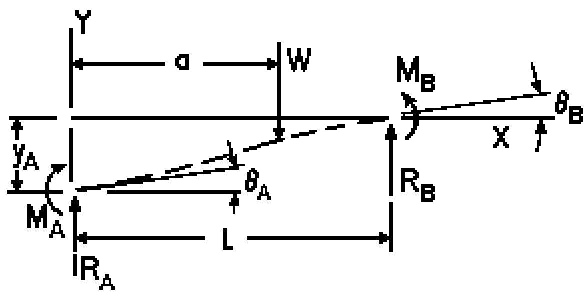
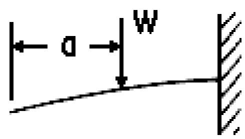
**Concentrated intermediate load**




**Left end free, right end fixed (cantilever)**




| | |
|---|---|
| Area moment of inertia: | $I \equiv 644 \cdot 10^{6} mm^{4}$ |
| Length of beam: | $L \equiv 3m$ |
| Distance from left edge to load: | $a \equiv 0m$ |
| Modulus of elasticity: | $E \equiv 66000 \frac{N}{mm^{2}}$ |
| Load: | $W \equiv 1000000 \cdot N$ |

The following specify the reaction forces (R), moments (M), slopes (θ) and deflections (y) at the left and right ends of the beam (denoted as A and B, respectively).

At the left end of the beam (free):

$R_A := 0 \cdot N$

$M_A := 0 \cdot N \cdot m$

$\theta_A := \dfrac{W \cdot (L - a)^2}{2 \cdot E \cdot I}$ $\qquad$ $\theta_A = 6.066 \cdot deg$

$y_A := \dfrac{-W}{6 \cdot E \cdot I} \cdot \left(2 \cdot L^3 - 3 \cdot L^2 \cdot a + a^3\right)$ $\qquad$ $y_A = -211.745 \cdot mm$

At the right end of the beam (fixed):

$R_B := W$ $\qquad$ $R_B = 1 \times 10^6 \cdot N$

$M_B := -W \cdot (L - a)$ $\qquad$ $M_B = -3 \times 10^6 \cdot N \cdot m$

$\theta_B := 0$

$y_B := 0$

$S_x := 3800 \cdot 10^3 mm^3$

$$\sigma_b := \frac{|M_B|}{I} = 4658.385 \frac{1}{m} \cdot MPa$$

**Note:** To find the maximum and minimum values of a graphed function, simply **click** once on the graph and read the extreme values to the left of the plot.

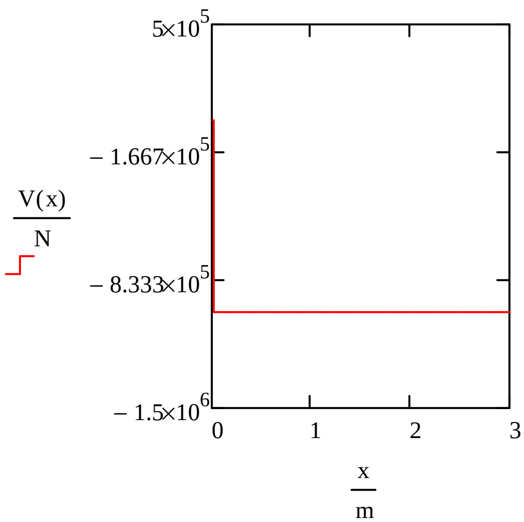
$x := 0 \cdot L, .01 \cdot L .. L$ x ranges from 0 to L, the length of the beam.

$x_1 := 15 \cdot m$ Define a point along the length of the beam.

