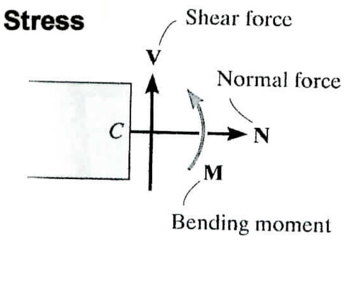
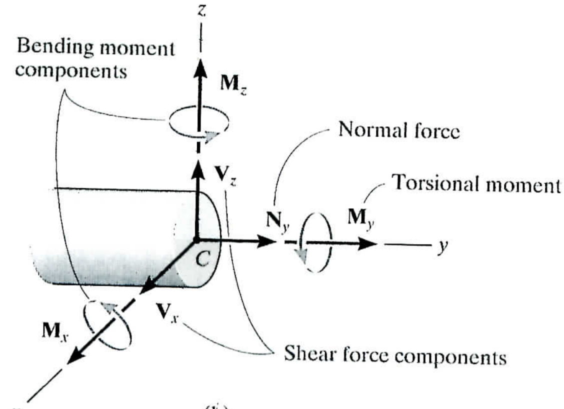
ME219

ME218- Review

State of Stress



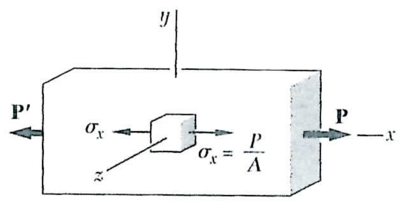
(a)



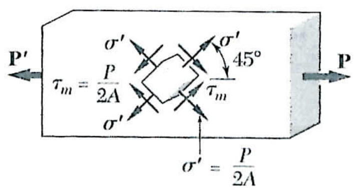
(b)

INTERNAL FORCES DEVELOPED IN STRUCTURAL MEMBERS

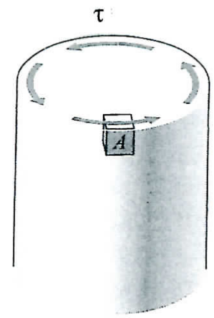
a- Uni-Axial Stress
b- Stress at 45°



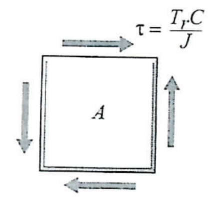
(a)



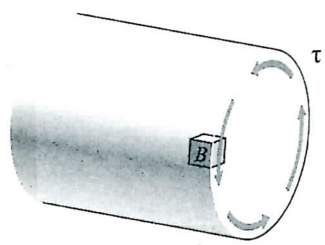
(b)



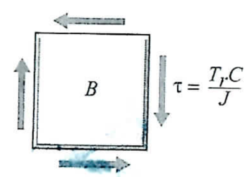
(a)



(b)



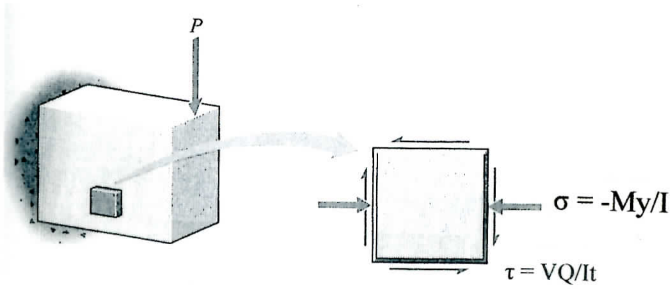
(c)



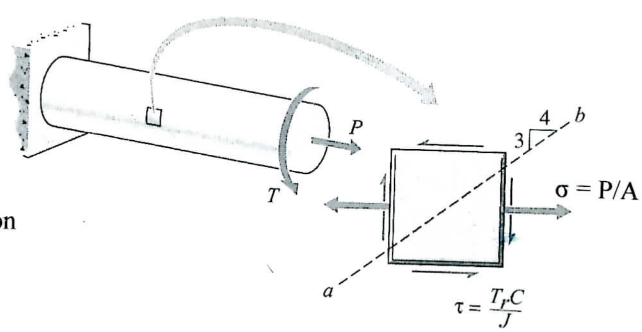
(d)

