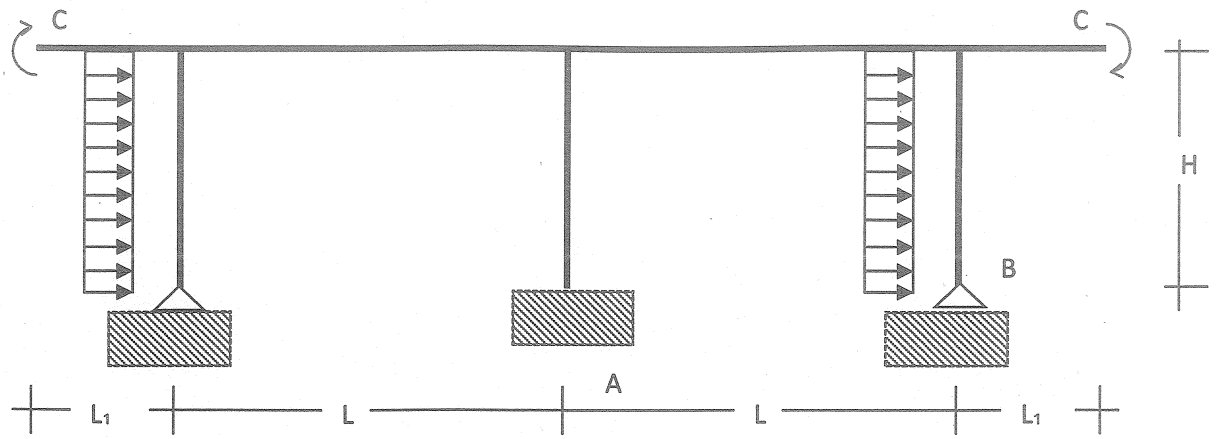
B

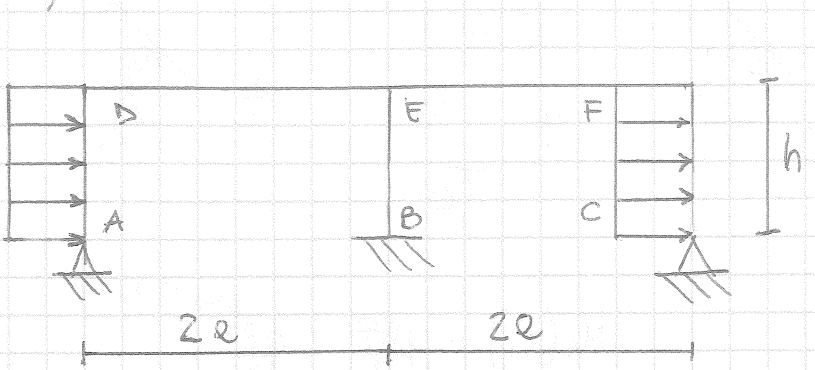


Si trascuri la deformabilità assiale della struttura.

1. Risolvere la struttura antisimmetrica in figura mediante il metodo delle forze avendo posto: L=8m, L_1=4 m, H=4 m, q=1000 N/m. In questa fase si ponga per semplicità la coppia C=0.
2. Si risolva la stessa struttura del caso 1 in cui avviene una rotazione oraria ϕ=0.01 rad in A avendo utilizzato per le travi un profilato in acciaio IPE 200 (E= 210000 MPa, J_x=1943 cm^4, J_y= 142.4 cm^4.
3. Determinare i coefficienti di cedevolezza nel caso 1 in cui si sia posto C=500 Nm ed L_1=4 m.

