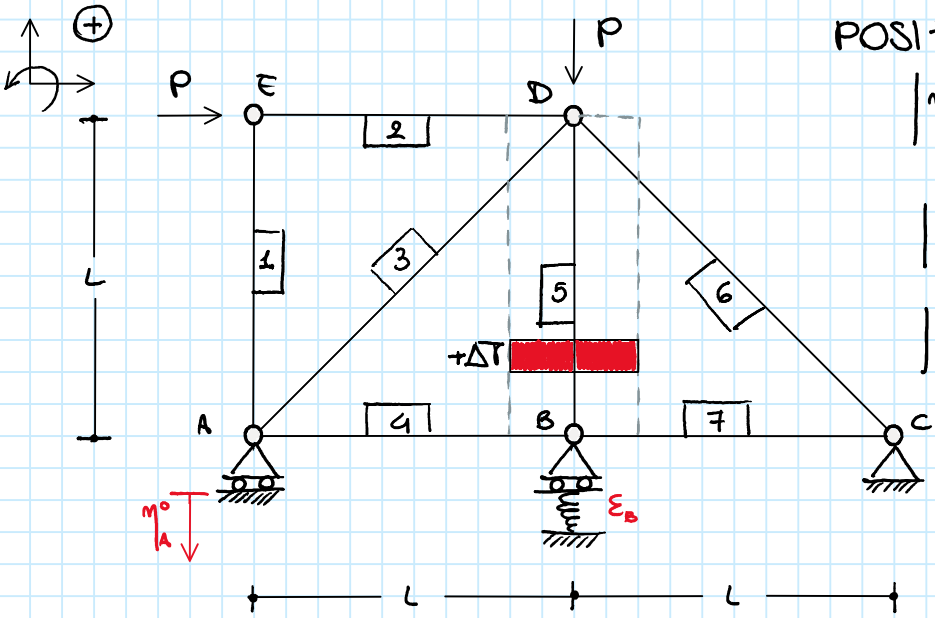
IPER 8

RISOLVERE LA STRUTTURA RETICOLARE PIANA



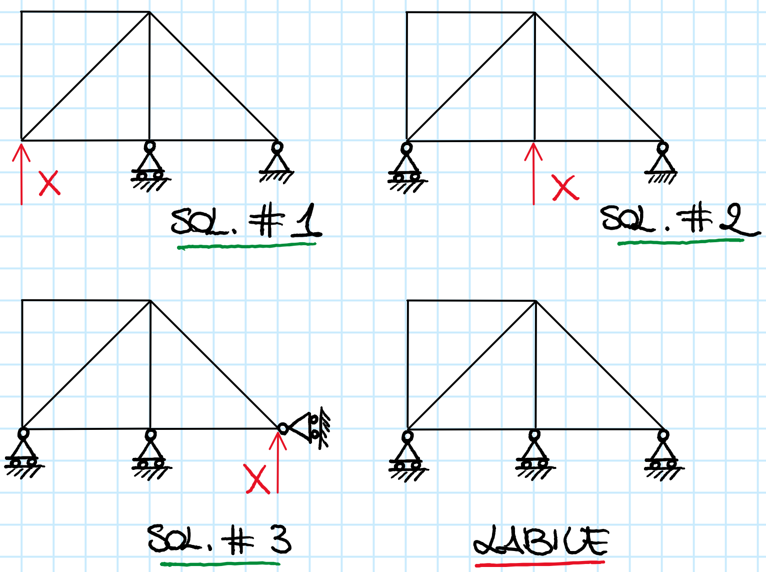
POSIZIONI:

$$|\eta_A^\circ| = \frac{2LP\sqrt{2}}{EA}$$

$$|\varepsilon_B| = \frac{L}{2EA}\left[2\sqrt{2}+3\right]$$

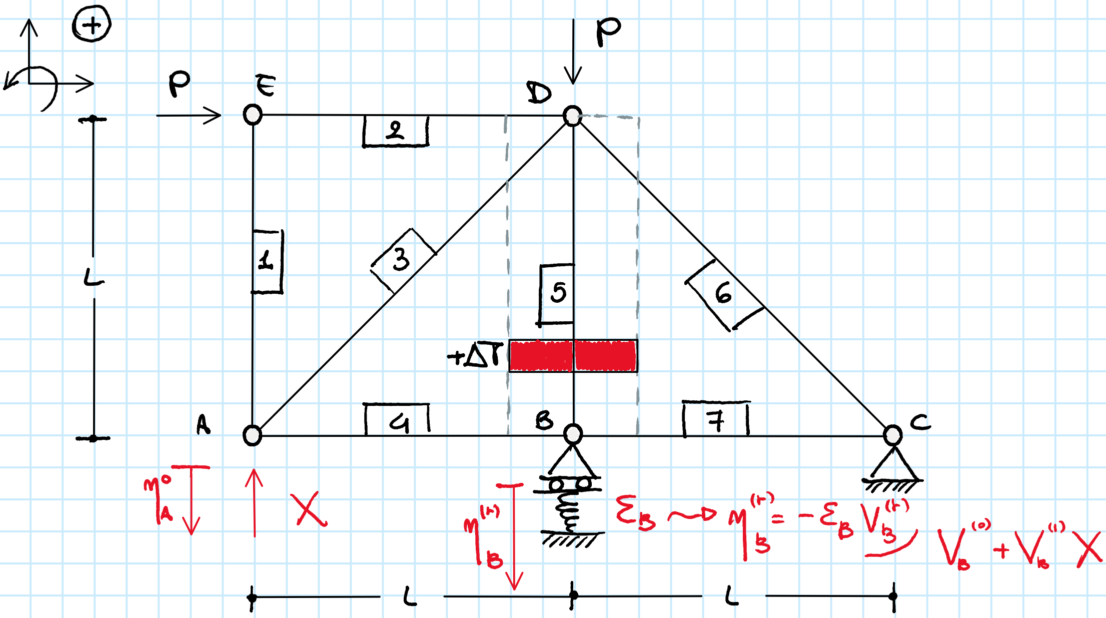
$$|\alpha\Delta T| = \frac{3P}{EA}$$

SOLUZIONI POSSIBILI:

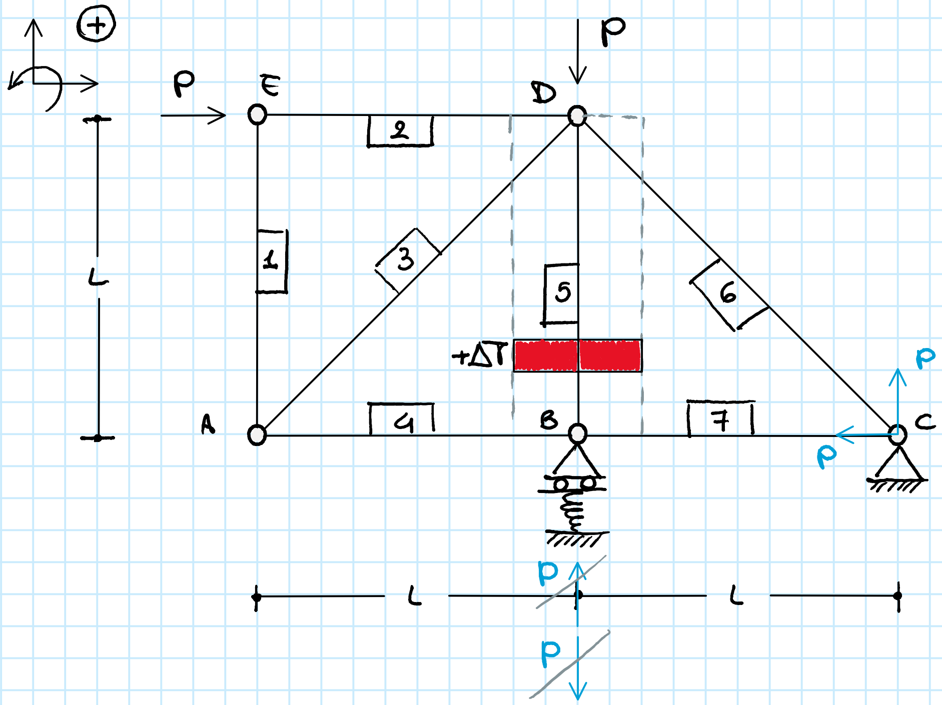


SOLUZIONE # 1

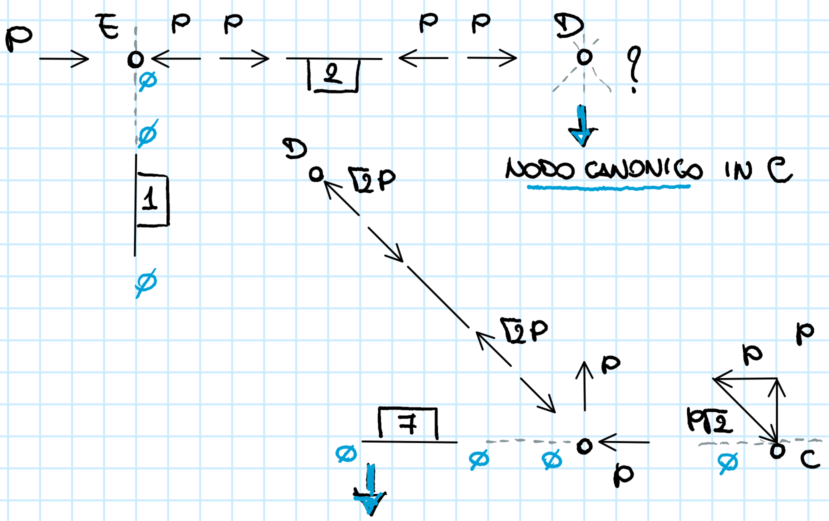
SISTEMA PRINCIPALE ISOSTATICO



SCHEMA [0] SOLO CARICHI ESTERNI

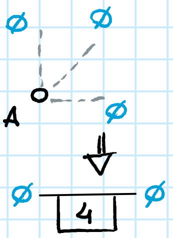


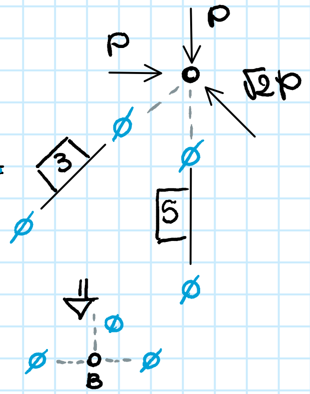
NODO E



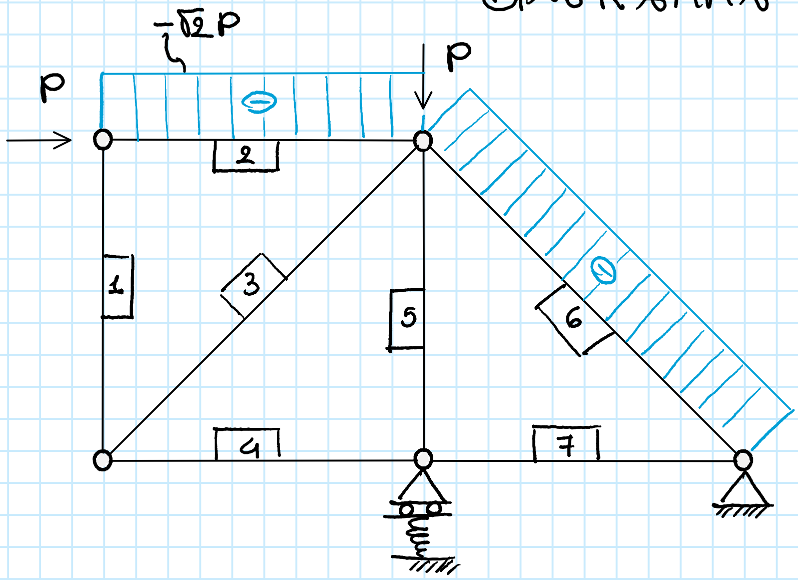
NODO D

NODO A

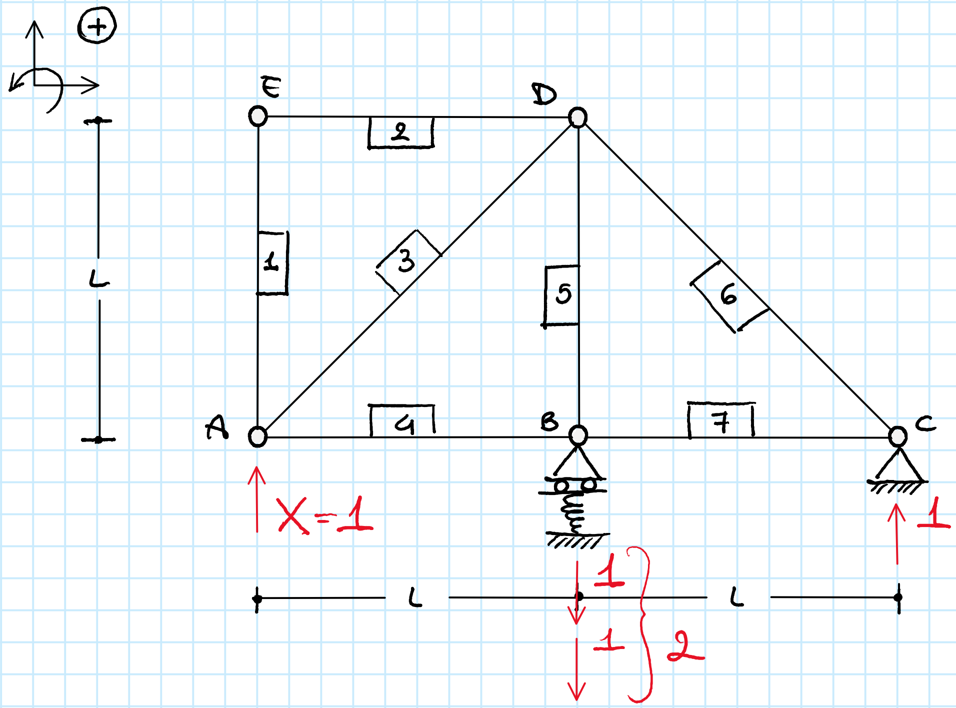




DIAGRAMMA



SCHEMA [1] SOLO $X=1$



NODO E

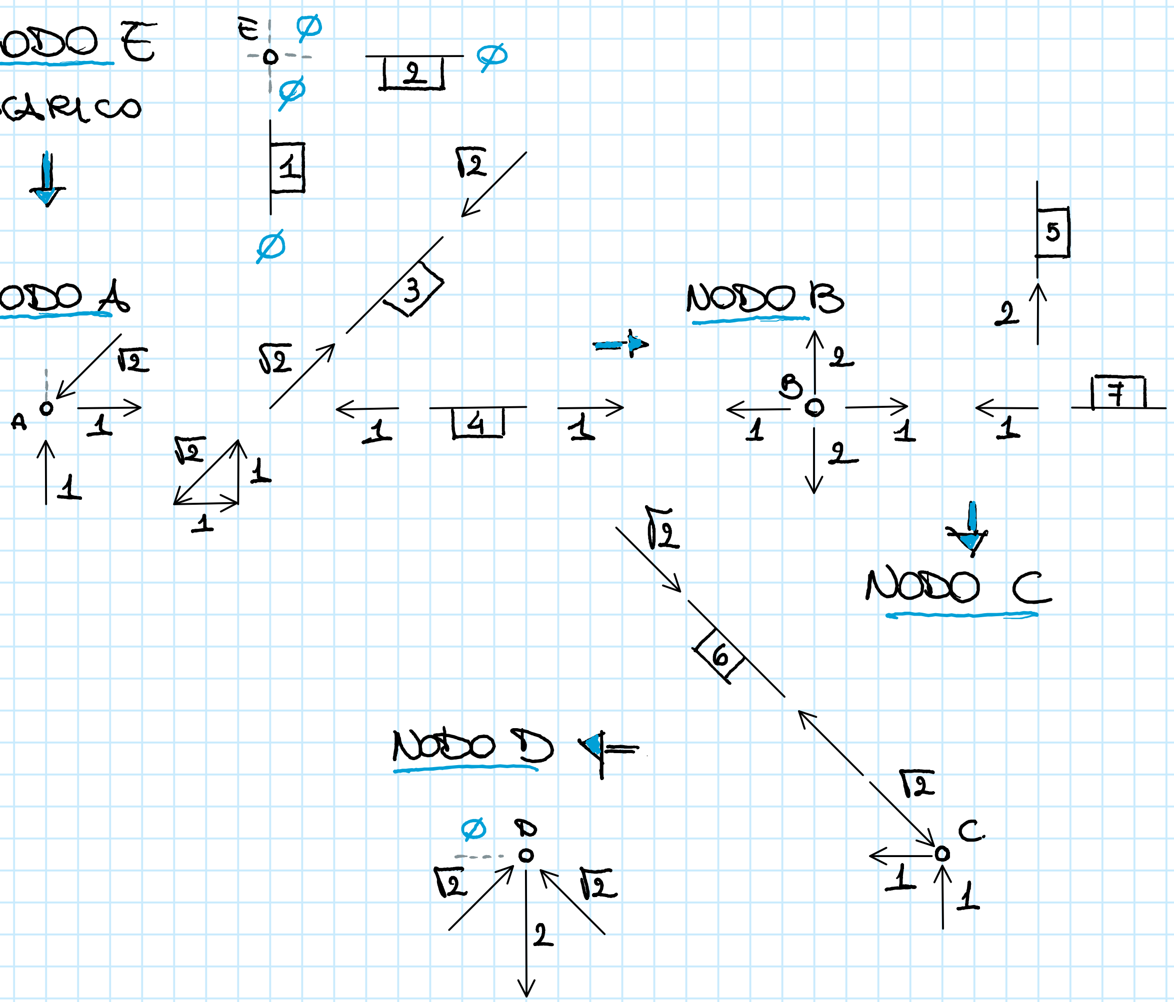
SCARICO

NODO A

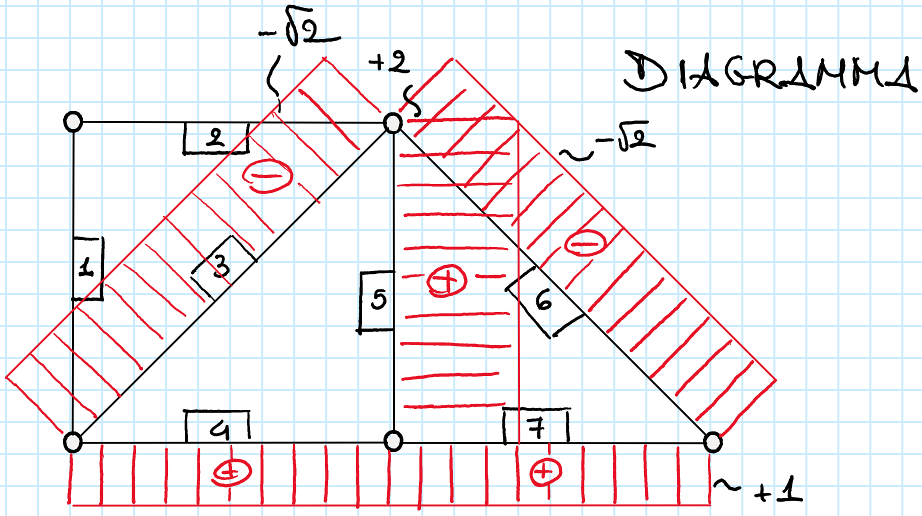
NODO B

NODO C

NODO D



DIAGRAMMI



$$\underbrace{\mathcal{L}_{ve}} = 1 \cdot \eta_i^{(r)} + \sum_j \mathbb{R}_j^{(f)} \eta_j^{(r)} =$$

$$= -1 \cdot \eta_A^{0} + \underbrace{V_B^{(1)}}_{2} \underbrace{\eta_B^{(r)}}_{\to -\varepsilon_B \underbrace{V_B^{(r)}}_{\to \underbrace{V_B^{(0)}}_{0} + \underbrace{V_B^{(1)}}_{2} X}} =$$

$$= \underbrace{-\eta_A^{0} - \varepsilon_B 4 X}$$

