



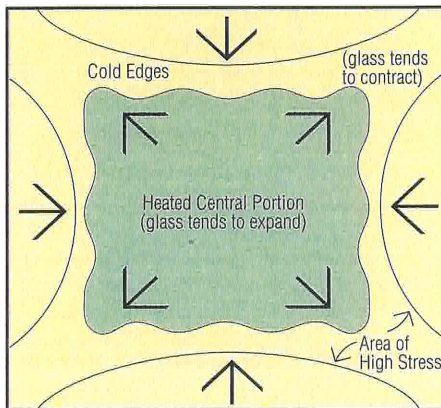
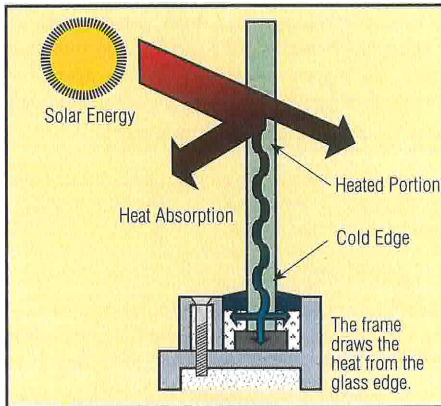
Thermal Breakage



Glass which is not heat-treated (heat-strengthened or tempered) can experience thermal breakage. In those applications where thermal stress may be a concern, the glass should be heat-strengthened or tempered.

In non-heat-treated glass, the risk of thermal breakage is greatest when the central area of glass becomes hotter than the edge. This condition can occur when the center of the glass is heated by the sun and the edges remain cool. Under these conditions, the center of the glass expands but is restricted from natural expansion by the cool edges. This results in stress within the glass that could cause thermal breakage.

The degree to which the central area of the glass becomes hot is largely dependent on the solar absorptance of the glass, which varies between different types of glass as shown in the table below.

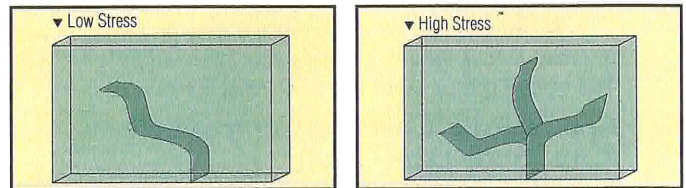


Glass Type	Solar Absorptance %	Risk of Thermal Breakage
Clear	18	low
Colored or tinted	30-40	medium
High light-transmitting coating on colored or tinted	45-55	medium-high
Reflective coating on clear	60-70	high
Reflective coating on colored or tinted	80-85	very high

The risk of thermal breakage is also influenced by the condition of the glass edge and type of framing. Glass with clean-cut edges has the greatest resistance to thermal breakage. Non-heat-treated glass edges that have been damaged in handling or during installation have greater risk of thermal breakage.

For those applications where thermal breakage is a concern, Heat-strengthened glass should be specified. Heat-strengthened glass, because of its compressive stresses, resists thermal breakage.

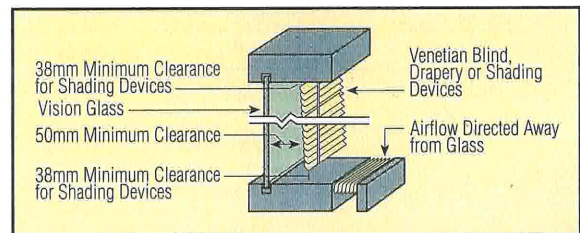
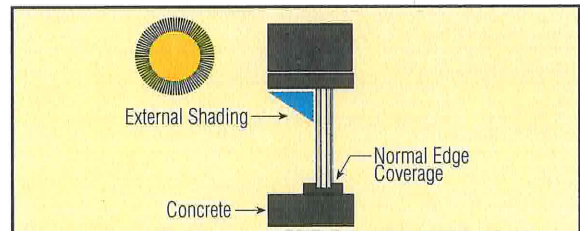
Non-heat-treated glass which has cracked as a result of thermal stress can be easily identified by a break pattern that is unique to thermal breakage.



The crack in the glass is initially perpendicular to the edge and glass face for 2cm to 5cm and then branches out into one or more directions. The number of branches or secondary cracks is dependent on the amount of stress in the glass.

Some additional factors which may have influence on thermal breakage are shown below:

- External shading of the glass by the frame or building extensions
- Glass framing that is in direct contact with concrete or other materials that may contribute to the cooling of the glass edge
- Excessive coverage of the glass edge by the frame
- Heat-absorbing films attached to the glass after installation



- The use of internal shading devices such as drapes, curtains or venetian blinds. If shading devices are used, they must be placed away from the glass to allow for a free flow of air at the glass surface.
- The air flow from room cooling or heating vents must be directed away from the glass.
- Buildings not heated during the construction phase can experience an increase in thermal breakage.
- Generally speaking, the greater the glass edge area, the greater the risk of thermal breakage.

The potential risk of thermal breakage can be estimated by a computer-aided thermal stress analysis and for those areas of high risk, Guardian recommends heat-strengthened glass. For specific applications where heat-strengthened or tempered glass is specified, i.e., spandrels, entranceways, fire knockouts or sloped glazing, a thermal stress analysis is not necessary and not offered as a common practice.