8.16. Venetian Blinds – Between Glass (Integral)

NFRC has approved using WINDOW and THERM to model venetian blinds between glass for vertical products only (no tilted products).

Venetian blinds between glass (venetian blinds between two glazing layers in a glazing system) fall into the category of a dynamic glazing product. The rules for rating dynamic glazing products, according to NFRC 100 and 200, state that they must be rated in both their fully open and fully closed positions. In the case of modeling retractable integral venetian blinds as part of a dynamic glazing product, the fully open position is when the venetian blind is completely retracted. However, even when completely retracted, the stacked venetian blind slats become a "block" of material that must be modeled.

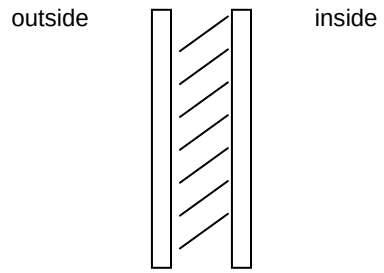


Figure 8-1. Venetian Blind Between Glass is a blind between two pieces of glass

The following cases must be modeled for each venetian blind configuration:

- **OPEN** -- Venetian blind fully retracted, ie, the most transmitting state
- **CLOSED** -- Venetian blind fully deployed, ie, the least transmitting state

8.16.1. WINDOW Preferences

It is important to set the values correctly in the Preferences dialog box in order to produce reasonable results in WINDOW. The settings should be as follows:

Thermal Calcs Tab

- Calculation standard: **ISO 15099**
- Integral Model: **ISO 15099**

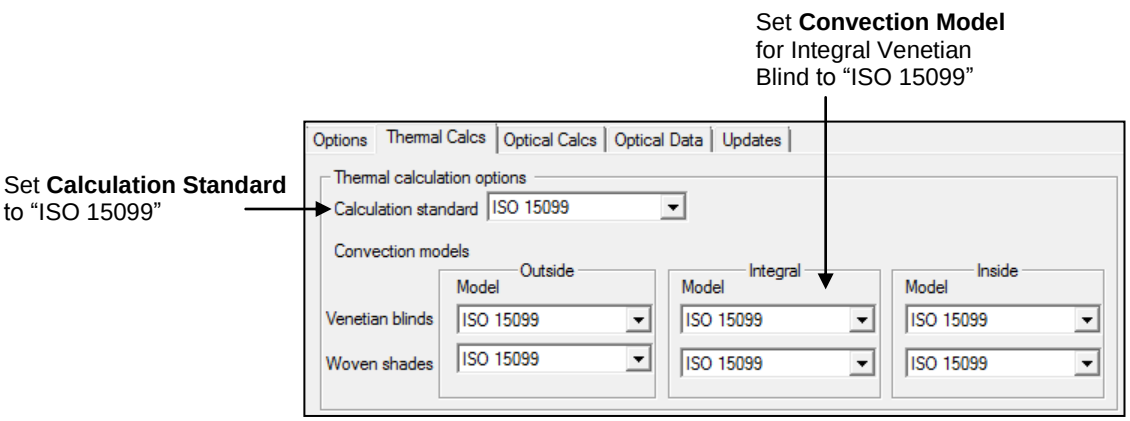


Figure 8-2. Preferences settings for Thermal Calcs Tab for Integral Venetian Blind

Optical Calcs Tab

- Use matrix method for specular systems (glazing systems without shading devices): **unchecked**
- Spectral data: **Condensed spectral data**
- Number of visible bands: **5**
- Number of IR bands: **10**
- Generate ful spectrally-averaged matrix for Solar Band: **unchecked**
- Generate ful spectrally-averaged matrix for Visible Band: **unchecked**
- Angular basis: **W6 quarter-size**
- Solar/Visible range: **Directional diffuse**
- FIR range: **Directional diffuse**
- # of segments: **5**

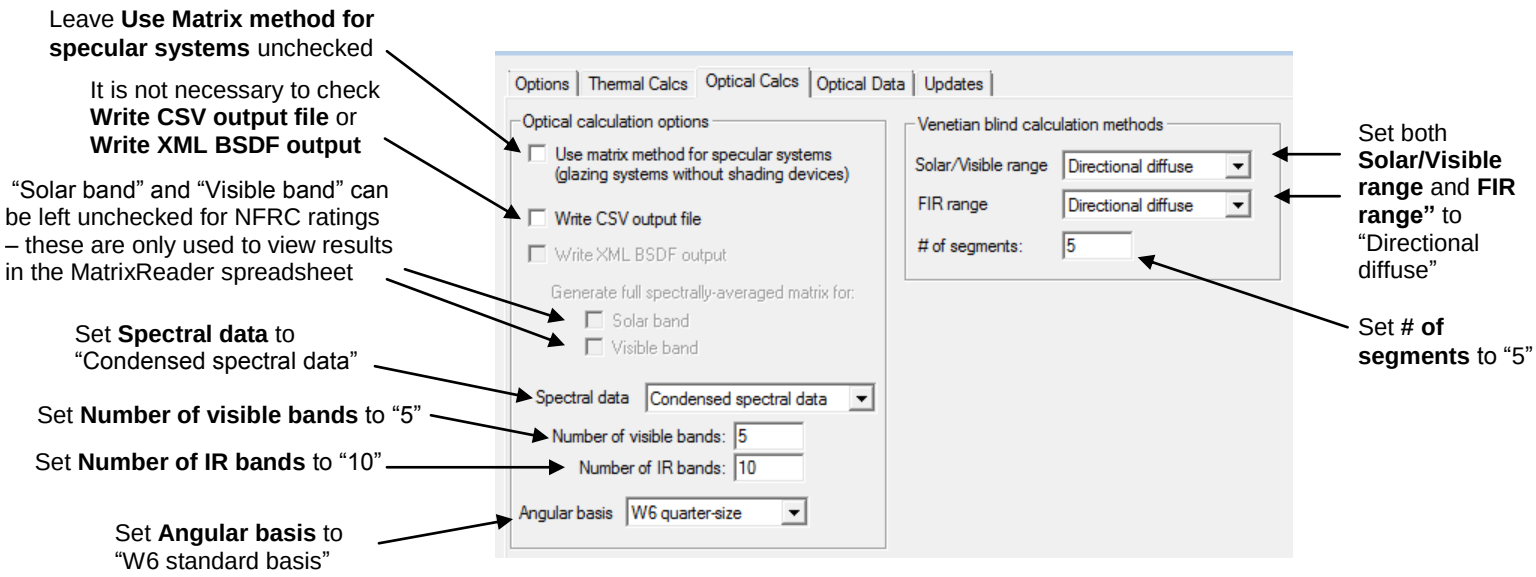


Figure 8-3. Preferences settings for Optical Calcs Tab forIntegral Venetian Blind

8.16.2. Modeling Rules / Definitions

WINDOW

Glazing System Library: Dtop, Dbot, Dleft, Dright

In the Glazing System Library, the values for Dtop, Dbot, Dleft and Dright represent the space between the edge of the Venetian blind shading system (including hardware) and the top (bottom, left or right) of the glazing system cavity. These values are used to define the convection that will occur around the venetian blind inside the glazing system. These values are only used for the glazing system thermal calculations in WINDOW and are not used in THERM.

THERM

Sight line

The Venetian blind hardware can define the sightline+ rather than the frame, depending on the geometry of both the frame and the Venetian blind. The sightline is used in the Tvis and SHGC calculations.

Linking Glazing System Cavities to other cavities

Cavities around the Venetian blind that touch the glazing system cavities (imported from WINDOW) can be linked to the glazing system cavity if the width of the cavity to be linked is equal to or greater than half the width of the glazing system cavity. This is because the effective conductivity of the glazing system cavity is calculated based on the width of the cavity. If the width of the cavity to be linked to the glazing system cavity is too small (or too large) relative to the glazing system cavity, the effective conductivity calculation will not be valid. In these cases, assign the "Frame Cavity NFRC 100" material to the cavity.

In the example below, none of the cavities around the Venetian blind system (this is the Head cross section with a retracted, open Venetian blind) are equal to or greater than half the width

of the glazing system cavity, so none of them are linked to the glazing system cavity and they are all defined as material "Frame Cavity NFRC 100".

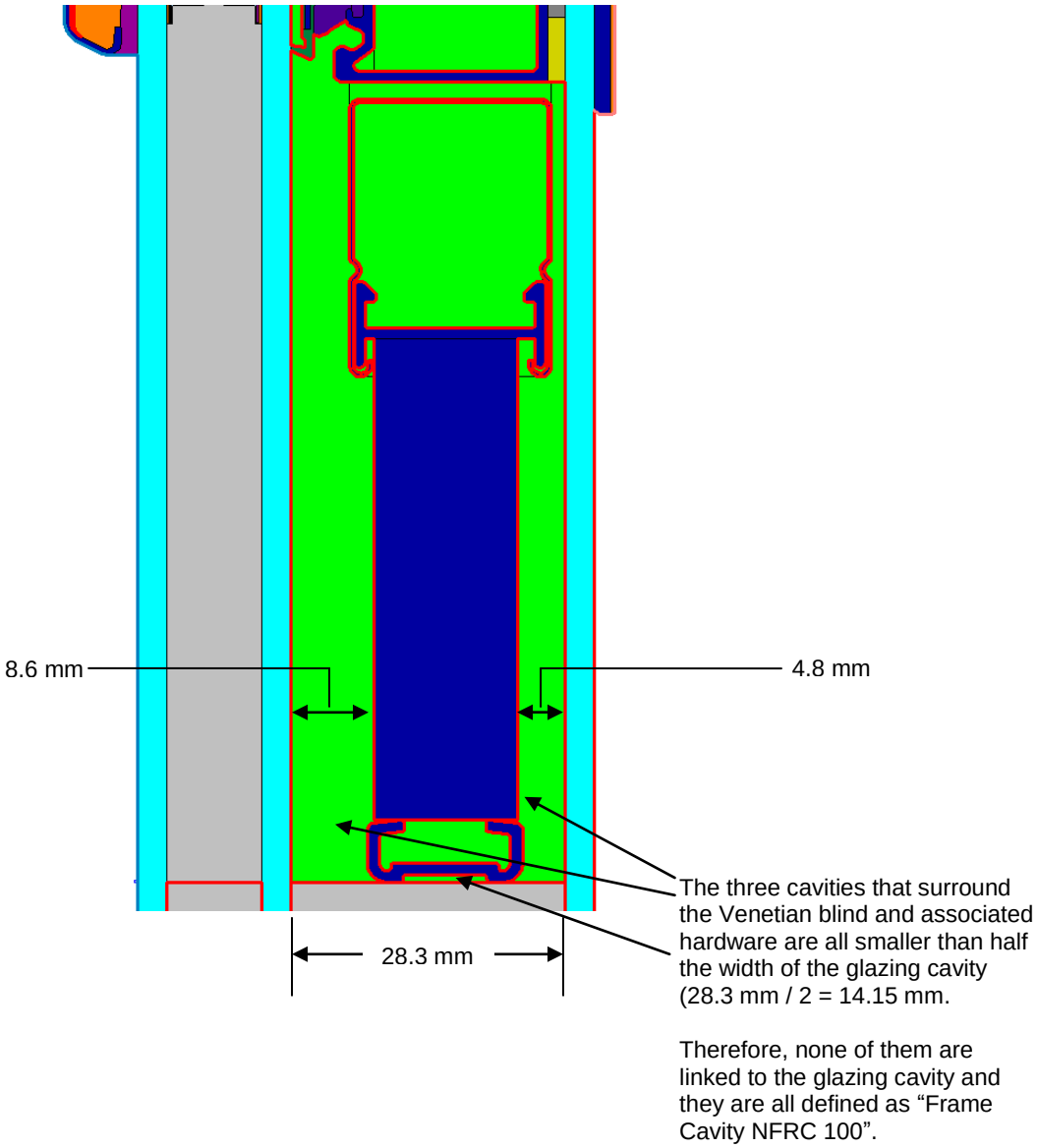


Figure 8-4. Determine which cavities around the Venetian blind can be linked to the Glazing System Cavity

8.16.3. Open Venetian Blind

There are two scenarios for Open venetian blinds:

- **Retractable / Open:** Venetian blinds that retract up to the top of the glazing system

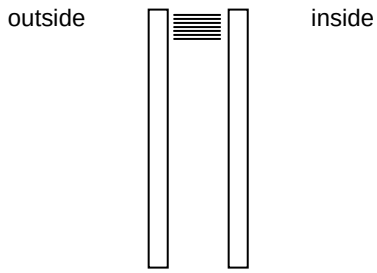


Figure 8-5. Retractable / Open Venetian Blind

- **Non-Retractable / Open:** Venetian blinds that are fixed at the bottom (do not retract up) – the "open" state is defined as having the blind slats horizontal (perpendicular) to the plane of the glass.

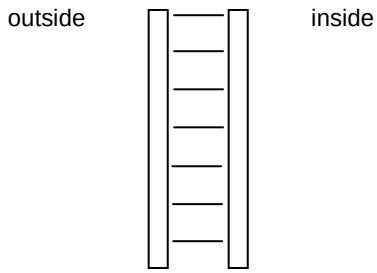


Figure 8-6. Non-Retractable / Open Venetian Blind

For **Retractable / Open**, two examples will be illustrated:

- The venetian blind fully retracted inside a double glazed system.
- The venetian blind fully retracted between an IGU and a third glazing layer (such as, but not limited to, an add-on panel).

For **Non-Retractable / Open**, one example will be illustrated:

- The venetian blind inside a double glazed system with the venetian blind slots in a horizontal (open) position.

8.16.1.1. Fully Retracted / Open Venetian Blind Inside a Double Glazed System

The following section discusses how to model a fully retracted venetian blind that has a stack of blind slats at the top of the glazing system. The following figure shows the Head cross section for a venetian blind in the fully-retracted position inside a double-glazed system.

In this example, only the Head section will be shown. For Vertical Sliding windows where the lower sash contains avenetian blind between glass, the lower sash portion of the Meeting Rail section will be modeled with the same venetian blind considerations as the Head section. The other cross sections (Jambs, Sills and Meeting Stiles) are modeled normally, without any venetian blind considerations.

In WINDOW:

1. **Glazing System Library:** Create the appropriate glazing system in the Glazing System Library. In this case, it is not necessary to model a venetian blind in WINDOW, because the blind is fully retracted.

In THERM

1. **Frame Geometry:** Draw the frame geometry, including Head, Sill, Jamb and Meeting Rail if appropriate
2. **Glazing System:** Import the glazing system defined in WINDOW (no venetian blind modeling needed) into the frame geometry. Make sure that the **Sight line to bottom of glass** value includes the height of the block representing the closed venetian blind, so that the Frame and Edge of Glass boundary conditions and U-factor tags are defined automatically by THERM.
3. **Boundary Conditions:** Define the Boundary Conditions in the normal manner; no venetian blind was modeled in WINDOW, so the Boundary Conditions in THERM do not need to be modified for a Shading System

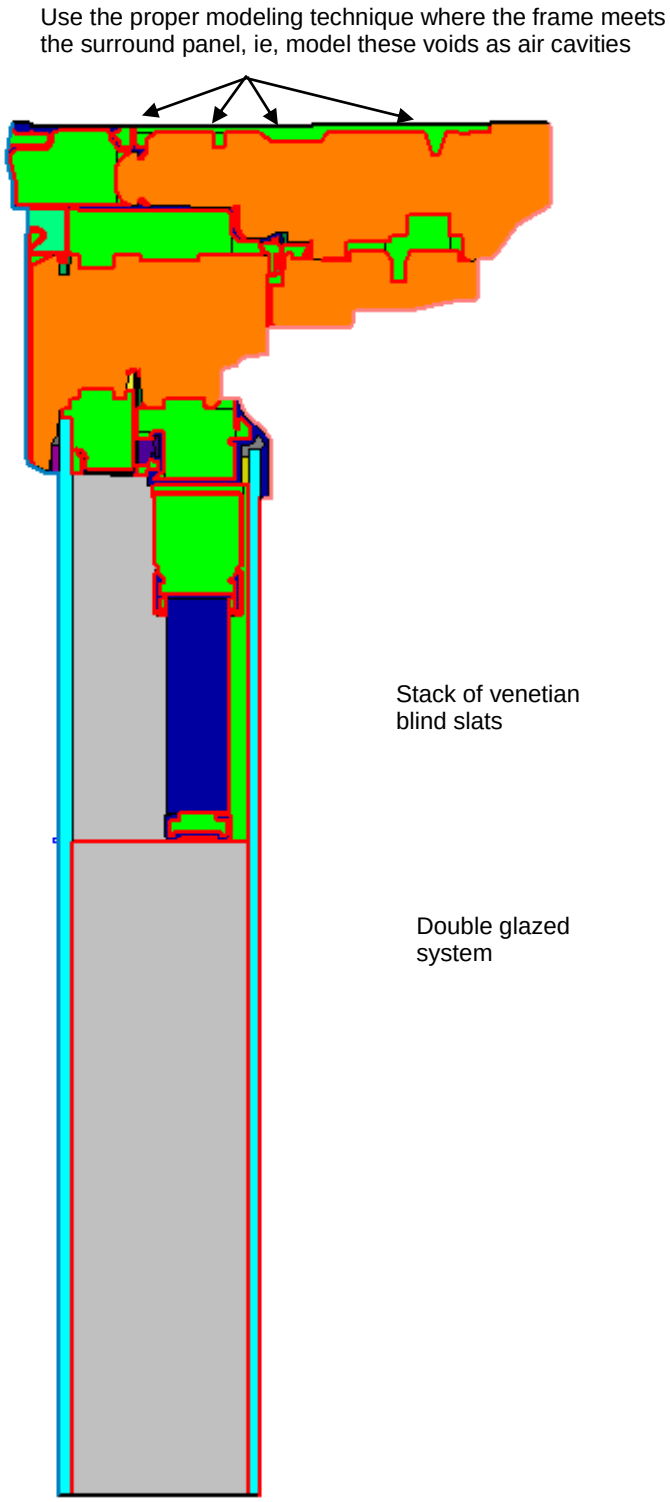


Figure 8-7. Head cross section with fully retracted venetian blind inside a double-glazed system.

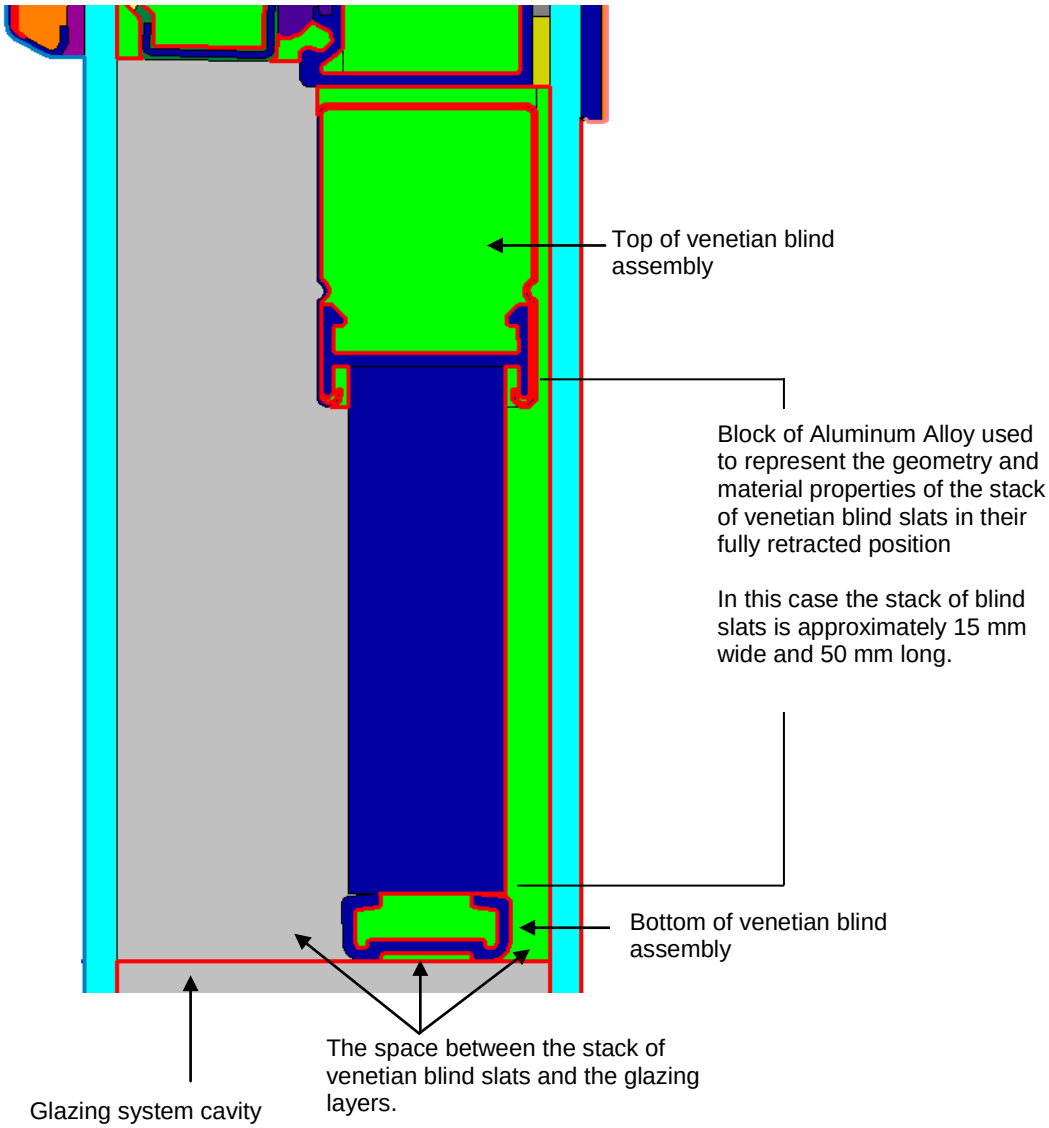


Figure 8-8. The Head cross section with the retracted venetian blind, including the stacked slats, and the top and bottom assemblies for the blind that are continuous across the section.

Follow these steps to model a fully retracted venetian blind:
(*Note: This example was done for Aluminum slat blinds. If the material of the blinds is not Aluminum, use the appropriate material properties from NFRC 101 "Procedure for Determining Thermo-Physical Properties of Materials for Use in NFRC-Approved Software Programs" for the stack of retracted venetian blind slats.)*

1. Draw the Head cross section of the product frame.
2. Draw the geometry of the retracted venetian blind, including the length and width of the stacked venetian blind slats and any continuous hardware that holds the blind in place (top and bottom). (*Note: In this case, the system seems to be "floating" because non-continuous hardware is used to attach the blind to the fenestration system.*)

3. Insert the glazing system.
   The example shown below has glazing layers that intersect the frame at two different heights. There are numerous methods for modeling this. The method shown is to "stretch" the glazing layers to meet the frame at the appropriate place, and this method also necessitates inserting points on the glazing system for the correct boundary conditions segments.

   Note: Another method would be to insert "float glass" polygons for the glazing layer extensions – this method eliminates the need to insert the points in the glazing system for the boundary condition segments.

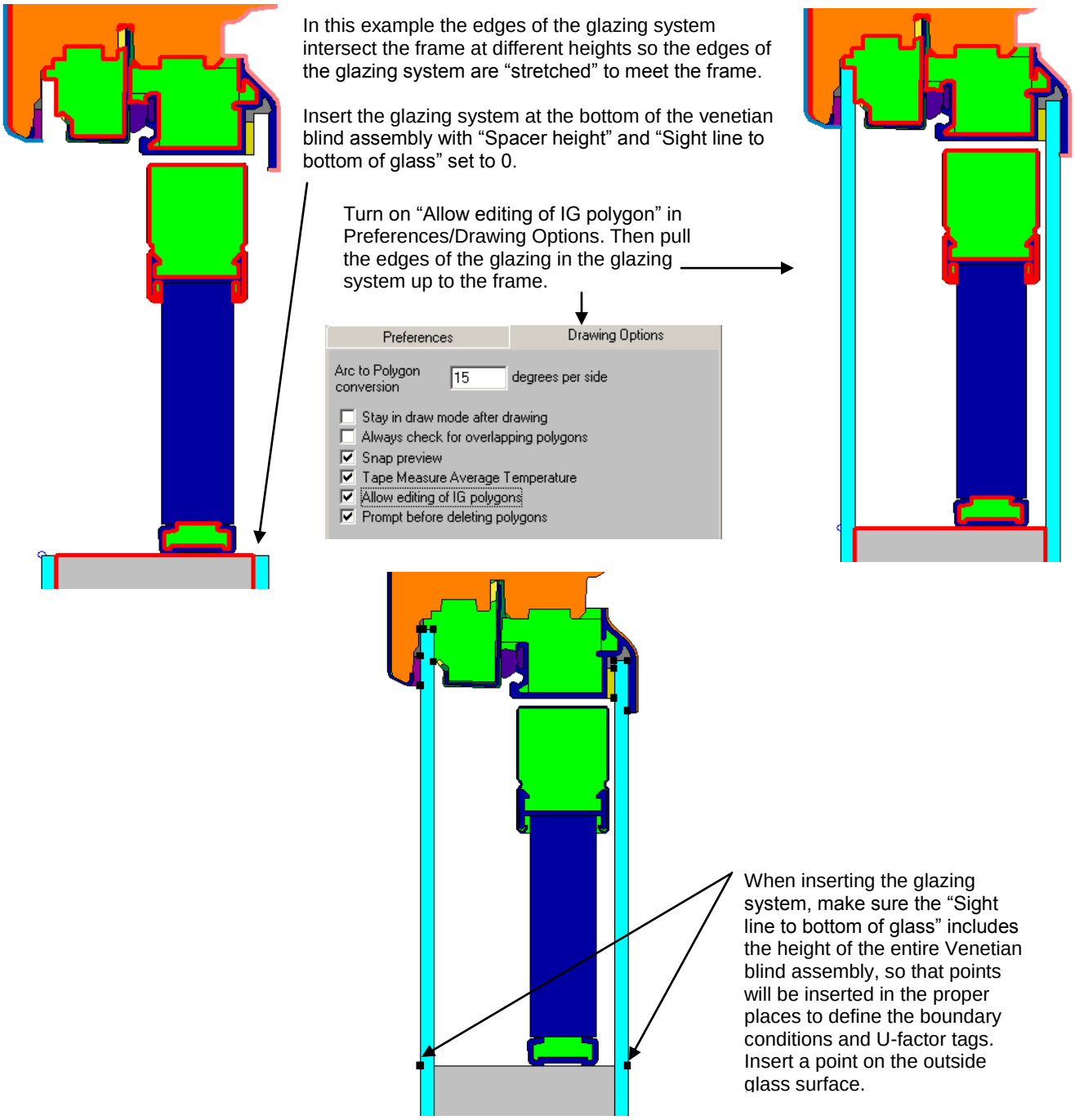
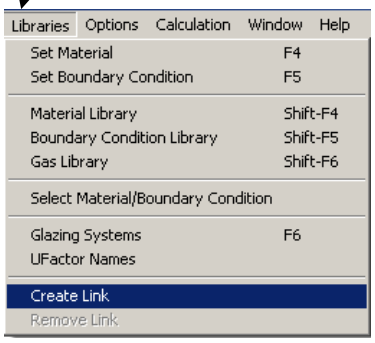


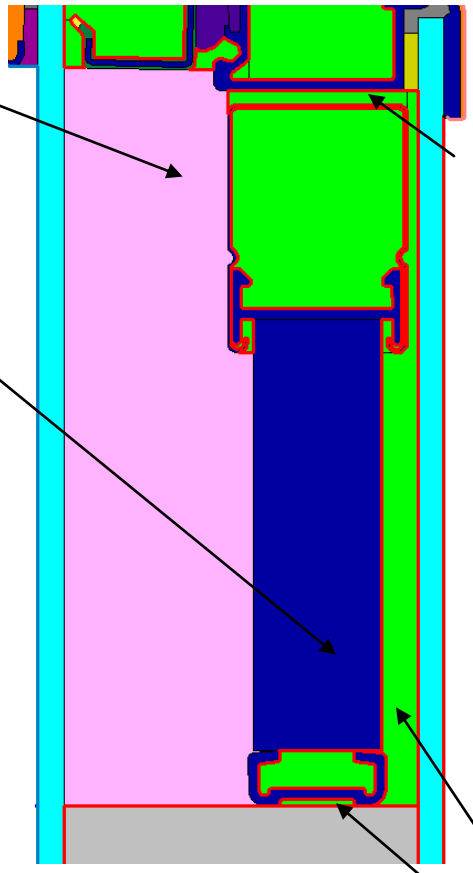
Figure 8-9. Insert the glazing system.

