AFRC 300-01-1.0

AFRC Louvre Window System Simulation Manual

Version 1.0
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1. Louvre Window Systems

A louvre window system consists of a surround frame with a number of operable blades. The number of blades is determined by the overall window height and individual blade heights. A vertical assembly of blades is also known as a gallery. The individual blades are attached to the jamb section via an operating mechanism and are held in place using a blade holder or clip. The material used for the operating mechanism and blade holder may vary as can the blade material. Common operating mechanisms and blade holders are made from a combination of metal and plastic, whilst the blades can be made from glass, aluminium and timber.

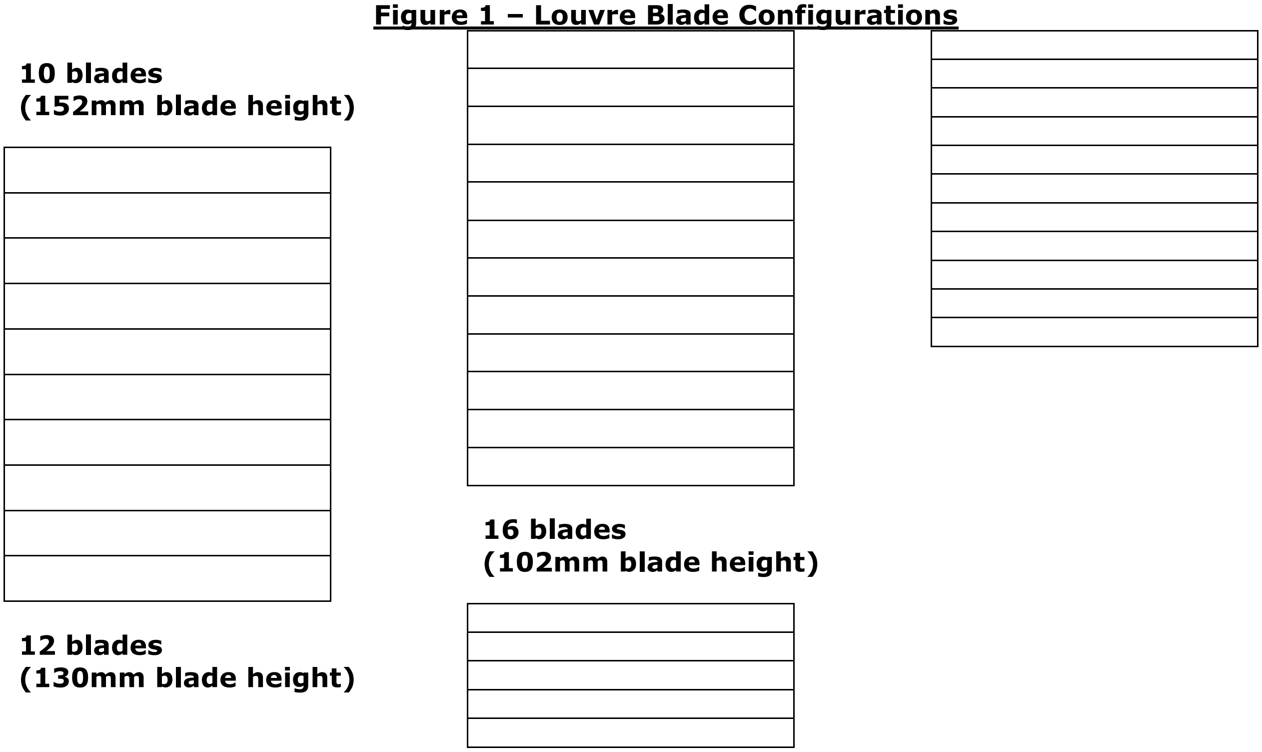
A number of challenges are faced when simulating U-value and SHGC for these products due to a number of factors:

- When the blades are in a closed position, each blade is typically a few degrees off vertical (up to 10°)
- Blades overlap when the product is in the closed position
- Clip profiles are rarely uniform along their length.

