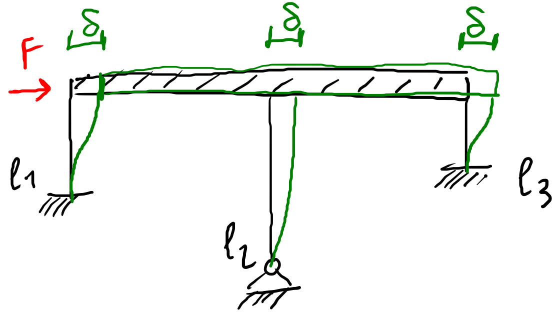
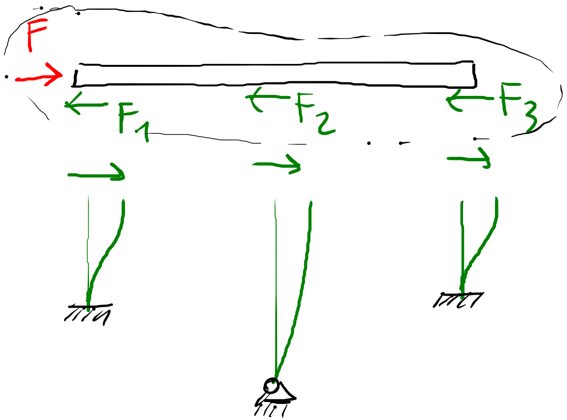
(PROSEGUIAMO CON IL METODO SPOST. ...) 23/4/24

RIPARTIZIONE AZIONI TELAIO CON TRAVE SHEAR-TYPE

(δ: UNICO GDL DEL PROBL.)



EI: cost



EQUIL. ORIZZ:

$$F - F_1 - F_2 - F_3 = 0 \Rightarrow \delta(F)$$

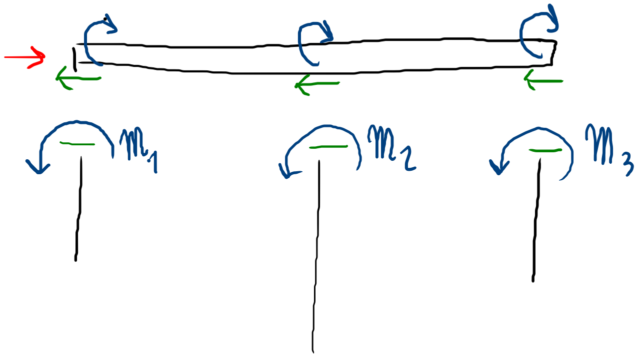
$$F - \frac{12EI}{l_1^3}\delta - \frac{3EI}{l_2^3}\delta - \frac{12EI}{l_3^3}\delta = 0$$

$$F = \underbrace{\left(\frac{12EI}{l_1^3} + \frac{3EI}{l_2^3} + \frac{12EI}{l_3^3}\right)}_{K_T\text{: RIGIDEZZA}}\delta \Rightarrow \delta = \frac{F}{K_T}$$

$$F_1 = \underbrace{\frac{12EI}{l_1^3}\frac{F}{K_T}}_{\rho_1} = \rho_1 F$$ COEFF DI RIP.

$$F_2 = \frac{3EI}{l_2^3}\frac{F}{K_T} = \rho_2 F$$

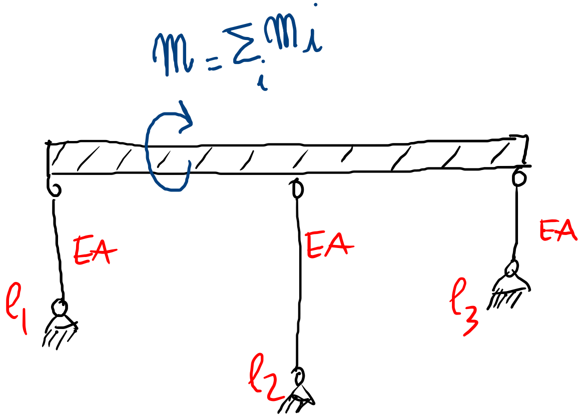
$$F_3 = \rho_3 F, \quad \rho_3 = \frac{12EI}{l_3^3}\frac{1}{K_T}$$

