ENGR 220 Statics and Mechanics of Materials

Practice Problems for Exam 2

The following represents some of the types of problems that you might encounter in ENGR 220 Exam 2. This document is intended to give you additional practice for your exam preparation, but should not be considered a comprehensive collection of ENGR 220 Exam 2 problems. Solutions to the problems will not be explicitly provided.

REMINDER: You are responsible for all content covered in your ENGR 220 coursework.

NOTE 1: Qualitative questions have been omitted from this exam. You should also be able to answer content-based questions / fill-in-the-blank / etc.

NOTE 2: These problems were collected from several previous exams to provide additional practice for Exam 2, and are not representative of a single sample exam in terms of balance of different problem types.

ENGR220 Exam 2 Practice Problems

1. The x location of the centroid of the shape shown is closest to:

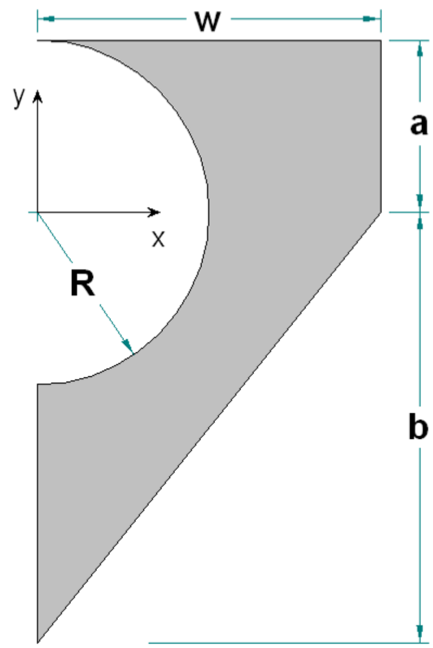
$$\text{Choices} = \begin{pmatrix} \text{"A"} & 1.428 \\ \text{"B"} & 1.515 \\ \text{"C"} & 1.602 \\ \text{"D"} & 1.688 \\ \text{"E"} & 1.774 \end{pmatrix} \cdot m$$

$a = 1.1\,m$

$b = 4.2\,m$

$w = 3.2\,m$

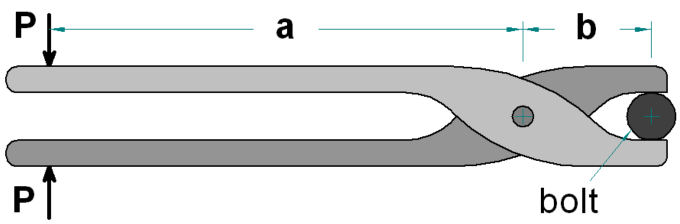
$R = 1.1\,m$



2. The y location of the centroid of the shape shown is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & -0.678 \\ \text{"B"} & -0.733 \\ \text{"C"} & -0.787 \\ \text{"D"} & -0.842 \\ \text{"E"} & -0.896 \end{pmatrix} \cdot m$$

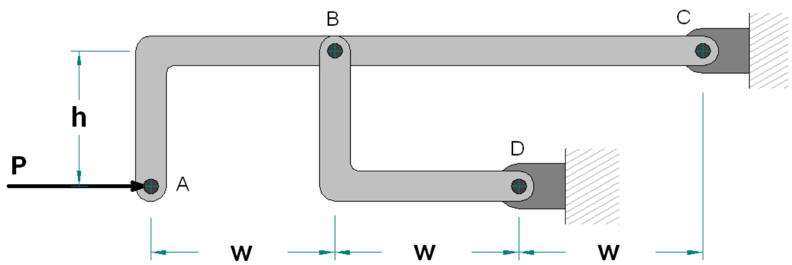
3. If the bolt shown is to be gripped with a force of $F = 33 \cdot lbf$, then the force P required at the handles of the pliers is closest to:



$a = 5.3 \cdot in$ $b = 1.4 \cdot in$

$$Choices = \begin{pmatrix} "A" & 6.60 \\ "B" & 7.13 \\ "C" & 7.66 \\ "D" & 8.19 \\ "E" & 8.72 \end{pmatrix} \cdot lbf$$

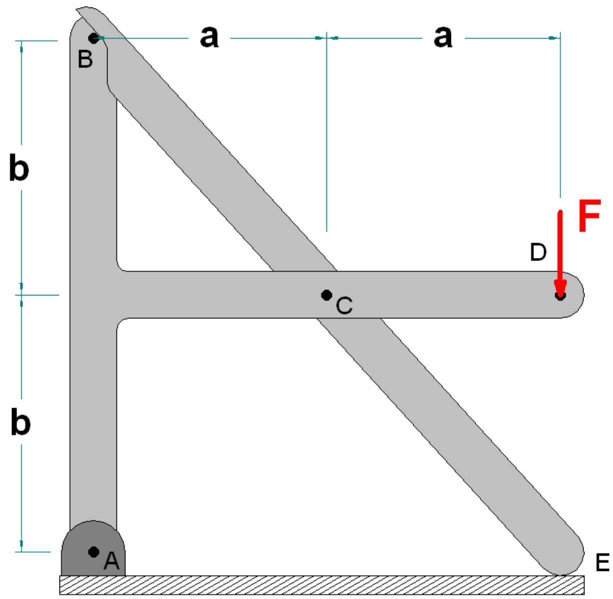
4. Given that $P = 410 \cdot N$, $h = 72 \cdot mm$, $w = 159 \cdot mm$, the reaction at pin D is closest to:



$$Choices = \begin{pmatrix} "A" & 225.04 \\ "B" & 238.72 \\ "C" & 252.40 \\ "D" & 266.13 \\ "E" & 279.85 \end{pmatrix} \cdot N$$

5. The total force that pin C is carrying (the combination of the x and y components) is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 100.0 \\ \text{"B"} & 105.9 \\ \text{"C"} & 111.9 \\ \text{"D"} & 117.8 \\ \text{"E"} & 123.8 \end{pmatrix} \cdot \text{lbf}$$



Note: the pin at B makes frictionless sliding contact with member BCE (like a roller).