2. Product Size and Configurations

For Simulation:
Product Height = 1500mm
Product Width = 600mm

Figure 1 – Louvre Blade Configurations



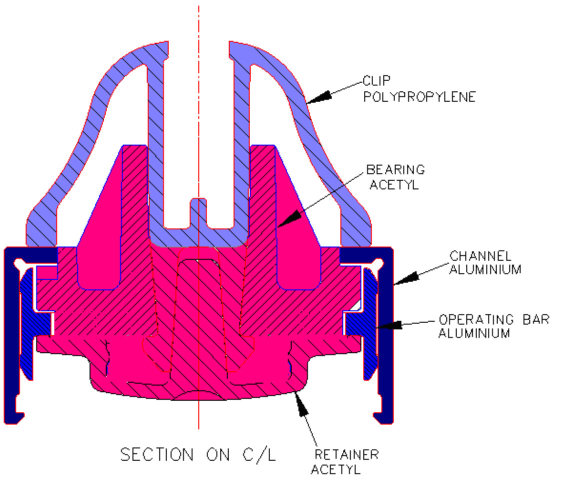
10 blades
(152mm blade height)

16 blades
(102mm blade height)

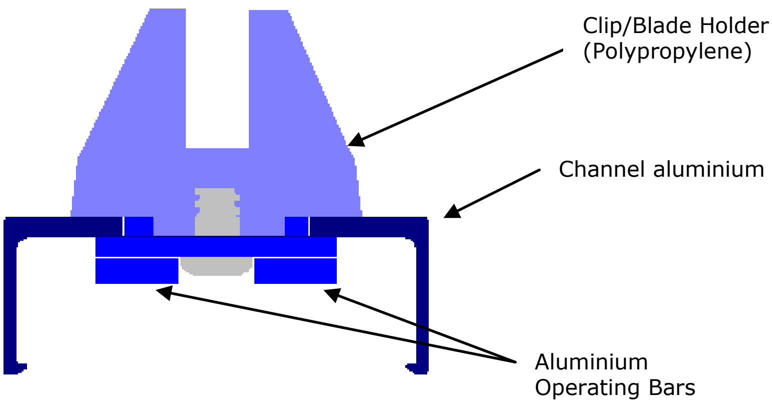
12 blades
(130mm blade height)

Cross sections of two of the common louvre gallery operating components are shown in Figure 2. The pivots operate using plastic or metal components.

Figure 2 - Louvre Gallery Operating Components and Nomenclature



Plastic Operating Pivot (See pink acetyl components above)



Metal Operating Pivot (See Aluminium Components above)

3. Modelling Steps

In WINDOW,

- Create the glazing as a single layer system at a 90° tilt and simulate as per a normal vertically glazed product. No additional work is required.

