9. COMPLEX GLAZING

9.1. Overview

The following special cases are covered in this section:

9.2 Integral Venetian Blinds

Integral venetian blinds (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.

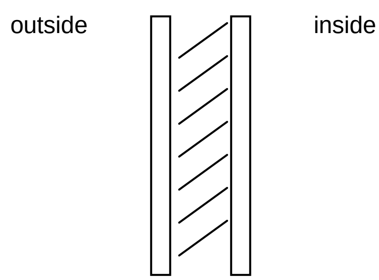


Figure 9-1. Integral Venetian Blind is a blind between two pieces of glass

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

9.2.1. 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**

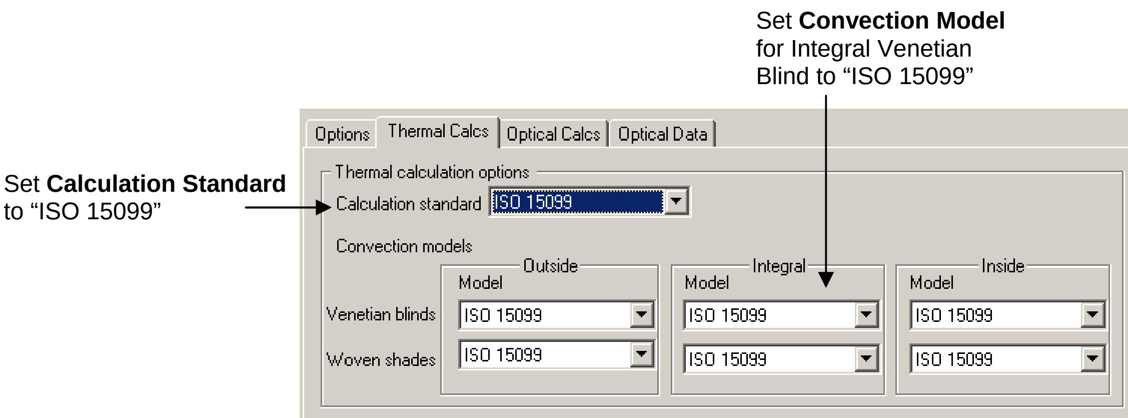


Figure 9-2. Preferences settings for Thermal Calcs Tab for Integral Venetian Blind

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**

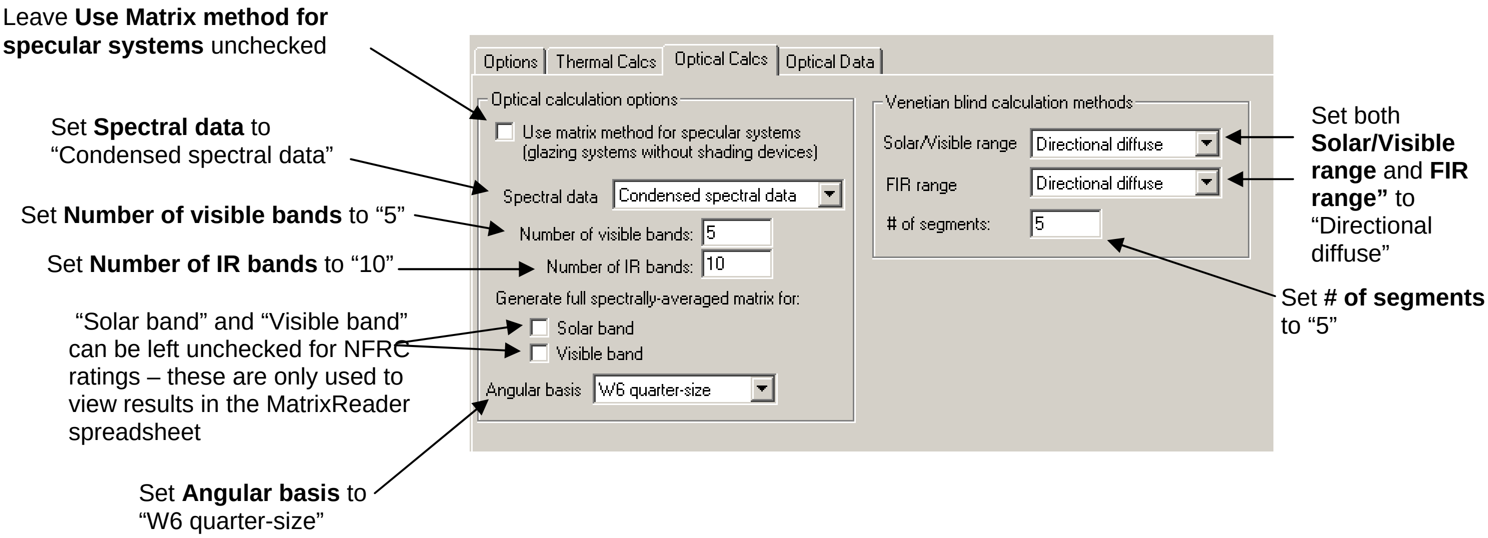


Figure 9-3. Preferences settings for Optical Calcs Tab forIntegral Venetian Blind

9.2.2. 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

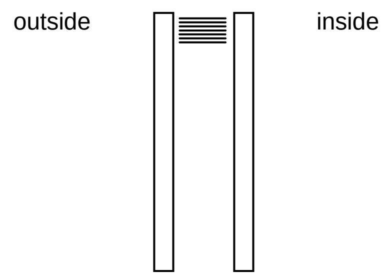


Figure 9-4. Retractable / Open Venetian Blind

- **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.

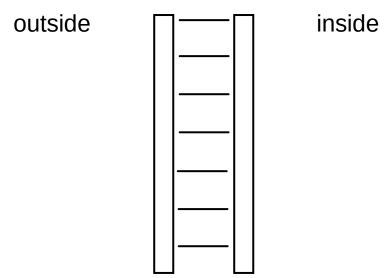


Figure 9-5. Non-Retractable / Open Venetian Blind

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.

9.2.1.1. 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 an integral venetian blind, 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

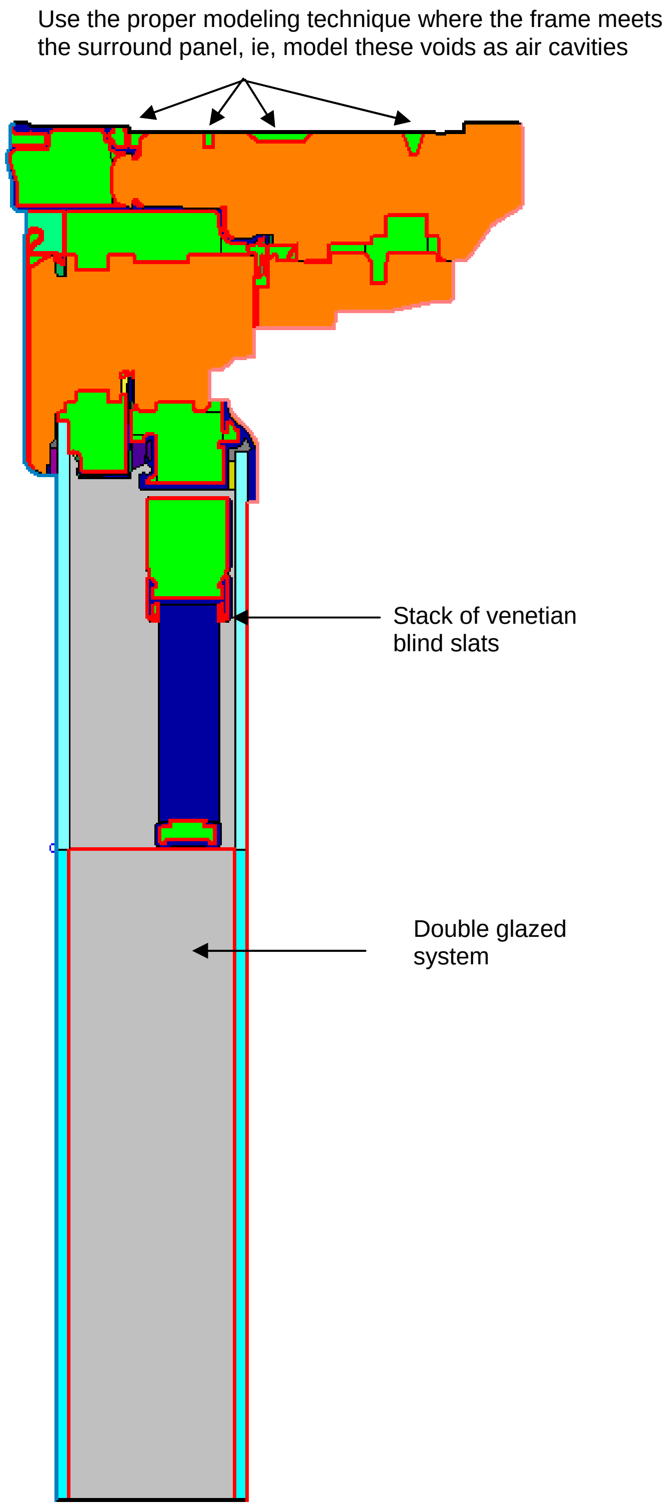


Figure 9-6. Head cross section with fully retracted venetian blind inside a double-glazed system.

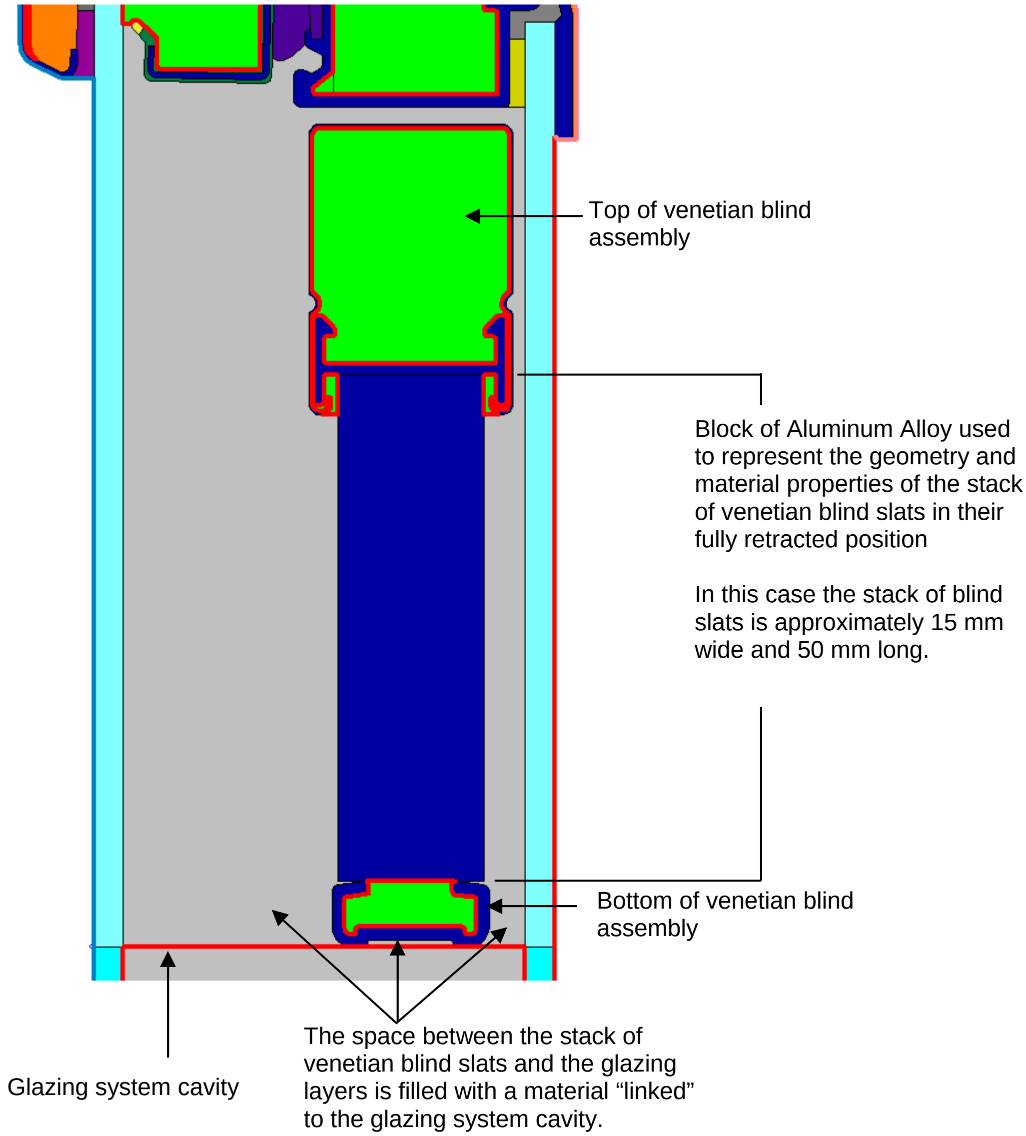


Figure 9-7. The Head cross section with the retracted venetian blind, including the stacked slats, and the top and bottom assemblies for the blind that are continuous across the section.

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.

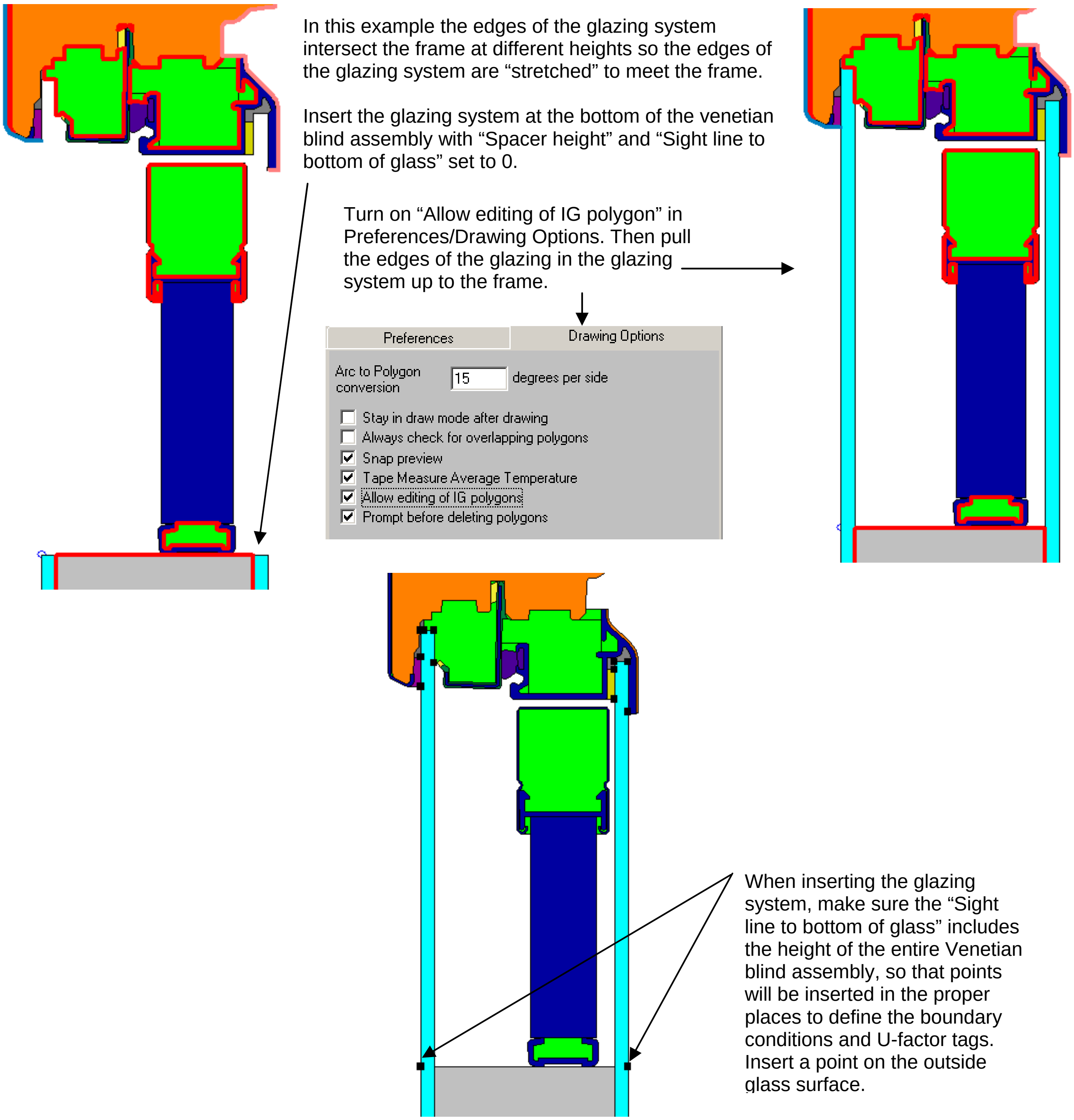


Figure 9-8. Insert the glazing system.

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.

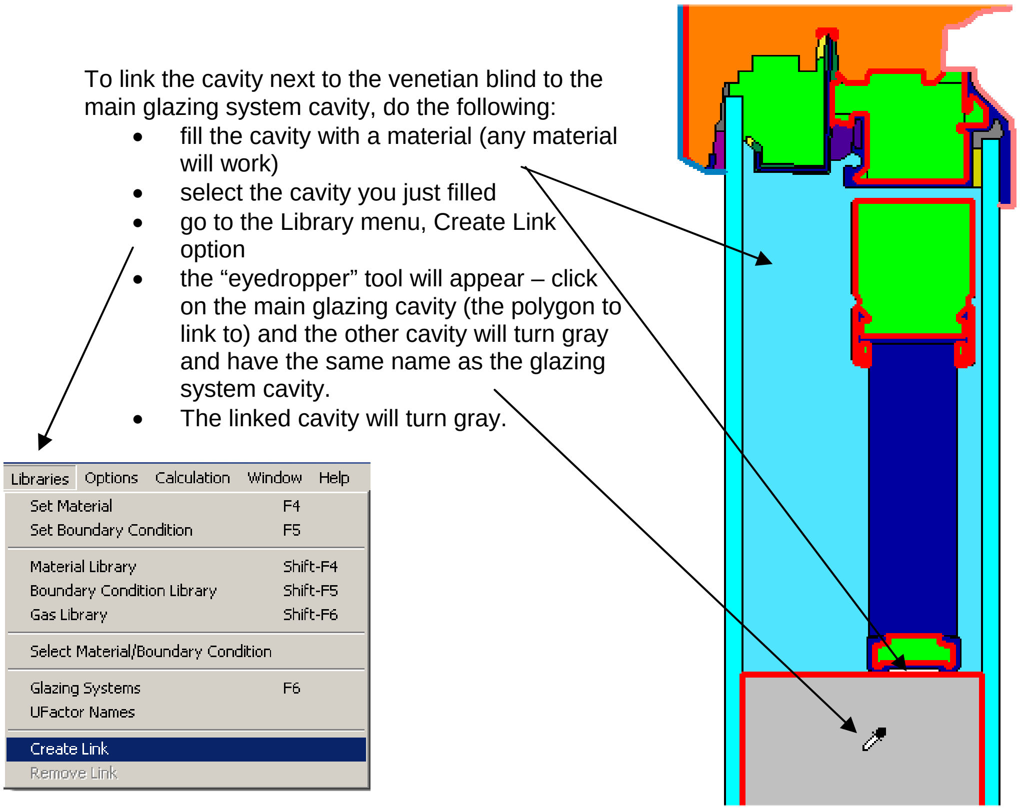


Figure 9-9. Fill the cavity next to the venetian blind by linking it to the main glazing cavity.

