Optical Distortion in Laminated Glass Fabricated with Heat-Strengthened Glass Substrates

Laminated glass is produced by bonding a plastic interlayer (most typically the compound Polyvinyl Butyral) between two or more panes of glass under heat and pressure in an autoclave. The result is a durable, high performance glazing composite material, which if broken, tends to retain glass fragments and reduces the risk of injury or property damage. Laminated glass is typically used in applications requiring safety glazing, security glazing, burglary resistance, sound control, ultraviolet filtering and hurricane resistant glazing products. Listed below are comments concerning the use of annealed and heat strengthened glass laminates.

- Utilizing heat-strengthened glass in lieu of the standard annealed glass offers several benefits to laminated glass. Heat-strengthened glass is twice as strong as annealed glass of the same thickness. This added strength provides the opportunity to offer larger window sizes to meet wind load requirements without the necessity of using thicker annealed glass. Heat-strengthened glass also reduces breakage potential from thermal and bending stresses. Although heat-strengthened glass has these attributes, it also has physical properties (due to the manufacturing process) of roll ripple, bow, warp and kink, which can create visible distortion. (See Fig. LG03-1)

- Distortion in heat-strengthened glass when used monolithically or incorporated into insulating glass units is detectible, but seldom aesthetically objectionable. Heat-strengthened glass, when utilized as the substrate within laminated glass, will have some degree of distortion. This distortion may be significantly increased due to the lens affect of having the substrates out of phase or non-parallel surfaces. (See Fig. ILG03-2) This lens affect can create a magnification of objects when they are viewed through the glass (transmission) as well as viewing reflected images.

- Distortion of images whether viewed in transmission or reflectance may be accentuated when viewed at angles other than normal (90°) to the surface; often the more acute or obtuse the angle the greater the distortion. This distortion is normal and expected with these high performance impact resistant glazing options.

Because of the above distortion issue concerns, Cardinal recommends that annealed glass laminates be used in lieu of heat-strengthened glass laminates unless heat strengthened glass is required to meet extreme conditions (i.e. high wind loads or thermal stress conditions). When heat-strengthened glass laminates are specified, the customer should be notified about the distortion issues raised in this TSB. In addition, mock-ups should be shown of the heat-strengthened laminated glass product to the customer so that they can view and sign off on the distortion concerns.

Heat-strengthened glass distortion nomenclature

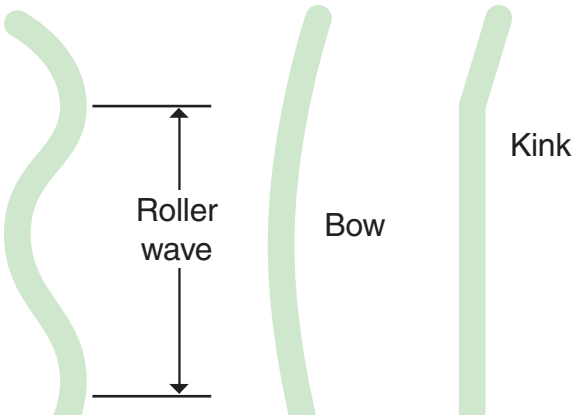

Fig. LG03-1

Heat-strengthened laminated glass composite showing lens effect

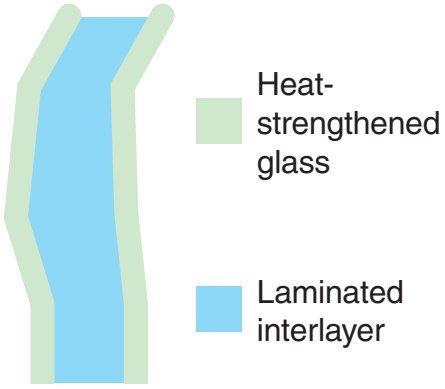

Fig. LG03-2