MAE 212: Spring 2001

HW 1

Due Thursday, February 1

1. For the state of stress shown, determine the maximum shear stress when (a) $\sigma_{zz} = 0$, (b) $\sigma_{zz} = +10$ ksi and (c) $\sigma_{zz} = -10$ ksi.

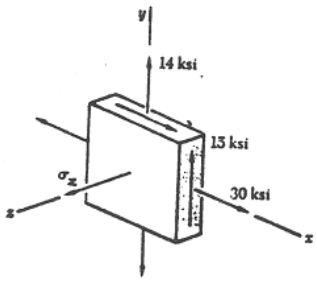

Figure 1: Problem 1.

2. The grain of a wooden member forms an angle of 15° with the vertical. For the state of stress shown, determine

   (a) the in-plane shearing stress parallel to the grain

   (b) the normal stress perpendicular to the grain.

3. The centric force P is applied to a short post as shown. Knowing that the stresses on plane $\alpha - \alpha$ are $\sigma = -20$ ksi and $\tau = 4$ ksi, determine

   (a) the angle β that plane $\alpha - \alpha$ forms with the horizontal

   (b) the maximum compressive stress in the post.

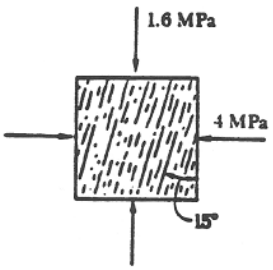

Figure 2: Problem 2.

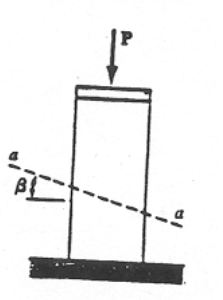

Figure 3: Problem 3.

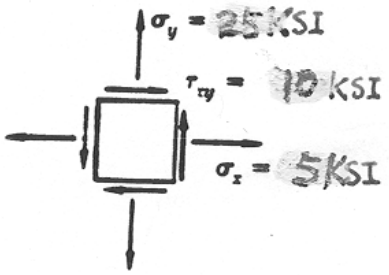

Figure 4: Problem 6.

4. Under plane-stress loading ($\sigma_{zz} = \tau_{xz} = \tau_{yz} = 0$), measured values of e_{xx} and e_{yy} are 0.002 and +0.001, respectively. For this metal, $E = 10^7$ psi and $v = 0.3$. Find e_{zz}.

5. A slab of metal is subjected to plane-strain deformation ($e_2 = 0$) such that $\sigma_1 = 80$ ksi and $\sigma_3 = 0$. If $E = 300$ GPa and $v = 0.4$ (note the mixed units), determine:

   (a) The magnitudes of the three normal strains

   (b) The strain energy per unit volume.

6. The given state of plane stress is known to exist on the surface of a machine component. Knowing that $E = 30 \times 10^6$ psi and $v = 0.3$, determine the direction and magnitude of the in-plane principal strains,

   (a) by using the generalized Hooke's law to determine the corresponding state of strain and then using Mohr's circle for strain

   (b) by using Mohr's circle for stress to determine the principal stresses and then using Hooke's law to find the principal strains.

   (Note: Instead of Mohr's circle, you can use the appropriate transformation equations.)