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".

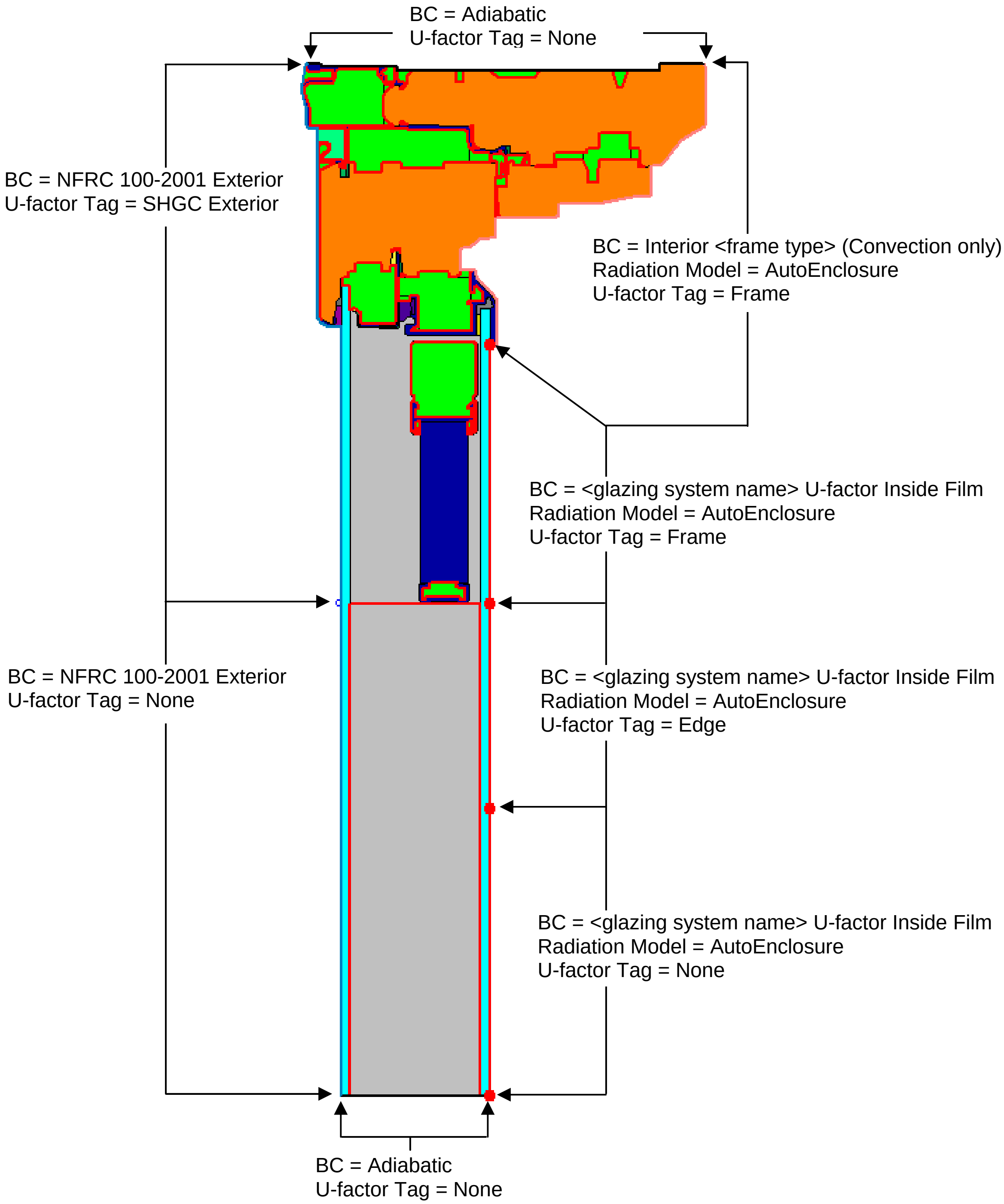


Figure 9-10 Define the boundary conditions for the cross section

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.

9.2.1.2. 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.

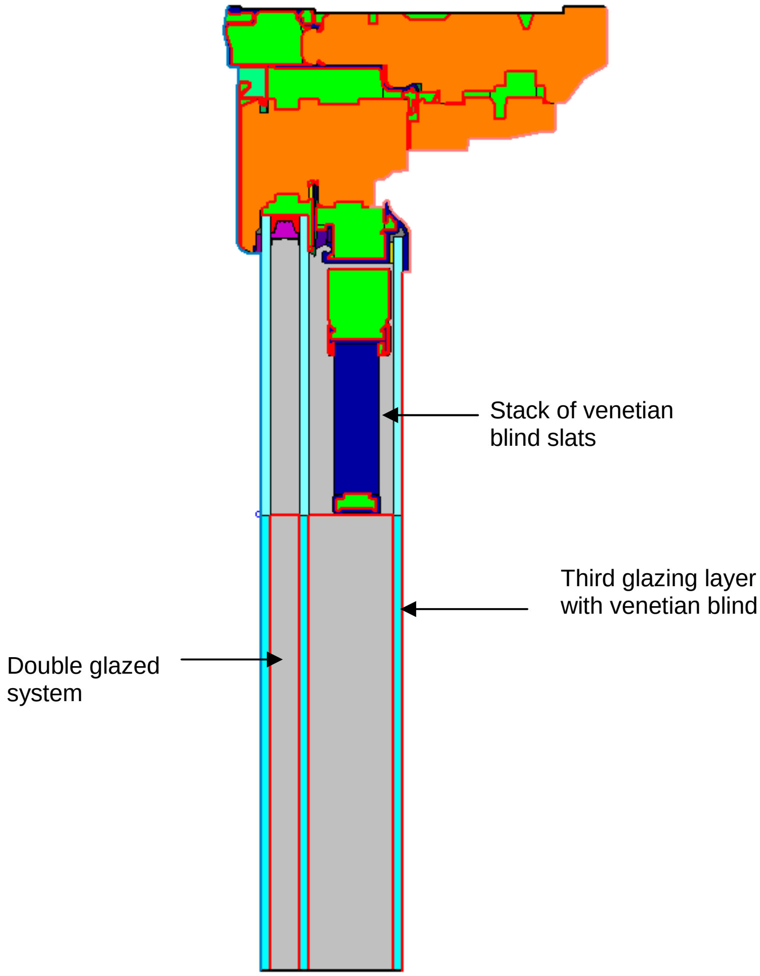


Figure 9-11. Head cross section with fully retracted venetian blind between a double-glazed system and a third glazing layer.

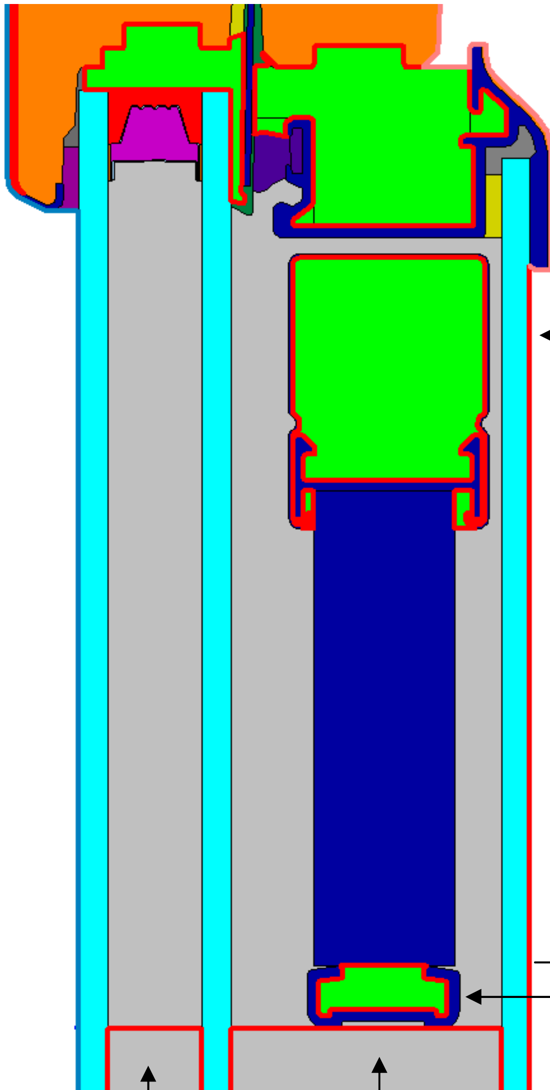


Figure 9-12. The Head cross section with the retracted venetian blind, including the stacked slats, and the top and bottom assemblies for the blind that are continuous across the section.

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.

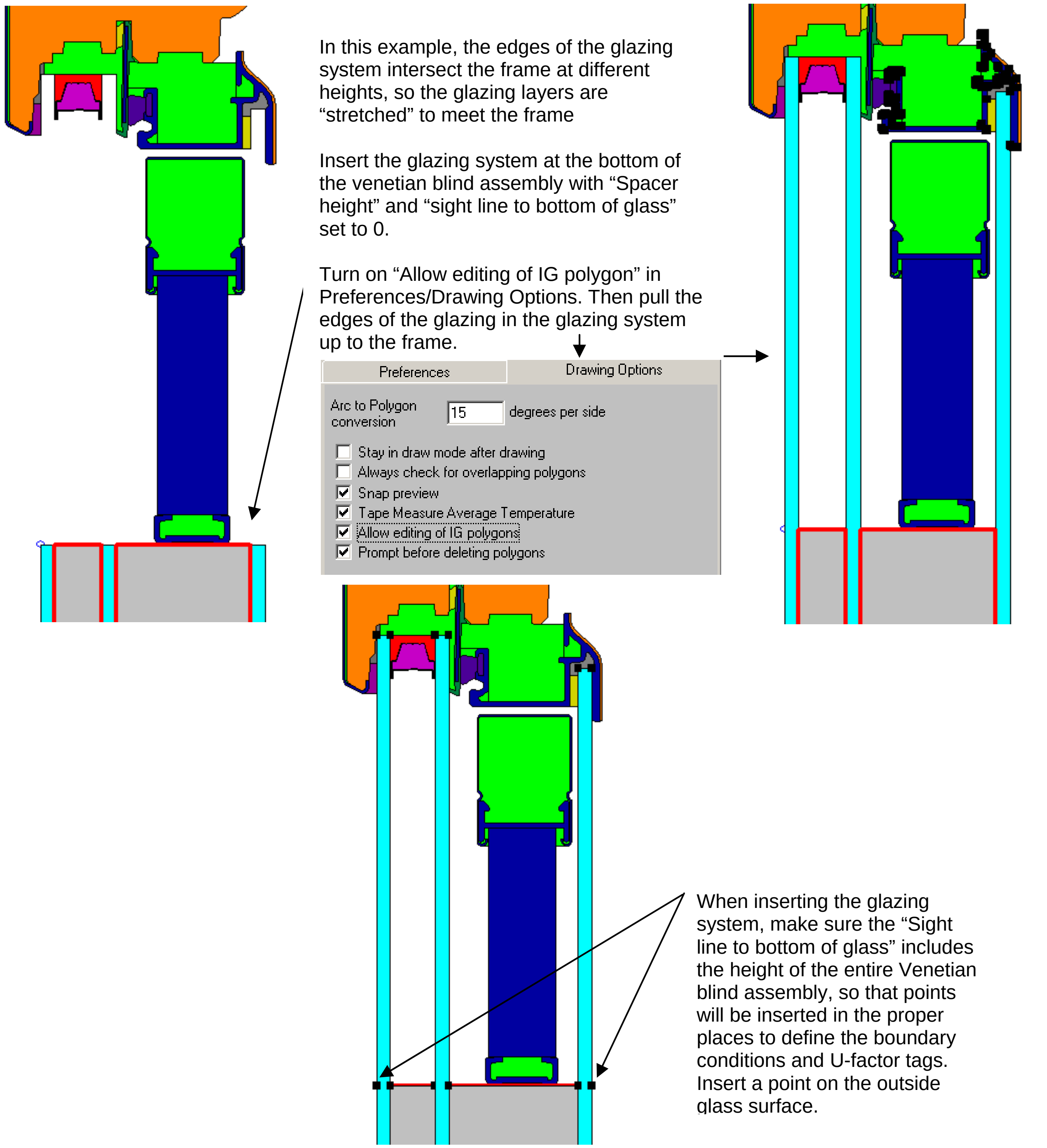


Figure 9-13. Insert the glazing system and edit it if necessary to bring the glazing layers to the frame.

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.

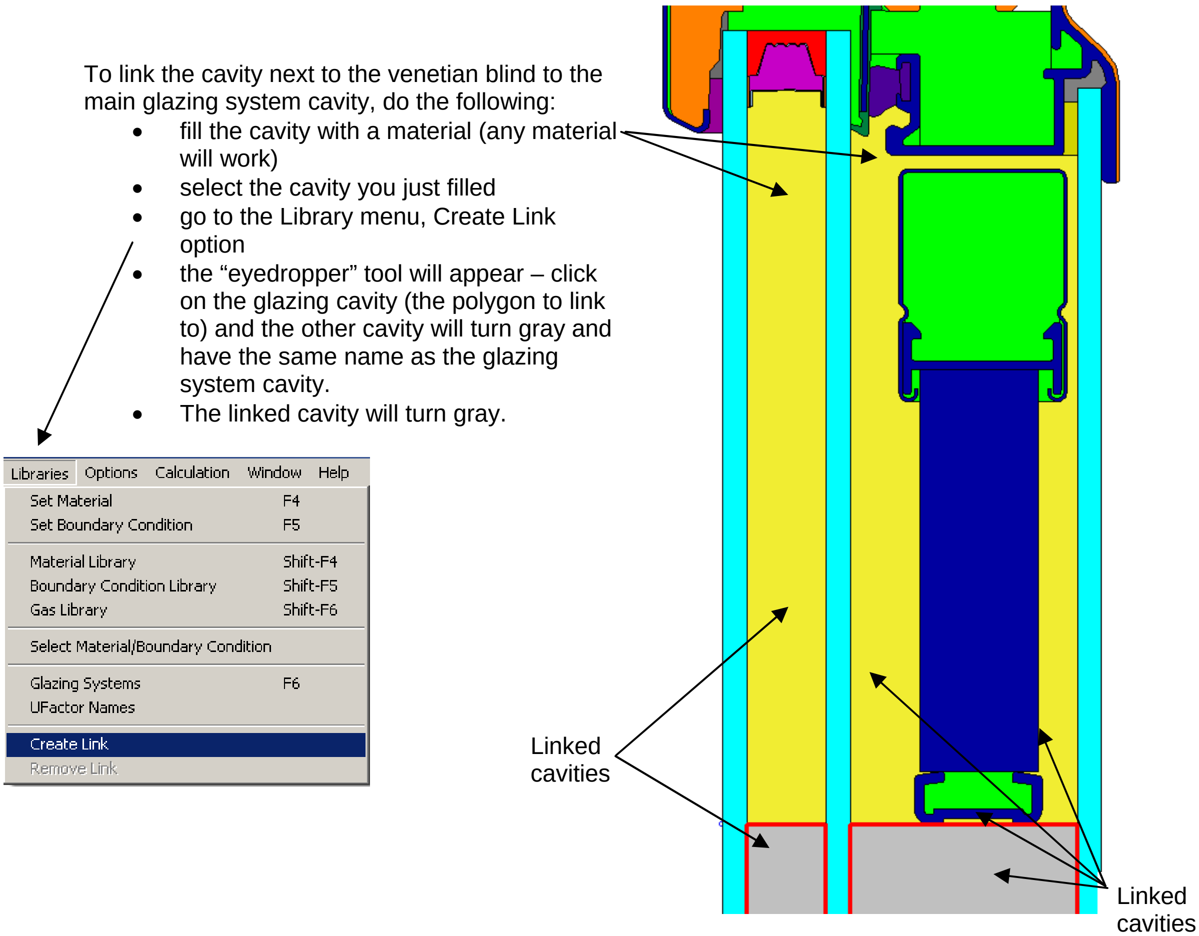


Figure 9-14. Fill the cavity next to the venetian blind by linking it to the main glazing cavity.

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”.