$$\underbrace{\mathcal{L}_{vi}} = \int_{Str} N^{(f)} \frac{N^{(r)}}{EA} dStr + \int_{Str} N^{(f)} \underbrace{\lambda^{(r)}}_{\downarrow\, +\alpha\Delta T \text{ nell'asta } 5} dStr =$$

$$= \sum_i N_i^{(f)} \left[\frac{N_i^{(r)} L_i}{EA} + \alpha \Delta T L_i \right] = \qquad \text{con } N_i^{(r)} = N_i^{(0)} + N_i^{(1)} X$$

$$= \sum_{i=1}^{7} N_i^{(1)} \frac{N_i^{(0)} L_i}{EA} + \left\{ \sum_{i=1}^{7} \frac{\left[N_i^{(1)}\right]^2}{EA} \right\} X + N_5^{(1)} \alpha \Delta T L_5 =$$

$$= N_6^{(1)} \frac{N_6^{(0)} L_6}{EA} + \left\{ \left[N_3^{(1)}\right]^2 L_3 + \left[N_4^{(1)}\right]^2 L_4 + \left[N_5^{(1)}\right]^2 L_5 + \left[N_6^{(1)}\right] L_6 + \right.$$

$$\left. + \left[N_7^{(1)}\right]^2 L_7 \right\} \frac{X}{EA} + N_5^{(1)} \alpha \Delta T L_5 =$$

$$= (-\sqrt{2}) \frac{(-P\sqrt{2}) L\sqrt{2}}{EA} + \left\{ 2 \cdot L\sqrt{2} + 1 \cdot L + 4 \cdot L + 2 \cdot L\sqrt{2} + 1 \cdot L \right\} \frac{X}{EA} +$$

$$+ 2L \alpha \Delta T =$$

$$= \underbrace{\frac{2PL\sqrt{2}}{EA} + 2L(2\sqrt{2}+3)\frac{X}{EA} + 2L\alpha\Delta T}$$