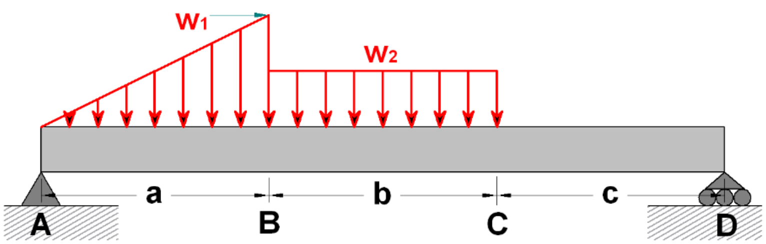
$F = 81.7 \cdot \text{lbf}$

$a = 3 \cdot \text{in}$

$b = 4 \cdot \text{in}$

6. If you were to "lump" the distributed loads shown into a single concentrated load that would cause the same reactions at the supports, the concentrated load would be located closest to how far from the left support?

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 4.589 \\ \text{"B"} & 4.884 \\ \text{"C"} & 5.177 \\ \text{"D"} & 5.469 \\ \text{"E"} & 5.761 \end{pmatrix} \cdot \text{ft}$$

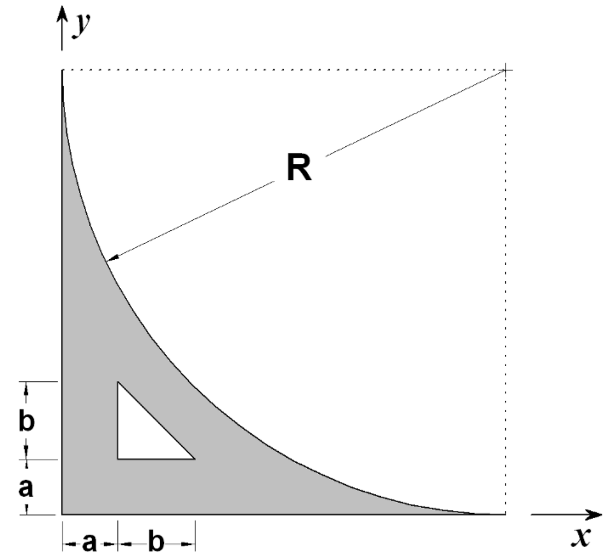


$w_1 = 800 \cdot \frac{\text{lbf}}{\text{ft}}$ $w_2 = 500 \cdot \frac{\text{lbf}}{\text{ft}}$

$a = 5.1 \cdot \text{ft}$ $b = 5.1 \cdot \text{ft}$ $c = 5 \cdot \text{ft}$

7. The x-location of the centroid of the shape shown is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 0.538 \\ \text{"B"} & 0.571 \\ \text{"C"} & 0.603 \\ \text{"D"} & 0.636 \\ \text{"E"} & 0.668 \end{pmatrix} \cdot \text{in}$$



$R = 3 \cdot \text{in}$

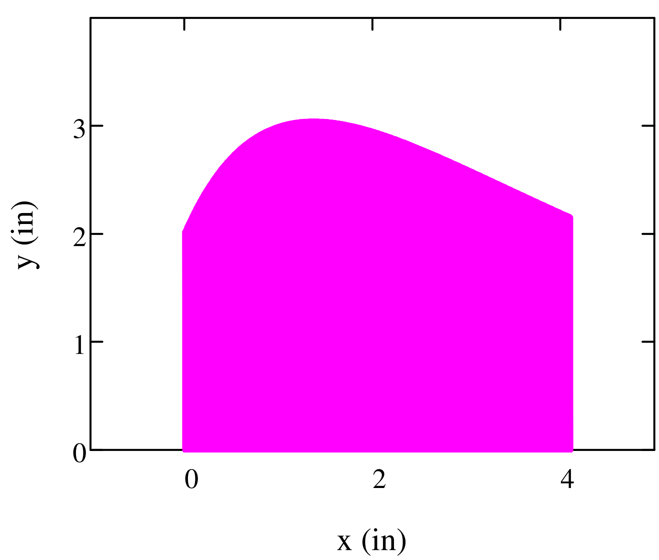
$a = 0.5 \cdot \text{in}$

$b = 0.9 \cdot \text{in}$

8. The equation of the curve shown is given below. Find the x-location of the centroid of the shaded region which has limits from $x_1 = 0 \cdot \text{in}$ to $x_2 = 4.1 \cdot \text{in}$

$$y(x) \rightarrow 5 \cdot \text{in} \cdot e^{-\frac{x}{5 \cdot \text{in}}} - 3 \cdot \text{in} \cdot e^{-\frac{x}{\text{in}}}$$

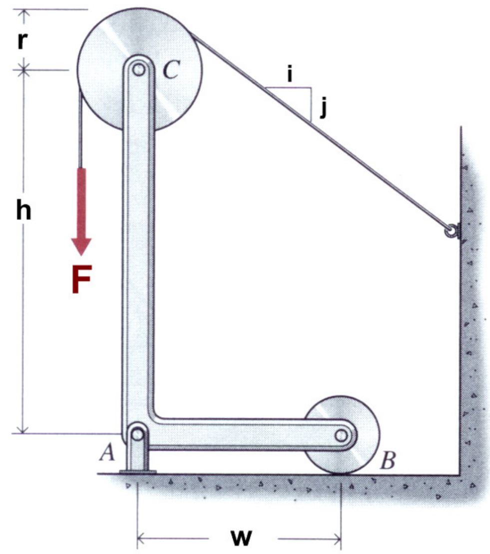
$$\text{Choices} = \begin{pmatrix} \text{"A"} & 1.998 \\ \text{"B"} & 2.159 \\ \text{"C"} & 2.320 \\ \text{"D"} & 2.481 \\ \text{"E"} & 2.645 \end{pmatrix} \cdot \text{in}$$



For reference:

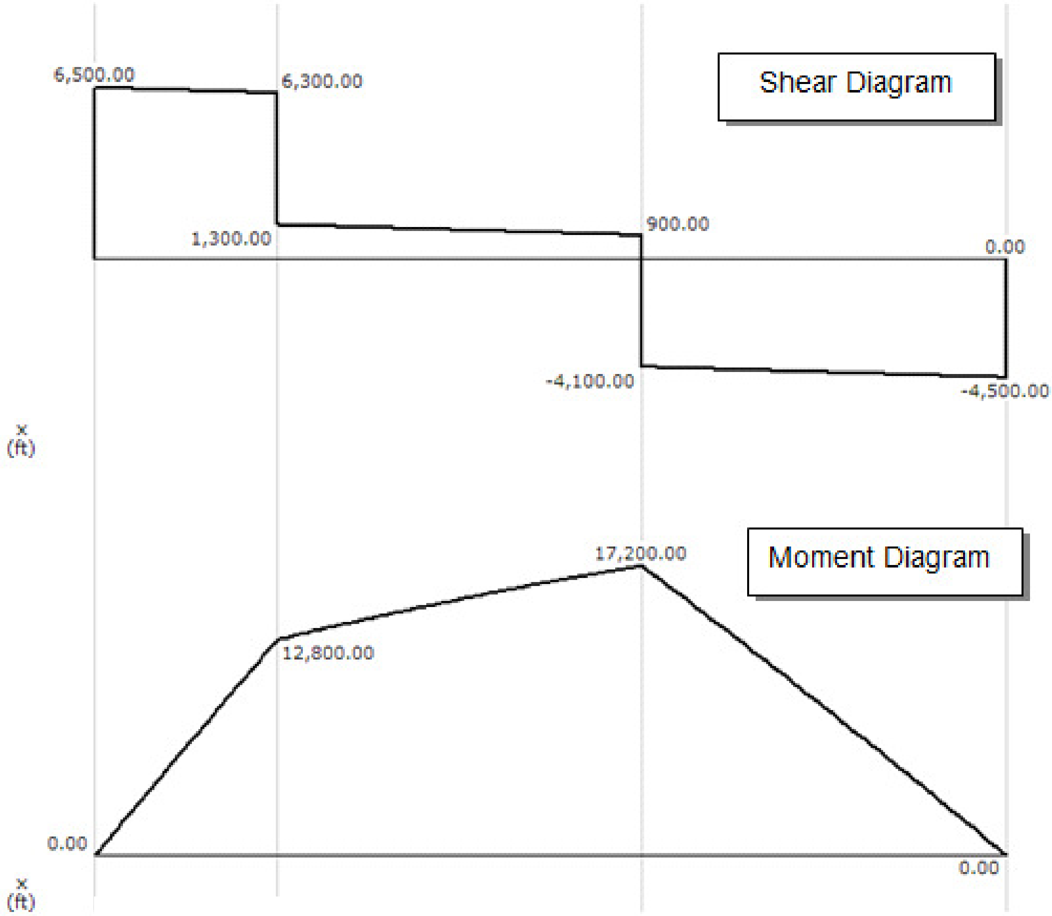
$$\int x \cdot e^{-C_1 \cdot x} \, dx = \frac{-C_1 \cdot x \cdot e^{-C_1 \cdot x} - e^{-C_1 \cdot x}}{C_1^{\,2}} \quad \text{and} \quad \int e^{-C_1 \cdot x} \, dx = \frac{-e^{-C_1 \cdot x}}{C_1}$$

9. The slope of the cable given by $i = 15$ and $j = 8$. If $h = 11 \cdot in$, $w = 9 \cdot in$, $r = 3 \cdot in$, and the force exerted on the cable is $F = 95 \cdot lbf$, the reaction at A is closest to:



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 77.82 \\ \text{"B"} & 82.39 \\ \text{"C"} & 87.08 \\ \text{"D"} & 91.73 \\ \text{"E"} & 96.37 \end{pmatrix} \cdot lbf$$

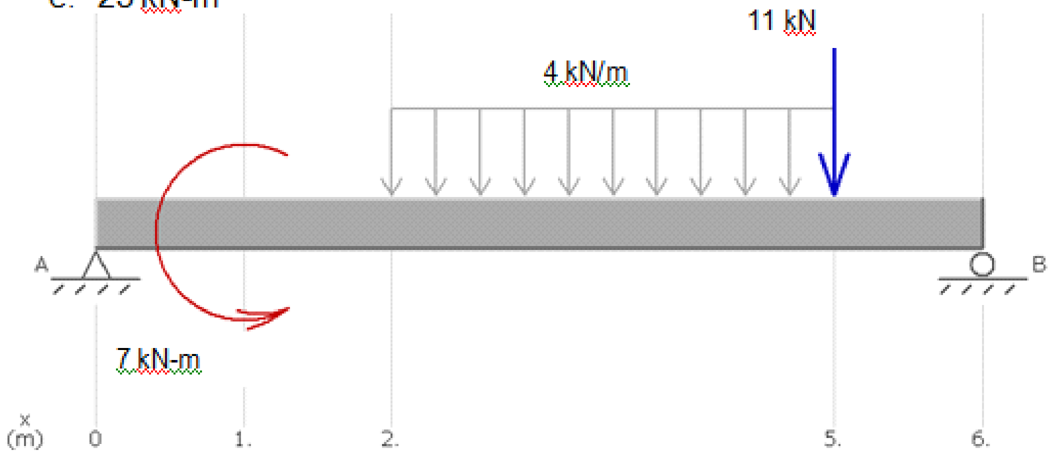
10. A structural steel wide flange I-beam is to be designed to have a factor of safety equal to 3.0 against yielding. Given the shear and bending moment diagrams shown below for this beam, the lightest weight beam that can support this load is: *(Units in the diagrams are in feet and pounds. Neglect shear, and assume self weight has already been factored.)*



a. W6 x 25
b. W8 x 15
c. W8 x 24
d. W10 x 22
e. W16 x 26

11. The maximum bending moment in the beam loaded as shown is closest to:

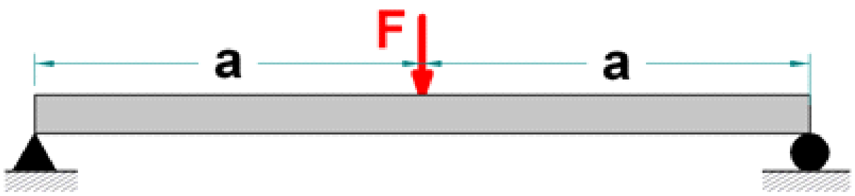
a. 11 kN-m
b. 14 kN-m
c. 17 kN-m
d. 20 kN-m
e. 23 kN-m

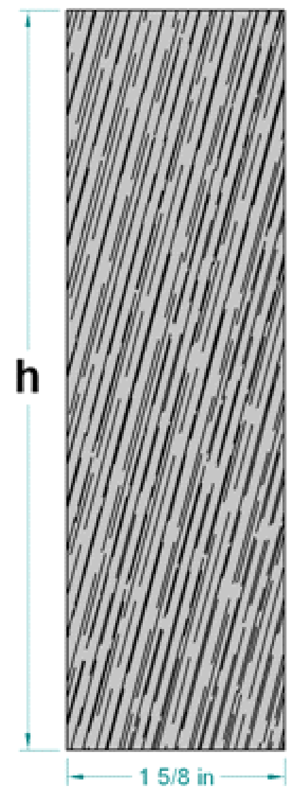


12.

