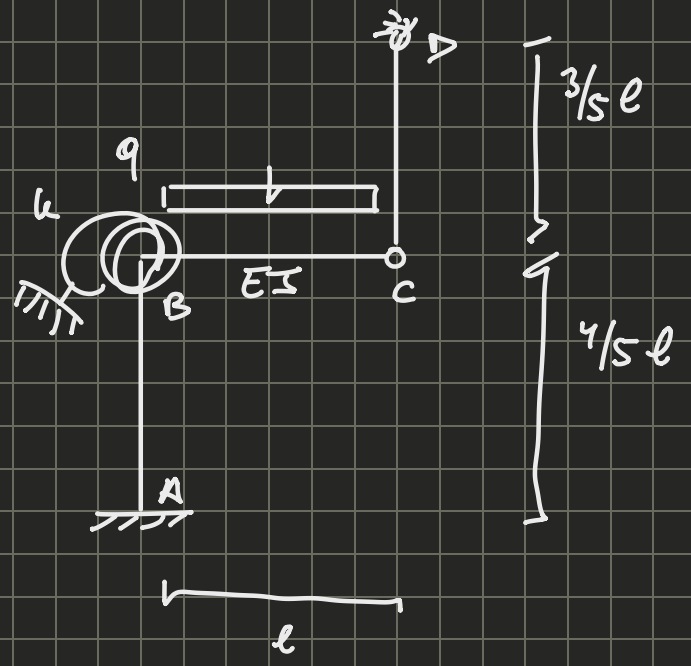
Esercitazione 7 -

Esercizio 1



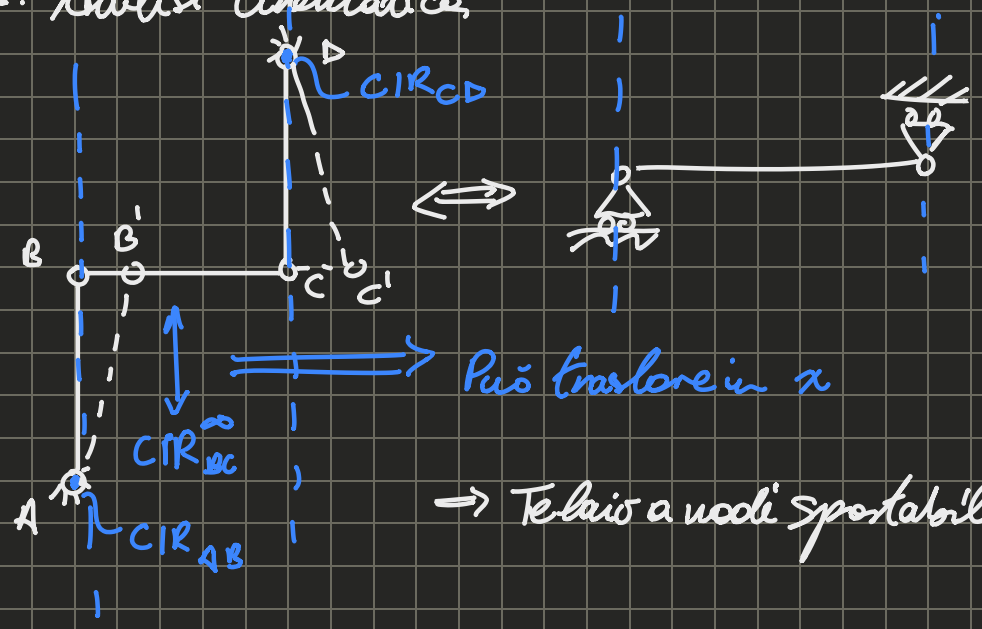
$EA \to \infty$

$GA^* \to \infty$

$k = \frac{3EJ}{2\ell}$

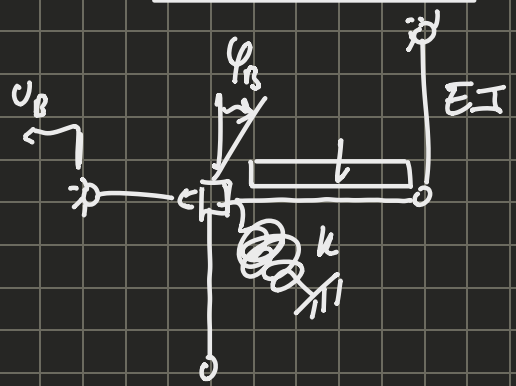
MdS

1. Analisi Cinematica



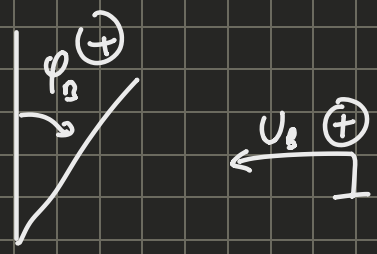
→ Telaio a nodi spostabili

Schema di calcolo