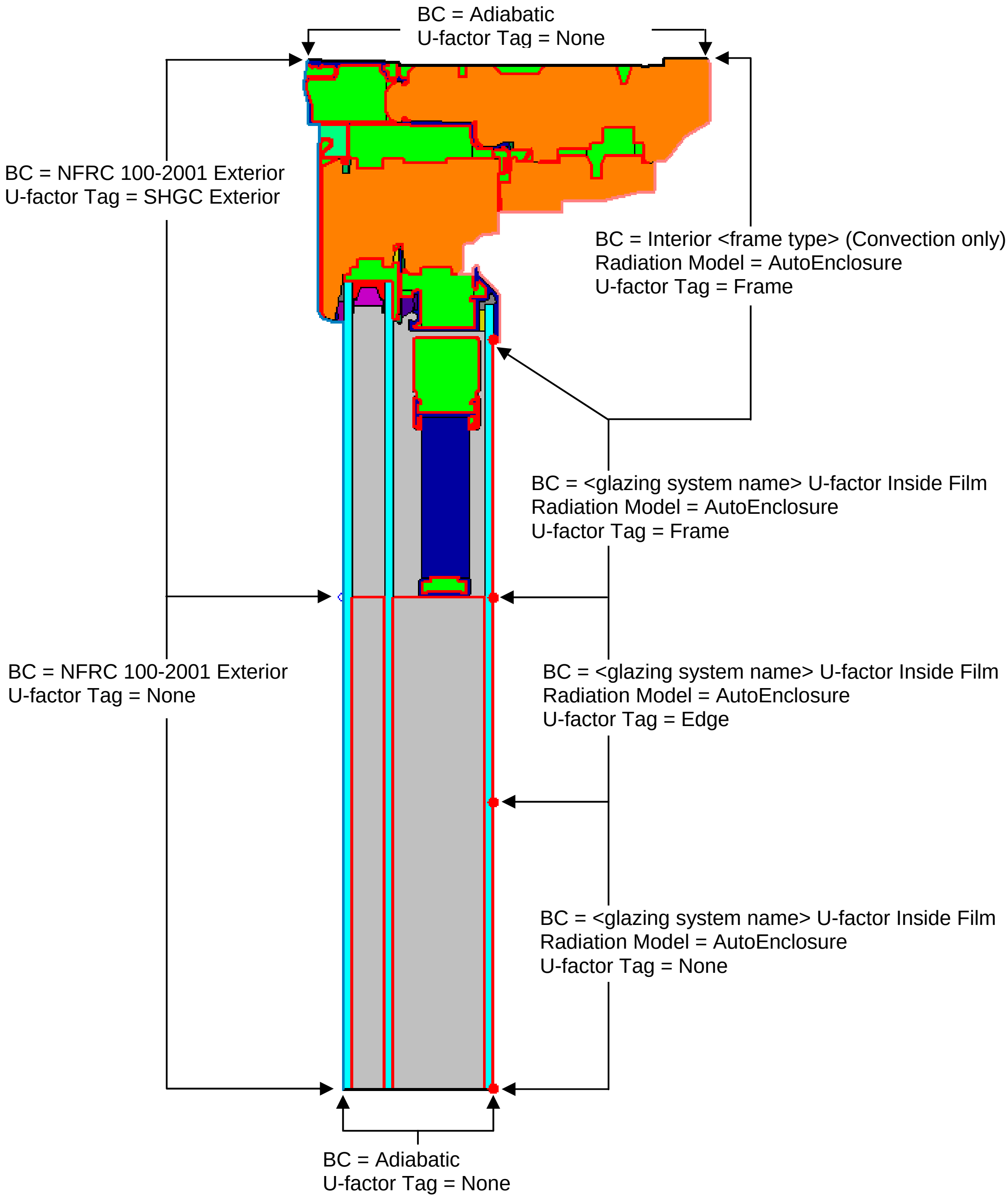
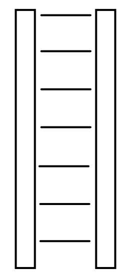


Figure 9-15 Define the boundary conditions for the cross section

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.

9.2.1.3. 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. **Shade Material Library:** Make sure that the appropriate material is in the Shade Material Library. If it is not, contact the manufacturer to submit data to the Complex Glazing Database (CGDB). For this example, we are using the generic blind material called "Off White Slat".

   Make sure to check the slat thickness of the material definition, and create a new record with the appropriate thickness if the default material does not have the thickness used in the blind being modeled.
2. **Shading Layer Library:** Reference the "Off White Slat" material and define the Venetian Blind geometry (horizontal slats) in the Shading Layer 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. **Shade Material Library:** Make sure that the appropriate material is in the Shade Material Library (accessed from Libraries/Shade Material). If it is not, contact the manufacturer to submit data to the CGDB. For this example, we are using the generic blind material called “Off White Slat”.

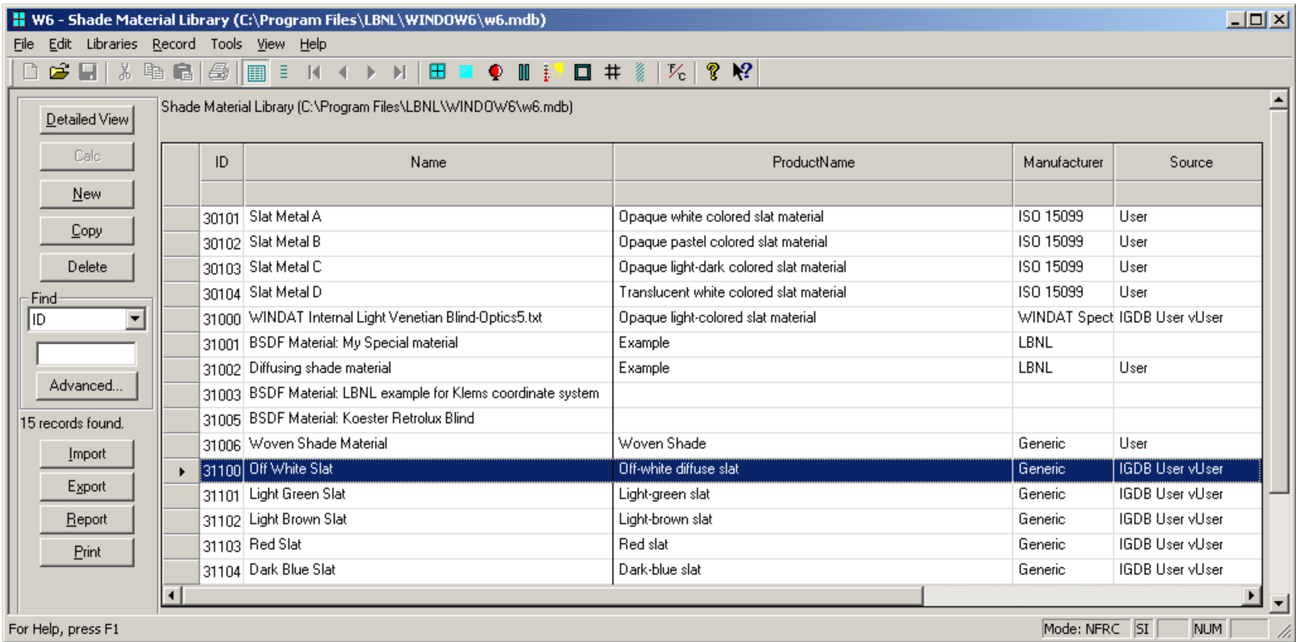


Figure 9-16 Make sure the appropriate material is defined in the Shade Material Library (accessed from Libraries/Shade Material)

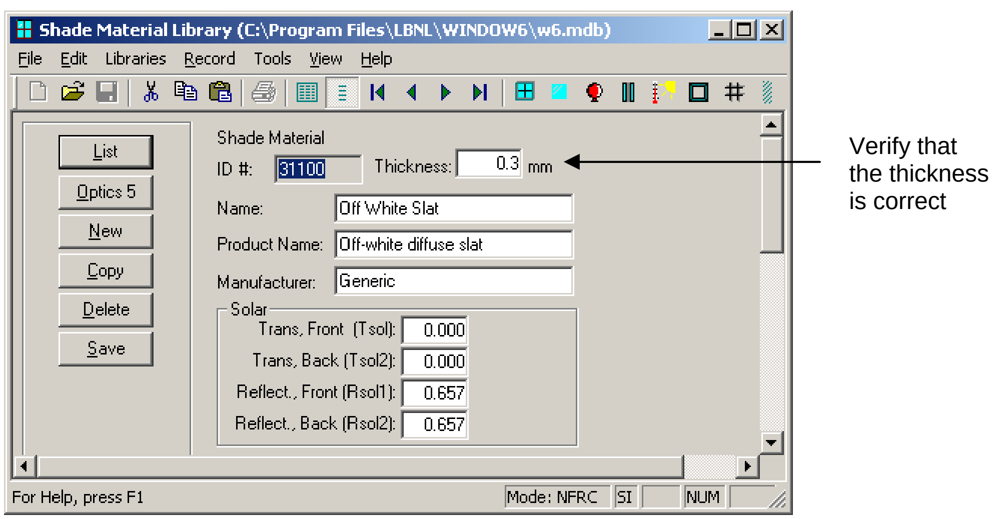


Figure 9-17 Make sure the Venetian blind thickness is correct in the Shade Material Library.

Make sure that the thickness defined in the Shade Material is correct for the Venetian blind slat material being modeled.

2. **Shading Layer Library:** Define the Venetian Blind geometry (horizontal slats) in the Shading Layer Library

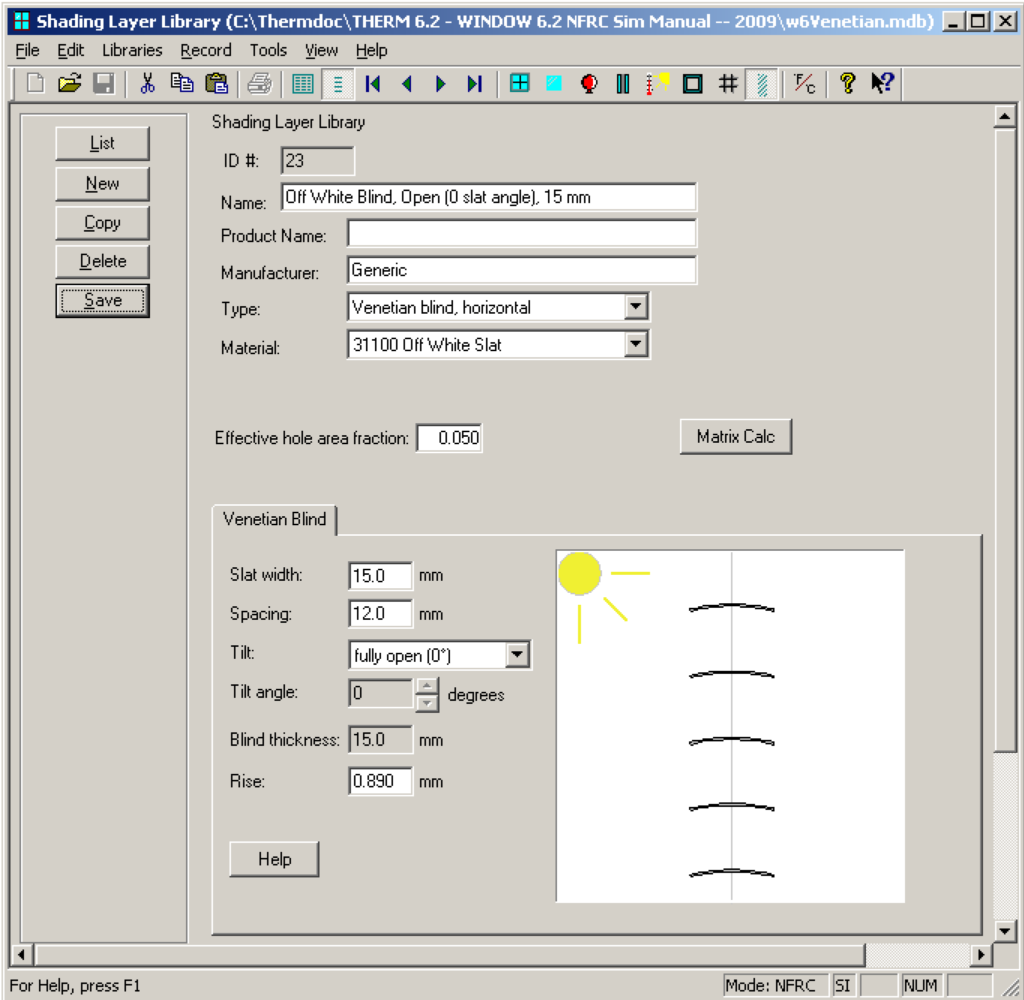


Figure 9-18 Define the venetian blind geometry for the "open" (horizontal) slats

- **Type** = Venetian blind, horizontal
- **Material** = Off White Slat
- **Slat Width** = appropriate value, in this example 15 mm
- **Spacing** = spacing between each slat, in this example 12 mm
- **Tilt** = "fully open (0°)" for a slat in the horizontal position

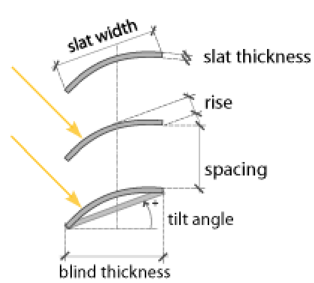


Figure 9-19 Venetian blind geometry definition

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

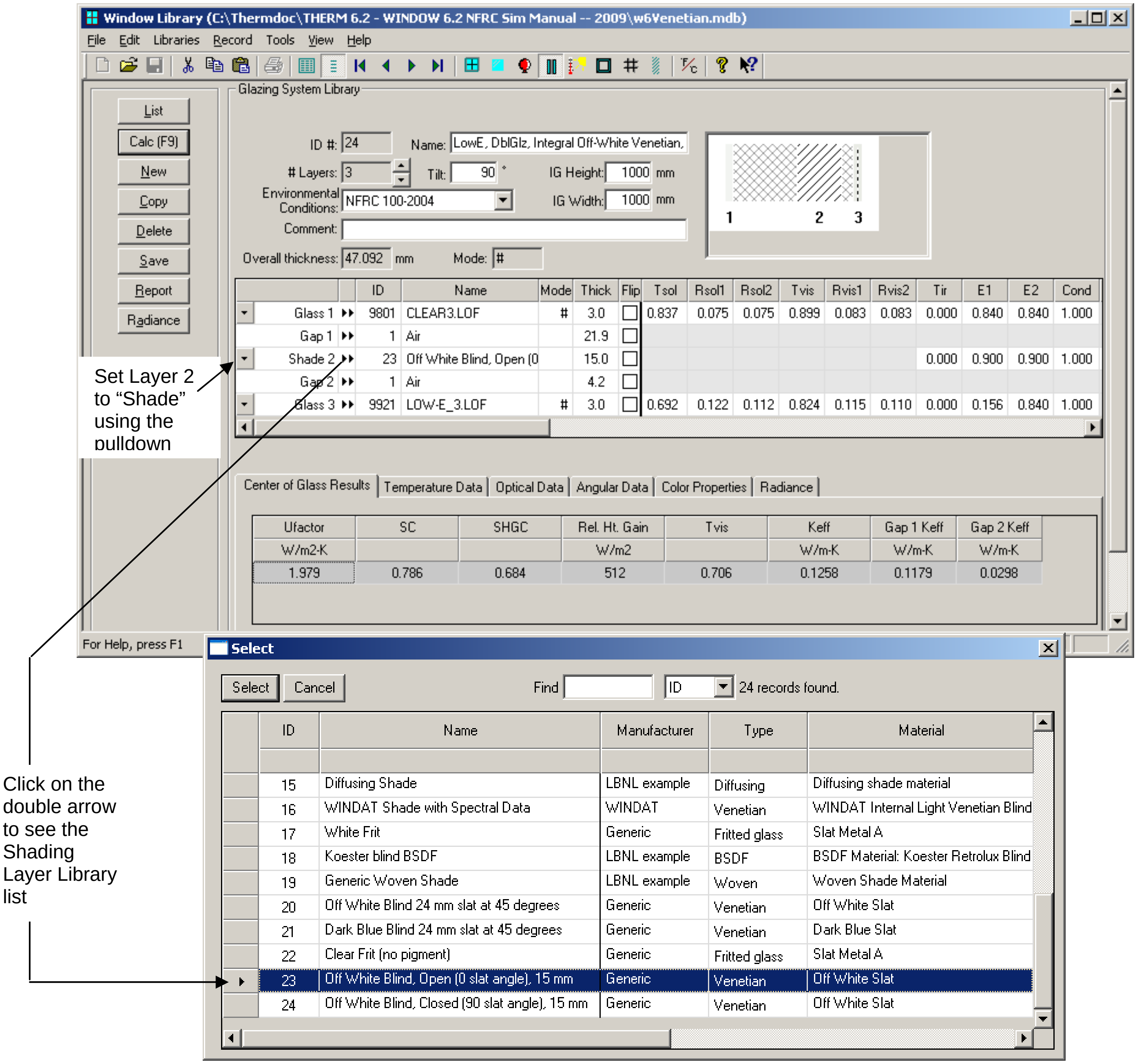


Figure 9-20.For the middle layer in the Glazing System (Layer #2), select the venetian blind from the Shading System Library.

- 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

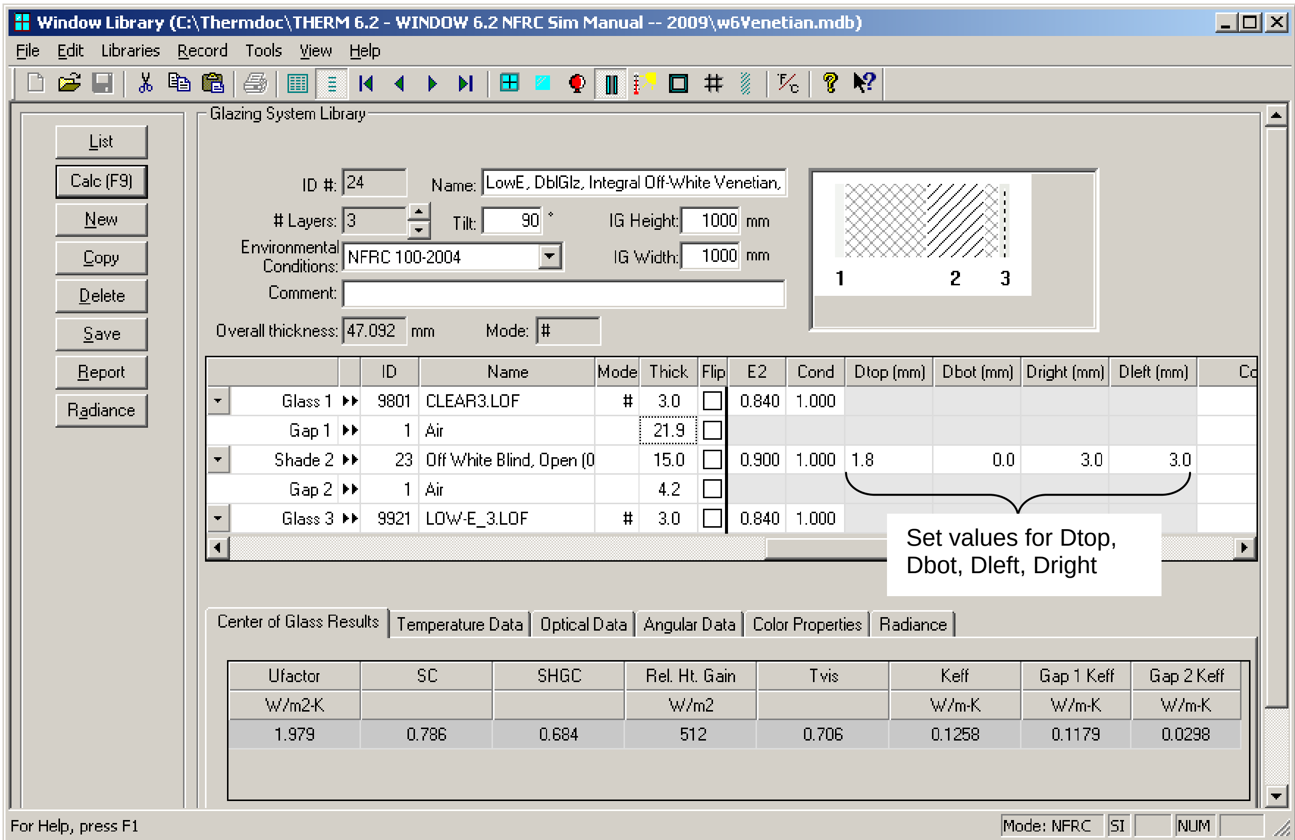


Figure 9-21. Define a Dtop, Dbot, Dleft and Dright in the Glazing System Library.