4. Fill the cavities around the venetian blind with a material, and then link that material to the cavity of the main glazing system. There may be several cavities to be linked, as shown in the figure below.

To link the left-hand cavity next to the venetian blind to the main glazing system cavity, do the following:

- fill the cavity with a material (any material will work)
- select the cavity you just filled
- go to the Library menu, Create Link option
- the "eyedropper" tool will appear – click on the main glazing cavity (the polygon to link to) and the other cavity will turn gray and have the same name as the glazing system cavity.
- The linked cavity will turn gray.





Apply the 5 mm rule to this space -- model this space as a frame cavity rather than connecting it to the glazing system cavity (it is 1.75 mm in this example)

Because the width of this thin cavity to the right of the Venetian blind stack and the cavity below the bottom hardware are both < 50% of the width of the glazing system cavity, they are modeled as frame cavities, and NOT linked to the glazing system cavity.

Figure 8-10. Fill the cavity next to the venetian blind by linking it to the main glazing cavity.

5. Generate the Boundary Conditions. The section of the warm side of the glazing system adjacent to the retracted venetian blind should be defined with a U-factor Surface tag of "Frame".

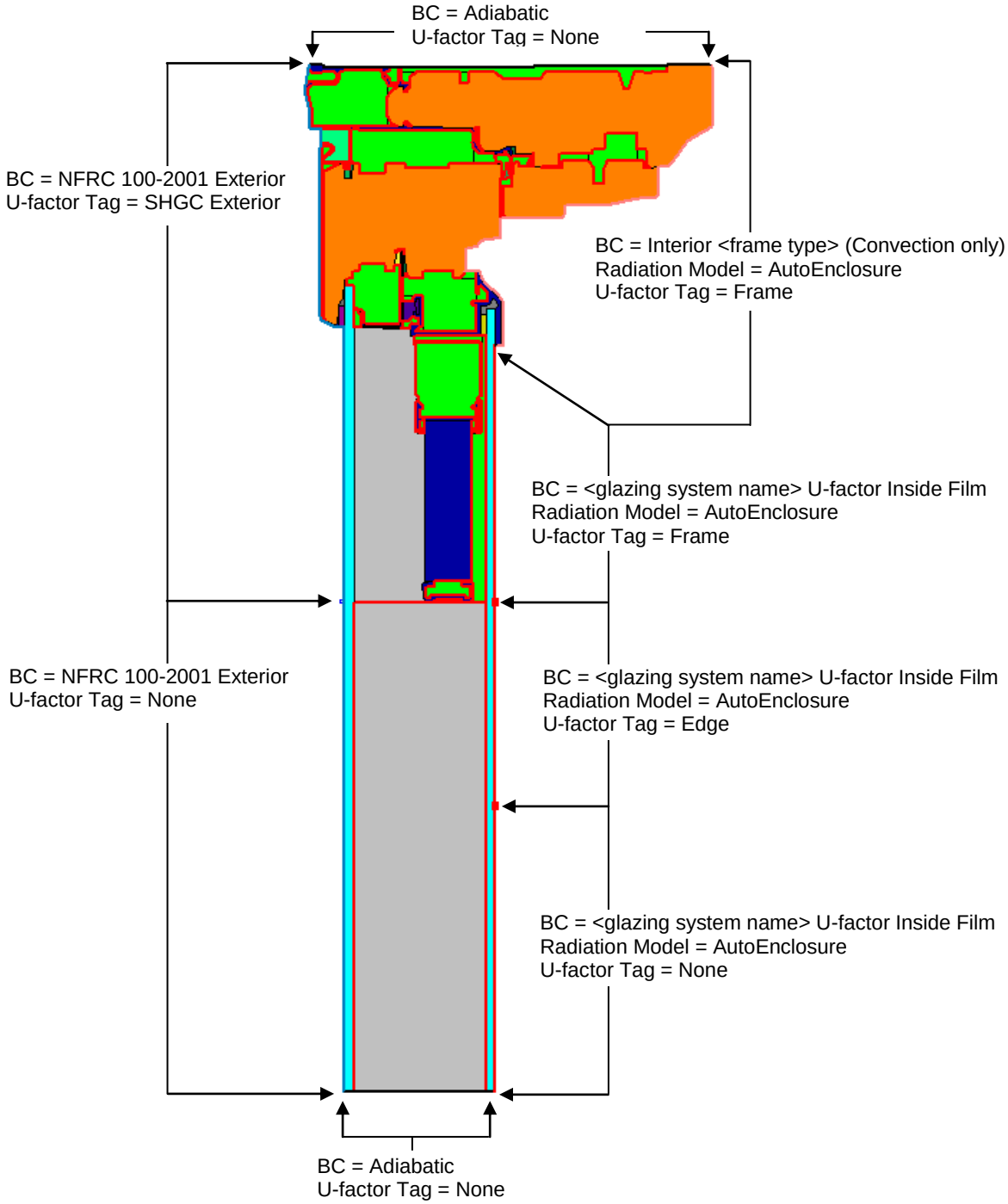


Figure 8-11 Define the boundary conditions for the cross section

6. Calculate the results for this cross section.
7. Complete the calculations for the other product cross sections (Sill, Jambs and Meeting Rails / Stiles as appropriate).
8. Import all the cross sections into the WINDOW Frame Library and calculate the total product U-value, SHGC and VT.

8.16.1.2. Fully Retracted / Open Venetian Blind Between a Double-Glazed System and a Third Glazing Layer

The following figure shows the Head cross section for a venetian blind in the fully-retracted position between a double-glazed system with a third glazing layer, such as, but not limited to, an add-on panel.

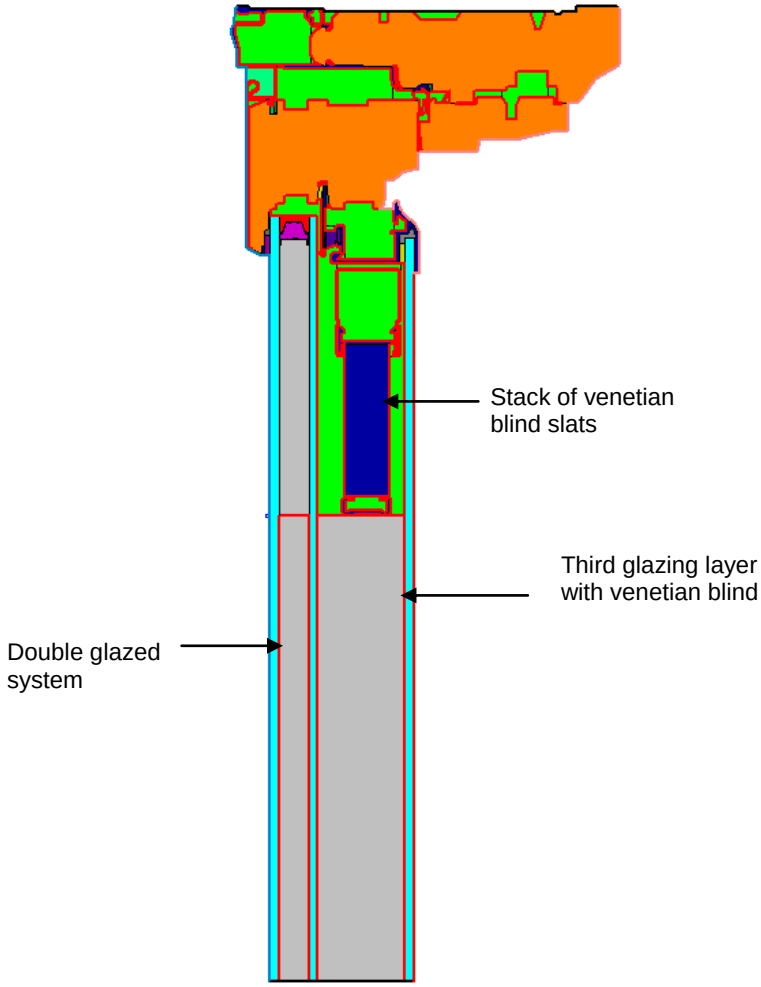


Figure 8-12. Head cross section with fully retracted venetian blind between a double-glazed system and a third glazing layer.

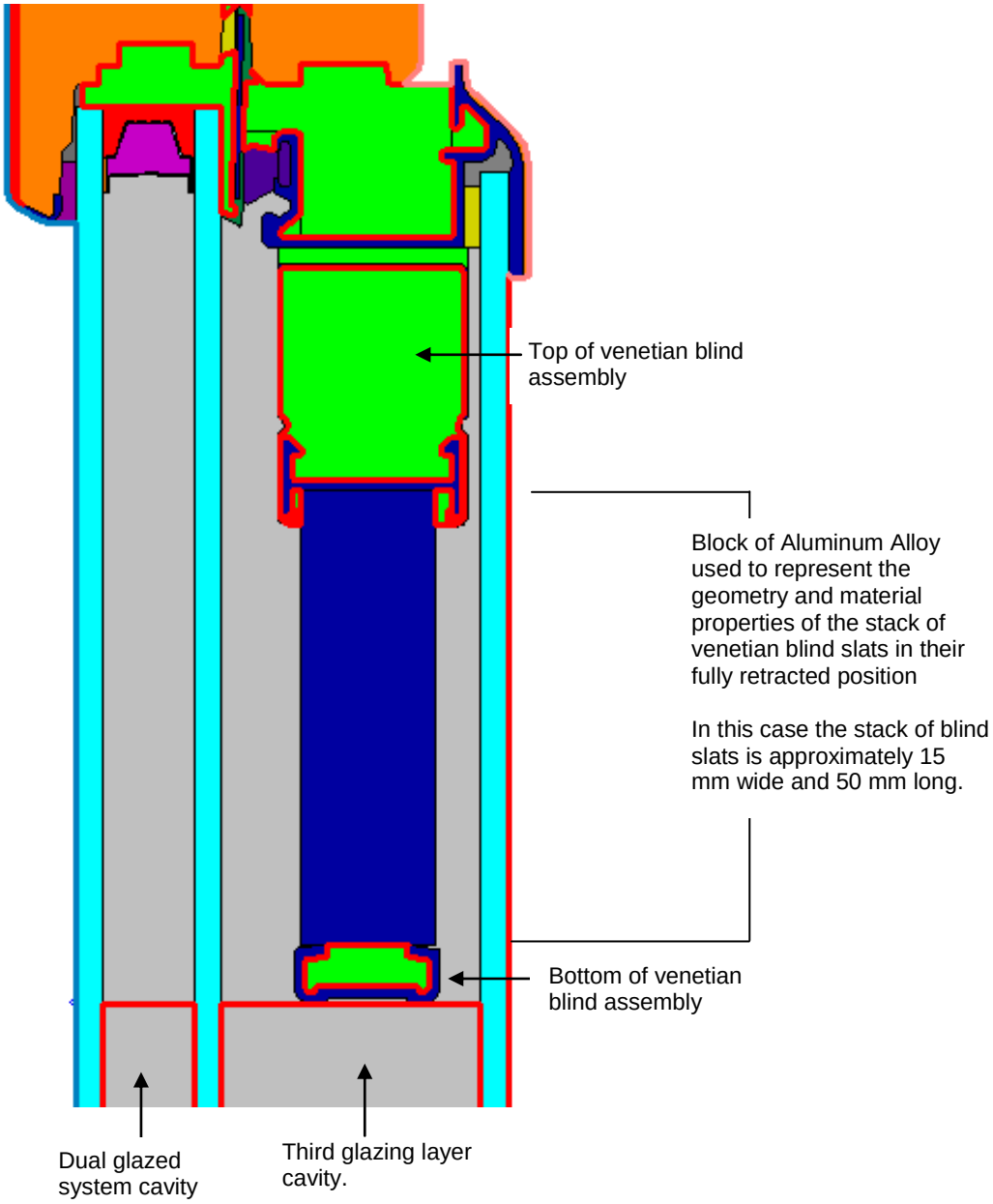


Figure 8-13. The Head cross section with the retracted venetian blind, including the stacked slats, and the top and bottom assemblies for the blind that are continuous across the section.

Follow these steps to model a fully retracted venetian blind between a double glazed system and a third glazing layer:
(*Note: This example was done for Aluminum slat blinds. If the material of the blinds is not Aluminum, use the appropriate material properties from NFRC 101 "Procedure for Determining Thermo-Physical Properties of Materials for Use in NFRC-Approved Software Programs" for the stack of retracted venetian blind slats.)*

1. Draw the Head cross section of the product frame.
2. Draw the geometry of the retracted venetian blind, including the length and width of the stacked venetian blind slats and any continuous hardware that holds the blind in place (top and bottom).
3. In WINDOW, make the appropriate glazing system (in this case a triple glazed system that represents the double glazed system and a third glazing layer (such as an add-on panel)).

4. Insert the glazing system.
   The example shown below has glazing layers that intersect the frame at two different heights. There are numerous methods for modeling this. The method shown is to "stretch" the glazing layers to meet the frame at the appropriate place, and this method also necessitates inserting points on the glazing system for the correct boundary conditions segments. Another method would be to insert "float glass" polygons for the glazing layer extensions – this method eliminates the need to insert the points in the glazing system for the boundary condition segments.

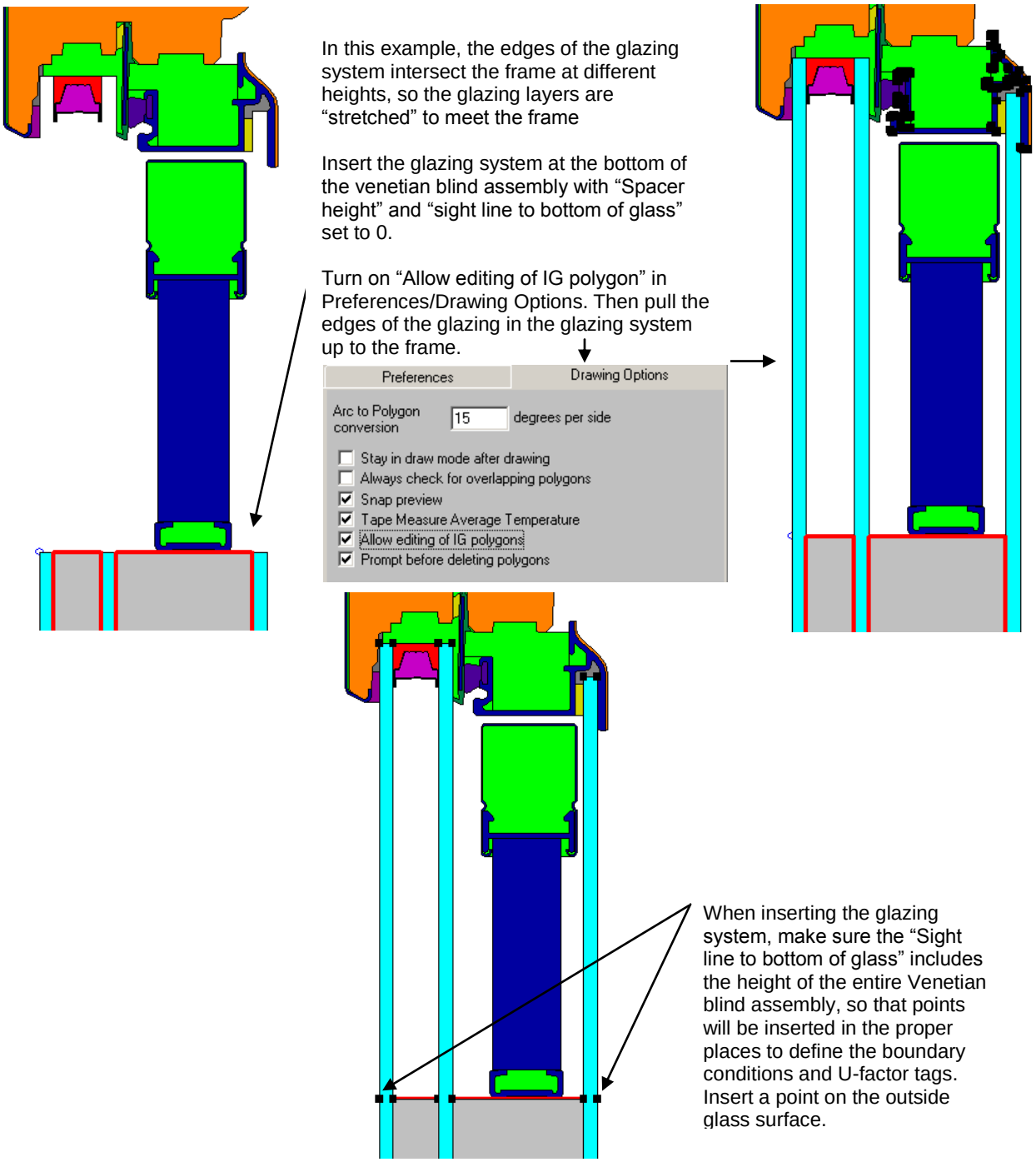
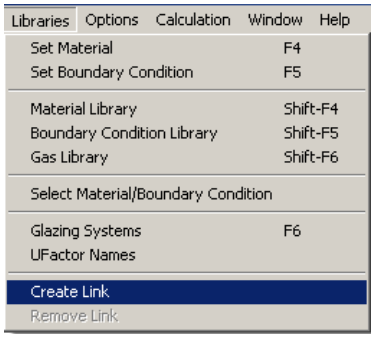


Figure 8-14. Insert the glazing system and edit it if necessary to bring the glazing layers to the frame.

5. Fill the cavities in the double glazing system and around the venetian blind in the third glazing layer with a material (any material), and then link that material to the appropriate cavity – the double glazing system cavity to the double glazing system and the third glazing layer cavity to the third glazing layer. There may be more than one area that is linked to a cavity, so make sure to link them all.

To link the cavity next to the venetian blind to the main glazing system cavity, do the following:

- fill the cavity with a material (any material will work)
- select the cavity you just filled
- go to the Library menu, Create Link option
- the "eyedropper" tool will appear – click on the glazing cavity (the polygon to link to) and the other cavity will turn gray and have the same name as the glazing system cavity.
- The linked cavity will turn gray.



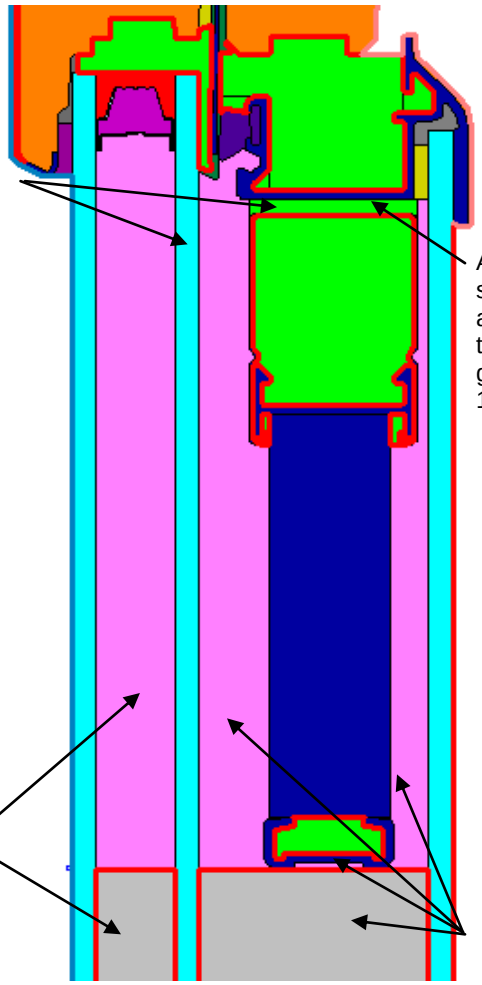


Figure 8-15. Fill the cavity next to the venetian blind by linking it to the main glazing cavity.

6. Generate the Boundary Conditions. The section of the warm side of the glazing system adjacent to the retracted venetian blind should be defined with a U-factor Surface tag of "Frame".

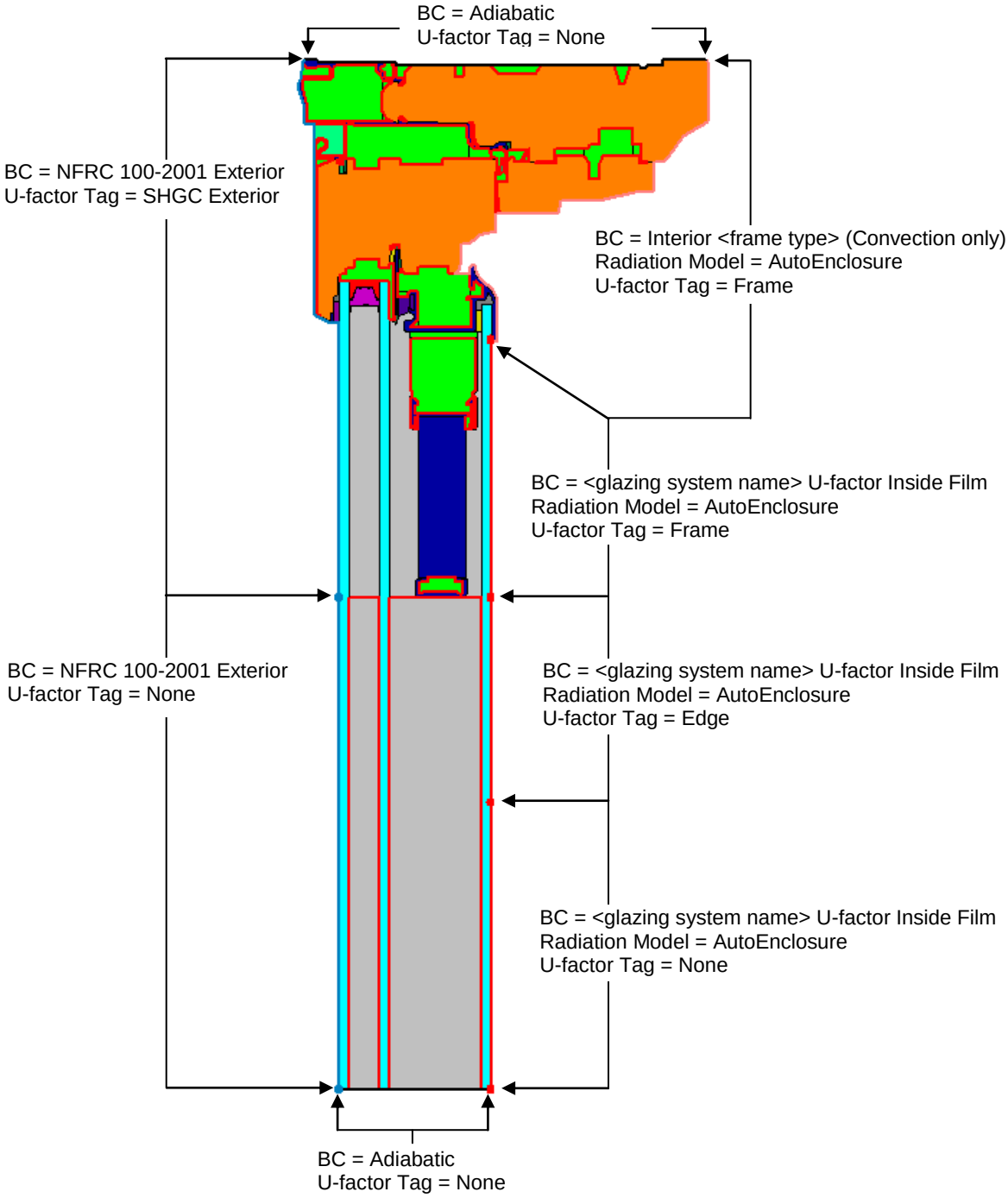
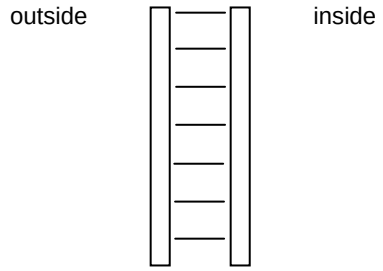


Figure 8-16 Define the boundary conditions for the cross section

7. Calculate the results for this cross section.
8. Complete the calculations for the other product cross sections (Sill, Jambs and Meeting Rails / Stiles as appropriate).
9. Import all the cross sections into the WINDOW Frame Library and calculate the total product U-value, SHGC and VT.