FILA B

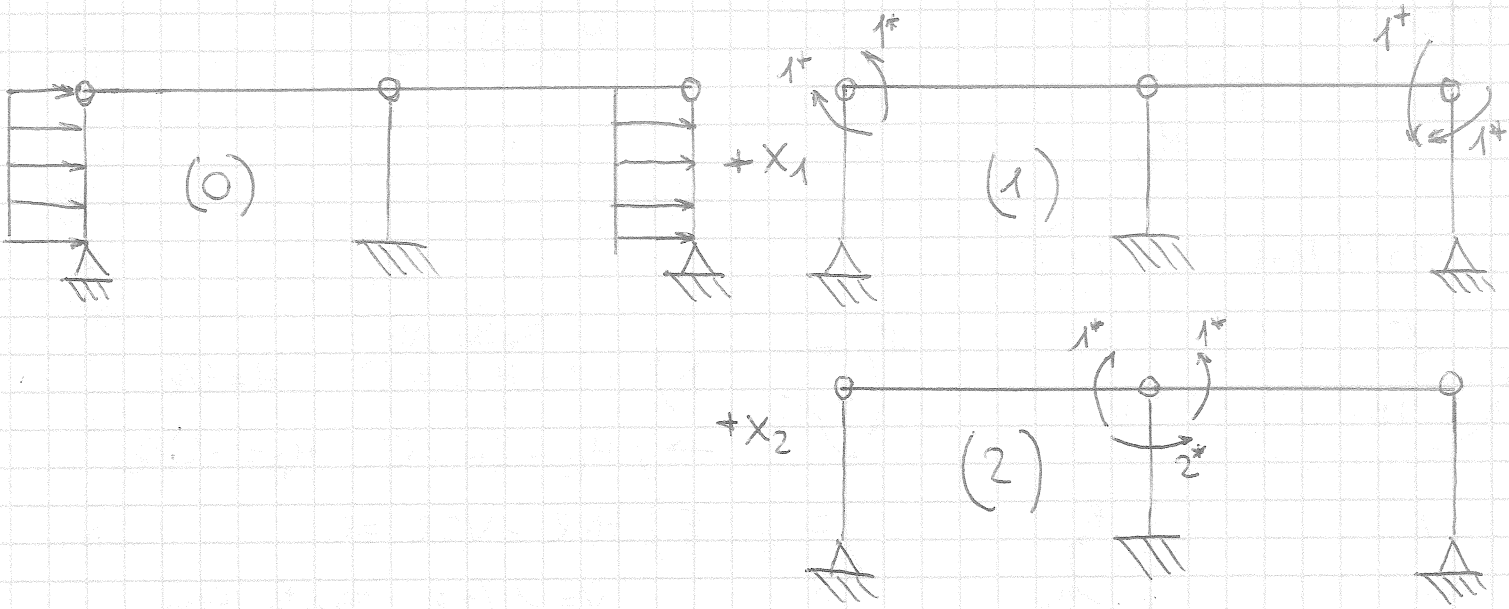
1)



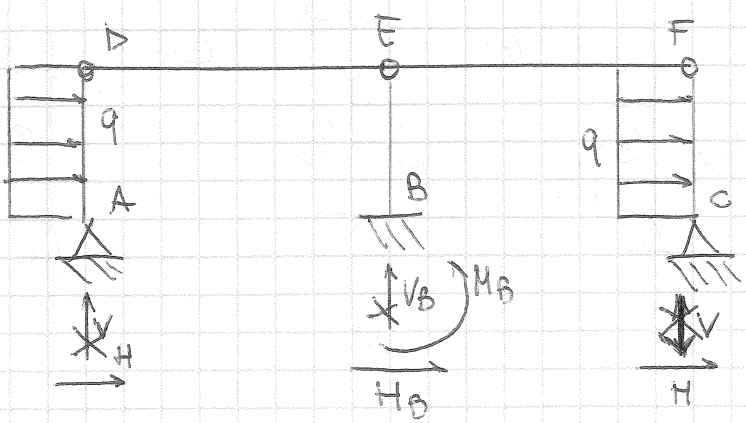
$2\ell = 8\,m$

$h = 4\,m = \ell$

$q = 1\,KN/m$



SISTEMA (0)



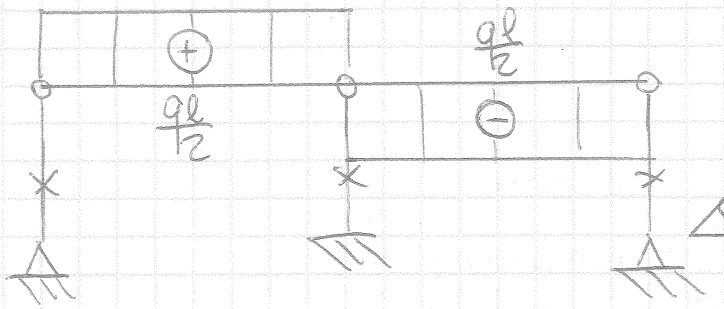
D) $\frac{q\ell^2}{2} + H\ell = 0$ tratto AD $\quad H = -\frac{q\ell}{2}$

