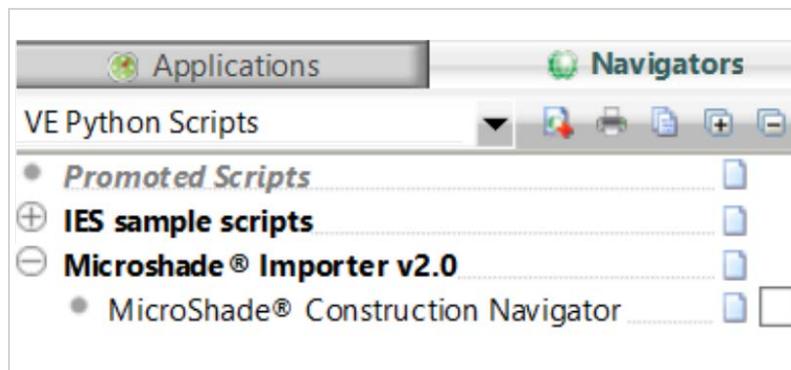
Figure 2: Navigator interface of IES.

Figure 3: MicroShade® Importer start page.

Once the navigator is loaded just follow the steps in the navigator. Select the MicroShade® constructions you wish to simulate in your model.
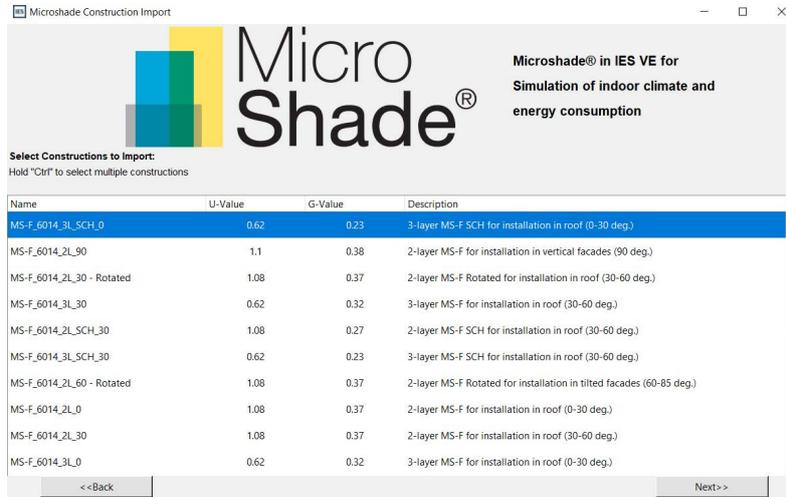

Figure 4: List of MicroShade® constructions in the navigator. Select the one(s) you want to include in your model.
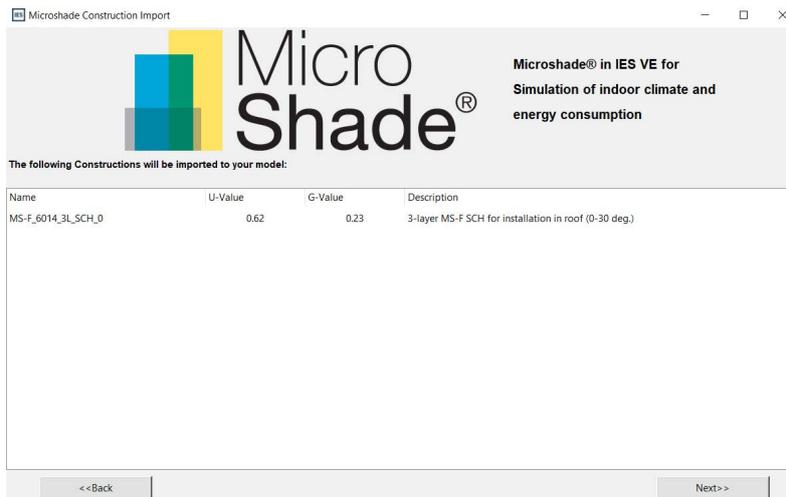

Figure 5: Selected MicroShade® construction.

The selected MicroShade® constructions will now be included in your Apache Constructions Database in the Apache module. Please refer to table 3 for the naming convention used to identify each MicroShade® case.