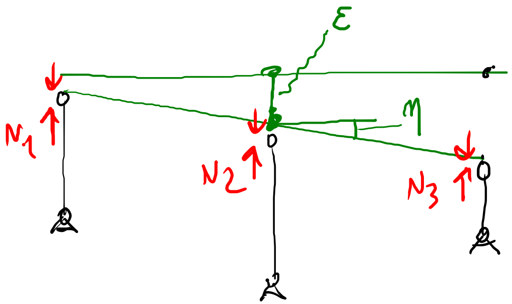


DOPO AVER RIPARTITO LA F CONOSCO:

- M, T di tutti i pilastri
- N nelle trave

SONO ANCORA INCOGNITI GLI SFORZI N dei pilastri (E QUINDI T DELLA TRAVE).





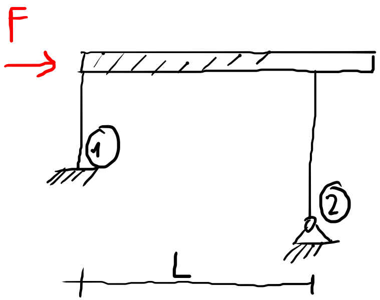
IMPOSTO UN PROBL. AGLI SPOST. DOVE CONSIDERO 2 GDL (ε, η) DELLA TRAVE (ESCLUSO TRASLAZ. ORIZZONTALE)

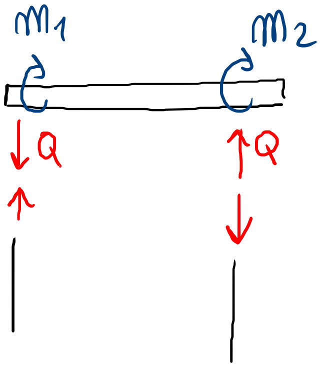
$N_1 = N_1(\varepsilon, \eta)$; $N_2 = N_2(\varepsilon, \eta)$; $N_3 = N_3(\varepsilon, \eta)$

LE 2 EQUAZ. PER DETERMINARE ε, η SONO:

- EQUIL. TRASL. VERTIC.
- EQUIL ROTAZ.

CASO PARTICOLARE (PROBL. STATIC. DETERMINATO PER GLI N_i)





$N_1 = +Q$ $\quad$ $N_2 = -Q$

$$Q = \frac{m_1 + m_2}{L}$$

OSSERVAZIONE

FORZA-MOMENTO APPL.

— PROBL. AGLI SPOST. CON 1 GDL: $F = K\delta$

RIGIDEZZA

GDL SPOST-ROTAZ

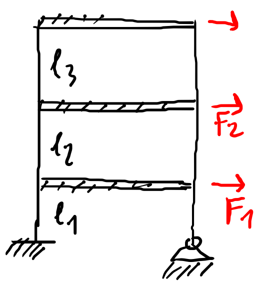
— " " " CON $N>1$ GDL: $\underset{\sim}{K}\,\underline{q} = \underline{F}$

MAT. RIGIDEZZA

VETTORE FORZE APPLIC.

COSTRUZ. DELLA $\underset{\sim}{K}$: DAL PUNTO DI VISTA OPERATIVO LA COMPONENTE K_{ij} CORRISPONDE ALLA FORZA CORRELATA ALLO SPOSTAMENTO i-ESIMO QUANDO IL GDL j-ESIMO VALE 1 E TUTTI I RESTANTI GDL SONO NULLI.