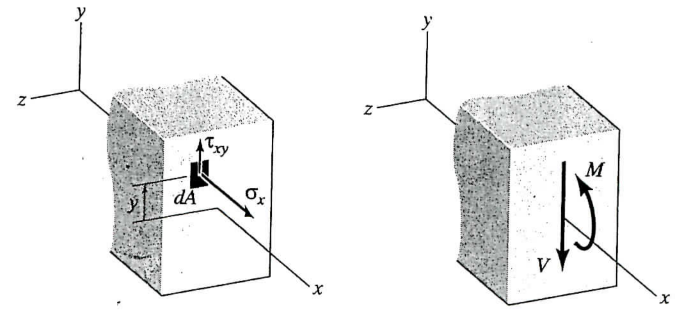
Pure Shear Stress (Torsion)

Bending & Transverse Shear Stress

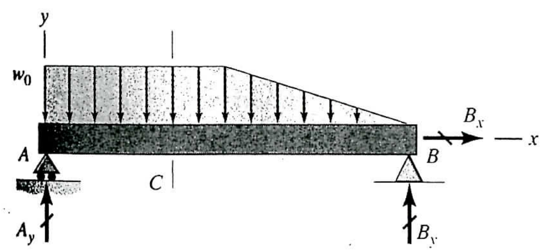


Stress for combined Axial and Torsion

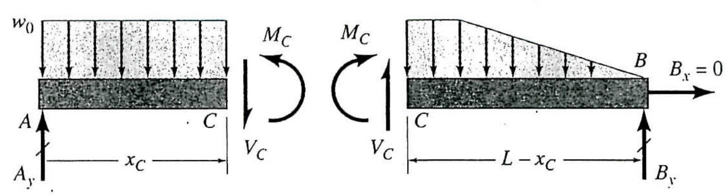




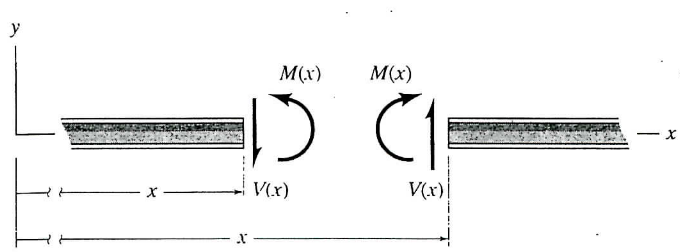
Definition of stress resultants—transverse shear force $V(x)$ and bending moment $M(x)$.



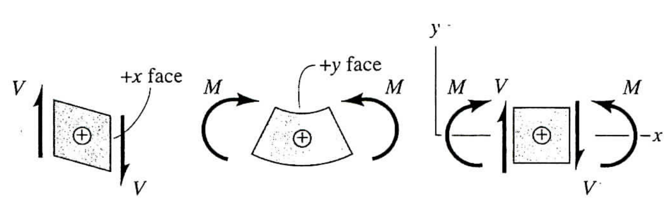
(*a*) A simply supported beam with distributed load.



The transverse shear force V_C and bending moment M_C at cross section C.



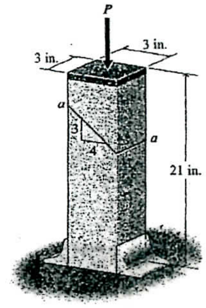
(*a*) Positive *V* and *M* on section "*x*."



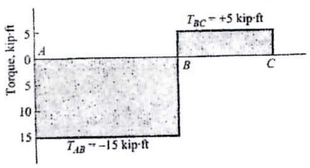
(*b*) Positive shear. (*c*) Positive moment. (*d*) Positive *V* and *M*.

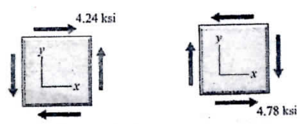
NAME:______________________________ **SID #**________________________

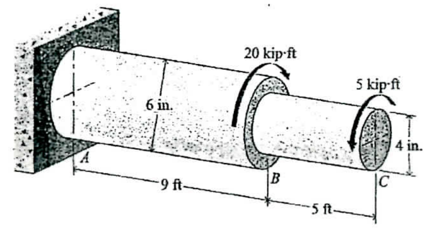
Question 1:
For P = 135-kips determine the state of stress on inclined surface a-a.



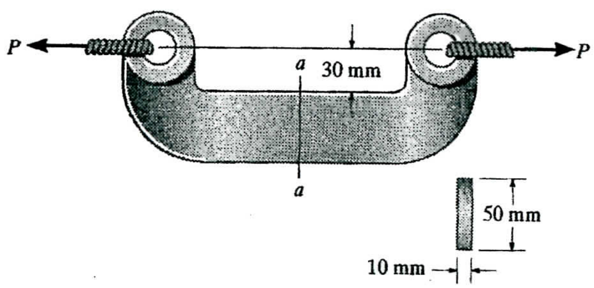
Question 2:
Determine the state of stress on the outside surface of shaft AB and BC.







