SELECTED FE/PE TOPICS COVERED IN THIS ISSUE

- First Things First, what do we need?
- CASIO FX-115-ES PLUS

**Mathematics**
- Sample math computations using the CASIO FX-115
  - Definite integrals
  - Matrices and determinants
  - Converting decimal numbers to binary numbers and vice versa.

**Statics**
- Determining beam reactions
- Simple and cantilever beams
- Centroids and moments of inertia
- One truss problem

**Mechanics of Solids**
- One axial load problem
- Shear force and bending moment diagrams
- Deflections of beams
- Wide Flange Shapes, W-Shapes
- NCEES-Reference Handbook, Page-155

Tips, answers and solutions will be in the next issue of ASCE-NCS Newsletter.
WHAT DO YOU NEED?

- NCEES REFERENCE MANUAL
- FX-115ESPLUS CALCULATOR
- ONLY FOR FE & PE PROBLEMS
- D-RING BINDER
- ONLY FOR FE & PE MATERIAL
- CANVAS BAG
CASIO-115 ES PLUS

This $15 gadget will definitely be your best helper during your FE or PE exams. This calculator is Casio's latest and most advanced scientific calculator that features new Natural Textbook Display and Improved Math Functionality.

Starting next ASCE-NCS newsletter issue, we will actually show you, step by step, how to solve dozens of problems and get the correct answers in less than 15 SECONDS using this calculator.

ASCE-111
ZEYTINCI
FALL 2014
DEFINITE INTEGRALS
AREAS UNDER CURVES
Using CASIO FX-115 ES PLUS

Problem:

\[ f(x) = \left(\frac{2}{3}\right)^x \]

The area under the graph shown is most nearly:

(A) 5.06
(B) 4.25
(C) 2.15
(D) 1.37
Problem:

\[ I = \int_{0}^{3} x^2 \cdot (e^{x^2}) \, dx \]

The value of the definite integral shown above is most nearly:

(A) 20
(B) 3986
(C) 1112
(D) 11432

Comments:

At first sight, this problem seems highly complex, but it is not. You can easily get the correct answer in exactly 15 seconds. Yes, in 15 seconds!
What can you do with your CASIO FX-115 ES PLUS?

Enter the equation into the calculator

Just hit the key and wait 15 seconds

Answer = 11432.353
Problem: (Matrix Algebra)

\[
B = \begin{bmatrix}
1 & 2 & 0 \\
2 & -5 & -2 \\
-1 & 3 & 1
\end{bmatrix}
\]

A square matrix \([B]\) is given above. Answer the following questions:

(1) the determinant of matrix \([B]\) is most nearly, \(\text{det} \ [B]\)

- (A) 1
- (B) 2
- (C) -3
- (D) -1

(2) the inverse of matrix \([B]\) is most nearly, \((B^{-1})\)

- (A) \[
B^{-1} = \begin{bmatrix}
1 & 2 & 4 \\
0 & 13 & 1 \\
4 & -5 & 3
\end{bmatrix}
\]
- (B) \[
B^{-1} = \begin{bmatrix}
10 & -2 & 7 \\
0 & 13 & 9 \\
2 & -8 & 2
\end{bmatrix}
\]
- (C) \[
B^{-1} = \begin{bmatrix}
1 & -2 & -4 \\
0 & -3 & -8 \\
3 & -9 & 2
\end{bmatrix}
\]
- (D) \[
B^{-1} = \begin{bmatrix}
1 & -2 & -4 \\
0 & 1 & 2 \\
1 & -5 & -9
\end{bmatrix}
\]
Problem: (Matrix Algebra)

\[
A = \begin{bmatrix}
2 & -3 \\
1 & -1
\end{bmatrix} \quad \quad B = \begin{bmatrix}
1 & 2 & 0 \\
2 & -5 & -2
\end{bmatrix}
\]

Using the matrices given above, answer the following questions:

(1) the determinant of the matrix \( A \) is most nearly

(A) \( 4 \)  
(B) \( -3 \)  
(C) \( -2 \)  
(D) \( 1 \)

(2) the matrix product of \( A \) and \( B \) is most nearly, \( A \times B \)

(A) \( A \times B = \begin{bmatrix}
-4 & 12 & -10 \\
2 & -5 & -2
\end{bmatrix} \)

(B) \( A \times B = \begin{bmatrix}
-1 & 12 & -4 \\
0 & -5 & -2
\end{bmatrix} \)