8.16.1.3. Non-Retractable / Open Venetian Blind Inside a Double Glazed System

Non-Retractable / Open Venetian Blind are systems that are fixed at the bottom (do not retract up), and the "open" poisition is defined as the blind slats set to a horizontal position, perpendicular to the plane of the glass.



In WINDOW:

1. **Shading Layer Library:** If the appropriate venetian blind product is not already in the Shading Layer Library, import it from the Complex Glazing Database (CGDB). If the product is not in the CGDB, the manufacturer will need to have the blind slat material measured and added to the CGDB before the product can be simulated.

   The Shading Layer should be defined with the venetian blind slats in a horizontal position, or as "open" as the blind geometry allows.
2. **Shade Material Library:** When the Shading Layer Library is imported from the CGDB, WINDOW will also import the associated Shade Material record for that Shade Layer into the Shade Material Library. In general, this should be automatic and you should not have to manipulate the records in the Shade Material Library.
3. **Glazing System Library:** Define the glazing system with the venetian blind between two layers of glass

In THERM:

4. **Frame Geometry:** Draw the frame geometry, including Head, Sill, Jamb and Meeting Rail if appropriate
5. **Glazing System:** Import the glazing system defined with the venetian blind (horizontal slats) into the frame geometry
6. **Boundary Conditions:** For Integral Venetian Blinds, set "Shading System Modifier" to "None"
7. Simulate the model, save the results

In WINDOW:

8. **Frame Library:** Import the THERM files into the Frame Library
9. **Window Library:** Construct the window using the THERM files in the Frame Library and the glazing system defined in Glazing System Library

These steps are illustrated in more detail in the following discussion.

In WINDOW:

1. **Shading Layer Library:** If the appropriate venetian blind product is not already in the Shading Layer Library, import it from the Complex Glazing Database (CGDB).

   In the CGDB Shading Layer Library, for Venetian blinds that are defined as Type "Venetian" (and not Type "BSDF"), there may be one or more definitions for the same Venetian blind product. These different records will represent different geometries of the Venetian blind, such as slat thickness, width and slat spacing. However, if you are modeling the same Venetian blind product, but with a different slat thickness, width or slat spacing, you can make a new Shading Layer Library and change the slat geometry.

   In this example, the Venetian blind has three records in the CGDB Shading Layer Library, representing three different slat tilts – "Closed", "45 degrees" and "Open". For NFRC certification, the 45 degree geometry is not needed, and therefore only the "Closed" and "Open" records are imported from the CGDB, as shown in the figure below.

Shading Layer Library (C:\Users\Public\LBNL\WINDOW6\w6Venetian.mdb)

ID	Name	ProductName	Manufacturer	Type	Material	Openness	Source	Version
1	Venetian A0		ISO 15099 appendix	Venetian	Slat Metal A	0.050	User	0.00
2	Venetian A45		ISO 15099 appendix	Venetian	Slat Metal A	0.050	User	0.00
3	Venetian A90		ISO 15099 appendix	Venetian	Slat Metal A	0.050	User	0.00
4	Venetian B0		ISO 15099 appendix	Venetian	Slat Metal B	0.050	User	0.00
5	Venetian B45		ISO 15099 appendix	Venetian	Slat Metal B	0.050	User	0.00
6	Venetian B90		ISO 15099 appendix	Venetian	Slat Metal B	0.050	User	0.00
7	Venetian C0		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
8	Venetian C45		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
9	Venetian C80		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
10	Venetian C90		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
11	Venetian D0		ISO 15099 appendix	Venetian	Slat Metal D	0.050	User	0.00
12	Venetian D45		ISO 15099 appendix	Venetian	Slat Metal D	0.050	User	0.00
13	Venetian D90		ISO 15099 appendix	Venetian	Slat Metal D	0.050	User	0.00
17	White Frit		Generic	Fritted glass				0.00
22	Clear Frit (no pigment)		Generic	Fritted glass				0.00
3000	Slim White VB Closed	Slim White Venetian Blind	Pella	Venetian	White Venetian Blind Slat I	0.000	CGDB	1.20
3002	Slim White Open	Slim White Venetian Blind	Pella	Venetian	White Venetian Blind Slat I	1.000	CGDB	1.20
5000	Viraspan(TM) Medium Gray (V-948) 30%	Viraspan(TM) Ceramic Frit, Medium Gray (V-948) 30% Coverage	Viracon	Fritted glass				0.00
5001	Simulated Sandblast (V-1086) 70%	Translucent Frit, Simulated Sandblast (V-1086) 70% Coverage	Viracon	Fritted glass				0.00
5002	Viraspan(TM) Medium Gray (V-948) 60%	Viraspan(TM) Ceramic Frit, Medium Gray (V-948) 30% Coverage	Viracon	Fritted glass				0.00

Figure 8-17 Import the appropriate records from the CGDB Shading Layer Library

If only one slat geometry is represented in the CGDB, import that record into the working database, and then make new records for the missing slat geometries, so that there is a separate Shading Layer record for both the Open and Closed geometries.

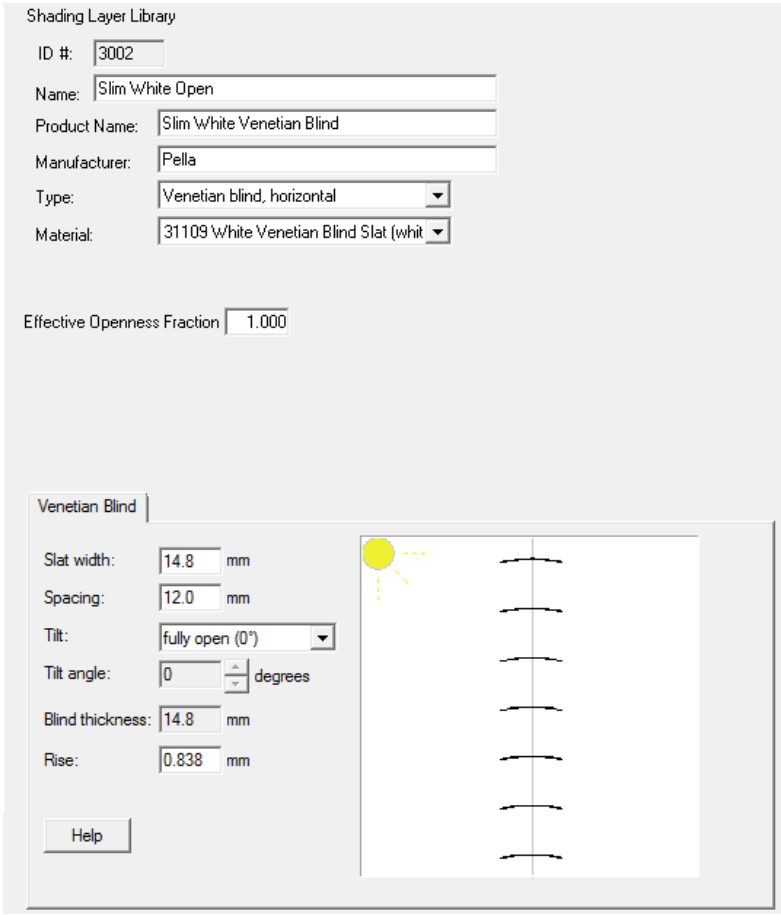


Figure 8-18 Define the venetian blind geometry for the "open" (horizontal) slats

- **Type**: Venetian blind, horizontal
- **Material**: White Venetian Blind Slat; this pulldown references the record in the Material Library that is associated with this Shading Layer. When a Shading Layer is imported from the CGDB, the associated record for the material is automatically added to the Shade Material Library. If you need to make a new Shading Layer record for a different slat geometry, make sure to reference the same material record in the Shade Material Library.
- **Effective Openness Fraction:** If a Shading Layer is imported from the CGDB, this value will automatically be set. If you are making a new record, the Effective Openness Fraction = 1 for the "Open" blind case.
- **Slat Width:** appropriate value, in this example 14.8 mm
- **Spacing** = spacing between each slat, in this example 12 mm

- **Tilt:** "fully open (0°)" for a slat in the horizontal position

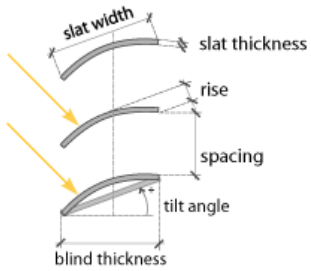


Figure 8-19 Venetian blind geometry definition

- **Blind thickness**: This value is not editable, and shows the width of the blind "assembly" based on the slat tilt. In this "Open" case, the blind thickness will equal the slat width. At any other slat angle, this value will be less than the slat width.
- **Rise:** this value defines the curve of the slat, and is defined in the CGDB for each Venetian blind product. It can be changed if it does not represent the slat curvature being modeled – this would be necessary if the slat width was changed, for example.

2. **Shade Material Library:** When a Shading Layer record is imported from the CGDB, the Shad e Material is automatically imported, and therefore it is not necessary to add or change records in the Shade Material Library. However, you may need to reference existing records in the Shade Material Library if you are defining a new Shading Layer record (for example to define a differen slat geometry for a product).

Shade Material Library (C:\Users\Public\LBNL\WINDOW6\w6.mdb)

ID	Name	ProductName	Manufacturer	Source	Mode	Color	Thickness	Tsol	Rsol1	Rsol2	Tvis	Rvis1	Rvis2	Tir	emis1	emis2
							mm									
30101	Slat Metal A	Opaque white colored slat mat	ISO 15099	CGDB			0.600	0.000	0.700	0.700	0.000	0.700	0.700	0.000	0.900	0.900
30102	Slat Metal B	Opaque pastel colored slat mat	ISO 15099	CGDB			0.600	0.000	0.550	0.550	0.000	0.550	0.550	0.000	0.900	0.900
30103	Slat Metal C	Opaque light-dark colored slat	ISO 15099	CGDB			0.600	0.000	0.700	0.400	0.000	0.700	0.400	0.000	0.900	0.900
30104	Slat Metal D	Translucent white colored slat	ISO 15099	CGDB			0.600	0.400	0.500	0.500	0.400	0.500	0.500	0.400	0.550	0.550
31006	Woven Shade Material	Woven Shade	Generic	CGDB			0.600	0.000	0.500	0.500	0.000	0.500	0.500	0.000	0.900	0.900
31100	Off White Slat	Off-white diffuse slat	Generic	CGDB			1.000	0.000	0.657	0.657	0.000	0.709	0.709	0.000	0.900	0.900
31101	Light Green Slat	Light-green slat	Generic	CGDB			1.000	0.000	0.422	0.422	0.000	0.357	0.357	0.000	0.900	0.900
31102	Light Brown Slat	Light-brown slat	Generic	CGDB			1.000	0.000	0.332	0.332	0.000	0.326	0.326	0.000	0.900	0.900
31103	Red Slat	Red slat	Generic	CGDB			1.000	0.000	0.373	0.373	0.000	0.127	0.127	0.000	0.900	0.900
31104	Dark Blue Slat	Dark-blue slat	Generic	CGDB			1.000	0.000	0.111	0.111	0.000	0.073	0.073	0.000	0.900	0.900
31105	White Venetian Blind Slat (white.txt)	White Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.677	0.677	0.000	0.743	0.743	0.000	0.900	0.900
31106	White Venetian Blind Slat (white.txt)	White Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.677	0.677	0.000	0.743	0.743	0.000	0.900	0.900
31107	White Venetian Blind Slat (white.txt)	White Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.677	0.677	0.000	0.743	0.743	0.000	0.900	0.900
31108	Marine Venetian Blind Slat (marine.txt)	Marine Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.186	0.186	0.000	0.073	0.073	0.000	0.900	0.900
31109	Marine Venetian Blind Slat (marine.txt)	Marine Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.186	0.186	0.000	0.073	0.073	0.000	0.900	0.900
31110	Marine Venetian Blind Slat (marine.txt)	Marine Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.186	0.186	0.000	0.073	0.073	0.000	0.900	0.900

Figure 8-20 Shade Material Library records are automatically created when Shading Layers are imported from the CGDB.

Glazing System Library: Define the glazing system with the venetian blind between two layers of glass

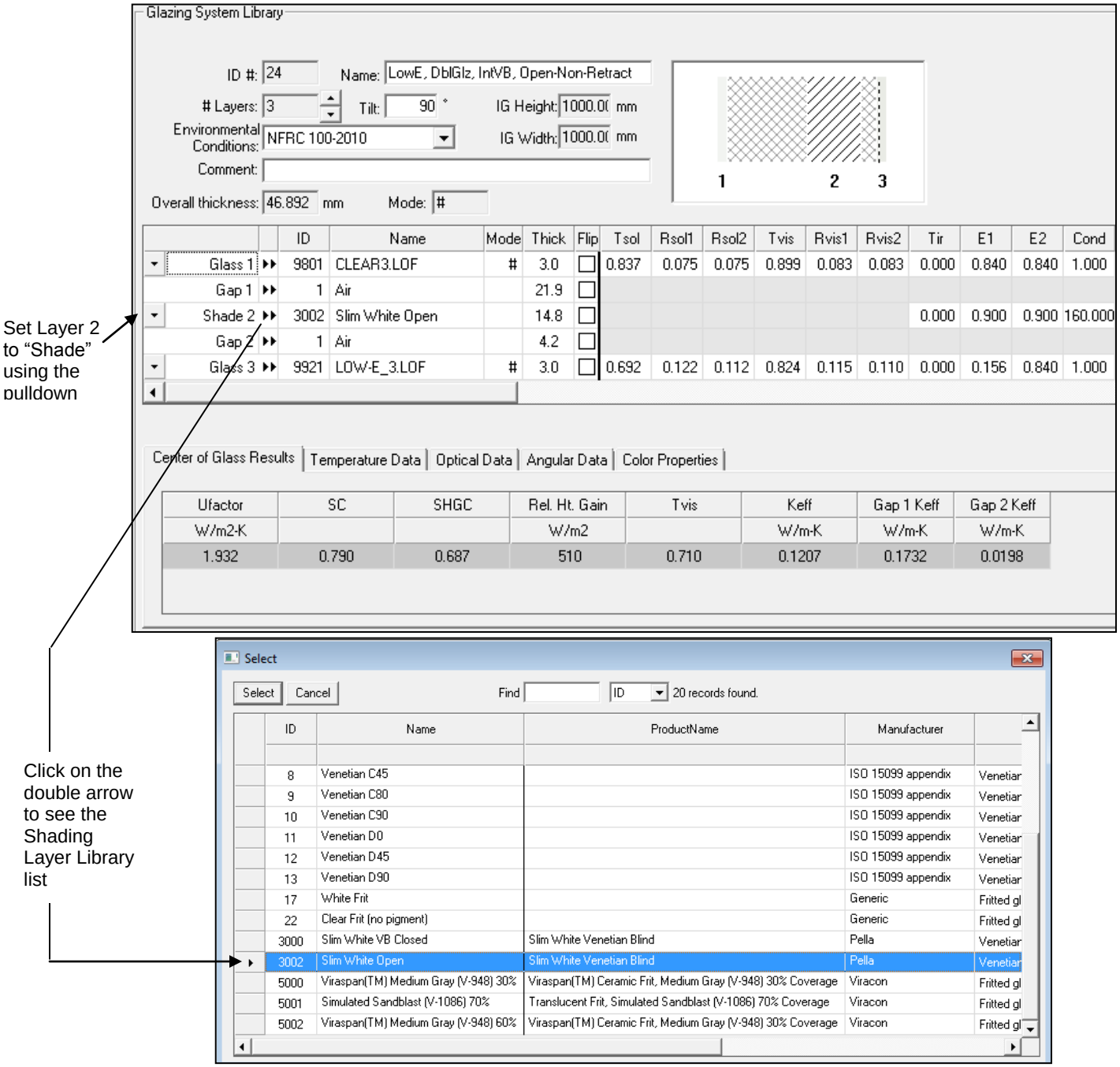


Figure 8-21.For the middle layer in the Glazing System (Layer #2), select the venetian blind from the Shading System Library.

- Set Number of layers = 3
- Set **Layer #2** to "Shade" (from pulldown arrow to the left in the first column)
- Set **Dtop**, **Dbot**, **Dright**, **Dleft** to the appropriate values for the venetian blind geometry. These distances are based on the distance between the top of the venetian blind (including hardware) and the top (or left, right, bottom) of the glazing system cavity.

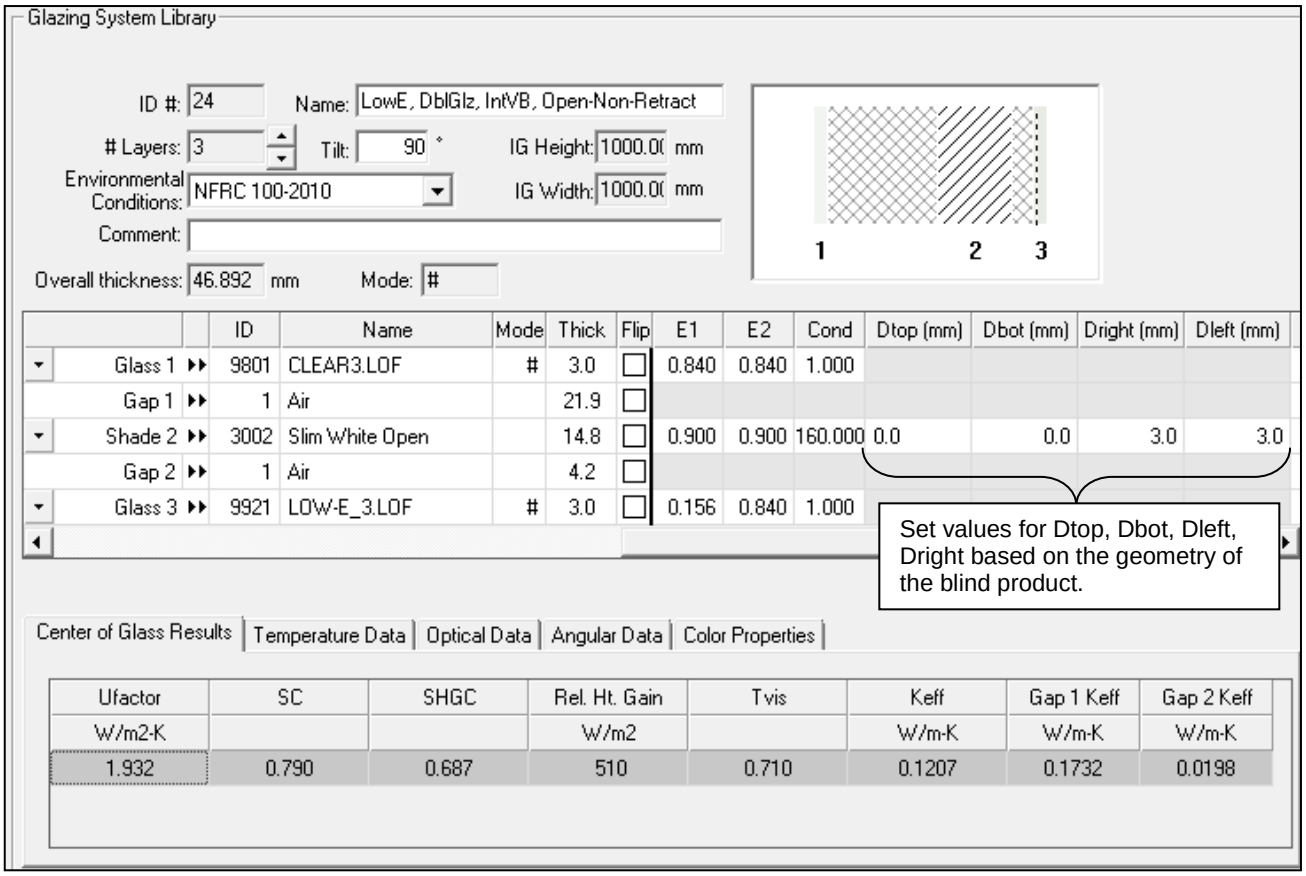


Figure 8-22. Define a Dtop, Dbot, Dleft and Dright in the Glazing System Library.

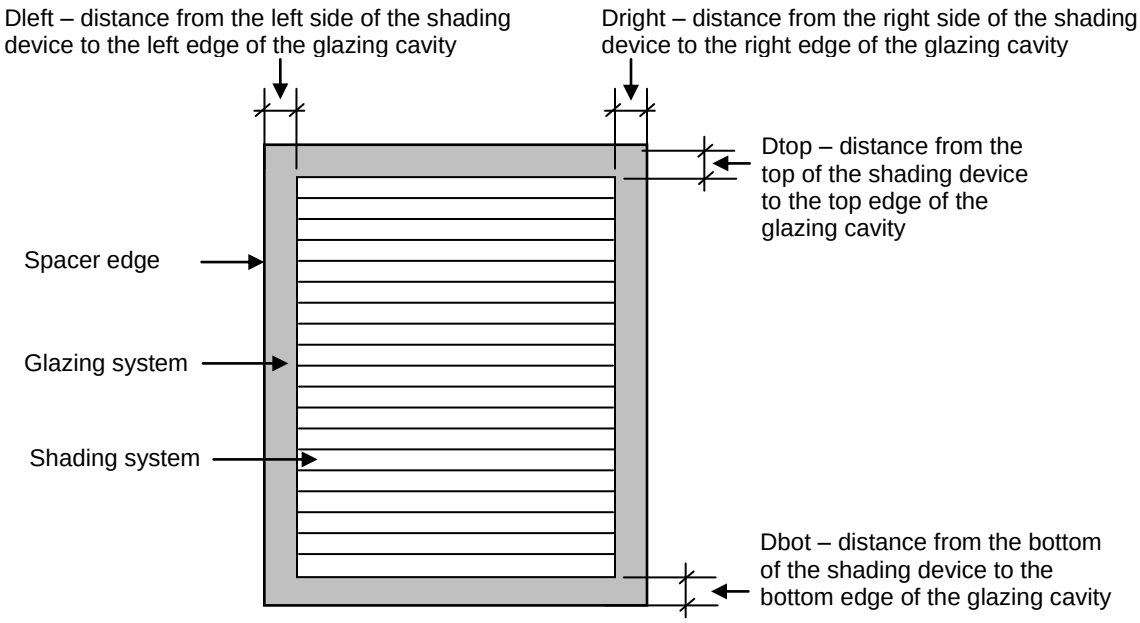


Figure 8-23. Definition of Dtop, Dbot, Dleft and Dright for an interior venetian blind.

In THERM:

1. **Frame Geometry:** Draw the frame geometry, including Head, Sill, Jamb and Meeting Rail if appropriate
2. **Glazing System:** Import the glazing system defined with the venetian blind (horizontal slats) into the frame geometry. For this example, the Head cross section, the following settings were used in the Insert Glazing System dialog box:
   - **Orientation:** Down (for the Head cross section
   - **Cross Section Type:** Head
     Setting the Cross Section Type to the approriate value allows THERM to automatically insert a polygon in the correct place for the Dtop (for Head), Dbottom (for Sill), Dright (for Right Jamb) and Dleft (for Left Jamb).
   - **Spacer Height:** 0 or 38.826 mm
     You can use the spacer height value to make room for the Venetian blind hardware, or you can set it to zero and pull the glass layers into the frame (make sure Options/Preferences/Drawing Options has "Allow Editing of IG Polygons" checked).
   - **Site Line to bottom of glass:** The sight line is defined by the edge of the venetian blind hardware.
   - **Sight line to shade edge:** In this case, the sight line to shade edge is 0 because the venetian blind actually sits inside the hardware, and will need to be edited to move it into place.