→) $q\ell + q\ell - \frac{2q\ell}{2} + H_B = 0$

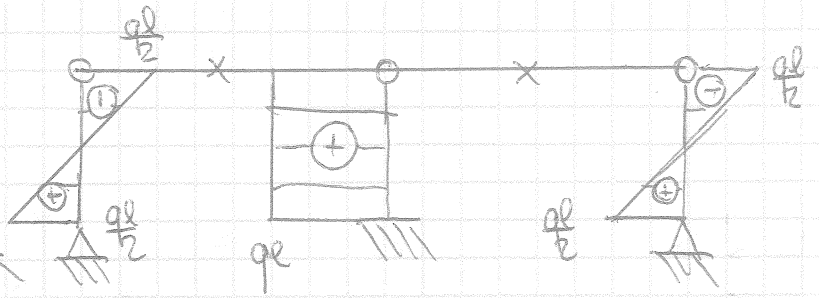
$H_B = -q\ell$

E) $-\frac{q\ell^2}{2} + M_B = 0$ tratto EB $\quad M_B = q\ell^2$

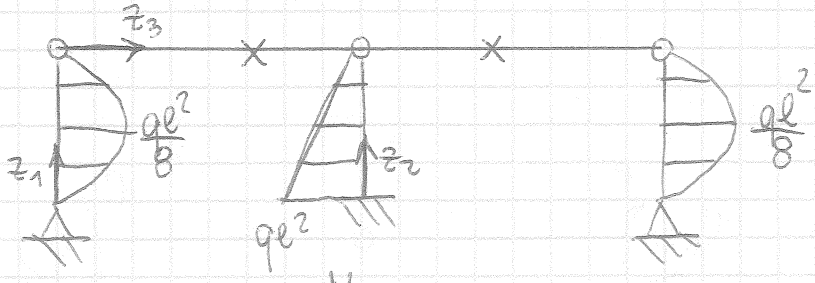
E) $V = 0 \quad V_B = 0$ tratto EB



N_0



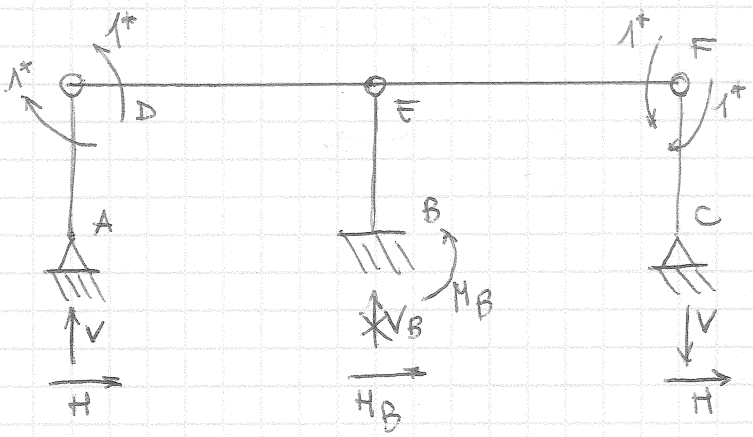
T_0



M_0

$$M_0(z_1) = \frac{q\ell z}{2} - \frac{qz^2}{2}$$
$$M_0(z_2) = q\ell^2 - q\ell z$$
$$M_0(z_3) = 0$$

SISTEMA (1)



tratto AD

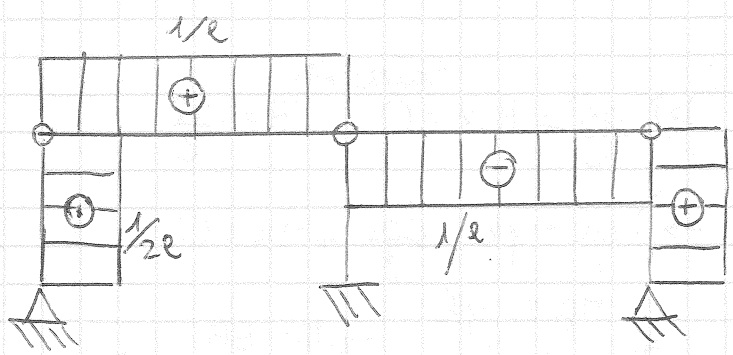
D↑ $-1 + H\cdot\ell = 0 \quad H = 1/\ell$

