The Effect of Brise Soleil on the Thermal Performance of a Facade

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A philosophy of the design of commercial buildings is to utilise the available natural light to its maximum potential. Large areas of vision glazing allow the penetration of daylight into the building, thus reducing the demands on the artificial lighting system.

But visible light is only part of the energy radiated from the sun, and as direct sunlight enters through a window, so does the solar heat energy which can lead to overheating. It is primarily for this reason that a range of external solar shading devices, such as brise soleil have been developed.

The potential energy saving benefits of external solar shading devices are widely documented. These types of system are generally acknowledged to be amongst the most efficient means of reducing excessive internal solar heat gains.

The connection of these devices to curtain wall systems is commonly achieved through the use of aluminium bracketry. Although structurally aluminium is an ideal material to manufacture such a bracket from, its principle disadvantage in this application is its high thermal conductance.

Modern curtain wall systems are designed with thermal breaks between the outer and inner aluminium sections, with effective seals to prevent the ingress of weather and air infiltration. The brackets puncture this thermal break, creating a 'path of least resistance', and thus thermally bridging the system locally.

Thermal bridges are shown to have the potential for a dramatic effect upon the thermal performance and life expectancy of the whole façade, not just the area directly affected. Locations of increased thermal transmittance can drastically raise the overall U-value of the building envelope and until recently have often been ignored in simplified thermal calculation methods. Even when thermal bridges are accounted for in the thermal calculation and the overall façade U-value is amended, often a double glazed unit with a higher insulating performance is installed to compensate and ensure compliance with the Building Regulations. But this does not alleviate the issues associated with potential condensation.

The heat flow through a section of curtain wall can be accurately simulated through the use of 2 and 3 dimensional computer software. This software can also help to identify areas of increased heat transfer by showing heat flow lines on the detail. The distribution and increased density of these lines indicate path of least thermal resistance.

Most readers will be familiar with flow line diagrams of curtain wall sections, indicating increased concentration of heat flow around the aluminium spacer bars in the double glazed units. This signifies relatively high rates of heat transfer across these components when compared to the heat flow across the glazing cavity and the plastic thermal break profile of the mullion bar.

When the brise soleil bracket is introduced to the nose of the mullion, a significantly smaller mass of heat flow lines around the aluminium spacer bars in the double glazed units is evident (Figure 1). This indicates that the spacer bars are no longer the area of highest heat transfer. Unmistakably, the highest concentration is centred on the bracketry elements and mullion back box. This shows the path of heat transfer from the internal environment, through the mullion box, along the bracket and out to the external environment.

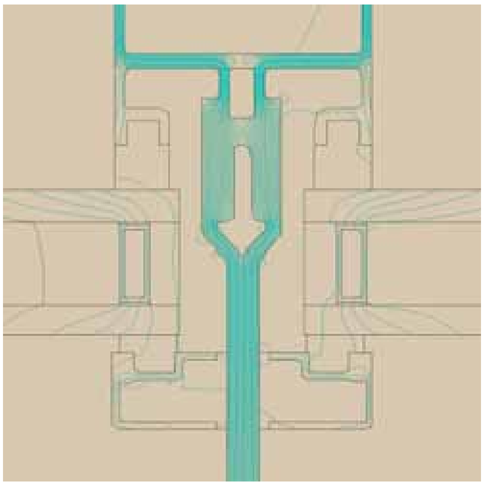

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Figure 1

The effects of this thermal bridge are not confined to the height of the bracket, though. The heat flow within the system of the surrounding area is also increased, as indicated in Figure 2. The compromised thermal performance can also lead to lower internal surface temperatures, which in turn can result in condensation on surfaces not intended to be wetted.

Calculations conducted by the author indicate the average U-Value of the sample mullion (U_f) increases significantly when the brise soleil bracket is incorporated and rises further when the full brise soleil assembly is attached (by over 38%).

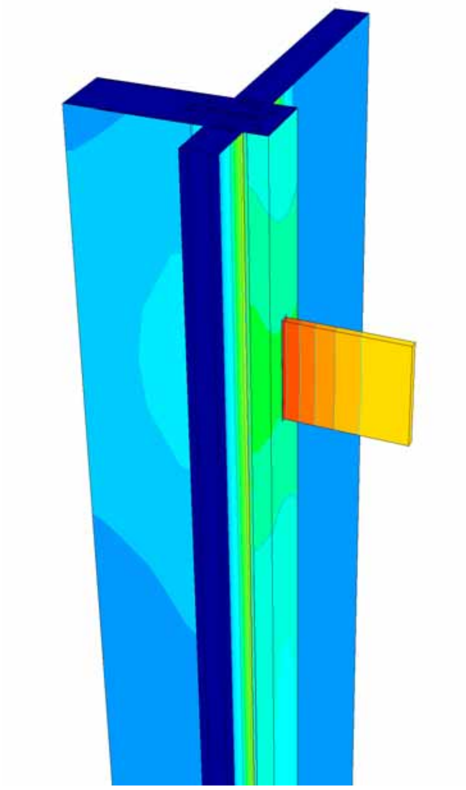

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Figure 2

Further calculations indicate the overall U-value of a glazed curtain wall screen may be increased by up to 10%. This may be sufficient to jeopardise Part L compliance of the project if not factored into the overall building energy consumption model early enough.

Brise soleil assemblies offer many benefits in terms of reducing energy consumption and maintaining occupant comfort levels in summertime, but consideration should be given to the potential for increased heating loads during winter from a compromised façade U-Value.