CE224 Strength of Materials
Fall 2015
HW-1

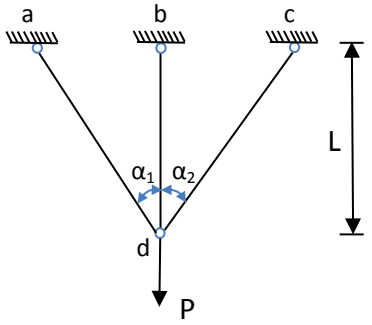
Due: 09/11/2015

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

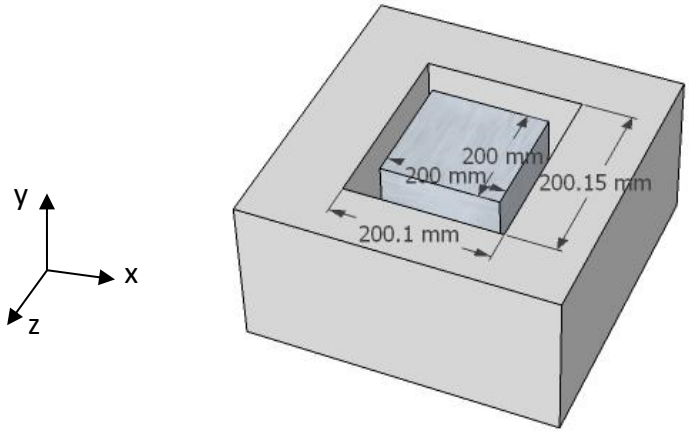
$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\nu}{E}(\sigma_y + \sigma_z) \qquad \varepsilon_y = \frac{\sigma_y}{E} - \frac{\nu}{E}(\sigma_x + \sigma_z) \qquad \varepsilon_z = \frac{\sigma_z}{E} - \frac{\nu}{E}(\sigma_x + \sigma_y)$$

Determine expressions for $\sigma_x, \sigma_y, \sigma_z$ in terms of $\varepsilon_x, \epsilon_y, \epsilon_z$.

2) A system composed of three pin-connected steel bars supports a load of P as shown in figure. Knowing that $A_{ad} = 2A_{bd} = 1.5A_{cd} = 2A$, compute bar forces and tip deflection for:
   a) $\alpha_1 = \alpha_2 = 45°$
   b) $\alpha_1 = 2\alpha_2 = 60°$

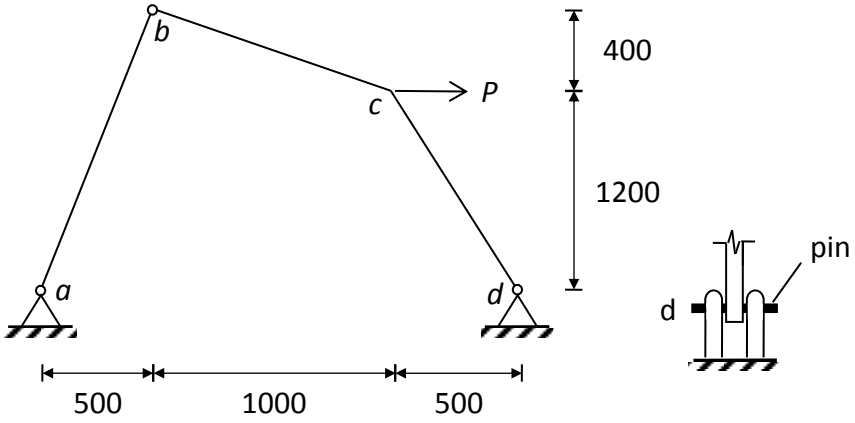


3) An aluminum cube is placed in a rigid box. Given a temperature increase of $\Delta T = 100℃$, determine:
   a) The normal stresses (σ_x, σ_z)
   b) Elongation in the y direction.



$\alpha = 23.11 \times 10^{-6}/℃$, $\nu = 0.3$, $a = 200$ mm and $E = 70$ GPa

4) The average shear stress at the pin of hinge *d* due to the horizontal force *P* at point *c* should not exceed 100 MPa. Pin *d* has a cross-sectional area of 1400 mm^2. Determine the minimum area of bar *ab*, if the allowable normal stress for the bar is given as 200 MPa.



5) A circular tapered bar is subjected to a linearly increasing distributed axial line load *p* and a concentrated axial load *N*. Compute the axil tip deflection δ_2 of the bar, if $N = 25\ kN,\ r_1 = 30\ mm,\ r_2 = 10\ mm,\ L = 1\ m,$ $p_1 = 0\ kN/m,\ p_2 = 12\ kN/m,$ and $E = 200000\ MPa.$