(C) \( A \times B = \begin{bmatrix}
-4 & 19 & 6 \\
-1 & 7 & 2
\end{bmatrix} \)

(D) \( A \times B = \begin{bmatrix}
-2 & 11 & -20 \\
2 & 13 & 7
\end{bmatrix} \)
Frequently asked two Number Systems:

1- Decimal Number System (base 10)
2- Binary Number System (base 2)

In Decimal System 10 different digits are used to create any number, but in Binary System only 0s and 1s are used to create any number.
SIMPLE BEAM SUPPORT REACTIONS
SHORTCUT FORMULAS

1

\[ A_y = P \left( \frac{b}{L} \right) \]

\[ B_y = P \left( \frac{a}{L} \right) \]

(FBD)

2

\[ A_y = \frac{M}{L} \]

\[ B_y = \frac{M}{L} \]

(FBD)
SIMPLE BEAM SUPPORT REACTIONS
SUPERPOSITION METHOD

Example-1

\[ A_y = P \left( \frac{b}{L} \right) \]

\[ B_y = P \left( \frac{a}{L} \right) \]

Example-2

\[ A_y = \frac{M}{L} \]

\[ B_y = \frac{M}{L} \]

Example-3

\[ A_y = \frac{M}{L} \]

\[ B_y = \frac{M}{L} \]
Problem: (Beam Support Reactions / Superposition Method)

Determine the support reactions using the superposition (shortcut) method.

\[ A_y = 3.17 \text{ k} + 2.5 \text{ k} + 1.33 \text{ k} = 7.0 \text{ kips} \]
\[ B_y = 0.83 \text{ k} + 2.5 \text{ k} + 6.67 \text{ k} = 10.0 \text{ kips} \]

Support Reactions
\[ A_y = 7 \text{ kips} \]
\[ B_y = 10 \text{ kips} \]
Problem (Beam Support Reactions)

\[
\begin{align*}
&9k \quad 2k/ft \quad 18k \\
&\text{Support } A: \text{Hinge} \\
&\text{Support } B: \text{Roller}
\end{align*}
\]

Determine the support reactions.

Solution:

Three Simple Steps:
1- take moment about support A
2- take moment about support B
3- do the final check: \( \sum F_y = 0 \):

Taking moment about support A \( (M_A) \)
\[
\begin{align*}
\sum M_A &= 0: \quad (-9k)(6 \text{ ft}) + R(6 \text{ ft}) + 18k (8 \text{ ft}) - 18B_y = 0 \\
18B_y &= 54 + (48)(6 \text{ ft}) - 144 \\
18B_y &= 378 \\
B_y &= 21 \text{ kips}
\end{align*}
\]

Taking moment about support B \( (M_B) \)
\[
\begin{align*}
\sum M_B &= 0: \quad (18k)(10 \text{ ft}) + R(12 \text{ ft}) + 9k (24 \text{ ft}) - 18A_y = 0 \\
18A_y &= 180 + (48)(12) + 216 \\
18A_y &= 972 \\
A_y &= 54 \text{ kips}
\end{align*}
\]

Check:
\[
\begin{align*}
\sum F_y &= 0: \quad A_y + B_y = 9k + 18k + R \\
21k + 54k &= 9k + 18k + 48k \\
75k &= 75k \text{ O.K.}
\end{align*}
\]
**Problem:** (Beams/Support Reactions)

Find the support reactions.

Support \( A \): Hinge  
Support \( B \): Roller

**Solution:**

(FBD)

**Horizontal Equilibrium Equation:** \( (F_x) \)

\[
\sum F_y = 0 \quad -A_x + 15 = 0 \quad A_x = 15 \text{kN}
\]

Taking moment about point \( A \)

\[
\sum M_A = 0 \quad -60(2) + 20(4) + 15(8) + 90(12) - 10B_y = 0 \\
10B_y = 60 + 120 + 160 + 720 + 480 \quad \text{solving for } B_y : \quad B_y = 142 \text{kN}
\]

Taking moment about point \( B \)

\[
\sum M_B = 0 \quad 60(8) + 20(6) + 15(2) + 90(2) - 40(2) - 10A_y = 0 \\
10A_y = 60 + 480 + 240 + 180 - 80 \quad \text{solving for } A_y : \quad A_y = 88 \text{kN}
\]

**Check:**

\[
\sum F_y = 0 \quad A_x + B_y = 60 + 20 + 20 + 90 + 40 \\
88 + 142 = 230 \\
230 = 230 \quad \text{O.K.}
\]