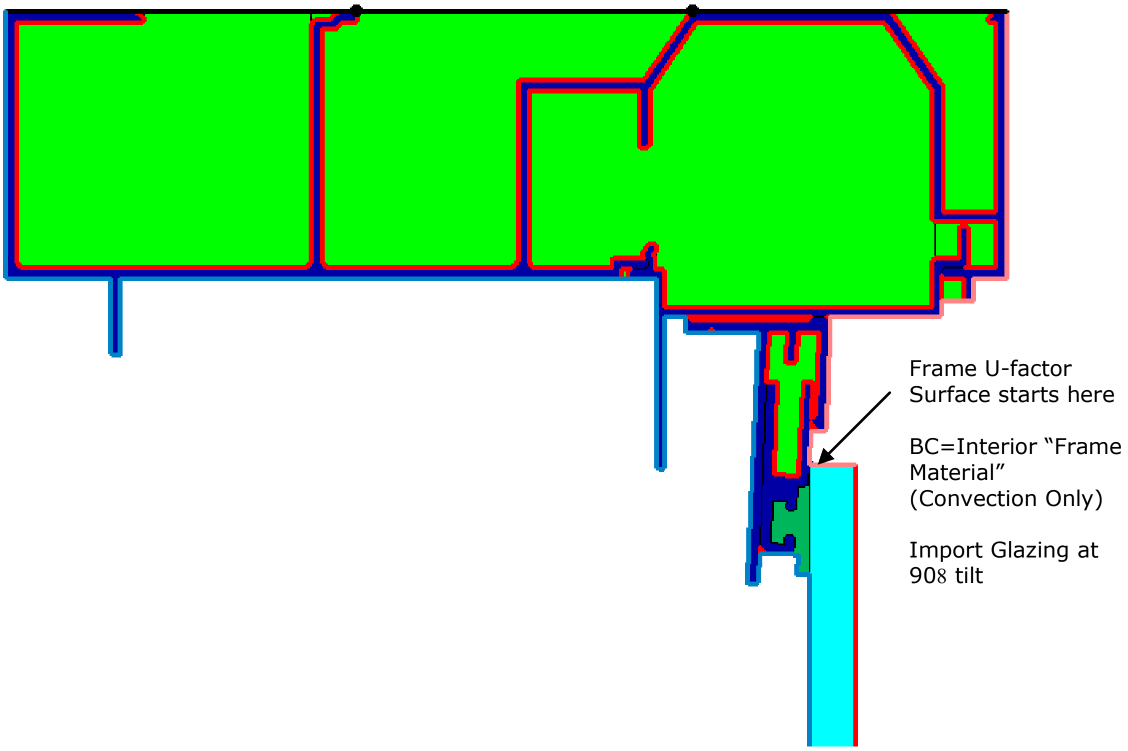
Creating the cross sections in THERM for a louvre window shows little variation from that of other cross sections. The points to be aware of prior to commencing simulation are:

- Review the drawings for non-continuous thermal bridge elements
- If a non-continuous thermal bridge is present, note the blade height to determine the properties of the non-continuous thermal bridge element.
- Ensure the material type for all the components are known
- Check the blade holder profile for uniformity
- Check whether the operating mechanism is present on one or both jambs

In THERM,

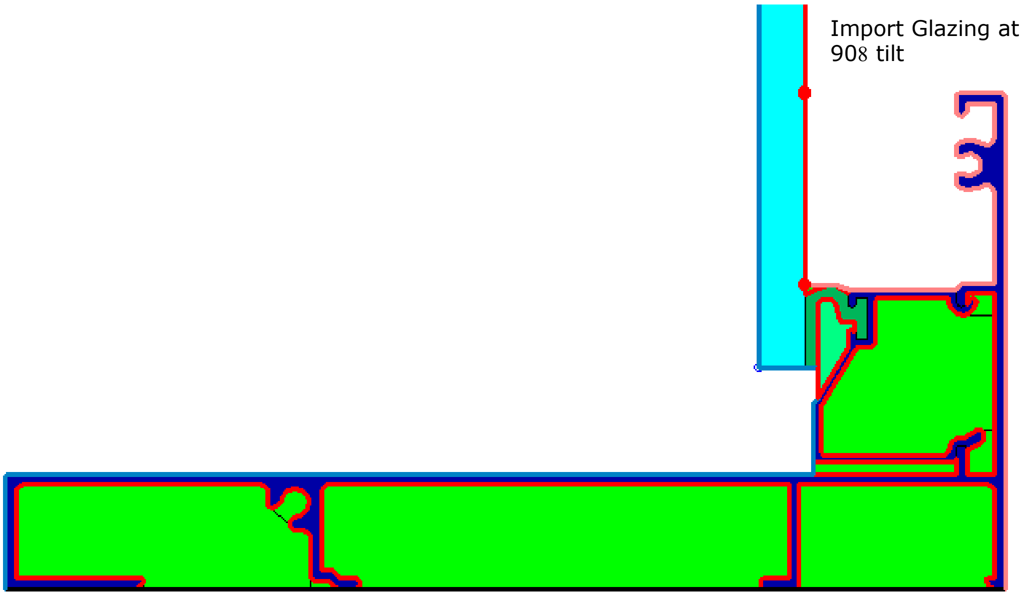
- Draw the frame components for the product (i.e. head, sill, jambs).
- For the head section,
    - Import the glazing in a vertical orientation (i.e. 90° tilt)
    - Start the frame boundary condition from the top right hand corner of the glazing
    - See Figure 3

