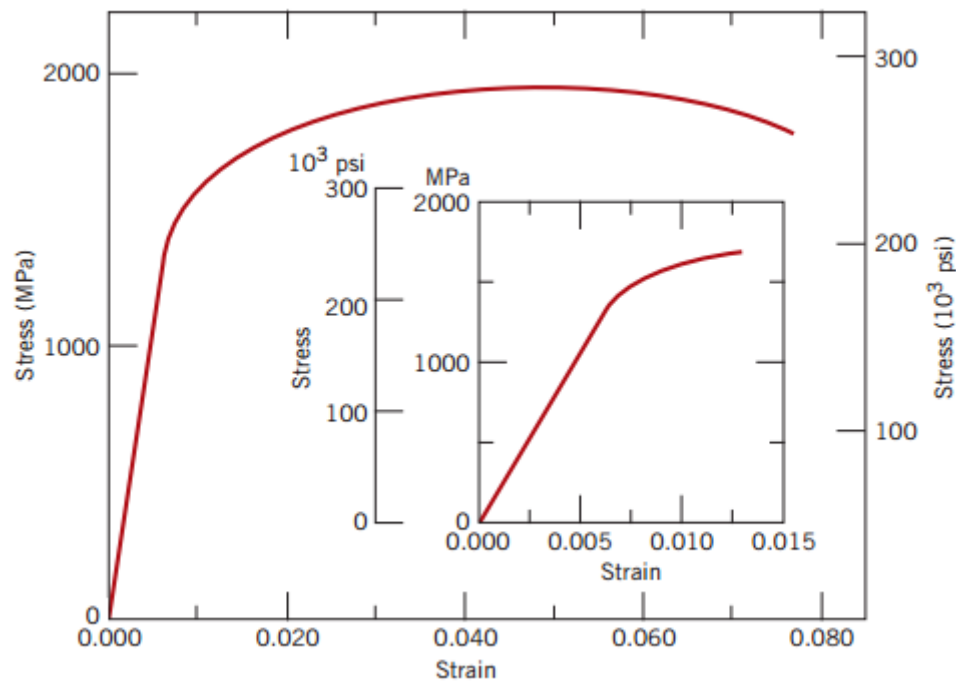# Chapter 8 – FAILURE

1. **(Example from previous week)** Consider a cylindrical specimen of a steel alloy whose stress-strain diagram shown in figure has 8.5 mm in diameter and 80 mm long that is pulled in tension. Determine its elastic modulus and also its elongation when a load of 65,250 N is applied.

Tensile stress strain behavior for an alloy steel

2. What is the magnitude of the maximum stress that exists at the tip of an internal crack having a radius of curvature 2.5×10^{-4} mm and a crack length of 2.5×10^{-2} mm when a tensile stress of 170 MPa is applied?

3. When a ceramic material having modulus of elasticity of 250GPa is pulled in tension with a stress of 750 MPa. Will the specimen fail if its more ever flaw is an internal crack that has a length of 0.2mm and a tip radius of curvature of 0.001 mm. why or why not?

4. An MgO component must not fail when tensile stress of 13.5 MPa is applied. Determine the maximum allowable surface crack length if the surface energy of MgO is 1.0 J/m². (E=225 GPa)

5. Cite the significant differences between the stress intensity factor, the plane stress fracture toughness, and the plane strain fracture toughness.

6. Some aircraft component is fabricated from an aluminum alloy that has a plane strain fracture toughness of 40 MPa$\sqrt{m}$. It has been determined that fracture results at a stress of 300 MPa when the maximum internal crack length is 4.0 mm. For the same component and alloy, will fracture occur at a stress level of 260MPa when the maximum internal crack length is 6.00mm? Why or why not?

7. Calculate the maximum internal crack length allowable for Ti-6Al-4V titanium alloy component that is loaded to a stress one half of its yield strength. Assume that the values of Y is 1.50. (Yield strength of Ti-alloy: 910MPa, K$_{IC}$: 55MPa$\sqrt{m}$)

8. A structural component in the shape of a flat plate 25.4 mm thick is to be fabricated from a metal alloy for which the yield strength and plain strain fracture toughness values are 700 MPa and 49.5 MPa$\sqrt{m}$, respectively; for this particular geometry, the value of Y is 1.65. Assuming a design stress of one half of the yield strength, is it possible to compute the critical length of a surface flaw? If so, determine its length; if this computation is not possible from given data, then explain why.