ME 649
Instructor: Ramesh Singh
HW#1

1. For a material following power law $K\varepsilon^n$
   - Derive the value of ε where necking begins (Hint: It occurs at UTS as shown in the figure)

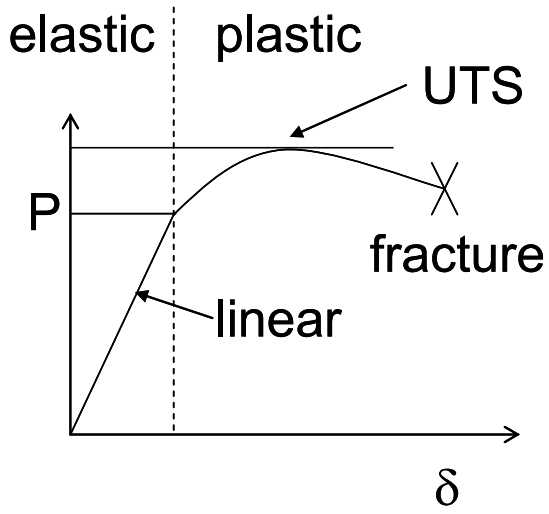


Fig. 1 Load –deflection curve

   - A cable is made of four parallel strands of different materials, where n=0.3 and
     Material A: K = 450 MPa, A_0=7 mm^2
     Material B: K = 600 MPa, A_0=2.5 mm^2
     Material C: K = 300 MPa, A_0=3 mm^2
     Material D: K = 760 MPa, A_0=2 mm^2
     Calculate the maximum tensile load this cable can withstand prior to necking.
   - Explain how you would arrive at an answer if the n values were different.

2. The notched torsion tube under combined loading is shown in Fig. 2. Find the state of stress in the thin shaded section. Assume the stresses do not vary in that section. Compute the stresses and draw the stress element. Compute the expression for principal stresses. Also if the yield stress is Y right down the Tresca and VonMises criteria for the given loading. (Hint: assume r>>t)

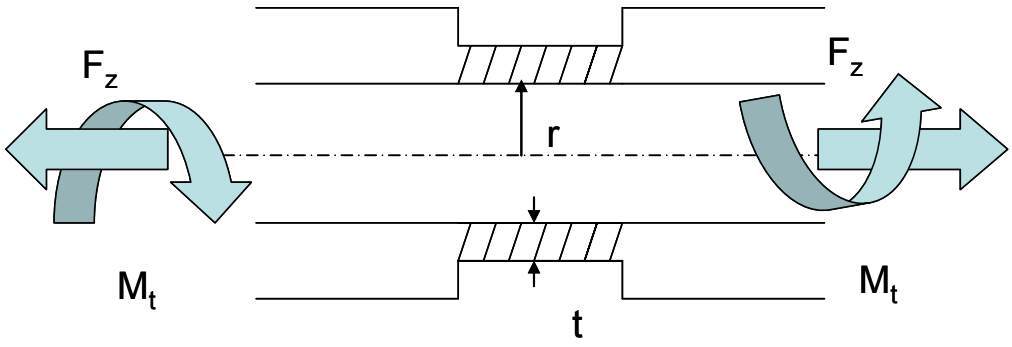
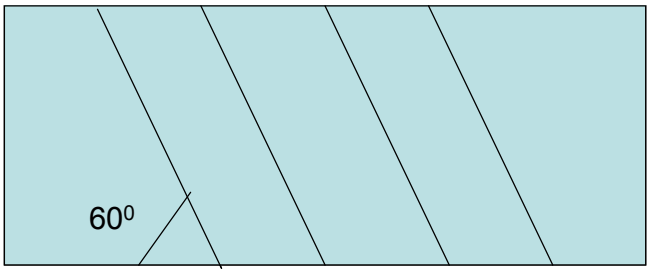


Fig. 2. Torsion tube

3. A pressurized welded tank is constructed with helical weld that makes α =60 deg. Use thin pressure vessel assumption.
   Radius, r = 0.5 m
   Wall thickness, t = 15 mm
   Pressure, p = 2.4 MPa
   E = 200 GPa
   Poisson's ratio, v = 0.5
   Determine (a) circumferential and longitudinal stresses; (b) Maximum in plane and out of plane shear stresses; (c) the circumferential and longitudinal strains; (d) Normal and shear stress acting on plane parallel and perpendicular to plane. Show it on properly oriented element. Plot the Mohr's circle and show the components at weld plane. (Do not plot to scale, use geometry to compute)



4. Show that for plastic deformation, $\varepsilon_x + \varepsilon_y + \varepsilon_z = 0$ and find the value of Poisson's ratio, v.
5. The stress state is as follows: $\sigma_x = 50; \sigma_y = 10; \sigma_z = -20; \tau_{xy} = -15; \tau_{xz} = \tau_{yz} = 0$. Find the principal stresses and maximum shear stresses.
6. If a small ball and large ball are subjected to hydrostatic pressure. Which one could take more pressure before yielding? Explain in no more than 5 lines.