

Collage of Engineering  
Materials Department

Third Class  
Lecture (6-b)

# GLASS

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### 5-4-2 Tempering of Glass

The strength of glass piece may be enhanced by intentionally inducing compressive residual surface stress. This can be accomplished by a heat treatment procedure called thermal tempering. With this technique, the glass is heated to a temperature above the glass transition region yet below the softening point.

It is then cooled to room temperature in a jet of air or in some cases an oil bath. The residual stresses arise from differences in cooling rate for surface and interior regions. Initially, the surface cools more rapidly, and once having dropped to a temperature below the strain point, becomes rigid. At this time, the interior having cooling less rapidly is at a higher temperature above the strain point and therefore

is still plastic. With continued cooling, the interior attempts to contract to greater degree than the now rigid exterior will allow. Thus, the inside tends to draw in the outside or to impose inward radial stresses.

As a consequence, after the glass piece has cooled to room temperature, it sustains compressive stresses on the surface, with tensile stresses at interior regions.

This tempering treatment increases the strength of the glass because applied tensile stresses must surpass the compressive stresses on the surface before fracture occurs.

Tempered glass has a higher resistance to impact than annealed glass and is about four times stronger than annealed glass. Tempered glass is used for application in which high strength is important, these include large doors, automobile

windshields, auto side windows, safety glass for doors and  
eye glass lenses