**Answers**

\[ 
A_x = 15 \text{kN} \\
A_y = 88 \text{kN} \quad \uparrow \\
B_y = 142 \text{kN} \quad \uparrow
\]
**Problem:** (Determinate Beams / Maximum moment)

The dimensions and loads of a simple beam are given as shown in the figure. Using the listed data, answer the following questions:

(1) the magnitude of the left support reaction (kips) is most nearly

(A) 16
(B) 18
(C) 26
(D) 29

(2) the magnitude of the right support reaction (kips) is most nearly

(A) 20
(B) 22
(C) 24
(D) 30

(3) the distance (ft) for shear crossing the reference line, is most nearly

(A) 6.5
(B) 6.0
(C) 5.0
(D) 4.5

(4) the maximum bending moment (ft-kips) is most nearly

(A) 154
(B) 144
(C) 122
(D) 105
**Problem:** (Cantilever Beams)

The cantilever beam is loaded as shown in the figure. Using the given loads and the support condition, answer the following questions:

1. The vertical support reaction (kN) at the fixed support, $A_y$
   - (A) 80
   - (B) 75
   - (C) 60
   - (D) 50

2. The bending moment (kN.m) at the fixed support, $M_A$
   - (A) 230
   - (B) 340
   - (C) 425
   - (D) 560

3. The moment (kN.m) at $C$, the mid-point of $AB$, is most nearly, $M_C$
   - (A) 110
   - (B) 125
   - (C) 138
   - (D) 155

4. The shear force (kN) at the mid-point of $AB$ is most nearly
   - (A) 42.5
   - (B) 50.0
   - (C) 67.5
   - (D) 70.0
**Problem:** (Cantilever Beams)

The cantilever beam is loaded as shown in the figure. Using the given loads and the support condition, answer the following questions:

(1) The vertical support reaction (kN) at the fixed support, $A_y$

   (A) 140  
   (B) 125  
   (C) 110  
   (D) 100

(2) The bending moment (kN.m) at the fixed support, $M_A$

   (A) 290  
   (B) 390  
   (C) 465  
   (D) 520

(3) The moment (kN.m) at $C$, the mid-point of $AB$, is most nearly, $M_C$

   (A) 515  
   (B) 420  
   (C) 338  
   (D) 210

(4) The shear force (kN) at the mid-point of $AB$ is most nearly

   (A) 42.5  
   (B) 50.0  
   (C) 60.5  
   (D) 70.0
**Problem:** (Cantilever Beams)

The cantilever beam is loaded as shown in the figure. Using the given loads and the support condition, answer the following questions:

1. The horizontal and vertical support reactions (kN) at the fixed support, $A_x, A_y$
   - (A) 5.46 and 38
   - (B) 6.68 and 42
   - (C) 7.12 and 64
   - (D) 9.24 and 82

2. The bending moment (kN.m) at the fixed support, $M_A$
   - (A) 416
   - (B) 314
   - (C) 225
   - (D) 176

3. The moment (kN.m) at C, the mid-point of $AB$, is most nearly, $M_C$
   - (A) 93
   - (B) 113
   - (C) 128
   - (D) 136

4. The shear force (kN) at the mid-point of $AB$ is most nearly
   - (A) 22.5
   - (B) 24.6
   - (C) 37.5
   - (D) 42.0
Problem: (Cantilever Beams)

A cantilever beam is loaded as shown in the figure. Using the given loads and the support condition, answer the following questions:

(1) The vertical support reaction (kN) at the fixed support, $A_y$

(A) 69  
(B) 78  
(C) 87  
(D) 99

(2) The bending moment (kN.m) at the fixed support, $M_A$

(A) 125  
(B) 185  
(C) 205  
(D) 225

(3) The horizontal support reaction (kN) at the fixed support, $A_x$

(A) 15.0  
(B) 18.0  
(C) 21.5  
(D) 28.0

(4) The bending moment (kN.m) at the mid-point of $AB$ is most nearly

(A) 94.5  
(B) 108.4  
(C) 122.5  
(D) 148.7
**Problem:** (Cantilever Beams)

A cantilever beam is loaded as shown in the figure. Using the given loads and support condition, answer the following questions:

(1) The vertical support reaction (kN) at the fixed support, $A_y$:

(A) 88  
(B) 105  
(C) 113  
(D) 128

(2) The bending moment (kN.m) at the fixed support, $M_A$:

(A) 510  
(B) 414  
(C) 325  
(D) 284

(3) The moment (kN.m) at C, the mid-point of $AB$ is most nearly, $M_C$:

(A) 90  
(B) 110  
(C) 122  
(D) 134

(4) The shear force (kN) at the mid-point of $AB$ is most nearly:

(A) 21.5  
(B) 34.0  
(C) 47.5  
(D) 52.5
OVERHANGING BEAM SUPPORT REACTIONS
SUPPLEMENTAL PROBLEMS

1

$A_y = 20 \text{ kip}$
$B_y = 40 \text{ kip}$
$x = 8.0 \text{ ft}$
$M_{\text{max}} = 96 \text{ ftkip}$

2

$A_y = 21 \text{ kip}$
$B_y = 36 \text{ kip}$
$x = 8.0 \text{ ft}$
$M_{\text{max}} = 104 \text{ ftkip}$

3

$A_y = 16 \text{ kip}$
$B_y = 32 \text{ kip}$
$x = 8.0 \text{ ft}$
$M_{\text{max}} = 64 \text{ ftkip}$

4

$A_y = 24 \text{ kip}$
$B_y = 37 \text{ kip}$
$x = 9.5 \text{ ft}$
$M_{\text{max}} = 120.25 \text{ ftkip}$

5

$A_y = 30 \text{ kip}$
$B_y = 56 \text{ kip}$
$x = 8.0 \text{ ft}$
$M_{\text{max}} = 144 \text{ ftkip}$
A simply supported beam is loaded as shown. Using the listed support conditions, the maximum bending moment (k-ft) in the beam is most nearly:

(A) 45.00  
(B) 56.25  
(C) 64.50  
(D) 72.75
SAMPLE (FE) PROBLEM

STATICS

A plane truss system is loaded as shown. Using the listed support conditions, the magnitude of the member force (kN) in member $BD$ is most nearly:

(A) 15.00 (C)
(B) 25.25 (T)
(C) 30.00 (C)
(D) 20.00 (T)
Problem: (Plane Truss)

Support Reactions and Member Forces

A

\[ P_1 = 4 \text{ kN} \]
\[ P_2 = 12 \text{ kN} \]

\[ A_x = 4 \text{ kN} \]
\[ A_y = 15 \text{ kN} \]
\[ D_y = 27 \text{ kN} \]

B

\[ P_1 = 8 \text{ kN} \]
\[ P_2 = 12 \text{ kN} \]

\[ A_x = 8 \text{ kN} \]
\[ A_y = 18 \text{ kN} \]
\[ D_y = 30 \text{ kN} \]

C

\[ P_1 = 2 \text{ kN} \]
\[ P_2 = 3 \text{ kN} \]

\[ A_x = 2 \text{ kN} \]
\[ A_y = 4.5 \text{ kN} \]
\[ D_y = 7.5 \text{ kN} \]

D

\[ P_1 = 4 \text{ kN} \]
\[ P_2 = 18 \text{ kN} \]

\[ A_x = 4 \text{ kN} \]
\[ A_y = 21 \text{ kN} \]
\[ D_y = 39 \text{ kN} \]
SAMPLE (FE) PROBLEM
MECHANICS OF MATERIALS

Problem: (Axial Load)

A stepped rod with circular cross-section is subjected to the axial loads as shown in the figure. Using the listed data answer the following:

(1) The axial stress (psi) in segment #1 is most nearly:

(A) 3,500 (C)
(B) 4,250 (T)
(C) 5,360 (C)
(D) 6,220 (T)

(2) The axial stress (psi) in segment #2 is most nearly:

(A) 2,120 (C)
(B) 3,820 (C)
(C) 4,440 (C)
(D) 5,000 (T)
**IMPORTANT FORMULAS**

**Problem: (Rectangle)**

![Rectangle Diagram]

- Area of the rectangle \( A = bh \)
- Centroid \( \bar{y} = \frac{h}{2} \)
- Moment of inertia about the x axis \( I_{cx} = \frac{bh^3}{12} \)
- Moment of inertia about the y axis \( I_{cy} = \frac{bh^3}{12} \)

**Example:**

\[
A = bh = (8)(4) = 32 \text{ in}^2 \\
\bar{y} = \frac{h}{2} = \frac{4}{2} = 2 \text{ in.} \\
I_{cx} = \frac{bh^3}{12} = \frac{(8)(4)^3}{12} = 42.67 \text{ in}^4 \\
I_{cy} = \frac{bh^3}{12} = \frac{(4)(8)^3}{12} = 170.67 \text{ in}^4 
\]