$\mathcal{L}_{ve} = \mathcal{L}_{vi}$ fornisce

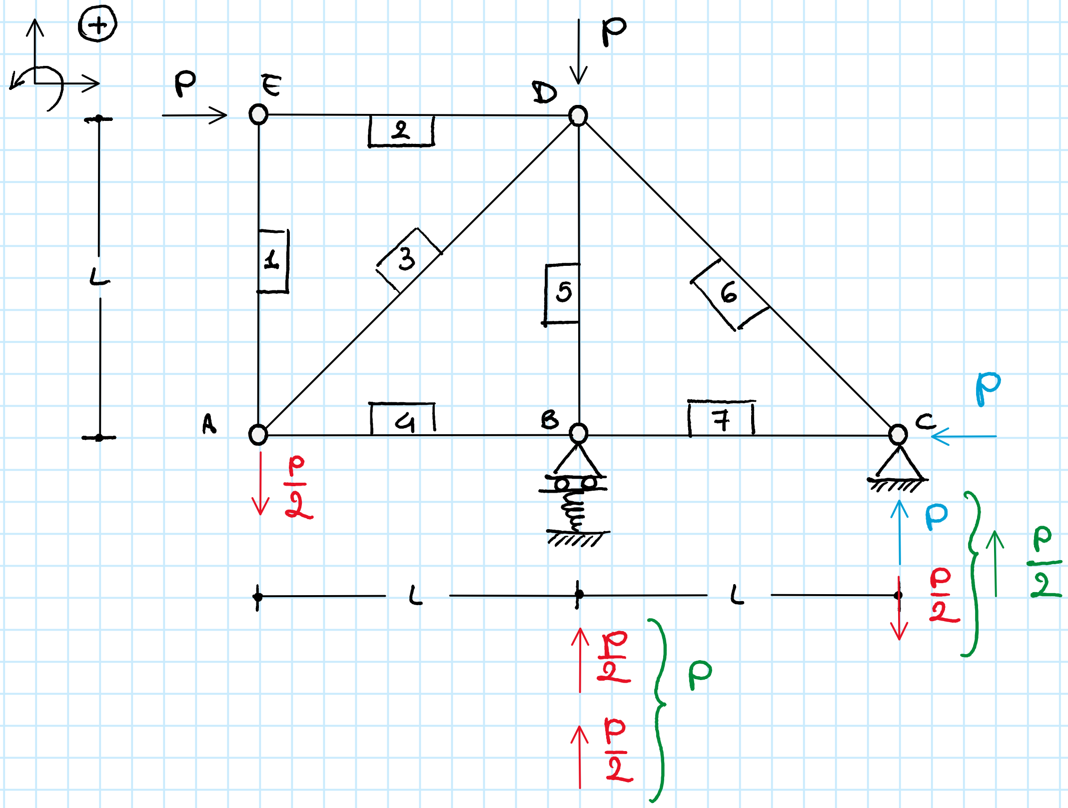
$$-M_A^\circ - 4\varepsilon_B X = \frac{2LP\sqrt{2}}{EA} + \frac{2L}{EA}\left[2\sqrt{2}+3\right]X + 2L\alpha\Delta T$$

$$-M_A^\circ - \frac{2LP\sqrt{2}}{EA} - 2L\alpha\Delta T = X\left\{\frac{2L}{EA}\left[2\sqrt{2}+3\right] + 4\varepsilon_B\right\}$$

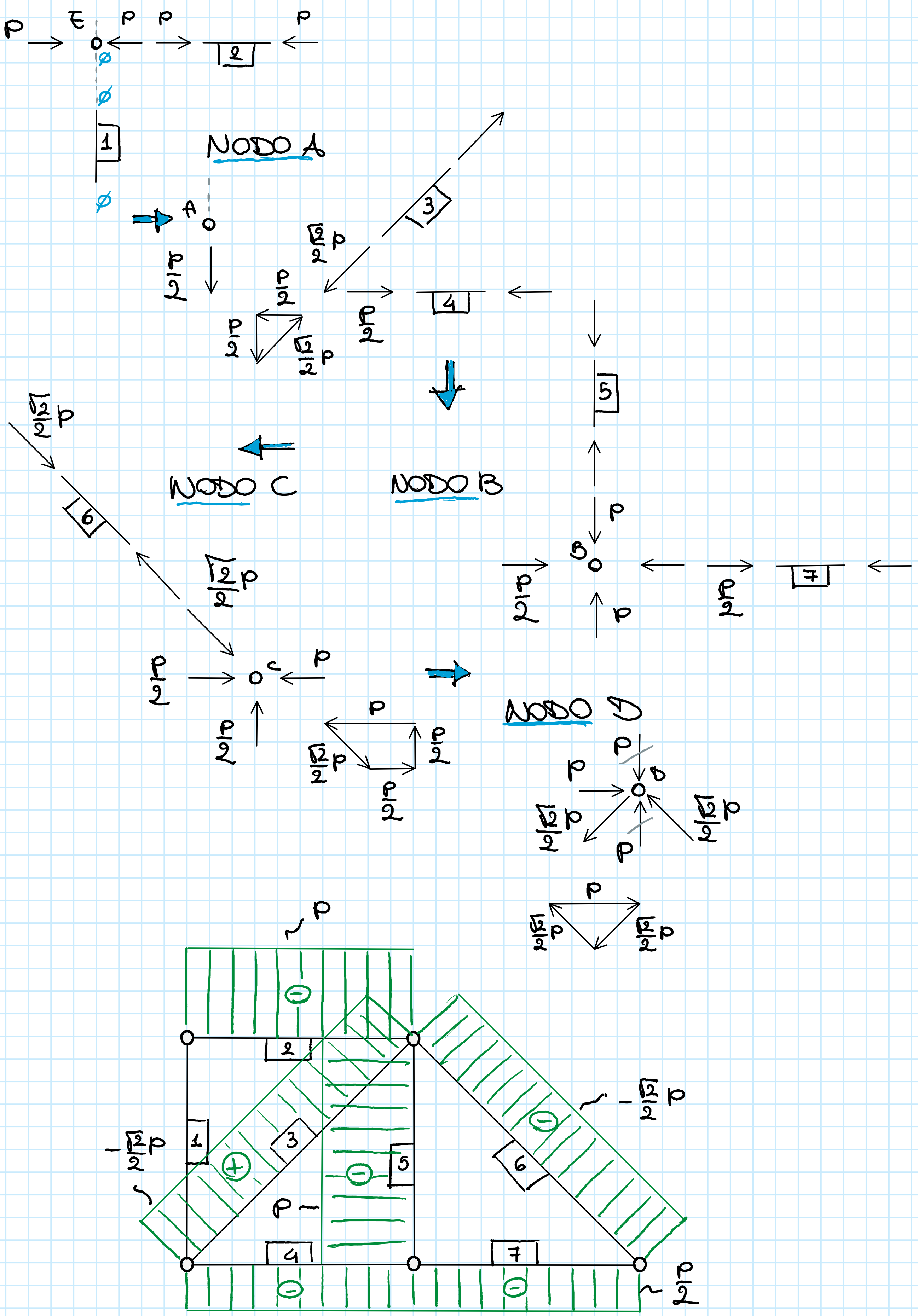
$$X = -\frac{M_A^\circ + \frac{2LP\sqrt{2}}{EA} + 2L\alpha\Delta T}{\frac{2L}{EA}\left[2\sqrt{2}+3\right] + 4\varepsilon_B}$$

$$X = -\frac{\frac{4LP\sqrt{2}}{EA} + \frac{6LP}{EA}}{\frac{4L}{EA}\left[2\sqrt{2}+3\right]} = -\frac{2P\left[2\sqrt{2}+3\right]}{4\left[2\sqrt{2}+3\right]} = -\frac{P}{2}$$