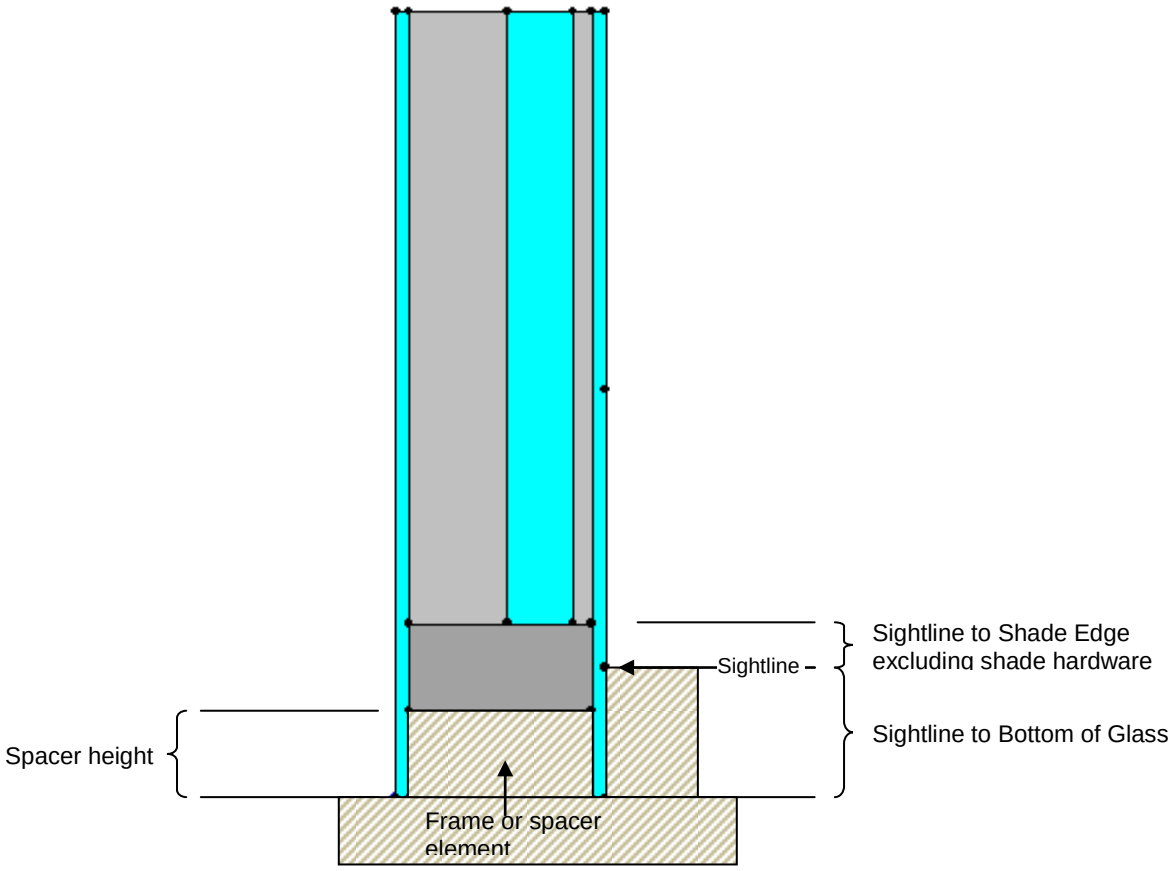


Figure 8-24. Sightline to Shade Edge definition for inserting glazing system

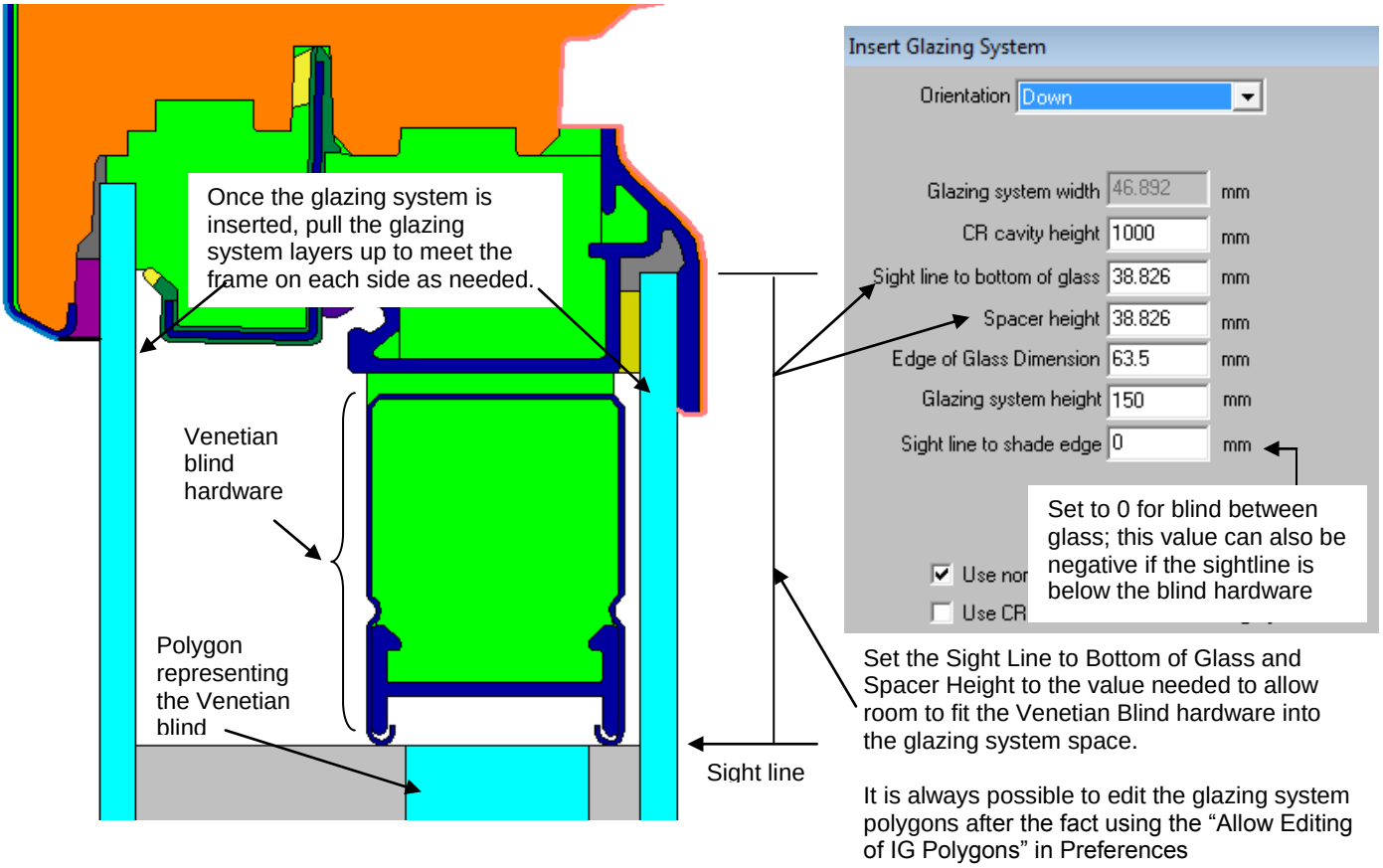


Figure 8-25. Insert the glazing system with the Venetian blind

3. Fill in the remaining cavities and link them to the appropriate glazing system cavity.

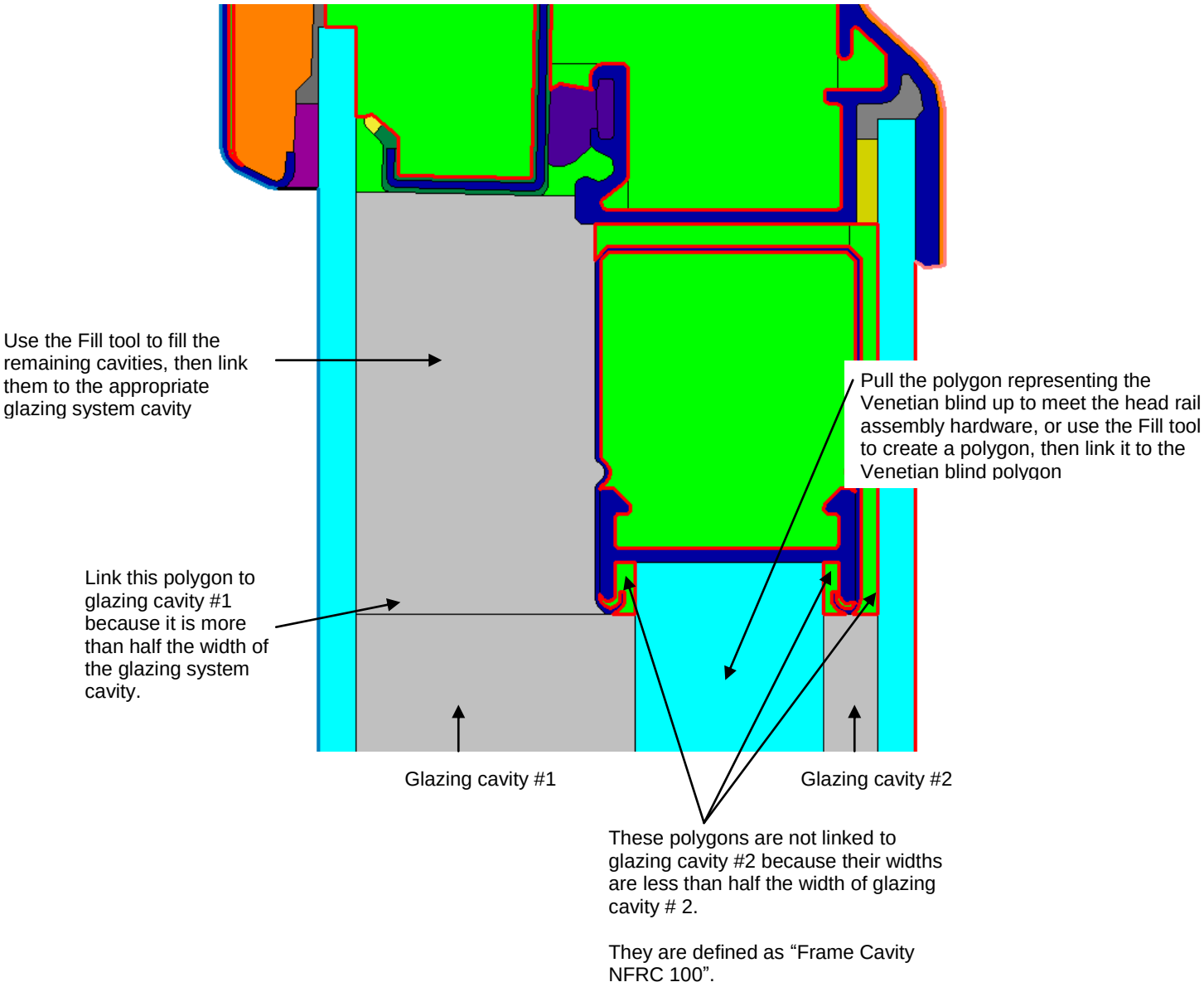


Figure 8-26. Fill the remaining cavities and link to the appropriate glazing system cavities.

4.

Create the other cross sections in this manner.

In the case of the Head and Sill cross sections, the Sight Line to Shade Edge is zero. However, for the Jamb cross section, the blind does not touch the edge of the frame, but rather is 3 mm off the frame, so the Sight Line to Shade Edge is non-zero.

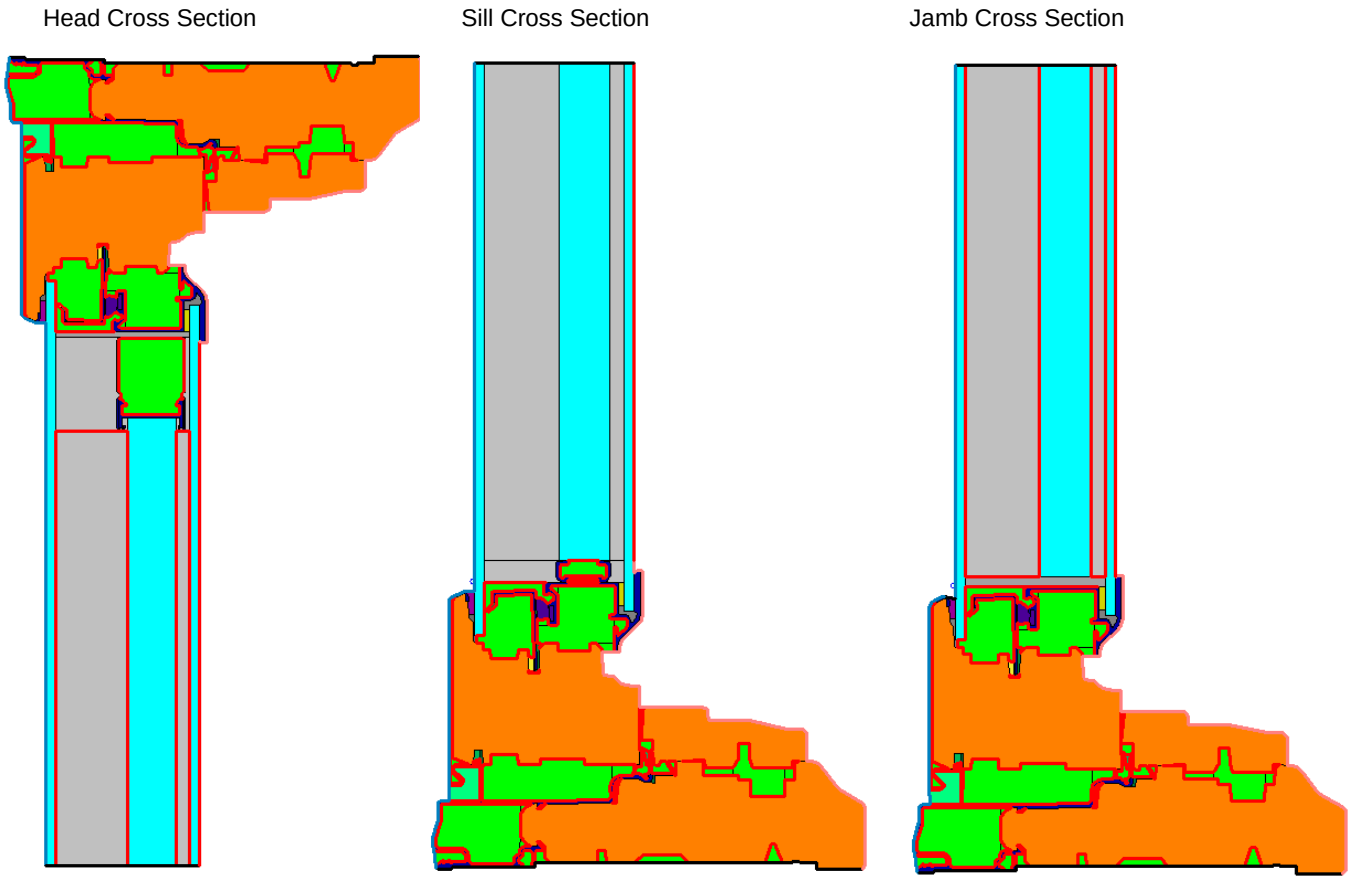


Figure 8-27. Head, Sill and Jamb cross sections for Non-retractable Open Venetian Blind between glass layers (Integral)

5.

6. **Boundary Conditions:** The program will not automatically insert a point in the exterior glass layer for the SHGC Exterior U-factor tag, so you will need to do that by hand by editing the glazing system. For Integral Venetian Blinds, the **Shading System Modifier** choice will automatically be set to "None"

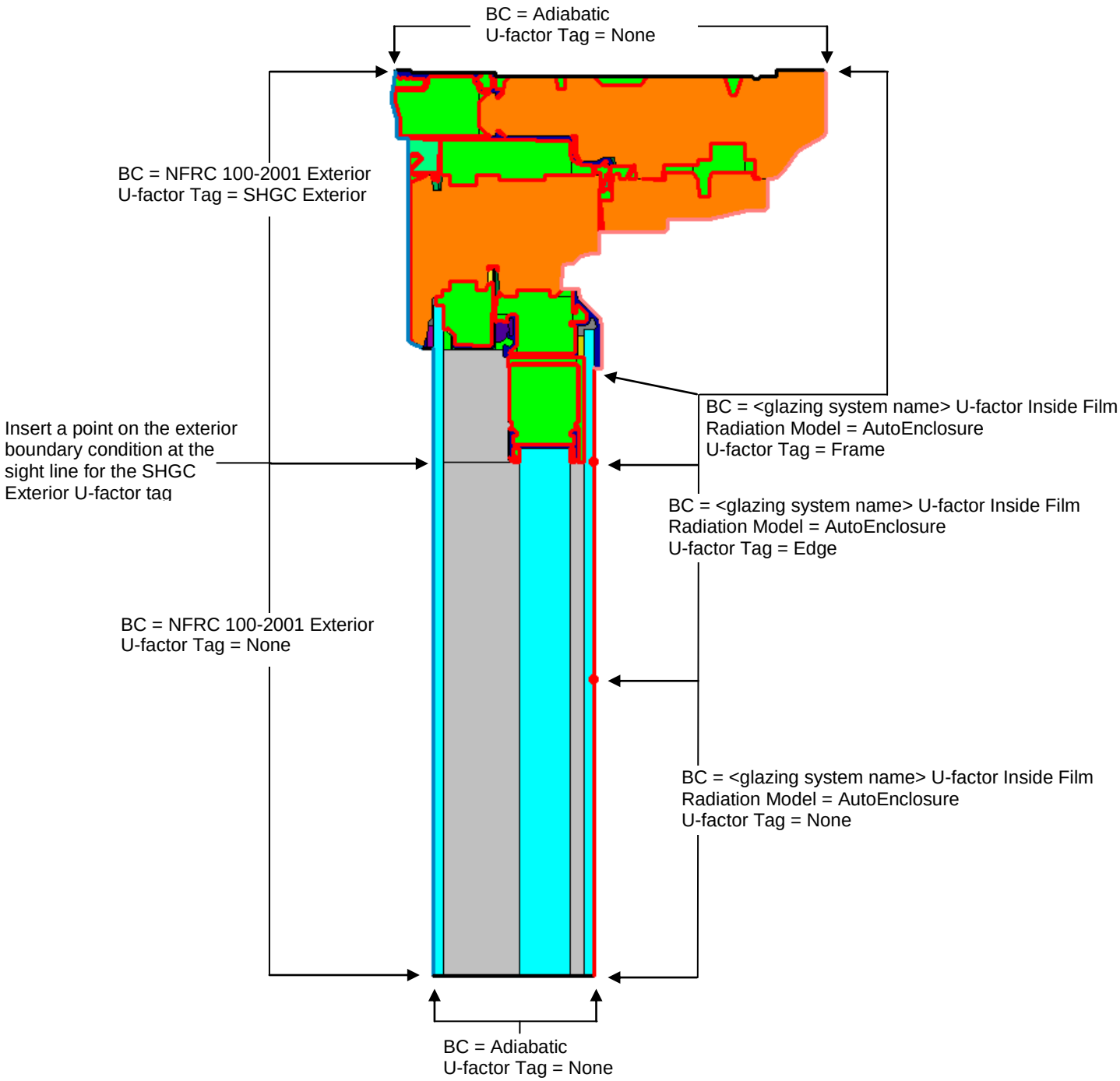


Figure 8-28. Define the boundary conditions for the Head Non-Retractable Open Venetian Blind cross section

BC = Interior <frame type> (Convection only)

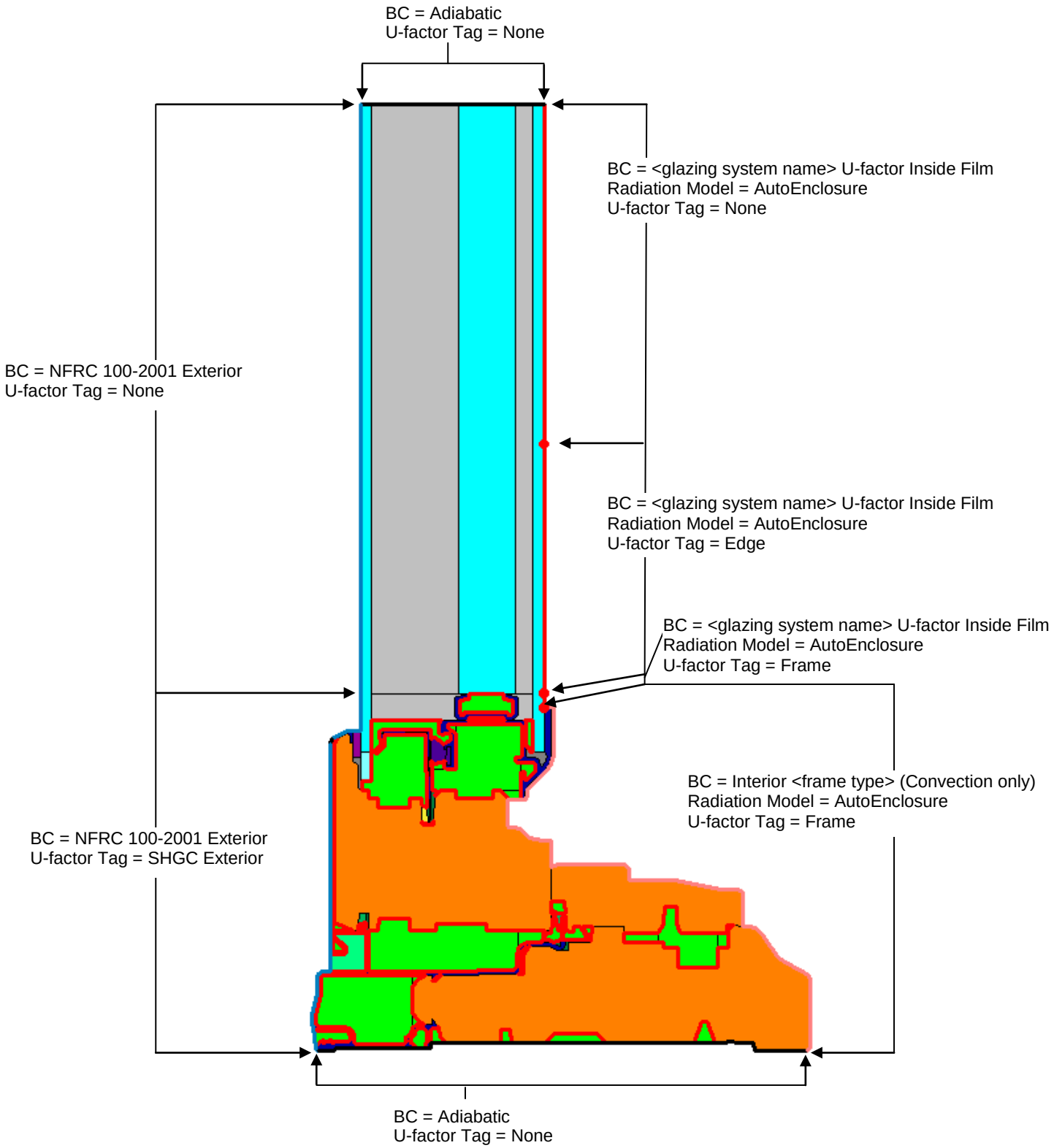


Figure 8-29. Define the boundary conditions for each Sill Non-Retractable Open Venetian Blind cross section

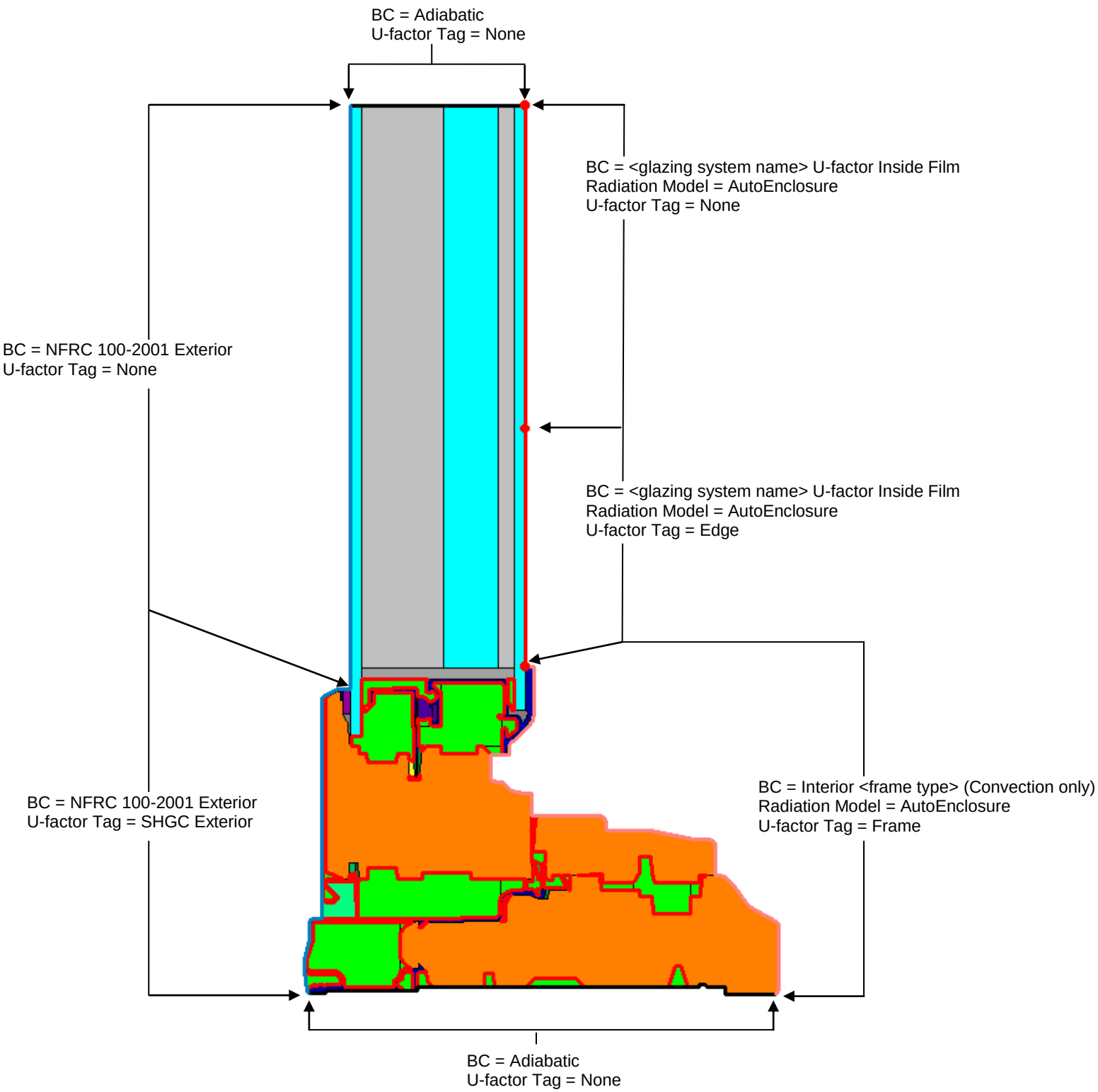


Figure 8-30. Define the boundary conditions for each Jamb Non-Retractable Open Venetian Blind cross section

7. Simulate each cross section and save the results

In WINDOW:

1. **Frame Library:** Import the THERM files into the Frame Library

Frame Library (C:\Users\Public\LBNL\WINDOW6\w6Venetian.mdb)

ID	Name	Source	Type	Frame Uvalue	Edge Uvalue	Edge Correlation	Glazing Thickness	Pfd	Abs
				W/m2-K	W/m2-K		mm	mm	
1	Al w/break	ASHRAE	N/A	5.680	N/A	Class1	N/A	57.2	0.90
2	Al flush	ASHRAE	N/A	3.970	N/A	Class1	N/A	57.2	0.90
3	Wood	ASHRAE	N/A	2.270	N/A	Class1	N/A	69.8	0.90
4	Vinyl	ASHRAE	N/A	1.700	N/A	Class1	N/A	69.8	0.90
5	VenetianClosed-Head.THM	Therm	Head	2.874	1.746	N/A	47.1	114.8	0.30
6	VenetianClosed-Jamb.THM	Therm	Jamb	2.661	1.809	N/A	47.1	87.6	0.30
7	VenetianClosed-Sill.THM	Therm	Sill	2.732	1.853	N/A	47.1	87.6	0.30
8	VenetianFixedOpen-Head.THM	Therm	Head	2.752	1.667	N/A	46.9	114.8	0.30
9	VenetianFixedOpen-Jamb.THM	Therm	Jamb	2.659	1.846	N/A	46.9	87.6	0.30
10	VenetianFixedOpen-Sill.THM	Therm	Sill	2.785	1.825	N/A	46.9	90.8	0.30

Figure 8-31. Import the THERM files into the WINDOW Frame Library

2. **Window Library:** Construct the window using the THERM files in the Frame Library and the glazing system defined in Glazing System Library

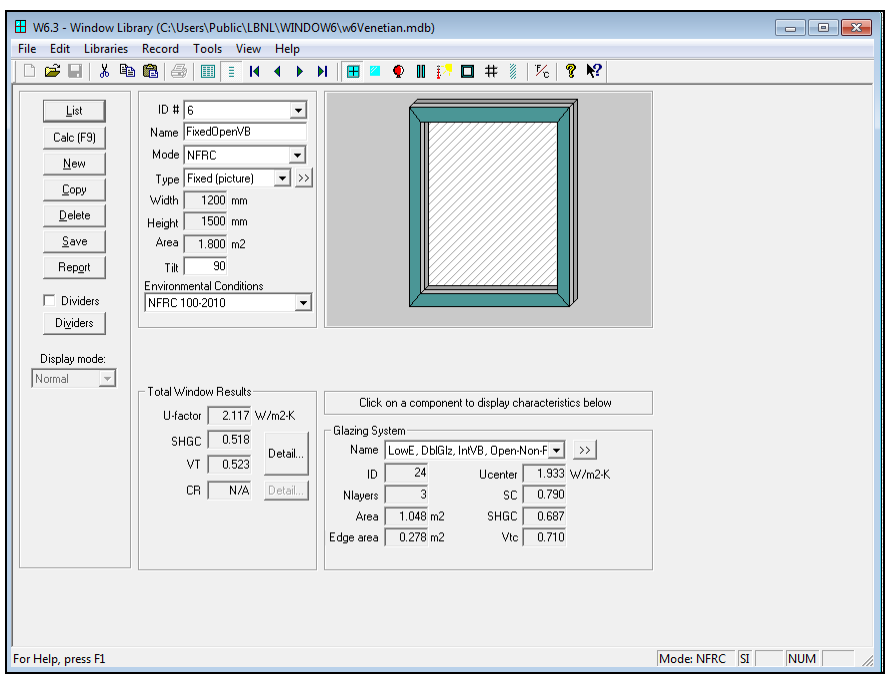


Figure 8-32. Define the window.