. For the beam below, F = 1205 lb, a = 8 ft and h = 7.5 in. (The cross-section of the beam is shown to the right.) The maximum normal flexural stress in the beam is closest to:

a. 3.0 ksi
b. 3.2 ksi
c. 3.4 ksi
d. 3.6 ksi
e. 3.8 ksi



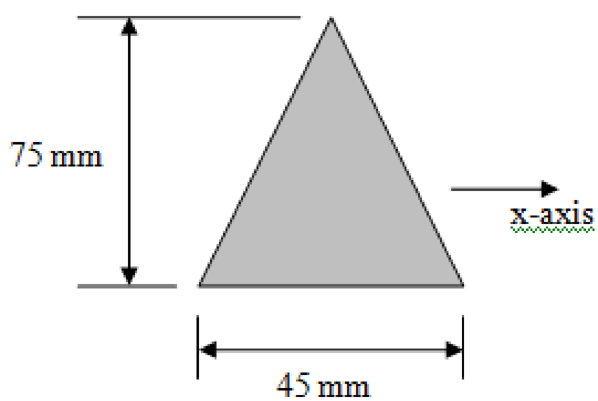


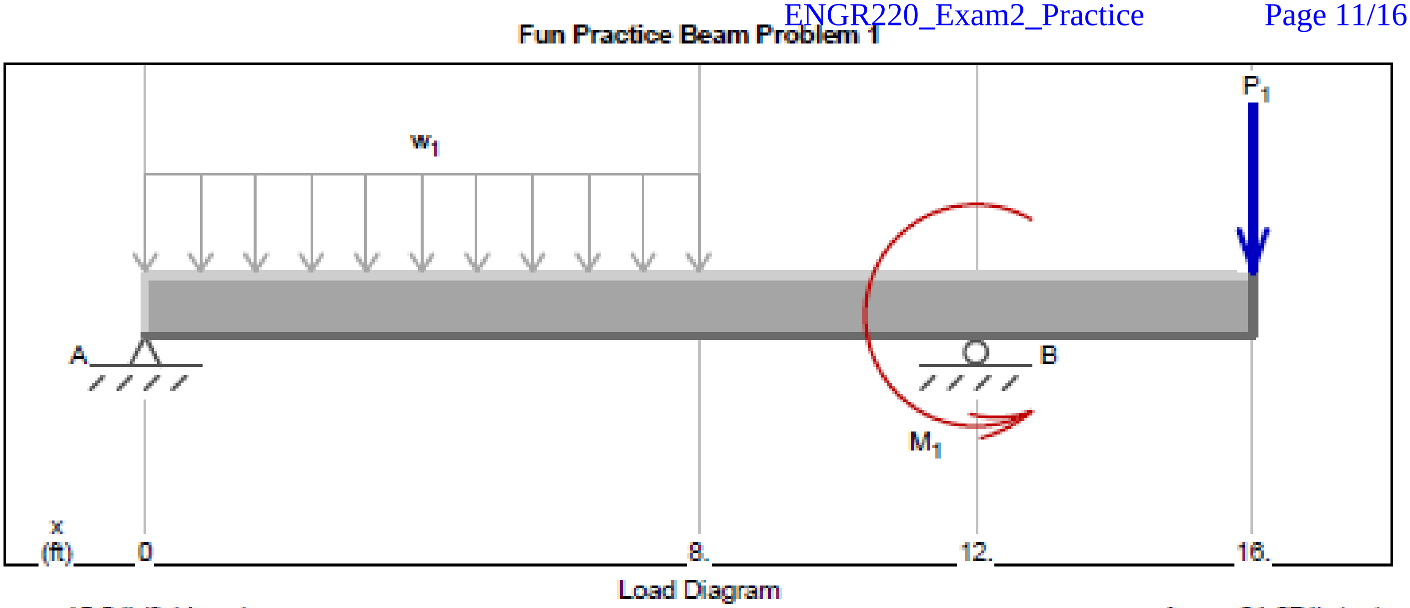
13. An air-dried red oak beam is loaded as shown above with F = 1000lb and a = 6.5 ft. It has a cross-section that is $1^5/_8$ inches wide and is to be cut only to the necessary height h so as to keep the beam from experiencing a flexural normal stress greater than 1305 psi. The minimum height *h* required for this beam is closest to:

a. 9.5 in
b. 10.0 in
c. 10.5 in
d. 11.0 in
e. 11.5 in

14. When a 216 N-m bending moment is applied about the x-axis (neutral axis) of a beam with the cross section shown, the maximum flexural stress is closest to:

a. 12.5 MPa
b. 14.5 MPa
c. 16.5 MPa
d. 18.5 MPa
e. 20.5 MPa

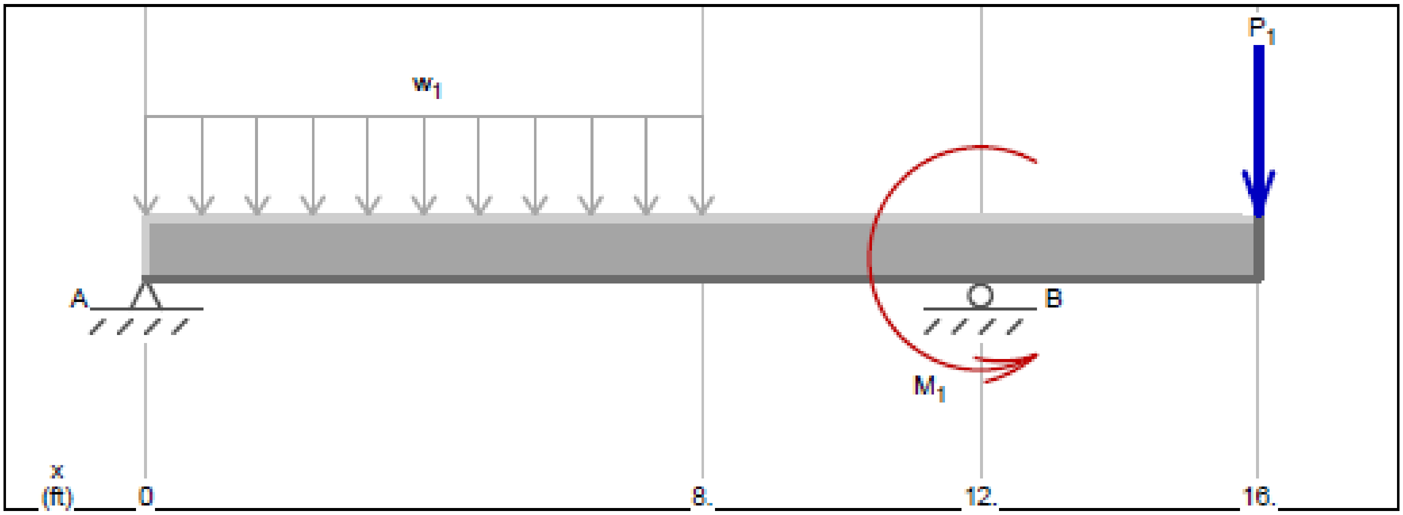




w_1 = 15.0 lb/ft (down)
M_1 = 180.0 lb-ft (ccw)
P_1 = 100.0 lb (down)

