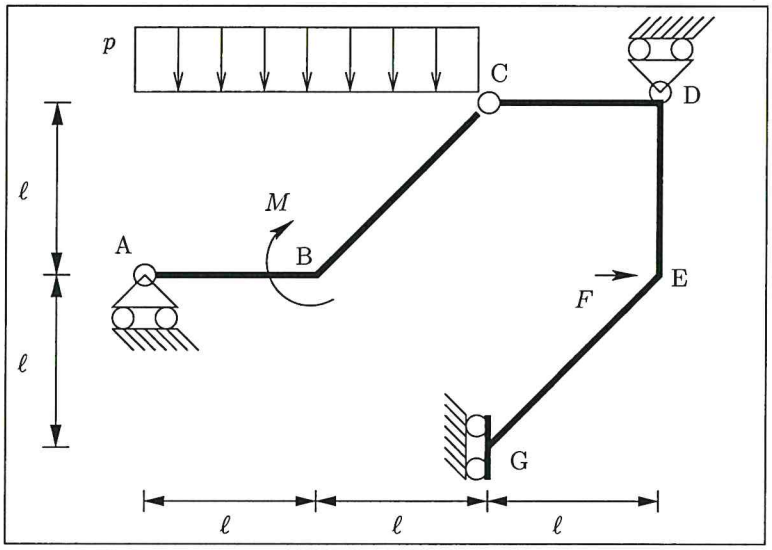
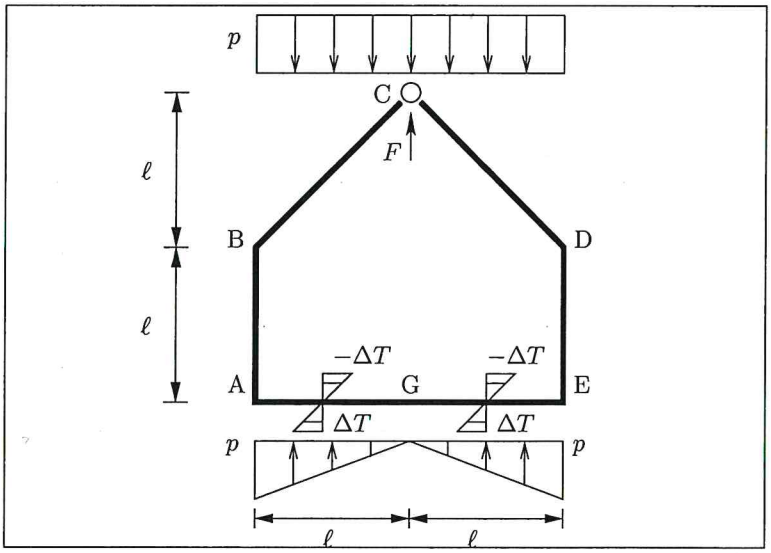
Statica - Ingegneria Civile e Ambientale - Prof. Daniele Zulli

APPELLO DEL 27/1/2025 - DURATA 3 ORE

Esercizio 1: Scrivere e diagrammare le leggi di variazione delle caratteristiche di sollecitazione per la struttura in figura, nel caso in cui sia $F = p\ell$ e $M = p\ell^2$. Calcolare la rotazione della sezione in D, noto EI e per $EA \to +\infty$.



Esercizio 2: Diagrammare le caratteristiche di sollecitazione per la struttura in figura nel caso in cui sia $F = p\ell$, $EA \to +\infty$, $\Delta T = \frac{p\ell^2 h}{\alpha EI}$ sul tratto AE.



