PFG
BUILDING GLASS

Thermal Stress: Practice Note and Recommendations

PFG recommends calculating the thermal safety of glass in any building design using solar controlling glass.

1. What is Thermal Stress in Glass

Solar controlling glasses incorporate a tint or a reflective coating, or a combination of both, in order to function effectively. Due to the nature of their colour and metallic characteristics, tinted and reflective glasses absorb varying degrees of solar heat. The darker the tint and the denser the coating, the greater the degree of solar heat absorbed by the glass. Low emissivity coatings add to the solar heat absorption of glass, particularly when combined with dark tints and dense coatings. To use an example for understanding of the above, a Solarshield S10 Grey Low E laminate would absorb more solar heat than a Solarshield S10 Grey, which in turn absorbs more heat than a SolarShield S10 Silver, in turn absorbing more heat than a SolarVue HL Neutral laminate. When exposed to direct solar radiation, tinted and coated glasses heat up in the area that is subjected to direct sunlight. Glass edges on the perimeter of the pane that are shielded from solar radiation by the framing system remain cooler than the exposed area. The temperature differential between the warm exposed area and the cooler enclosed areas causes thermal stress to be generated. If the thermal stress exceeds the breaking stress point of the glass, thermal stress fracture may occur.

2. Designing Facades with Solar Control Glass

The thermal safety of glass should be considered in the design of any building incorporating a solar controlling glass in the external facades. The safety of glass against thermal stress failure can be calculated to determine those elements of the glazing design that need to be changed, in order to reduce the thermal stresses to safe levels.

Factors contributing to the creation of thermal stresses brought about by the warm centre – cool edge condition in glass include:

- ✓ Extended exposure and high intensity of solar radiation.
- ✓ Temperature differences between daily minimum and maximum temperatures.
- ✓ Low air movement to the interior of the glass. This could be due to blinds, back-up walls or the inner glass of an Insulated Glass Unit (IGU).
- ✓ The solar heat absorption properties of the glass selected for the design.

- ✓ The framing system selected for the design. The colour and design are both important considerations.
- ✓ External shading. Particular attention needs to be given to partial static and dynamic shading conditions in the design.

All of the above must be considered in order to reduce thermal stress and to design out any risk of thermal fracture.

3. Thermal Stress Fracture Patterns

Thermal stress fractures characteristically run perpendicular to the glass edge at the point of origin. Fractures that do not separate within 50mm of the glass edge, are indicative of a low stress condition. If this is the case, typically the glass edge has a flaw. Fractures separating into multiple fracture streams within 50mm of the glass edge, are indicative of thermal stresses present, that exceed the safe temperature differential of the glass.

4. Precautionary Measures for Cutting, Polishing and Handling

Good edge quality is critical in order to minimize the risk of thermal stress fracture. The strongest glass edge is a clean cut edge. In practice, flaws such as shells, chips or vents that are present can result in weakness and increase the risk of thermal stress fracture, at temperature differentials that are significantly lower than the theoretical safe temperature differential of the glass. When cutting it is recommended that all solar controlling glass, be it monolithic or laminated, should be edge worked by a wet polishing process that is parallel to the edges. This polished all round (PAR) minimizes the possibility of thermal stress.

PFG will gladly assist in answering any questions and assist in thermal stress assessments for a specific glazing installation.