DesignBuilder

SageGlass® Glazing - User Guide

DesignBuilder v5.4

SageGlass® Electrochromic Windows – User Guide

This document provides instructions for simulating SageGlass® Electrochromic windows in DesignBuilder v5.2.

Creating a SageGlass® Electrochromic System

The first step in modelling SageGlass® glazing is to create one or more SageGlass® Electrochromic glazing configurations, through the creation (or selection) of specific SageGlass® window shading systems[1]. These are used to define the tinting properties of the SageGlass® windows in the model.

> **Note:** One SageGlass® *window shading* system is required per sensor group. A sensor group is a group of windows equipped with SageGlass® to be controlled the same way (i.e. by the same sensor object).

Follow these steps to create a SageGlass® Electrochromic Glazing:

1. Navigate to the **Openings** tab.

2. Select the base **Glazing type** to represent the "clear state" SageGlass® glazing performance.

   Note: by default, there are already some SageGlass double and triple glazing units defined in DesignBuilder glazing library

3. Check the **Window shading** checkbox and add a new (or edit an existing) SageGlass *window shading* system under the category "SageGlass Electrochromic".

   Note: by default, there are already some SageGlass electrochromic *window shading* defined in DesignBuilder window shading library

4. Once the **Window shading** component dialog is opened, navigate to the Electrochromic tab to edit its properties:

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[1] Note that while SageGlass® is a whole façade system and not strictly speaking a shading system, DesignBuilder uses its standard window shading mechanism to model it.

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Window shading Data

General | Tinting | Cost

Tinting	
Pane replacement position	1-Outermost pane
⌐▣Electrochromic sensor	Default
Number of electrochromic states	4
Setpoint 1	
☐ Pane	SAGE Electrochromics Inc. Sage
Setpoint (W/m2)	125
Setpoint 2	
☐ Pane	SAGE Electrochromics Inc. Sage
Setpoint (W/m2)	250
Setpoint 3	
☐ Pane	SAGE Electrochromics Inc. Sage
Setpoint (W/m2)	1000

5. Ensure that the **Pane replacement position** is set to **1-Outermost pane.**

6. When using the sensor groups option (see below), select a sensor object that has been or will be used in the model.

   Note: Each sensor object should only be selected by one **SageGlass**® **Electrochromic** component.

7. Set the number of electrochromic states.

8. For each electrochromic state:
   a. Set the solar incident setpoint.
   b. Select the corresponding glass pane. Note that the solar transmittance of the panes selected will normally reduce with increasing setpoint values, e.g. under "Setpoint 3" the pane selected should have lower transmittance and have a higher setpoint than the values in "Setpoint 2" which in turn has a pane of lower transmittance and higher setpoint than the settings under "Setpoint 1".

Note: in the existing SageGlass window shading systems defined in the software, default value for the solar incident setpoints are already pre-defined. However, those may be adjusted and adapted on each project in order to reach optimum performance results.

9. Confirm the settings by pressing OK to complete the SageGlass® system.

There are 2 broad ways to control SageGlass®:

1. **Sensor groups** where a single sensor sensing exterior incident solar radiation can be used to control multiple windows, or,

2. **Individual sensors** where each window has its own built in sensor and there is no need to define control connections between windows and sensors.

You can select the Multi-state electrochromic control method from the *Model options* dialog under the *Construction and Glazing Data* header.

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Simulating Sensor Groups

Sensor Groups are the default Multi-State Electrochromic method. In this case the signal from a single sensor window is used to control all windows with the associated SageGlass® window shading system applied. To use sensor groups, on the *Model options* dialog ensure that the **Multi-state electrochromic control method** is **1-Sensor Groups.** This is the default option so this step is not normally necessary.