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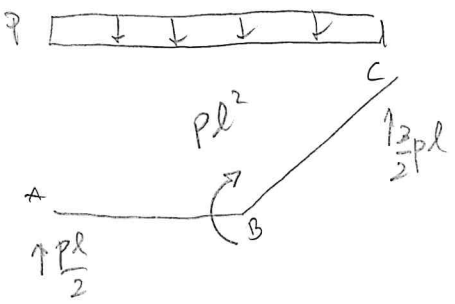
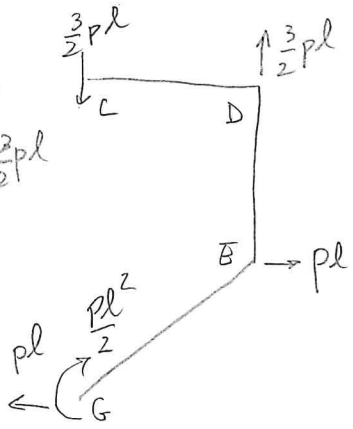
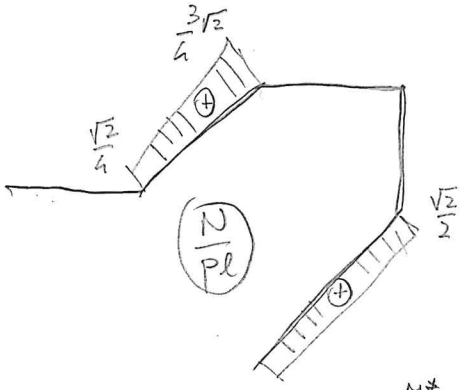
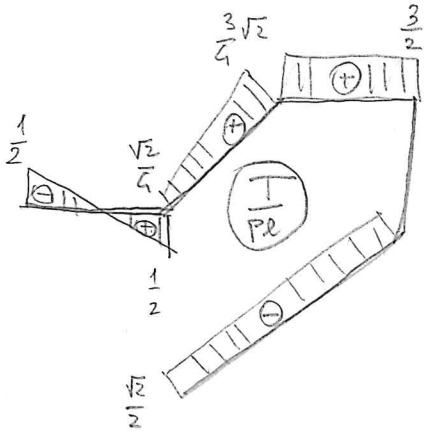
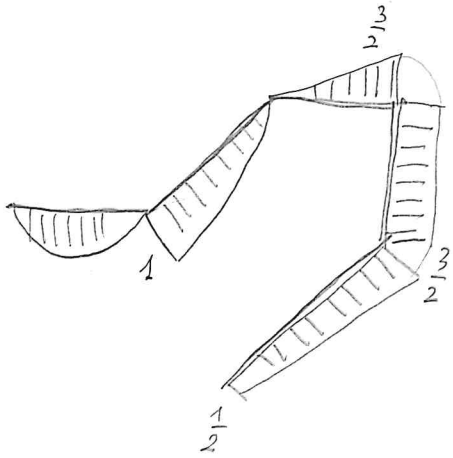




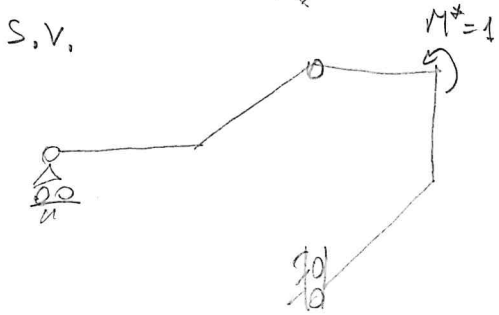
TRAVO	LUNG.	N	T	M
AB	l	0	$-\frac{pl}{2}+px$	$\frac{pl}{2}x-\frac{px^2}{2}$
BC	$l\sqrt{2}$	$\frac{\sqrt{2}}{4}pl+\frac{px}{2}$	$\frac{pl\sqrt{2}}{4}+\frac{px}{2}$	$pl^2-\frac{pl\sqrt{2}}{4}x-\frac{px^2}{4}$
CD	l	0	$\frac{3}{2}pl$	$-\frac{3}{2}plx$
DB	l	0	0	$-\frac{3}{2}pl^2$
GE	$l\sqrt{2}$	$\frac{\sqrt{2}}{2}pl$	$-\frac{pl\sqrt{2}}{2}$	$\frac{pl^2}{2}+\frac{pl\sqrt{2}}{2}x$

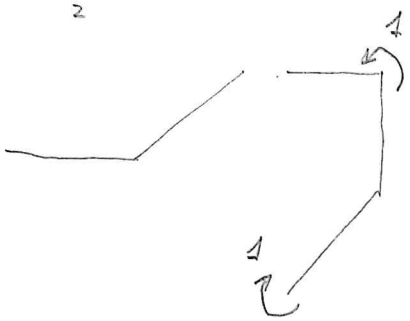






S.V.





$M^*_{DB}(x) = -1$

$M^*_{GB}(x) = 1$

altrove $M^*(x) = 0$

$$\varphi_D = \frac{1}{EI}\left[\int_0^l (-1)\left(-\frac{3}{2}pl^2\right)dx + \int_0^{l\sqrt{2}} (1)\left(\frac{pl^2}{2} + pl\frac{\sqrt{2}}{2}x\right)dx\right] = \left(\frac{3}{2}+\sqrt{2}\right)\frac{pl^3}{EI}$$

