

**PROFESSIONAL ENGINEERING I
SPRING 2022**

TEST 3: MECHANICS OF MATERIALS TEST

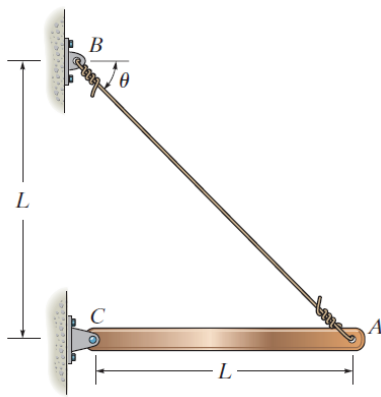
TOPICS COVERED IN TEST 3:

1. FUNDAMENTALS OF MECHANICS OF MATERIALS

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
MECHANICS OF MATERIALS TEST
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
February 8, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

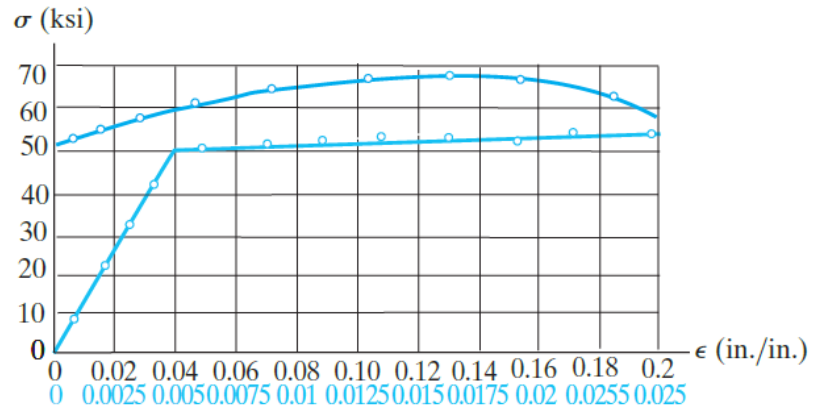
Name: _____

1. The wire AB is un-stretched when $\theta = 45^\circ$. If a vertical load is applied at point A of the bar AC , which causes θ to become 47° , the *normal strain in the wire* is nearly:



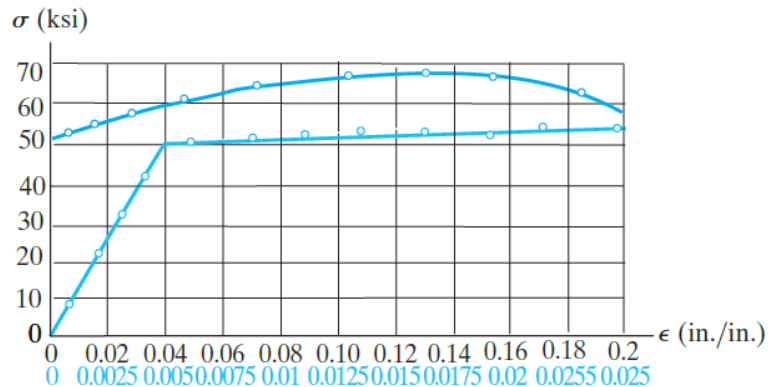
- a. 0.0043
- b. 0.0343
- c. 0.0558
- d. 0.0032

2. The stress–strain diagram for an aluminum alloy specimen having an original diameter of 0.5 in. and a gage length of 2 in. is given in the figure. The *modulus of elasticity* for the material approximately:



- a. 10.0 (10^3) psi
- b. 10.0 (10^3) ksi
- c. 14.0 (10^3) psi
- d. 14.0 (10^3) ksi

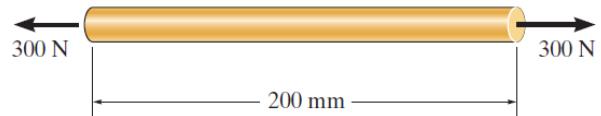
3. The yield stress for the situation in Problem #2 is exactly:



- a. 50 ksi
- b. 68 ksi
- c. 53 ksi
- d. None of the above

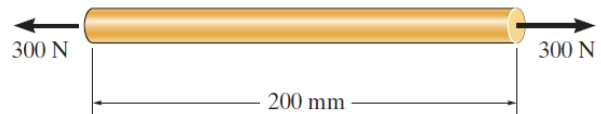
4. The acrylic plastic rod is 200 mm long and 15 mm in diameter. If an axial load of 300 N is applied to it, the *change in its length* is nearly:

$E_{\text{plastic}} = 2.70 \text{ GPa}$, $\nu_{\text{plastic}} = 0.4$.



- a. 0 mm
- b. 0.500 mm
- c. 0.350 mm
- d. 0.126 mm

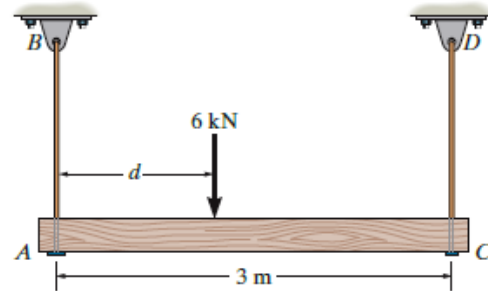
5. The *change in diameter* of the rod in Problem #4 is most nearly:



The acrylic plastic rod is 200 mm long and 15 mm in diameter. An axial load of 300 N is applied to it. $E_{\text{plastic}} = 2.70 \text{ GPa}$, $\nu_{\text{plastic}} = 0.4$.

