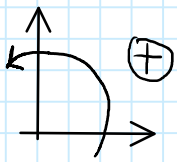
MECCANICA DELLE STRUTTURE - Corso P. FUSCHI Prova scritta 17 Apr 2024

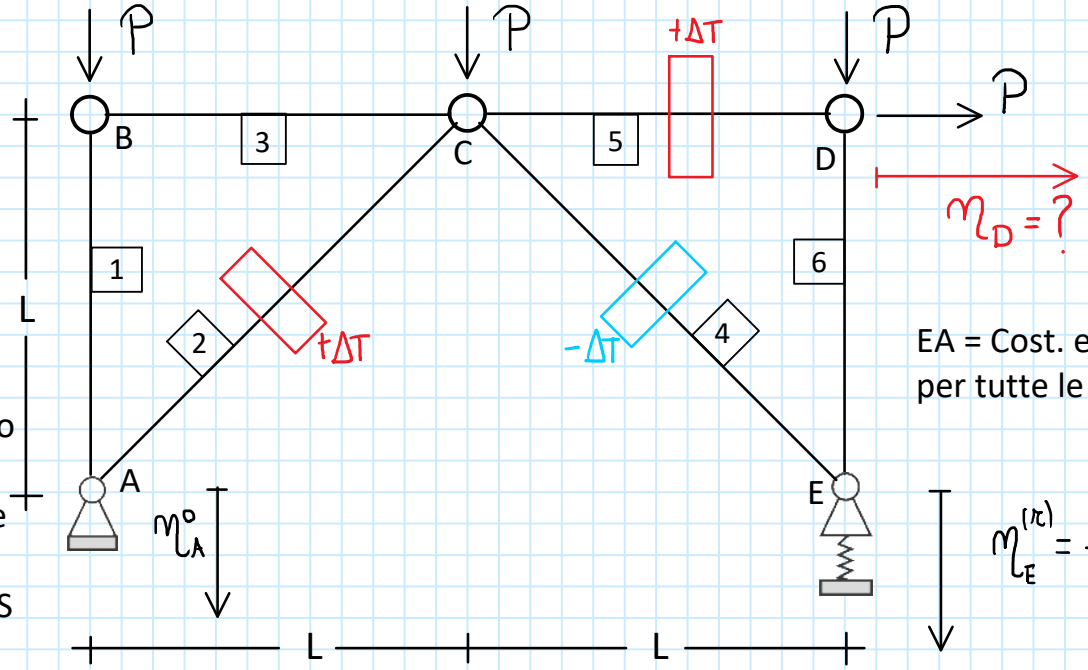
Quesito N. 2

Determinare lo spostamento orizzontale del nodo D della struttura reticolare riportata in figura con il metodo forza unitaria (PLV).



STRUTTURA REALE

Sulla quale si valutano gli spostamenti generalizzati reali e le CD congruenza espresse tramite le CS associate ai carichi reali !!