→ $H_B + 2H = 0 \quad H_B = -2/\ell$

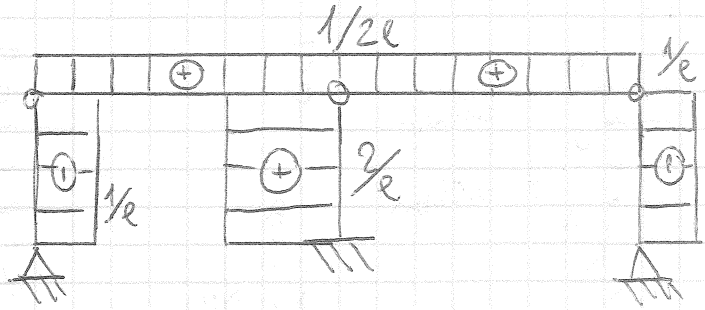
E↑ $H\cdot\ell - V2\ell = 0$

$V = 1/2\ell$ tratto EDA

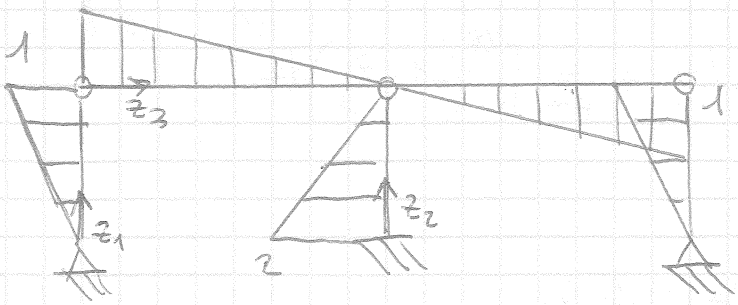
E↑ $H_B = 2$ tratto EB



N_1



T_0



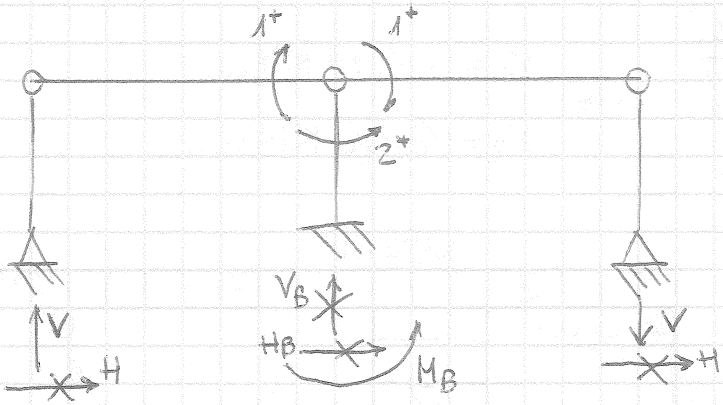
M_1

$M_1(z_1) = -\frac{z}{\ell}$

$M_1(z_2) = 2 - \frac{2}{\ell} z$

$M_1(z_3) = -1 + \frac{z}{2\ell}$

SISTEMA (2)

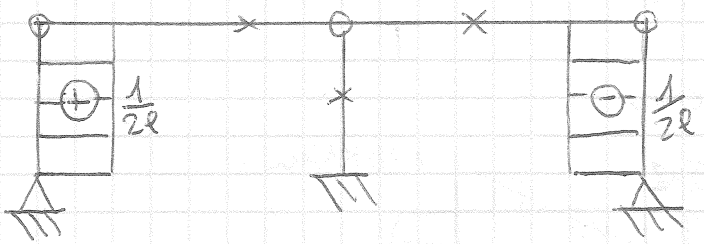


D↑ $H = 0$ tratto AD

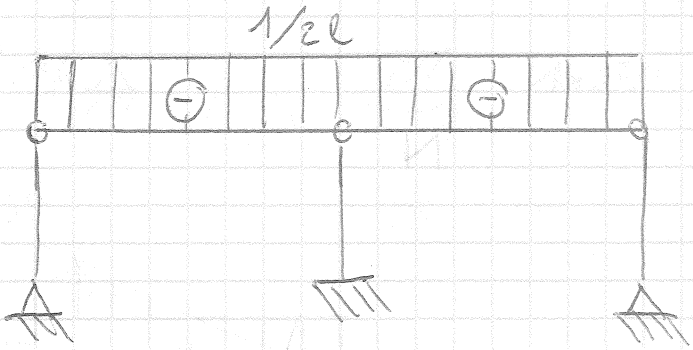
E↑ $-1 - 2V\ell = 0$ tratto EDA $\quad V = -1/2\ell$

