FOUR POINTS BENDING BEAM

Beam spans

Span lenght	[mm]	$L := 4320$

Section geometry

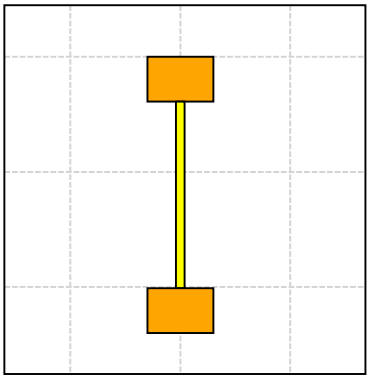
		Width	Height
Top subsection	[mm]	$b_1 := 60$	$h_1 := 39$
Middle subsection	[mm]	$b_2 := 8$	$h_2 := 162$
Bottom subsection	[mm]	$b_3 := 60$	$h_3 := 39$
Total section height	[mm]	$h := h_1 + h_2 + h_3$	

Section material

		Elastic modulus	Shear modulus
Top subsection	[N/mm²]	$E_1 := 14500$	$G_1 := 600$
Middle subsection	[N/mm²]	$E_2 := 5300$	$G_2 := 2100$
Bottom subsection	[N/mm²]	$E_3 := 14500$	$G_3 := 600$
Shear stiffness	[N]	$GA := G_1 \cdot h_1 \cdot b_1 + G_2 \cdot h_2 \cdot b_2 + G_3 \cdot h_3 \cdot b_3$	

SECTION VIEW

Section view



$$y_n := \frac{b_3 \cdot h_3 \cdot E_3 \cdot \left(h_1 + h_2 + \frac{h_3}{2}\right) + b_2 \cdot h_2 \cdot E_2 \cdot \left(h_1 + \frac{h_2}{2}\right) + b_1 \cdot h_1 \cdot E_1 \cdot \frac{h_1}{2}}{b_1 \cdot h_1 \cdot E_1 + b_2 \cdot h_2 \cdot E_2 + b_3 \cdot h_3 \cdot E_3}$$

$$EI := \frac{{h_1}^3 \cdot b_1 \cdot E_1}{12} + \frac{{h_2}^3 \cdot b_2 \cdot E_2}{12} + \frac{{h_3}^3 \cdot b_3 \cdot E_3}{12} + b_1 \cdot h_1 \cdot E_1 \cdot \left(y_n - \frac{h_1}{2}\right)^2 + b_2 \cdot h_2 \cdot E_2 \cdot \left(h_1 + \frac{h_2}{2} - y_n\right)^2 + b_3 \cdot h_3 \cdot E_3 \cdot \left(h_1$$

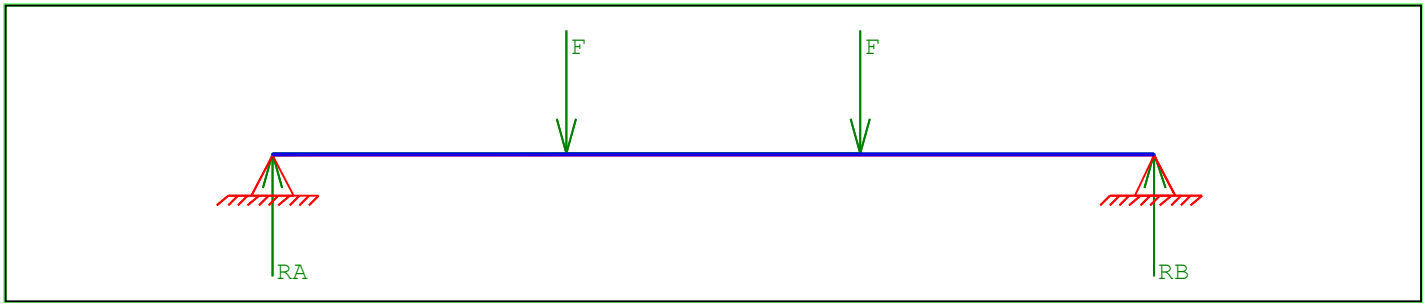
$$k_s := \frac{6 \cdot \left(-E_2 \cdot b_2 \cdot \left(h_3 + h_1 - h\right) + E_3 \cdot b_3 \cdot h_3 + E_1 \cdot b_1 \cdot h_1\right)^4 \cdot \left(\left(E_1{}^2 \cdot b_1 \cdot h_1{}^3 \cdot \left(10 \cdot E_2{}^5 \cdot b_2{}^5 \cdot h^7 + h_3 \cdot \left(h_3 \cdot \left(h_3 \cdot \left(h_3 \right.\right.\right.\right.\right.$$

