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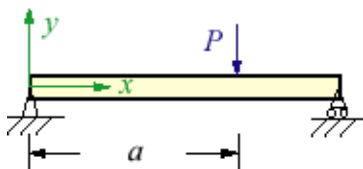
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Beam Diagram and Calculator Input


Here we display a specific beam loading case. Integrated into each beam case is a calculator that can be used to determine the maximum displacements, slopes, moments, stresses, and shear forces for this beam problem. Note that the maximum stress quoted is a positive number, and corresponds to the largest stress magnitude in the beam. It does not distinguish between tension or compression (this distinction depends on which side of the beam's neutral plane your c input corresponds).

Calculator Input

Length of beam, L : ▼

Load on beam, P : ▼

Location of load, a : ▼

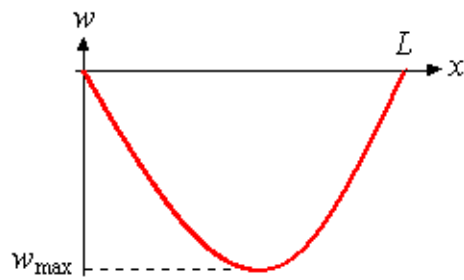
[Young's Modulus, \$E\$](#) : ▼

Distance from neutral axis to extreme fibers, c : ▼

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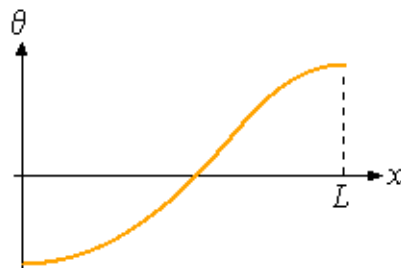
Displacement



$$w(x) = \begin{cases} -\frac{(L-a)Px(-a^2+2La-x^2)}{6EIL} & 0 \leq x \leq a \\ \frac{aP(L-x)(a^2+x^2-2Lx)}{6EIL} & a \leq x \leq L \end{cases}$$

$$w_{\max} = \begin{cases} -\frac{a^{3/2}(L-a)(2L-a)^{3/2}P}{9\sqrt{3}EIL}, & a \geq \frac{L}{2} \\ -\frac{a(L^2-a^2)^{3/2}P}{9\sqrt{3}EIL}, & a \leq \frac{L}{2} \end{cases} = -0.00123 \text{ in } \text{in} \quad \text{Calc. Again}$$

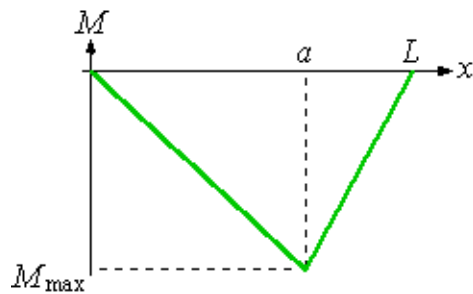
Slope



$$\theta(x) = \begin{cases} -\frac{(a-L)P(a^2-2La+3x^2)}{6EIL} & 0 \leq x \leq a \\ -\frac{aP(a^2+2L^2+3x^2-6Lx)}{6EIL} & a \leq x \leq L \end{cases}$$

$$\theta_{\max} = \begin{cases} \theta(0) = -\frac{a(a-2L)(a-L)P}{6EIL} & a \leq \frac{L}{2} \\ \theta(L) = -\frac{a(a^2-L^2)P}{6EIL} & a \geq \frac{L}{2} \end{cases} = 0.00190 \text{ deg } \text{deg} \quad \text{Calc. Again}$$

Moment and Maximum Bending Stress

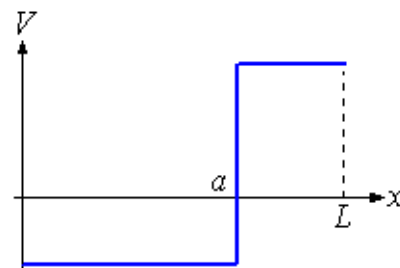


$$M(x) = \begin{cases} -Px \left(1 - \frac{a}{L}\right) & 0 \leq x \leq a \\ -Pa \left(1 - \frac{x}{L}\right) & a \leq x \leq L \end{cases}$$

$$M_{\max} = M(a) = -Pa \left(1 - \frac{a}{L}\right) = -2400 \text{ lbf-ft} \quad \text{lbf-ft} \quad \text{Calc. Again}$$

$$\sigma_{\max} = |M_{\max}| \frac{c}{I} = \left| \frac{Pa}{L} \left(1 - \frac{a}{L}\right) \right| = 280 \text{ psi} \quad \text{psi}$$

Shear



$$V(x) = \begin{cases} -P \left(1 - \frac{a}{L}\right) & 0 \leq x < a \\ P \left(\frac{a}{L}\right) & a \leq x \leq L \end{cases}$$

$$V_{\max} = \begin{cases} -P \left(1 - \frac{a}{L}\right) & a \leq \frac{L}{2} \\ P \left(\frac{a}{L}\right) & a \geq \frac{L}{2} \end{cases} = 600 \text{ lbf} \quad \text{lbf} \quad \text{Calc. Again}$$

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