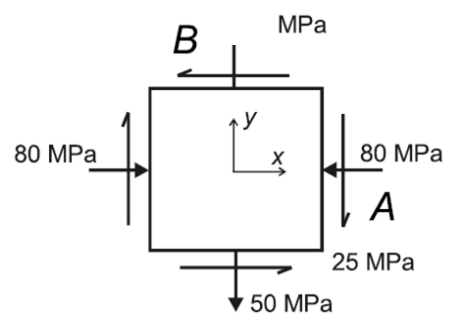
- a. 0.00377 mm (reduction)
- b. 0.00377 mm (increase)
- c. 0.04356 mm (reduction)
- d. 0.04356 mm (increase)

6. The beam is supported by two rods AB and CD that have cross-sectional areas of 12 mm^2 and 8 mm^2 , respectively. What is **position d** of the 6-kN load so that the *normal stress* in each rod is the same? [**HINT:** Free Body Diagram of the beam and Statics analysis will help]



- a. 2.2 m
- b. 1.2 m
- c. 3.0 m
- d. 3.1 m

7. The principal normal stresses on the element shown are:

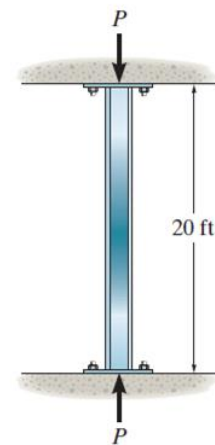


- a. 54.6 kPa; -84.6 kPa
- b. 54.6 MPa; -84.6 MPa
- c. 54.6 MPa; 84.6 MPa
- d. None of the above

8. The wall thickness of a 4-ft-diameter *spherical* tank is 5/16 inch. If the stress is limited to 8000 psi, the allowable internal pressure is most nearly:

- a. 608 psi
- b. 108 psi
- c. 300 psi
- d. 208 psi

9. The W12 x 50 structural member is made of A992 steel and *is used as a column* that has a length of 20 ft. If its *ends are assumed pin supported*, and it is subjected to an axial load of 150 kip, what is, most nearly, the *critical normal stress* if $\sigma_{\text{Yield}} = 50$ ksi?



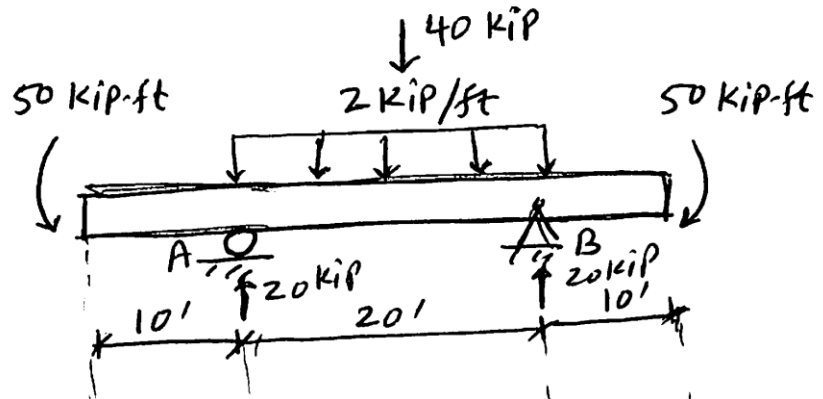
- a. 19 ksi
- b. 25 ksi
- c. 55 ksi
- d. 66 ksi

10. The *factor of safety* for the situation in Problem #9 is most nearly:

The W12 x 50 structural member is made of A992 steel and *is used as a column* that has a length of 20 ft. The *ends are assumed pin supported*, and it is subjected to an axial load of 150 kip, $\sigma_{\text{Yield}} = 50$ ksi?

- a. 2
- b. 3
- c. 1
- d. None of the above

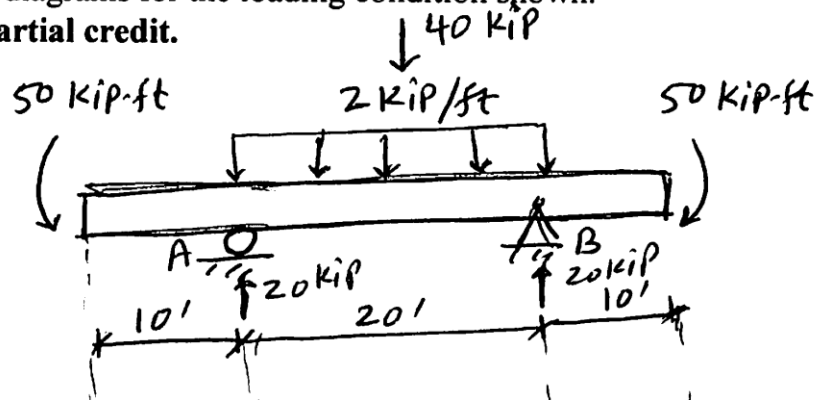
11. The maximum positive shear force anywhere on the beam is most nearly:



- a. 40 kip
- b. 30 kip
- c. 20 kip
- d. None of the above

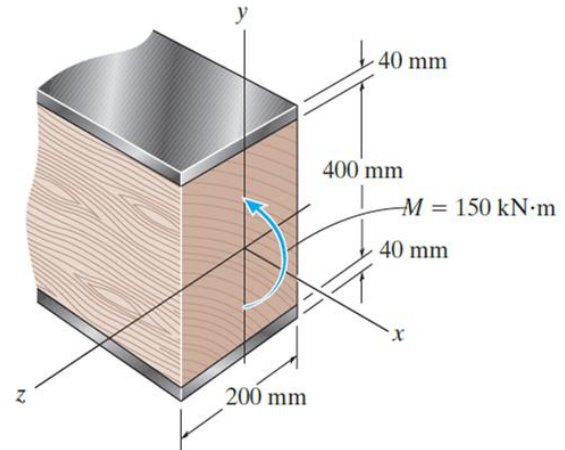
12. The maximum negative bending moment anywhere in the beam of Problem #11 is most nearly:

diagrams for the loading condition shown.
partial credit.