8.16.2. Closed Venetian Blind

According to NFRC 100 and 200, dynamic glazing products must be rated in both their fully open and fully closed positions. This section describes modeling a Venetian blind in it's closed position. The modeling procedures presented here will apply to either a retractable or non-retractable Venetian blind.

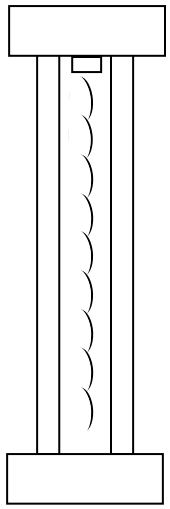


Figure 8-33. A closed Venetian blind.

In WINDOW:

1. **Shading Layer Library:** If the appropriate venetian blind product is not already in the Shading Layer Library, import it from the Complex Glazing Database (CGDB). If the product is not in the CGDB, the manufacturer will need to have the blind slat material measured and added to the CGDB before the product can be simulated.

   The Shading Layer should be defined with the venetian blind slats in a vertical position, or as "closed" as the blind geometry allows.

2. **Shade Material Library:** When the Shading Layer Library is imported from the CGDB, WINDOW will also import the associated Shade Material record for that Shade Layer into the Shade Material Library. In general, this should be automatic and you should not have to manipulate the records in the Shade Material Library

3. **Glazing System Library:** Define the glazing system with the venetian blind between two layers of glass

In THERM:

1. **Frame Geometry:** Draw the frame geometry, including Head, Sill, Jamb and Meeting Rail if appropriate

2. **Glazing System:** Import the glazing system defined with the venetian blind (vertical "closed" slats) into the frame geometry

3. **Boundary Conditions:** For Integral Venetian Blinds, set "Shading System Modifier" to "None"

4. Simulate the model, save the results

In WINDOW:

5. **Frame Library:** Import the THERM files into the Frame Library
6. **Window Library:** Construct the window using the THERM files in the Frame Library and the glazing system defined in Glazing System Library

These steps are illustrated in more detail in the following discussion.

In WINDOW:

3. **Shading Layer Library:** If the appropriate venetian blind product is not already in the Shading Layer Library, import it from the Complex Glazing Database (CGDB).

   In the CGDB Shading Layer Library, for Venetian blinds that are defined as Type "Venetian" (and not Type "BSDF"), there may be one or more definitions for the same Venetian blind product. These different records will represent different geometries of the Venetian blind, such as slat thickness, width and slat spacing. However, if you are modeling the same Venetian blind product, but with a different slat thickness, width or slat spacing, you can make a new Shading Layer Library and change the slat geometry.

   In this example, the Venetian blind has three records in the CGDB Shading Layer Library, representing three different slat tilts – "Closed", "45 degrees" and "Open". For NFRC certification, the 45 degree geometry is not needed, and therefore only the "Closed" and "Open" records are imported from the CGDB, as shown in the figure below.

Shading Layer Library (C:\Users\Public\LBNL\WINDOW6\w6Venetian.mdb)

ID	Name	ProductName	Manufacturer	Type	Material	Openness	Source	Version
1	Venetian A0		ISO 15099 appendix	Venetian	Slat Metal A	0.050	User	0.00
2	Venetian A45		ISO 15099 appendix	Venetian	Slat Metal A	0.050	User	0.00
3	Venetian A90		ISO 15099 appendix	Venetian	Slat Metal A	0.050	User	0.00
4	Venetian B0		ISO 15099 appendix	Venetian	Slat Metal B	0.050	User	0.00
5	Venetian B45		ISO 15099 appendix	Venetian	Slat Metal B	0.050	User	0.00
6	Venetian B90		ISO 15099 appendix	Venetian	Slat Metal B	0.050	User	0.00
7	Venetian C0		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
8	Venetian C45		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
9	Venetian C80		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
10	Venetian C90		ISO 15099 appendix	Venetian	Slat Metal C	0.050	User	0.00
11	Venetian D0		ISO 15099 appendix	Venetian	Slat Metal D	0.050	User	0.00
12	Venetian D45		ISO 15099 appendix	Venetian	Slat Metal D	0.050	User	0.00
13	Venetian D90		ISO 15099 appendix	Venetian	Slat Metal D	0.050	User	0.00
17	White Frit		Generic	Fritted glass				0.00
22	Clear Frit (no pigment)		Generic	Fritted glass				0.00
3000	Slim White VB Closed	Slim White Venetian Blind	Pella	Venetian	White Venetian Blind Slat I	0.000	CGDB	1.20
3002	Slim White Open	Slim White Venetian Blind	Pella	Venetian	White Venetian Blind Slat I	1.000	CGDB	1.20

Figure 8-34 Import the appropriate records from the CGDB Shading Layer Library

If only one slat geometry is represented in the CGDB, import that record into the working database, and then make new records for the missing slat geometries, so that there is a separate Shading Layer record for both the Open and Closed geometries.

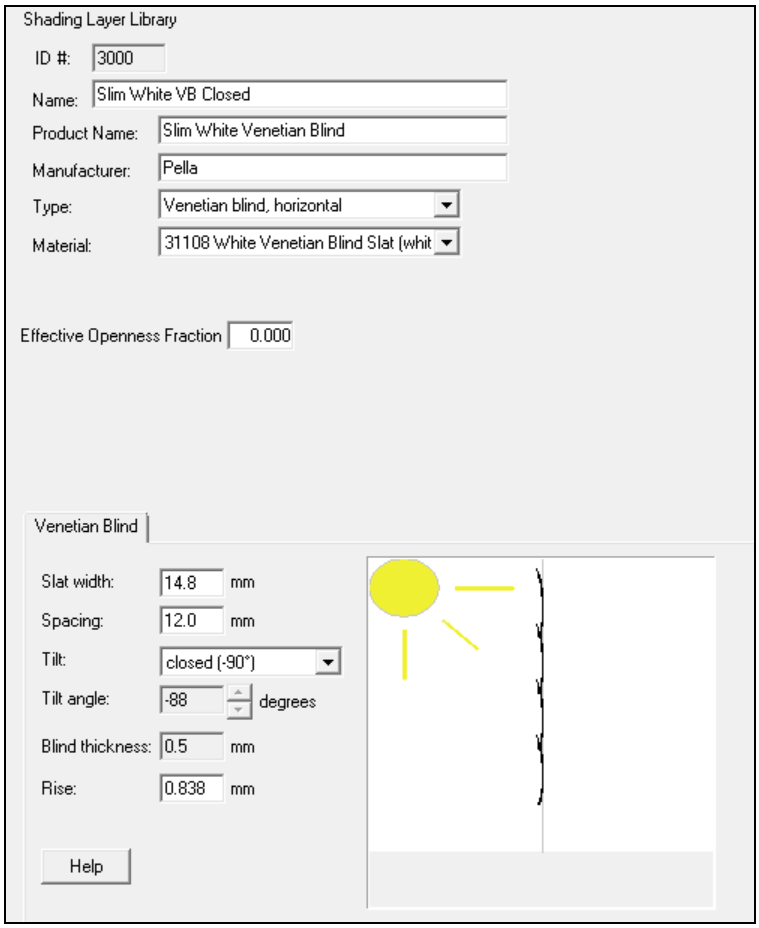


Figure 8-35 Define the venetian blind geometry for the "closed" (vertical) slats

- **Type**: Venetian blind, horizontal
- **Material**: White Venetian Blind Slat; this pulldown references the record in the Material Library that is associated with this Shading Layer. When a Shading Layer is imported from the CGDB, the associated record for the material is automatically added to the Shade Material Library. If you need to make a new Shading Layer record for a different slat geometry, make sure to reference the same material record in the Shade Material Library.
- **Effective Openness Fraction:** If a Shading Layer is imported from the CGDB, this value will automatically be set. If you are making a new record, the Effective Openness Fraction = 0 for the "Closed" blind case.
- **Slat Width:** appropriate value, in this example 14.8 mm
- **Spacing** = spacing between each slat, in this example 12 mm

- **Tilt:** "closed (-90)" or "closed (+90)" depending on the product geometry

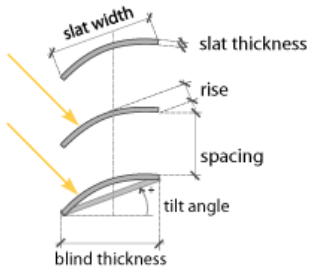


Figure 8-36 Venetian blind geometry definition

- **Blind thickness**: This value is not editable, and shows the width of the blind "assembly" based on the slat tilt. In this "Closed" case, the blind thickness is very small.
- **Rise:** this value defines the curve of the slat, and is defined in the CGDB for each Venetian blind product. It can be changed if it does not represent the slat curvature being modeled – this would be necessary if the slat width was changed, for example.

4. **Shade Material Library:** When a Shading Layer record is imported from the CGDB, the Shad e Material is automatically imported, and therefore in general, it is not necessary to add or change records in the Shade Material Library. However, you may need to reference existing records in the Shade Material Library if you are defining a new Shading Layer record (for example to define a differen slat geometry for a product).

Shade Material Library (C:\Users\Public\LBNL\WINDOW6\w6.mdb)

ID	Name	ProductName	Manufacturer	Source	Mode	Color	Thickness	Tsol	Rsol1	Rsol2	Tvis	Rvis1	Rvis2	Tir	emis1	emis2
							mm									
30101	Slat Metal A	Opaque white colored slat mat	ISO 15099	CGDB			0.600	0.000	0.700	0.700	0.000	0.700	0.700	0.000	0.900	0.900
30102	Slat Metal B	Opaque pastel colored slat mat	ISO 15099	CGDB			0.600	0.000	0.550	0.550	0.000	0.550	0.550	0.000	0.900	0.900
30103	Slat Metal C	Opaque light-dark colored slat	ISO 15099	CGDB			0.600	0.000	0.700	0.400	0.000	0.700	0.400	0.000	0.900	0.900
30104	Slat Metal D	Translucent white colored slat	ISO 15099	CGDB			0.600	0.400	0.500	0.500	0.400	0.500	0.500	0.400	0.550	0.550
31006	Woven Shade Material	Woven Shade	Generic	CGDB			0.600	0.000	0.500	0.500	0.000	0.500	0.500	0.000	0.900	0.900
31100	Off White Slat	Off-white diffuse slat	Generic	CGDB			1.000	0.000	0.657	0.657	0.000	0.709	0.709	0.000	0.900	0.900
31101	Light Green Slat	Light-green slat	Generic	CGDB			1.000	0.000	0.422	0.422	0.000	0.357	0.357	0.000	0.900	0.900
31102	Light Brown Slat	Light-brown slat	Generic	CGDB			1.000	0.000	0.332	0.332	0.000	0.326	0.326	0.000	0.900	0.900
31103	Red Slat	Red slat	Generic	CGDB			1.000	0.000	0.373	0.373	0.000	0.127	0.127	0.000	0.900	0.900
31104	Dark Blue Slat	Dark-blue slat	Generic	CGDB			1.000	0.000	0.111	0.111	0.000	0.073	0.073	0.000	0.900	0.900
31105	White Venetian Blind Slat (white.txt)	White Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.677	0.677	0.000	0.743	0.743	0.000	0.900	0.900
31106	White Venetian Blind Slat (white.txt)	White Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.677	0.677	0.000	0.743	0.743	0.000	0.900	0.900
31107	White Venetian Blind Slat (white.txt)	White Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.677	0.677	0.000	0.743	0.743	0.000	0.900	0.900
31108	Marine Venetian Blind Slat (marine.txt)	Marine Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.186	0.186	0.000	0.073	0.073	0.000	0.900	0.900
31109	Marine Venetian Blind Slat (marine.txt)	Marine Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.186	0.186	0.000	0.073	0.073	0.000	0.900	0.900
31110	Marine Venetian Blind Slat (marine.txt)	Marine Venetian Blind Slat	Pella	CGDB			0.100	0.000	0.186	0.186	0.000	0.073	0.073	0.000	0.900	0.900

Figure 8-37 Shade Material Library records are automatically created when Shading Layers are imported from the CGDB.

Glazing System Library: Define the glazing system with the venetian blind between two layers of glass

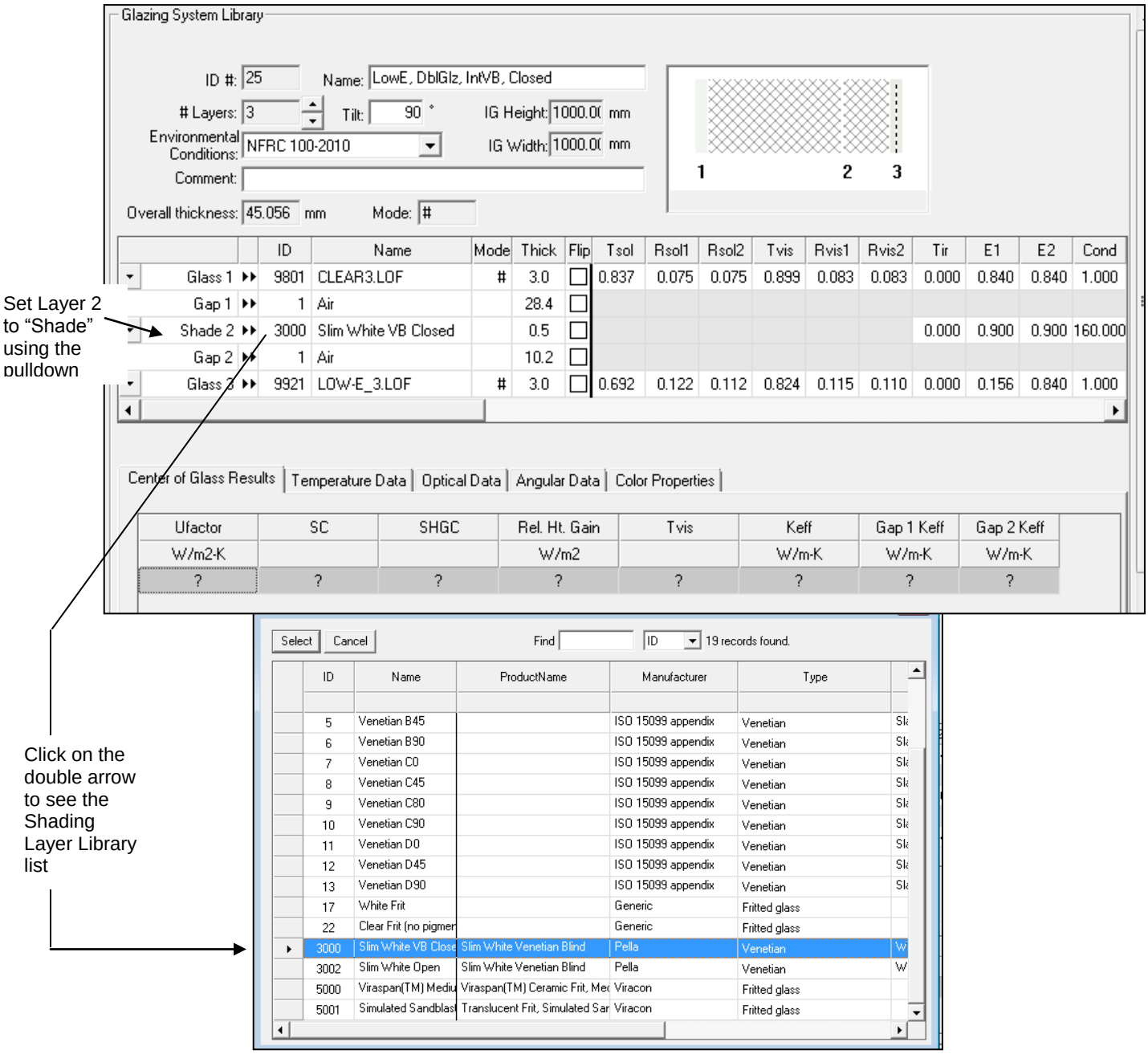


Figure 8-38.For the middle layer in the Glazing System (Layer #2), select the venetian blind from the Shading System Library.

- Set Number of layers = 3
- Set **Layer #2** to "Shade" (from pulldown arrow to the left in the first column)
- Set **Dtop**, **Dbot**, **Dright**, **Dleft** to the appropriate values for the venetian blind geometry

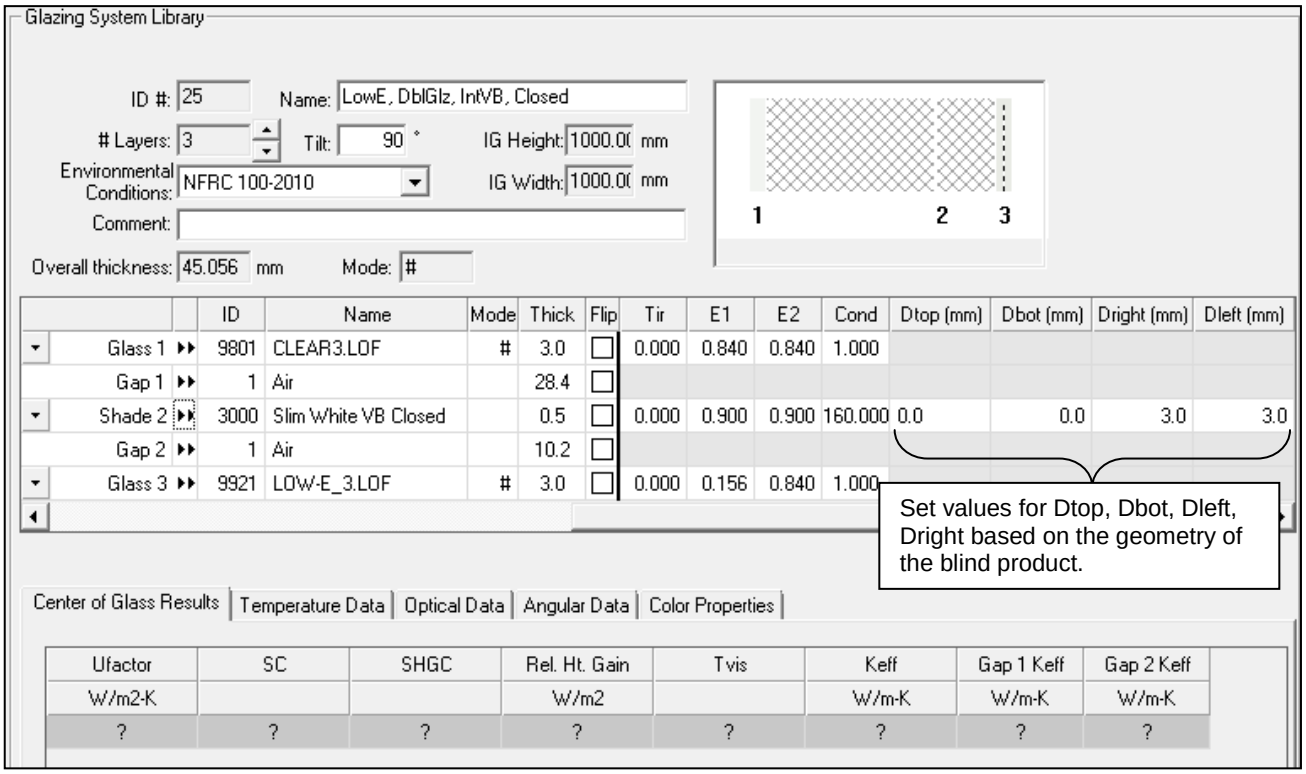


Figure 8-39. Define a Dtop, Dbot, Dleft and Dright in the Glazing System Library.

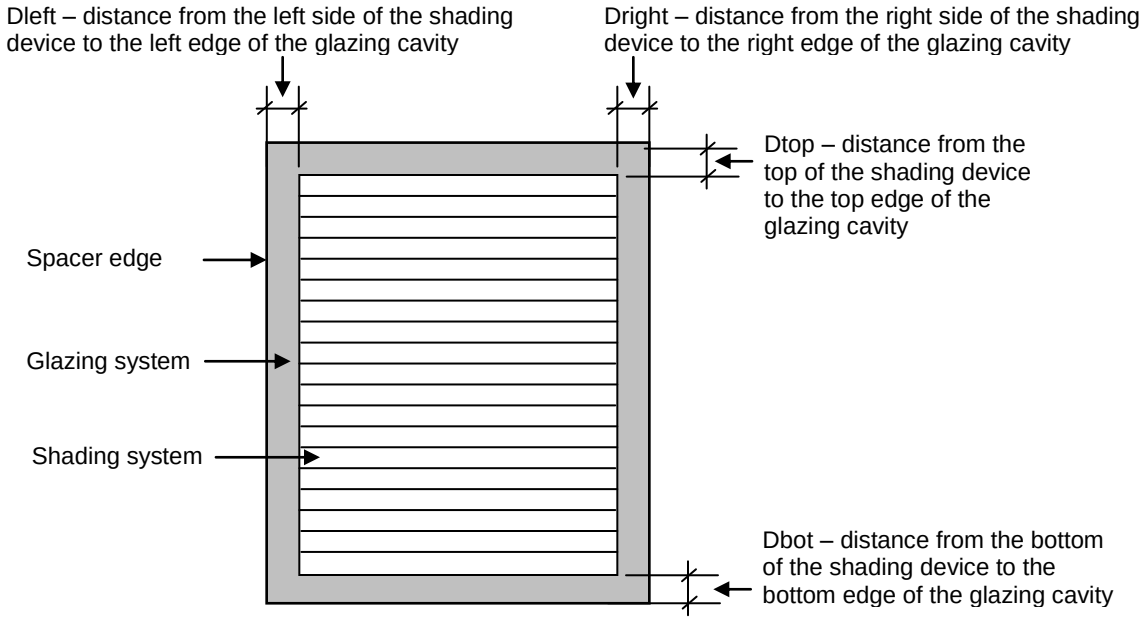


Figure 8-40. Definition of Dtop, Dbot, Dleft and Dright for an interior venetian blind.

In THERM:

1. **Frame Geometry:** Draw the frame geometry, including Head, Sill, Jamb and Meeting Rail if appropriate
2. **Glazing System:** Import the glazing system defined with the venetian blind (horizontal slats) into the frame geometry. For this example, the Head cross section, the following settings were used in the Insert Glazing System dialog box:
   - Orientation: **Down** (for the Head cross section
   - Cross Section **Type: Head**
     Setting the Cross Section Type to the approriate value allows THERM to automatically insert a polygon in the correct place for the Dtop (for Head), Dbottom (for Sill), Dright (for Right Jamb) and Dleft (for Left Jamb).
   - Spacer Height: **0**
     In this case, it was easiest to set the spacer height to 0 and pull the sides of the glazing sysetm layers up to the frame on each side (make sure Options/Preferences/Drawing Options has "Allow Editing of IG Polygons" checked).

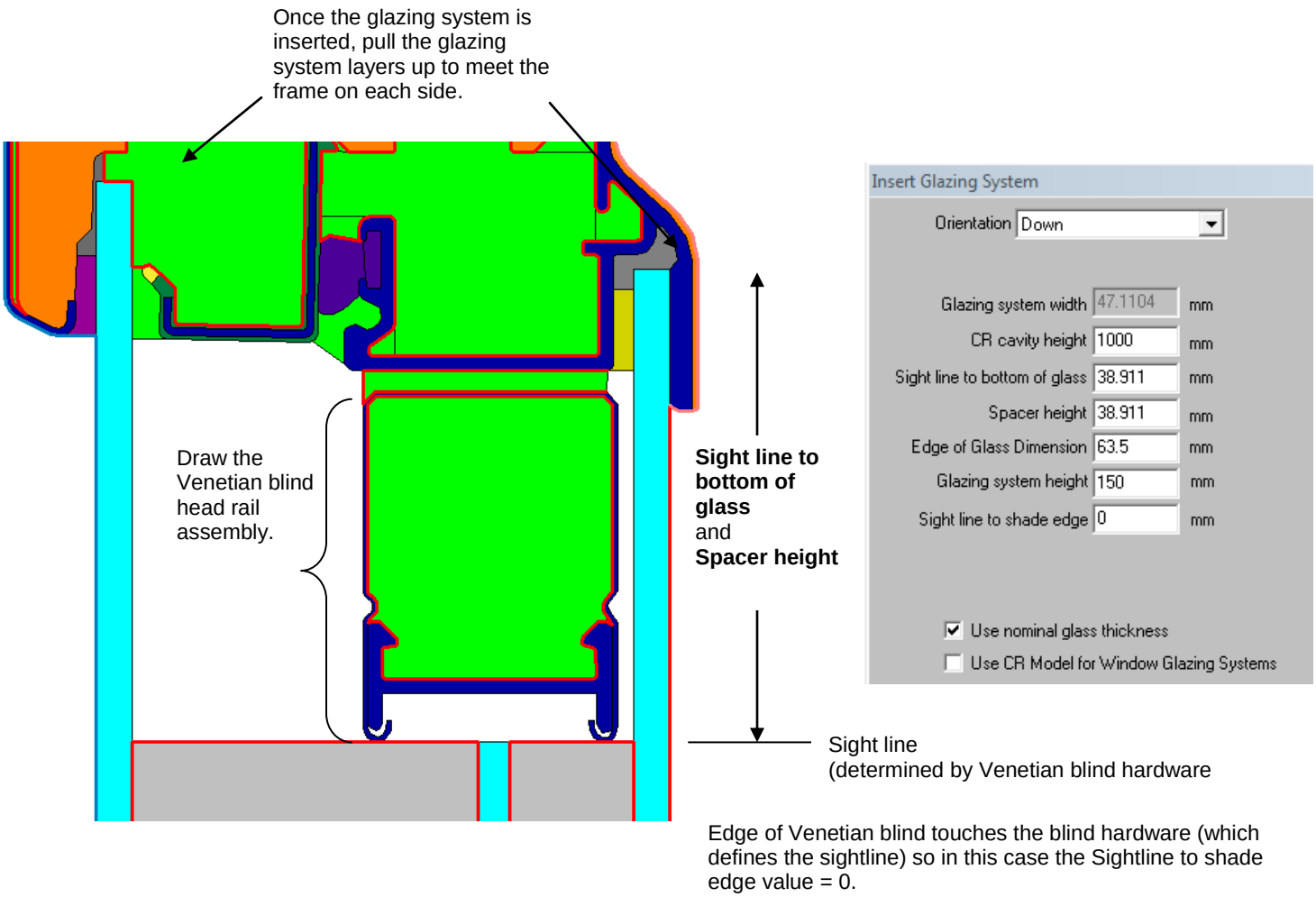


Figure 8-41. Insert the glazing system with the Venetian blind

3.