$GAc := \frac{GA}{k_s} = 3{,}9408 \cdot 10^6$ [N]

Beam load

Load position (symmetric)	[mm]	$aF := \frac{L}{3} = 1440$
Concentrated force	[N]	$F := 1000$

STATIC SYSTEM



NUMERICAL ELASTIC CURVE CALCULATIONS (DIRAC DELTA FUNCTION)

Deflection expression		$u(x) := \left(v(x) - \frac{EI}{GAc} \cdot v''(x)\right)$
Moment expression		$M(x) := (-EI) \cdot v''(x)$
Shear force expression		$V(x) := (-EI) \cdot v'''(x)$
Deflection - midspan	[mm]	$u\left(\frac{L}{2}\right) = 4,4013$
Deflection - force position	[mm]	$u(aF) = 3,8749$
Moment - midspan	[Nmm]	$M\left(\frac{L}{2}\right) = 1,44 \cdot 10^{6}$
Shear force - support	[N]	$V(0) = 999,9997$

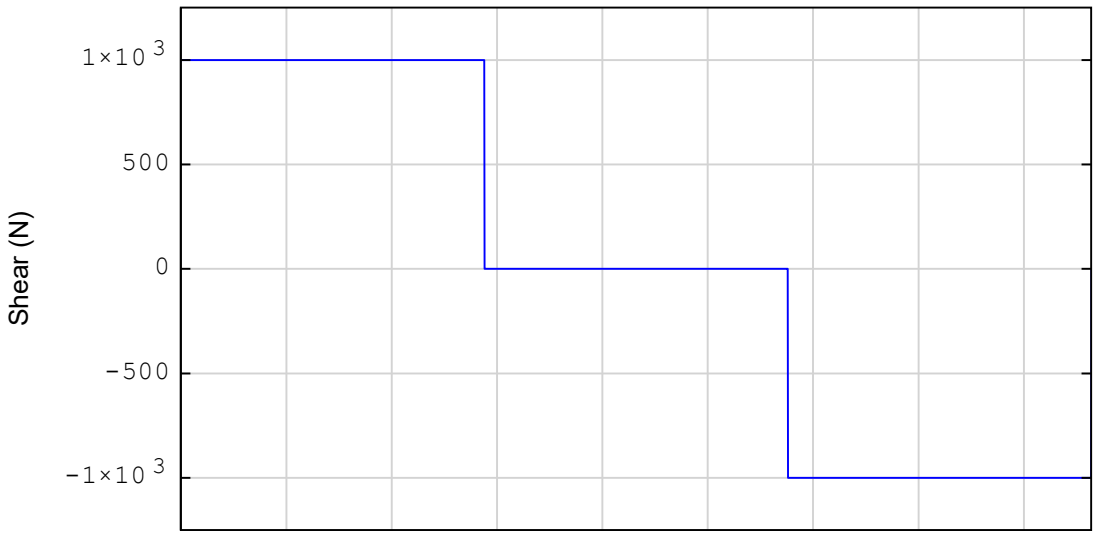
SYMBOLIC ELASTIC CURVE CALCULATIONS

$$u_{Midspan} := \frac{(-F) \cdot aF \cdot \left(\left(-2 \cdot \left(aF \cdot \left(aF + 3 \cdot \left(\frac{L}{2} - aF\right)\right) + 3 \cdot \left(\frac{L}{2} - aF\right)^2\right) + 3 \cdot \left(\frac{L}{2} - aF\right)^2\right) \cdot GAc - 6 \cdot EI\right)}{6 \cdot GAc \cdot EI}$$

$$u_{ForceP} := \frac{F \cdot aF \cdot \left(-aF \cdot \left(aF + 3 \cdot (aF - L)\right) \cdot GAc + 6 \cdot EI\right)}{6 \cdot GAc \cdot EI}$$