A_y = 61.67 lb (up)
B_y = 158.33 lb (up)

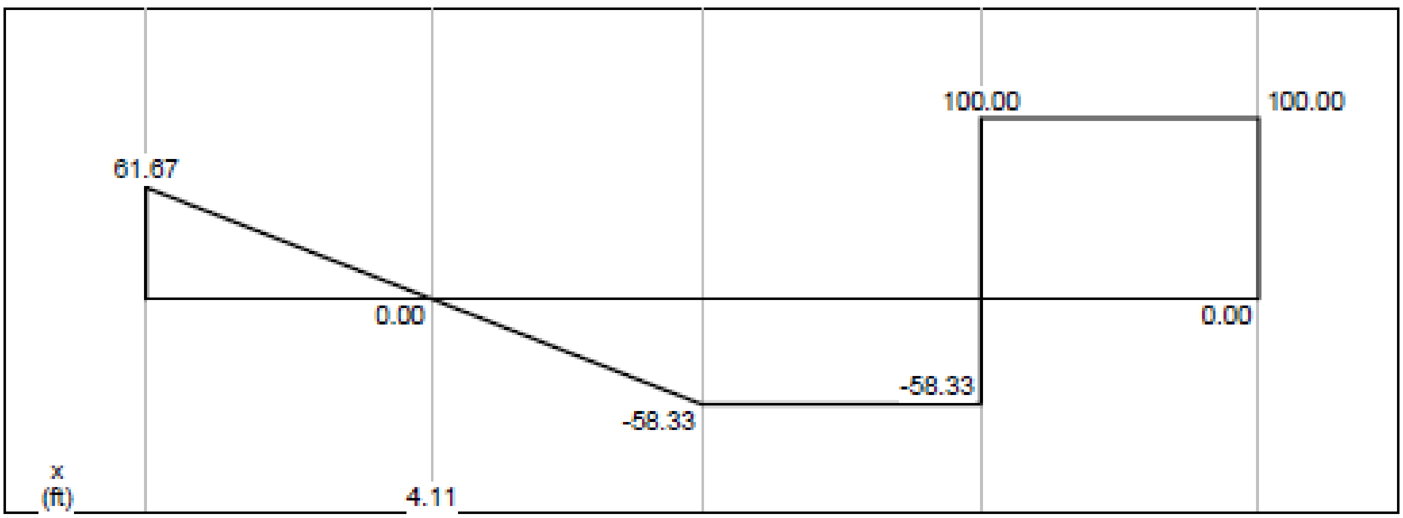
Fun Practice Beam Problem 1



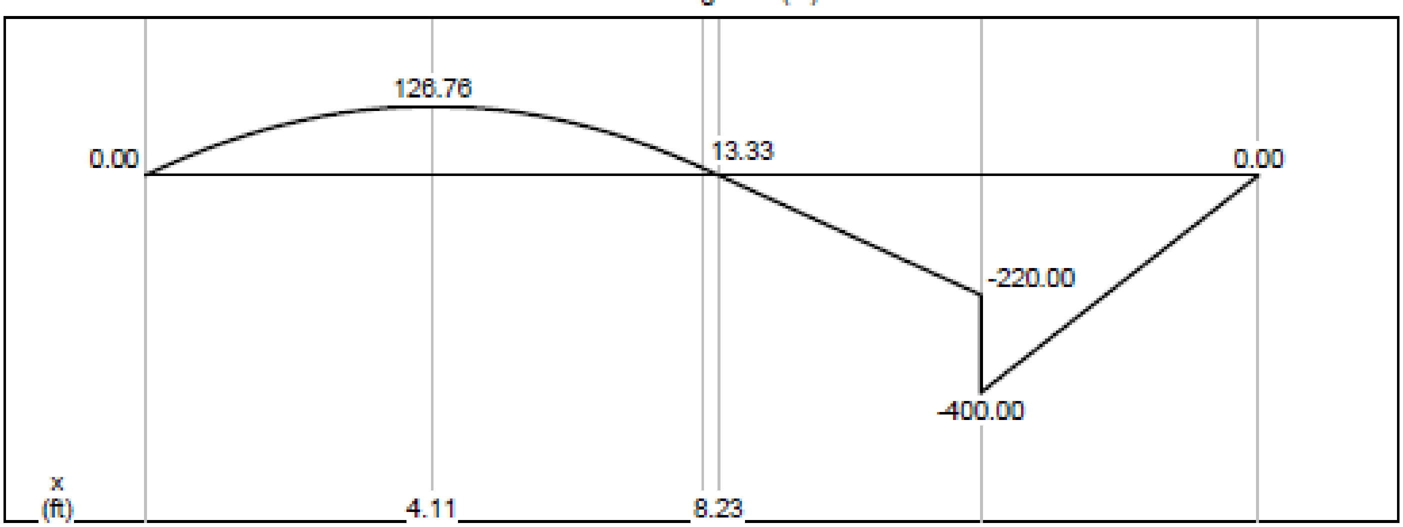
Load Diagram

w_1 = 15.0 lb/ft (down)
M_1 = 180.0 lb-ft (ccw)
P_1 = 100.0 lb (down)

A_y = 61.67 lb (up)
B_y = 158.33 lb (up)

