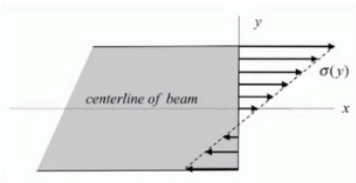
ME 323 - Fall 2021
Quiz #3

Q1 Beam stress 1

2 Points



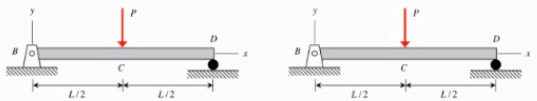
The distribution of the normal stress σ at the cross section of a beam varies linearly with the coordinate y and is constant in its depth (in z-direction). The magnitude of the tensile stress at the top is greater than the magnitude of the compressive stress at the bottom. Let F represent the resultant normal force due to this normal stress on the cross section. Circle the correct answer:

- (•) F > 0 (tensile)
- ( ) F = 0
- ( ) F < 0 (compressive)

$F = \int \sigma \, dA > 0$
Area

Q2 Beam stress 2

6 Points



Beams (i) and (ii) shown above are identical, except that Beam (i) is made up of steel, and Beam (ii) is made up of aluminum. Note that $E_{steel} > E_{aluminum}$.

Q2.1 Part 2.1

2 Points

Let $\left(|\sigma|_{max}\right)_i$ and $\left(|\sigma|_{max}\right)_{ii}$ represent the maximum magnitude of flexural stress in Beams (i) and (ii), respectively. Circle the correct relationship between these two stresses:

a) $\left(|\sigma|_{max}\right)_i > \left(|\sigma|_{max}\right)_{ii}$

b) $\left(|\sigma|_{max}\right)_i = \left(|\sigma|_{max}\right)_{ii}$

c) $\left(|\sigma|_{max}\right)_i < \left(|\sigma|_{max}\right)_{ii}$

- ( ) Answer a)
- (•) Answer b)
- ( ) Answer c)

determinate $\Rightarrow$ M(x) independent of material

$\Rightarrow \sigma = -\frac{My}{I}$ also ind. of material

Q2.2 Part 2.2

2 Points

Let $\left(|\tau|_{max}\right)_i$ and $\left(|\tau|_{max}\right)_{ii}$ represent the maximum magnitude of the xy-component of shear stress in Beams (i) and (ii), respectively. Circle the correct relationship between these two stresses:

a) $\left(|\tau|_{max}\right)_i > \left(|\tau|_{max}\right)_{ii}$

b) $\left(|\tau|_{max}\right)_i = \left(|\tau|_{max}\right)_{ii}$

c) $\left(|\tau|_{max}\right)_i < \left(|\tau|_{max}\right)_{ii}$

- ○ Answer a)
- ◉ Answer b)
- ○ Answer c)

determinate ⇒ ∇ independent of material

$\Rightarrow \tau = \frac{VQ}{It}$ ∴ ind. of material

Q2.3 Part 2.3

2 Points

Let $\left(|\delta|_{max}\right)_i$ and $\left(|\delta|_{max}\right)_{ii}$ represent the maximum magnitude of deflection in Beams (i) and (ii), respectively. Circle the correct relationship between these two deflections:

a) $\left(|\delta|_{max}\right)_i > \left(|\delta|_{max}\right)_{ii}$

b) $\left(|\delta|_{max}\right)_i = \left(|\delta|_{max}\right)_{ii}$

c) $\left(|\delta|_{max}\right)_i < \left(|\delta|_{max}\right)_{ii}$

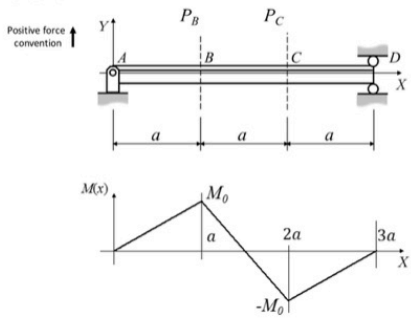
deflection goes as $\frac{1}{EI}$

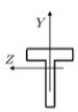
- ○ Answer a)
- ○ Answer b)
- ◉ Answer c)

Q3 Beam stress 3

4 Points

A T-beam of length $3a$ is supported at the two ends and loaded by forces P_B and P_C. The line of action of the forces is indicated (dashed lines) but the direction is to be determined. The correct moment diagram is properly shown below.





Q3.1 Part 3.1

2 Points

Indicate the cross-section on which the maximum TENSILE stress occurs:

- ○ x = 0
- ◉ x = a
- ○ x = 2a
- ○ x = 3a
- ○ This occurs are more than one location on the beam.

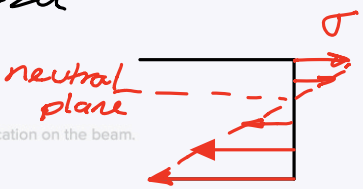
At x=a

Q3.2 Part 3.2
2 Points

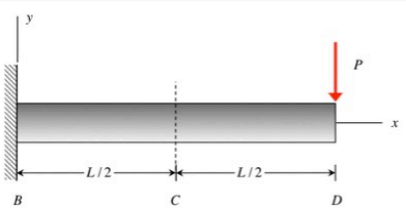
Indicate the cross-section on which the maximum COMPRESSIVE stress occurs:

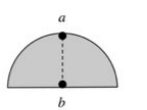
At x=2a

- ○ x = 0
- ○ x = a
- ◉ x = 2a
- ○ x = 3a
- ○ This occurs are more than one location on the beam.



Q4 Beam stress 4
2 Points





beam cross section at C

Consider the cantilevered beam above with the concentrated load P at end D. Consider the axial components of stress at points "a" and "b" (σ_a and σ_b, respectively) at location C along the beam. Circle the response below that most accurately describes the relative sizes of the magnitudes of these two stresses:

- ◉ $|\sigma_a| > |\sigma_b|$
- ○ $|\sigma_a| = |\sigma_b|$
- ○ $|\sigma_a| < |\sigma_b|$