- a. 20 kip-ft
- b. 50 kip-ft
- c. 30 kip-ft
- d. None of the above

13. A wood beam is reinforced with steel straps at its top and bottom as shown. Determine the **maximum bending stress developed in the steel** if the beam is subjected to a moment of $M = 150 \text{ kN}\cdot\text{m}$. Take $E_w = 10 \text{ GPa}$, $E_{st} = 200 \text{ GPa}$. [**Hints: Convert Wood to Steel; Note the Transformation Factor, n**]

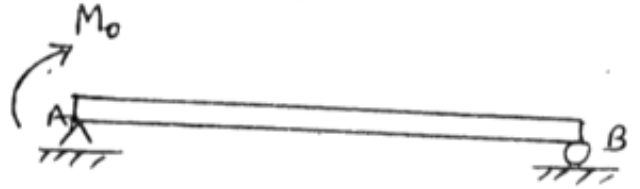


- a. 90 MPa
- b. 13 MPa
- c. 18 MPa
- d. 43 MPa

14. The **maximum bending stress developed in the wood** for Problem # 13 is *most nearly* (**Remember**, you have converted Wood to Steel in Problem #13):

- a. 2 MPa
- b. 4 MPa
- c. 6 MPa
- d. None of the above

15. The correct *bending moment equation* as a function of distance x along the beam (from left to right) is (**Consider the beam is Horizontal**):



- a. $M(x) = M_0$
- b. $M(x) = (M_0x/L) + M_0$
- c. $M(x) = - (M_0x/L) + M_0$
- d. $M(x) = - (M_0x^2/L) + M_0x$

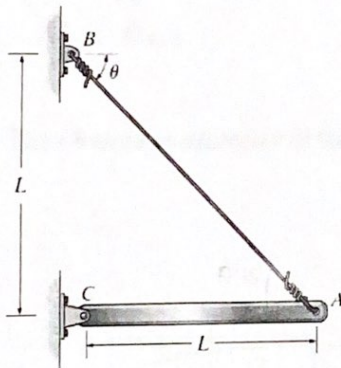
ABOVE AVERAGE

12/15 P

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
MECHANICS OF MATERIALS TEST
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February 8, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

Name: Perla Zaldivar

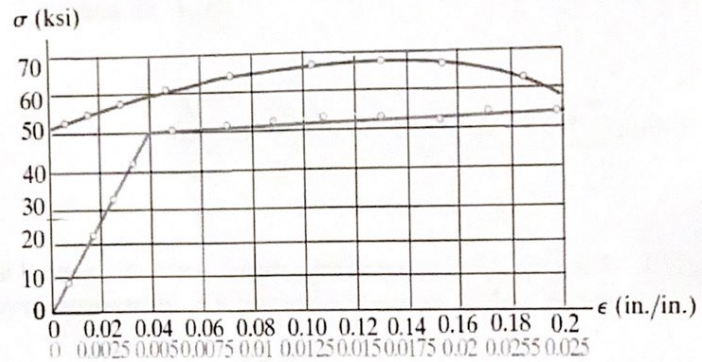
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- a. 0.0043
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d. 0.0032

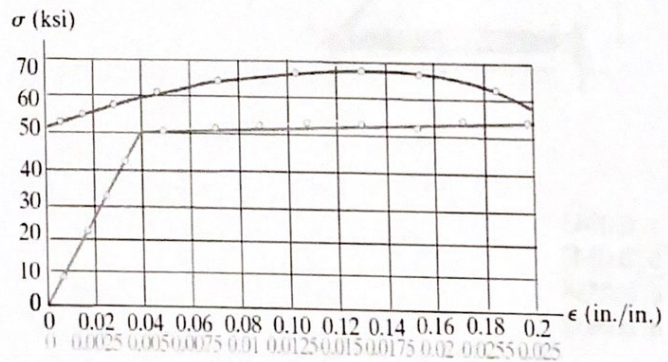
2. The stress-strain diagram for an aluminum alloy specimen having an original diameter of 0.5 in. and a gage length of 2 in. is given in the figure. The *modulus of elasticity* for the material approximately:

E



- a. 10.0 (10^3) psi
- ☒ b. 10.0 (10^3) ksi
- c. 14.0 (10^3) psi
- d. 14.0 (10^3) ksi

3. The yield stress for the situation in Problem #2 is exactly:



- ☒ a. 50 ksi
- b. 68 ksi
- c. 53 ksi
- d. None of the above

4. The acrylic plastic rod is 200 mm long and 15 mm in diameter. If an axial load of 300 N is applied to it, the *change in its length* is nearly:

$E_{\text{plastic}} = 2.70 \text{ GPa}$, $\nu_{\text{plastic}} = 0.4$.

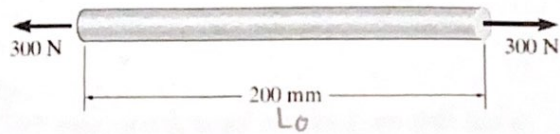
$$\epsilon_y = -\frac{\nu}{1+\nu} \epsilon_x$$

$$P = 300 \text{ N}$$

$$E = 2.70 \text{ GPa}$$

$$\nu = 0.4$$

$$\sigma = \frac{P}{A} = \frac{300 \text{ N}}{3000 \text{ mm}^2} = 0.1 \text{ N/mm}^2 \text{ or } 100,000 \text{ N/m}^2$$



$$E = \frac{\sigma}{\epsilon}$$

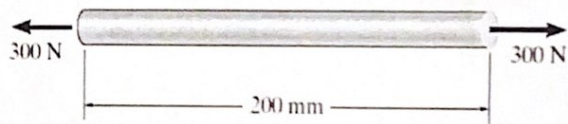
$$\epsilon = \frac{\sigma}{E} = \frac{100,000 \text{ Pa}}{2.7 \times 10^9 \text{ Pa}} =$$