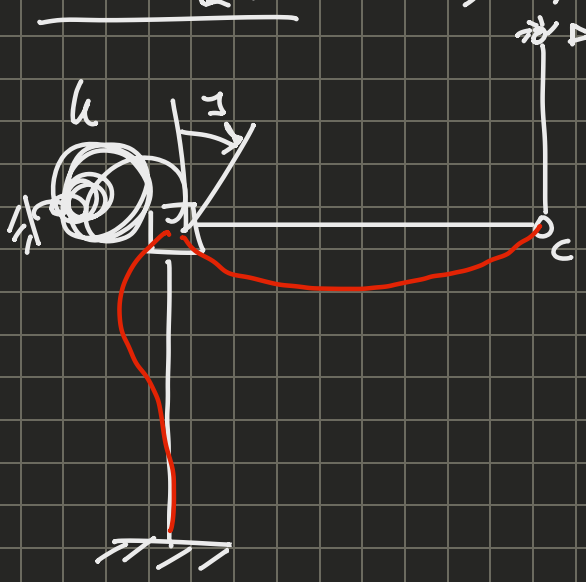


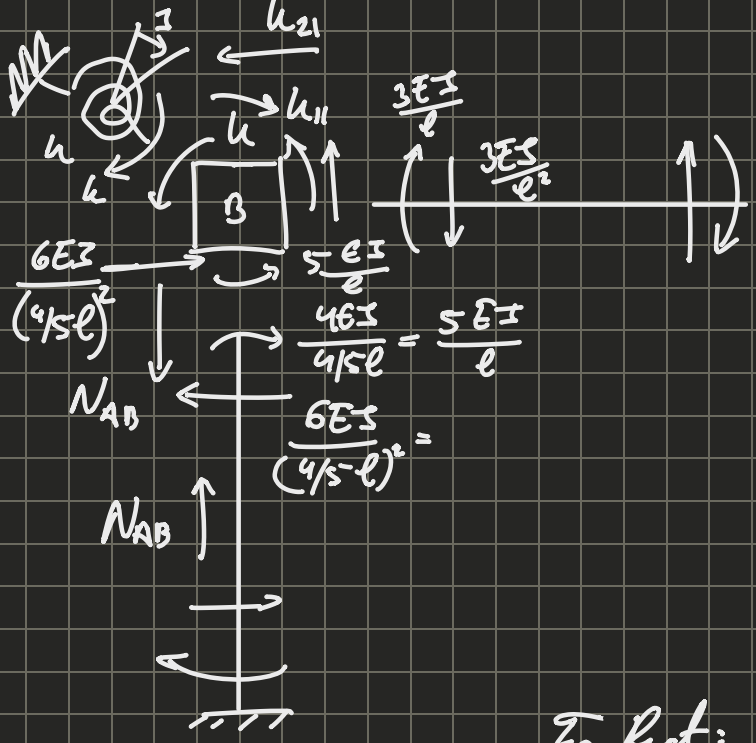
$\underline{U} = [\varphi_B, U_B]^T$

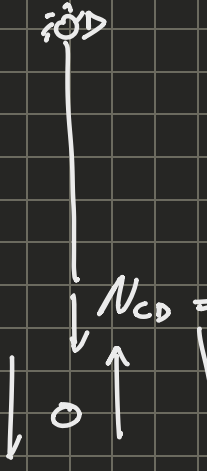
$= [U_1, U_2]$



Struttura "1" $\quad \varphi_1 = 1,\ q = 0,\ U_B = 0$







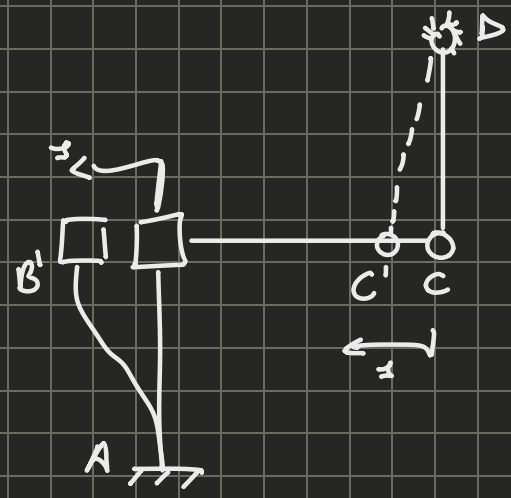
$M = k_r \Delta\varphi = k_r \cdot 1 = k_r$