Add Venetian Blind Hardware: Add the head rail assembly of the venetian blind between the polygon representing Dtop and the polygon representing the Venetian blind.

4. Fill in the remaining cavities by linking them to the appropriate glazing system cavity.

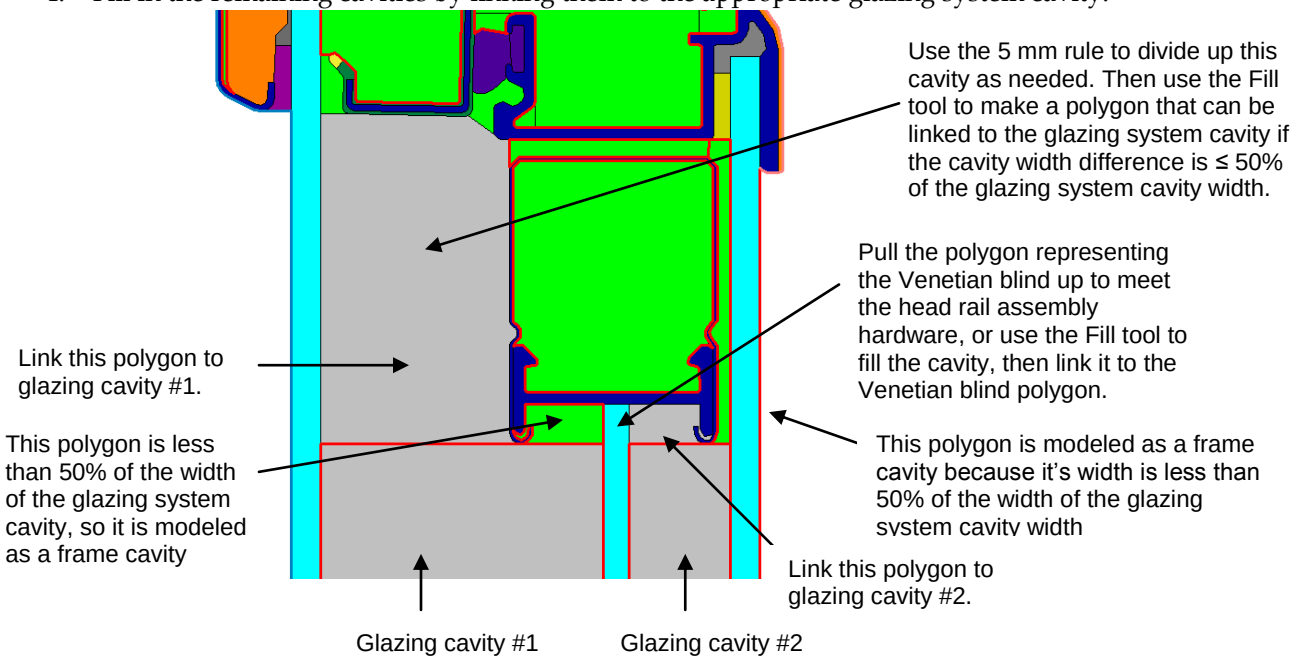


Figure 8-42. Fill the remaining cavities and link to the appropriate glazing system cavities.

5. Create the other cross sections in this manner.

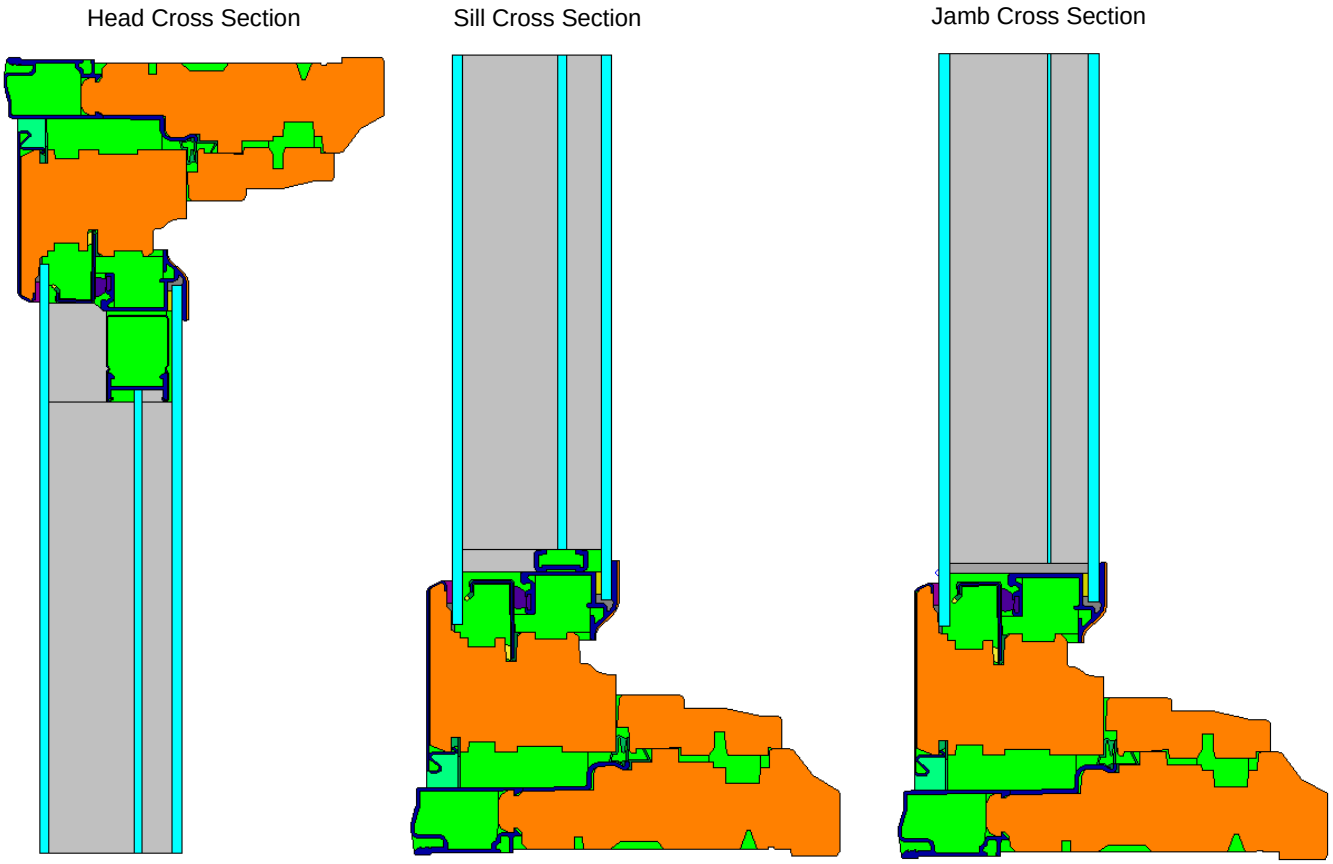


Figure 8-43. Head and Sill cross sections for Closed Venetian Blind between glass layers (Integral)

6. **Boundary Conditions:** For Integral Venetian Blinds, set "Shading System Modifier" to "None"

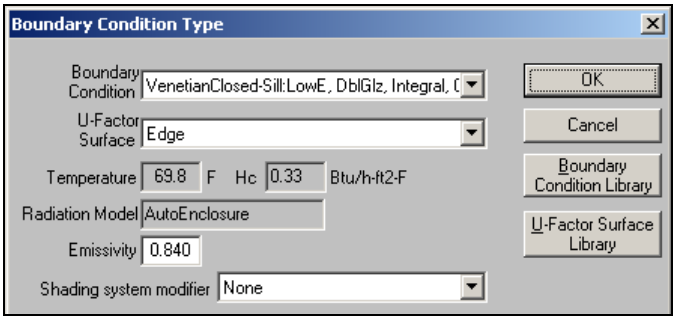


Figure 8-44. For Integral Venetian blinds, set the Shading System Modifier to "None".

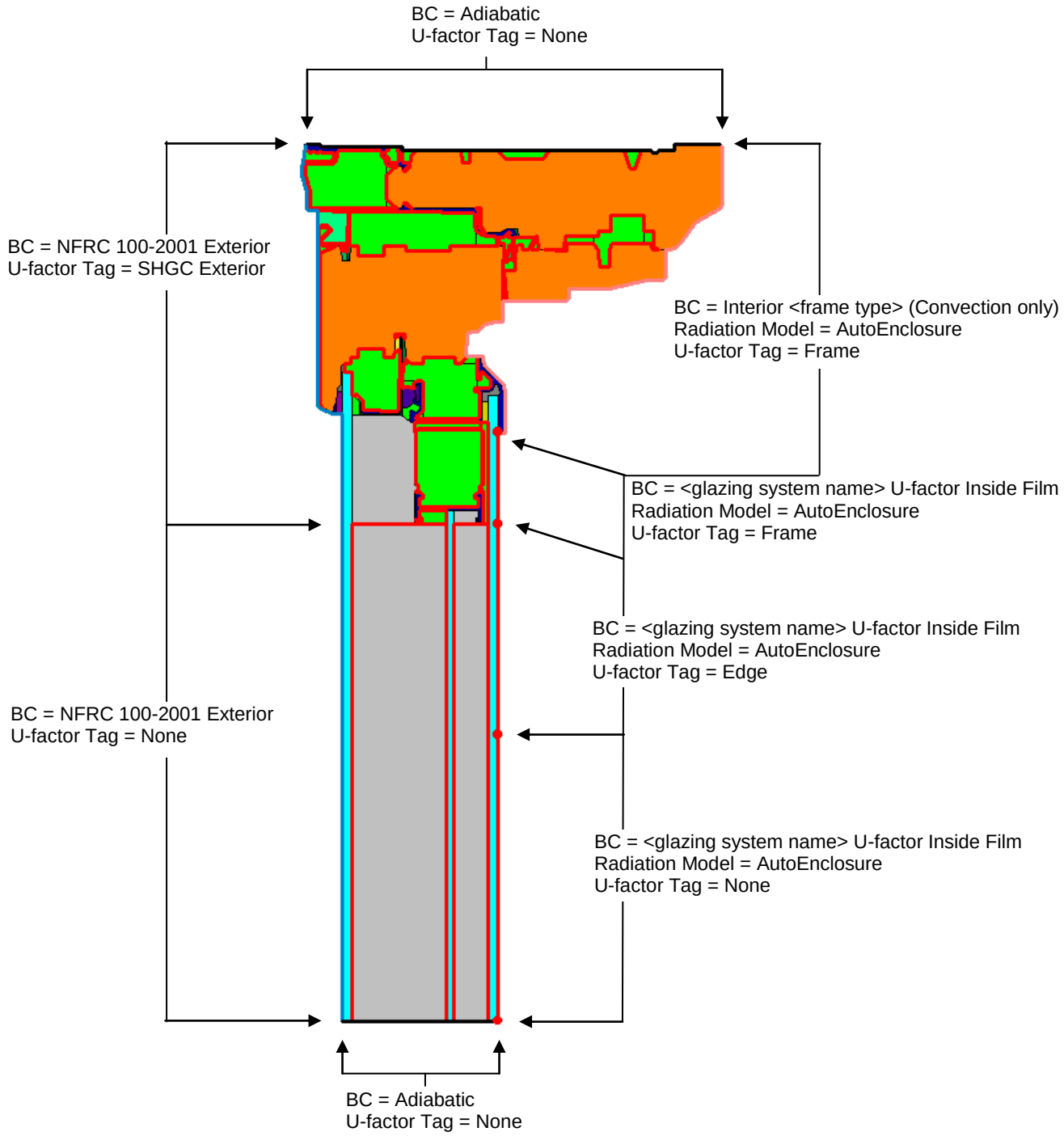


Figure 8-45. Define the boundary conditions for Head Non-Retractable Closed Venetian Blind section

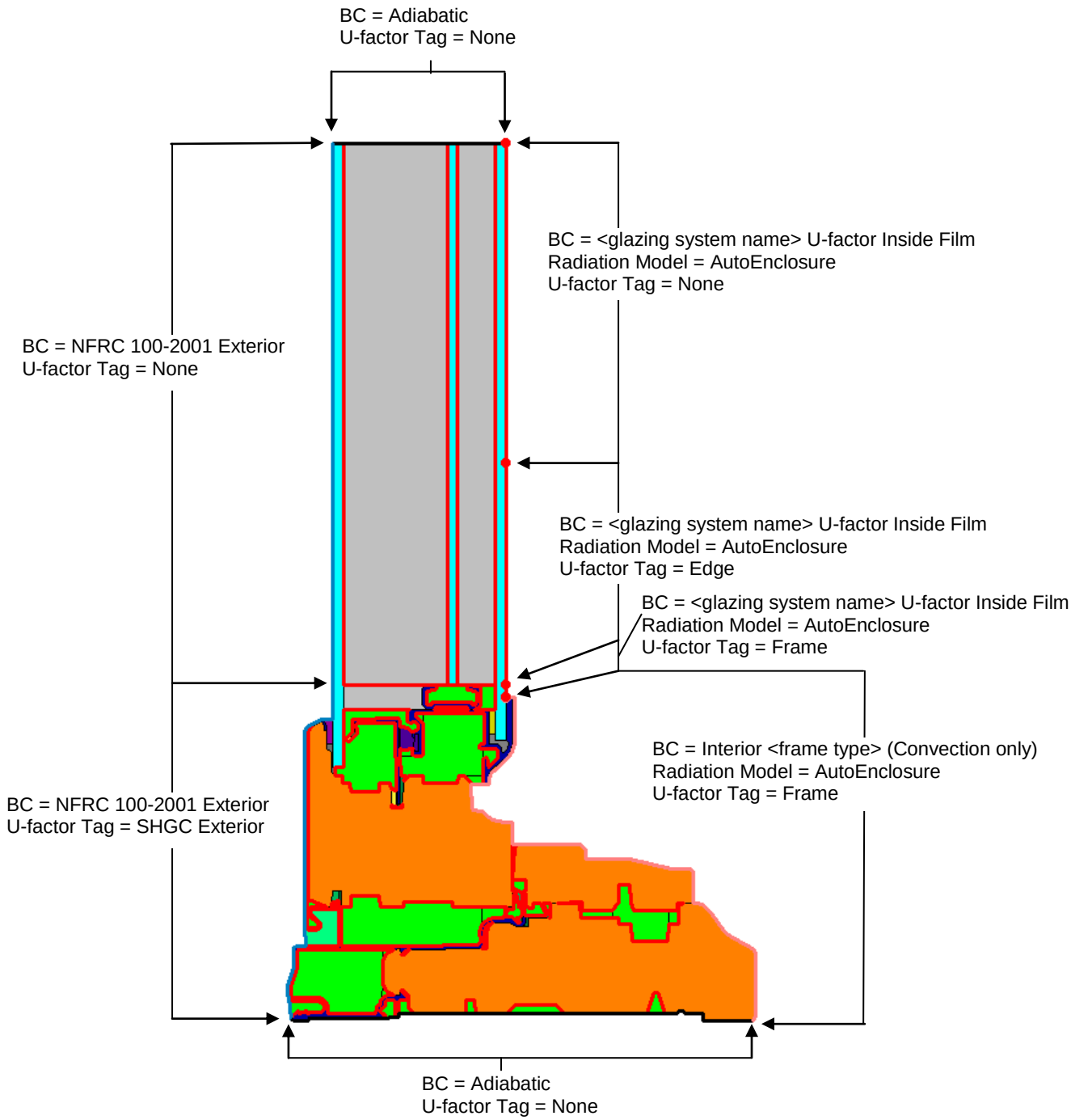


Figure 8-46. Define the boundary conditions for Sill Non-Retractable Closed Venetian Blind section

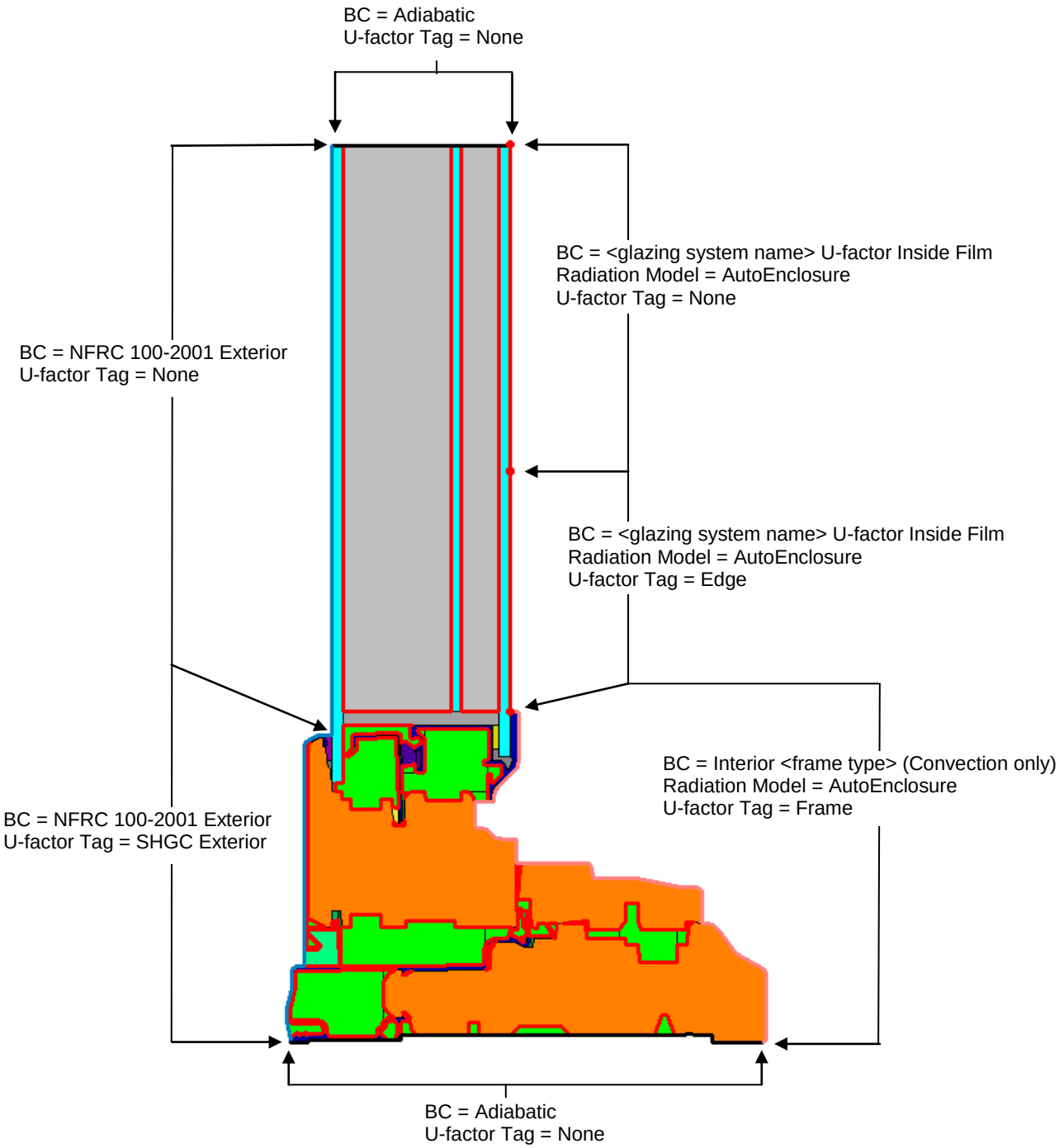
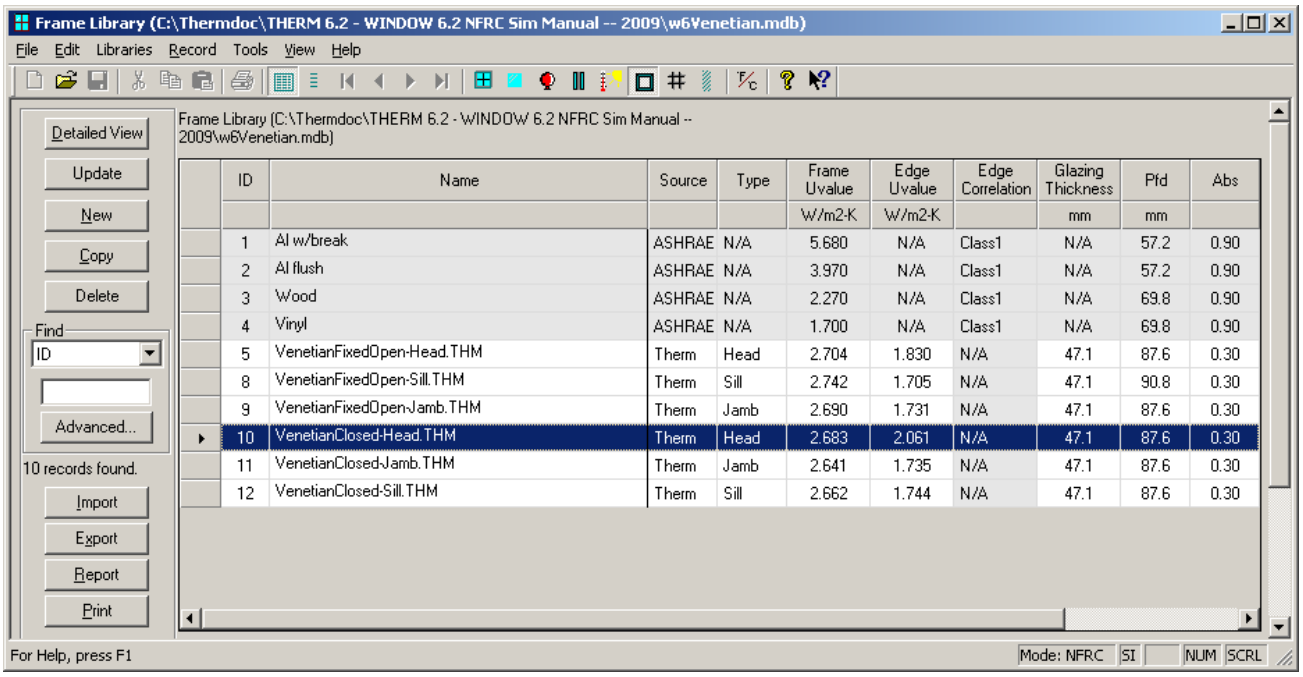


Figure 8-47. Define the boundary conditions for Jamb Non-Retractable Closed Venetian Blind section

7. Simulate each cross section and save the results

In WINDOW:

8. **Frame Library:** Import the THERM files into the Frame Library



ID	Name	Source	Type	Frame Uvalue	Edge Uvalue	Edge Correlation	Glazing Thickness	Pfd	Abs
				W/m2-K	W/m2-K		mm	mm	
1	Al w/break	ASHRAE	N/A	5.680	N/A	Class1	N/A	57.2	0.90
2	Al flush	ASHRAE	N/A	3.970	N/A	Class1	N/A	57.2	0.90
3	Wood	ASHRAE	N/A	2.270	N/A	Class1	N/A	69.8	0.90
4	Vinyl	ASHRAE	N/A	1.700	N/A	Class1	N/A	69.8	0.90
5	VenetianFixedOpen-Head.THM	Therm	Head	2.704	1.830	N/A	47.1	87.6	0.30
8	VenetianFixedOpen-Sill.THM	Therm	Sill	2.742	1.705	N/A	47.1	90.8	0.30
9	VenetianFixedOpen-Jamb.THM	Therm	Jamb	2.690	1.731	N/A	47.1	87.6	0.30
10	VenetianClosed-Head.THM	Therm	Head	2.683	2.061	N/A	47.1	87.6	0.30
11	VenetianClosed-Jamb.THM	Therm	Jamb	2.641	1.735	N/A	47.1	87.6	0.30
12	VenetianClosed-Sill.THM	Therm	Sill	2.662	1.744	N/A	47.1	87.6	0.30

Figure 8-48. Import the THERM files into the WINDOW Frame Library

9. **Window Library:** Construct the window using the THERM files in the Frame Library and the glazing system defined in Glazing System Library and calculate the results.

