THERMAL SAFETY 2B
GLASS UNDER EXTERNAL SHADING

As discussed previously, thermally induced stresses in glazing are generated when a temperature differential across a glass pane occurs. Initial consideration is given to the portion of the glass panes concealed by the framing system, and so shaded from the sun.

The temperature differences generated can be increased due to the presence of shading, which as well as blocking incident solar radiation from portions of the glass; can also block incident solar radiation from heating up the framing system. As such under some conditions, any temperature increase in the frame will lag behind the heating of the glass due to solar radiation, resulting in a more significant thermal gradient and increased resultant stresses.

EXTERNAL SHADING PATTERNS FROM STRUCTURAL ELEMENTS

When shading is considered, the most obvious elements considered are often the overhangs and mullions, which will cast vertical and horizontal shadows respectively, or in combination will create shaded sections and potentially higher levels of stress. The distance that overhangs and mullions extend from the glass external surface, in conjunction with the position of the sun will influence the area of the glass shaded.

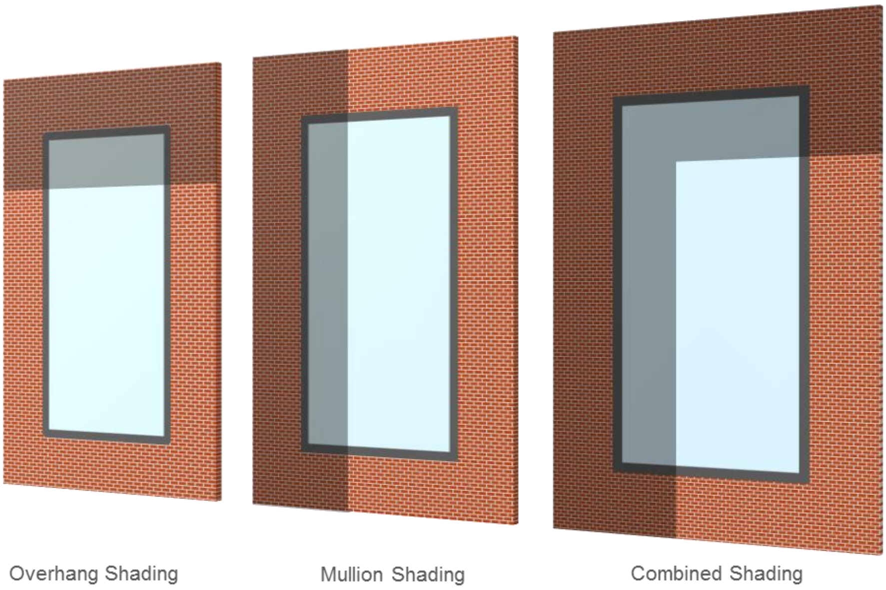
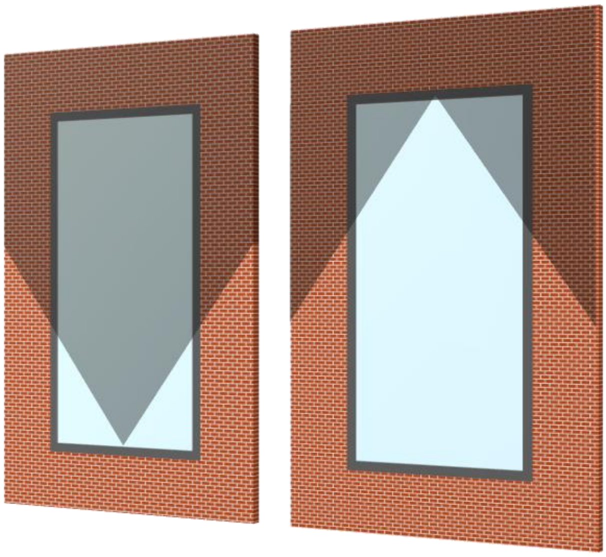


Figure 1 – Simple External Shading Patterns

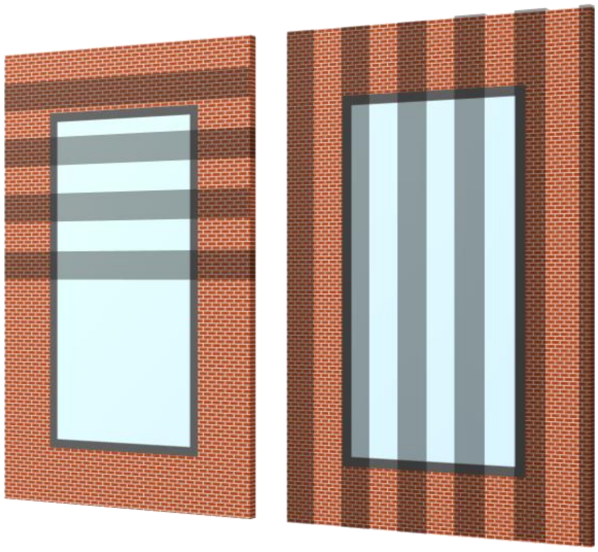
Diagonal shade lines, specifically where two are intersecting, have the potential to generate higher thermal stresses, typically over more localised regions of the glass edge. These localised maximums would occur where the point of the shaded region coincides with the edge of the glass, as illustrated below.