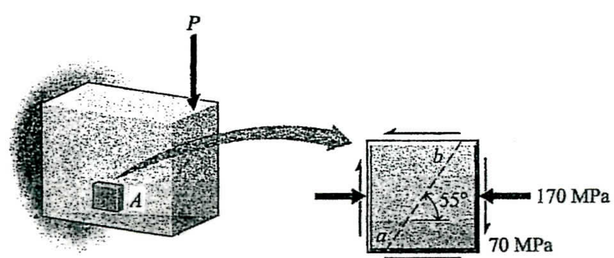
Question 3:
A strain-gage is installed on the top surface of a steel link at section a-a as shown. When load P is applied the reading of the gage is $\varepsilon = +1{,}000 \times 10^{-6}$ mm/mm. Given E = 200-GPa, determine the value of P. Also draw the normal stress distribution in this section.



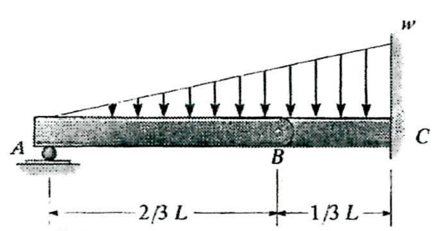
Question 4:
In the cantilever beam shown, for P = 80-kN determine the state of stress at point A 16-mm below the neutral surface and 102-mm from load P. Figure not in scale.

The height and width of the beam is

80-mm and 18-mm respectively.



Question 5:
The compound beam consists of two segments pinned together at B. For L = 9-ft and w = 6-kips/ft, draw shear and moment diagrams. Find location of maximum shear and moment and their magnitudes.

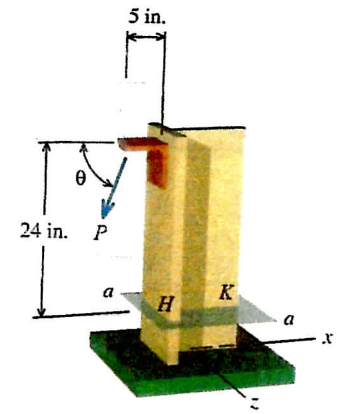


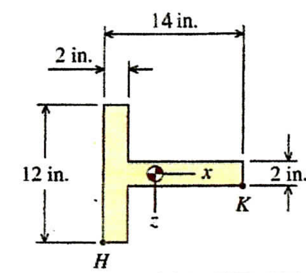
ME 219 SEC 01
Date: 01-12-'17

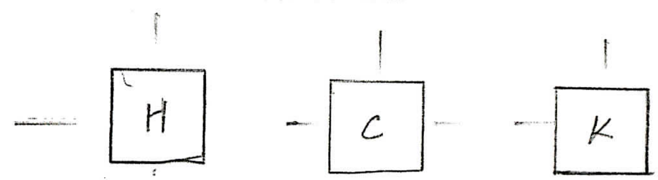
Eccentric Loadings

NAME:________________________ **SID #**__________________

Question 1: (20 Points)
A force P = 40-kips is applied to a short post with a T cross section shown.
Given θ = 60° and the centroid location of the cross section at 9.5-in from point K:
a-Determine the internal forces and moment acting at the section a-a shown.
b-Find state of stresses at points H, K and at the centroid of the cross section.



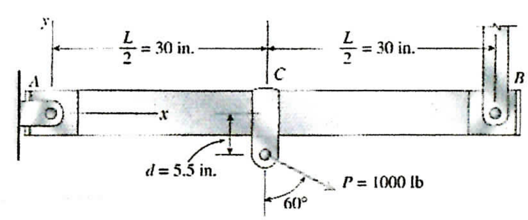


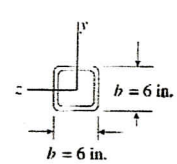


ME 219 SEC 02
Date: 1-12-'17

NAME:________________________ **SID #**__________________

Question 1: (20 Points)
A tubular beam ACB is loaded as shown. Assuming support A is a pin, support B is a roller and the thickness of the tube is t = ¼-in, Determine:
a-The maximum tensile and compressive stresses at a section 20-in from support A.
b-The maximum shear stress in this section.





