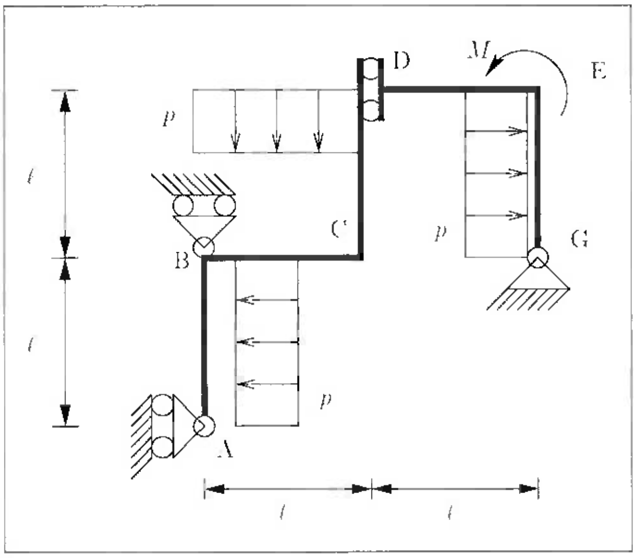
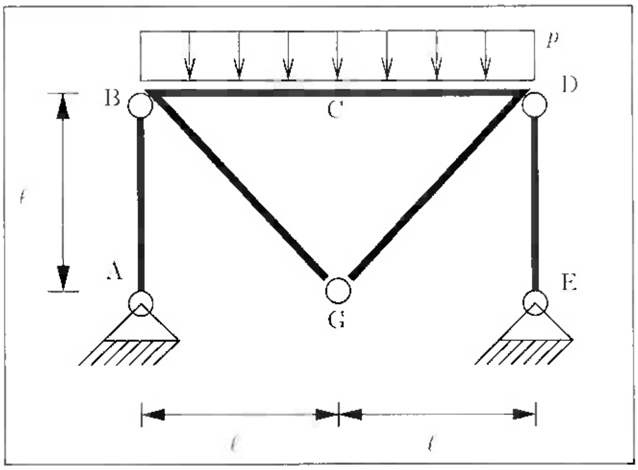
Statica - Ingegneria Civile - Prof. Daniele Zulli

APPELLO DEL 16/6/2026 - DURATA 3 ORE

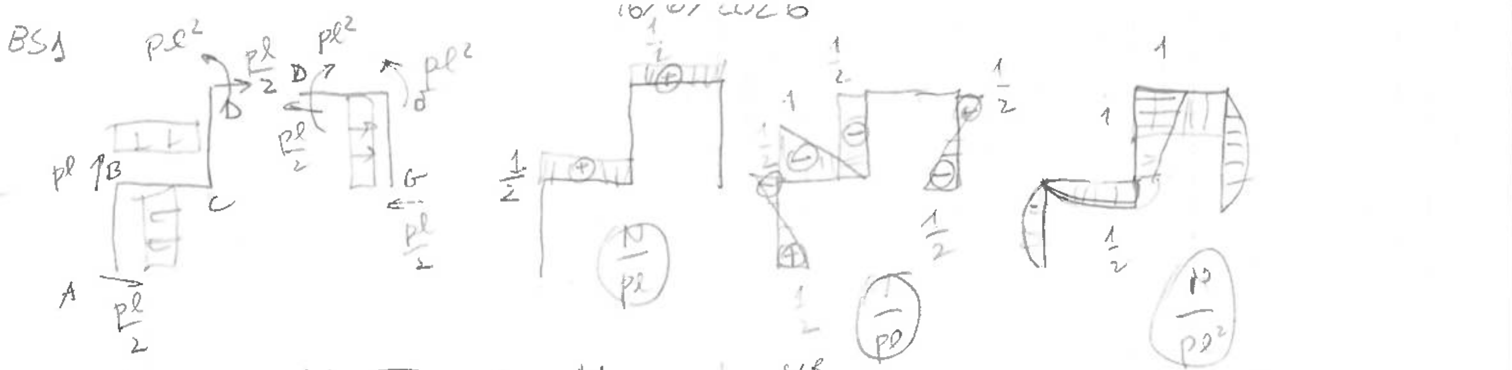
Esercizio 1: Scrivere e diagrammare le leggi di variazione delle caratteristiche di sollecitazione per la struttura in figura, nel caso in cui sia $M = p\ell^2$. Calcolare la rotazione della sezione in E, noto EI e per $EA \to +\infty$.



Esercizio 2: Diagrammare le caratteristiche di sollecitazione per la struttura in figura nel caso in cui sia $EA = \frac{EI}{\ell^2}$ sui tratti AB e DE. $EA \to +\infty$ altrove.