Once the SageGlass® system has been defined you should follow the steps below to complete the SageGlass® window definition.
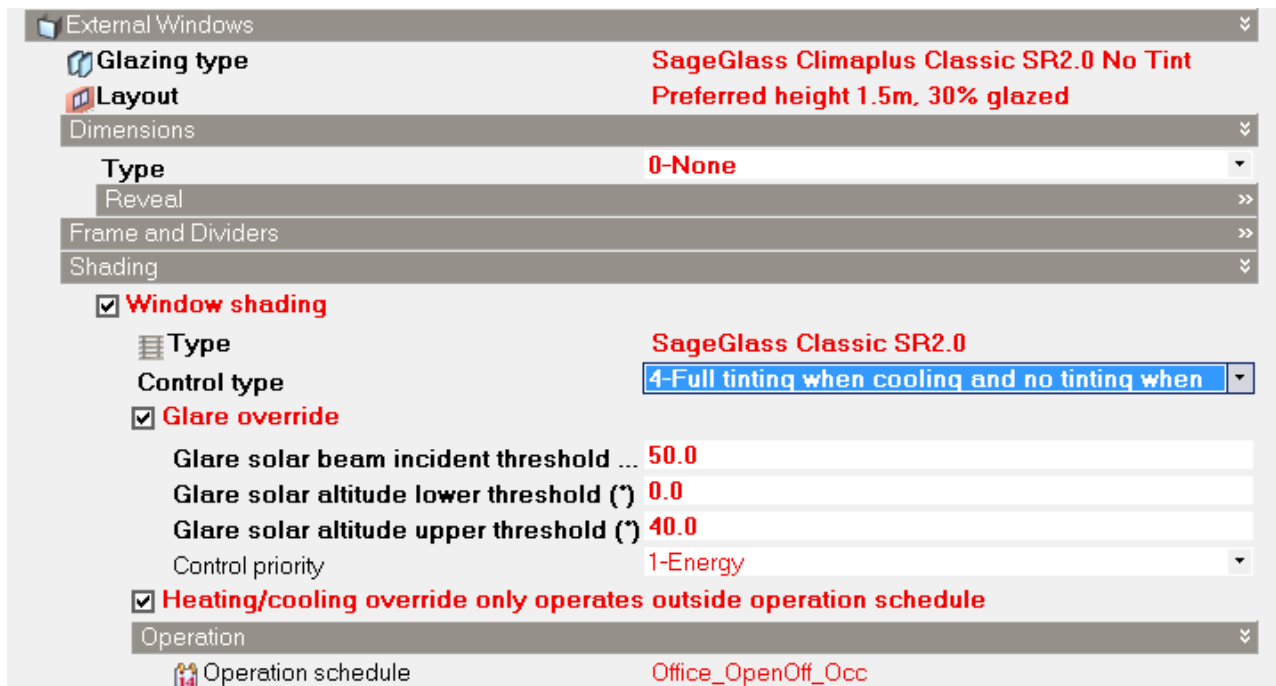
1. Navigate to the **Openings** tab.

2. Select the base **Glazing type** to represent the "clear state" glazing performance.

3. Under the Shading header, select a previously defined **SageGlass® Electrochromic** component (see section above).

4. Select the shading **Operation schedule** to define when tinting can occur. When the schedule has a value of > 0 then the other controls can take effect. At times when the schedule has a value has of 0, tinting cannot occur, regardless of any glare etc. The exception is when the **Heating/cooling override only operates outside operation schedule** option is selected. In this case tinting can occur outside the operation schedule (see below). To exclude scheduling from the control configuration you should set the schedule to **On 24/7**.

5. Select the **Control type** from the list of options:

   - **1-Daylight only** where the stepped tinting based on the sensor operation is defined only by the operation schedule. When the schedule has a value of 0 the glazing is clear, otherwise the tint state is defined by the stepped daylighting rules from the SageGlass® component.

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- o **2-No tinting when heating** where the glazing is kept in the clear state at times when any heating energy is being delivered to the space. When heating is off the tinting is determined by incident solar as described for **1-Daylight only** above. If the **Heating/cooling override only operates outside operation schedule** option is selected then this option only takes effect outside the operation schedule.

- o **3-Full tinting when cooling** where the glazing is fully tinted when there is a cooling load. When cooling is off the tinting is determined by incident solar as described based on daylighting requirements below. If the **Heating/cooling override only operates outside operation schedule** option is selected then this option only takes effect outside the operation schedule.

- o **4-Full tinting when cooling and no tinting when heating**, a combination of options 2 and 3 where the glazing is kept in the clear state at times when any heating energy is being delivered to the space and is fully tinted when there is a cooling load. Otherwise tinting is determined by incident solar as described based on daylighting requirements below. If the **Heating/cooling override only operates outside operation schedule** option is selected then this option only takes effect outside the operation schedule.

Note: All control methods include the schedule control, i.e. the schedule must be active for any tinting to occur.