→) $H_B = 0$

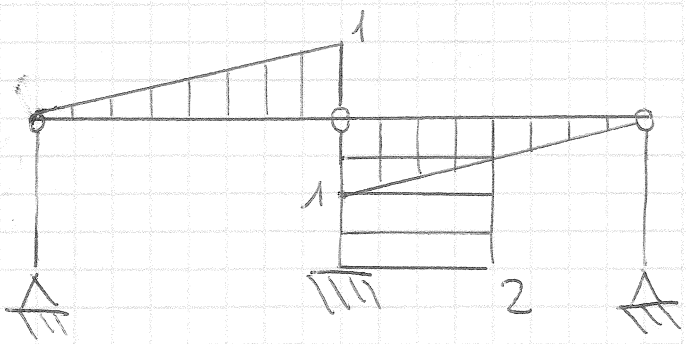
E↑ $2 + M_B = 0$ tratto EB $\quad M_B = -2$



N_2



T_2



$M_2(z_1) = 0$

$M_2(z_2) = -2$

$M_2(z_3) = -\frac{z}{2\ell}$

$$M_{10} = \frac{2}{EJ}\int_0^\ell \left(\frac{q\ell z}{2} - \frac{qz^2}{12}\right)\left(-\frac{z}{\ell}\right)dz + \frac{1}{EJ}\int_0^\ell \left(q\ell^2 - q\ell z\right)\left(2 - \frac{2z}{\ell}\right)dz = \frac{7}{12}\frac{q\ell^3}{EJ}$$

$$M_{20} = \frac{1}{EJ}\int_0^\ell \left(q\ell^2 - q\ell z\right)(-2)\,dz = -\frac{q\ell^3}{EJ}$$

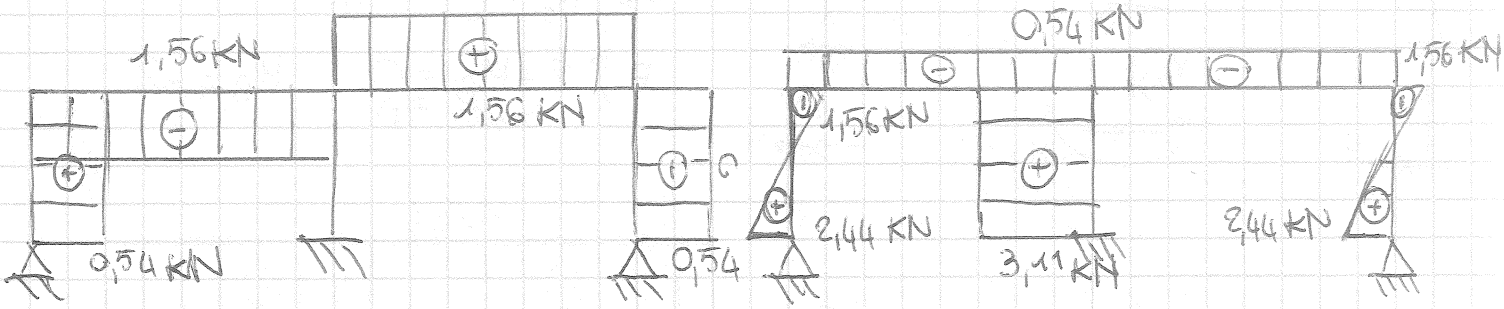
$$\eta_{11} = \frac{2}{EJ}\int_0^{\ell}\left(-\frac{z}{\ell}\right)^2 dz + \frac{1}{EJ}\int_0^{\ell}\left(2-\frac{2z}{\ell}\right)^2 dz + \frac{2}{EJ}\int_0^{2\ell}\left(-1+\frac{z}{2\ell}\right) dz$$