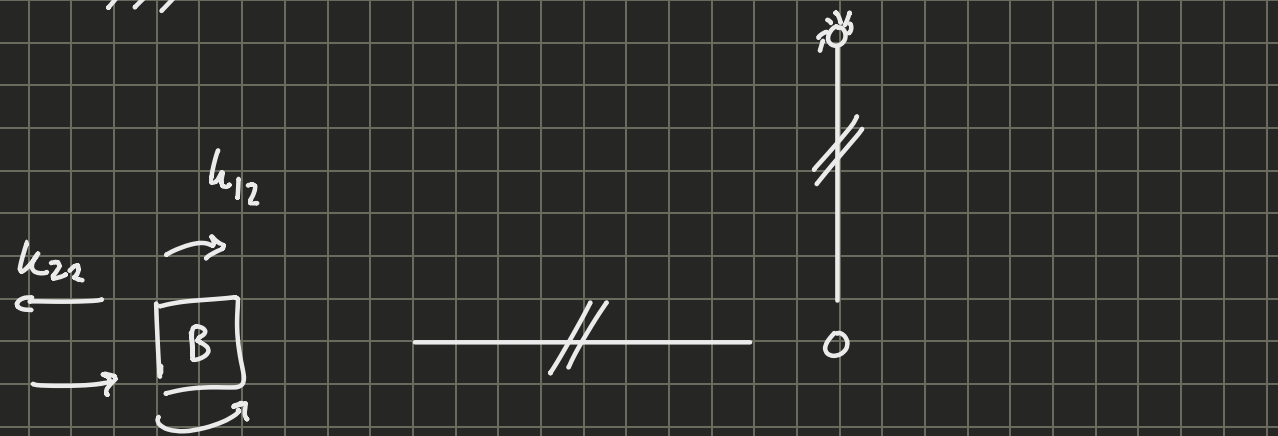
$N_{AB} = N_{CD} = \frac{3EI}{\ell^2}$

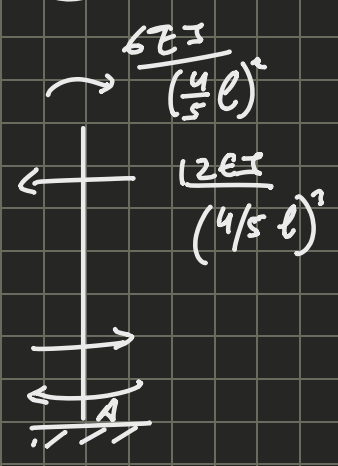
Eq. Rot: $\quad \frac{3EI}{\ell} + \frac{5EI}{\ell} + k = k_{11} = \frac{19EI}{2\ell}$

Eq. F_x $\quad k_{21} = \frac{6EI}{\left(\frac{4}{5}\ell\right)^2} = \frac{75EI}{8\ell^2}$

Struttura "2" $v_B = 1$, $\varphi_B = 0$, $q = 0$



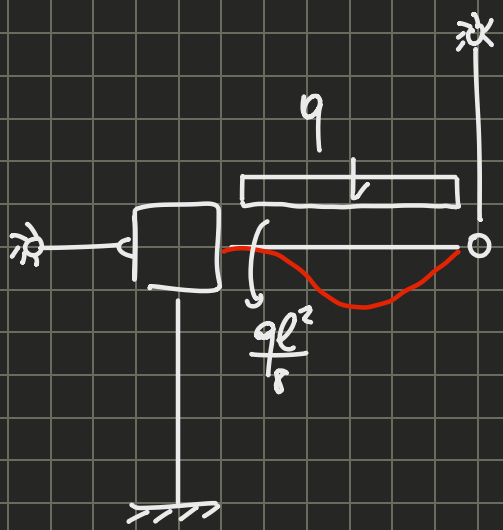




$$k_{12} = \frac{6EJ}{(4/5\,\ell)^2} = \frac{75EJ}{8\ell^2} = k_{21} \checkmark$$