SOLUZIONE SISTEMA PRINCIPALE ISOSTATICO

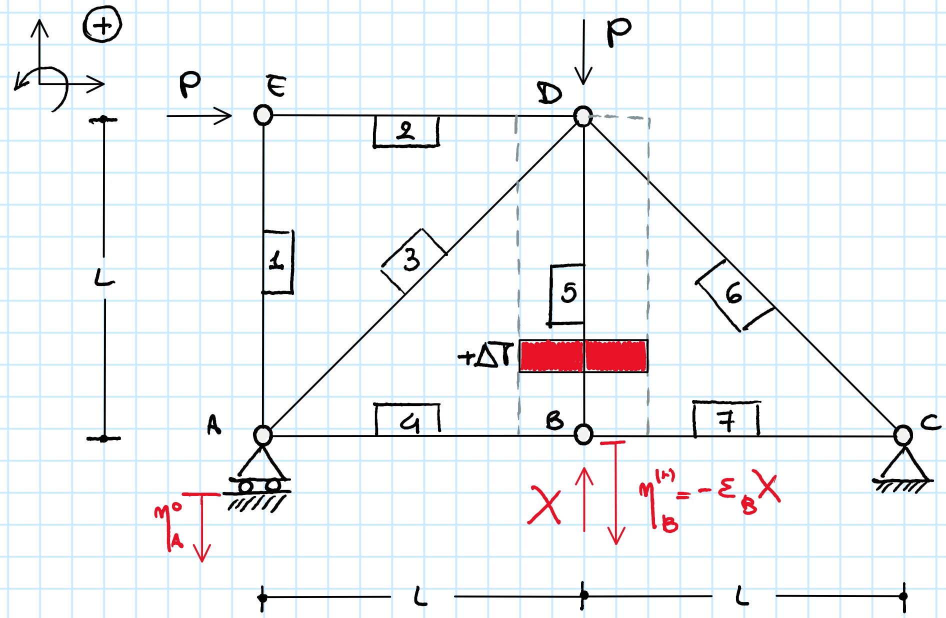


NODO E

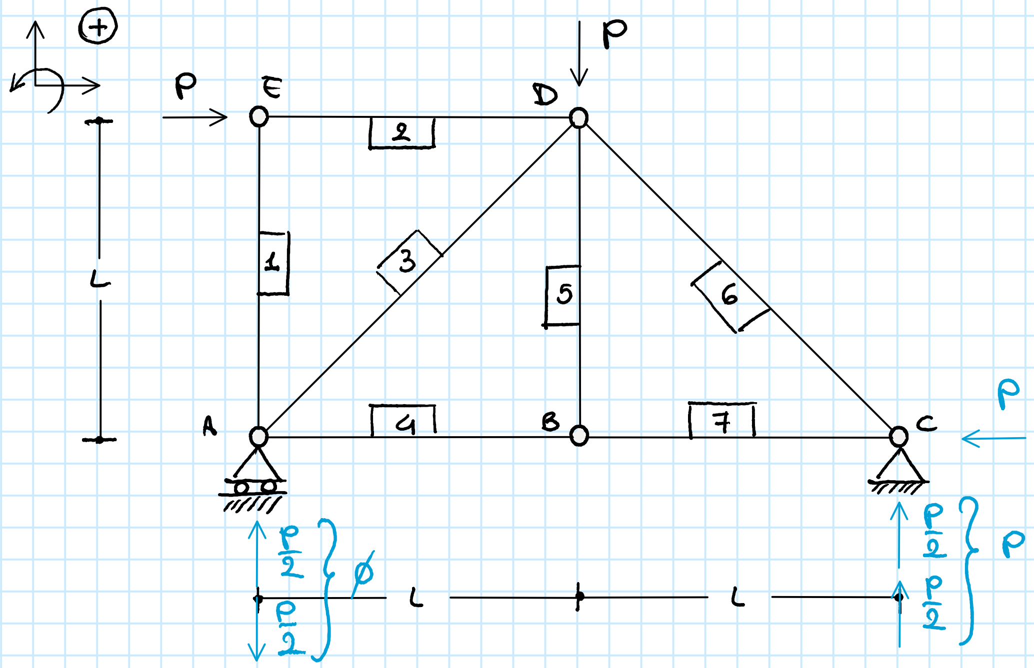


SOLUZIONE # 2

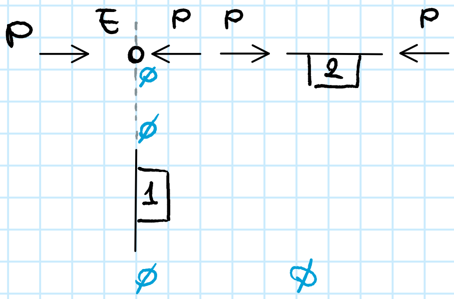
SISTEMA PRINCIPALE ISOSTATICO



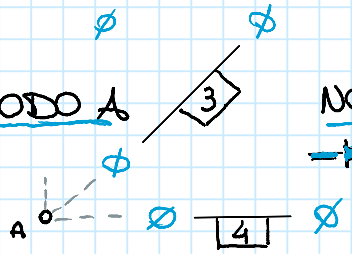
SCHEMA [0] SOLO CARICHI ESTERNI



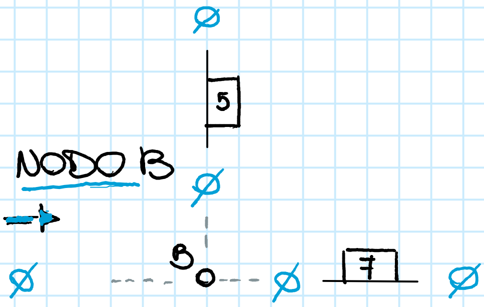
NODO E



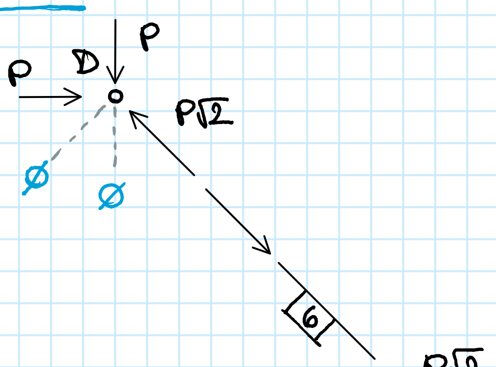
NODO A



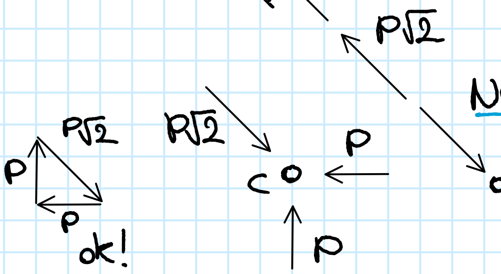
NODO B

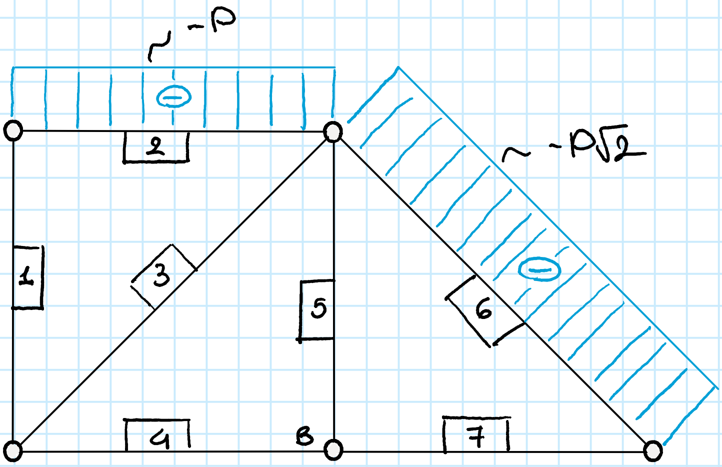


NODO D

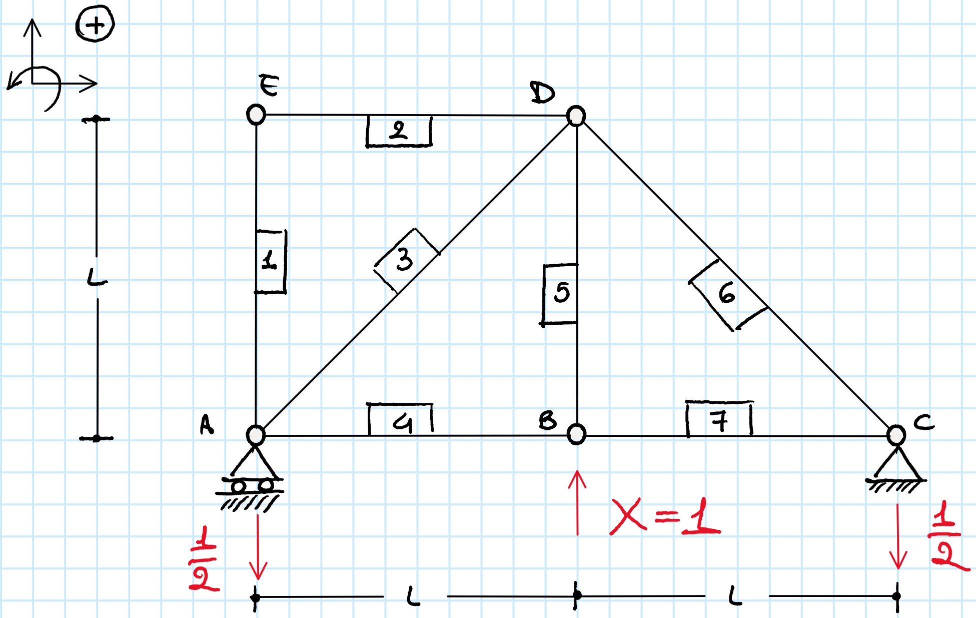


NODO C

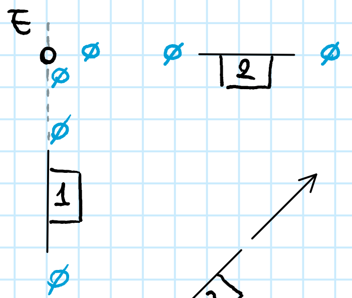




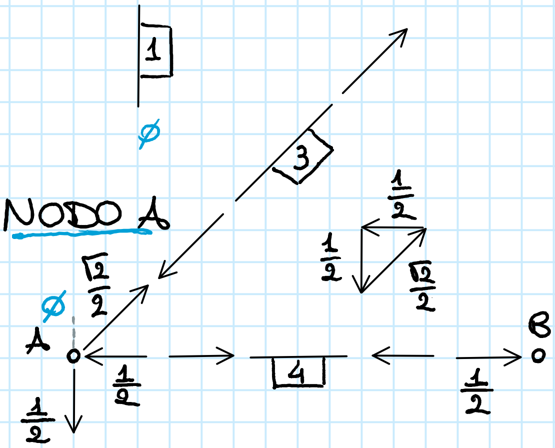
SCHEMA [1] SOLO X = 1



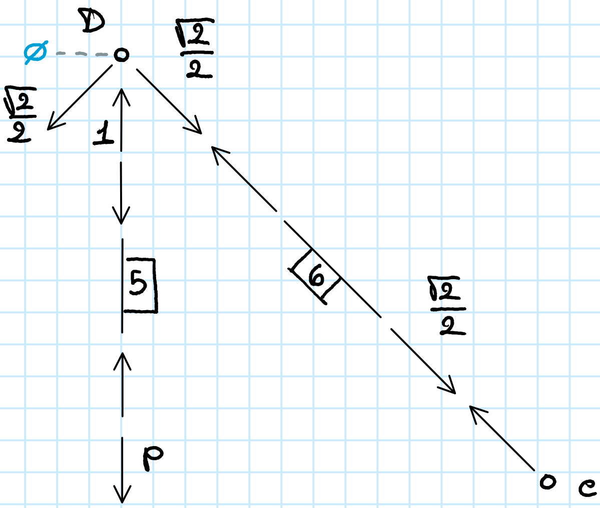
NODO E SCARICO



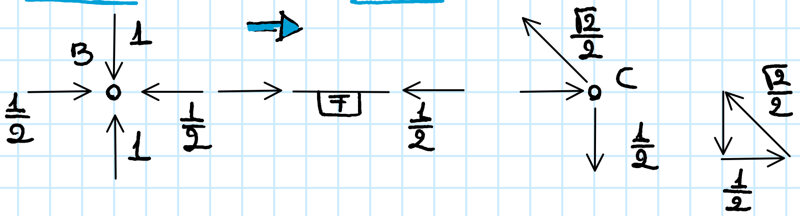
NODO A

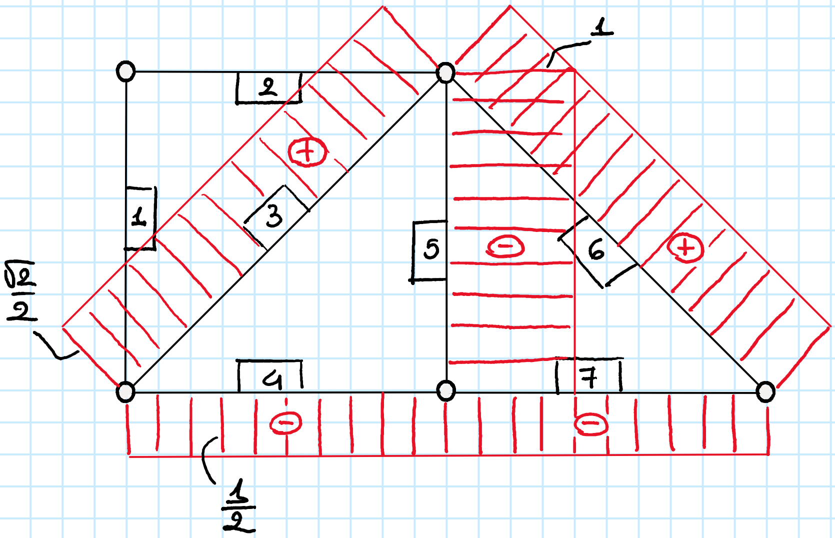


NODO D



NODO B NODO C





$$\mathcal{L}_{ve} = X \cdot \eta_B^{(1)} + \sum_j R_j^{(f)} \cdot \eta_j^{(1)} =$$