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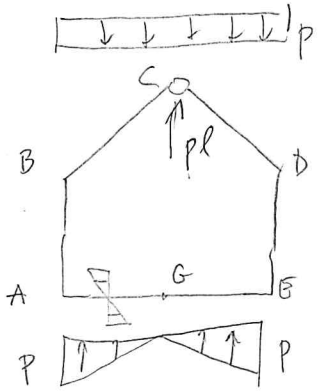
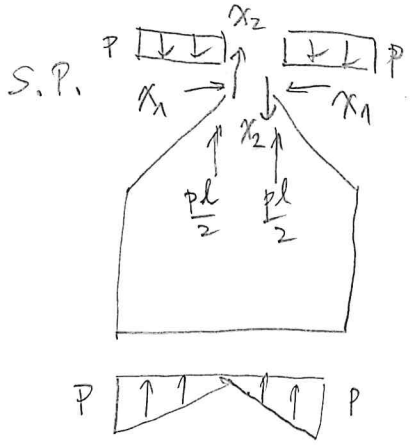
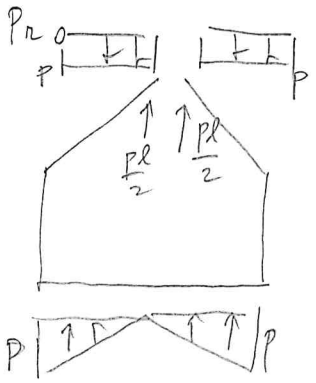
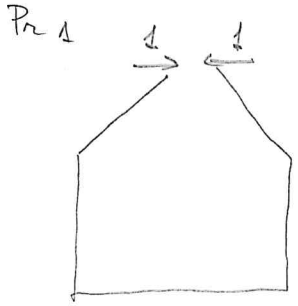


Anello ad una cerniera: 2 volte iperstatico per vincoli interni.
Le labilità esterne è risolta dai carichi esterni autoequilibrati.



$X_2 = 0$ per simmetria di geometria e carichi!
La struttura è quindi 1 volta iperstatica





TRAVE	LUNG.	M_0	M_1
CB	$l\sqrt{2}$	$-\frac{pl\sqrt{2}}{4}x + \frac{px^2}{4}$	$\frac{\sqrt{2}}{2}x$
BA	l	0	$l+x$
AG	l	$\frac{p}{l}(l-x)\frac{x^2}{2} + \frac{p}{l}\frac{x^3}{3} - \frac{pl}{2}x$	$2l$

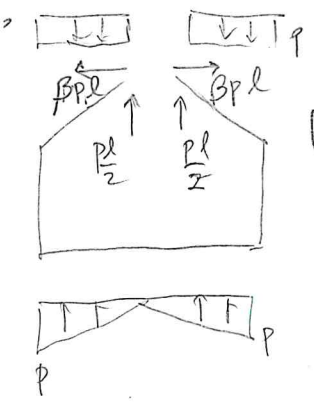
$$\eta_{11} = \frac{1}{EI}\int_D M_1^2\,dx = 2\left[\frac{2(18+\sqrt{2})}{3}\right]\frac{l^3}{EI}$$

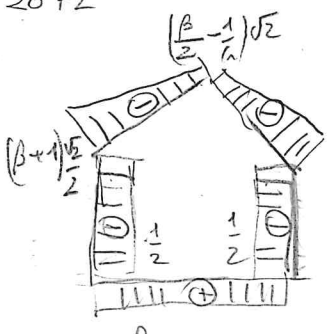
$$\eta_{10} = \frac{1}{EI}\int_D M_1 M_0\,dx = 2\left[\frac{6+\sqrt{2}}{24}\right]\frac{pl^4}{EI}$$

$$\bar{\eta}_1 = \int_D M_1 \bar{\varepsilon}\,dx = 2\left[\frac{4pl^4}{EI}\right]$$

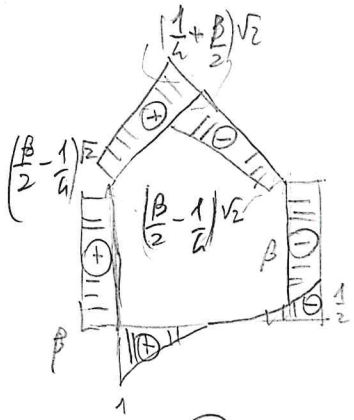
$$\eta_{11}X_1 + \eta_{10} + \bar{\eta}_1 = 0 \Rightarrow X_1 = -\beta\, pl$$

con $\beta = \dfrac{1712 - 109\sqrt{2}}{2872} \simeq 0{,}54$

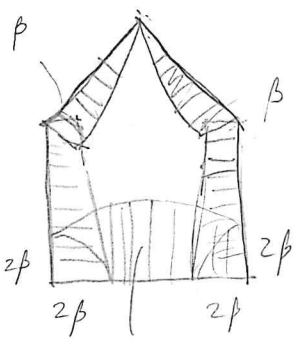




$\frac{N}{pl}$



$\frac{T}{pl}$



$\frac{M}{pl^2}$