3.   Go to ApCDB in Apache and look for the MicroShade® constructions under the Glazed tab to confirm they have loaded successfully in your model.
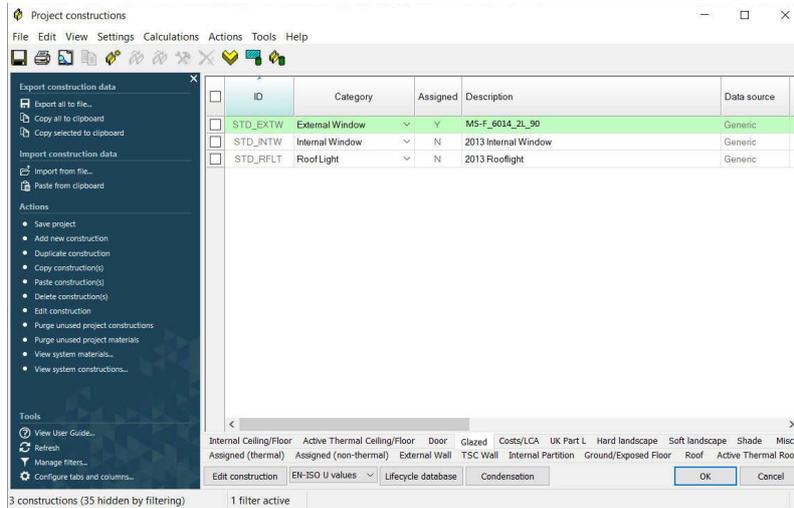

Figure 6: Glazed tab in ApCDB.

Open each MicroShade® construction that you wish to include and make sure to adjust the frame percentage and properties as per your project's windows. The default setting is a 0% frame factor.
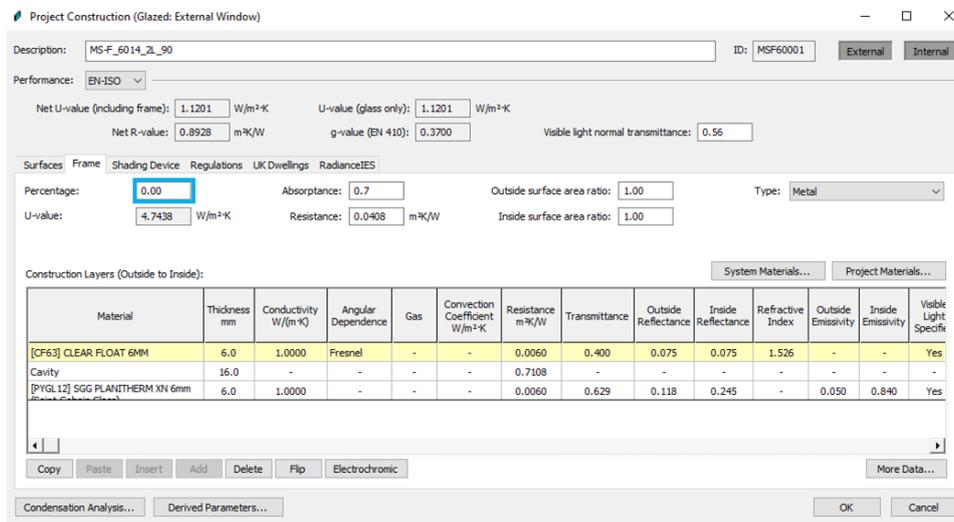

Figure 7: Adjust the frame percentage, as the default Is 0%.

