

Cantilever Beam - v2

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$$q(x) := -5 + 0 \cdot x$$

$$YS := 30000$$

$$i0 := 22.33 \cdot 10^{-5} \quad i1 := 0 \quad e0 := 29 \cdot 10^6 \quad e1 := 0 \quad I(x) := i0 + i1 \cdot x \quad E(x) := e0 + e1 \cdot x$$

$$f(x) := E(x) \cdot I(x) \quad f1(x) := i1 \cdot e0 + 2 \cdot i1 \cdot e1 \cdot x \quad f2(x) := 2 \cdot i1 \cdot e1$$

$$D(x, y) := \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ \frac{q(x) - f2(x) \cdot y_2 - 2 \cdot f1(x) \cdot y_3}{f(x)} \end{bmatrix} \quad \begin{array}{l} y' = \text{slope} \\ y'' = \text{Moment/EI} \\ y''' = \text{Shear/EI} \\ y'''' = p/E(x) \cdot I(x) \end{array}$$

$$\text{load}(x, w) := \begin{bmatrix} 0 \\ 0 \\ w_0 \\ w_1 \end{bmatrix} \quad w := \begin{bmatrix} 0 \\ 0 \end{bmatrix} \quad \text{score}(x, y) := \begin{bmatrix} y_2 \\ y_3 \end{bmatrix}$$

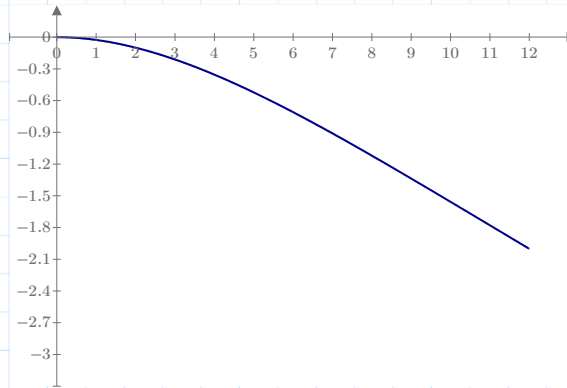
$$\text{sol} := \text{sbval}(w, 0, 12, D, \text{load}, \text{score}) \quad \text{sol} = \begin{bmatrix} -0.056 \\ 0.009 \end{bmatrix}$$

$$Iy := \begin{bmatrix} 0 \\ 0 \\ \text{sol}_0 \\ \text{sol}_1 \end{bmatrix} \begin{array}{l} \text{Initial } y \\ y' \\ y'' \\ y''' \end{array} \quad N := 1000 \quad \text{ans} := \text{rkfixed}(Iy, 0, 12, N, D)$$

$$\text{Dist} := \text{ans}^{(0)} \cdot 1 \cdot \text{in} \quad \text{Defl} := \text{ans}^{(1)} \cdot 1 \cdot \text{in}$$

ans =

Defl (in)



Dist (in)

Cantilever deflection vs length

Check

$xp := 12$

$M := \text{if } xp > 0$	forward deriv approx at $x > 0$
$\left\ \begin{array}{l} 1000 \cdot \frac{xp}{12} \\ \text{else} \\ 1 \end{array} \right\ $	
	backward deriv approx at $x = 0$

$Deflection(xp) := \text{ans}_{M,1} = -2.001$

$Slope(xp) := \text{ans}_{M,2} = -0.222$

$Moment(xp) := E(xp) \cdot I(xp) \cdot \text{ans}_{M,3}$

$Moment(xp) = -1.867 \cdot 10^{-8}$

$Shear(xp) := E(xp) \cdot I(xp) \cdot \text{ans}_{M,4}$

$Shear(xp) = -1.005 \cdot 10^{-8}$

$Load(xp) := E(xp) \cdot I(xp) \cdot \frac{(\text{ans}_{M,4} - \text{ans}_{M-1,4})}{\frac{12}{N}}$

$Load(xp) = -5$

$$k := 0, 1 \dots N$$

$$Stress_k := \text{abs} \left(\frac{\text{ans}_{k,3} \cdot E \left(\frac{k}{N} \cdot 12 \right) \cdot I \left(\frac{k}{N} \cdot 12 \right)}{\frac{2}{3} \cdot b \cdot h^2} \right) \cdot 1 \cdot \text{psi} \quad Z_k := \frac{k}{N} \cdot 12 \cdot 1 \cdot \text{in}$$