- a. 0 mm
- b. 0.500 mm
- c. 0.350 mm
- ☒ d. 0.126 mm

$$\epsilon = \frac{\Delta L}{L_0}$$

$$\Delta L = \epsilon L_0$$

5. The *change in diameter* of the rod in Problem #4 is most nearly:



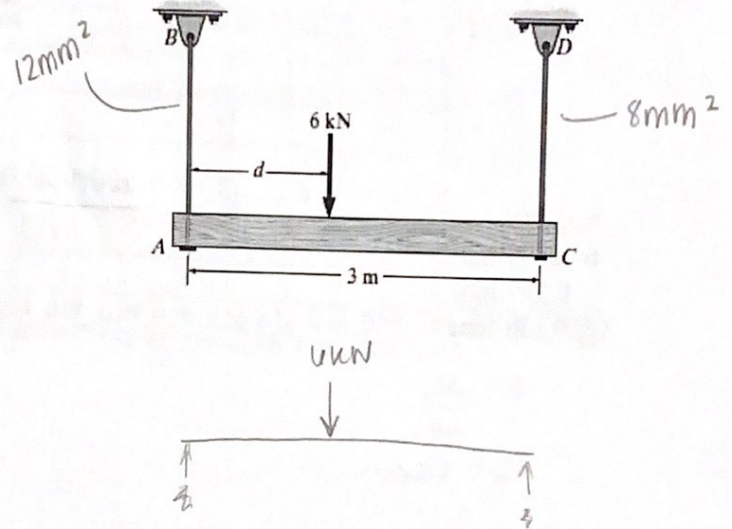
$$A = 0.3 \text{ m}^2 \text{ or } 3000 \text{ mm}^2$$

The acrylic plastic rod is 200 mm long and 15 mm in diameter. An axial load of 300 N is applied to it. $E_{\text{plastic}} = 2.70 \text{ GPa}$, $\nu_{\text{plastic}} = 0.4$.

- ☒ a. 0.00377 mm (reduction)
- b. 0.00377 mm (increase)
- c. 0.04356 mm (reduction)
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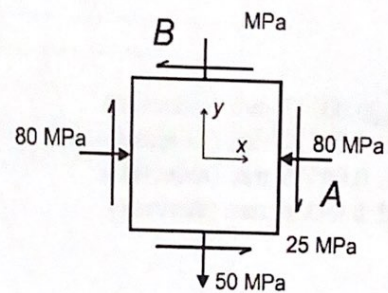
6. The beam is supported by two rods AB and CD that have cross-sectional areas of 12 mm^2 and 8 mm^2 , respectively. What is **position d** of the 6-kN load so that the **normal stress** in each rod is the same? **[HINT: Free Body Diagram of the beam and Statics analysis will help]**

$$\sigma = \frac{P}{A}$$



- a. 2.2 m
- ☒ b. 1.2 m
- c. 3.0 m
- d. 3.1 m

7. The principal normal stresses on the element shown are:



- a. 54.6 kPa ; -84.6 kPa
- ☒ b. 54.6 MPa ; -84.6 MPa
- c. 54.6 MPa ; 84.6 MPa
- d. None of the above

4 ft

$$24 \text{ in} = r$$



$$5/16 \text{ in} \rightarrow r = 0.3125 \text{ in}$$

8. The wall thickness of a 4-ft-diameter *spherical* tank is 5/16 inch. If the stress is limited to 8000 psi, the allowable internal pressure is most nearly:

- a. 608 psi
- b. 108 psi
- c. 300 psi
- d. 208 psi

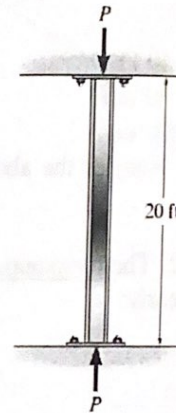
$$\sigma_r = P_i \left(\frac{24 \text{ in}^2 + 0.3125 \text{ in}^2}{24 \text{ in}^2 - 0.3125 \text{ in}^2} \right)$$

$$200.14 \text{ PSI}$$

9. The W12 x 50 structural member is made of A992 steel and is used as a *column* that has a length of 20 ft. If its *ends are assumed pin supported*, and it is subjected to an axial load of 150 kip, what is, most nearly, the critical normal stress if $\sigma_{\text{Yield}} = 50 \text{ ksi}$?

$$P = 150 \text{ kip}$$

$$\sigma_{\text{actual}} = \sigma_{\text{Yield}} = 50 \text{ ksi}$$



- a. 19 ksi
- b. 25 ksi
- c. 55 ksi
- d. 66 ksi

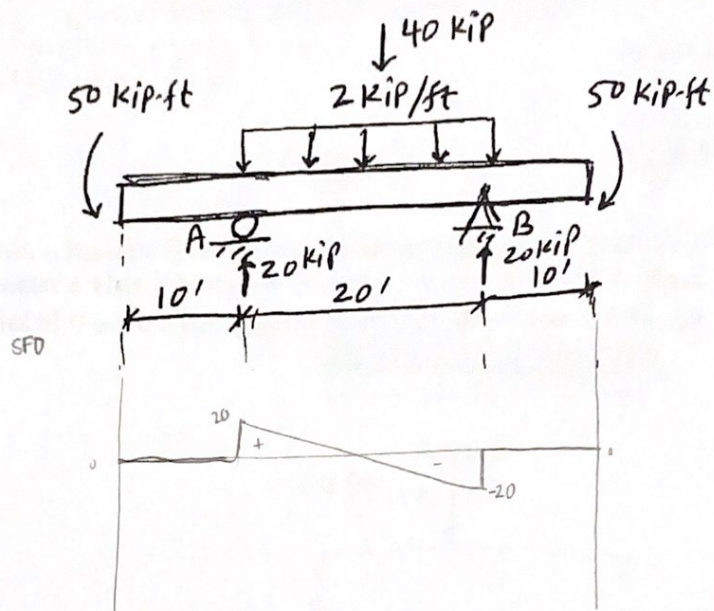
10. The *factor of safety* for the situation in Problem #9 is most nearly:

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- a. 2
- b. 3
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- d. None of the above