$$= 1 \cdot (-\varepsilon_B X) + R_{y_A}^{(1)} \cdot \eta_A^{\circ} = \underbrace{-\varepsilon_B X + \frac{\eta_A^{\circ}}{2}}$$

$$\mathcal{L}_{vi} = \sum_i N_i^{(1)} \cdot \frac{N_i^{(f)} L_i}{EA} + N_s^{(1)} \alpha \Delta T L_s = \left(\text{essendo } N_i^{(f)} = N_i^{(0)} + N_i^{(1)} X \right)$$

$$= \sum_i N_i^{(1)} \frac{N_i^{(0)} L_i}{EA} + \sum_i \left[N_i^{(1)} \right]^2 \frac{X L_i}{EA} + N_s^{(1)} \alpha \Delta T L_s =$$

$$= \frac{\sqrt{2}}{2} \cdot \left(-P\sqrt{2}\right) \frac{L\sqrt{2}}{EA} + \frac{X}{EA} \left\{ \left(\frac{\sqrt{2}}{2}\right)^2 \cdot L\sqrt{2} + \frac{L}{4} + L + \left(\frac{\sqrt{2}}{2}\right)^2 L\sqrt{2} + \frac{L}{4} \right\} - \alpha \Delta T L =$$

$$= \underbrace{-\frac{P\sqrt{2} L}{EA} + \frac{X}{EA} \left\{ L\sqrt{2} + \frac{3}{2} L \right\} - \alpha \Delta T L}$$

$$\mathcal{L}_{ve} = \mathcal{L}_{vi}$$

$$-\varepsilon_B X + \frac{\mathring{M}_1}{2} = -\frac{P\sqrt{2}}{EA}L + \frac{X}{EA}\left\{L\sqrt{2} + \frac{3}{2}L\right\} - \frac{3P}{EA}L$$