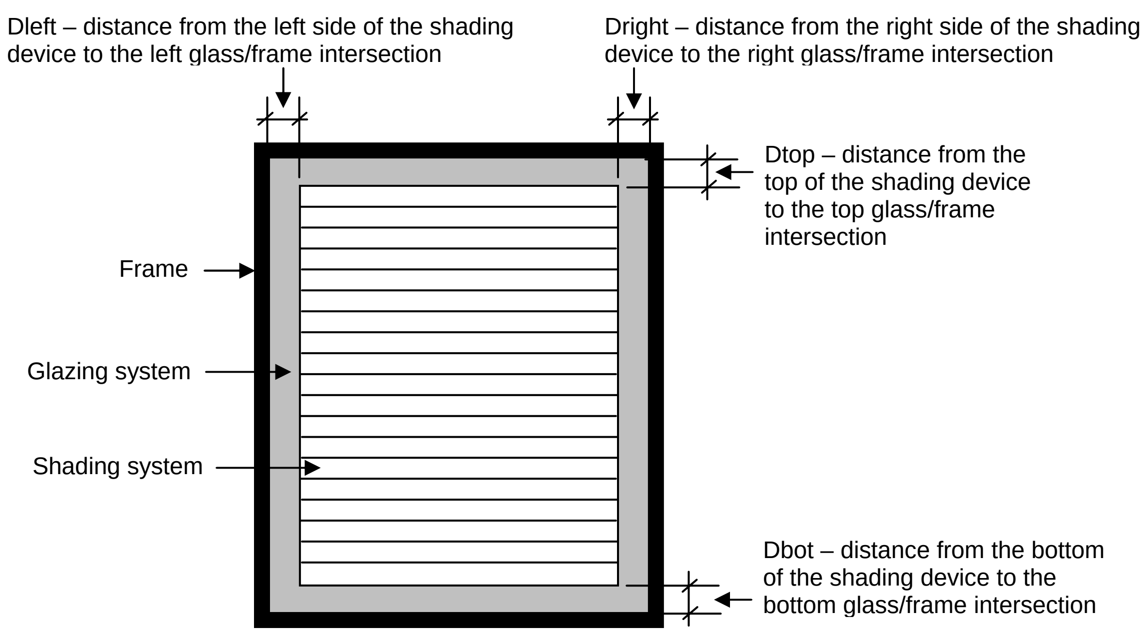


Figure 9-22. Definition of Dtop, Dbot, Dleft and Dright for an interior venetian blind.

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).
   - Site Line to bottom of glass: include the **height of both the Venetian blind hardware and Dtop (or Dbot, Dleft or Dright depending on the cross section)**. This will automatically insert a point in the glazing system and set the U-factor tag as Frame based on where the Venetian blind hardware ends.

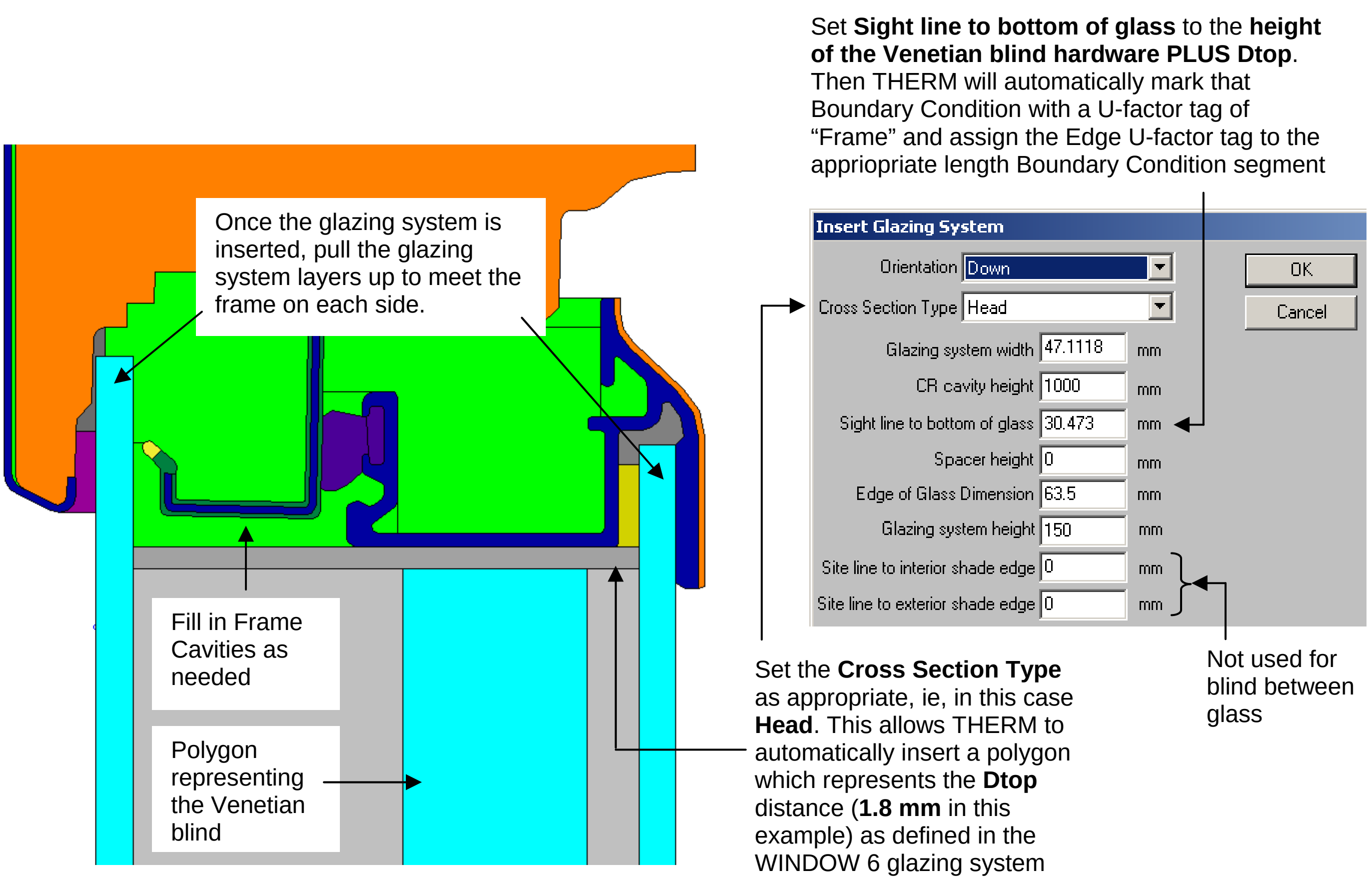


Figure 9-23. Insert the glazing system with the Venetian blind

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. **(Allow editing of IG polygons** must be checked in Options\Preferences\Drawing Options tab).

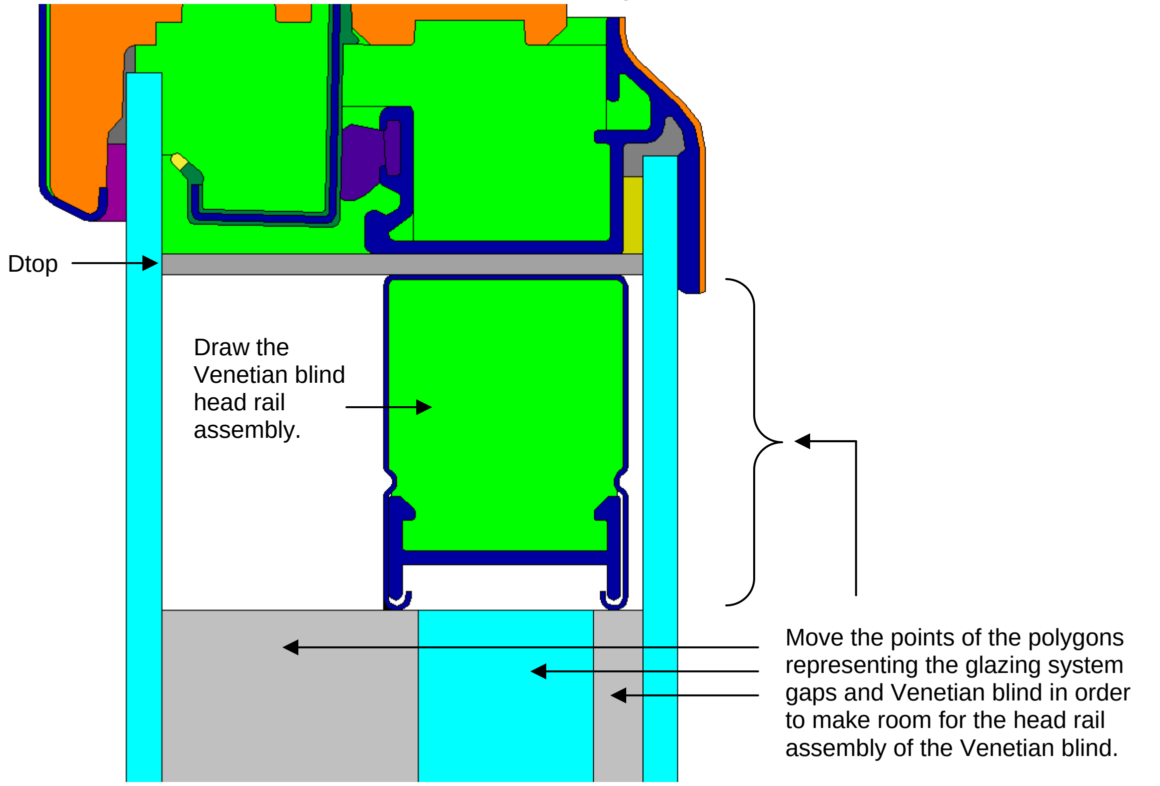


Figure 9-24. Insert the Venetian blind hardware.

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

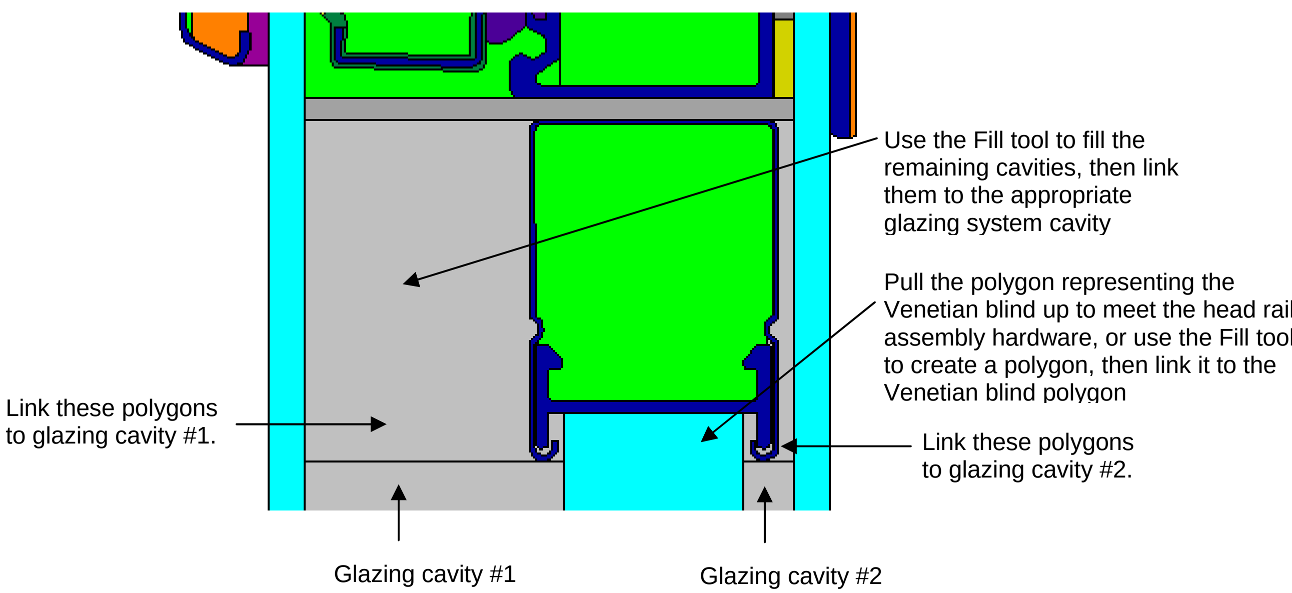


Figure 9-25. Fill the remaining cavities and link to the appropriate glazing system cavities.

5. Create the other cross sections in this manner.

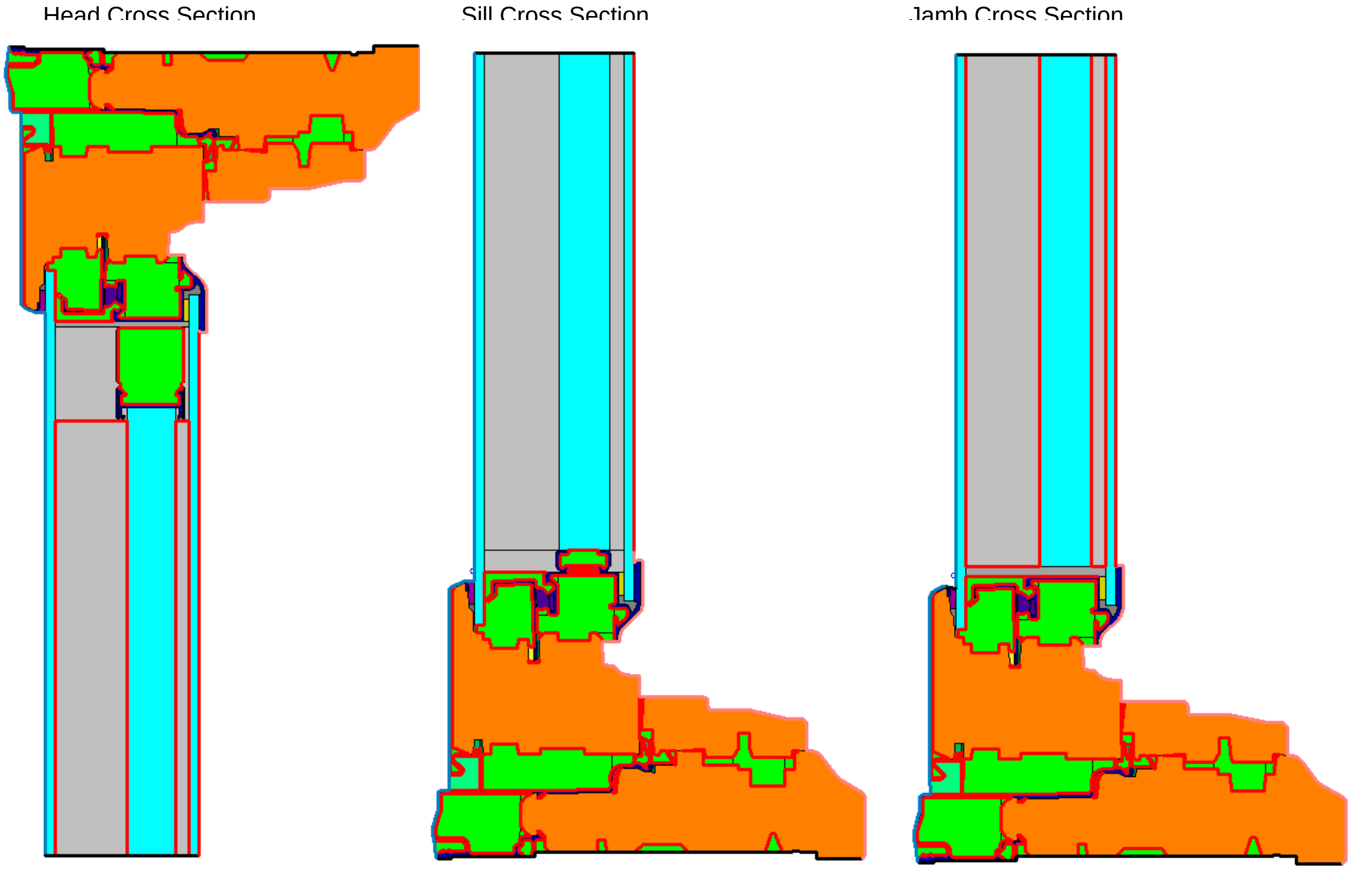


Figure 9-26. Head, Sill and Jamb cross sections for Non-retractable Open Venetian Blind between glass layers (Integral)

6. **Boundary Conditions:** For Integral Venetian Blinds, the **Shading System Modifier** choice will autoatically be set to "None"