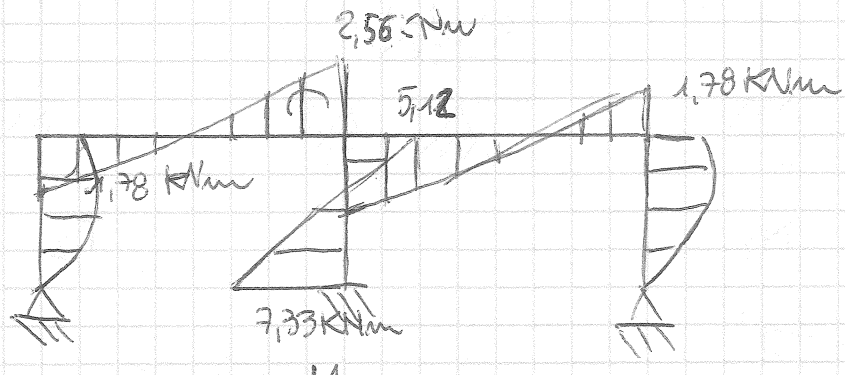
$$= \frac{10}{3}\frac{\ell}{EJ}$$

$$\eta_{22} = \frac{1}{EJ}\int_0^{\ell}(-2)^2 dz + \frac{2}{EJ}\int_0^{2\ell}\left(-\frac{z}{2\ell}\right)^2 dz = \frac{16}{3}\frac{\ell}{EJ}$$

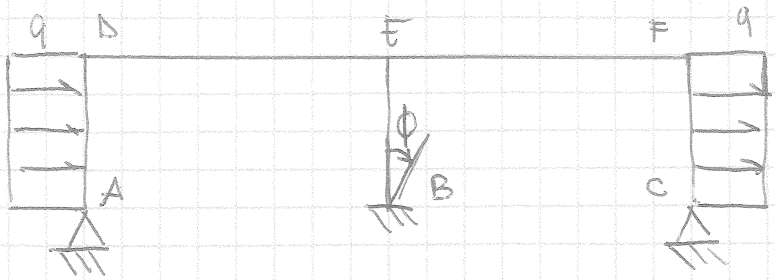
$$\eta_{12} = \frac{1}{EJ}\int_0^{\ell}(-2)\left(2-\frac{2z}{\ell}\right) dz + \frac{2}{EJ}\int_0^{2\ell}\left(-1+\frac{z}{2\ell}\right)\left(-\frac{z}{2\ell}\right) dz = -\frac{4}{3}\ell$$

$$\begin{cases} \frac{10}{3}\frac{\ell}{EJ}x_1 - \frac{4}{3}\frac{\ell}{EJ}x_2 = -\frac{7}{12}\frac{q\ell^3}{EJ} \\ -\frac{4}{3}\ell\frac{x_1}{EJ} + \frac{16}{3}\frac{\ell}{EJ}x_2 = -\frac{q\ell^3}{EJ} \end{cases} \rightarrow \begin{array}{l} x_1 = -1{,}77\ \text{KNm} \\ x_2 = 2{,}56\ \text{KNm} \end{array}$$





2)



$\phi = 0{,}01$ rad

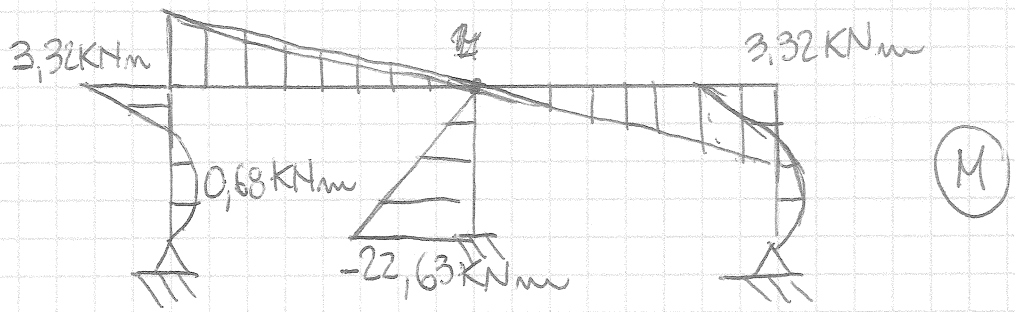
$E = 210000\ MPa = 2{,}1 \cdot 10^9\ kPa$