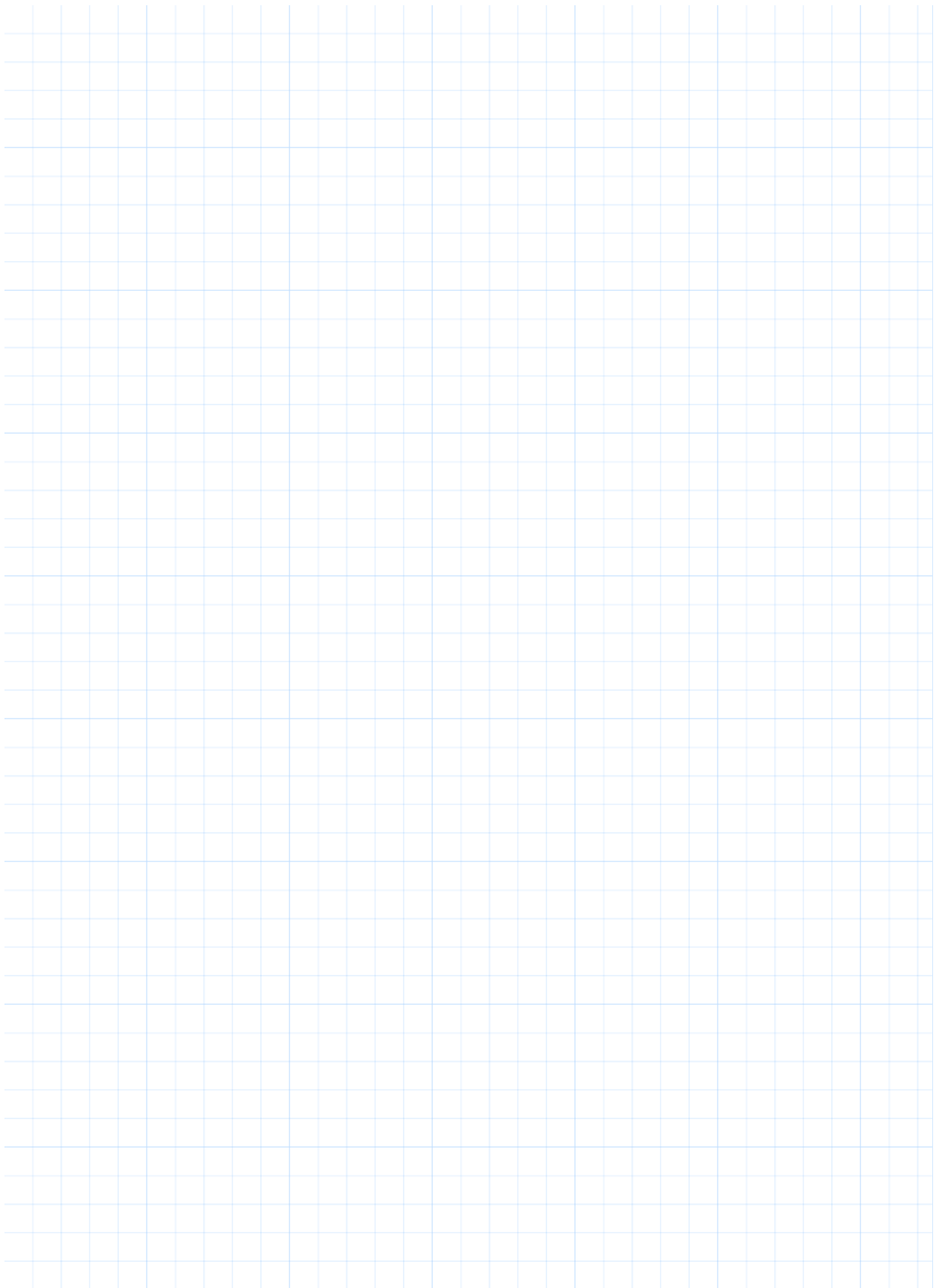
$$MaxStress := \max(Stress^{(0)}) = (5.038 \cdot 10^4) \text{ psi}$$

$$YSt_k := YS \cdot 1 \cdot \text{psi}$$



Maximum Stress vs position

FAILS! - Beef up Cantilever end or use more flexible bundled fibers



abs