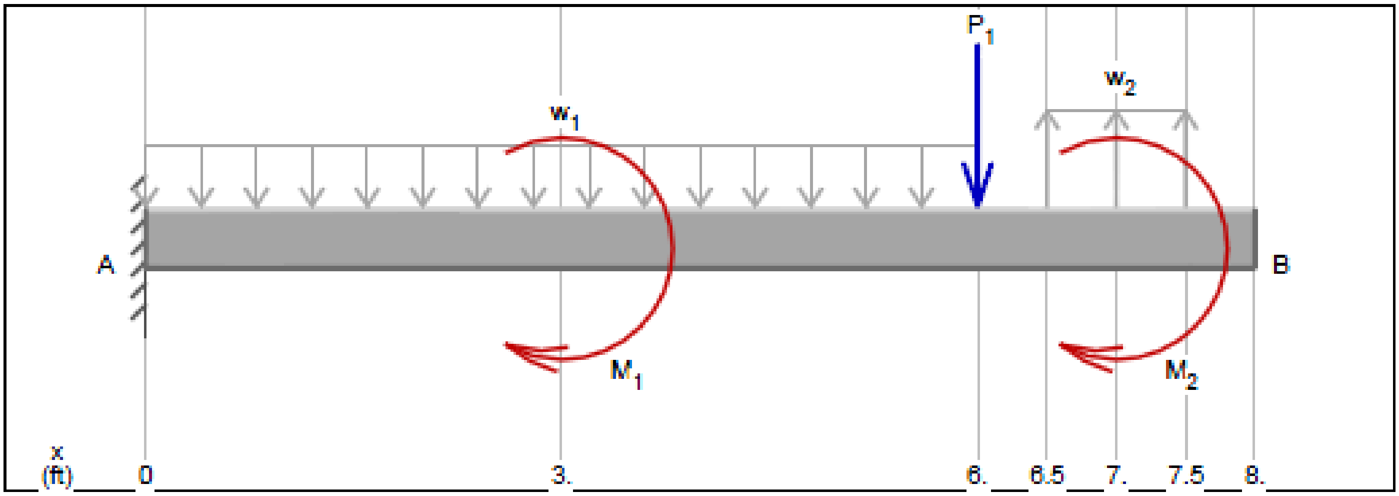


Shear Diagram (lb)



Moment Diagram (lb-ft)

Fun Practice Beam Problem 2

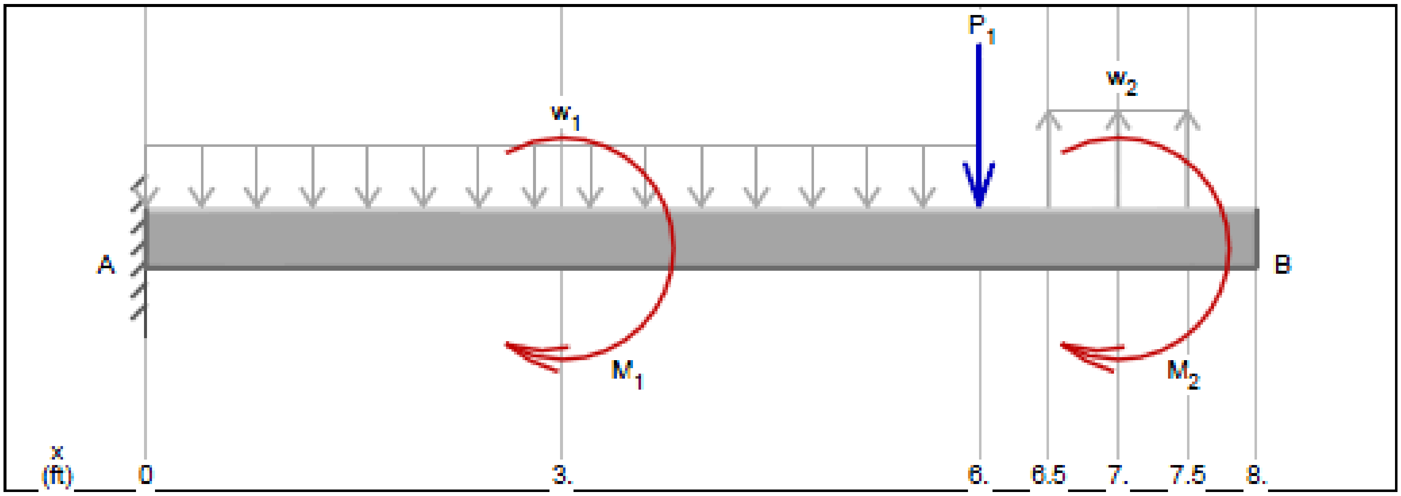


Load Diagram

w_1 = 15.0 lb/ft (down)
M_1 = 400.0 lb-ft (cw)
P_1 = 100.0 lb (down)
w_2 = 20.0 lb/ft (up)
M_2 = 300.0 lb-ft (cw)

A_y = 170.00 lb (up)
Moment A = 1,430.00 lb-ft (ccw)