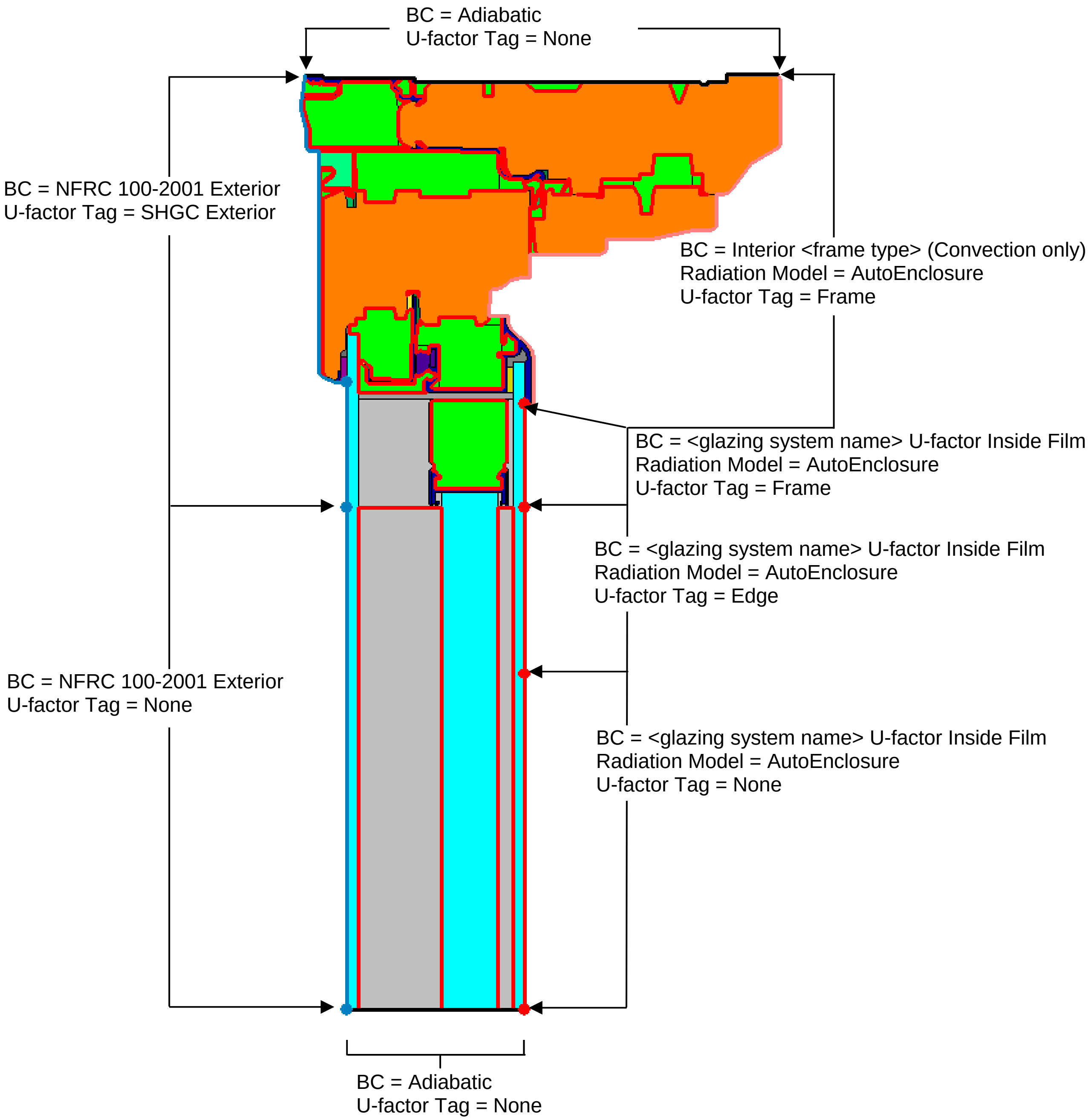


Figure 9-27. Define the boundary conditions for each cross section

7. Simulate each cross section and save the results

.In WINDOW:

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

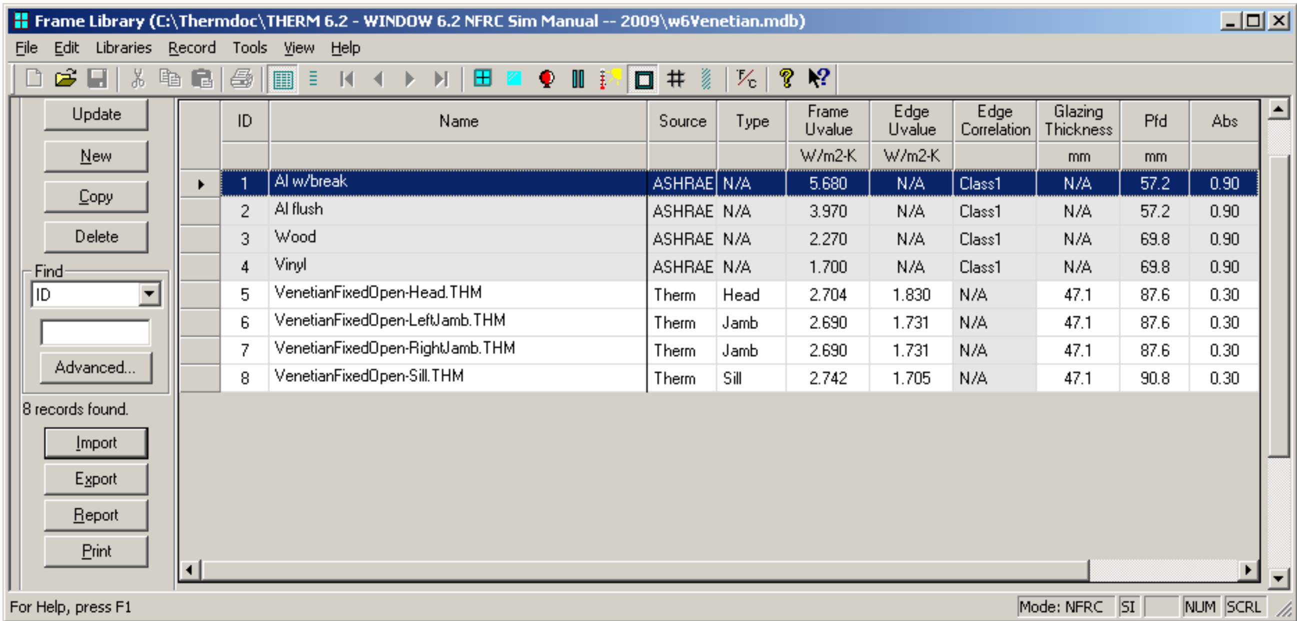


Figure 9-28. Import the THERM files into the WINDOW Frame Library

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

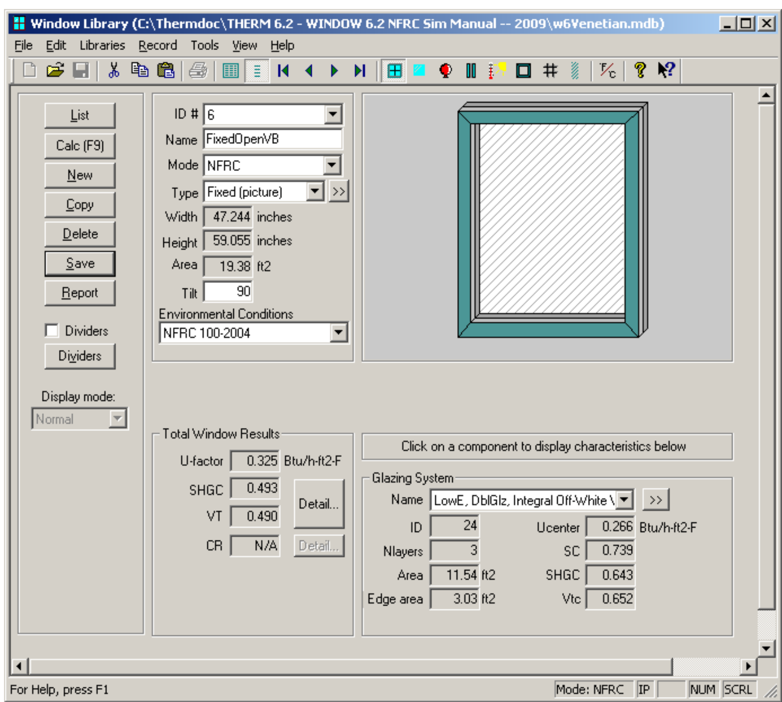


Figure 9-29. Define the window.

9.2.2. 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.

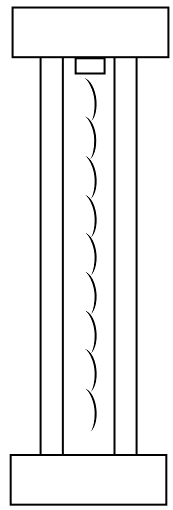


Figure 9-30. A closed Venetian blind.

In WINDOW:

1. **Shade Material Library:** Make sure that the appropriate material is in the Shade Material Library. If it is not, contact the manufacturer to submit data to the CGDB. For this example, we are using the generic blind material called "Off White Slat".
2. **Shading Layer Library:** Reference the "Off White Slat" material and define the Venetian Blind geometry (vertical "closed" slats) in the Shading Layer Library
3. **Glazing System Library:** Define the glazing system with the closed 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 (vertical "closed" 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. **Shade Material Library:** Make sure that the appropriate material is in the Shade Material Library. If it is not, contact the manufacturer to submit data to the CGDB. For this example, we are using the generic blind material called "Off White Slat".

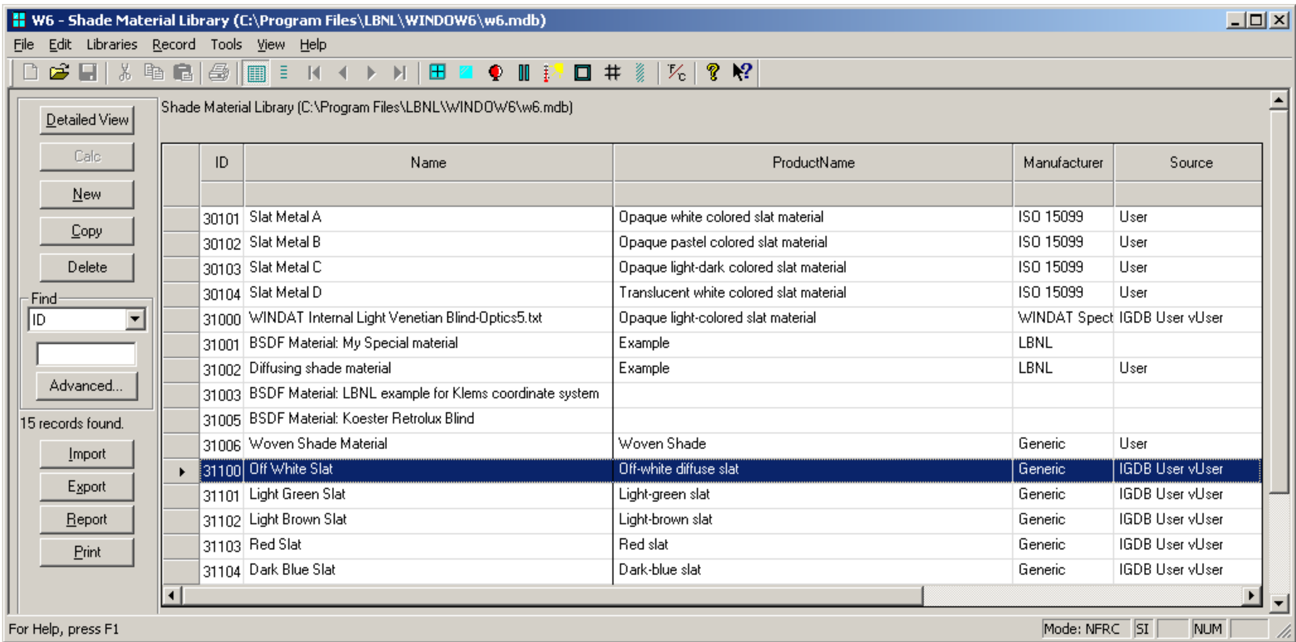


Figure 9-31 Make sure the appropriate material is defined in the Shade Material Library (accessed from Libraries/Shade Material)

2. **Shading Layer Library:** Reference the "Off White Slat" material and define the Venetian Blind geometry (vertical "closed" slats) in the Shading Layer Library.

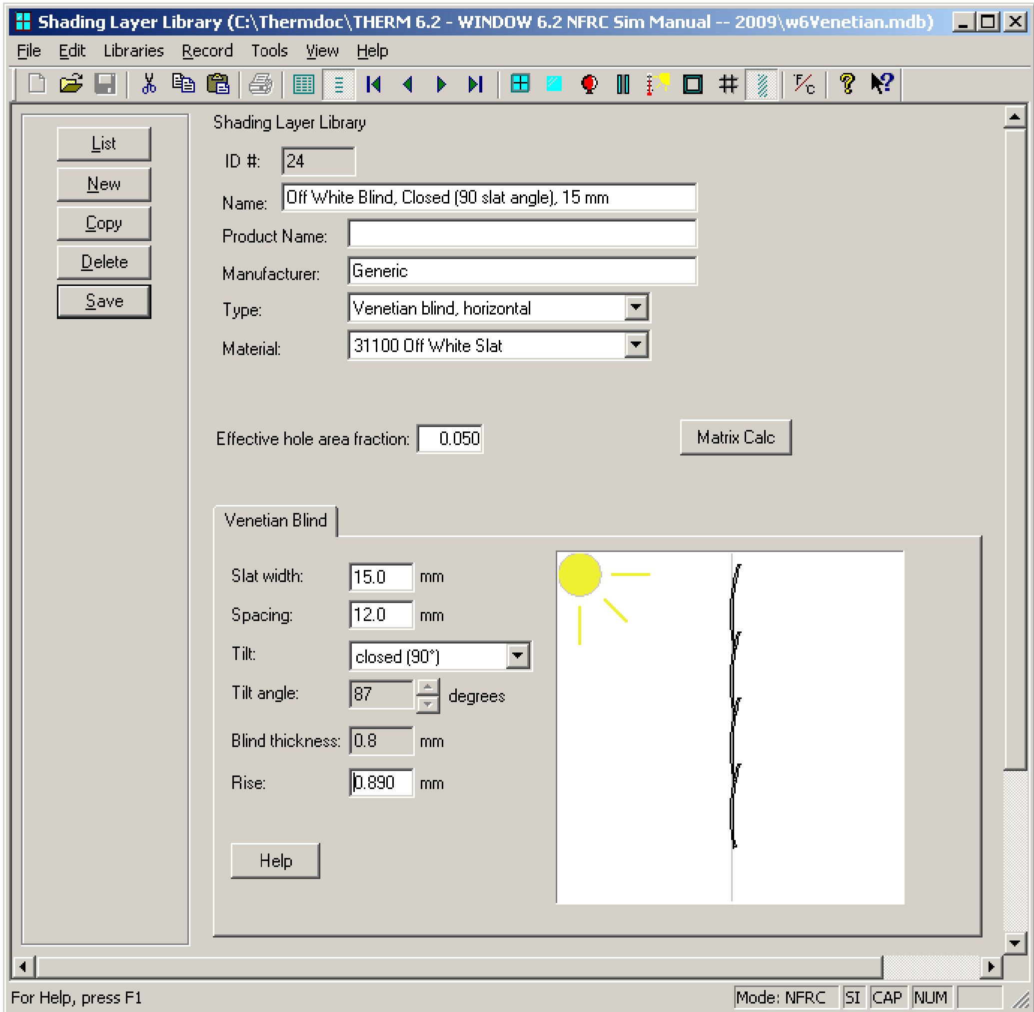


Figure 9-32 Define the venetian blind geometry for the "closed" (vertical) slats

NOTE: The tilt definition should actually be Closed -90 to have the curves of the slat facing the correct direction, but WINDOW will not model a tilt of -90. This is abug and will be fixed in the final version of the program.

Glazing System Library: Define the glazing system with the closed venetian blind between two layers of glass. Make sure to adjust the thickness of the gaps on either side of the Venetian blind, because in the closed position the blind thickness is quite small.

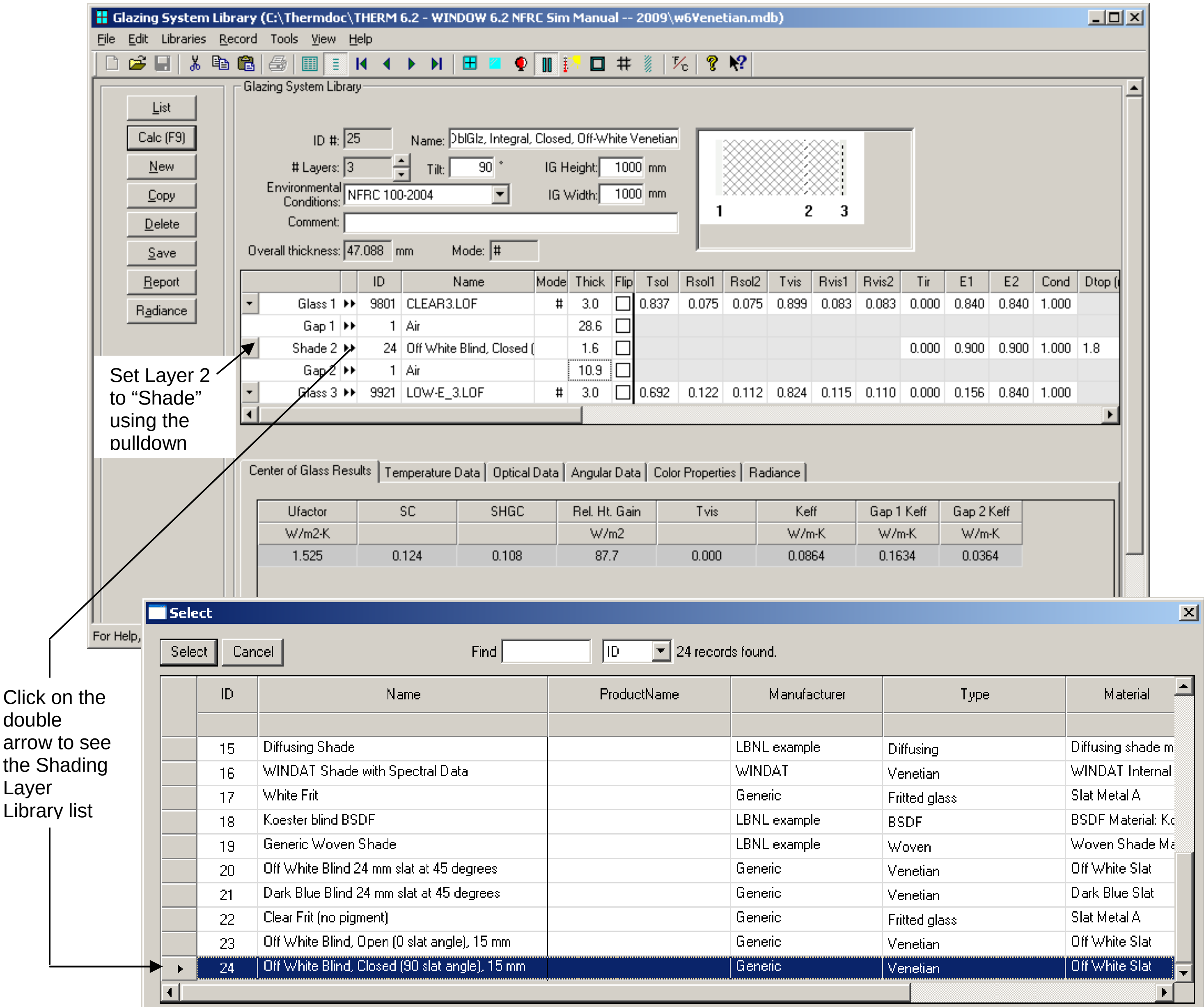


Figure 9-33.For the middle layer in the Glazing System (Layer #2), select the venetian blind from the Shading System Library.

