MEEM 2150 **FINAL EXAM** **NAME:_____**
DEC. 16th, 2003

1a. Associate the strain states with the appropriate Mohr's circle for strain

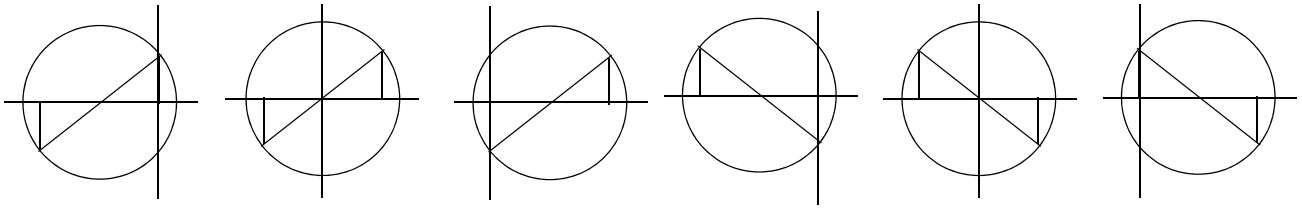
$\varepsilon_{xx} = -600\ \mu$ $\varepsilon_{xx} = 0$

$\varepsilon_{yy} = 0$ $\varepsilon_{yy} = 600\ \mu$

$\gamma_{xy} = -600\ \mu$ $\gamma_{xy} = 600\ \mu$

State 1 State 2

Strain State	Circle
1	
2	



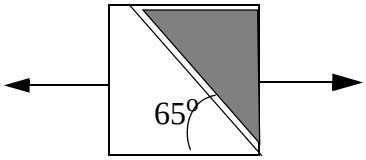
circle A circle B circle C circle D circle E circle F

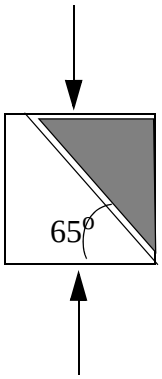
(b) For the two cases shown determine by inspection if the normal stress on the shaded wedge is in tension or compression. and whether the shear stress is acting up or down the incline on the shaded wedge.

Circle the appropriate answer.

σ–––(T) or (C)

τ––––– Up or Down

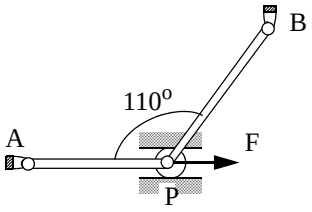




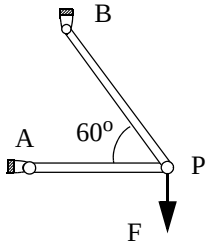
σ–––(T) or (C)

τ––––– Up or Down

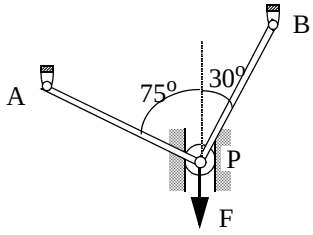
(c) Identify the members in the two bar structures that you would check for buckling. Circle the correct answers.



Structure 1



Structure 2

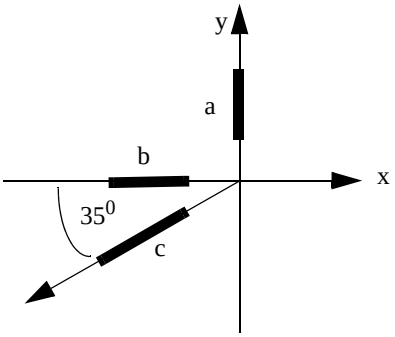


Structure 3

Structure 1	AP	BP	Both	None
Structure 2	AP	BP	Both	None
Structure 3	AP	BP	Both	None

(d) The strain at a point were found to be $\varepsilon_{xx} = 1000\ \mu$, $\varepsilon_{yy} = -2000\ \mu$, and $\gamma_{xy} = +2500\ \mu$. Determine the

strains recorded by the three strain gages.



ε_a = ----------

ε_b = ----------

ε_c = ----------

2. At a point on a free surface the stresses were found to be

σ_{xx} = 100MPa(T) σ_{yy} = 150MPa(T) τ_{xy} = –200MPa

The modulus of elasticity of the material is 70 GPa and the Poisson's ratio is 0.25. Determine strains ε_{xx}, ε_{yy}, γ_{xy}, and ε_{zz}.