4.   Apply the MicroShade® constructions to the respective windows of your model using the "Assign constructions" button.
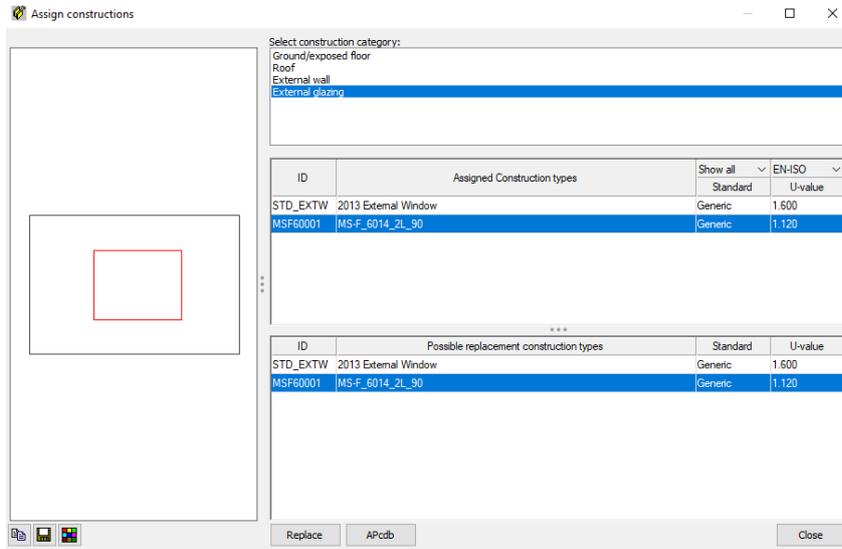

Figure 8: Assign MicroShade® to your constructions.

Your model is now ready for analysis using MicroShade®. Click the "ApacheSim (Dynamic Simulation)" button to run the dynamic thermal analysis.

Route 2 – Applying MicroShade® on alternative base glazing

1.   Please contact support@microshade.com to request a data sheet of the MicroShade® product(s) you wish to use in combination with the base glazing of your choice. You can also use SimShade to calculate the desired base glazing.

Follow steps 1 to 3 of Route 1.

2.   To set up the glazing of your choice in combination with MicroShade® go to ApCDB in Apache. Select the MicroShade® construction on which you wish to apply your glazing, ensuring to select the two-layer or three-layer version, according to whether the glazing you wish to simulate is double or triple. Create a copy of the construction and open it for editing, giving it an appropriate name in the field "Description".
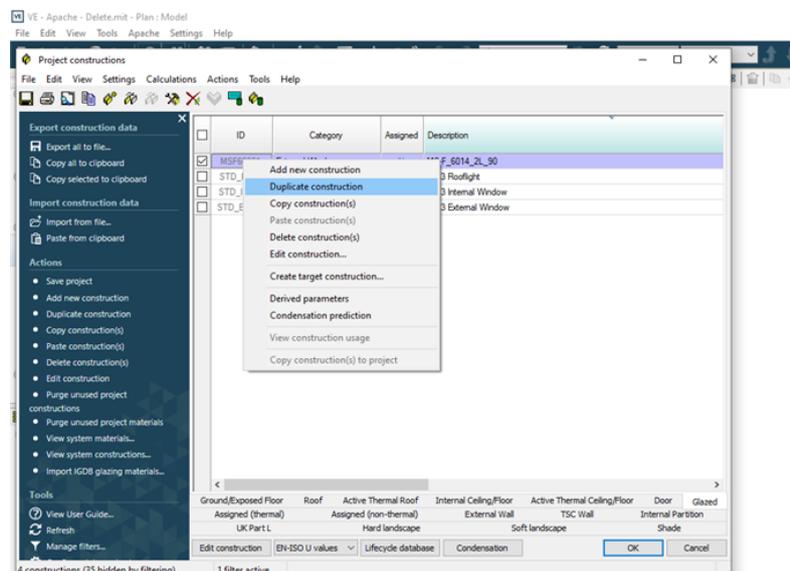

Figure 9: Create a copy of the MIcroShade® glazing you wish to modify.