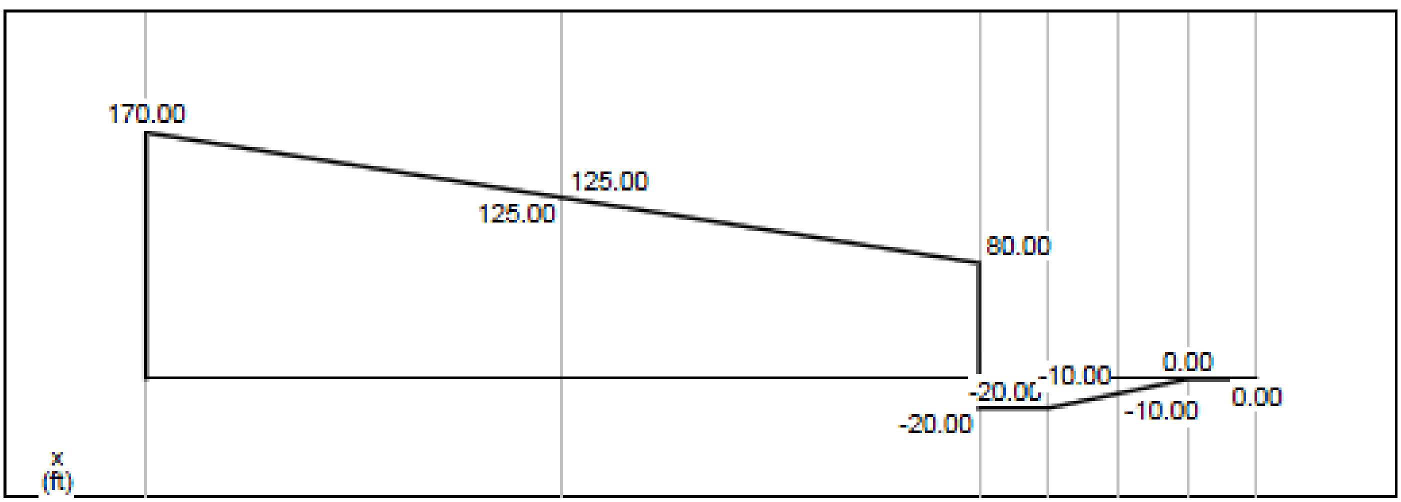
Fun Practice Beam Problem 2



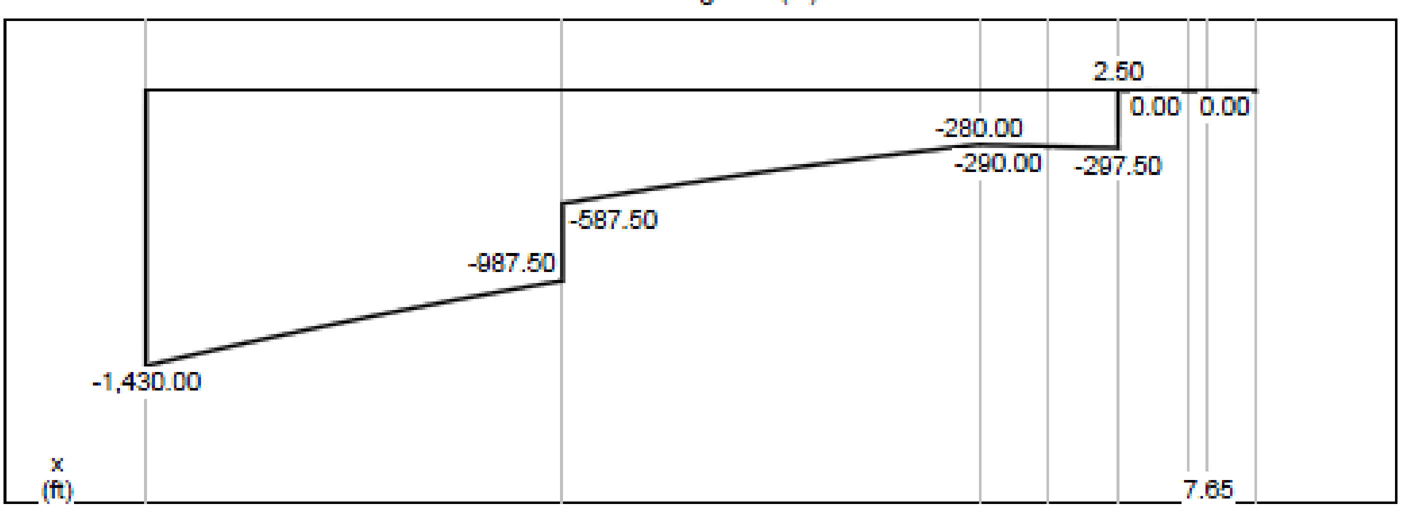
Load Diagram

w_1 = 15.0 lb/ft (down)
M_1 = 400.0 lb-ft (cw)
P_1 = 100.0 lb (down)
w_2 = 20.0 lb/ft (up)
M_2 = 300.0 lb-ft (cw)

A_y = 170.00 lb (up)
Moment A = 1,430.00 lb-ft (ccw)

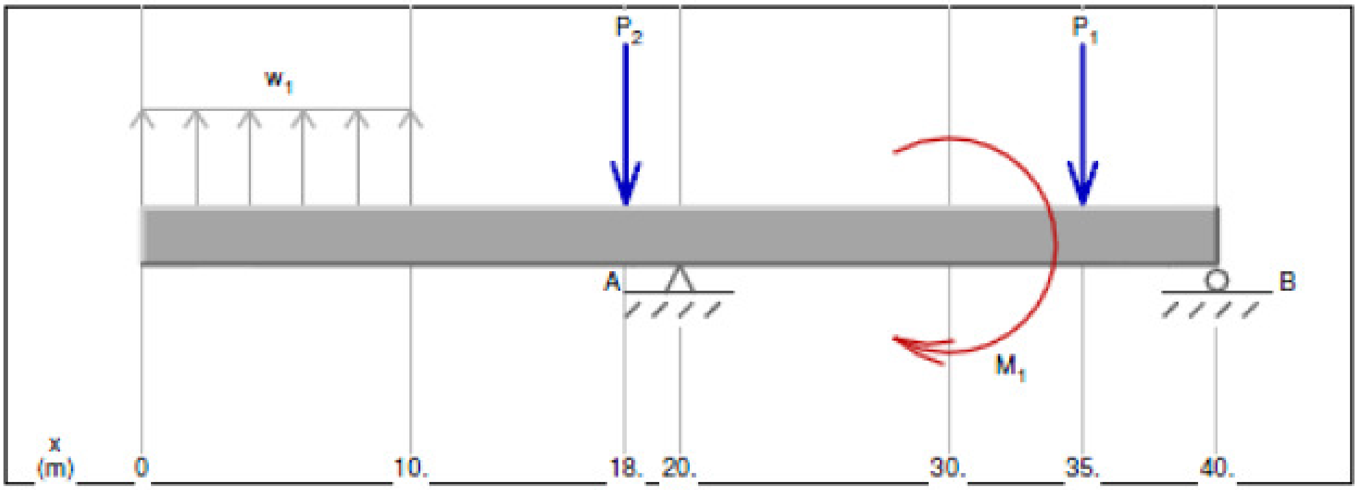


Shear Diagram (lb)



Moment Diagram (lb-ft)