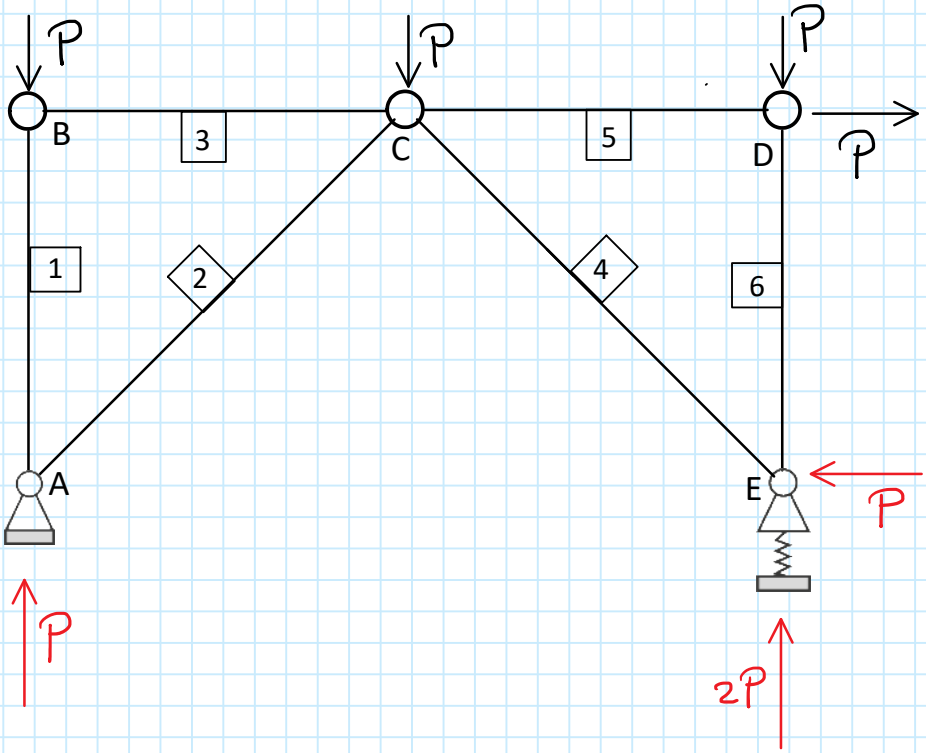
EA = Cost. e uguali per tutte le aste

$m_E^{(1)} = -\varepsilon_E R_{yE}^{(1)}$

POSIZIONI :

$|m_A^0| = \frac{2PL}{EA}(1+\sqrt{2})$; $|\varepsilon| = \frac{L}{EA}$; $|\alpha\Delta T| = \frac{P}{3EA}$

Calcolo delle RV sulla struttura (ISOSTATICA) reale: Per via analitica



$\sum F_x = 0 \quad R_{xA} - R_{xE} - P = 0 \Rightarrow \quad R_{xE} - P = 0$
$R_{xE} = +P$

$\sum F_y = 0 \quad R_{yA} + R_{yE} - 3P = 0 \Rightarrow \quad R_{yA} + 2P - 3P = 0$
$R_{yA} = P$

$\sum M_A = 0 \quad -PL - P2L - PL + R_{yE} \cdot 2L = 0 \Rightarrow$
$\Rightarrow -PL - 2PL - PL + R_{yE} \cdot 2L = 0 \Rightarrow$
$R_{yE} = 2P$

$\sum M_C^{(sx)} = 0 \quad PL - R_{yA} \cdot L - R_{xA} \cdot L = 0 \Rightarrow \quad PL - PL - R_{xA} L = 0$
$R_{xA} = 0$

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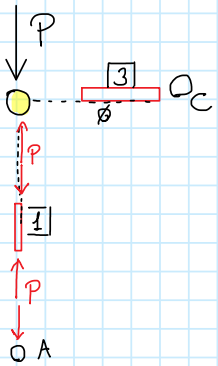
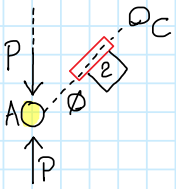
Calcolo delle CS (Solo SFORZO NORMALE) sulle strutture reali: si procede con il metodo dell'equilibrio ai nodi.

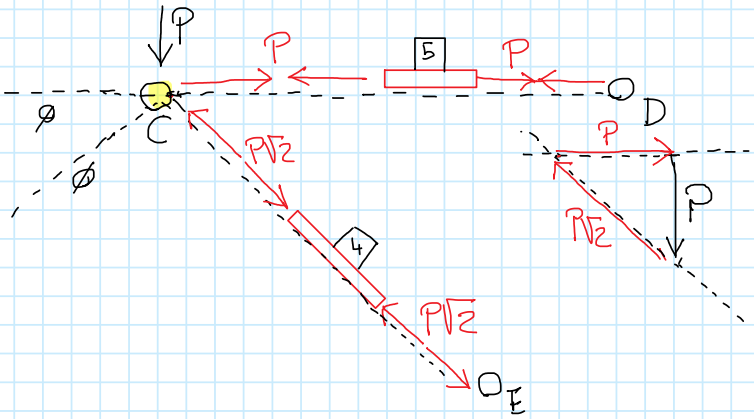
1. Nodo B (Canonico)



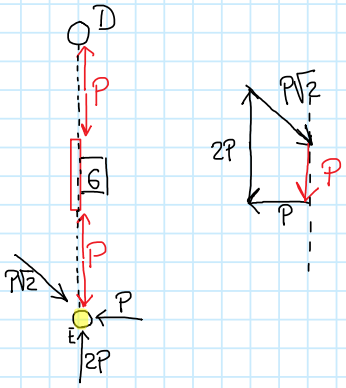
2. Nodo A



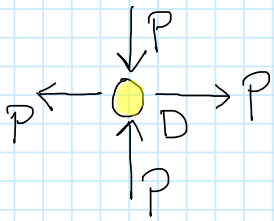
3. Nodo C



4. Nodo E



5. Nodo D (Verifica)



ok!