Figure 3 - Louvre System Head THERM Image



- For the sill section,
    - Import the glazing in a vertical orientation (i.e. 90° tilt)
    - See Figure 4

Figure 4 - Louvre System Sill THERM Image



- For the jamb sections,
  - Determine whether the blade holder has a uniform or non-uniform profile
  - If the profile is uniform, draw profile "as is"
  - If the profile is not uniform, draw an "average" profile
  - Check for non-continuous thermal bridge elements such as blade holders
  - Determine and assign properties for non-continuous thermal bridge elements. Non-continuous thermal bridge elements are defined and assigned as per the NFRC Simulation Manual
  - Determine whether the operating bars are present on a single jamb or both jambs
  - Draw operating bars as a continuous component
  - Import the glazing in a vertical orientation (i.e. 90° tilt)
  - See Figures 5 & 6

Note:
Pivots within a frame cavity are simulated depending on their material type.

- For metal pivots, simulate the pivot component in the frame cavity
- For plastic pivots, do not model the pivot component in the frame cavity

Figure 5 - Louvre System Jamb – Non-Operating Bar Side THERM Image

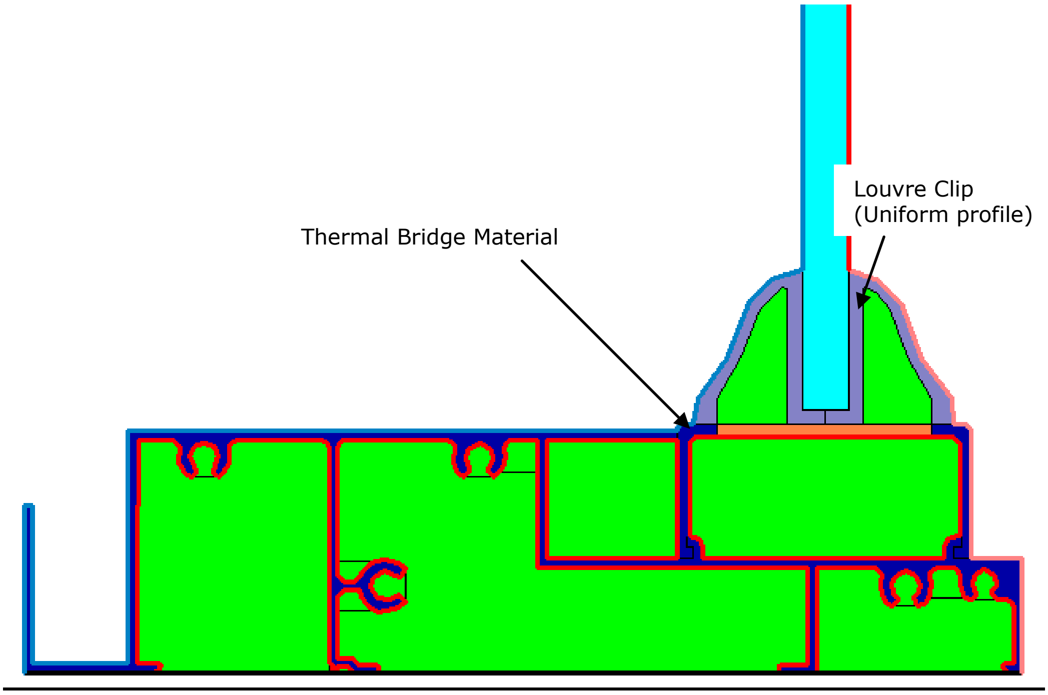
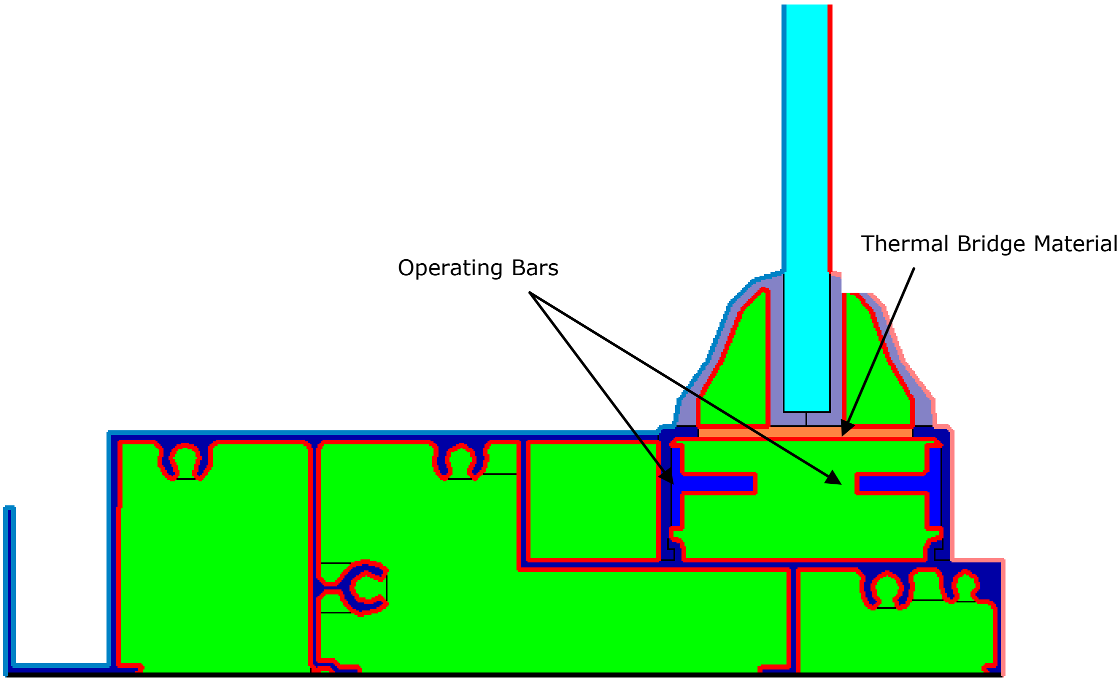