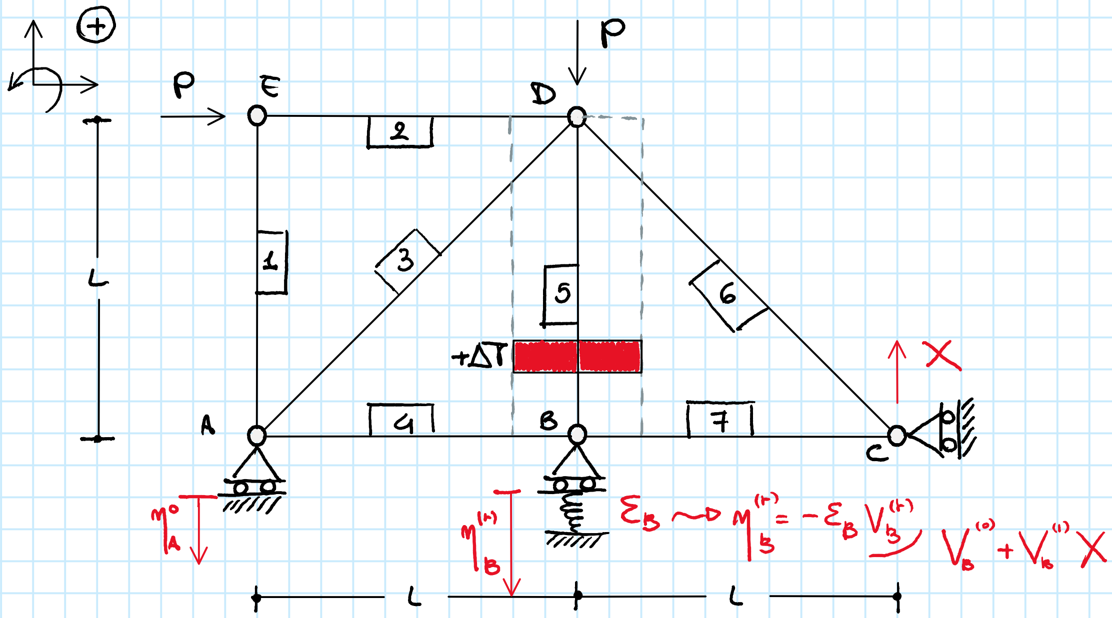
$$-\frac{L}{2EA}\left[2\sqrt{2} + 3\right]X + \frac{P\sqrt{2}}{EA}L = X\left\{-\sqrt{2} - \frac{3}{2} - \sqrt{2} - \frac{3}{2}\right\}$$

$$X\left[2\sqrt{2} + 3\right] = +P\left[2\sqrt{2} + 3\right]$$

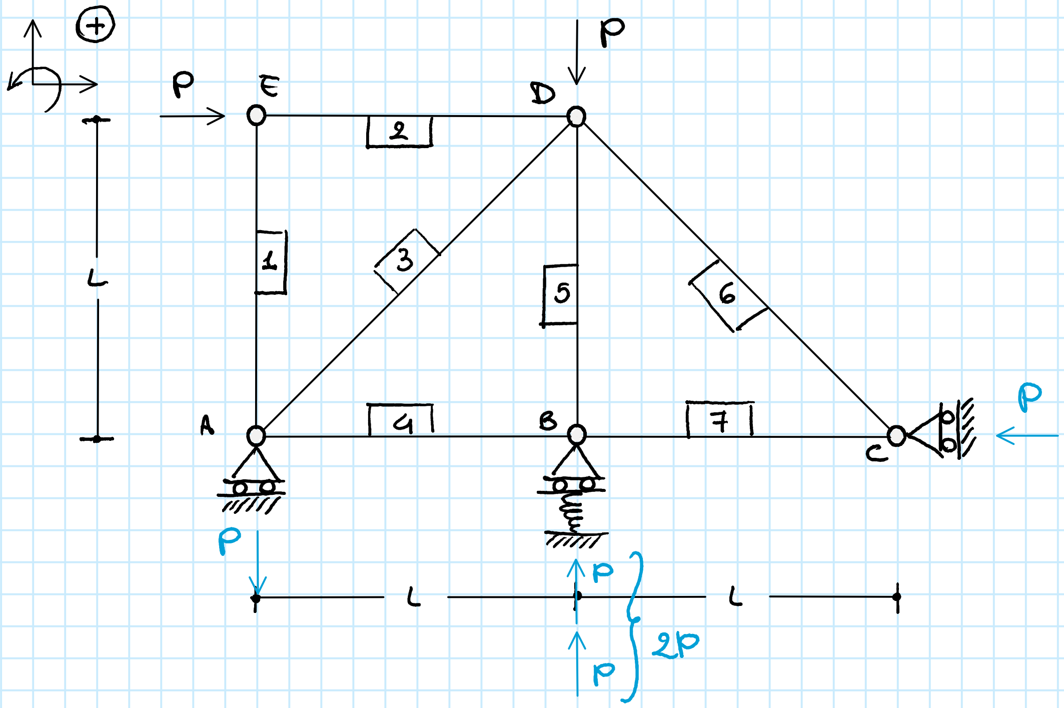
$X = P$ Positivo, verso ipotizzato corretto