Adjust the glazing properties to fit the glazing you have selected, making sure the g-value, glass U-value and outside solar reflectance match the data of the glass. Adjust the cavity resistance to meet the target U-value (the IES help page provides guidance on representing glass properties in IES. The "Hints & Tips" > "Manufacturer's data" section is a recommended resource). Please note that you should **NOT** insert the properties of the combined glazing plus MicroShade®, but of the base glazing without MicroShade®.
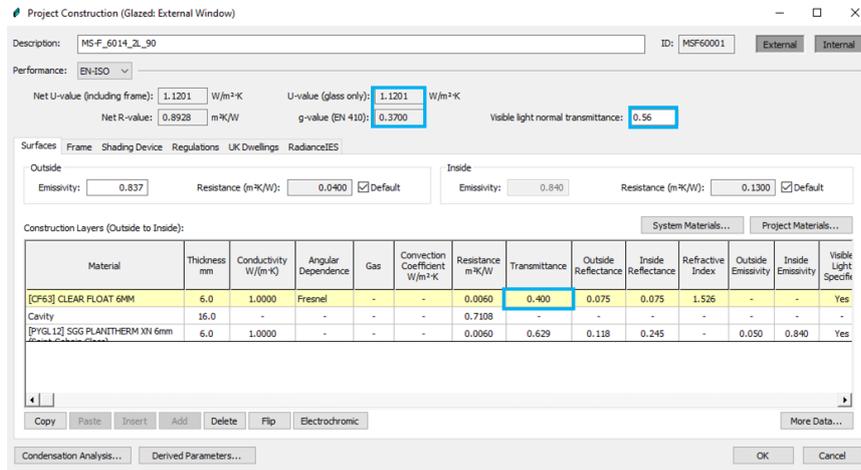

Figure 10: Adjust the U-value, g-value and outside reflection to match your required glazing specifications.

If you wish to use the constructions for daylight calculations, adjust the light transmittance to that of the combined glazing plus MicroShade®.

Adjust the transmittance of the external pane of your window (highlighted in green in Figure 11) so that the resulting g-value (highlighted in blue) is equal to that of the combined MicroShade®-glazing you have selected.
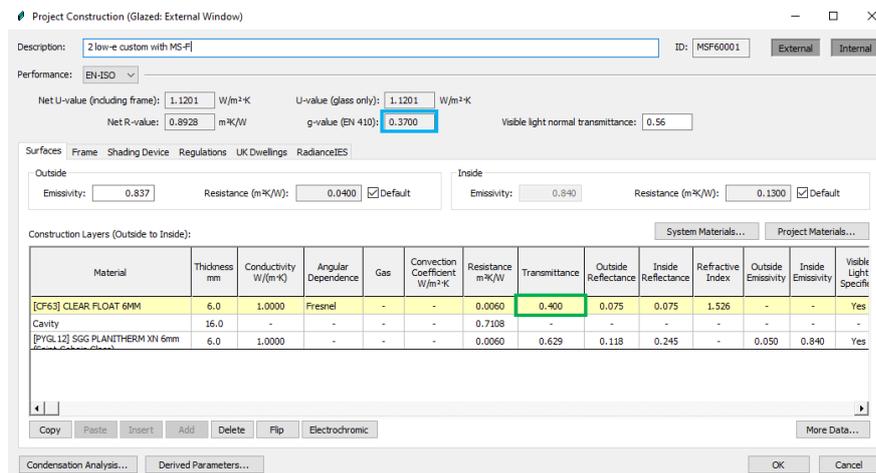

Figure 11: IES ApCDB glazed construction interface

The "Local shade" properties already included in the construction combined with the reduction in g-value will account for the shading effect of MicroShade®.

3. Apply the MicroShade® constructions you have created to the respective windows of your model using the "Assign constructions" button. Click the "ApacheSim (Dynamic Simulation)" button to run the dynamic thermal analysis.

Limitations

Location
The IES Navigator MicroShade® constructions and the guide can be used for any location, however for solar latitudes between -20˚ and 20˚ it is advised to contact the support@microshade.com, as large deviations may occur for these locations.

Window size and geometry
The IES Navigator MicroShade® constructions have minor sensitivity to the size and shape of the window, they can be readily used without any adjustments for any window size and shape.

Solar irradiation
It is noted that the calculation of solar irradiation can vary between different software programs, due to different calculation methods. The application of this guide and the IES Navigator MicroShade® constructions do not offer any input on mitigating solar irradiation discrepancies between software.

Deviation
The resulting performance of the IES Navigator MicroShade® constructions is estimated to be within ±10% deviation in monthly average g-value from the actual MicroShade® performance in most cases. In exceptional cases deviations can increase, primarily regarding the N (S) orientation for the North hemisphere (for the South hemisphere).

Peak solar gains
With regards to system sizing calculations, it should be noted that dynamic thermal modelling should be used when MicroShade is included in the building, as its performance is dependent on the solar positions over the year

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