$$k_{22} = \frac{12EJ}{(4/5\,\ell)^3} = \frac{375}{16}\frac{EJ}{\ell^3}$$

Struttura "0" $q \neq 0$



$P_2 = 0$

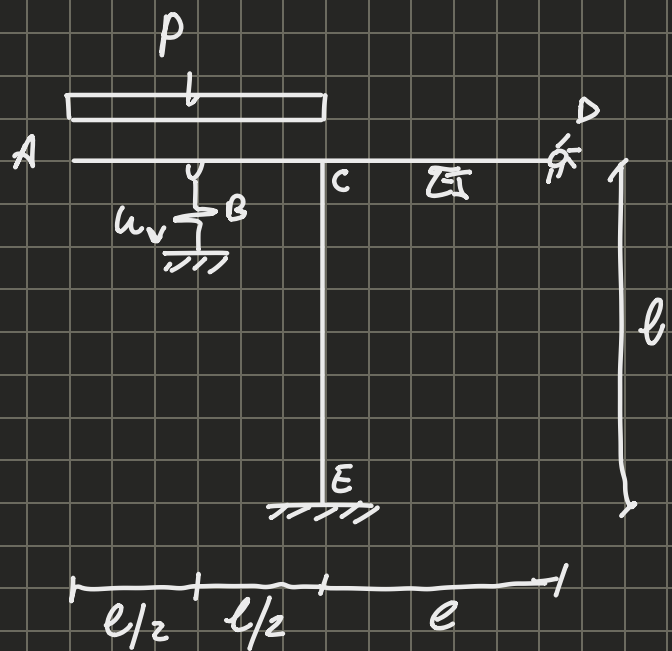
$P_1 = -\frac{q\ell^2}{8}$

Facciamo i diagrammi uscì da soli

Tot E 23/01/2023 Esercizio 2 → MdS fatto nell'ultimo tutorato

Esercizio 1 → MdCF

Esercizio 1.1

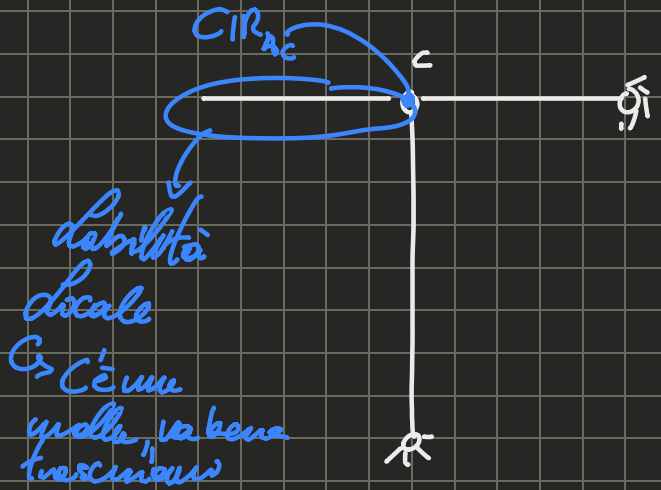


$u_v = \frac{ES}{\ell^3}$

MdCF

Tracciare cinematismo e tagliare su ABC

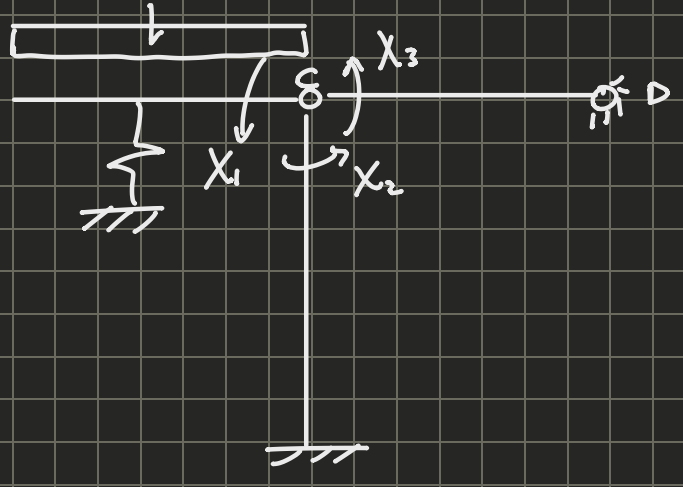
1. Analisi Cinematica



EC D → ABC non allineato ⇒ non labile

⟹ struttura a vincoli fissi

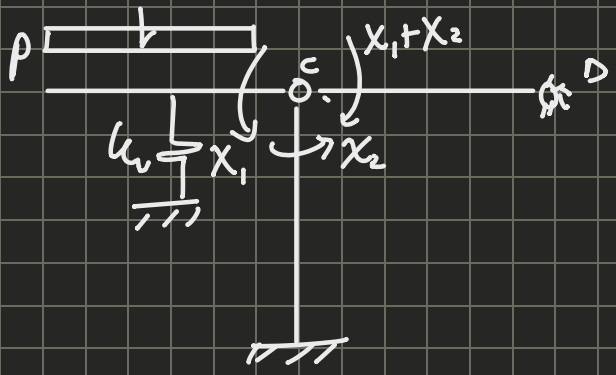
Torsione con MdF



Equilibrio Rot in C

$$X_1 + X_2 + X_3 = 0$$

$$\Rightarrow X_3 = -(X_1 + X_2)$$



Struttura "Iso" principale

$$\underline{X} = [X_1, X_2]^T$$

