CE224 Strength of Materials
Fall 2015
HW-1

Due: 30/10/2014

1) Generalized Hooke's law provides the following stress-strain relationships:

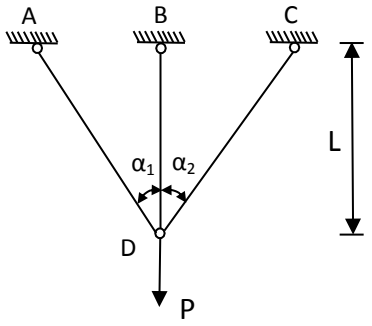
$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\gamma}{E} * (\sigma_y + \sigma_z)$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \frac{\gamma}{E} * (\sigma_x + \sigma_z)$$

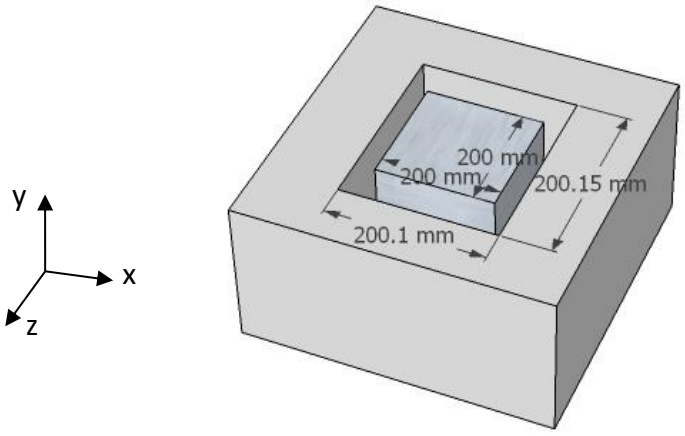
$$\varepsilon_z = \frac{\sigma_z}{E} - \frac{\gamma}{E} * (\sigma_x + \sigma_y)$$

Determine expressions for $\sigma_x, \sigma_y, \sigma_z$ in terms of ε_x , ϵ_y, ϵ_z.

2) A system composed of three pin-connected steel bars supports a load of P as shown in figure. Knowing that $A_{ad} = 2A_{bd} = A_{cd} = 2A$, compute bar forces and tip deflection for:
   $a)$ $\alpha_1 = \alpha_2 = 45°$,
   $b)$ $\alpha_1 = 2\alpha_2 = 60°$

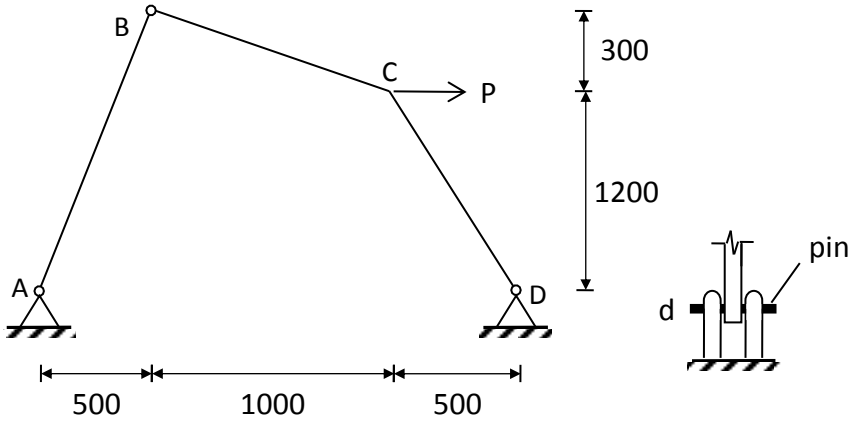


3) An aluminum cube is placed in a rigid box. Given $\Delta T = 70℃$, determine:
   a) The normal stresses (σ_x, σ_z) and
   b) Elongation in the y direction.

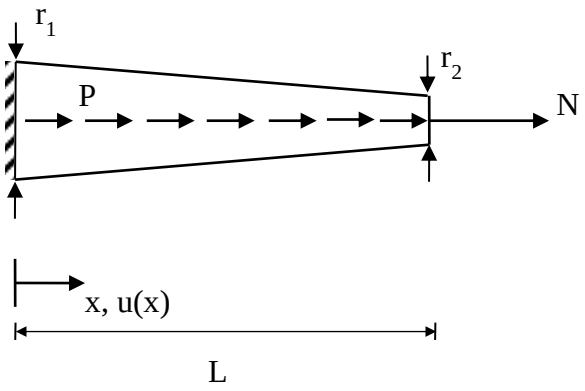


$$\alpha = 23.11 * \frac{10^{-6}}{℃}, , \gamma = 0.3, a = 200\ mm\ and\ E = 70\ GPa$$

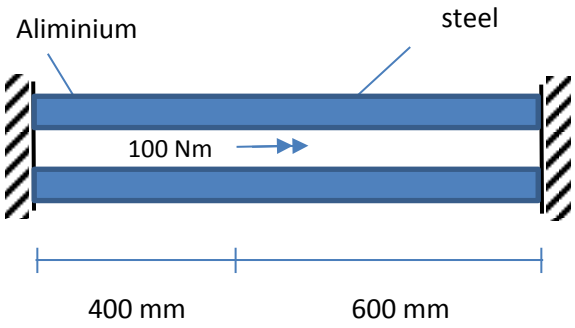
4) The load P shown in figure shown below is of a magnitude such that it causes a shearing stress in pin D of 100 MPa. Determine the minimum area of member AB if the allowable stress is given as 150 MPa. Pin D has a cross-sectional area of 1300 mm^2. Modulus of elasticity of the material is E=200GPa.



5) A circular tapered bar was subjected to a sustained axial load P and a concentrated axial load N. Compute the tip deflection δ_B of the bar if
$N = 250\ kN, P = 100kN/m\ , r_1 = 30\ mm, r_2 = 10mm, L = 1m\ and\ E = 200000MPa$



6) A circular steel member with a radius of 25 mm is inserted inside an aluminum tube with an inside radius of 25 mm and an outside radius of 50 mm. For the two ends of the bar being fixed a torque of 100 Nm is applied. Determine the maximum stresses in both materials. Gsteel: 80 GPa, Gal: 50 GPa



7) Determine the angle of twist at the tip of the circular bar with a radius of 50 mm and shear modulus of 50GPa