- Set Number of layers = 3
- Set Layer #2 to Shade (from pulldown arrow to the left in the first column) and select the appropriate shading layer from the **Shading Layer Library** using the double arrow button

3. Set Dtop, Dbot, Dright, Dleft to the appropriate values for the venetian blind geometry

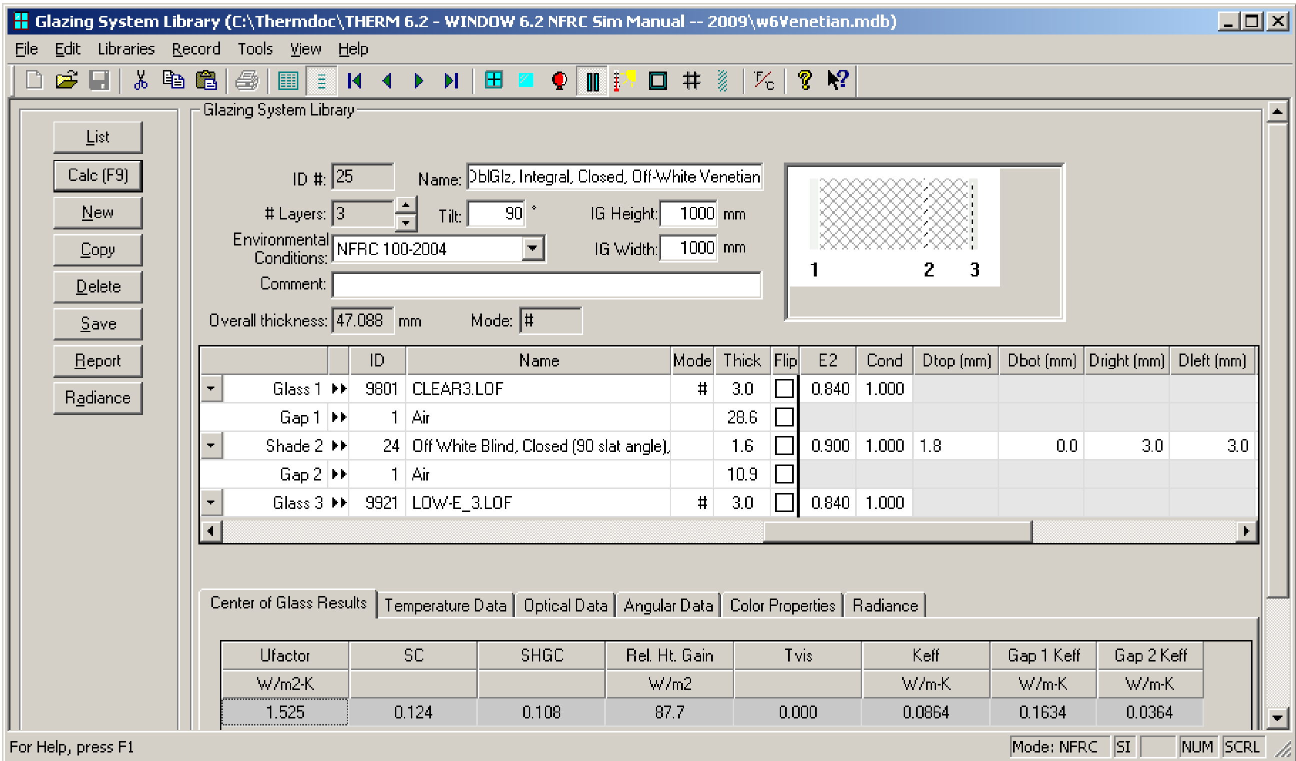


Figure 9-34. Define a Dtop, Dbot, Dleft and Dright in the Glazing System Library.

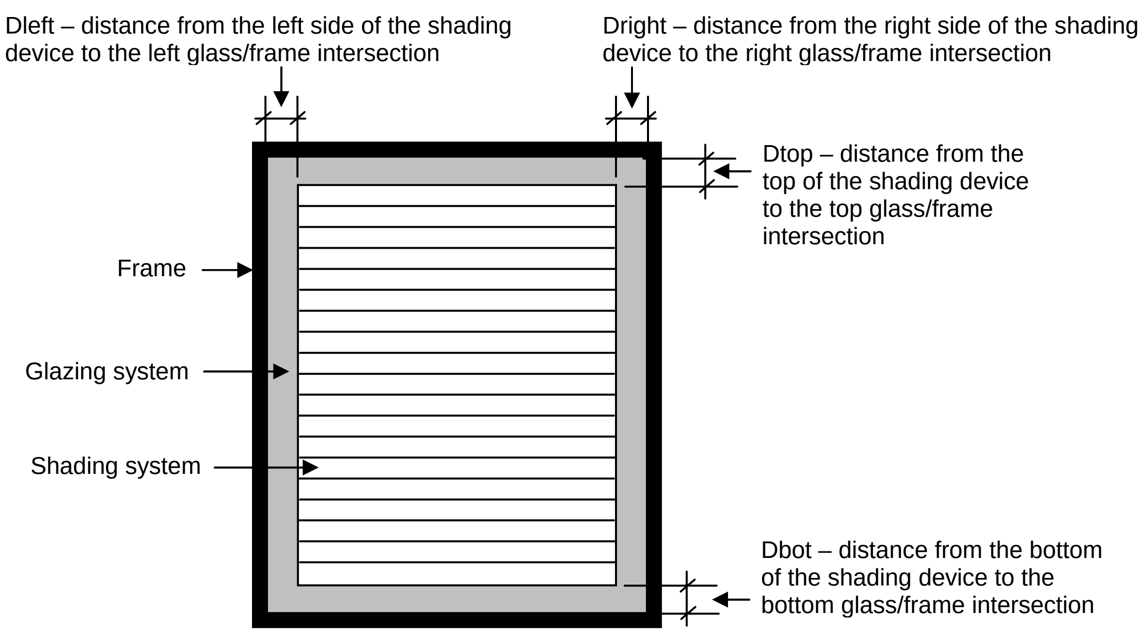
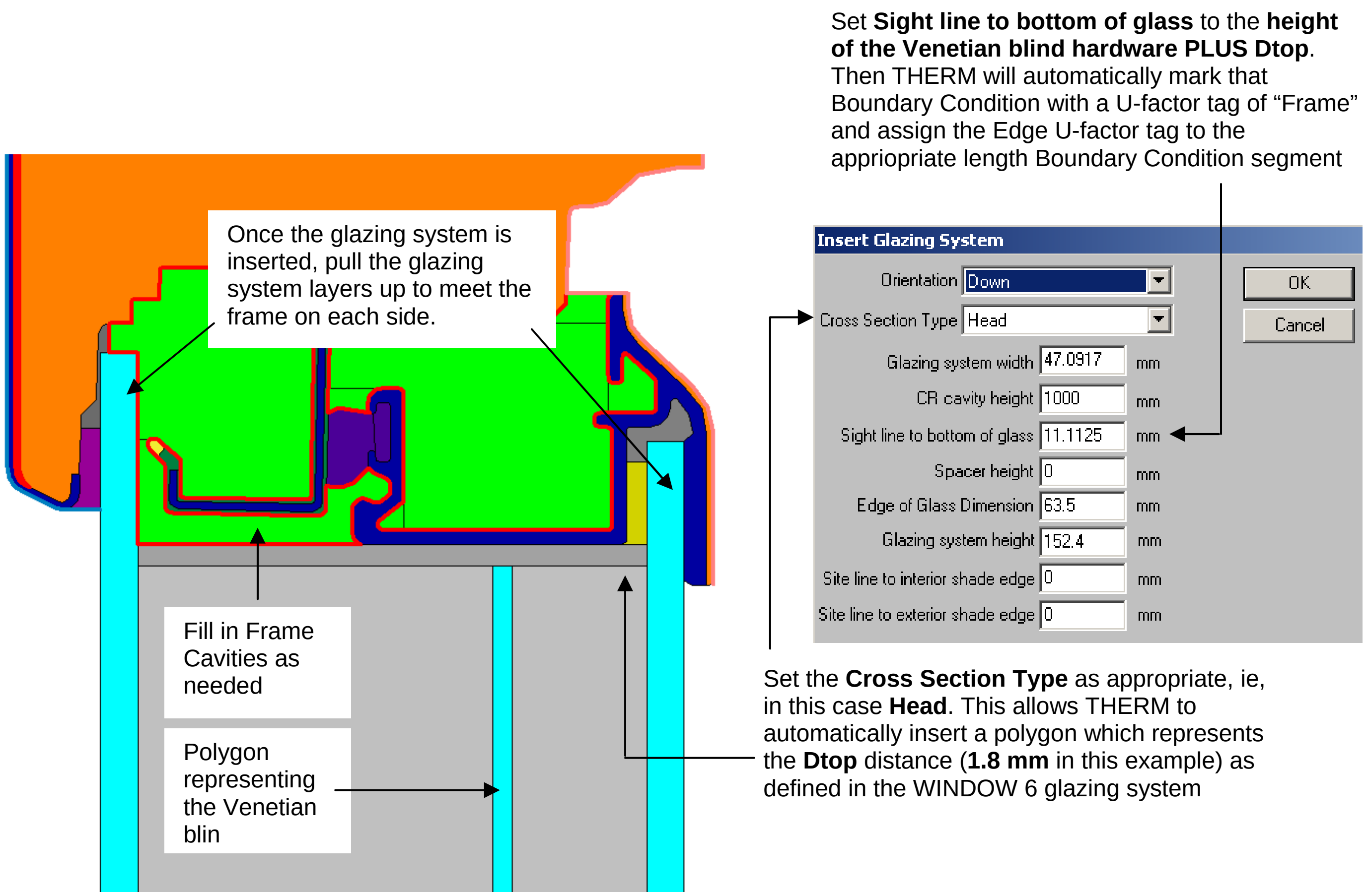


Figure 9-35. Definition of Dtop, Dbot, Dleft and Dright for an interior venetian blind.

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. 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 approrriate 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 9-36. Insert the glazing system with the Venetian blind

6. **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.

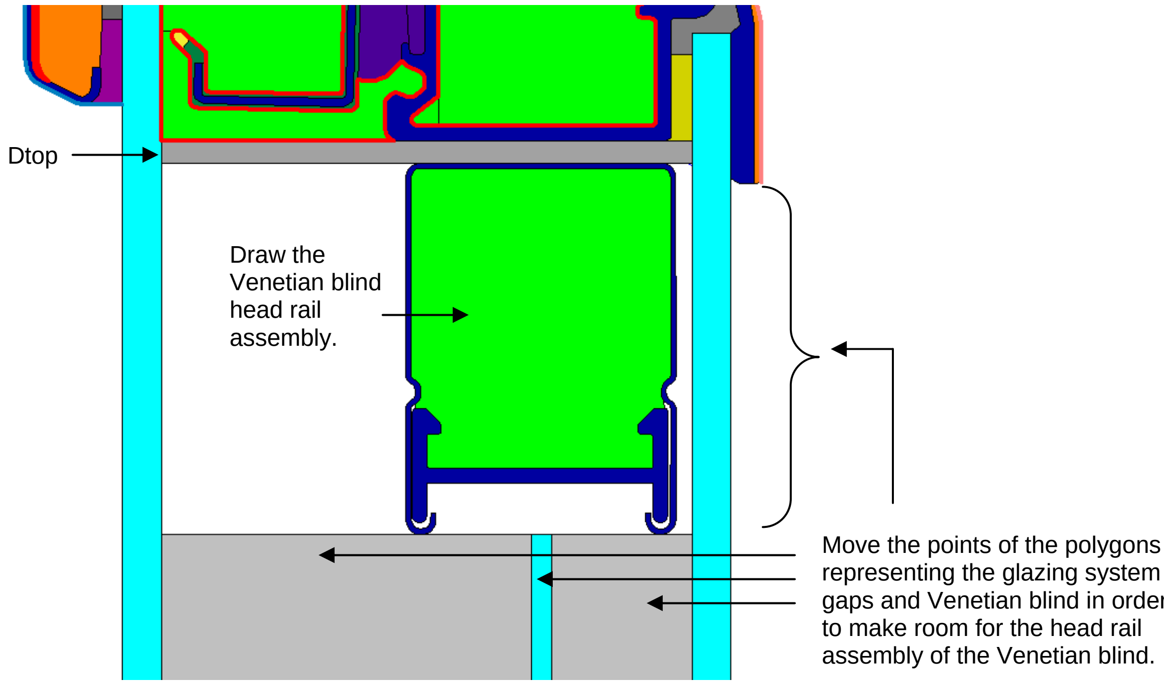


Figure 9-37. Insert the Venetian blind hardware.

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

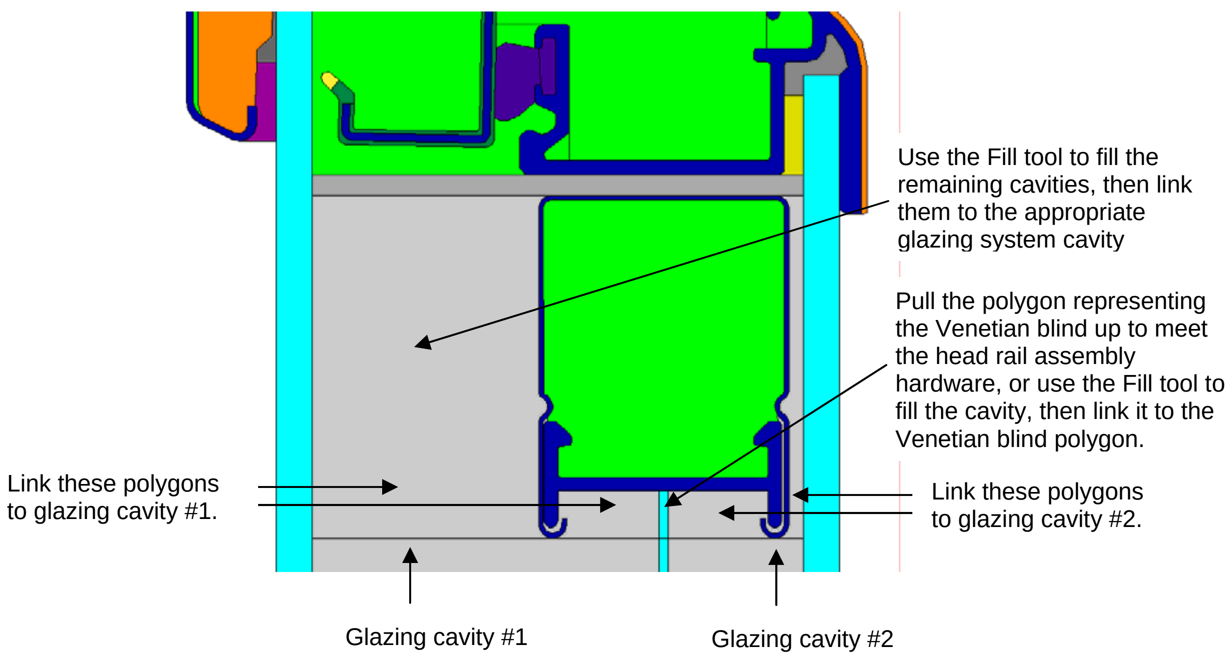


Figure 9-38. Fill the remaining cavities and link to the appropriate glazing system cavities.

8. Create the other cross sections in this manner.

Figure 9-39. Head and Sill cross sections for Closed Venetian Blind between glass layers (Integral)

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

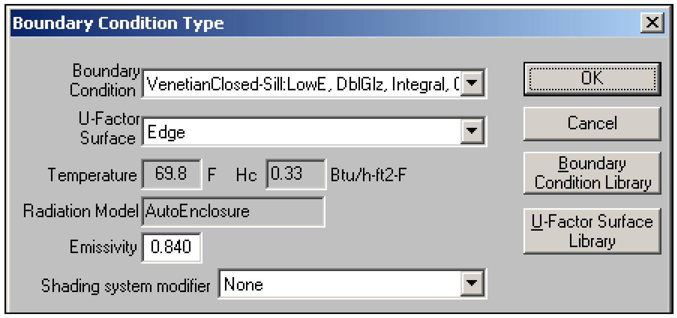


Figure 9-40. For Integral Venetian blinds, set the Shading System Modifier to "None".

