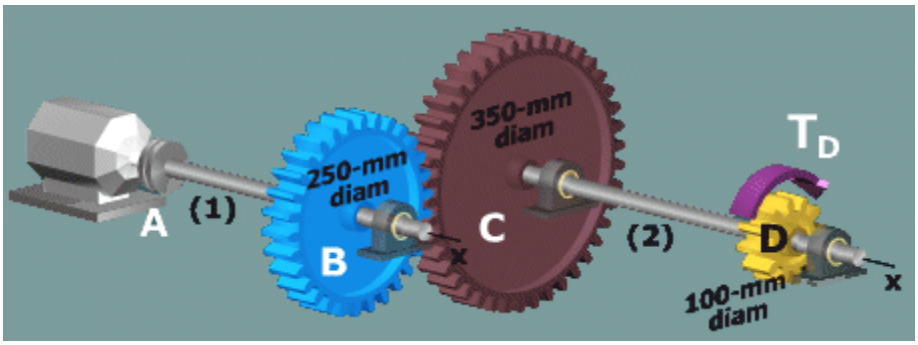
IDE 110 - Mechanics of Materials - Summer 2006

Name:

Exam 2 – Torsion, Stress and Strain Rotations

Section: A

1. A 2380 Nm torque is applied at D as shown. Shafts (1) and (2) are both 44-mm-diameter solid steel shafts 600-mm long (G = 80 GPa). Gear B has a 250-mm diameter, and gear C has a 350-mm diameter. Determine:



a) The maximum stress in shaft (2).
b) The maximum stress in shaft (1).
c) The rotation angle of gear D relative to motor A.

Write legibly – box answers
Include proper units

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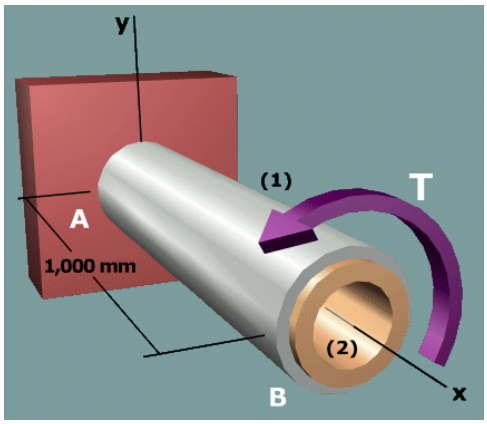
2. A composite shaft consists of a hollow aluminum shaft (1) (G = 26 GPa) bonded to a hollow bronze shaft (2) (G=38 GPa). The outside diameter of shaft (1) is 50 mm, and the inside diameter is 42 mm. The outside diameter of shaft (2) is 42 mm, and the inside diameter is 30 mm. Both shafts are 1000 mm long. A concentrated torque of T = 1400 Nm is applied to the composite shaft at the free end B. Determine:



a) The torques T_1 and T_2 developed in the shafts.

b) The maximum shear stress τ_1 in shaft (1).

Write legibly – box answers
Include proper units

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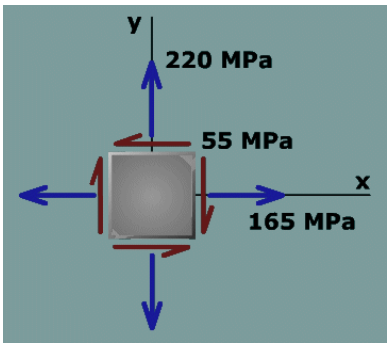
3. The state of plane stress at a point is shown on the element. Determine:



a) The principal stresses σ_1 and σ_2. (Draw these on a properly oriented and labeled element.)

b) The absolute maximum shear stress $\tau_{abs\ max}$. (This can be given simply as a boxed number.)

Write legibly – box answers
Include proper units

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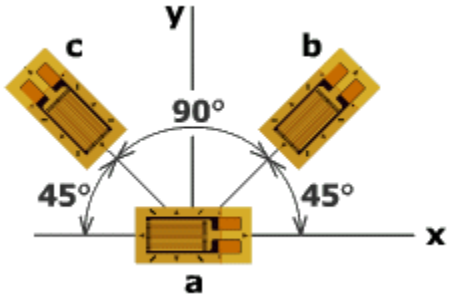
4. The strain rosette shown was used to obtain strain data at a point on the free surface of a machine part. Determine:

   a) The normal strains ε_x and ε_y and shear strain γ_{xy}. (These can be given simply as boxed numbers.)
   b) The maximum in-plane shear strain γ_{max}. (This can be given simply as a boxed number.)



$\varepsilon_a = -350\ \mu$

$\varepsilon_b = -600\ \mu$

$\varepsilon_c = -450\ \mu$

Write legibly – box answers
Include proper units