6. A typical application will include **Glare override.** In this case, when glare is detected (based on the user-defined settings below), the SageGlass® is fully darkened. Otherwise, if there is no glare risk, the SageGlass® state is controlled based on the remaining controls. To model glare override:

   a. Check the **Glare override** checkbox.

   b. Set the **glare solar beam incident threshold**. This is the intensity of the solar radiation incident on the window above which the glare override will take effect. Note that solar beam radiation is used as a proxy for direct (beam) visible light.

   c. Set the **glare solar altitude lower threshold**. This is the solar altitude angle above which the glare override will take effect. This value will normally be used to define the horizon.

   d. Set the **glare solar altitude upper threshold**. This is the solar altitude angle below which the glare override will take effect.

   e. **Control priority.** When one of the heating and/or cooling **Control types** is selected together with **Glare override**, use the **Control priority** drop list to define whether energy or visual comfort (glare avoidance) should be prioritised when conflicting control actions are indicated. For example, if the glare controls indicate presence of glare (and so the windows should be tinted) while at the same time the **Control type** indicates that the windows should be clear due to presence of heating there is a control conflict. The **Control priority** option allows you to define whether glare control or energy reduction takes priority in this case.

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When the **Control priority** mode is **1-Energy**, the presence of heating and cooling is checked for before the presence of glare and is prioritised. So for example if the **2-No tinting when heating** Control type is selected and during the simulation there is heating in a zone at the same time that the window is causing glare, the conflict is resolved by prioritising energy saving (rather than glare control) and glass is set to a clear state to allow the free solar gain to heat the space.

Likewise, when the **Control priority** mode is **2-Visual comfort**, the presence of glare is checked for before heating and cooling and is prioritised. So for example if the **2-No tinting when heating** Control type is selected and during the simulation there is heating in a zone at the same time that the window is causing glare, the conflict is resolved by prioritising glare control (rather than energy saving) and the glass is set to its darkest state.

Note: the **Control priority** selection is only required if using one of the **2-No tinting when heating**, **3-Full tinting when cooling** or **4-Full tinting when cooling no tinting when heating**, control types.

Taken together, the glare solar altitude limits give a band of solar positions across the sky where glare can occur.

7. **Heating/cooling override only operates outside operation schedule**. When this option is selected heating and cooling overrides defined in the **Control type** only take effect outside the operation schedule. During the operation schedule the window is tinted according to daylighting control and, if selected, glare override. This control option is provided to avoid strongly-tinting the windows during occupied periods when occupants can benefit from the natural light. When the control schedule is "off" the windows can be fully tinted to maximise energy savings. This selection is only required if using one of the **2-No tinting when heating**, **3-Full tinting when cooling** or **4-Full tinting when cooling no tinting when heating**, control types.

Tip: The range of SageGlass control options provided in DesignBuilder allow a flexible approach to adapting the design to the requirements and constraints of each specific project, including the relative priority of energy performance, visual comfort etc. Various control options can be tested and compared as part of the project analysis to help find the optimum configuration.

8. This completes the settings for 1 case. If all shading and control settings in the building are the same then the above settings should be made at building level and allowed to inherit down to individual blocks, zones, surfaces and windows. To make settings to accommodate further SageGlass® systems you can use one of the following 2 methods:

   a. Repeat for multiple blocks, zones, surfaces and openings, or,

   b. Save the opening settings to a Glazing template and load it to relevant blocks/zones/surfaces/openings. This method will be most convenient in larger buildings where settings are made based on glazing orientation and/or slope. Note the **Load data from template** dialog has filters which allows a template to be loaded to windows of particular orientation, slope, area or user-defined tag.

9. Navigate to the window that is to represent the sensor for the group.

10. On the Opening tab, tick the Shading > Electrochromic sensor window checkbox.

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Note: Only one sensor window can be defined per sensor group.