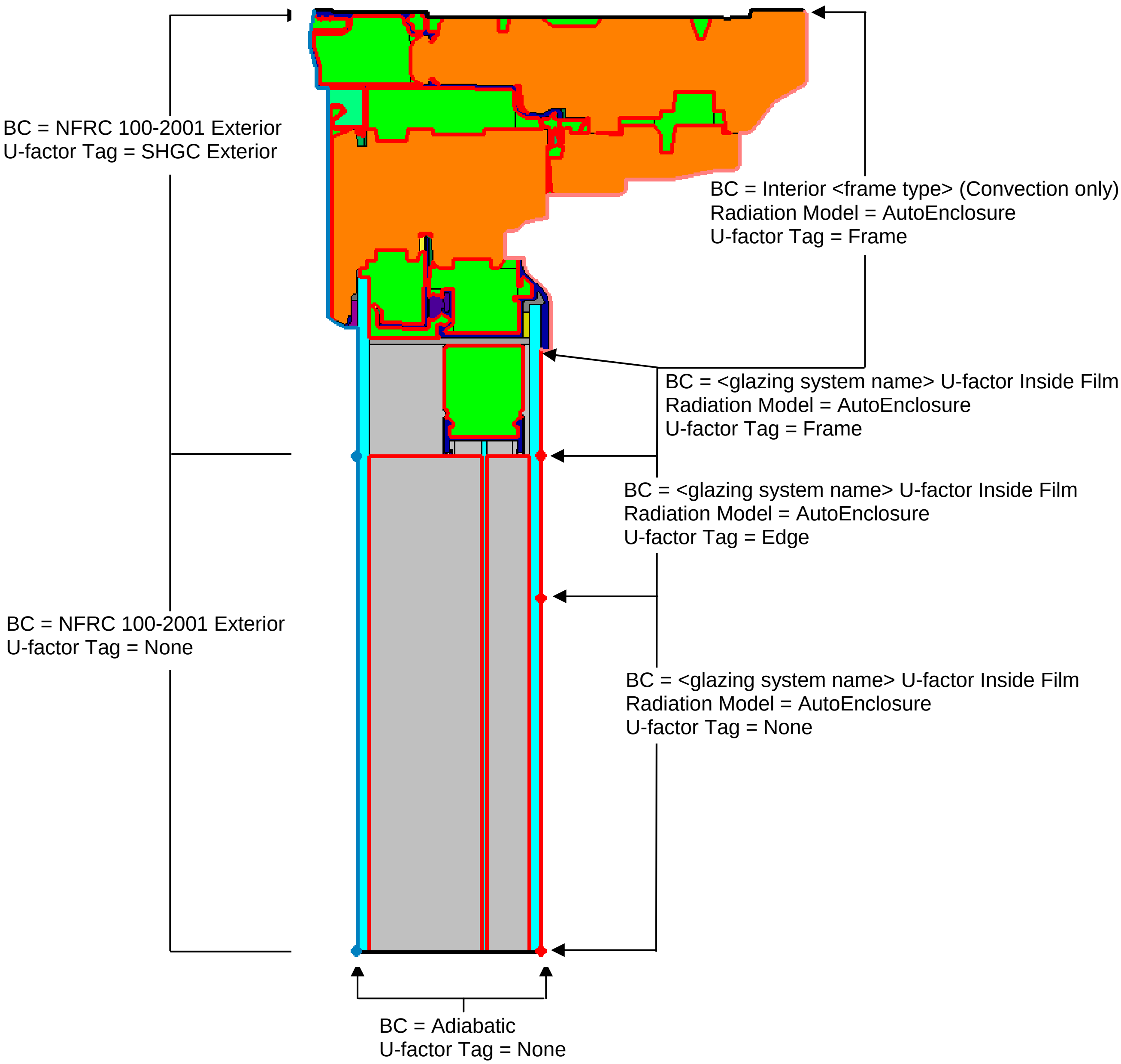
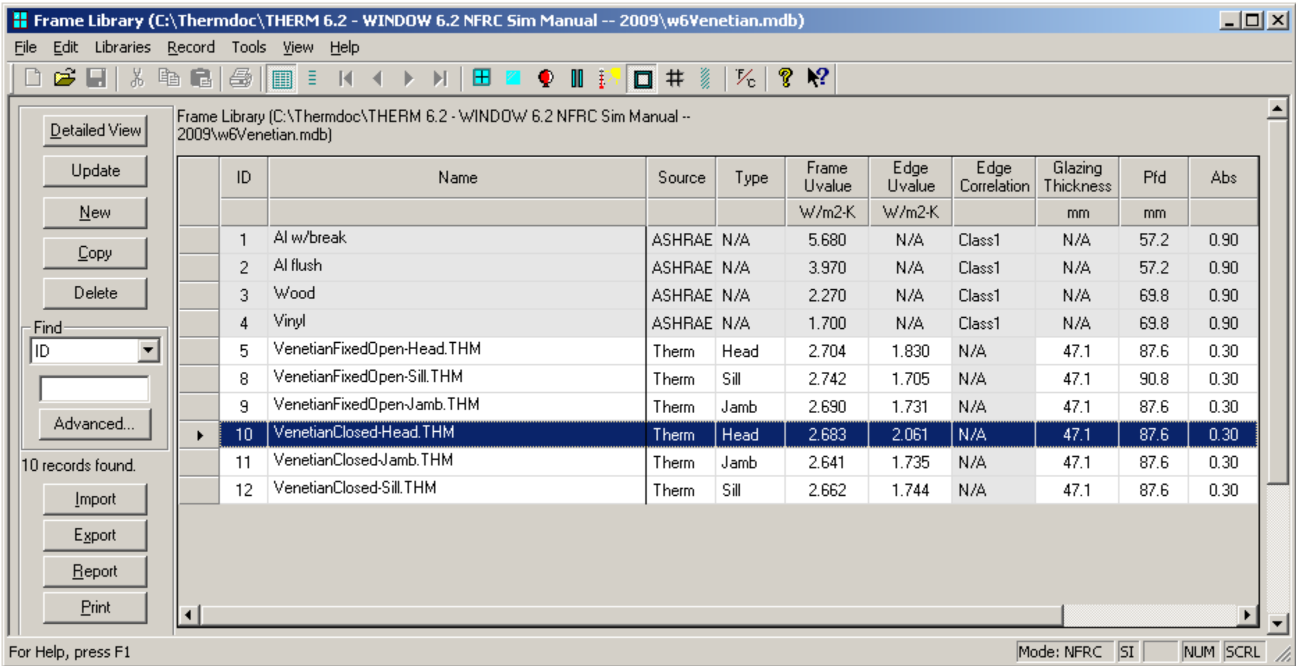


Figure 9-41. Define the boundary conditions for each cross section

10. Simulate each cross section and save the results

In WINDOW:

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



ID	Name	Source	Type	Frame Uvalue W/m2-K	Edge Uvalue W/m2-K	Edge Correlation	Glazing Thickness mm	Pfd mm	Abs
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 9-42. Import the THERM files into the WINDOW 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 and calculate the results.

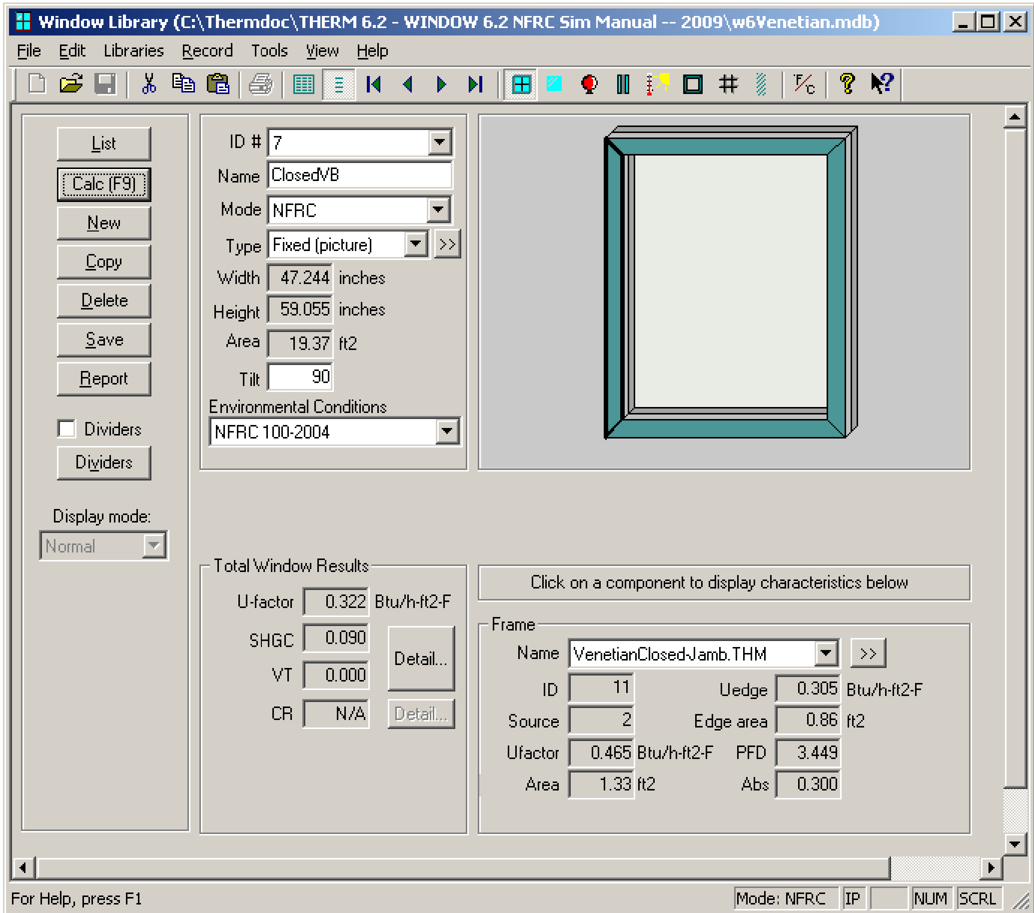


Figure 9-43. Define the window.

9.3 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.

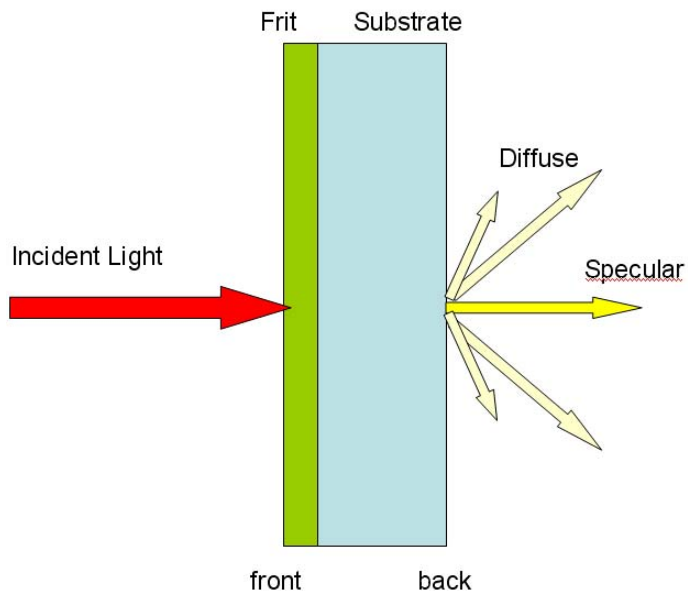


Figure 9-44. Ceramic frits have both a diffuse and specular optical properties component

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.

Modeling Steps

The steps for modeling fritted glazing layers are as follows:

1. Obtain 5 spectral data files, as described above, for the substrate, and the frit (100% coverage on substrate) for front and back specular and diffuse measurements (see Table 9.1 below).
2. Import these spectral data files into an Optics User database
3. Import these records from the Optics User database into the WINDOW Glass Library

9.3.1. White Frit Example

The following example is for a white frit on a 6 mm clear glass substrate.

The following spectral data files have been measured:

Table 9-1.

Measurement Type	Layer Side	Filename
Substrate Specular Measurement	n/a	Clear6.dat
100% Frit coverage on substrate, Specular Measurement	Front	WhiteFrit**SpecularFront**.lbl
	Back	WhiteFrit**SpecularBack**.lbl
100% Frit coverage on substrate, Diffuse Measurement	Front	WhiteFrit**DiffuseFront**.lbl
	Back	WhiteFrit**DiffuseBack**.lbl

1. **Import the spectral data files into Optics.**

   From the File menu, select Import Text Files(s) and then select the four files to import.

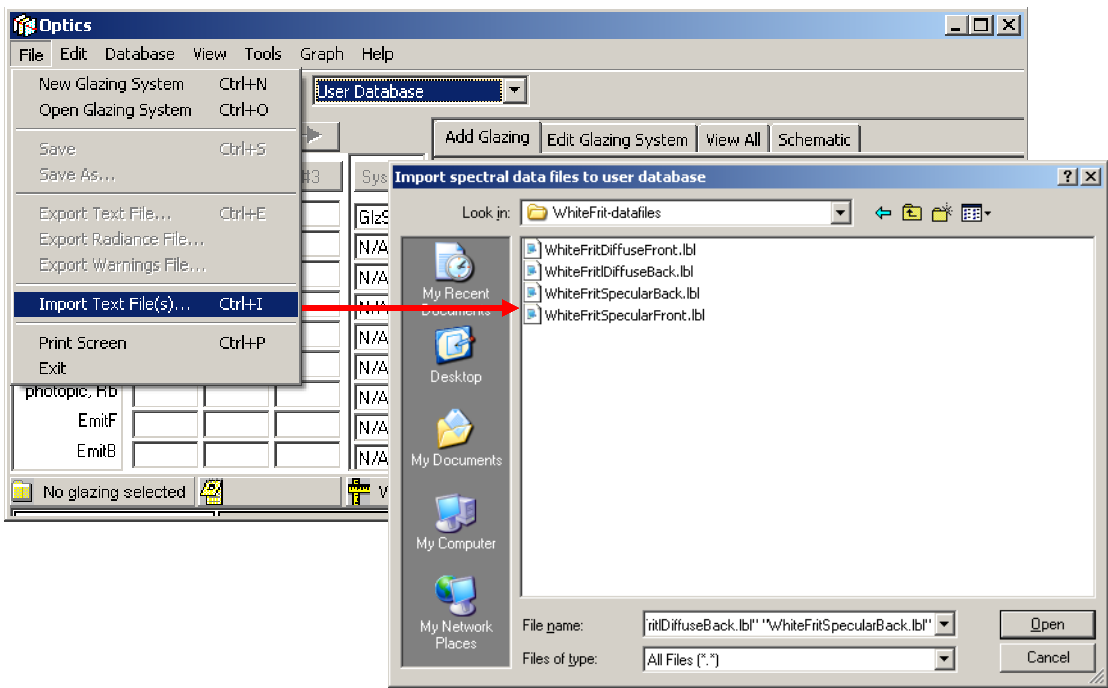


Figure 9-45. Import the measured spectral data files into the Optics user database.

A message may appear asking for you to fill in missing information. Click No to each of these dialog boxes that appears.

Figure 9-46. Click No to this message

The four new spectral data files are now imported as glass layers into the Optics User database under the **Coated** type.

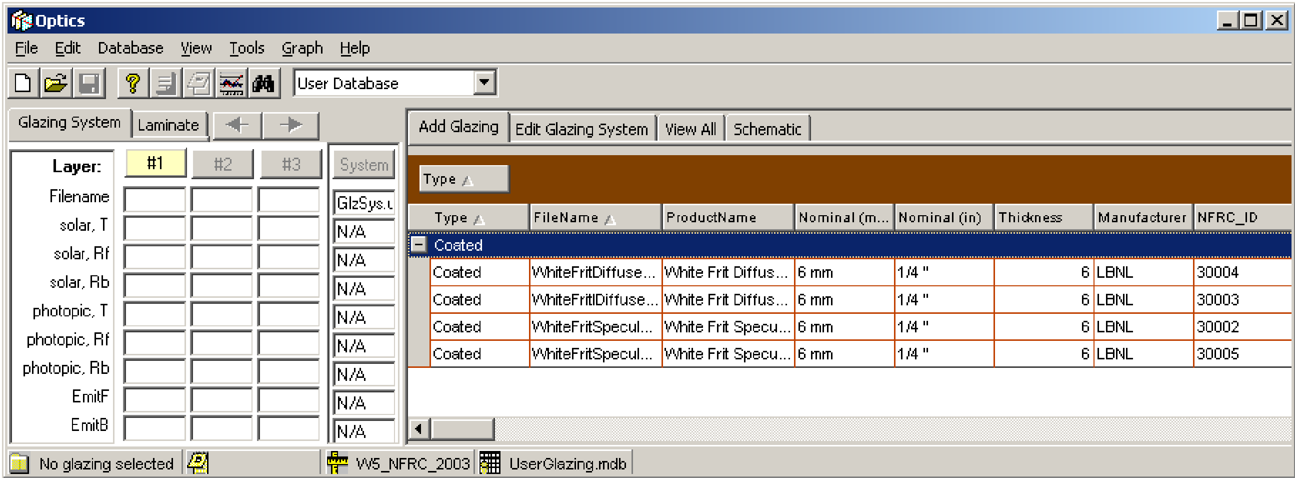


Figure 9-47. The four spectral data files for the frit layer are imported into the Optics User database.

Close Optics

2. Import the frit spectral data files into WINDOW

Import the four frit spectral data files from the Optics User database into the WINDOW Glass Library.

From the File/Preferences menu, in the Optical Data tab, set the database to the Optics 5 User database, and browse to the appropriate database (the default is C: \Program Files\LBNL\LBNL Shared\UserGlazing.mdb)

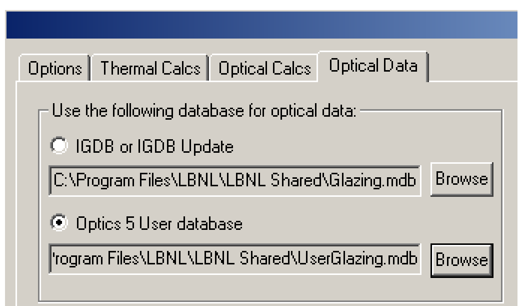


Figure 9-48. Set the Optics 5 User database to import the records from.

In the Glass Library, click the Import button, then set the Format to "Frit from IGDB or Optics User Database"

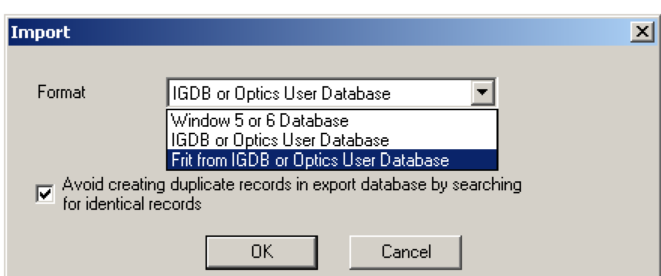


Figure 9-49. In the Glass Library, click the Import button and select Format = Frit

Pick the **front** property first (for either the specular or diffuse case).

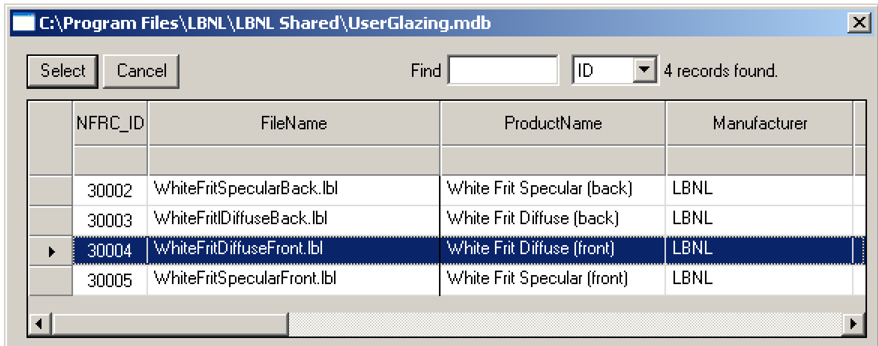


Figure 9-50. Select the "Front" file for either the diffuse or spectral case

The program then asks you to select the layer for the Back Transmittance (Tb) properties

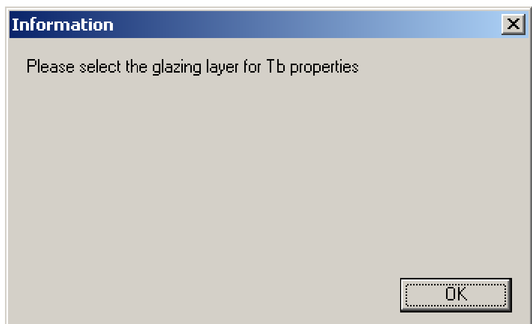


Figure 9-51. The program asks you to select the properties for the back transmittance.

Select the layer that corresponds to the **back** properties, in this case for the diffuse measurement, since that is the one we picked for the front case (be sure not to mix the diffuse and specular back and front files – this sequence of selecting the front and back files for each property type allows WINDOW to pair the files automatically so that you don't have to keep track of this later).