ASTA	SFORZO	COMPONENTE MECCANICA
1	-P	PUNTONE
2	0	-
3	0	-
4	$-P\sqrt{2}$	PUNTONE
5	P	TIRANTE
6	-P	PUNTONE

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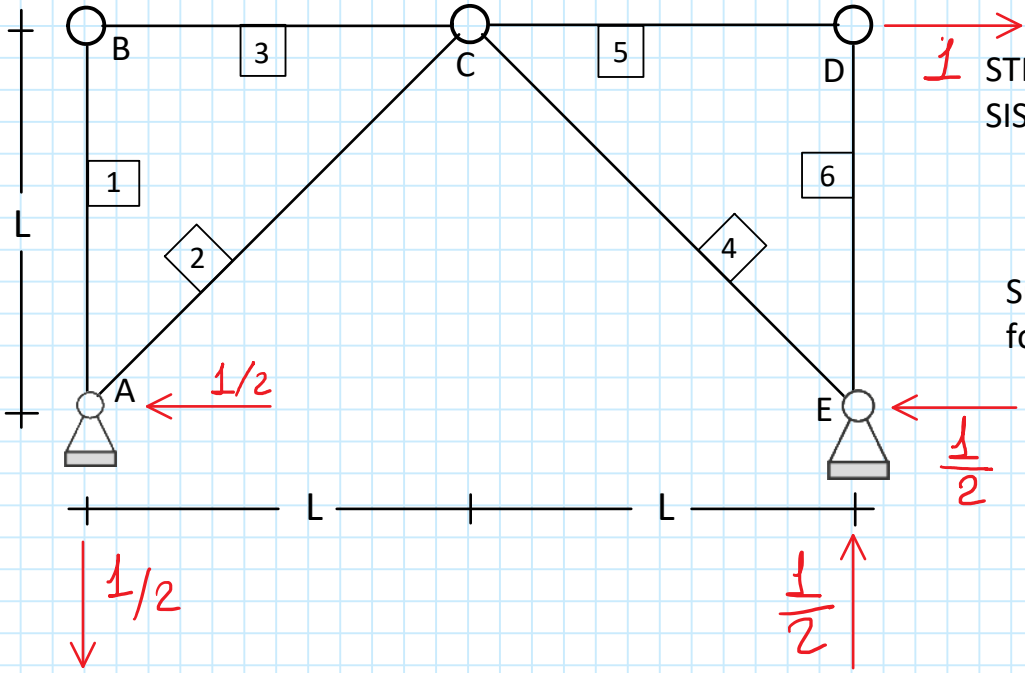


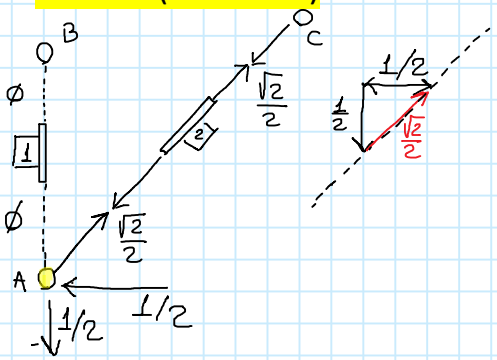
$\sum F_x = 0 \quad -R_{xA} + R_{xE} + 1 = 0 \Rightarrow R_{xA} = +\frac{1}{2} + 1 \quad R_{xA} = +\frac{1}{2}$

$\sum F_y = 0 \quad -R_{yA} + R_{yE} = 0 \Rightarrow R_{yE} = +\frac{1}{2}$

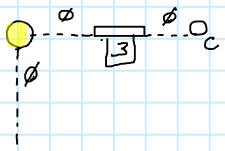
$\sum M_A = 0 \quad R_{yE} \cdot 2L - L = 0 \Rightarrow R_{yE} = \frac{1}{2}$