Transverse shear:

$V(x) := R_A - (x > a) \cdot W$

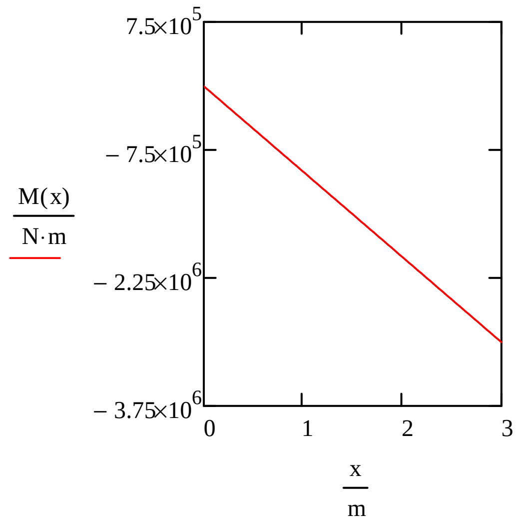
$V(x_1) = -1 \times 10^6 \cdot N$




Bending moment:

$M(x) := M_A + R_A \cdot x - (x > a) \cdot (x - a) \cdot W$

$M(x_1) = -1.5 \times 10^7 \cdot N \cdot m$

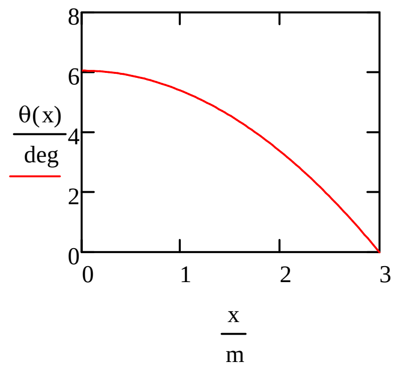


7.5×10^5
− 7.5×10^5
− 2.25×10^6
− 3.75×10^6
M(x)
N·m
0
1
2
3
x
m

Slope:

$$\theta(x) := \theta_A + \frac{M_A \cdot x}{E \cdot I} + \frac{R_A \cdot x^2}{2 \cdot E \cdot I} - \frac{(x > a) \cdot (x - a)^2 \cdot W}{2 \cdot E \cdot I}$$

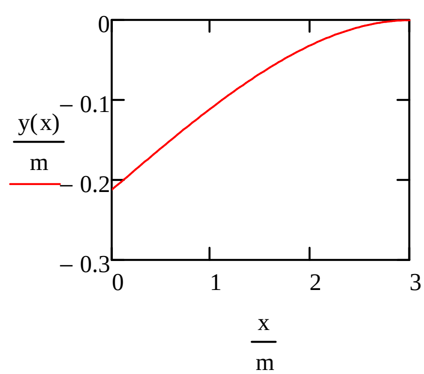
$$\theta(x_1) = -145.585 \cdot deg$$




Deflection:

$$y(x) := y_A + \theta_A \cdot x + \frac{M_A \cdot x^2}{2 \cdot E \cdot I} + \frac{R_A \cdot x^3}{6 \cdot E \cdot I} - (x > a) \cdot \left[\frac{W}{6 \cdot E \cdot I} \cdot (x - a)^3\right]$$

$$y(x_1) = -1.186 \times 10^4 \cdot mm$$



**Note:** The signs in this section correspond to direction.

The subscript **max** refers to the maximum magnitude of the most positive value for the given parameters.

$M_{max} := M_B$ $\qquad M_{max} = -2.655 \times 10^7 \cdot lbf \cdot in$

$\theta_{max} := \theta_A$ $\qquad \theta_{max} = 6.066 \cdot deg$

$y_{max} := y_A$ $\qquad y_{max} = -8.336 \cdot in$

The subscript **maxval** refers to the maximum attainable value when a = 0.

$M_{maxval} := -W \cdot L$ $\qquad M_{maxval} = -2.655 \times 10^7 \cdot lbf \cdot in$

$\theta_{maxval} := \dfrac{W \cdot L^2}{2 \cdot E \cdot I}$ $\qquad \theta_{maxval} = 6.066 \cdot deg$

$y_{maxval} := \dfrac{-W \cdot L^3}{3 \cdot E \cdot I}$ $\qquad y_{maxval} = -8.336 \cdot in$