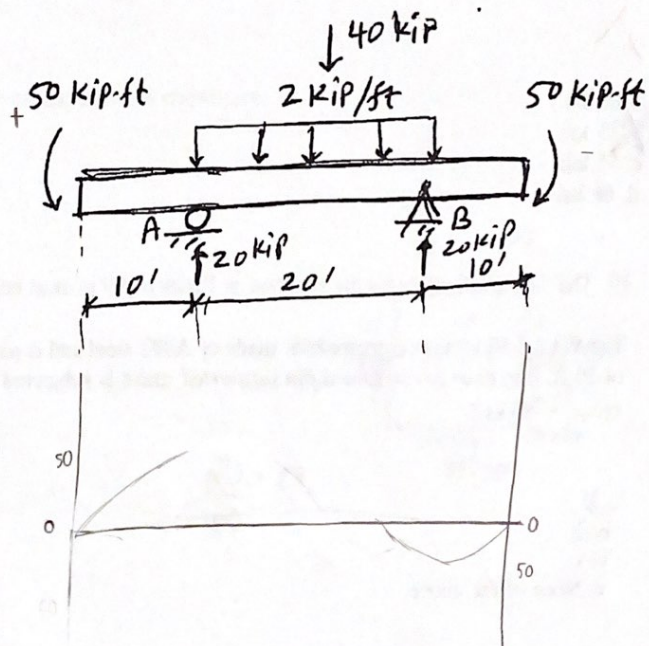
$$FS = \frac{\sigma_a}{\sigma_y}$$

11. The maximum positive shear force anywhere on the beam is most nearly:



- a. 40 kip
- b. 30 kip
- c. 20 kip
- d. None of the above

12. The maximum negative bending moment anywhere in the beam of Problem #11 is most nearly:



- a. 20 kip-ft
- b. 50 kip-ft
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13. A wood beam is reinforced with steel straps at its top and bottom as shown. Determine the **maximum bending stress developed in the steel** if the beam is subjected to a moment of $M = 150 \text{ kN}\cdot\text{m}$. Take $E_w = 10 \text{ GPa}$, $E_{st} = 200 \text{ GPa}$. [Hints: Convert Wood to Steel; Note the Transformation Factor, n]

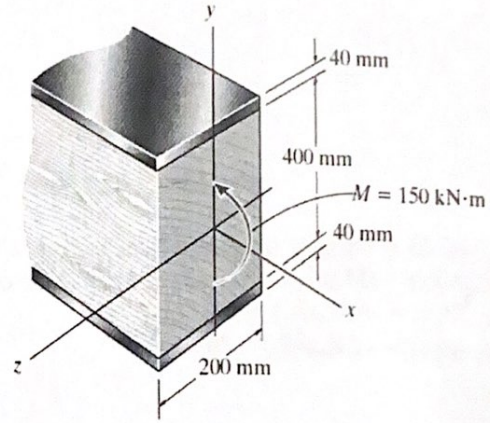
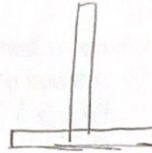
$$M = 150 \text{ kN}\cdot\text{m}$$

$$E_w = 10 \text{ GPa}$$

$$E_{st} = 200 \text{ GPa}$$

$$200 \text{ mm} (40 \text{ mm}) = 8000 \text{ mm}^2$$

$$I_1 = 1044$$

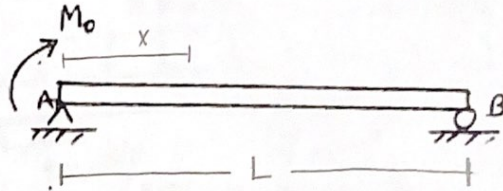


- a. 90 MPa
- b. 13 MPa
- ☒ c. 18 MPa
- d. 43 MPa

14. The **maximum bending stress developed in the wood** for Problem # 13 is *most nearly* (Remember, you have converted Wood to Steel in Problem #13):

- ☒ a. 2 MPa
- b. 4 MPa
- c. 6 MPa
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15. The correct *bending moment equation* as a function of distance x along the beam (from left to right) is (Consider the beam is Horizontal):



- a. $M(x) = M_0$
- b. $M(x) = (M_0 x/L) + M_0$
- c. $M(x) = - (M_0 x/L) + M_0$
- d. $M(x) = - (M_0 x^2/L) + M_0 x$

$$\frac{M_0(x)}{L}$$

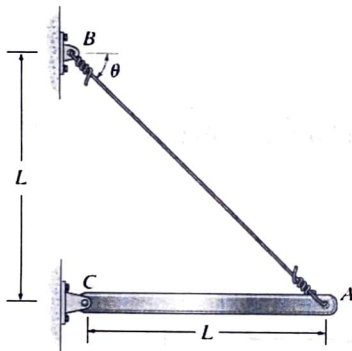
AVERAGE

08/15

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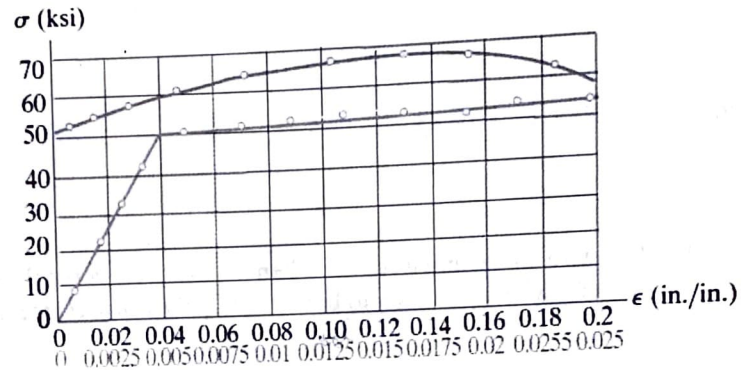
Name: Michael LeBlanc

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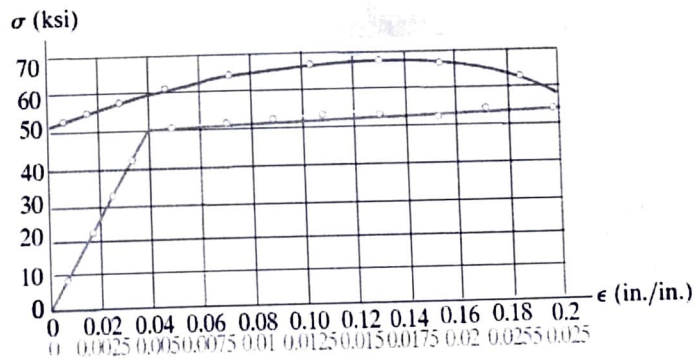
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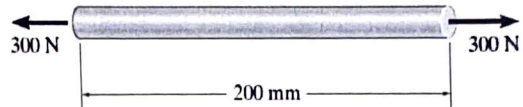