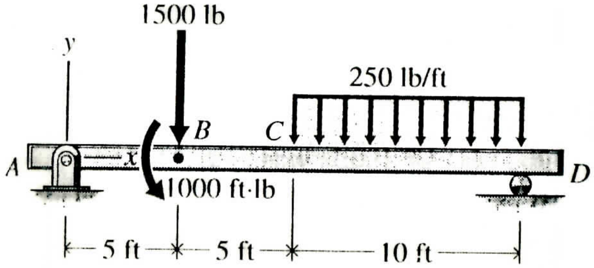
NAME:______________________________ SID #____________________

Question :

For the beams and loading shown:
a - Find reactions at supports.
b - Draw shear and moment diagrams. Find maximum shear and moment.
c - Write equations of shear and moment for all segments of the beams.
(***Use A as center of coordinates***)

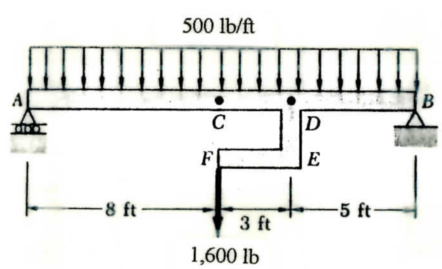
Question 1:

Answers:
V_{max} = -2,200-lbs @ D
M_{max} = 9,680-lb-ft @ x = 11.2-ft



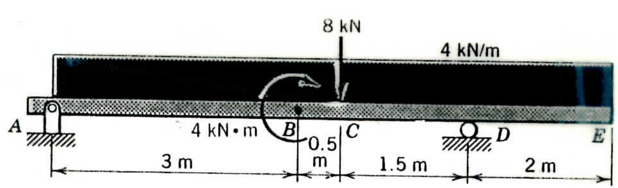
Question 2 :

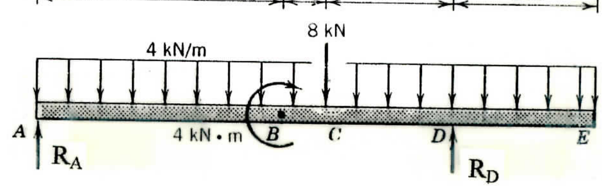
Answers:
V_{max} = ± 4,800-lbs @ A or B
M_{max} = 23,040-lb-ft @ x = 9.6-ft



Question 3:

Answers:
V_{max} = -18-kN @ D
M_{max} = 16-kN-m @ x = 3.0-m





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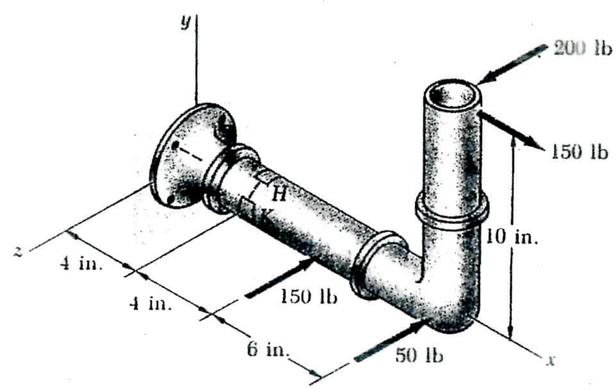
Question (1) :
Four forces are applied to the pipe assembly shown. Knowing that the pipe has an outer diameter of d_o = 1.90-in and inner diameter of d_i =1.61-in :
a- Determine the equivalent bonding forces and moments acting on a cross section 4-in from support.
b- Find stresses at points H and K and sketch the result on differential element for each point. Show axes of the elements.
c- Use **Mohr's Circle** to find the principal stresses and maximum shear for the most critically stressed point, and sketch the results on differential elements with proper orientation with respect to the original x, y, z coordinates.

Answers:

b: $(\sigma_x)_H = 4{,}785$-psi
$(\tau_{xz})_H = -3{,}065$-psi
$(\sigma_x)_K = -2{,}570$-psi
$(\tau_{xy})_K = -3{,}065$-psi



c: $\sigma_{max} = 6{,}281$-psi
$\sigma_{min} = -\ 1{,}495$-psi
$\tau_{max} = -3{,}888$-psi