**Problem: (Triangular Area)**

![Isosceles Triangle Diagram]

- Area of the triangle \( A = \frac{bh}{2} \)
- Centroid \( \bar{y} = \frac{h}{3} \)
- Moment of inertia about the x axis \( I_{cx} = \frac{bh^3}{36} \)
- Moment of inertia about the y axis \( I_{cy} = \frac{bh^3}{48} \)

**Example:**

\[
A = \frac{bh}{2} = \frac{(8)(6)}{2} = 24 \text{ in}^2 \\
\bar{y} = \frac{h}{3} = \frac{6}{3} = 2 \text{ in.} \\
I_{cx} = \frac{bh^3}{36} = \frac{(8)(6)^3}{36} = 48.00 \text{ in}^4 \\
I_{cy} = \frac{bh^3}{48} = \frac{(6)(8)^3}{48} = 64.00 \text{ in}^4 
\]

**Problem: (Half Circle)**

![Half Circle Diagram]

- Area of the semicircle \( A = \frac{\pi r^2}{2} \)
- Centroid \( \bar{y} = \frac{4r}{3\pi} \)
- Moment of inertia about the x axis \( I_{cx} = \frac{r^4}{12\pi} \cdot (9\pi^2 - 64) \)
- Moment of inertia about the y axis \( I_{cy} \approx 0.109757 \cdot r^4 \)

**Solution:**

\[
A = \frac{\pi r^2}{2} \\
\bar{y} = \frac{4r}{3\pi} \\
I_{cx} = \frac{r^4}{12\pi} \cdot (9\pi^2 - 64) \\
I_{cy} \approx 0.109757 \cdot r^4 
\]

**Problem: (Trapezoidal Area)**

![Trapezoid Diagram]

- Area of the trapezoid \( A = \frac{h}{2} (a + b) \)
- Centroid \( \bar{y} = \frac{h}{3} \left( \frac{2a + b}{a + b} \right) \)
- Moment of inertia about the x axis \( I_{cx} = \frac{h^3}{36} \cdot \frac{a^2 + 4ab + b^2}{(a + b)} \)
- Moment of inertia about the y axis \( I_{cy} = \frac{h}{48} \left( a + b \right) \left( a^2 + b^2 \right) \)

\[
I_{cx} = \frac{h^3}{36} \cdot \frac{a^2 + 4ab + b^2}{(a + b)} \\
I_{cy} = \frac{h}{48} \left( a + b \right) \left( a^2 + b^2 \right) \\
I_{y+1} = \frac{h^3}{12} \left( 3a + b \right) 
\]

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**Problem:** (Parallel Axis Theorem)

![Diagram showing the Parallel Axis Theorem (PAT) with labels for the moment of inertia about the x axis and the given axis.](image)

(a) Moment of inertia about the x axis \( (I_{cx} = \, ?) \)

(b) Moment of inertia about the (1-1) axis \( (I_{1-1} = \, ?) \)

**Formulas:**

\[
I_{cx} = \frac{bh^3}{12}
\]

\[
I_{1-1} = I_{cx} + A \cdot d^2
\]

\[
I_{cx} = \text{Moment of inertia about the centroidal x axis}
\]

\[
I_{1-1} = \text{Moment of inertia about axis (1-1)}
\]

\[
A = \text{Area} \ (A = bh)
\]

\[
d = \text{Distance from the centroid to the axis (1-1)}
\]

**Example:**

![Diagram showing an example problem with dimensions and calculations for the moment of inertia.](image)

\[
I_{cx} = \frac{bh^3}{12} = \frac{(6)(3)^3}{12} = 13.50 \text{ in.}^4
\]

\[
A = bh = (6)(3) = 18 \text{ in.}^2
\]

\[
d = 4 + \frac{3}{2} = 5.5 \text{ in.}
\]

\[
I_{1-1} = I_{cx} + A \cdot d^2 = 13.50 + (18)(5.5)^2 = 558 \text{ in.}^4
\]

\[
I_{1-1} = 558 \text{ in.}^4
\]
SHEAR FORCE AND MOMENT DIAGRAMS

1

2

3

4
SHEAR AND MOMENT DIAGRAMS

5

6

7

8
Problem: (Shear and Moment Diagrams)

(a) Determine the support reactions
(b) Draw the shear force diagram
(c) Draw the bending moment diagram

Support A: Pin
Support B: Roller

(FBD)

Shear Force (kips)

Bending Moment (ft-kips)
Shear Force and Bending Moment Diagrams

The **shear force** diagram of this beam is most nearly:

(FBD)
SHEAR FORCE & BENDING MOMENT DIAGRAMS

1. 