$\sum M_C^{(ax)} = 0 \quad R_{yE} L - R_{xE} \cdot L = 0 \Rightarrow \frac{L}{2} - R_{xE} L = 0 \Rightarrow R_{xE} = +\frac{1}{2}$

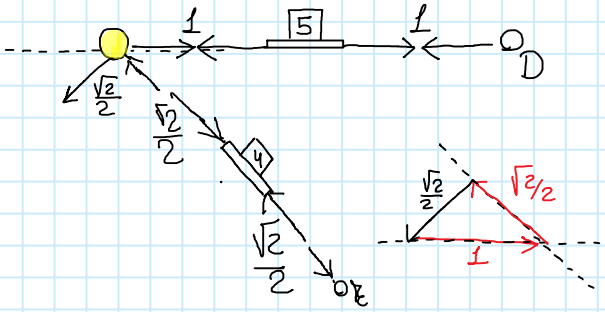
1. Nodo A (Canonico)



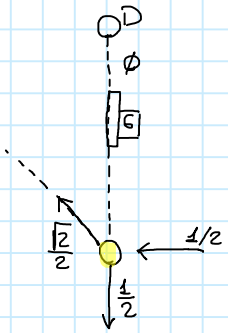
2. Nodo B



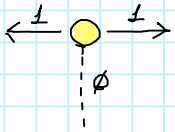
3. Nodo C



4. Nodo E



5. Nodo D VERIFICA



ASTA	SFORZO	COMPONENTE MECCANICA
1	Ø	-
2	$\sqrt{2}/2$	TIRANTE
3	Ø	-
4	$-\sqrt{2}/2$	PUNTONE
5	1	TIRANTE
6	Ø	-

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Applicando il PLV nell'ipotesi di EA costante ed uguale per tutte le aste, si ha:

$$Lve = 1\,\eta_i^{(2)} + \sum_j R^{(1)}\,\eta_j^{(2)} = 1\cdot\eta_D + \left(-\frac{1}{2}\right)\left(-\eta_A^0\right) + \frac{1}{2}\left[-\varepsilon_E\,(2P)\right]$$

$$Lve = \eta_D - \frac{1}{2}\eta_A^0 - \varepsilon_E P$$

$$Lvi = \sum_i N_i^{(1)}\cdot\frac{N^{(2)}\cdot L_i}{EA} + \sum_j N_j^{(1)}\,\alpha\Delta\bar{T}\cdot L_j =$$

$$= \left[\left(-\frac{\sqrt{2}}{2}\right)\frac{(-P\sqrt{2})(L\sqrt{2})}{EA}\right] + \left[1\,\frac{PL}{EA}\right] + \left(\frac{\sqrt{2}}{2}\right)\left(\alpha\Delta\bar{T}\,L\sqrt{2}\right) +$$

$$+\left[\left(-\frac{\sqrt{2}}{2}\right)\left(-\alpha\Delta\bar{T}\right)\left(L\sqrt{2}\right)\right] + \left[1\,(\alpha\Delta\bar{T})\,L\right] = \frac{PL}{EA}\left[\sqrt{2}+1\right] + \alpha\Delta\bar{T}L + \alpha\Delta\bar{T}L + \alpha\Delta\bar{T}L =$$

$$Lvi = \frac{PL}{EA}\left[\sqrt{2}+1\right] + 3\alpha\Delta\bar{T}L$$

$$\eta_D - \frac{1}{2}\eta_A^0 - \varepsilon_A P = \frac{PL}{EA}\left[\sqrt{2}+1\right] + 3\alpha\Delta\bar{T}L$$

$$\eta_D - \frac{1}{2}\left(-8\,\frac{PL}{EA}\right)\left(1+\sqrt{2}\right) - \frac{PL}{EA} = \frac{PL}{EA}\left(\sqrt{2}+1\right) + \frac{PL}{EA}$$

$$\eta_D + \frac{PL}{EA}\left(\sqrt{2}+1\right) - \frac{PL}{EA} = \frac{PL}{EA}\left(\sqrt{2}+1\right) + \frac{PL}{EA}$$

$$\eta_D = \frac{2PL}{EA}$$

POVITIVO !
VERSO DESTRA!!

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