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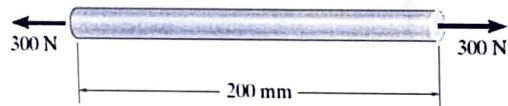
$$L - L_0$$



$$\epsilon_{\text{long}} = \frac{L - L_0}{L_0}$$

- a. 0 mm
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- d. 0.126 mm

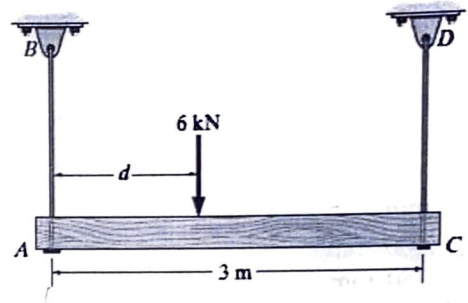
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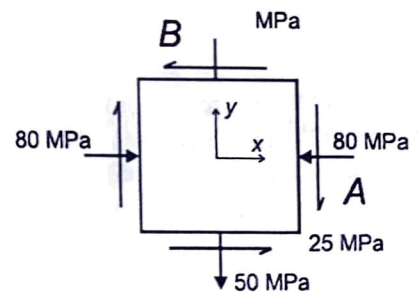
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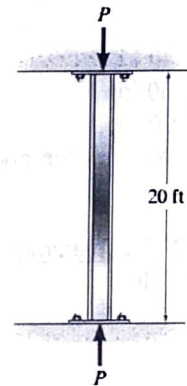


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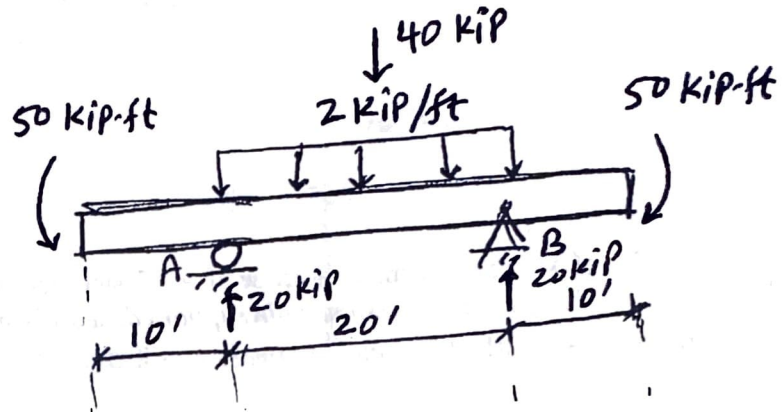
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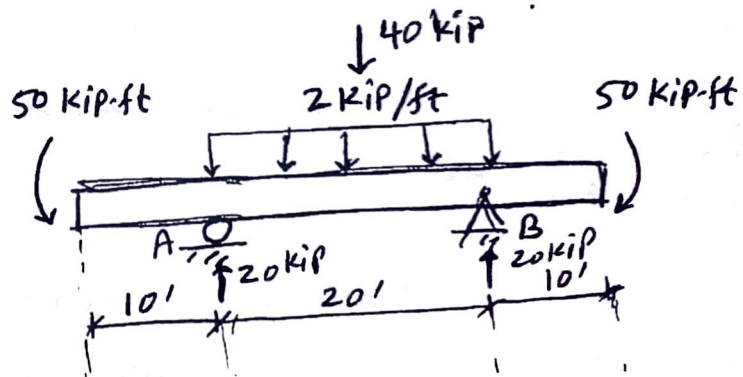
- ☒ a. 2
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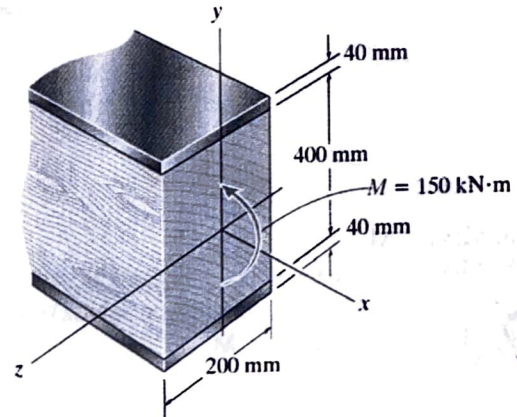
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- ☒ b. $M(x) = (M_0 x/L) + M_0$
- ☒ c. $M(x) = - (M_0 x/L) + M_0$
- ☒ d. $M(x) = - (M_0 x^2/L) + M_0 x$

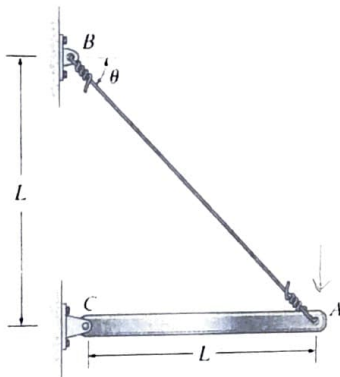
BELOW AVERAGE

10/15

Department of Civil & Environmental Engineering
CVEG 3102: Professional Engineering I
MECHANICS OF MATERIALS TEST
(CLOSED Books/Notes; OPEN NCEES Formula Sheets)
February 8, 2022 (IN-CLASS 2-Hour Test)
Dr. I. Ahmed