11. Select an **Electrochromic sensor** to be associated with this sensor window.
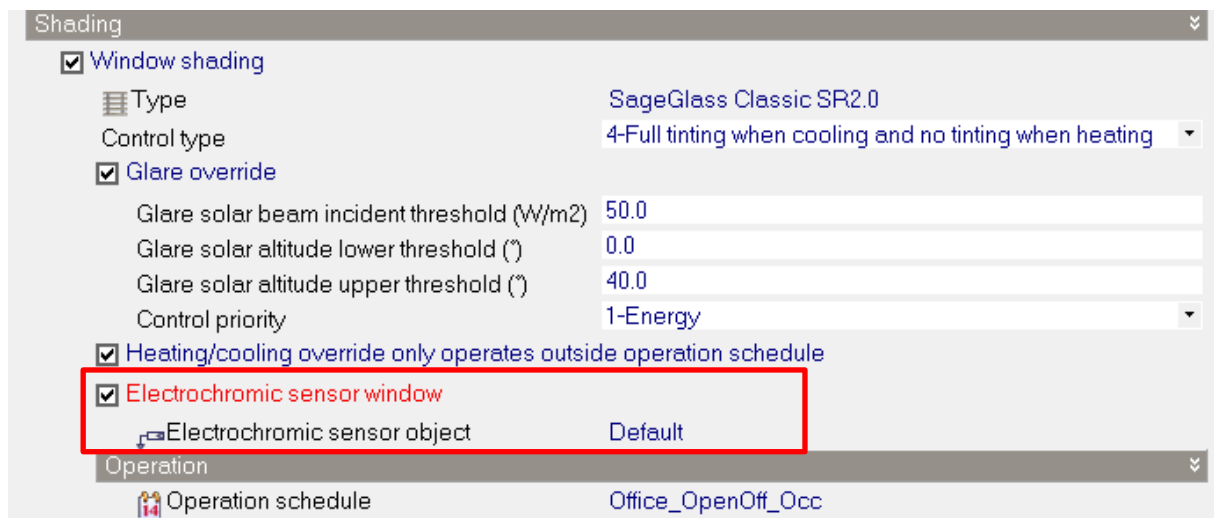
   a. Each sensor group must use a unique **Electrochromic sensor** component, i.e. the same sensor component cannot be used for more than one sensor window.

   b. Make sure that the **SageGlass®** **window** shading component selected on this window has the corresponding sensor object selected.

12. Check that the **Lump similar windows on surface** model option is off to ensure that any window selected as sensor window will be included explicitly in the model. Alternatively, if you don't want to switch off the **Lump similar windows on surface** model option then you should select the first window in the list of similar windows in the Navigator as the sensor window as that is the one that will be used as the representative window when lumping similar windows.

   Note: The window to be used as the sensor can be selected before loading a glazing template as **Electrochromic sensor window** and **electrochromic sensor object** aren't part of the glazing template.

13. Run the simulation or cooling design calculation.


Simulating Individual Sensors

When using the Individual Sensors option each window is treated as if it has its own sensor so there is no need to associate a separate sensor and the process is therefore easier than for the sensor group method. The modelling process is otherwise the same as above for sensor groups except that a sensor window does not need to be defined and the sensor does not need to be selected in the SageGlass® Window shading system.

Tip: This option might be attractive for quick early stage analysis or when a "most optimistic benefit" performance data is required.

Model Options

Switching Between SageGlass® Control Methods

1. Open the Model Options dialog.
2. Select the **Data** tab.
3. Under the **Construction and Glazing Data header**, there is a **Multi-state electrochromic control method** dropdown box. Change it to the relevant option: **1-Sensor groups** or **2-Individual sensors**.
4. Click OK to confirm and exit the Model Options dialog.
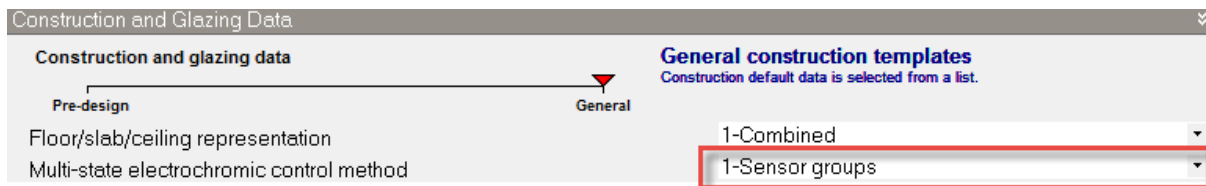
Shadow Calculation Method

The **2-Timestep frequency** Shadow Calculation Method must be used for SageGlass simulations to ensure that the transparency of the glazing is updated correctly during the simulation.

1. Open the Model Options dialog.
2. Select the **Simulation** tab.
3. Under the **Solar** header, there is a **Shadow calculation method** dropdown box. Change it to **2-Timestep frequency**.
4. Click OK to confirm and exit the Model Options dialog.

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