$J = 1943\ cm^4 = 1{,}943 \cdot 10^{-5}\ m^4$

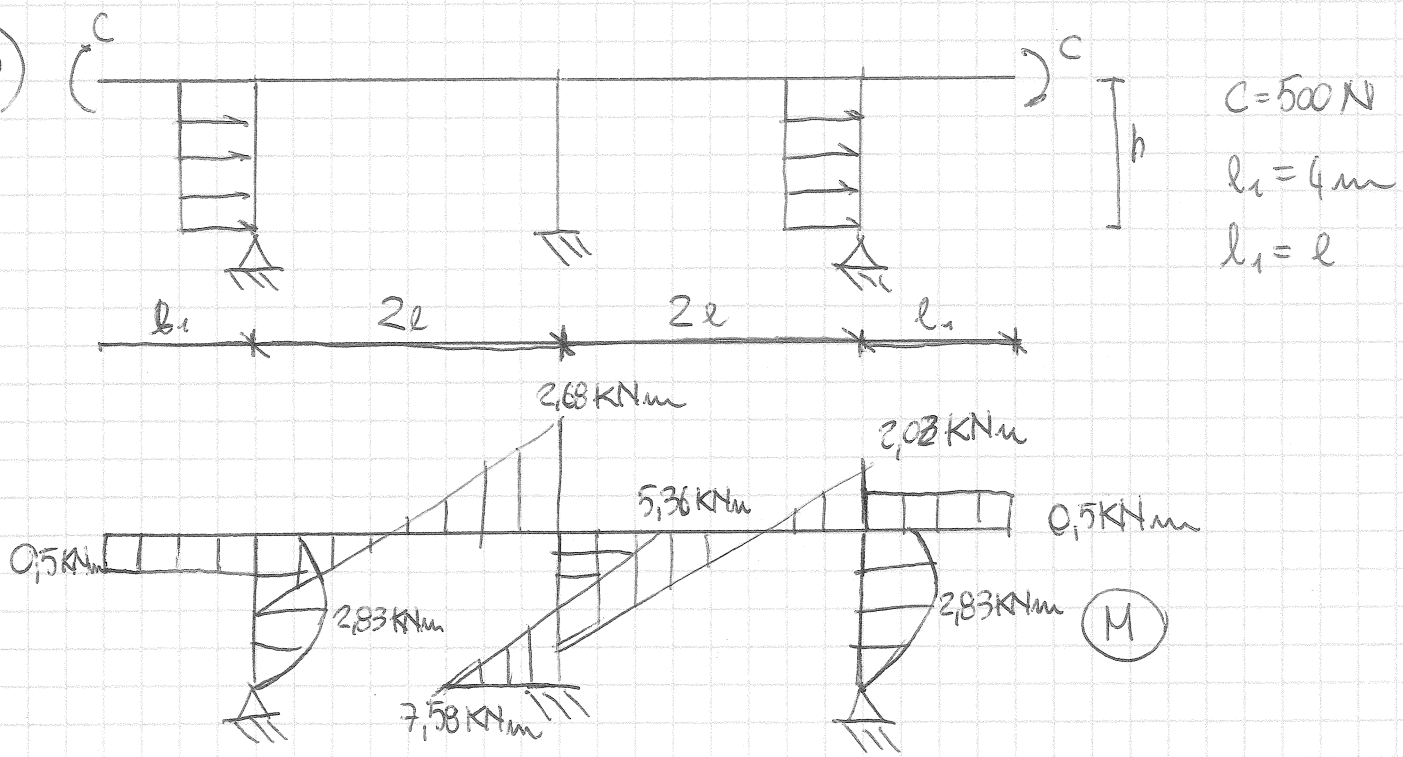
$$\begin{cases} \frac{10}{3}\frac{l}{EJ} x_1 - \frac{4}{3}\frac{l}{EJ} x_2 + \frac{7}{12}\frac{ql^3}{EJ} = 2 \cdot \phi \\ -\frac{4}{3}\frac{l}{EJ} x_1 + \frac{16}{3}\frac{l}{EJ} \cdot x_2 - \frac{ql^3}{EJ} = -2 \cdot \phi \end{cases}$$

$x_1 = 3{,}32\ KNm$

$x_2 = 0{,}0054\ KNm \cong 0\ KNm$



3)



$C = 500\ N$

$l_1 = 4\ m$

$l_1 = l$