Name: Sydney Jones

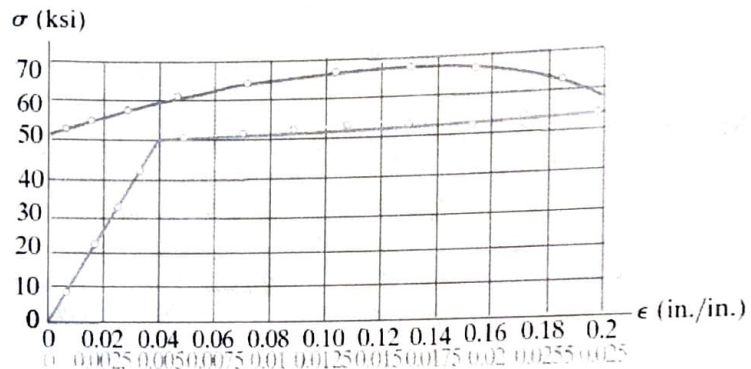
1. The wire AB is un-stretched when $\theta = 45^\circ$. If a vertical load is applied at point A of the bar AC , which causes θ to become 47° , the normal strain in the wire is nearly:



$$\epsilon = \frac{\Delta L}{L}$$

- a. 0.0043
b. 0.0343
c. 0.0558
d. 0.0032

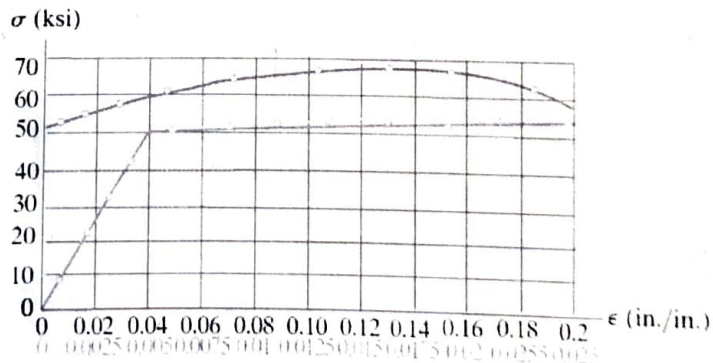
2. The stress-strain diagram for an aluminum alloy specimen having an original diameter of 0.5 in. and a gage length of 2 in. is given in the figure. The *modulus of elasticity* for the material approximately:



- a. 10.0 (10^3) psi
- ☒ b. 10.0 (10^3) ksi
- c. 14.0 (10^3) psi
- d. 14.0 (10^3) ksi

$$\frac{50}{0.005}$$

3. The yield stress for the situation in Problem #2 is exactly:



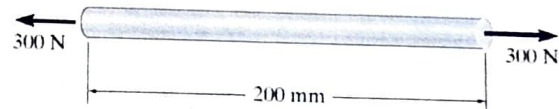
- ☒ a. 50 ksi
- b. 68 ksi
- c. 53 ksi
- d. None of the above

4. The acrylic plastic rod is 200 mm long and 15 mm in diameter. If an axial load of 300 N is applied to it, the *change in its length* is nearly:

$E_{\text{plastic}} = 2.70 \text{ GPa}$, $\nu_{\text{plastic}} = 0.4$.

N
mm

Pascal = $\frac{\text{N}}{\text{m}^2}$

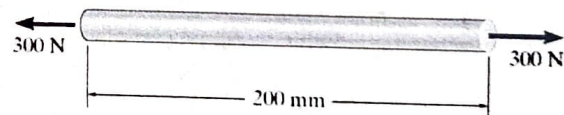


- a. 0 mm
- b. 0.500 mm
- c. 0.350 mm
- ☒ d. 0.126 mm

$$\delta = \frac{PL}{AE} = \frac{(300\text{N})(.2\text{m})}{(35.3\text{m}^2)(2.7\text{E}6 \frac{\text{N}}{\text{m}^2})} = .063 \times 2$$

$$7.5^2 \pi \times 200 \\ = 35.3\text{m}^2$$

5. The *change in diameter* of the rod in Problem #4 is most nearly:

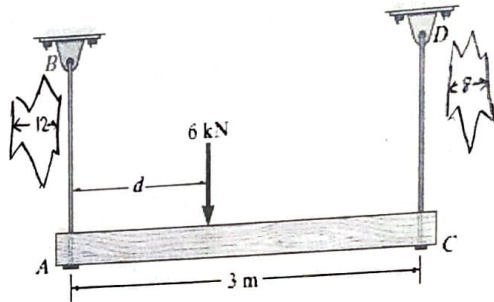


The acrylic plastic rod is 200 mm long and 15 mm in diameter. An axial load of 300 N is applied to it. $E_{\text{plastic}} = 2.70 \text{ GPa}$, $\nu_{\text{plastic}} = 0.4$.

$$\sigma = \frac{P}{A}$$

- ☒ a. 0.00377 mm (reduction)
- ~~b. 0.00377 mm (increase)~~
- ~~c. 0.04356 mm (reduction)~~
- ~~d. 0.04356 mm (increase)~~

6. The beam is supported by two rods AB and CD that have cross-sectional areas of 12 mm^2 and 8 mm^2 , respectively. What is **position d** of the 6-kN load so that the *normal stress* in each rod is the same? [HINT: Free Body Diagram of the beam and Statics analysis will help]



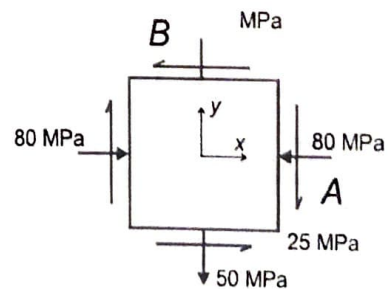
a. 2.2 m

☒ b. 1.2 m

~~c. 2.0 m~~

~~d. 3.1 m~~

7. The principal normal stresses on the element shown are:



~~a. 54.6 kPa; -84.6 kPa~~

~~b. 54.6 MPa; -84.6 MPa~~

~~c. 54.6 MPa; 84.6 MPa~~

☒ d. None of the above

8. The wall thickness of a 4-ft-diameter spherical tank is 5/16 inch. If the stress is limited to 8000 psi, the allowable internal pressure is most nearly:

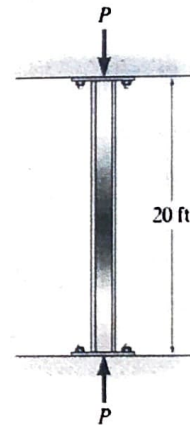
- ☒ a. 608 psi
- b. 108 psi
- c. 300 psi
- d. 208 psi

$$r = \frac{23.7 + 24}{2}$$

$$\sigma_t = \frac{P_i r}{t} \quad \therefore \quad \frac{P_i r}{2t}$$

$$\frac{(8000 \text{ psi})(23.85)}{.625}$$

9. The W12 x 50 structural member is made of A992 steel and is used as a column that has a length of 20 ft. If its ends are assumed **pin supported**, and it is subjected to an axial load of 150 kip, what is, most nearly, the critical normal stress if $\sigma_{\text{Yield}} = 50 \text{ ksi}$?