Fun Practice 3

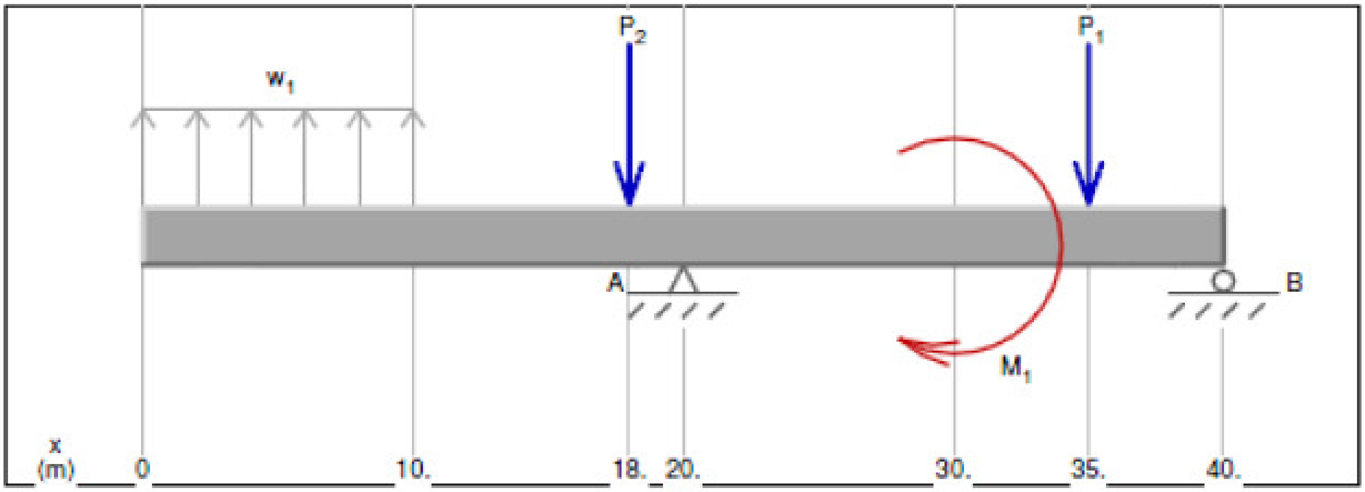


Load Diagram

P_1 = 500.0 N (down)
M_1 = 40.0 kN-m (cw)
w_1 = 30.0 N/m (up)
P_2 = 250.0 N (down)

A_y = 2,125.00 N (down)
B_y = 2,575.00 N (up)

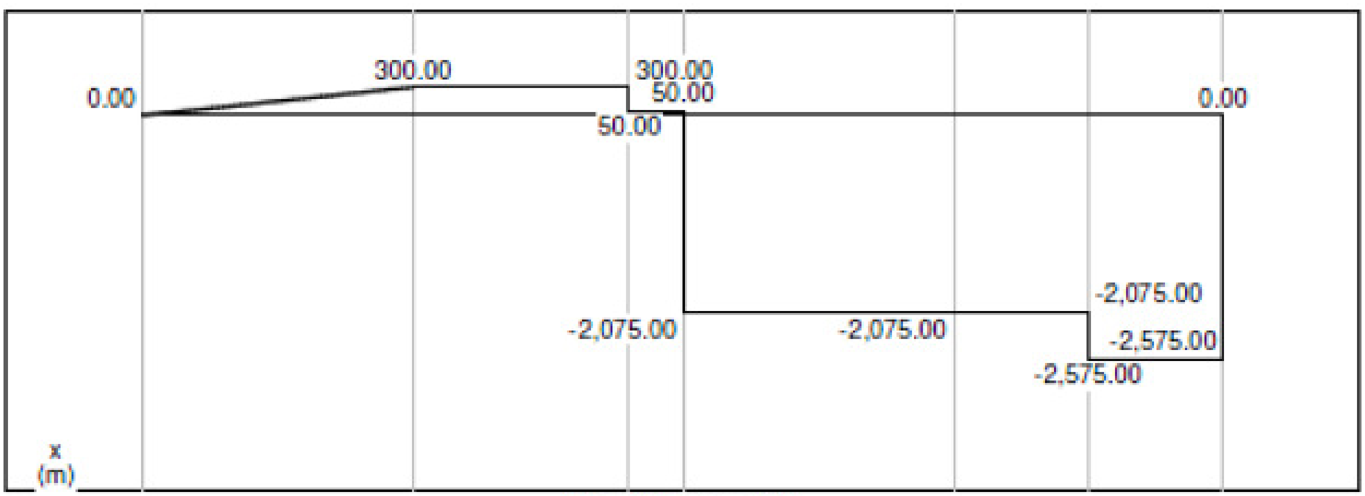
Fun Practice 3



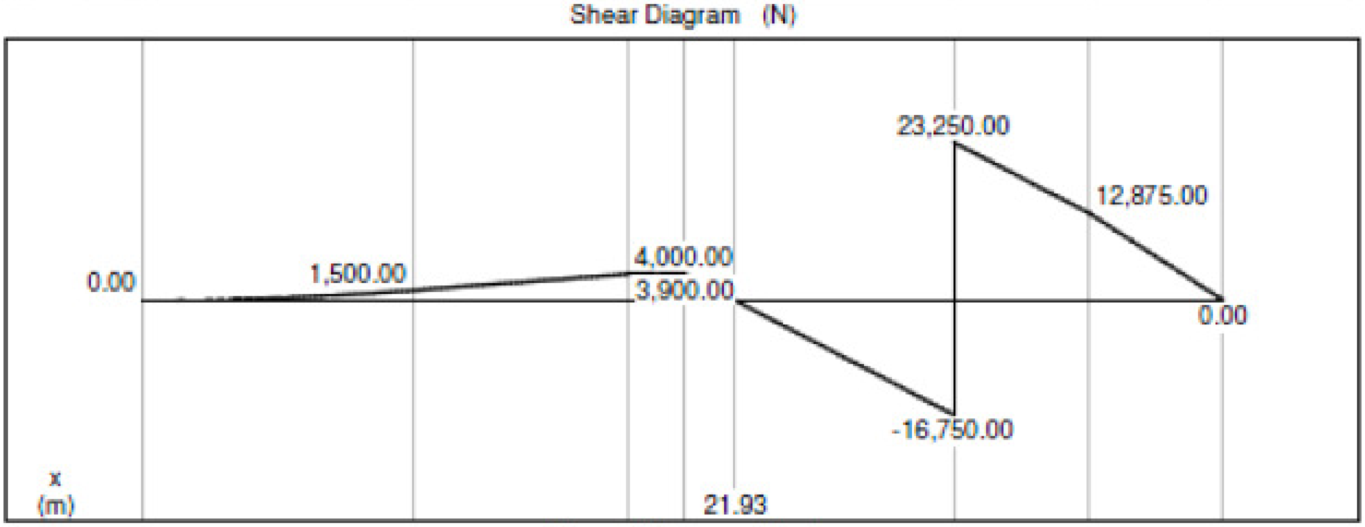
Load Diagram

P_1 = 500.0 N (down)
M_1 = 40.0 kN-m (cw)
w_1 = 30.0 N/m (up)
P_2 = 250.0 N (down)

A_y = 2,125.00 N (down)
B_y = 2,575.00 N (up)



Shear Diagram (N)



Moment Diagram (N-m)