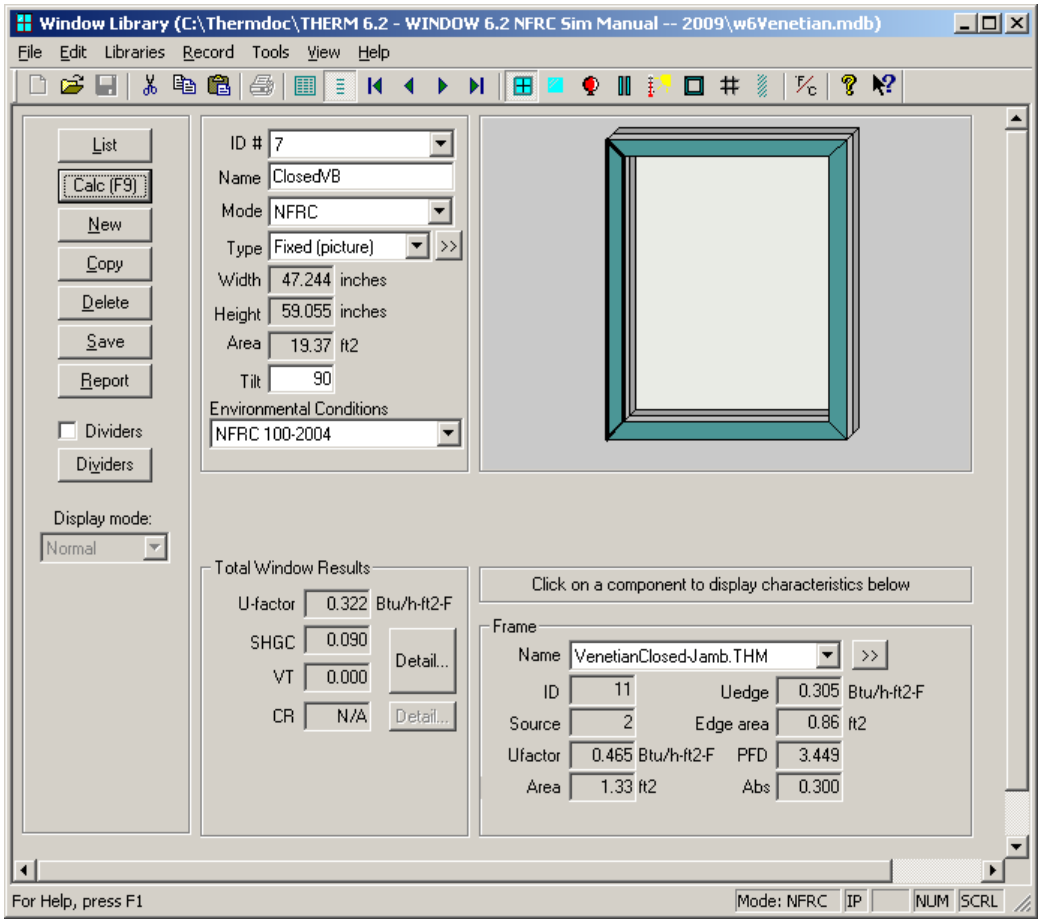


Figure 8-49. Define the window.

8.17 Frits

WINDOW 6 has the ability to model fritted glazing layers. At this time, it is not possible to model frits applied to coated substrates.

Frits are a ceramic surface treatment that is baked onto the surface of a piece of glass (called a substrate). The ceramic frit has the optical characteric that the incident light passing through it has both a specular component (that goes straight through the construction) and a diffuse component (that scatters the light in many different directions). This means that in order to model it correctly, it is necessary to measure both those different optical characteristics.

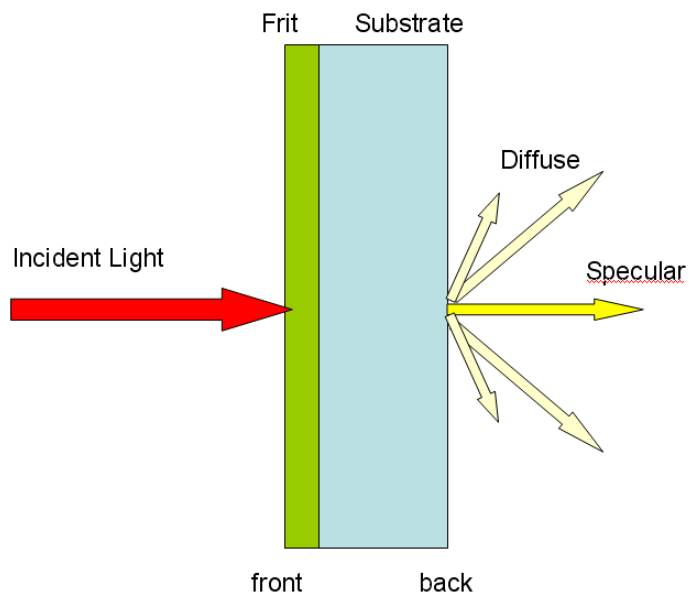


Figure 8-50. Ceramic frits have both a diffuse and specular optical properties component

In order for WINDOW 6 to model the optical and thermal properties of the fritted glass, the program must have the following data:

1. Spectral data for the substrate covered 100% by the frit
2. Spectral data for the substrate by itself.

Then to define a specific frit pattern, the user specifies the percent coverage of the frit on the substrate.

1. **Spectral data for the substrate covered 100% by the frit:** For specular glass, the transmittance is the same for the front and back surface, and the reflectance values are different. However, to obtain data for the first case above, ie, the spectral data for the substrate covered 100% by the frit, it is necessary to take measurements for four different cases. For glass with a frit applied, both the transmittance and reflectance values are different for the front and the back surfaces, and each of those are different for the diffuse and specular components. Therefore, it is necessary to measure (and obtain spectral data files) for each of the four cases:

   - Specular spectral data for the front surface
   - Specular spectral data for the back surface
   - Diffuse spectral data for the front surface

- Diffuse spectral data for the back surface

2. **Spectral data for the substrate by itself:** This is the same type o f spectral data measurement for any specular glass layer, and is only one file that contains the values (by wavelength) for transmittance (back and front are the same) and front and back reflectance.

8.17.1. Modeling Steps

The steps for modeling fritted glazing layers are as follows:

In WINDOW:

1. Find the appropriate frit product in the Complex Glazing Database (CGDB) and import it into the WINDOW Shading Layer Library
   http://windows.lbl.gov/software/CGDB
2. Input the appropriate frit coverage information in the Shading Layer record
3. Make a glazing system using the Frit layer in the appropriate location in the system.

In THERM:

4. Model the appropriate THERM files with the fritted glazing system.
5. Import the THERM files into the WINDOW Frame Library
6. Make the appropriate Window records using the fritted glazing system and the THERM files with the fritted glazing system.

In WINDOW:

1. **Shading Layer Library:** If the appropriate fritted product is not already in the Shading Layer Library, import it from the Complex Glazing Database (CGDB). If the product is not in the CGDB, the manufacturer will need to have the fritted product measured and added to the CGDB before the product can be simulated.
2. **Shade Material Library:** When the fritted layer is imported from the CGDB Shading Layer Library into WINDOW, the associated records will automatically be imported into the Glass Library. In general, you should not have to manipulate these records in the Glass Library
3. **Glazing System Library:** Define the glazing system with the venetian blind between two layers of glass

In THERM:

7. **Frame Geometry:** Draw the frame geometry, including Head, Sill, Jamb and Meeting Rail if appropriate
8. **Glazing System:** Import the glazing system defined with the fritted glass into the frame geometry
9. **Boundary Conditions:** For fitted glass products, set “Shading System Modifier” to “None” (the default)
10. Simulate the model, save the results

In WINDOW:

11. **Frame Library:** Import the THERM files into the Frame Library
12. **Window Library:** Construct the window using the THERM files in the Frame Library and the glazing system defined in Glazing System Library

These steps are illustrated in more detail in the following discussion.

8.17.2. Frit Example

The following example is for a "simulated sandblast" frit from the CGDB.

1. **Shading Layer Library: Import the frit product from the CGDB into the Shading Layer Library**

   In the Shading Layer Library List View, click the Import button and browse to the CGCB database, whose default location will be in:

   C:\Users\Public\LBNL\LBNL Shared

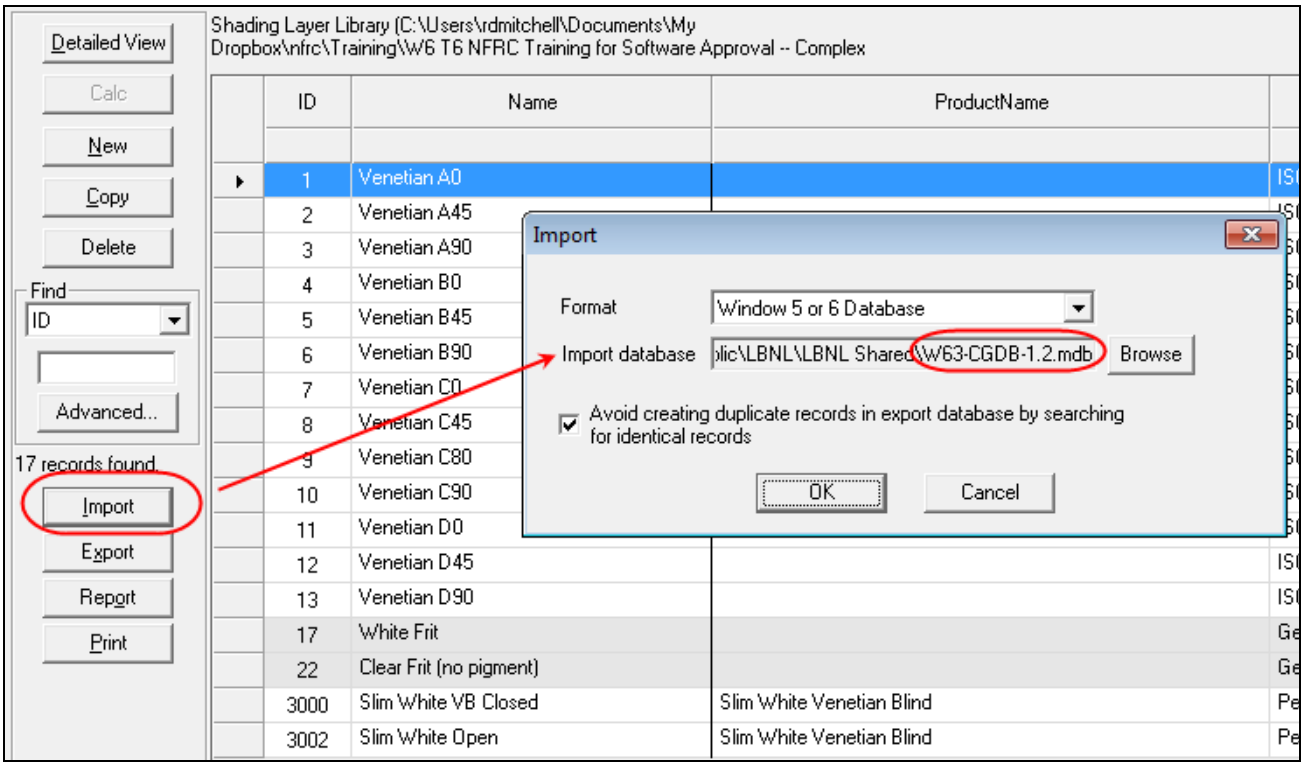


Figure 8-51. Browse to the CGDB database to import the frit records into the Shading Layer Library

When the CGDB dialog box appears, highlight the records to import and click the Select button (or click the Select All button to import all the records in the CGDB file).

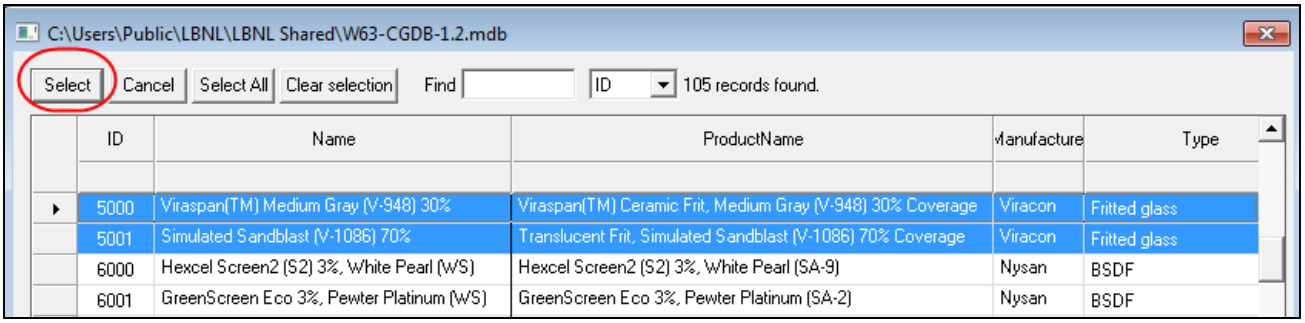
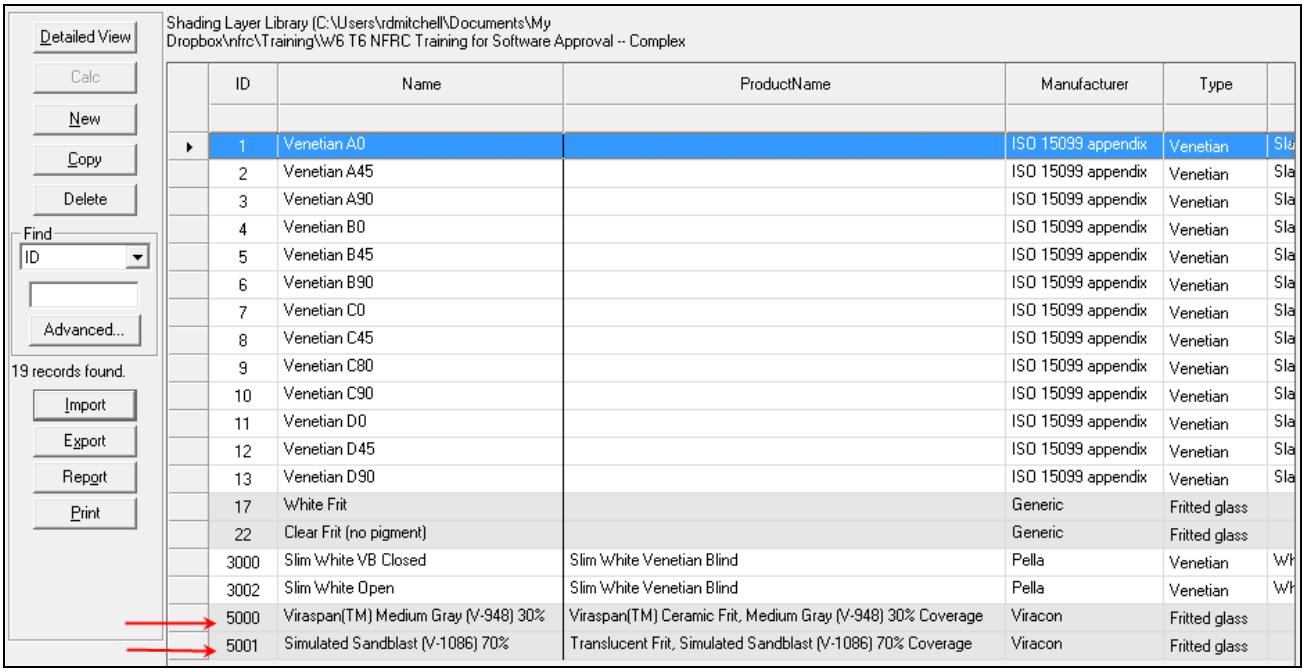


Figure 8-52. Select the desired records to be imported into the Shading Layer Library

The selected records will be imported into the Shading Layer Library.



ID	Name	ProductName	Manufacturer	Type
1	Venetian A0		ISO 15099 appendix	Venetian
2	Venetian A45		ISO 15099 appendix	Venetian
3	Venetian A90		ISO 15099 appendix	Venetian
4	Venetian B0		ISO 15099 appendix	Venetian
5	Venetian B45		ISO 15099 appendix	Venetian
6	Venetian B90		ISO 15099 appendix	Venetian
7	Venetian C0		ISO 15099 appendix	Venetian
8	Venetian C45		ISO 15099 appendix	Venetian
9	Venetian C80		ISO 15099 appendix	Venetian
10	Venetian C90		ISO 15099 appendix	Venetian
11	Venetian D0		ISO 15099 appendix	Venetian
12	Venetian D45		ISO 15099 appendix	Venetian
13	Venetian D90		ISO 15099 appendix	Venetian
17	White Frit		Generic	Fritted glass
22	Clear Frit (no pigment)		Generic	Fritted glass
3000	Slim White VB Closed	Slim White Venetian Blind	Pella	Venetian
3002	Slim White Open	Slim White Venetian Blind	Pella	Venetian
5000	Viraspan(TM) Medium Gray (V-948) 30%	Viraspan(TM) Ceramic Frit, Medium Gray (V-948) 30% Coverage	Viracon	Fritted glass
5001	Simulated Sandblast (V-1086) 70%	Translucent Frit, Simulated Sandblast (V-1086) 70% Coverage	Viracon	Fritted glass

Figure 8-53. The records selected from the CGDB will be imported into the WINDOW Shading Layer Library

Highlight one of the records and click on Detailed View to see the frit coverage and associated Glass Library records. You will see that there are several glass layers referenced, one for the substrate and two for the specular and diffuse optical data. If these records are not already in the Glass Library, they will automatically be imported when the Frit layer is imported into the Shading Layer Library.

If the frit coverage in the imported record does not correspond to the coverage of your product, change the value and save the record.

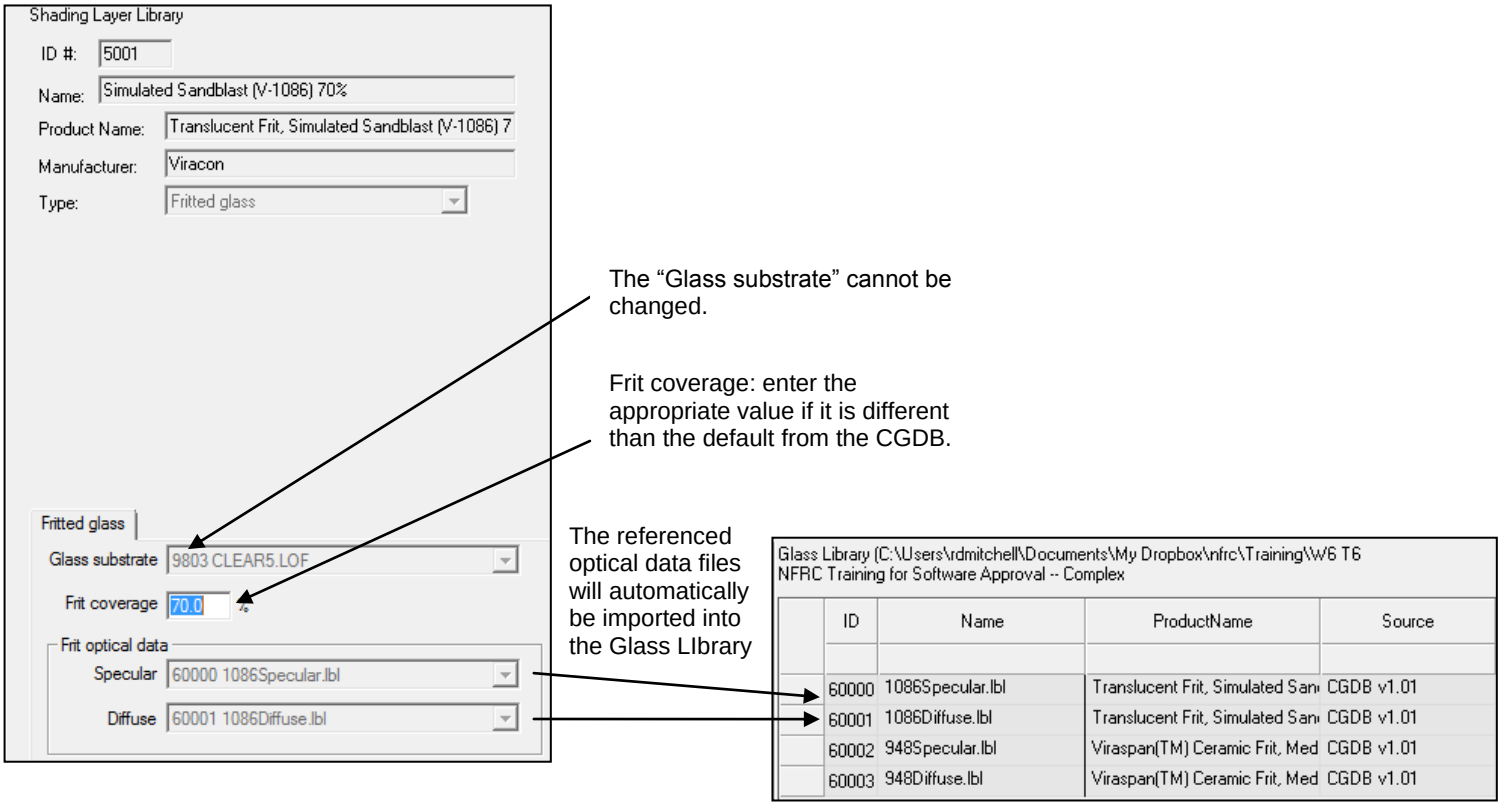


Figure 8-54. The necessary records will be imported into the Glass Library for the frit layer

2. **Glazing System:** Make a glazing system with the frit layer

- Select "Shade or Frit" from the pulldown to the left of the layer you want to make a frit

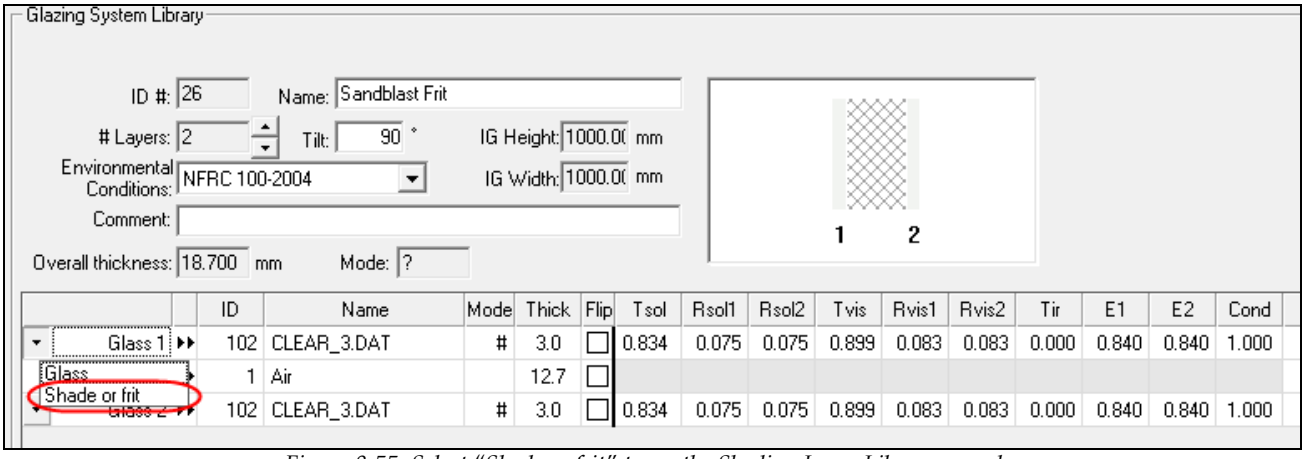


Figure 8-55. Select "Shade or frit" to see the Shading Layer Library records.

- Click on the Double arrow button to see the Shading Layer Library, and select the appropriate Fritted glass record.

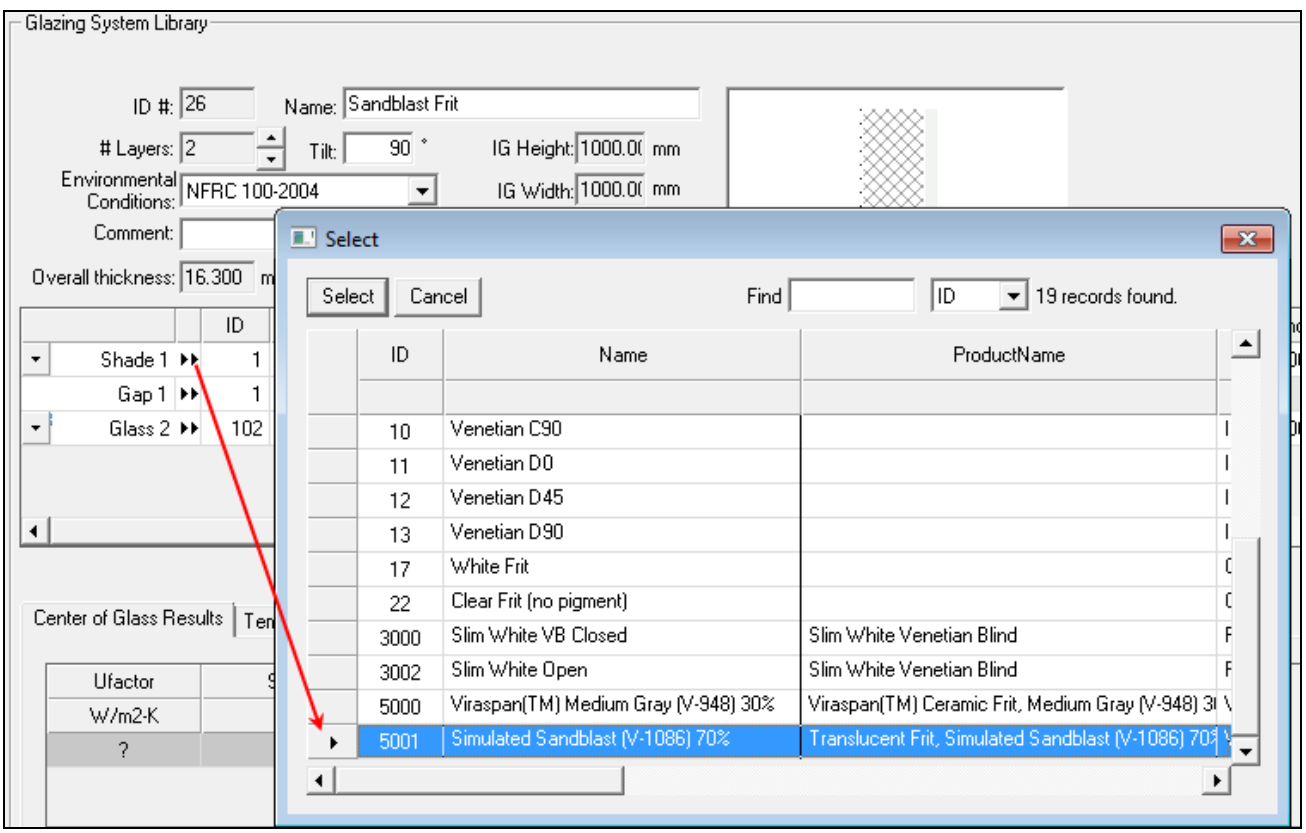


Figure 8-56. Click on the double arrow to show and select the layers in the Shading Layer Library.

- Click the Calc button to calculate the center-of-glass properties for this glazing system.