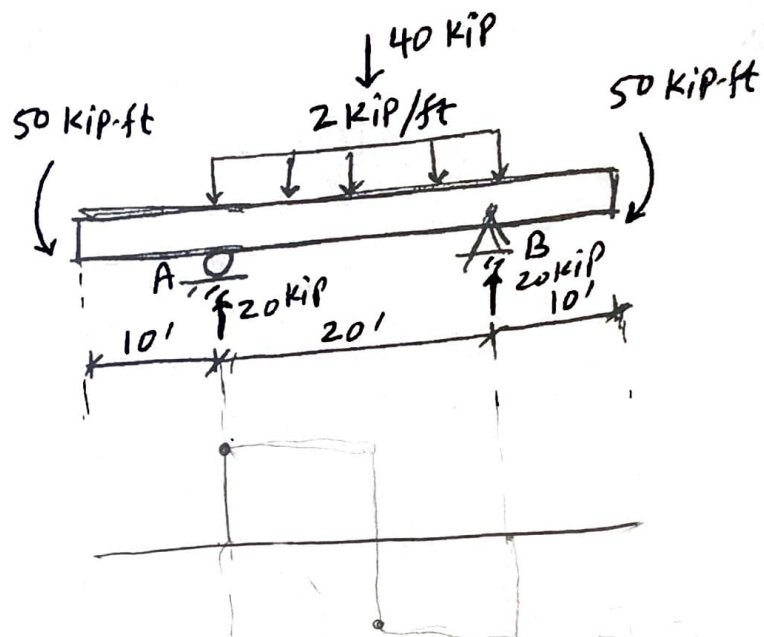
- a. 19 ksi
- ☒ b. 25 ksi
- c. 55 ksi
- d. 66 ksi

10. The factor of safety for the situation in Problem #9 is most nearly:

The W12 x 50 structural member is made of A992 steel and is used as a column that has a length of 20 ft. The ends are assumed **pin supported**, and it is subjected to an axial load of 150 kip, $\sigma_{\text{Yield}} = 50 \text{ ksi}$?

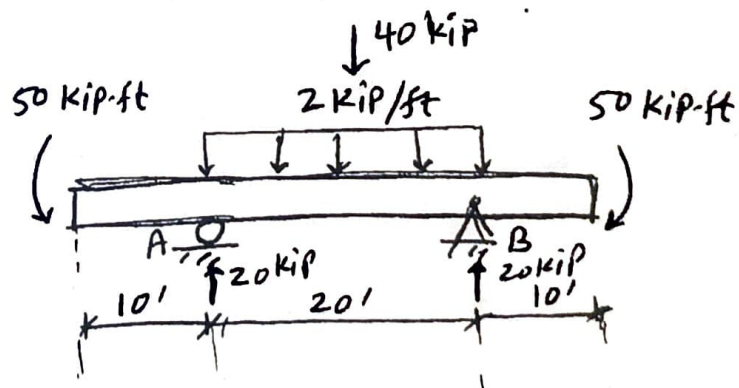
- ☒ a. 2
- b. 3
- c. 1
- d. None of the above

11. The maximum positive shear force anywhere on the beam is most nearly:



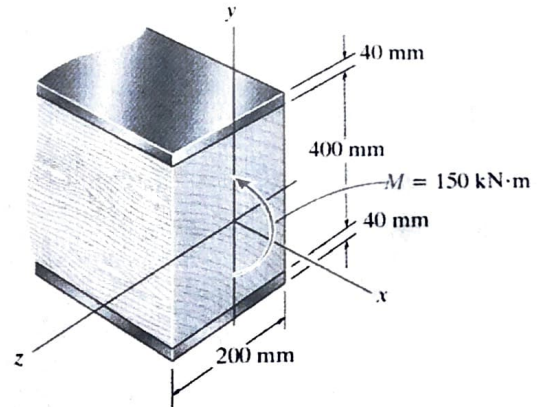
- a. 40 kip
- b. 30 kip
- ☒ c. 20 kip
- d. None of the above

12. The maximum negative bending moment anywhere in the beam of Problem #11 is most nearly:



- a. 20 kip-ft
- ☒ b. 50 kip-ft
- c. 30 kip-ft
- d. None of the above

13. A wood beam is reinforced with steel straps at its top and bottom as shown. Determine the **maximum bending stress developed in the steel** if the beam is subjected to a moment of $M = 150 \text{ kN}\cdot\text{m}$. Take $E_w = 10 \text{ GPa}$, $E_{st} = 200 \text{ GPa}$. [Hints: Convert Wood to Steel; Note the Transformation Factor, n]



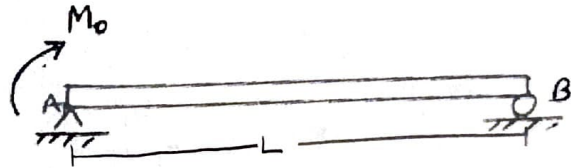
- a. 90 MPa
- b. 13 MPa
- c. 18 MPa
- ☒ d. 43 MPa

$$\sigma_c = \frac{150 \text{ kN}}{200}$$

14. The **maximum bending stress developed in the wood** for Problem # 13 is *most nearly* (Remember, you have converted Wood to Steel in Problem #13):

- a. 2 MPa
- ☒ b. 4 MPa
- c. 6 MPa
- d. None of the above

15. The correct *bending moment equation* as a function of distance x along the beam (from left to right) is (Consider the beam is Horizontal):



- a. $M(x) = M_0$
- b. $M(x) = (M_0 x/L) + M_0$
- c. $M(x) = - (M_0 x/L) + M_0$
- d. $M(x) = - (M_0 x^2/L) + M_0 x$