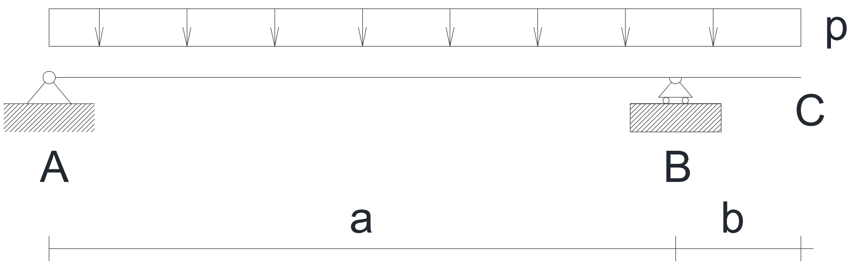
Acciaio: flessione, esercizo N.2



Data la trave in figura, determinare il valore massimo della tensione normale nella sezione più sollecitata e calcolare l'abbassamento e la rotazione del punto C.

Dimensioni:

$a := 3.0m \quad b := 1.0m$

Carico: $p := 200 \frac{kN}{m}$

Resistenza del materiale: $f_{yk} := 275MPa \qquad f_{yd} := \frac{f_{yk}}{1.05} \qquad f_{yd} = 261.905 \cdot MPa$

Modulo elastico: $E_s := 210000MPa$

IPE 330 $\quad W_x := 713.1cm^3 \qquad J_x := 11770cm^4 \qquad A := 62.61cm^2$

Reazioni Vincolari

$$Y_B := p \cdot \frac{(a+b)^2}{2} \cdot \frac{1}{a}$$

$$Y_B = 533.333 \cdot kN$$

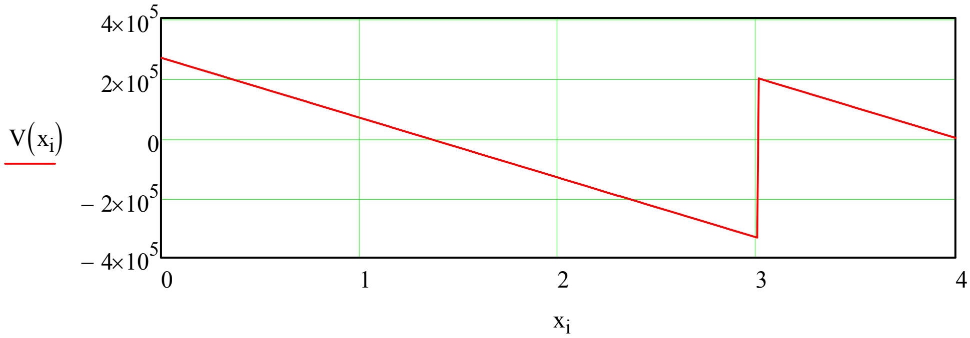
$$Y_A := p \cdot (a+b) - Y_B$$

$$Y_A = 266.667 \cdot kN$$

Forza di Taglio

$V(x) := \text{if}\left[x \le a, Y_A - p \cdot x, V(a) + Y_B - p \cdot (x - a)\right]$

$i := 0..500 \qquad x_i := \frac{(a+b)}{500} \cdot i \qquad\qquad V(a+b) = 0 \cdot kN$



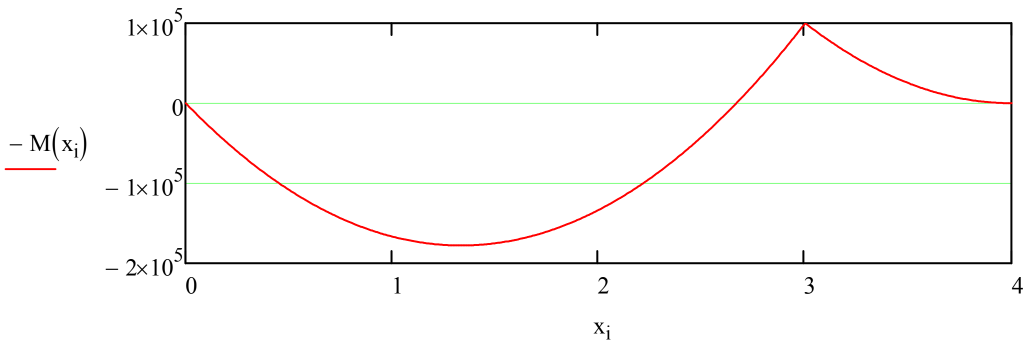
$V_A := V(0) \qquad V_A = 266.667 \cdot kN$

