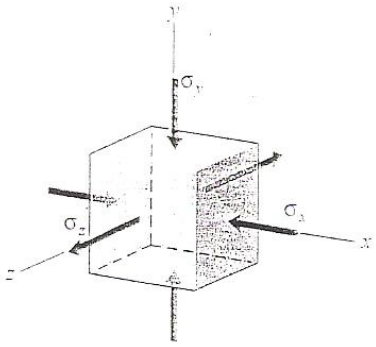
MECH320-SUMMER 2011- QUIZ I-1H30

Problem 1. (20 PTS). A 10 x 10 x 10-in. block of steel (E=30,000 ksi and $v = 0.30$) is loaded with a uniformly distributed pressure of 30,000 psi on the four faces having outward normals in the x- and y- directions. Rigid frictionless constraints limit the deformation of the block in the z-direction to +0.002 in. Determine the normal stress σ_z that develops as the pressure is applied.

Formula(s): $\epsilon_z = \frac{1}{E}[\sigma_z - v(\sigma_x + \sigma_y)]$

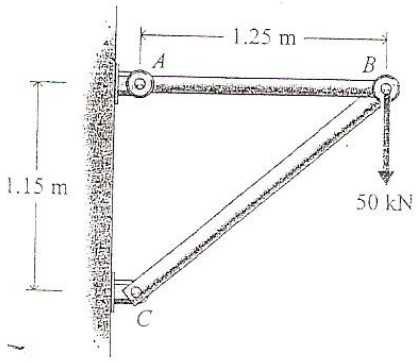


Problem 2. (40 PTS) A tie rod and a pipe strut are used to support a 50-kN load, as shown in the figure below. The cross sectional areas are 650mm^2 for tie rod AB and 925 mm^2 for pipe strut BC. Both members are made of structural steel that has a modulus of elasticity of 200 GPa. Determine:

a) The normal stresses in tie rod AB and pipe strut BC.
b) The lengthening or shortening of tie rod AB and pipe strut BC.
c) The horizontal and vertical components of the displacement point B.
d) The angles through which angles AB and BC rotates.

Formula(s):

$$\delta = \frac{\sigma L}{E} = \frac{PL}{AE}$$



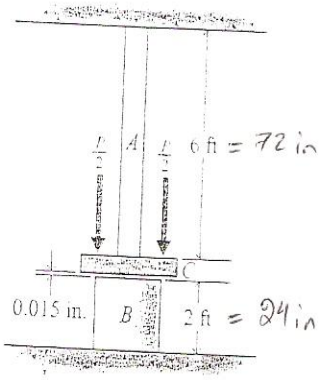
Problem 3. (40 PTS). The Assembly shown in the figure below consists of a steel rod A (E_A=30,000 ksi, A_A=2.50 in^2 and α_A=6.6 x 10^{-6}/°F), a rigid bearing plate C that is securely fastened to bar A, and a bronze bar (E_B=15,000 ksi, A_B=3.75 in^2 and α_B=9.4 x 10^{-6}/°F). A clearance of 0.015 in. exists between the bearing plate C and bar B before the assembly is loaded. If a load P=5 kip is applied to the bearing plate and the temperature of the assembly is

slowly raised, calculate and plot the stresses σ_A in the steel rod and σ_B in the bar bronze as a function of the temperature increase ΔT for $0°F < \Delta T < 50°F$.

Formulas:

$$\delta = \frac{\sigma L}{E} = \frac{PL}{AE}$$

$$\delta = \alpha \Delta T L$$



Units: 1 kip = 1000 lbf, 1 ft = 12 in

Quantity	U.S. Customary Units	MKS Unit Equivalent
Force	1 *lbf*	4.448 *N*
	0.2248 *lbf*	1 *N*
Stress or Pressure	1 lb/in^2 = 1 *psi*	6895. N/m^2 = 6895. *Pa*
	0.0001450 *psi*	1 *Pa*
	1000 lb/in^2 = 1 *ksi*	6 895 000 *Pa* = 6.895 *MPa*
	0.1450 *ksi*	1 *MPa*