Exact Deflection - midspan	[mm]	$u_{Midspan} = 4,4013$
Exact Deflection - force pos.	[mm]	$u_{ForceP} = 3,8749$
Exact Moment - midspan	[Nmm]	$M_{Midspan} := F \cdot aF = 1,44 \cdot 10^{6}$
Exact shear force - support	[N]	$V_{Support} := F = 1000$

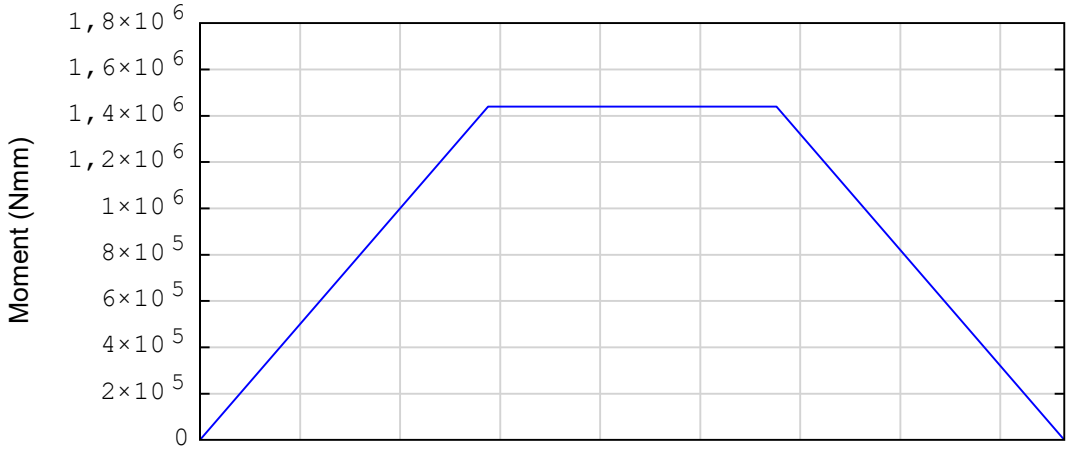
Shear Force Diagram



$V_{max} = 1000$

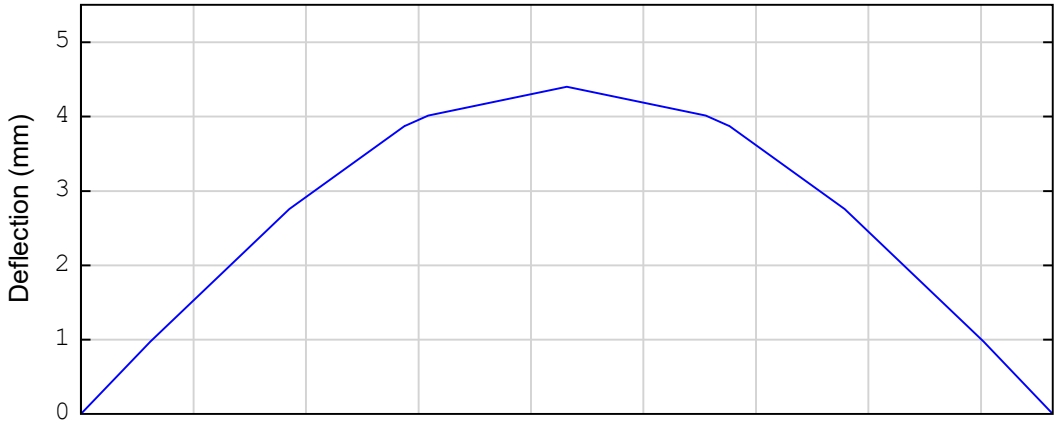
$V_{min} = -1000$

Moment Diagram



$M_{max} = 1,44 \cdot 10^{6}$

Deflection Diagram



$\Delta_{max} = 4,4013$

Reactions

$R_A := F = 1000$ $R_B := F = 1000$ [N]