Il pilastro è scarico quindi

Equazioni di congruenza

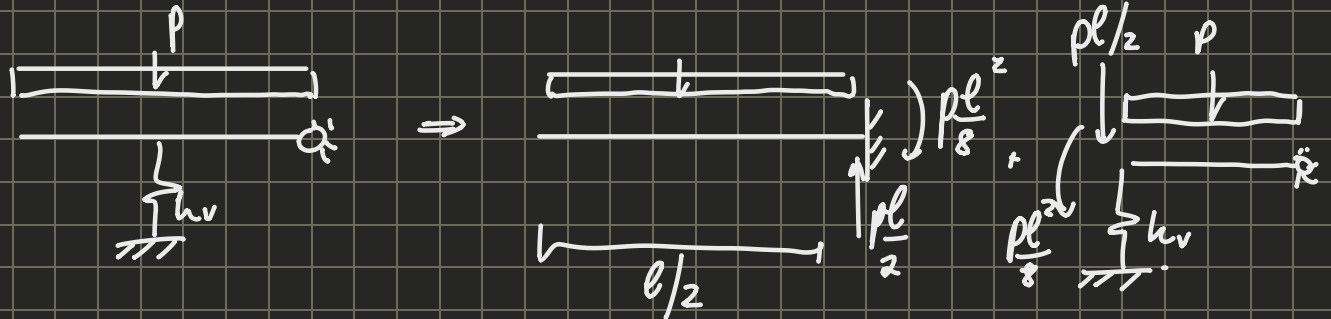
$$\Delta\varphi_{\hat{ACD}} = 0$$

$$\Delta\varphi_{\hat{ECD}} = 0$$

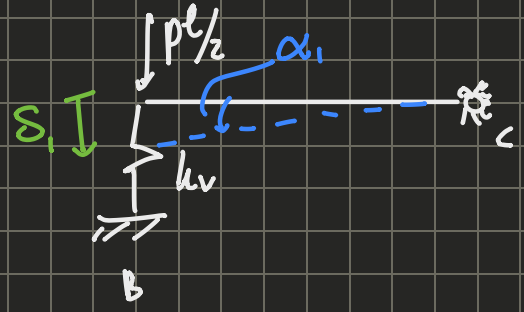
→ Associato a X_1

→ Associato a X_2

Struttura "0" $(p \neq 0,\ X_1 = X_2 = 0)$



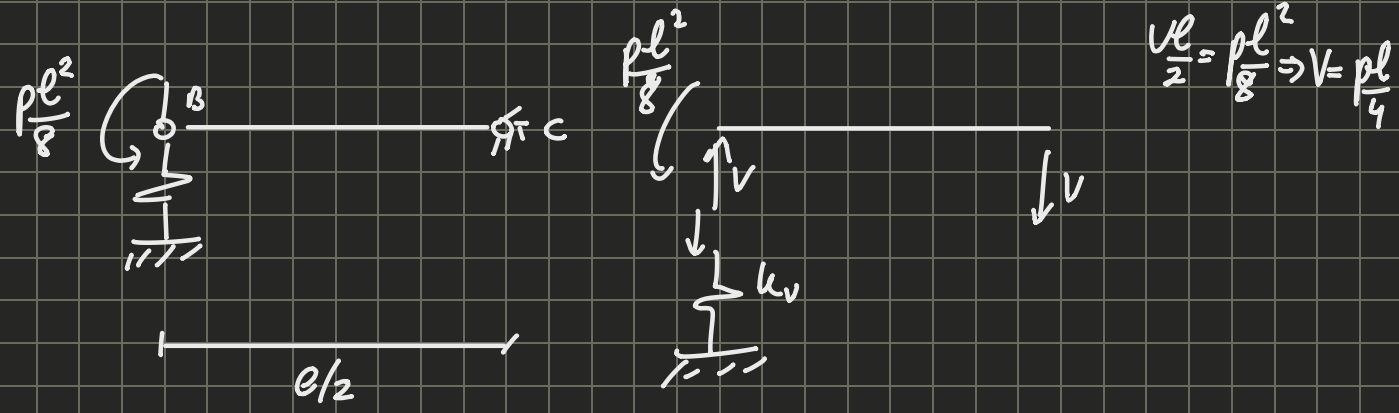
Caso 1: Effetto T dello sbalzo AB



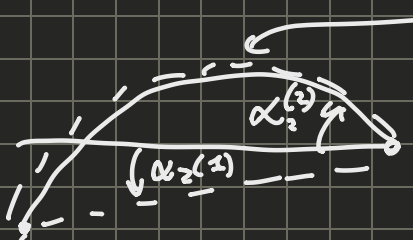
$$\delta_1 = \frac{pl}{2} \cdot \frac{1}{k_v} =$$

$$\alpha_1 = \frac{\delta_1}{l/2} = \frac{2}{l} \frac{pl}{2} \cdot \frac{1}{k_v} = \frac{p}{k_v} = \frac{pl^3}{8EI}$$

Caso 2: Effetto effetto di M dello sbalzo AB



$$\frac{Vl}{2} = \frac{pl^2}{8} \Rightarrow V = \frac{pl}{4}$$



Per il momento che tende a fibre l'asse in alto.