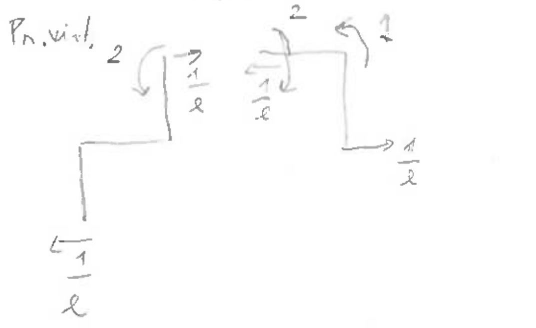


BS1



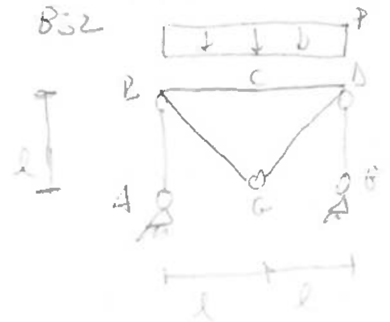
TRAVE	LUNG	N	T	M	M^δ
AB	l	0	$\frac{pl}{2} - px$	$-\frac{pl}{2}x + \frac{px^2}{2}$	$\frac{x}{l}$
BC	l	$\frac{pl}{2}$	$-pl + px$	$pl\,x - p\frac{x^2}{2}$	1
CD	l	0	$-\frac{pl}{2}$	$\frac{pl^2}{2} + \frac{pl}{2}x$	$1 + \frac{x}{l}$
DG	l	$\frac{pl}{2}$	0	pl^2	2
GB	l	0	$-\frac{pl}{2} + px$	$p\frac{l}{2}x - \frac{px^2}{2}$	$-\frac{x}{l}$

Pr. virt.



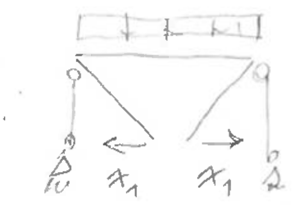
$$1 \cdot \varphi_E = \int_D \frac{M M^\delta}{EI}\,dx = \frac{41}{12}\frac{pl^3}{EI} \simeq 3{,}42\,\frac{pl^3}{EI}$$

BS2

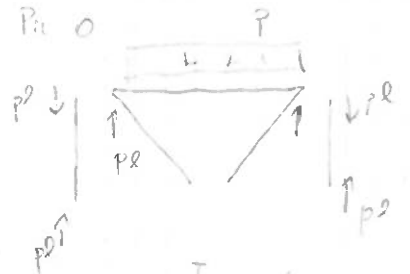


Struttura biconnessa due volte iperstatica per vincoli interni. Si sfrutta la simmetria che rende la struttura una volta iperstatica

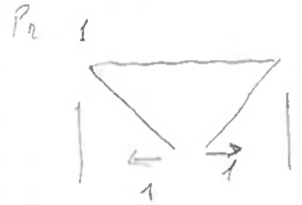
S.P.



Pr. 0



Pr. 1



TRAVE	LUNG	N_0	M_0	N_1	M_1
AB	l	$-pl$	0	0	0
GB	$l\sqrt{2}$	0	0	$-\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}x$
BC	l	0	$plx - \frac{px^2}{2}$	1	l

$$\eta_{11} = 2\left[\frac{1}{EA}\int_{AB} N_1^2\,dx + \frac{1}{EI}\left(\int_{GB} M_1^2\,dx + \int_{BC} M_1^2\,dx\right)\right] = \frac{2}{EI}\left[\int_0^{l\sqrt{2}} \frac{x^2}{2}\,dx + \int_0^{l} l^2\,dx\right] = \frac{2l^3}{EI}\left(\frac{\sqrt{2}}{3}+1\right)$$

$$\eta_{10} = 2\left[\frac{1}{EA}\int_{AB} N_1 N_0\,dx + \frac{1}{EI}\left(\int_{GB} M_1 M_0\,dx + \int_{BC} M_1 M_0\,dx\right)\right] = \frac{2}{EI}\int_0^{l}\left(plx - \frac{px^2}{2}\right) l\,dx = \frac{2}{EI}\left(\frac{1}{3}pl^4\right)$$

$$\bar{\eta}_1 = 0 \qquad X_1 = -\frac{\eta_{10}}{\eta_{11}} = -\frac{1}{3\left(\frac{\sqrt{2}}{3}+1\right)}\,pl = -\beta\,pl \qquad \beta \simeq 0{,}226$$