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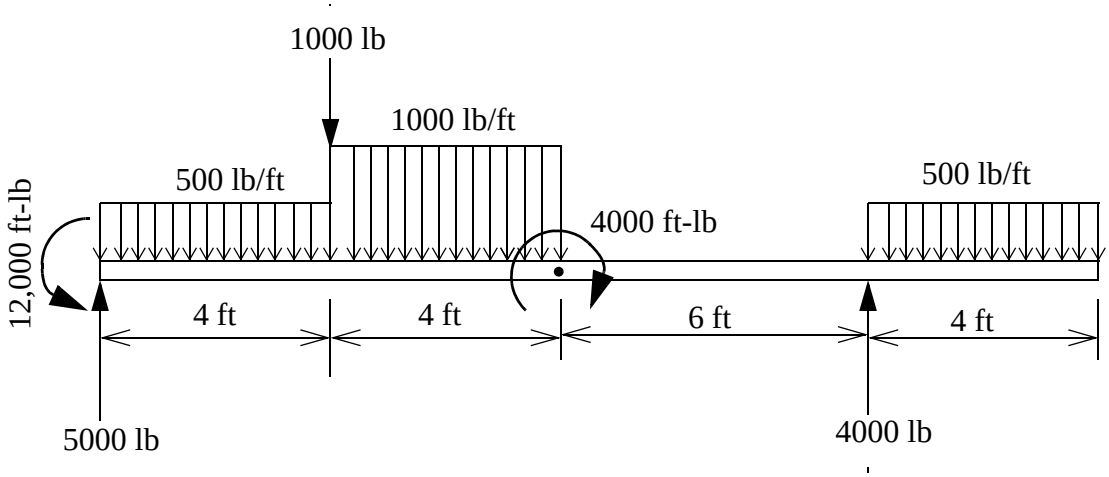
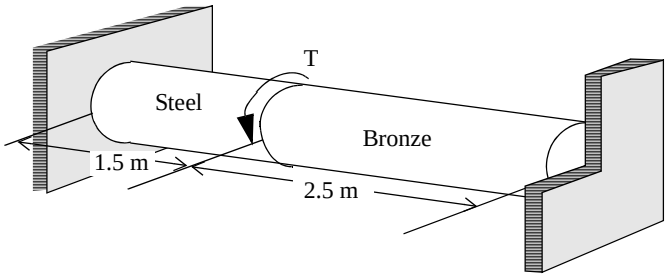
3. Draw complete shear and moment diagrams for the beam shown. Label each point.



4. Two 80-mm diameter solid circular steel (G = 80 GPa) and bronze (G = 45 GPa) shafts are rigidly connected and supported as shown. A torque T is applied at the junction of two shafts as indicated. The allowable shearing stresses are 140 MPa for the steel and 50 MPa for the bronze. Determine the maximum torque T that can be applied.



T_{max} = ----------

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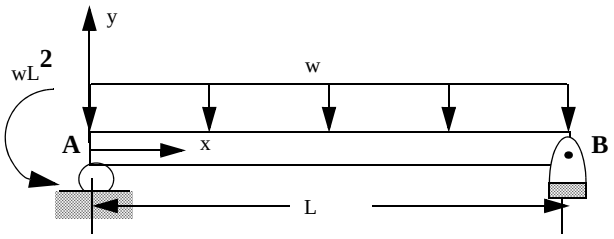
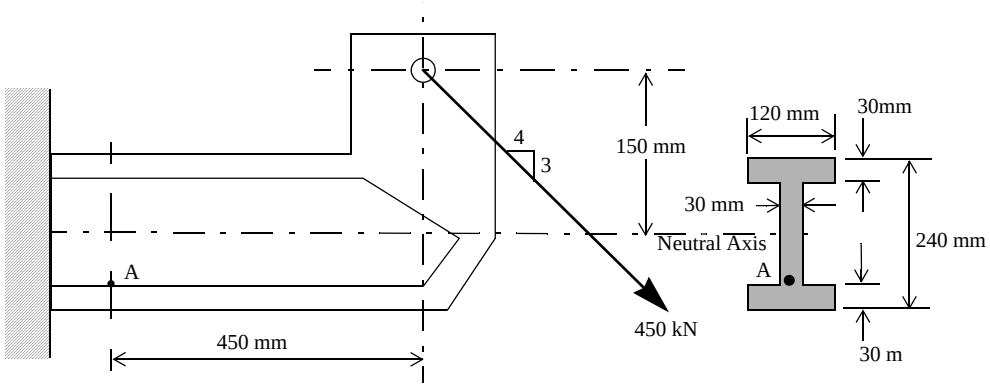
5. A beam is subjected to a uniform distributed load w and a moment as shown. In terms of w, L, E, and I determine the slope at point A.



6. The machine element shown is loaded in a plane of symmetry. Determine the principal stresses and maximum shearing stress at point A that is in the web just above the junction between the flange and the web. The second area moment of inertia about the neutral axis is $I = 94.5(10^6)\ \text{mm}^4$



σ_1 = ----------

σ_2 = ----------

τ_{max} = ----------

ANSWERS

1a 1D 2C

1b T & UP C & UP

1c Structure 1 BP Structure 2 AP Structure 3 None

1d $\varepsilon_a = -2000\ \mu$ $\varepsilon_b = 1000\ \mu$ $\varepsilon_c = 1187.7\ \mu$

2 $\varepsilon_{xx} = 892.8\mu$ $\varepsilon_{yy} = 1785.7\mu$ $\gamma_{xy} = -7142.9\mu$ $\varepsilon_{zz} = -892.9\mu$

3. $(\boldsymbol{V}_y)_{max} = -5000$ lb $(\boldsymbol{M}_z)_{max} = -12000$ ft – lb

4. $T_{max} = 18.83$ kN-m

5. $\dfrac{dv_A}{dx} = \dfrac{7wL^3}{24EI}$

6. $\sigma_1 = 8.8\text{MPa(T)}$ $\sigma_2 = 147.6\text{MPa(C)}$ $\tau_{max} = 78.06\text{MPa}$