ESEMPIO



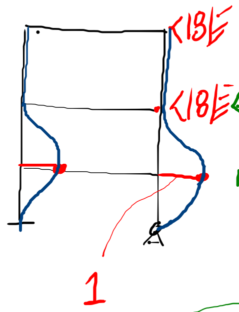
EI cost

$\underset{\sim}{K}\,\underline{q} = \underline{F}$ $\rightarrow$ $\underline{q} = \underset{\sim}{K}^{-1}\,\underline{F}$

$\underline{q} = \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix}$

$\underset{\sim}{K} = \begin{bmatrix} 3\times3 \end{bmatrix}$; $\underline{F} = \begin{bmatrix} F_1 \\ F_2 \\ F_3 \end{bmatrix}$

$\boxed{q_1=1,\ q_2=q_3=0} \Rightarrow K_{11},\ K_{21},\ K_{31}$

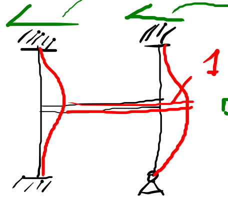


K_{31}, K_{21} REAZ. VINC. "AUSILIARIE" $= 0$

K_{11} FORZA CHE INDUCE $q_1 = 1$

$\boxed{K_{11}}$

$\boxed{K_{21}}$



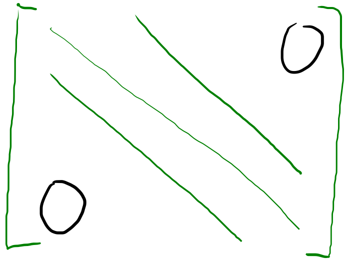
$K_{21} = -2\cdot 12\frac{EI}{\ell_2^3}1$ è DISCORDE RISPETTO a q_2

$\Rightarrow \frac{12EI}{\ell_1^3}1 + 3\frac{EI}{\ell_1^3}1 + 2\left(\frac{12EI}{\ell_2^3}\right)1 = K_{11}$

SPOST. $q_1 = 1$

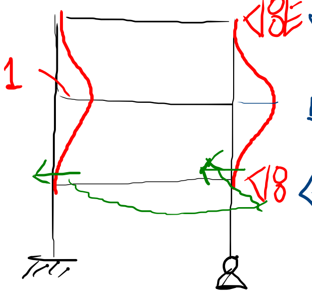
$$\underset{\sim}{K} = \begin{bmatrix} \frac{15EI}{\ell_1^3} + \frac{24EI}{\ell_2^3} & -24\frac{EI}{\ell_2^3} & 0 \\ -\frac{24EI}{\ell_2^3} & 24EI\left(\frac{1}{\ell_2^3}+\frac{1}{\ell_3^3}\right) & -24EI/\ell_3^3 \\ 0 & -24EI/\ell_3^3 & 24EI/\ell_3^3 \end{bmatrix}$$

è SIMMETRICA!!



TELAI SHEAR-TYPE: MATRICE TRIDIAGONALE

$\boxed{q_2 = 1,\ q_1 = q_3 = 0}$

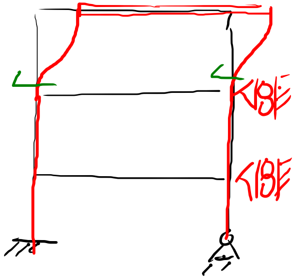


$K_{32} = -24\frac{EI}{\ell_3^3}$

$K_{22} \quad \frac{24EI}{\ell_2^3} + \frac{24EI}{\ell_3^3}$

$K_{12} = -24\frac{EI}{\ell_2^3}$

$\boxed{q_1 = q_2 = 0,\ q_3 = 1}$



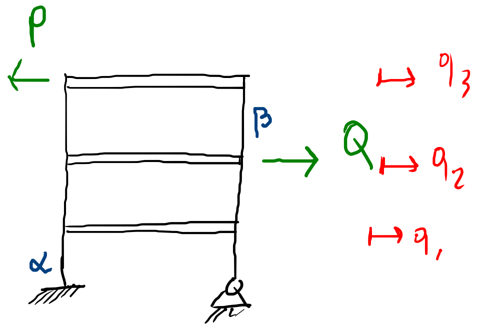
$(12+12)$

$K_{33} = 24\frac{EI}{\ell_3^3}$

$K_{23} = -24EI/\ell_3^3$

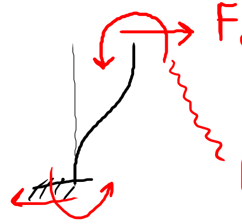
$K_{13} = 0$

ESEMPIO DI UTILIZZO DELLA $\underset{\sim}{K}$ OTTENUTA:



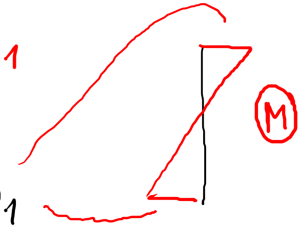
$$\underbrace{\begin{bmatrix} & & \\ & 3\times 3 & \\ & & \end{bmatrix}}_{\underset{\sim}{K}} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \end{bmatrix} = \begin{bmatrix} 0 \\ Q \\ -P \end{bmatrix} \; ; \quad \underline{q} = \underset{\sim}{K}^{-1} \begin{bmatrix} 0 \\ Q \\ -P \end{bmatrix} \rightarrow \begin{array}{l} q_1 > 0 \\ q_2 > 0 \\ q_3 > 0 \end{array}$$

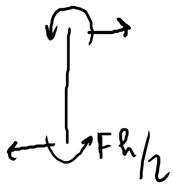
PILASTRO α



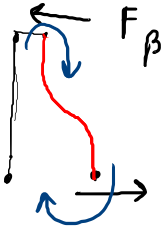
$$F_\alpha = \frac{12EI}{l_1^3} q_1$$

$$M_\alpha = \frac{6EI}{l_1^2} q_1$$



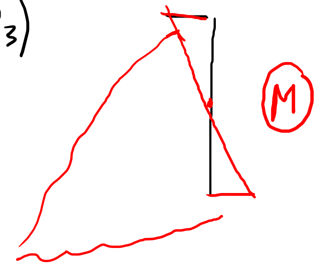


PILASTRO β

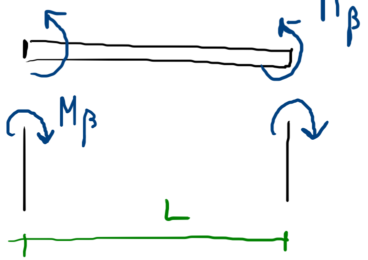


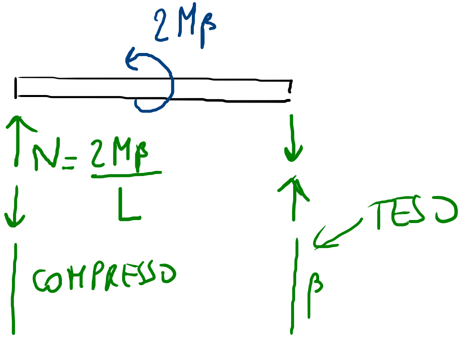
$$F_\beta = \frac{12EI}{l_3^3}(q_2 - q_3)$$

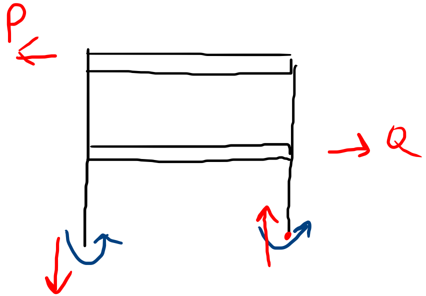
$$M_\beta = 6EI/l_3^2 \, (q_2 - q_3)$$



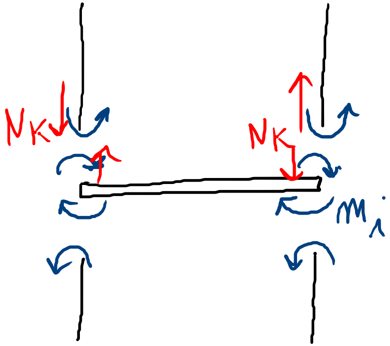
N del pilastro β



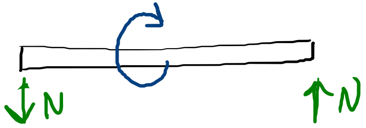




N del pilastro α



$m = \sum_i m_i + N_K L$



OCCORRE TENERE CONTO DEI MOMENTI AI PIEDI DEI PILASTRI SUPERIORI E DEI N_K DEI PILASTRI CHE ARRIVANO DA SOPRA