Per lo stesso abbassato per la molla.

$$\delta_2 = \frac{V}{k_v} = \frac{pl}{4k_v}$$

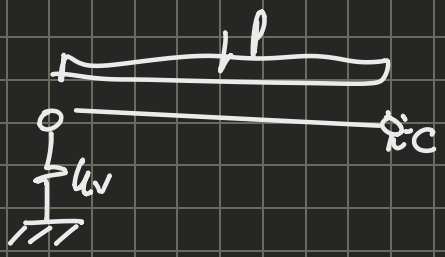
$\alpha_2^{(1)}$ effetto di δ_2 $\quad \alpha_2^{(2)}$ effetto di EI

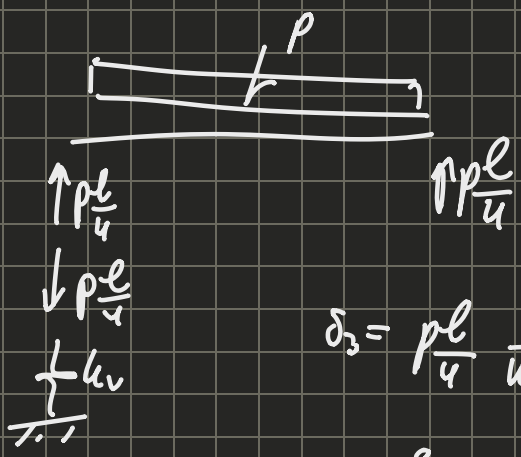
$$|\alpha_2^{(1)}| = \frac{\delta_2}{\frac{l}{2}} = \frac{2}{l} \cdot \frac{l}{4} \cdot \frac{p}{k_v} = \frac{pl^3}{24EI}$$

$$\alpha_2^{(2)} = \frac{l/2}{6EI} \cdot p\frac{l^2}{8} = \frac{pl^3}{96EI}$$

$$\alpha_2 = \alpha_2^{(1)} - \alpha_2^{(2)} = \frac{p\ell^3}{2EJ} - \frac{p\ell^3}{96EJ} = \frac{47}{96}\frac{p\ell^3}{EJ}$$

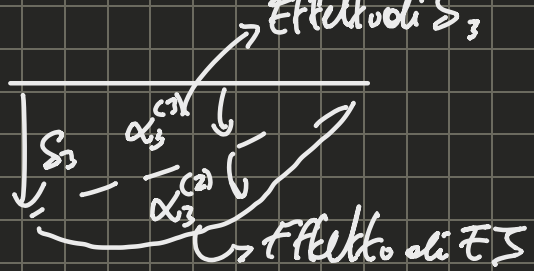
Caso 3 Effetto P





$$\delta_3 = p\frac{\ell}{4}\frac{1}{u_V}$$

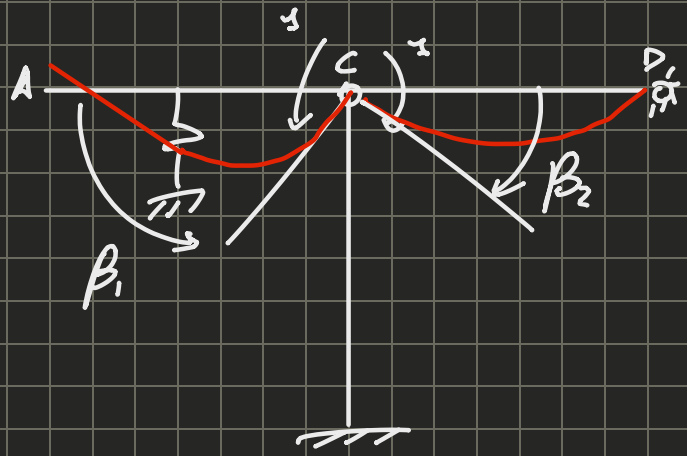
$$\alpha_3^{(1)} = \frac{\delta_3}{\frac{\ell}{2}} = \frac{p}{2u_V}$$