2. 

3. 

4. 

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Shear Force and Moment Diagrams

The shear force diagram of the beam is most nearly:

(A)  
(B)  
(C)  
(D)
**Problem:** Shear Force and Moment Diagrams

![Beam Diagram]

The moment diagram of this beam is most nearly:

(A) ![Diagram (A)]

(B) ![Diagram (B)]

(C) ![Diagram (C)]

(D) ![Diagram (D)]
**Problem: (Deflections)**

A simple beam is loaded as shown. The beam weight is included in the uniform load. Using the given cross-section and the modulus of elasticity answer the following questions:

(1) the max. deflection (in.) of the beam is most nearly \( \delta_{\text{max}} \)

   - (A) 0.75
   - (B) 1.00
   - (C) 1.91
   - (D) 2.50

(2) the slope (radians) at support A is most nearly \( \theta_A \)

   - (A) 1.226
   - (B) 0.425
   - (C) 0.055
   - (D) 0.021

(3) the maximum moment (k.ft) in the beam is most nearly \( M_{\text{max}} \)

   - (A) 174
   - (B) 250
   - (C) 285
   - (D) 316
**Problem:** (Deflections)

A cantilever beam is loaded as shown. The beam weight is included in the uniform load. Using the given cross-section and the modulus of elasticity answer the following questions:

1. the max. deflection (in.) of the beam is most nearly ($\delta_B$)
   - (A) 0.0367
   - (B) 0.4929
   - (C) 0.6525
   - (D) 1.4456

2. the slope (rad.) at the free end of the beam is most nearly ($\theta_B$)
   - (A) 0.06458
   - (B) 0.03782
   - (C) 0.00415
   - (D) 0.00596

3. the moment at the support is most nearly ($M_A$)
   - (A) 75
   - (B) 83
   - (C) 90
   - (D) 105

$E = 29 \times 10^6$ psi
Problem: (Beam Deflections)

A cantilever beam is loaded as shown. The beam weight is included in the uniform load. Using the listed data and the modulus of elasticity answer the following questions:

1. the max. deflection (in.) of the beam is most nearly \( \delta_B \)
   
   (A) 0.5426
   (B) 0.6550
   (C) 0.0877
   (D) 0.0915

2. the max. slope (rad.) at the free end is most nearly \( \theta_B \)
   
   (A) 0.02153
   (B) 0.01554
   (C) 0.00777
   (D) 0.00655

3. the bending moment (k.ft) at the support is most nearly \( M_A \)
   
   (A) 155
   (B) 182
   (C) 190
   (D) 220
Problem: (Deflections)

A composite beam is made of two W 12 x 40 welded together. The beam weight is included in the uniform load. Using the given beam dimensions and loads answer the following questions:

(1) the max. moment (ft.kips) in the beam is most nearly

(A) 126
(B) 165
(C) 225
(D) 300

(2) the moment of inertia (in.\(^4\)) about the horizontal centroidal axis is most nearly \(I_{cx}\)

(A) 307
(B) 515
(C) 614
(D) 720

(3) the max. deflection (in.) of the beam is most nearly

(A) 0.245
(B) 0.363
(C) 0.478
(D) 0.594

(4) the slope (radians) at the left support is most nearly

(A) 0.00985
(B) 0.00768
(C) 0.00643
(D) 0.02250
**W 12 X 50**

- **Nominal Depth (12 in.)**
- **Weight 50 lb/ft**

- $A = \text{Area} = 14.6 \text{ in}^2$
- $d = \text{Depth} = 12.2 \text{ in.}$
- $b_f = \text{Flange Width} = 8.08 \text{ in.}$
- $t_f = \text{Flange Thickness} = 0.640 \text{ in.}$
- $t_w = \text{Web Thickness} = 0.370 \text{ in.}$
- $I_x = \text{Moment of Inertia} = 391 \text{ in}^4$
- $I_y = \text{Moment of Inertia} = 56.3 \text{ in}^4$
- $S_x = \text{Section Modulus (x-x)} = 64.2 \text{ in}^3$
- $r_x = \text{Radius of Gyration} = 5.18 \text{ in}$
- Major axis or strong axis = (x-x)
- Minor axis or weak axis = (y-y)