Lecture 22, Mar 14, 2022

Tempered Glass

- Glass is made of SiO_2 or fused silica
  - A pure single crystal of SiO_2 is called quartz
- Typical glass is soda lime glass (70-74% SiO_2, 13% NaO and 10% CaO), added to lower the melting point and make it easier to work with
- Tempered glass is made by rapidly cooling the outside of glass and leaving the inside to cool slowly
  - The outside is frozen but the inside still contracts from cooling, so the outside zone is under compression since it's being pulled by the centre
  - Glass can also be chemically tempered, where the sodium ions are replaced with bigger ions to create the same compression
  - A Prince Rupert's drop is an extreme example of this

3-Point Test

- Since ceramics are brittle and have very low failure strain, it's hard to do a conventional tensile test
- A 3-point test is used instead, where the specimen is supported on 2 sides and a force is applied on the midpoint until the material breaks
- The maximum tensile stress can be found by $\sigma = \dfrac{3FL}{2wh^2}$

More About Stress-Strain Curves

- Since it is difficult to quantify where the linear relationship ends, the convention is to use a line at 0.2% strain with the same slope as the Young's Modulus
- Past the yield strength we have uniform plastic deformation, where the entire specimen stretches uniformly
  - Increased dislocation formation as the material strengthens under stress
- The peak of this curve is the ultimate tensile strength
- Past the ultimate tensile strength nonuniform plastic deformation happens as the material begins to neck
  - The strengthening of the necked area is not enough to keep up with the reduction of the cross-sectional area
  - Real stress goes up, but since engineering stress doesn't account for the reduced cross section, the engineering stress actually goes down