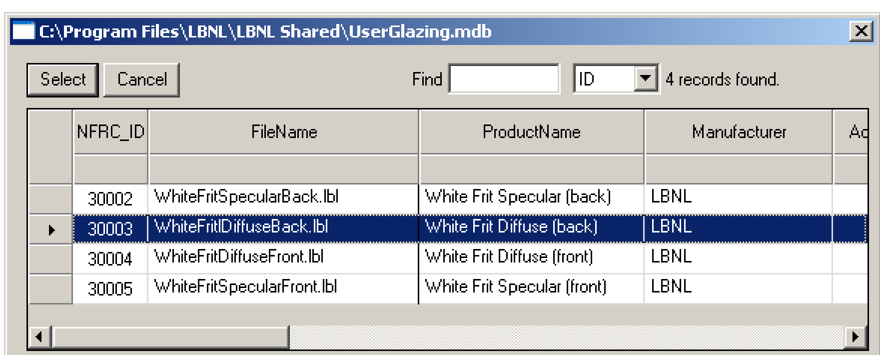


Figure 9-52. Specify the associated Back file associated with the Front file you first picked

Two new layers will be added to the WINDOW Glass Library, one for the Diffuse properties and one for the Spectral properties.

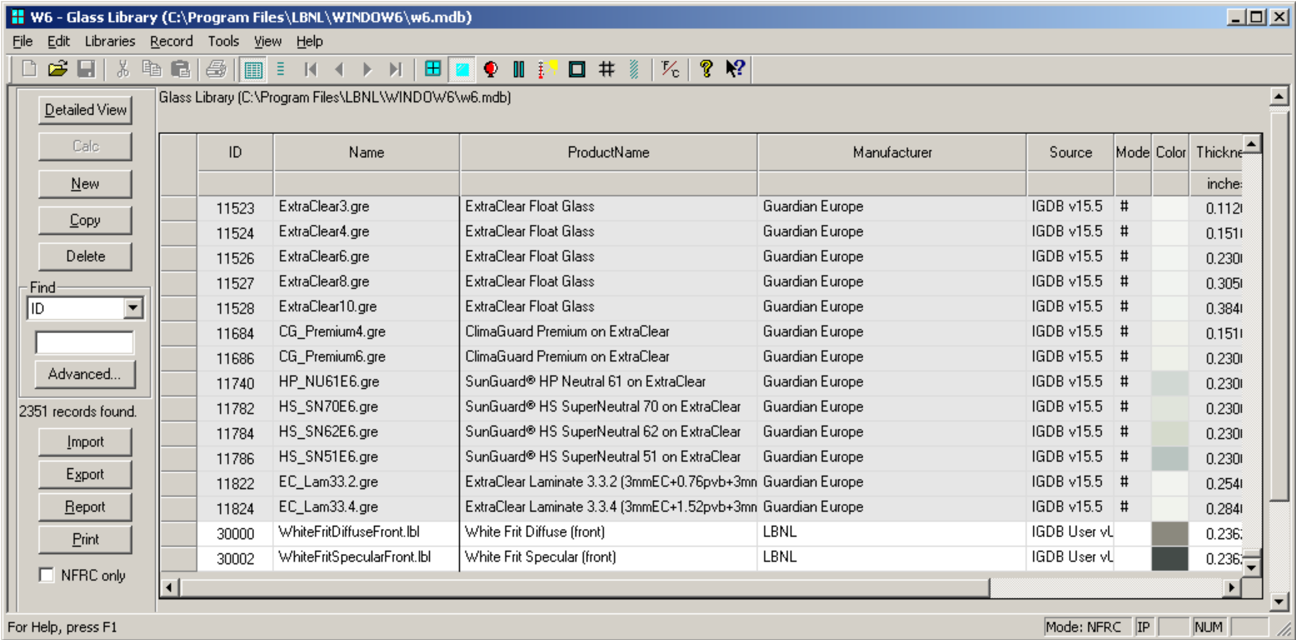


Figure 9-53. Two new layers for the frit are added to the Glass Library

3. Construct the Frit in the Shading Layer Library

The percent frit coverage is input in the Shading Layer Library, so a different record can be made for each different percent coverage. In this example, we will make two frit coverages, one for 100% coverage and one for 10% coverage.

Input the values as follows for the 100% frit coverage as follows:

- **Type:** Fritted glass
- **Glass Substrate:** This is a reference to the substrate used to measure the specular and diffuse components of the fritted glass. In this example it is 6 mm clear glass.
- **Frit coverage:** Set this value to the percent of the glass that is covered by frit. In this example, we are going to make one record for 100% frit coverage and another record for 10% frit coverage.
- **Frit Optical data, Specular:** This is a reference to the record in the Glass Library that represents the specular front and back measurements, in this example it is "WhiteFritSpecularFront.lbl"
- **Frit Optical data, Diffuse:** This is a reference to the record in the Glass Library that represents the diffuse front and back measurements, in this example it is "WhiteFritSpeculardiffuse.lbl"

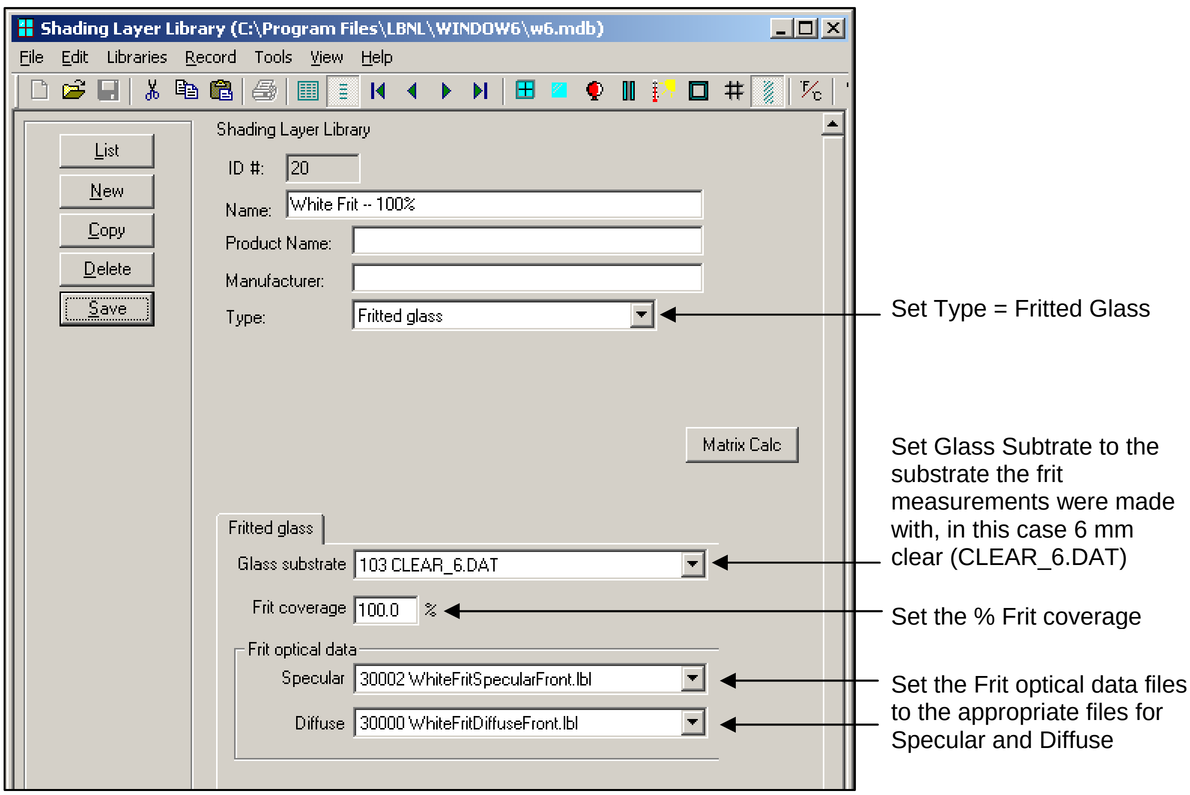


Figure 9-54. Define the frit in the Shading Layer Library.

Define as many different Shading Layer Library records as needed for each of the frit coverage cases. The example below has the frit coverage set to 10%.

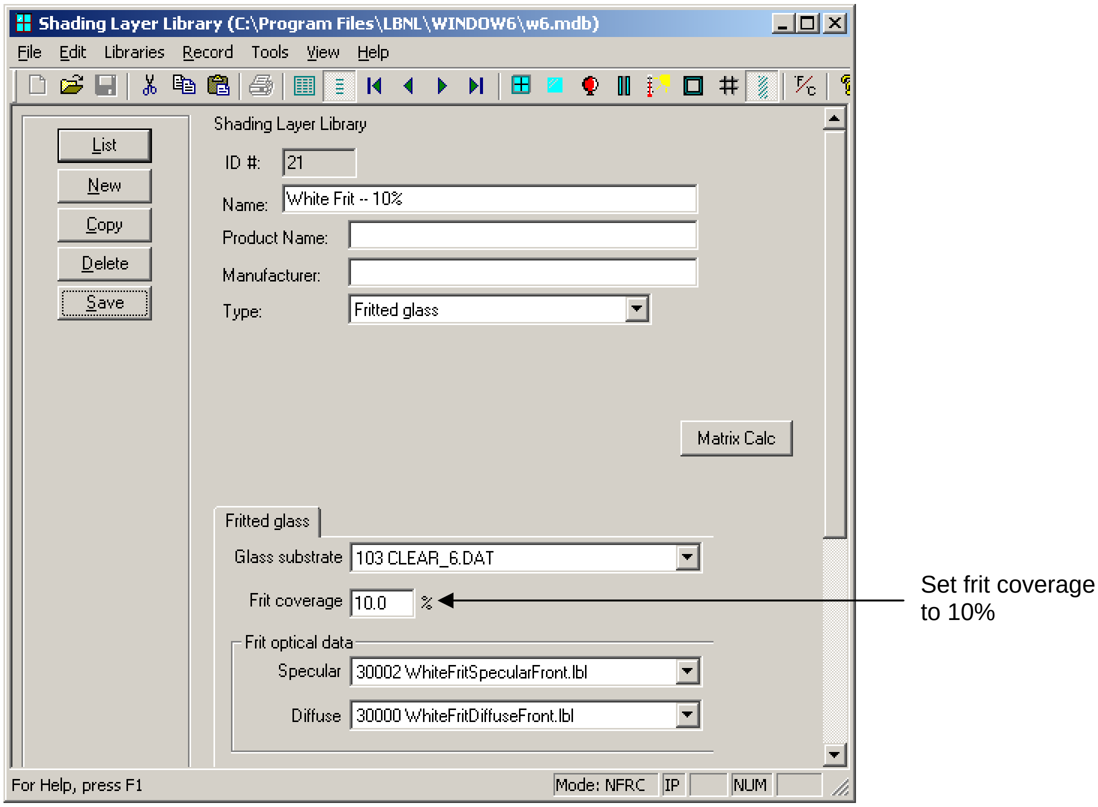


Figure 9-55. Another Shading Layer Library for 10% frit coverage

4. Make a glazing system with the frit layer
   - Select "Fritted glass" from the Type pulldown to the left Layer 1
   - Click on the Double arrow button to see the Shading Layer Library, and select the appropriate Fritted glass record.
   - Make sure that the frit is on the desired surface for fritted glass layer – click the Flip button if it is not.
   - Click the Calc button to calculate the center-of-glass properties for this glazing system.

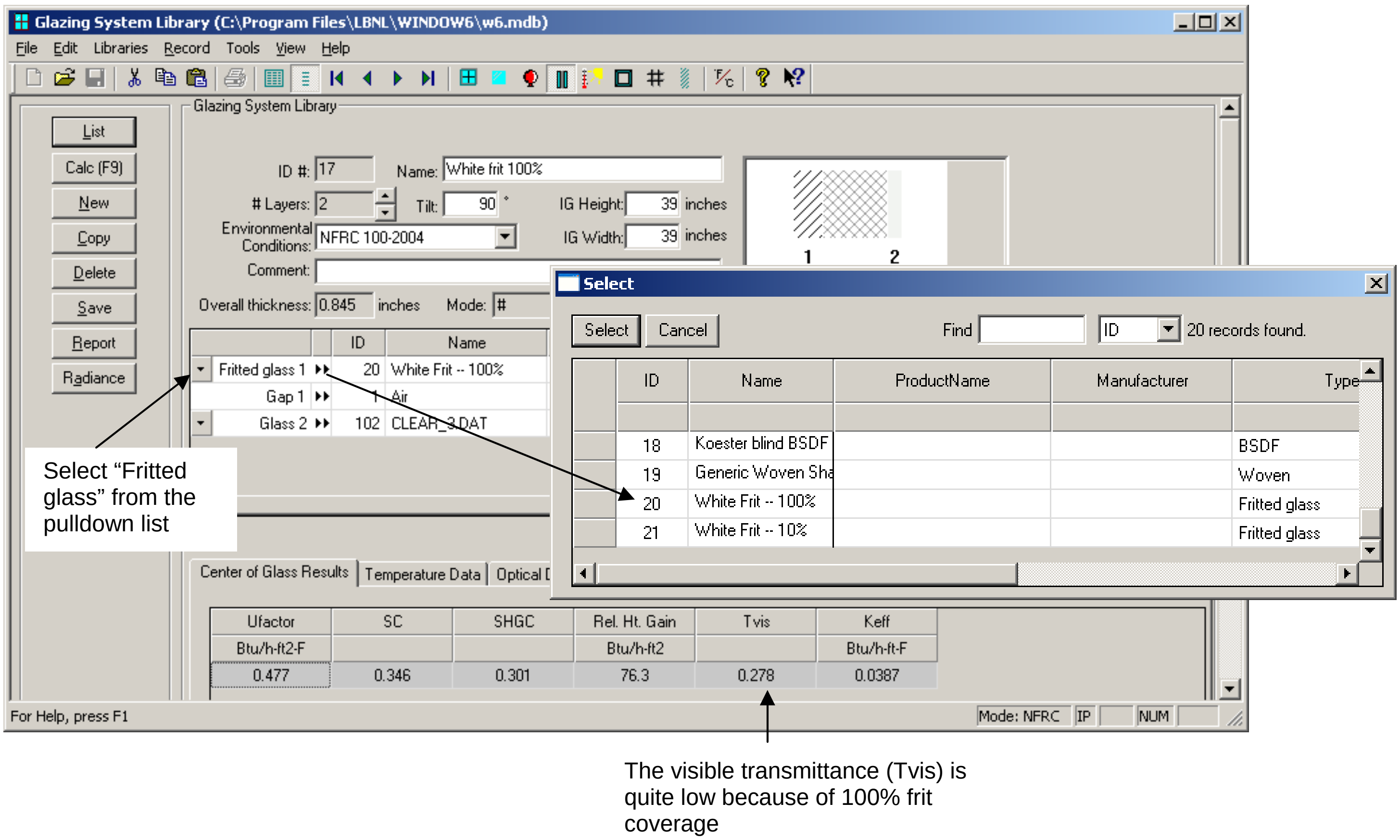
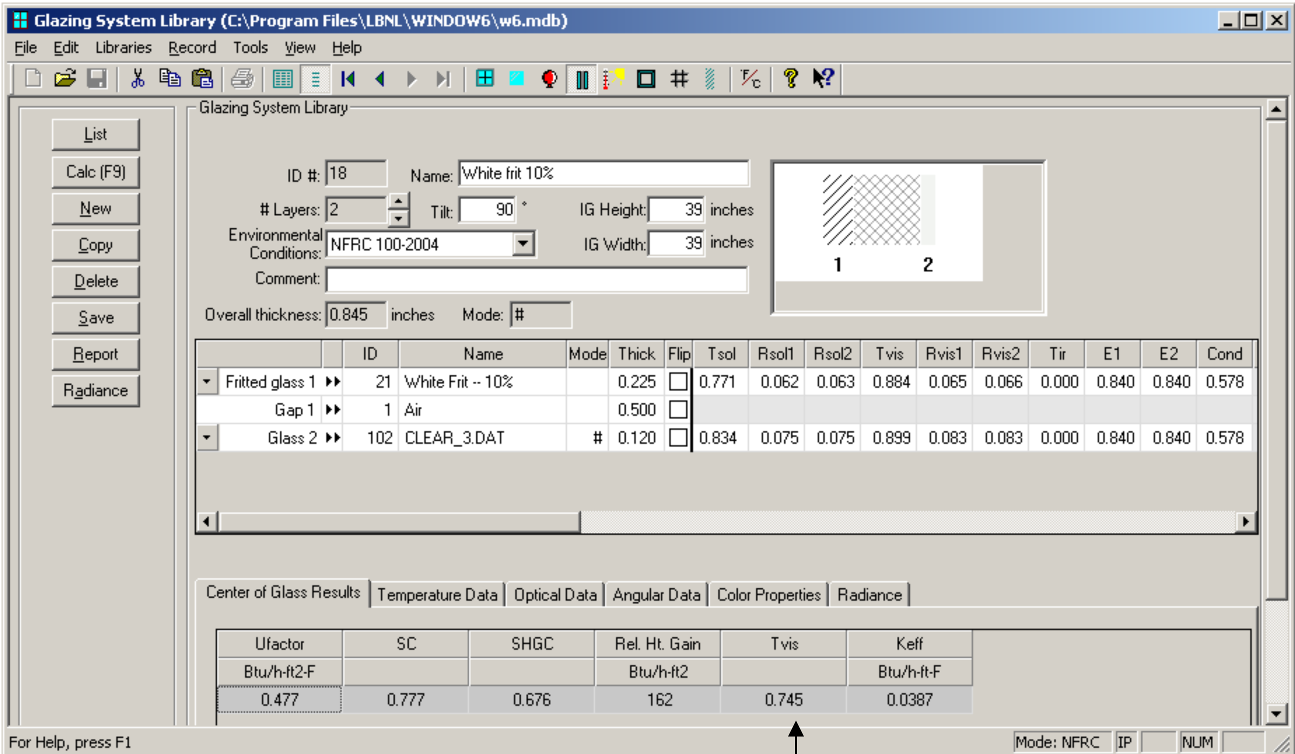


Figure 9-56. Construct a glazing system with the fritted glass layer.

A glazing system with only 10% frit coverage will have a much higher visible transmittance.



In this example of 10% frit coverage, the visible transmittance (Tvis) is much higher that the 100% coverage case

Figure 9-57. A glazing system with a 10% frit coverage

9.4 CGDB – Complex Glazing Database

LBNL plans to implement a peer reviewed process for manufacturers to submit spectral data for both Venetian blind and fritted glass spectral data in what will be known as the Complex Glazing Database (CGDB). Once the data has passed peer review, LBNL will provide the CGDB in a WINDOW 6 database format (downloadable from the LBNL website as the IGDB is now) so that it can be imported into either the Shade Material (for Venetian blind slat properties) or the Glass Library (for the fritted glass properties).