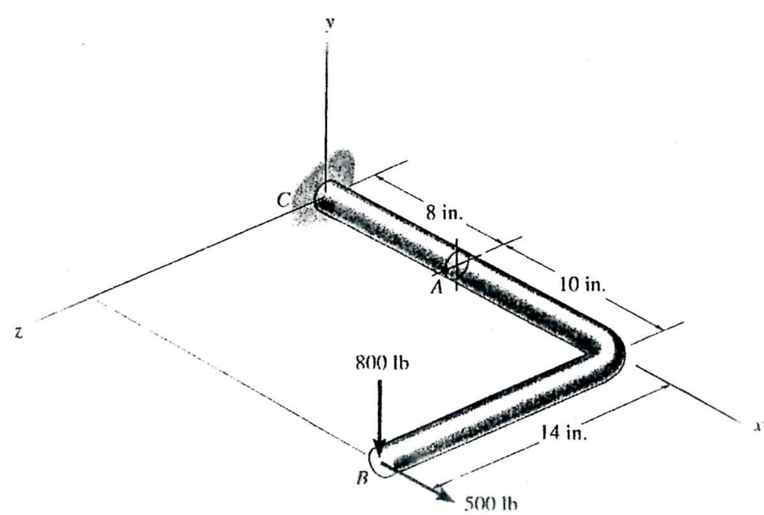
$\theta_P = -\ 26°$ or CW

$\theta_S = +\ 19°$ or CCW

Question (2) :
A solid rod with radius of r = 0.75-in is subjected to the loading shown.
a- Determine the equivalent bonding forces and moments acting on a cross section 8 inches from support C.
b- Determine the state of stress at point A and sketch the result on a differential element. (Show axes of the element.)
c- Use **Mohr's Circle** to find the principal stresses and maximum shear, and sketch the result on differential elements with proper orientation with respect to the original x, y, and z axes.

Answers:

b: $(\sigma_x)_A = 21.5$-ksi
$(\tau_{xy})_A = -17.5$-ksi



c: $\sigma_{max} = 31.3$-ksi
$\sigma_{min} = -\ 9{,}75$-ksi
$\tau_{max} = 20.5$-ksi in-plane

$\theta_P = -\ 29.2°$ or CW

$\theta_S = +\ 15.8°$ or CCW

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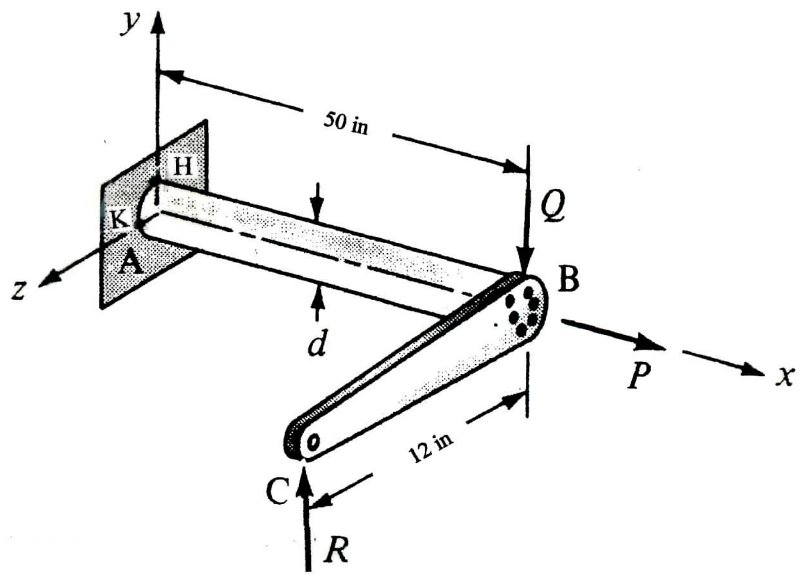
Question 3 :
Three forces are applied to the assembly shown. Knowing that the solid rod AB has a diameter of d = 2-in:

a- Determine the equivalent bonding forces and moments acting on a cross section near support A.
b- Find the state of stress at points H and K on the top and on the side of the rod and sketch the result on differential element for each point. Show axes of each element.
c- Use **Mohr's Circle** to find the principal stresses and maximum shear for the most critically stressed point, and sketch the results on differential elements with proper orientation with respect to the original x, y, z coordinates.
d- At point H find the stresses at a direction of $\theta = +40°$ with respect to the x-axis. Use equations and confirm the result with the Mohr's circle.

Assume : P = 6,280 lbs Q = 1,204 lbs R = 1,047 lbs
$E = 29 \times 10^6$ psi



Answers:

b:

$(\sigma_x)_H = 12$-ksi

$(\tau_{xz})_H = 8$-ksi

$(\sigma_x)_K = 2$-ksi

$(\tau_{xy})_K = 7.93$-ksi

c:

$\sigma_{max} = 16$-ksi

$\sigma_{min} = -4$-ksi

$\tau_{max} = 10$-ksi

$\sigma_{ave} = 6$-ksi

d:

$\sigma_{x'} = 14.92$-ksi

$\sigma_{y'} = -2.92$-ksi

$\tau_{x'y'} = -4.51$-ksi