Louvre Clip
(Uniform profile)
Thermal Bridge Material

Figure 6 - Louvre System Jamb – Operating Bar Side THERM Image



4. Simulation Example

In this Example, the louvre window system has the following properties:

- 10 blades (i.e. 152mm blade height)
- A uniform blade holder profile and a
- thermal bridge element is present.

The following materials are used:

- blade holder - polypropylene
- surround frame - painted aluminium alloy
- seals - flexible pvc
- operating pivot – acetal (Polyoxymethylene plastic)
- operating bars - mill finish aluminium alloy
- glazing - 6mm clear glass

5. Non-Continuous Thermal Bridge Calculation Example

The equations for determining the applicability and properties of a Non Continuous Thermal Bridge are in the NFRC Simulation Manual, July 2006, Section 8.9. (page 8-85)

The product used in this example contains non-continuous thermal bridge elements in the form of the louvre operating bearings. There are 10 operating bearings in both the left and right 1500mm high jambs. The operating mechanisms are spaced every 125mm and have a diameter of 28.2mm.

The depth of the thermal bridge is 1.6165mm and the width of the thermal bridge is 28.2mm. To determine how the thermal bridge element will be modelled, the following calculation was performed:

$$F_b = W_b / S_b = 28.2mm/125mm = 0.23$$

F_b is greater than 0.05. Therefore, the thermal bridge elements need to be modelled and the thermal conductivity, K_{eff}, calculated.

$$K_{eff} = (F_b \times K_b) + (F_n \times K_n)$$

K_b = 0.375W/m.K (assume acetyl (polyoxymethylene))

$$F_n = 1-0.23 = 0.77$$

K_n = 160W/m.K (assume painted aluminium)

$$K_{eff} = (F_b \times K_b) + (F_n \times K_n) = (0.23 \times 0.375) + (0.77 \times 160) = 123.3 \text{ W/m.K}$$

Therefore, the value is used for the thermal conductivity, K_{eff}, of the thermal bridge component (ie. the louvre operating bearing is equal to 123.3 W/m.K.