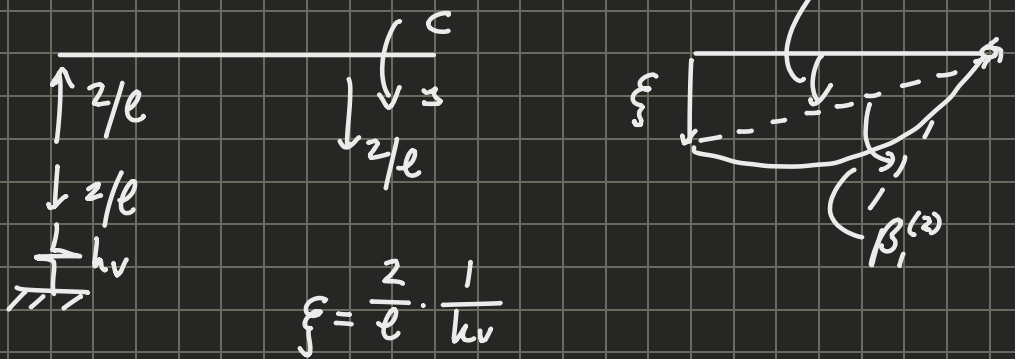
$$\alpha_3^{(2)} = \frac{p\left(\frac{\ell}{2}\right)^3}{24EJ} = \frac{1}{192}\frac{p\ell^3}{EJ}$$

$$\alpha_0 = \alpha_1 + \alpha_2 + \alpha_3 = \left(1 + \frac{47}{96} + \frac{97}{192}\right)\frac{p\ell^3}{EJ}$$

Struttura "3" $X_1 = 1$, $X_2 = 0$, $p = 0$



Calcolo di β_1:



$$\xi = \frac{z}{\ell} \cdot \frac{1}{h_v}$$

$$\beta_1^{(z)} = \frac{\xi}{\ell/2} = \frac{z}{\ell} \cdot \frac{1}{h_v} \cdot \frac{z}{\ell} = \frac{4}{h_v} \cdot \ell^2 = \frac{4\ell}{EI}$$

$$\beta_2 = \frac{\ell/2}{3EI} = \frac{\ell}{6EI}$$

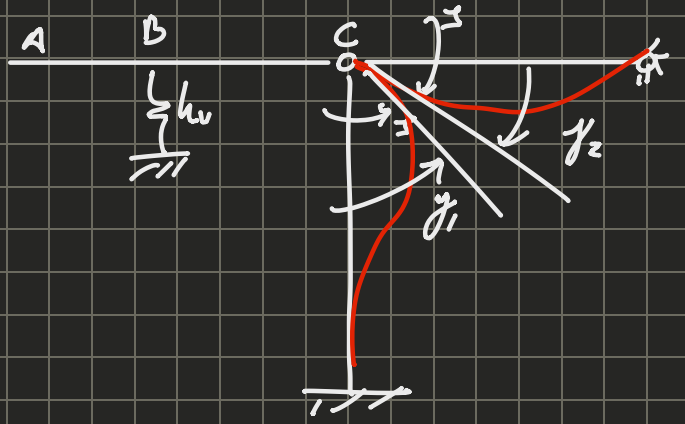
(↑ Tabelle)

$$\beta_1 = \beta_1^{(z)} + \beta_1^{(2)} = \frac{25\ell}{6EI}$$

$$\beta_2 = \frac{\ell}{3EI}$$

(↑ Tabelle)

Struttura "2" $X_2 = 1$, $X_1 = 0$, $p = 0$



$$\gamma_1 = \frac{\ell}{4EI}$$

$$\gamma_2 = \frac{\ell}{3EI} = \beta_2$$

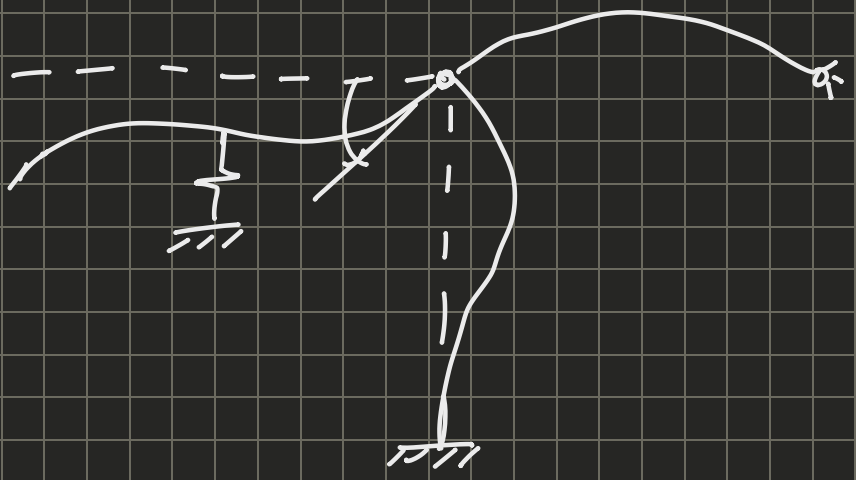
Equazioni Risolventi:

$$\begin{cases} \Delta\varphi_{B\hat{C}D} = 0 \\ \Delta\varphi_{E\hat{C}D} = 0 \end{cases} \qquad \begin{aligned} &(\beta_1+\beta_2)X_1 + \gamma_2 \cdot X_2 + \alpha_0 = 0 \\ &\beta_2 X_1 + (\gamma_1+\gamma_2)X_2 = 0 \end{aligned}$$

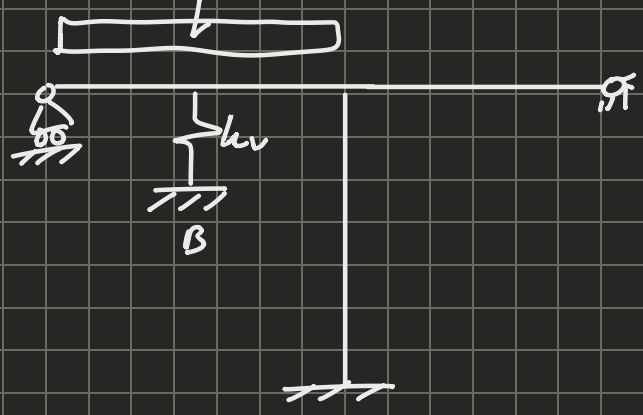
$\longrightarrow X_1, X_2$ da ricavare noi

$$\underline{\underline{\eta}}\,\underline{X} + \underline{\eta}_0 = \underline{0}$$

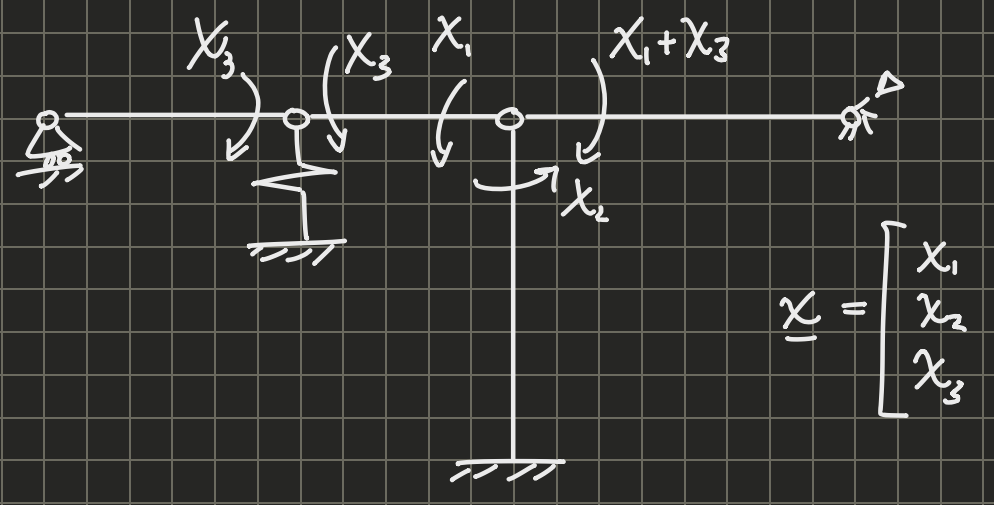
Deformata Qualitativa



Esercizio 1,2

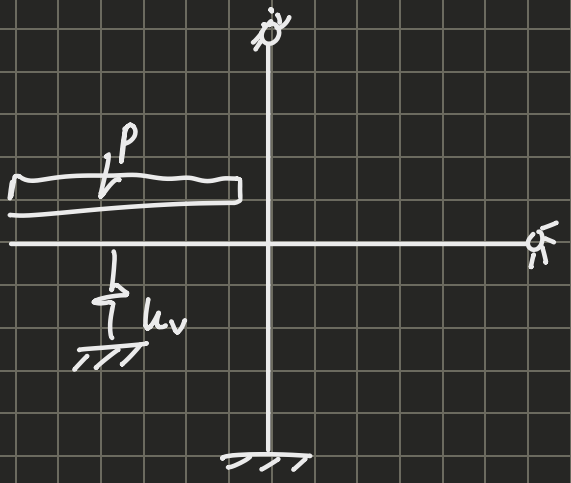


Si svincola sia in B che C.



$$\underline{X} = \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$

Esempio 1.3



Sconnesso in C