Intersecting Diagonal Shade Lines

Figure 2 – Complex External Shading Patterns

In addition to shading from framing elements, solar protection devices, such as brise soleil, will also cast shadows across facades, with the extent of the shading very much dependant on the design of the solar protection element and the direction of incident sunlight.



Brise Soleil Shading

Figure 3 – Shading System External Shading Patterns

EXTERNAL SHADING FROM NEIGHBOURING BUILDINGS

As well as shading caused by building elements, external shading can be caused by neighbouring buildings. In built up areas, such as city centres, shading will likely be caused by adjacent buildings for significant periods throughout the day, and in certain orientations and times of year, the shading may be present over the glass for relatively long periods.

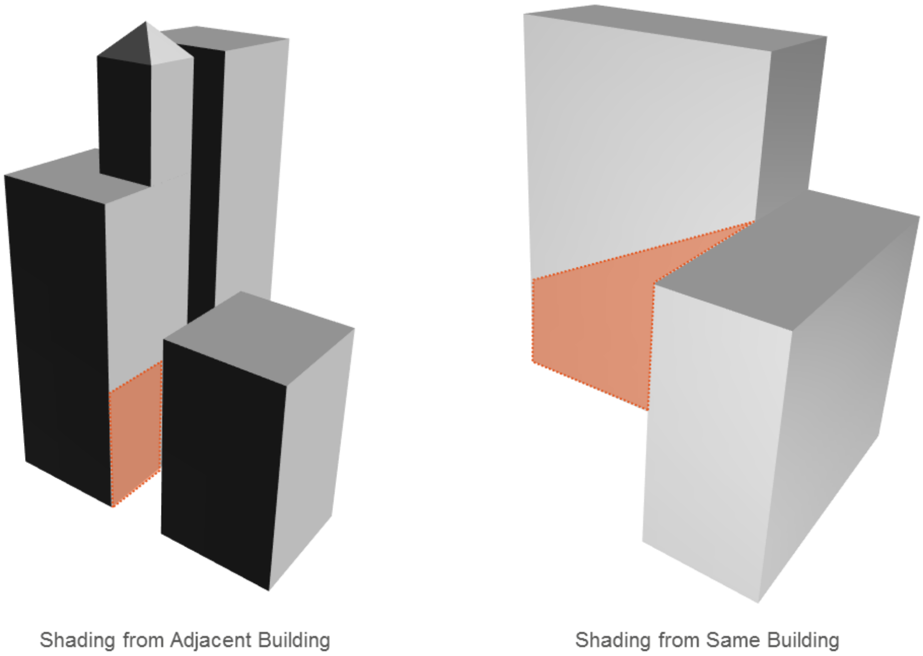


Figure 4 - Shading from Adjacent Structures

External shading can also be caused by other parts of the same building, where one section may overhang another, such as taller sections or L-shaped regions.

EXTERNAL SHADING DURING CONSTRUCTION

During installation of glazing, or any construction or maintenance work post installation, scaffolding may be present to provide a suitable working environment. Whilst scaffolding is in place, and element of it, particularly planking, may cast a relatively static shadow over the glass. Although scaffolding would not be expected to be present after construction is complete, during the construction period it should still be considered as an influencing factor for shading.

LEVELS OF EXTERNAL SHADING

The severity of shading will depend on how long the shadow remains over glass, whether it is static or not. This will depend upon the position and size of the object, or objects, casting the shadow and the movement of the sun. Typically, a shadow which is cast on the glass for 3 hours or more would be considered static, which is the worst case condition. Mobile or transient shadows will move relatively quickly across the glass, and have a reduced impact on the development of thermal gradients.

INFLUENCE ON CALCULATED TEMPERATURE DIFFERENCES

In general, when assessments are carried out, static shading is initially assumed, as this will account for any changes in conditions or environment which will result in static shading. This may be due to, for example, the construction of an building nearby, the installation of solar control devices or scaffolding present around the building.

The influence of pane size on the calculated temperature difference is obtained with the shading factor (F_s), which is based on the smaller dimension of panes (d), as this is the edge which will be subjected to the greater levels of stress from thermal gradients. A minimum value of 1.111 is imposed for the shading factor.

$$F_s = \frac{1}{\left[0.6 + \left(\frac{320}{d + 800}\right)\right]} \geq 1.111$$