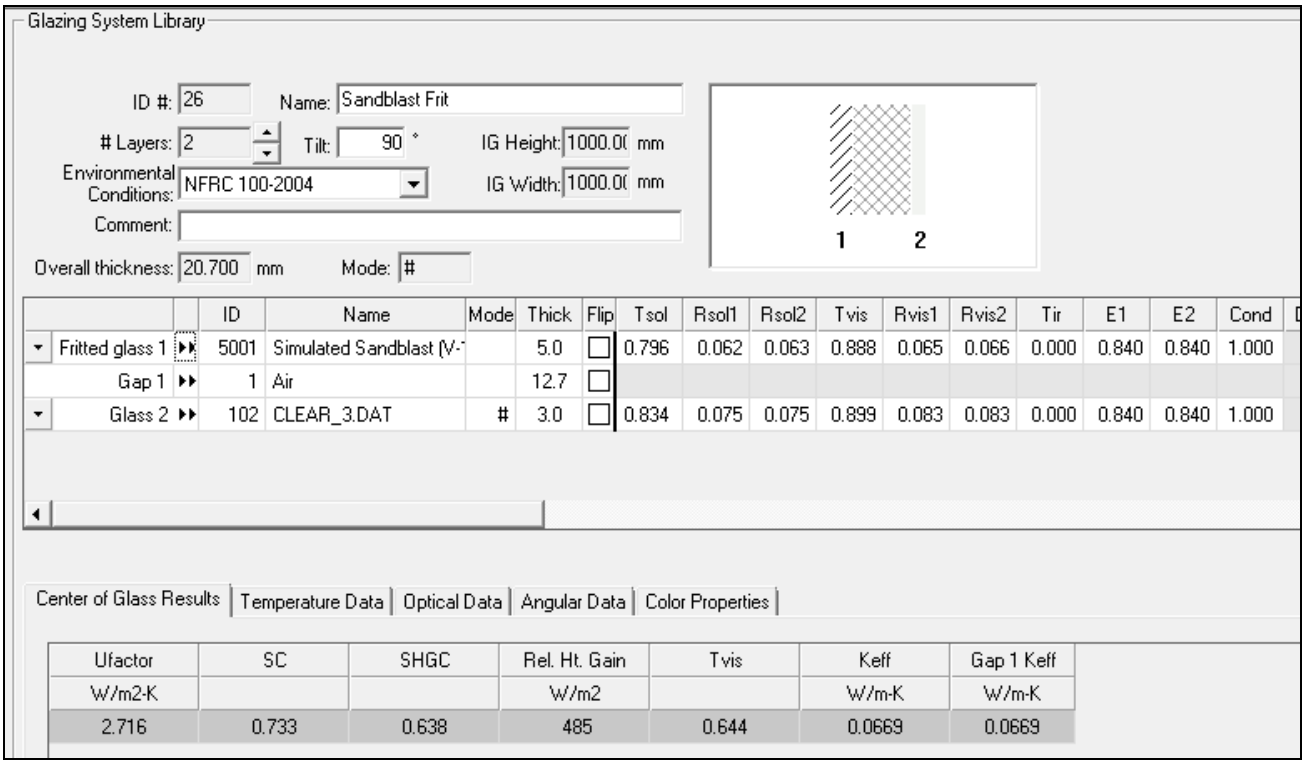


Figure 8-57. Calculate the results for the glazing system.

3. **THERM:** Import the glazing system into THERM in the usual way. A glazing system with a fritted layer does not have any different values in THERM than a normal glazing system (i.e., a glazing system without a shading system).
4. **WINDOW:** Import the THERM files into the WINDOW Frame Library, and then construct the whole product in the Window Library, in the normal manner.

8.18 Complex Glazing Database (CGDB)

The Complex Glazing Database (CGDB) is provided by LBNL for modeling complex glazing products. Over time, more products will be added to the database, as methodologies are developed to measure the properties of the complex glazing products, and manufacturers submit data to LBNL to be included in the CGDB.

The current version of the CGDB is located on the LBNL website:

http://windows.lbl.gov/software/CGDB

There is a version of the database for each version of WINDOW (at the time of this writing, WINDOW 6 and WINDOW 7). The databases are basically just WINDOW databases that only have the complex glazing records in them, so the products are easily imported into any WINDOW database (keeping in mind the program version compatibility).

The current WINDOW 6 CGDB database is called:

W63-CGDB-1.2.mdb

And by default will be installed into the following directory (depending on your operating system):

- **For Microsoft XP:**

  C:\Program Files\LBNL\LBNL Shared

- **For Microsoft Vista and Windows 7:**

  C:\Users\Public\LBNL\LBNL Shared

When you want to import records from the CGDB into the Shading Layer Library of your current WINDOW 6 working database, follow these steps:

1. **Shading Layer Library: Import the frit product from the CGDB into the Shading Layer Library**

   In the Shading Layer Library List View, click the Import button and browse to the CGCB database.

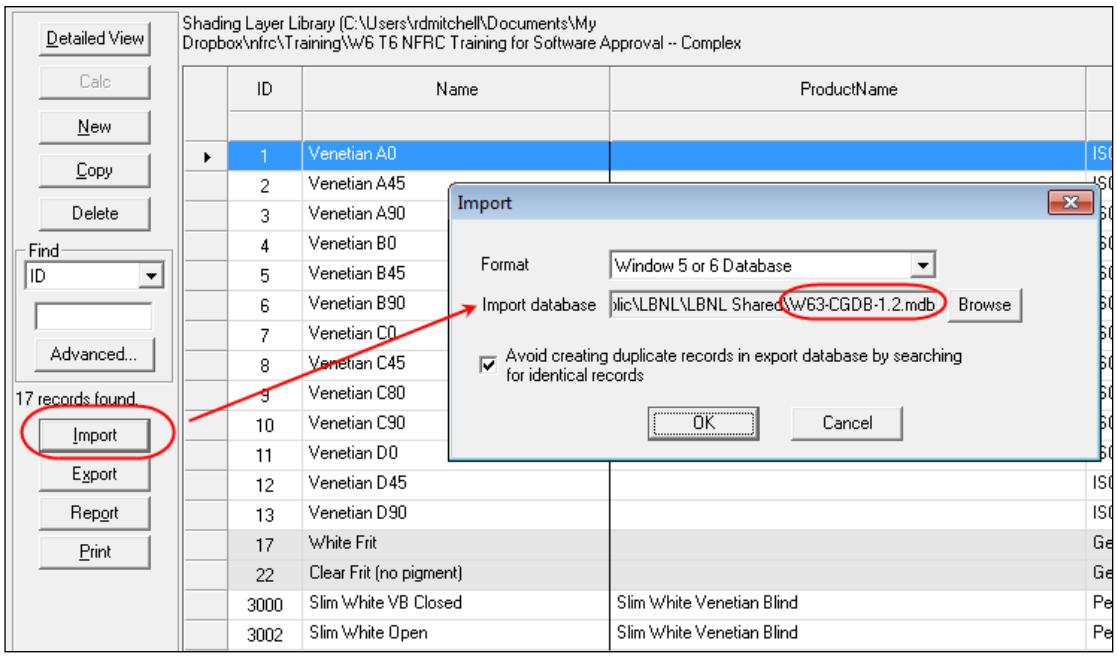


Figure 8-58. Browse to the CGDB database to import the frit records into the Shading Layer Library

When the CGDB dialog box appears, highlight the records to import and click the Select button (or click the Select All button to import all the records in the CGDB file). At this point, for NFRC certification, only the Fritted Glass and Venetian Blind products (which can be either Type = Venetian Blind, or Type = BSDF) can be used, so you may want to only select these products to import from the CGDB.

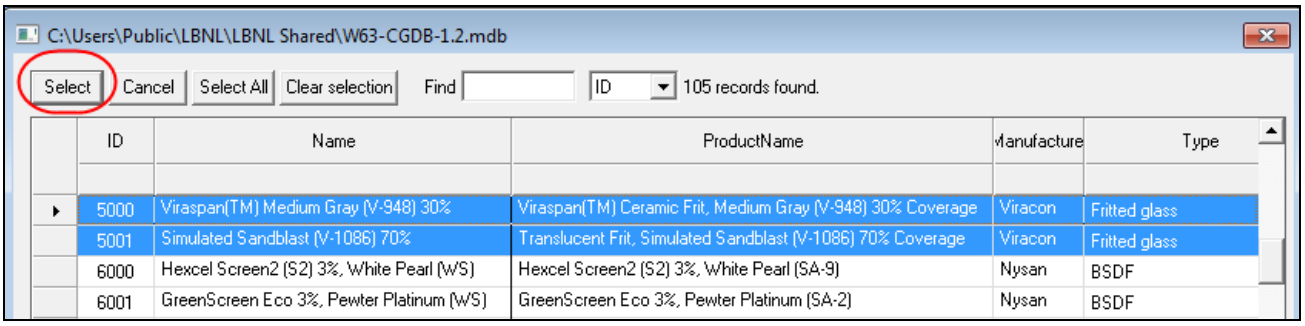


Figure 8-59. Select the desired records to be imported into the Shading Layer Library

The selected records will be imported into the Shading Layer Library.

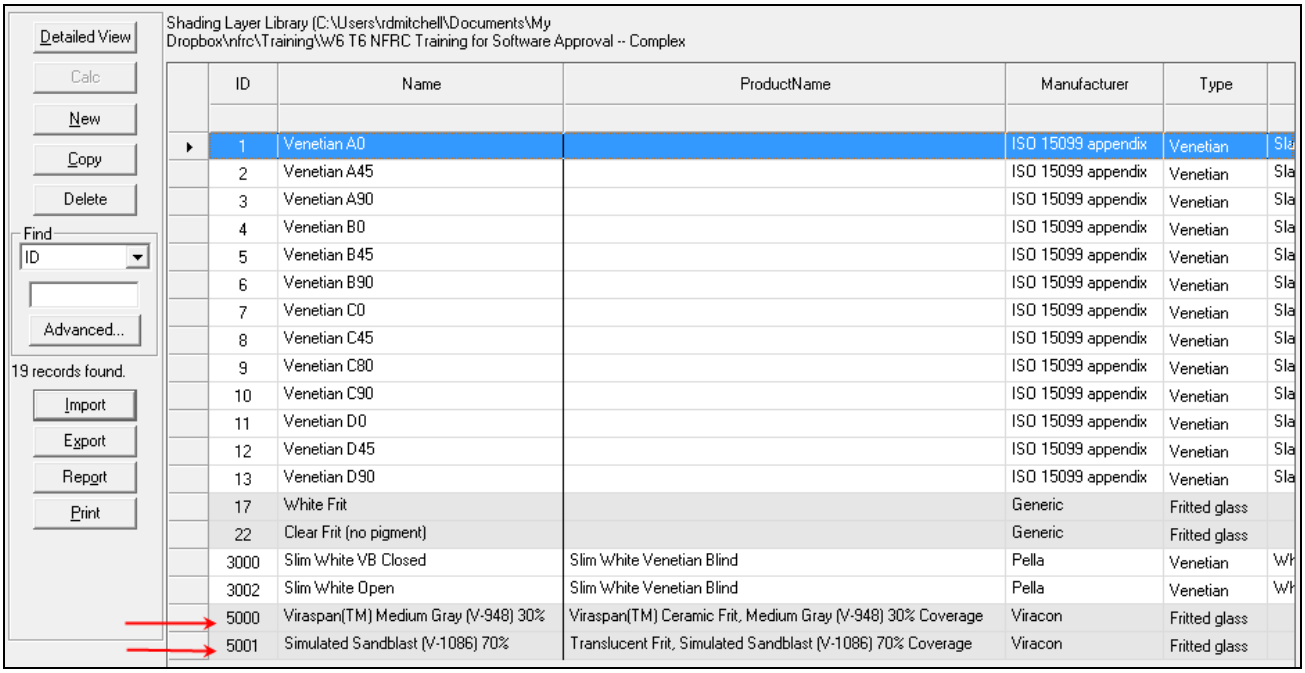


Figure 8-60. The records selected from the CGDB will be imported into the WINDOW Shading Layer Library

2. Shading Layer Library -- Fritted Glass Records

Highlight one of the fritted glass records and click on Detailed View to see the frit coverage and associated Glass Library records. You will see that there are several glass layers referenced, one for the substrate and two for the specular and diffuse optical data. If these records are not already in the Glass Library, they will automatically be imported when the Frit layer is imported into the Shading Layer Library.

If the frit coverage in the imported record does not correspond to the coverage of your product, change the value and save the record.

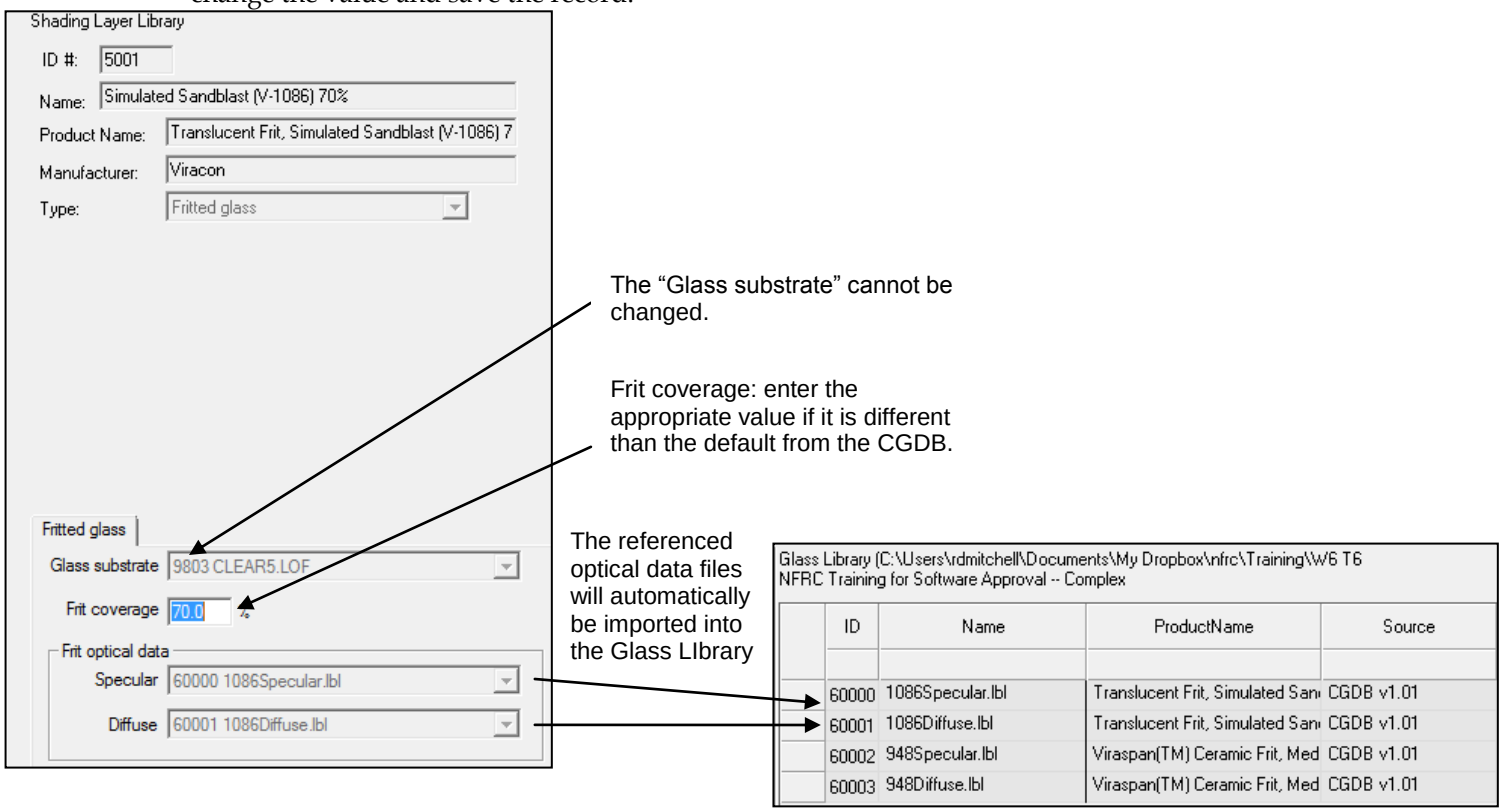


Figure 8-61. The necessary records will be imported into the Glass Library for the frit layer

3. Shading Layer Library – Venetian Blind Records

Highlight one of the Venetian blind records and click on Detailed View to see the details of the Venetian blind definition.

The Detailed View will show the Blind Geometry, which includes Effective Openness Fraction, Slat Width, Slat Spacing, Tilt, and Rise.

Effective Openness Fraction:
If the default values in the CGDB record are not what you want to model, you can edit these values as needed to model the Venetian blind correctly. In general, for NFRC certification, you are going to be modeling either Open or Closed blinds, so the Effective Openness Fraction will be:

- Retracted Open: 1.0
- Closed: 0

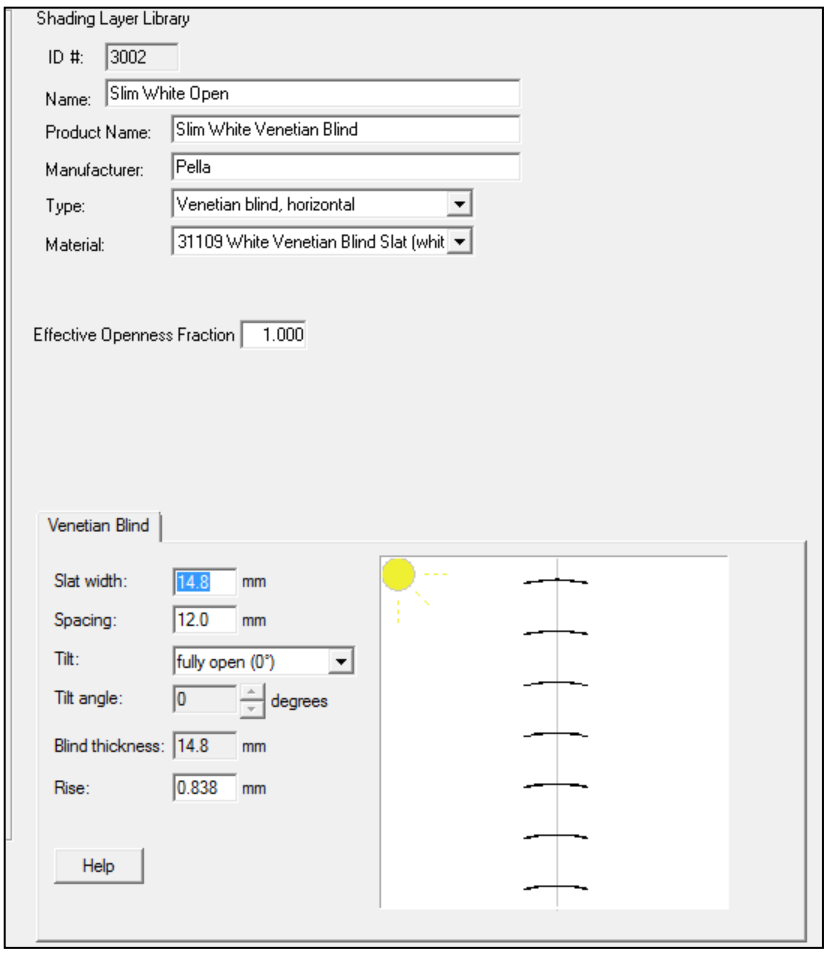
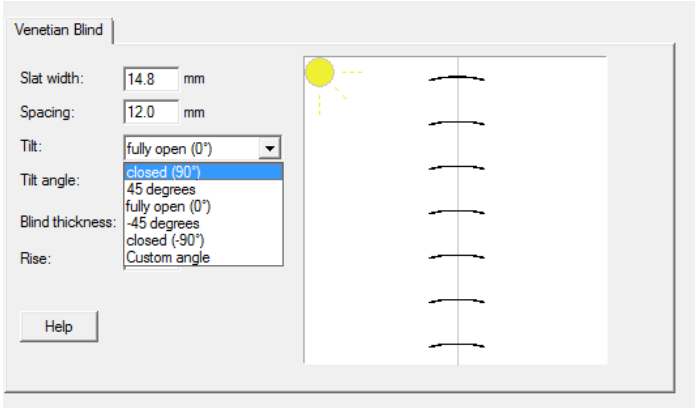


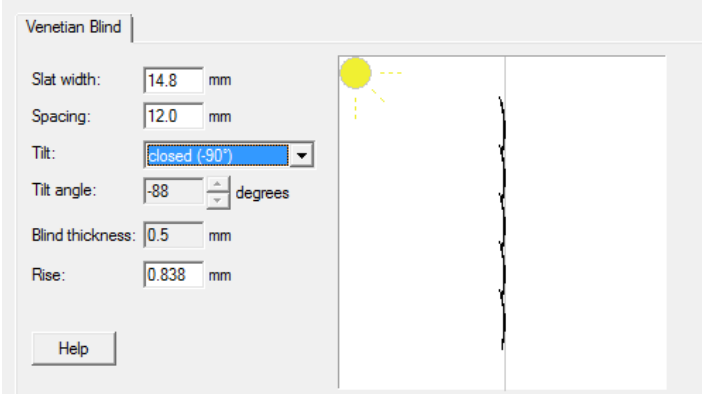
Figure 8-62. Set the Tilt as needed to define the slat geometry

Tilt:
Rather than entering a value for the Tilt angle, it is much better to select from the Tilt pulldown list, and the program will determine the actual tilt based on the curvature of the blind (derived from the Rise value)

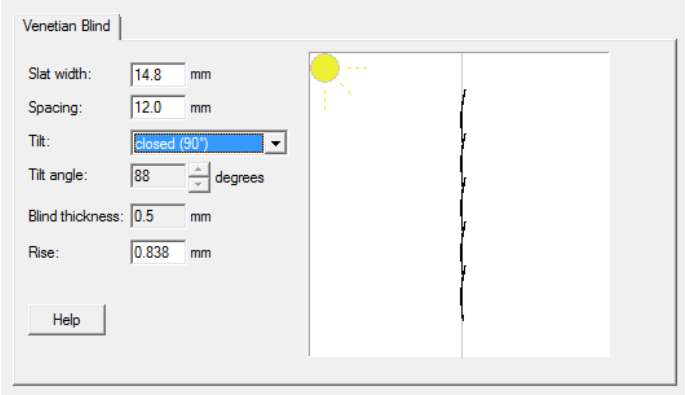
- Retracted Open: "fully open (0°)



- Closed: depending on the direction of the slat curvature, either
  - Closed (90)



  - Closed (-90)



4. **Shade Material Library – Venetian Blind Records**

When a record from the CGDB Shading Layer Library is imported into a working WINDOW database, the associated Shade Material Records are also imported.

For example, for the Venetian blind Shading Layer Library record below, the associated record in the Shade Material Library is automatically imported and associated with the Shading Layer.

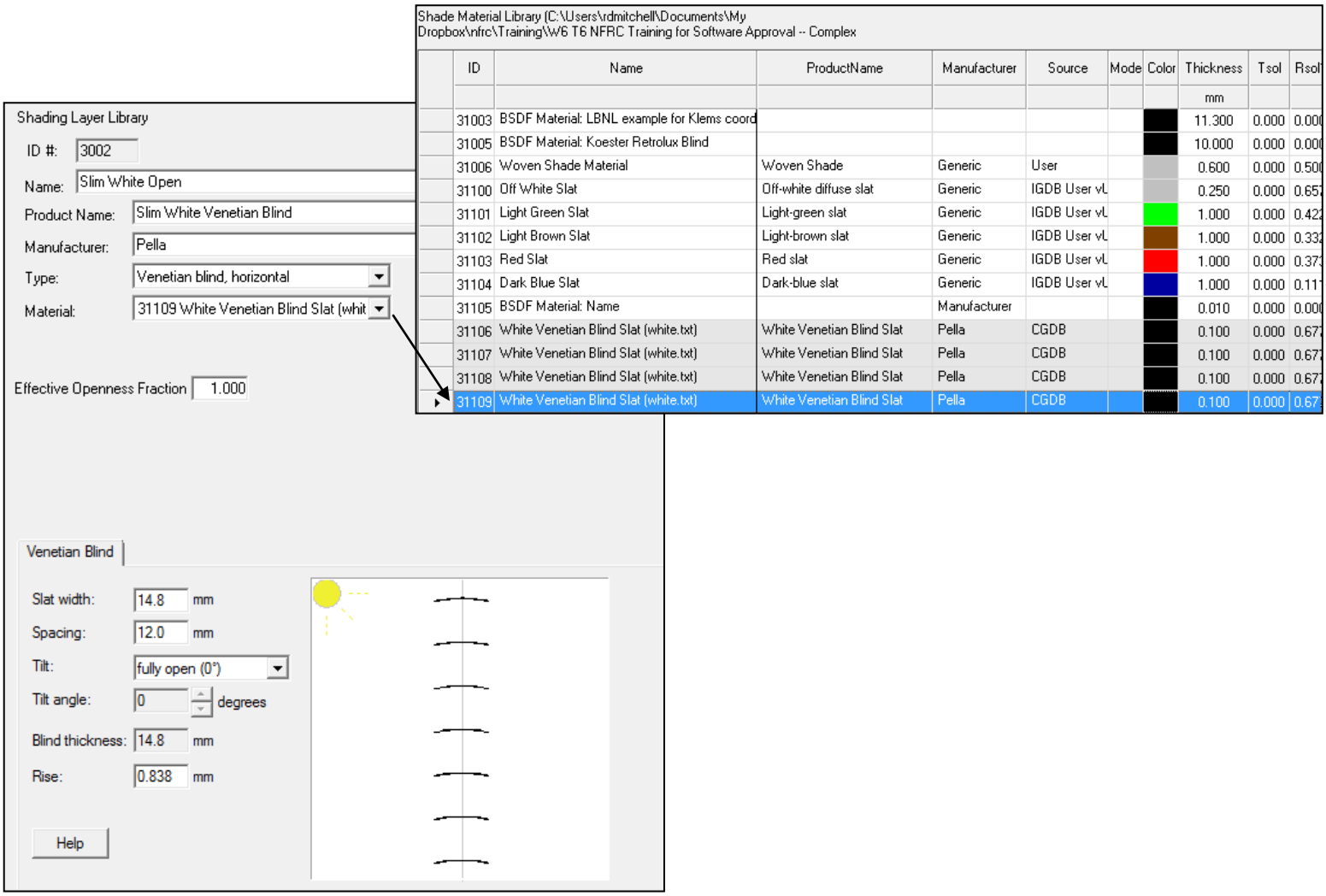


Figure 8-63. When a Shading Layer Library record is imported from the CGDB, the associated Shade Material Library record is imported automatically.