IDE 110 - Mechanics of Materials - Winter 2006

Name:

Exam 2 – Torsion, Stress and Strain Rotations

Section: D

1. A solid circular steel (G = 80 GPa) shaft 1.5 m long transmits 200 kW at a speed of 400 rpm. If the allowable shearing stress is 70 MPa and the allowable angle of twist is 0.045 rad, determine the minimum permissible diameter for the shaft.

Write legibly – box answers
Include proper units

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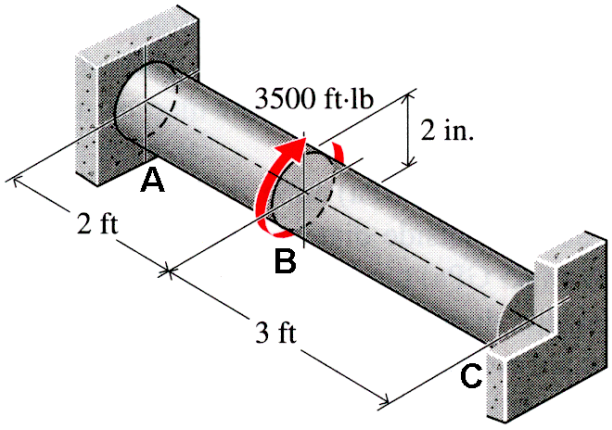
2. The 2-in. diameter steel (G = 12,000 ksi) shaft is fixed to rigid walls at both ends. When a torque of 3500 ft-lb is applied as shown, determine shearing stresses τ_{AB} and τ_{BC} in the shaft.



Write legibly – box answers
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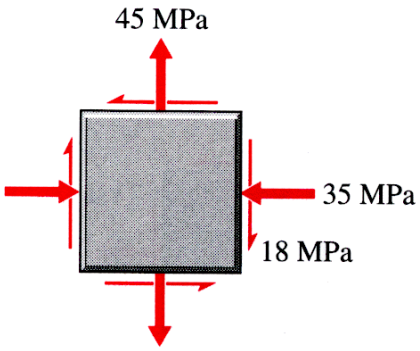
3. The stresses shown act at a point on the free surface of a stressed body. Determine, and show on properly oriented and labeled sketches, the principal stresses and maximum in-plane shear stress at the point.



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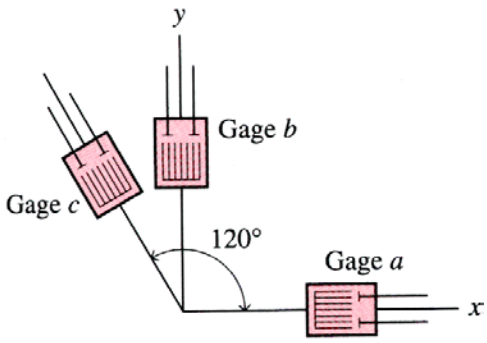
4. The strain rosette shown was used to obtain normal strain data at a point on the free surface of a machine part. Determine:



   a. The strain components ε_x, ε_y, and γ_{xy} at the point.
   b. The principal strains ε_1, ε_2, ε_3 and the maximum shearing strain $\gamma_{abs.max}$ *(consider both in- and out-of-plane values)* at the point.

$\varepsilon_a = +665\mu$
$\varepsilon_b = +390\mu$
$\varepsilon_c = +970\mu$
$\nu = 0.12$

Write legibly – box answers
Include proper units

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…extra paper if you need it…

Write legibly – box answers
Include proper units