$V_{Bs} := V(a \cdot 0.99999999) \qquad V_{Bs} = -333.333 \cdot kN$

$V_{Bd} := V(a \cdot 1.00000001) \qquad V_{Bd} = 200 \cdot kN$

Momento Flettente

$M(x) := \int_0^x V(\xi)\, d\xi$



$x_{mx} := \frac{V(0)}{p} \qquad x_{mx} = 1.333\, m$

$M(x_{mx}) = 177.778 \cdot kN \cdot m \qquad M(a) = -100 \cdot kN \cdot m$

$M_{max} := \max\left(\left|M\left(x_{mx}\right)\right|, \left|M(a)\right|\right)$ $\qquad M_{max} = 177.778 \cdot kN \cdot m$

Calcolo della tensione normale massima

$\sigma_{max} := \dfrac{M_{max}}{W_x}$ $\qquad \sigma_{max} = 249.303 \cdot MPa$

Calcolo degli abbassamenti e delle rotazioni della linea d'asse

Tratto BC:

$$\chi_{AB}(x) := \frac{M(x)}{E_s \cdot J_x}$$

$$\phi_{AB}(x) := \frac{\left(p \cdot \frac{x^3}{6} - Y_A \cdot \frac{x^2}{2}\right)}{E_s \cdot J_x} + C_1$$

$$u_{zAB}(x) := \frac{\left(p \cdot \frac{x^4}{24} - Y_A \cdot \frac{x^3}{6}\right)}{\left(E_s \cdot J_x\right)} + C_1 \cdot x + C_2$$

$u_{zAB}(0)=0$ $\qquad C_2 := 0$

$C_1 := \dfrac{\left(-p \cdot \frac{a^4}{24} + Y_A \cdot \frac{a^3}{6}\right)}{\left(E_s \cdot J_x\right)} \cdot \dfrac{1}{a}$ $\qquad C_1 = 7.08 \times 10^{-3}$

$$\phi_{AB}(x) := \frac{\left(p \cdot \frac{x^3}{6} - Y_A \cdot \frac{x^2}{2}\right)}{E_s \cdot J_x} + C_1$$

$\phi_{AB}(0) = 7.08 \times 10^{-3}$

$$u_{zAB}(x) := \frac{\left(p\cdot\frac{x^4}{24} - Y_A\cdot\frac{x^3}{6}\right)}{\left(E_s\cdot J_x\right)} + C_1\cdot x + C_2$$

$$u_{zAB}(0) = 0\,m$$

$$u_{zAB}(a) = 0\,m$$

$$\phi_{AB}(a) = -5.057\times 10^{-3}$$

$$\phi_{AB}(0) = 7.08\times 10^{-3}$$

Tratto BC:

$$\chi_{BC}(x) := \frac{M(x)}{E_s\cdot J_x}$$

$$\chi_{BC}(x) := \frac{\left(p\cdot\frac{x^2}{2} - M(a) - V_{Bd}\cdot x\right)}{\left(E_s\cdot J_x\right)}$$

$$\phi_{BC}(x) := \frac{\left(p\cdot\frac{x^3}{6} - M(a)\cdot x - V_{Bd}\cdot\frac{x^2}{2}\right)}{E_s\cdot J_x} + C_3$$

$$\phi_{BC}(0) := \phi_{AB}(a)$$

$$C_3 := \phi_{AB}(a)$$

$$C_3 = -5.057\times 10^{-3}$$

$$u_{zBC}(x) := \frac{\left(p\cdot\frac{x^4}{24} - M(a)\cdot\frac{x^2}{2} - V_{Bd}\cdot\frac{x^3}{6}\right)}{\left(E_s\cdot J_x\right)} + C_3\cdot x + C_4$$

$$u_{zBC}(0) := 0$$

$$C_4 := 0$$

$$\phi_{BC}(x) := \frac{\left(p \cdot \frac{x^3}{6} - M(a) \cdot x - V_{Bd} \cdot \frac{x^2}{2}\right)}{E_s \cdot J_x} + C_3$$

$$\phi_{BC}(0) = -5.057 \times 10^{-3}$$

$$\phi_{BC}(b) = -3.709 \times 10^{-3}$$

$$u_{zBC}(x) := \frac{\left(p \cdot \frac{x^4}{24} - M(a) \cdot \frac{x^2}{2} - V_{Bd} \cdot \frac{x^3}{6}\right)}{\left(E_s \cdot J_x\right)} + C_3 \cdot x + C_4$$

$$u_{zBC}(0) = 0\,\mathrm{m}$$

$$u_{zBC}(b) = -4.046 \times 10^{-3}\,\mathrm{m}$$