efunda

Mixed Supports: Intermediate Load

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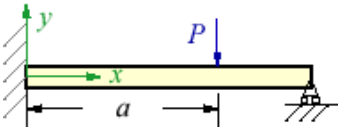
Beam Diagram and Calculator Input



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).

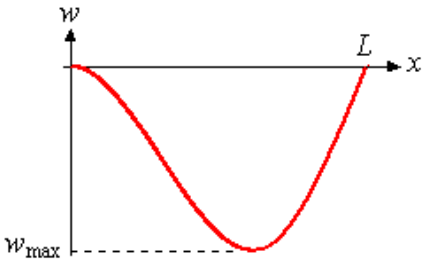
Calculator Input

Length of beam, *L*:	10	ft
Load on beam, *P*:	1000	lbf
Location of load, *a*:	7	ft
Young's Modulus, *E*:	30000	ksi
Distance from neutral axis to extreme fibers, *c*:	9	in
Moment of Inertia, *I*:	926	in^4

Calculate Again Default Values

Go To Solutions ⇒ Max Stress Displacement Slope Moment Shear

Displacement

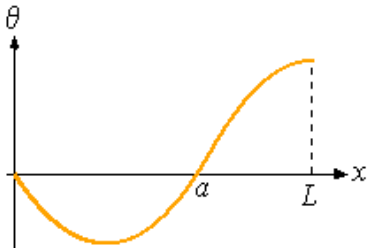


$$w(x) = \begin{cases} -\dfrac{(a-L)\,P\,x^2\left((3L-x)\,a^2+2L\,(x-3L)\,a+2L^2\,x\right)}{12\,EI\,L^3} & 0 \le x \le a \\ \dfrac{a^2\,P\,(L-x)\left(3L\,x\,(x-2L)+a\left(2L^2+2x\,L-x^2\right)\right)}{12\,EI\,L^3} & a \le x \le L \end{cases}$$

$$w_{max} = \begin{cases} -\dfrac{a^3\,(a-2L)^3\,(a-L)\,P}{3\,EI\,(a^2-2La-2L^2)^2}, & a \le 0.5858\,L \\ -\dfrac{a^2\,(L-a)^{\frac{3}{2}}\,P}{6\,EI\sqrt{(3L-a)}}, & a \ge 0.5858\,L \end{cases}$$

= -5.50 × 10^{-4} in [in] Calc. Again

Slope

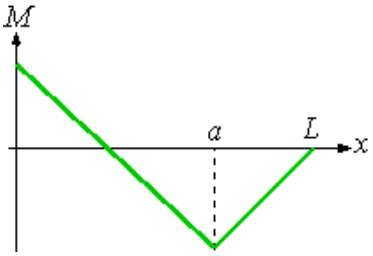


$$\theta(x) = \begin{cases} -\dfrac{(a-L)\,P\,x\left((2L-x)\,a^2+2L\,(x-2L)\,a+2L^2\,x\right)}{4\,EI\,L^3} & 0 \le x \le a \\ -\dfrac{a^2\,P\left(2L^3-6x\,L^2+x\,(2a+3x)\,L-a\,x^2\right)}{4\,EI\,L^3} & a \le x \le L \end{cases}$$

$$\theta_{max} = \begin{cases} \theta\left(\dfrac{a\,(a-2L)\,L}{a^2-2La-2L^2}\right) = -\dfrac{a^2\,(a-2L)^2\,(a-L)\,P}{4EI\,L\,(a^2-2La-2L^2)}, & a \le 0.3820\,L \\ \theta(L) = -\dfrac{a\,(a^2-L^2)\,P}{6\,EI\,L}, & a \ge 0.3820\,L \end{cases}$$

= 0.00177 deg [deg] Calc. Again

Moment and Maximum Bending Stress

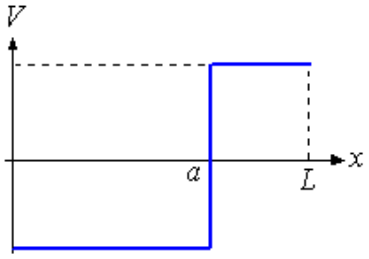


$$M(x) = \begin{cases} -\dfrac{(L-a)\,P\left((L-x)\,a^2 - 2\,L\,(L-x)\,a + 2\,L^2\,x\right)}{2\,L^3} & 0 \le x \le a \\ -\dfrac{a^2\,(3\,L-a)\,P\,(L-x)}{2\,L^3} & a \le x \le L \end{cases}$$

$$M_{max} = \begin{cases} M(0) = \dfrac{a\,(a-2\,L)\,(a-L)\,P}{2\,L^2}, & a \le 0.5858\,L \\ M(a) = -\dfrac{a^2\,(a-3\,L)\,(a-L)\,P}{2\,L^3}, & a \ge 0.5858\,L \end{cases}$$ = -1690 lbf-ft lbf-ft Calc. Again

$$\sigma_{max} = |M_{max}|\,\frac{c}{I} = \frac{|M_{max}|}{Z}$$ = **197** psi psi

Shear



$$V(x) = \begin{cases} -\dfrac{\left(a^3 - 3a^2L + 2L^3\right)P}{2L^3} & 0 \le x \le a \\ \dfrac{a^2\left(3L-a\right)P}{2L^3} & a \le x \le L \end{cases}$$

$$V_{max} = \begin{cases} -\dfrac{\left(a^3 - 3a^2L + 2L^3\right)P}{2L^3} & a \le 0.6527L \\ \dfrac{a^2\left(3L-a\right)P}{2L^3} & a \ge 0.6527L \end{cases}$$ = 564 lbf lbf Calc. Again

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