SOLUZIONE # 3

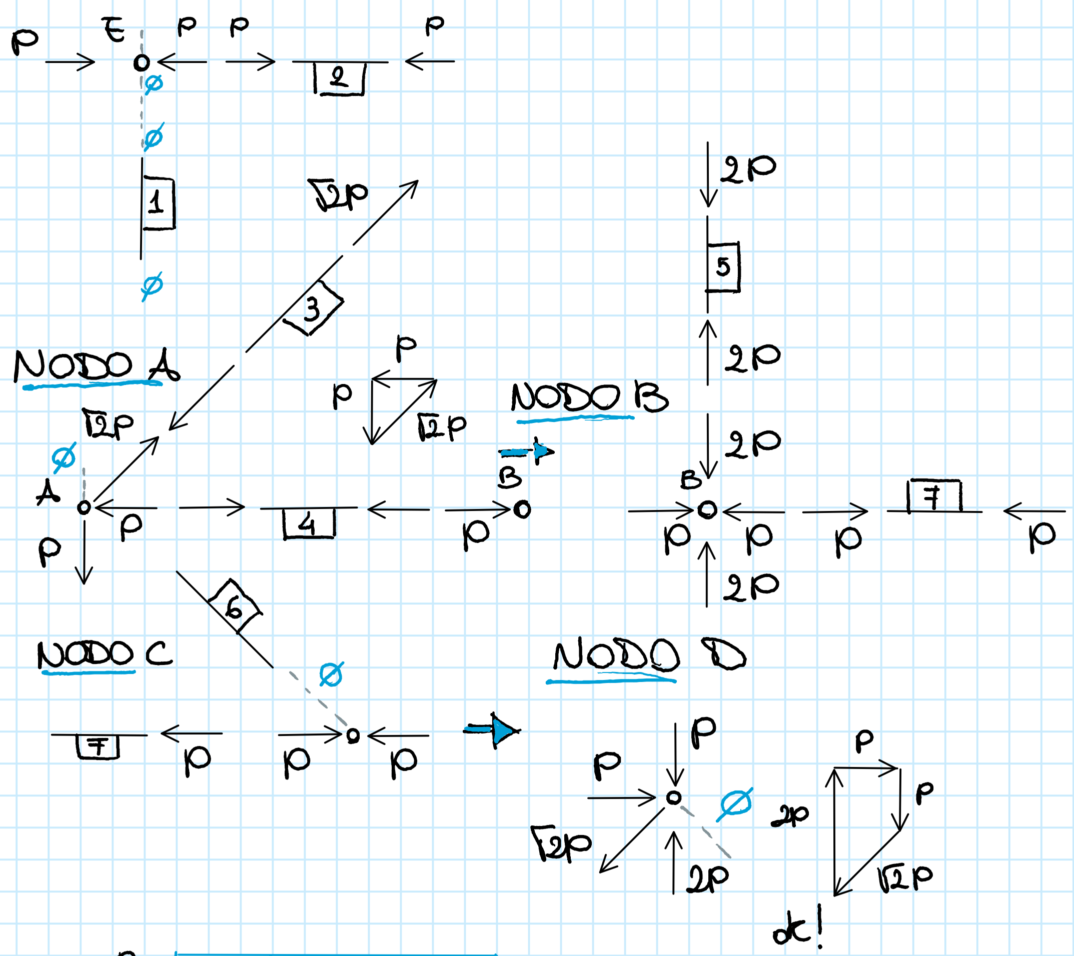
SISTEMA PRINCIPALE ISOSTATICO

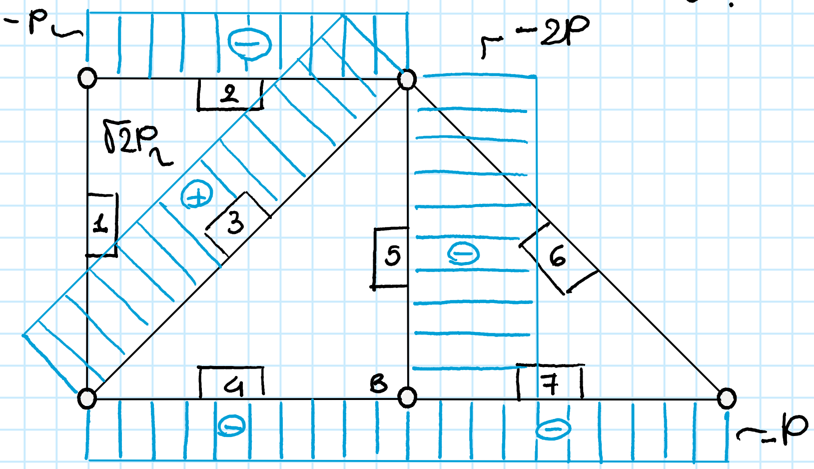


SCHEMA [0] SOLO CARICHI ESTERNI

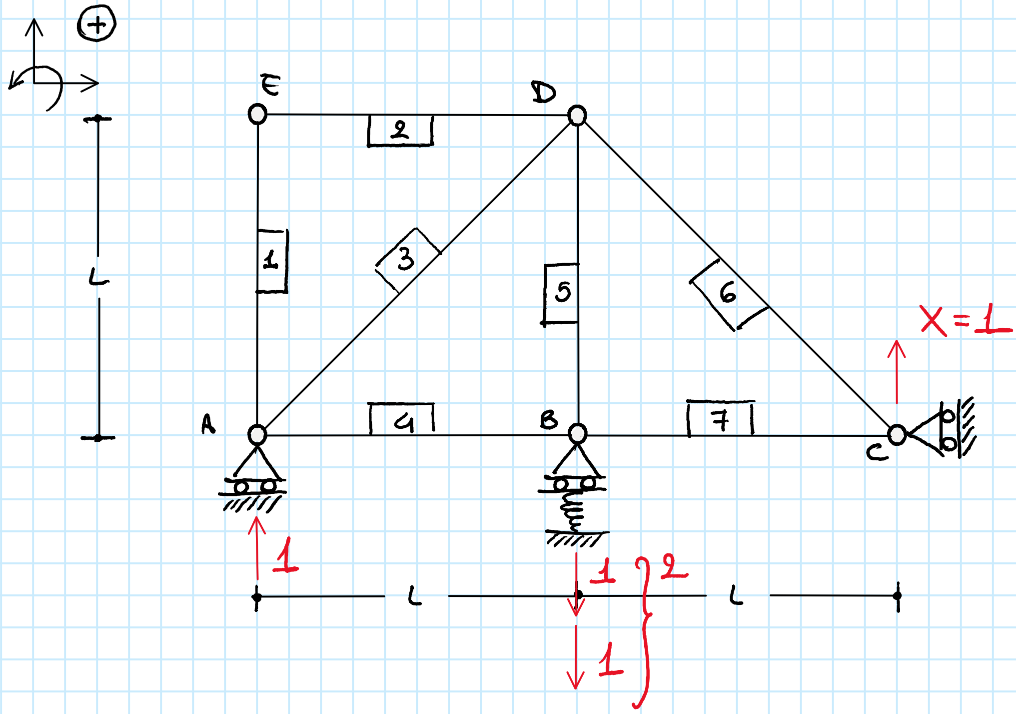


NODO E

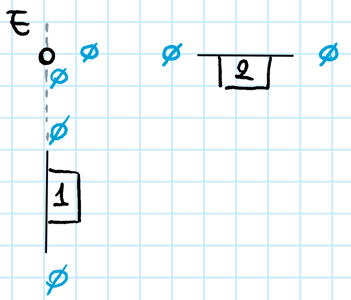

E
P
P
P
P
2
1
3
$\sqrt{2}P$
NODO A
A
P
$\sqrt{2}P$
4
P
P
6
NODO B
B
2P
5
2P
2P
7
P
P
P
P
2P
NODO C
7
P
P
P
NODO D
P
P
$\sqrt{2}P$
2P
2P
P
$\sqrt{2}P$
ok!


-P
-2P
2
$\sqrt{2}P$
1
3
5
6
4
B
7
-P

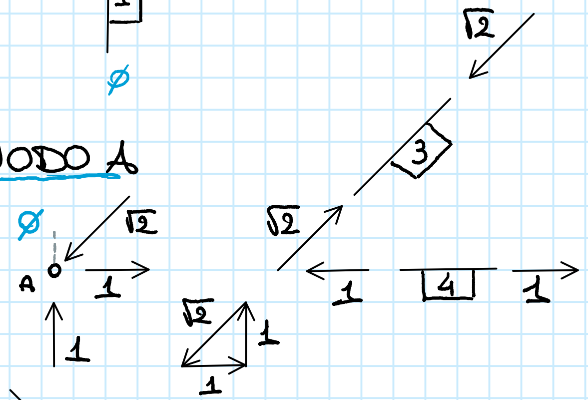
SCHEMA [1] SOLO X = 1



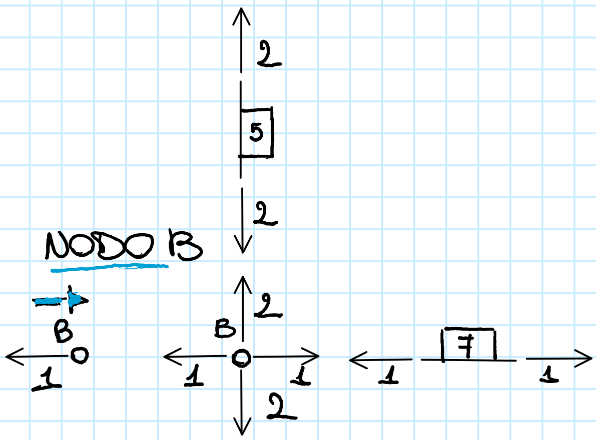
NODO E SCARICO



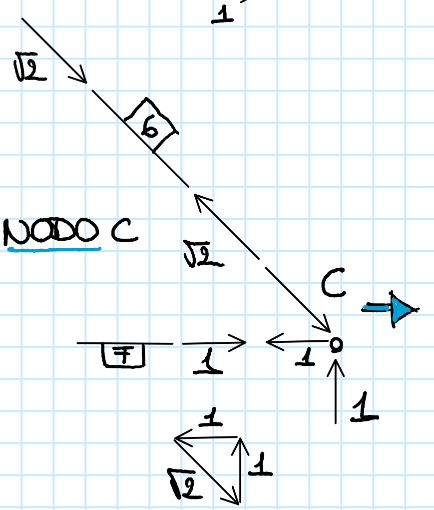
NODO A



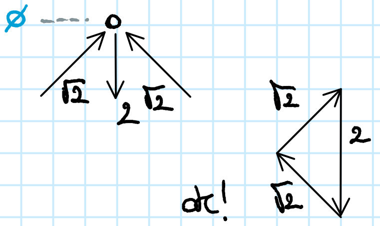
NODO B



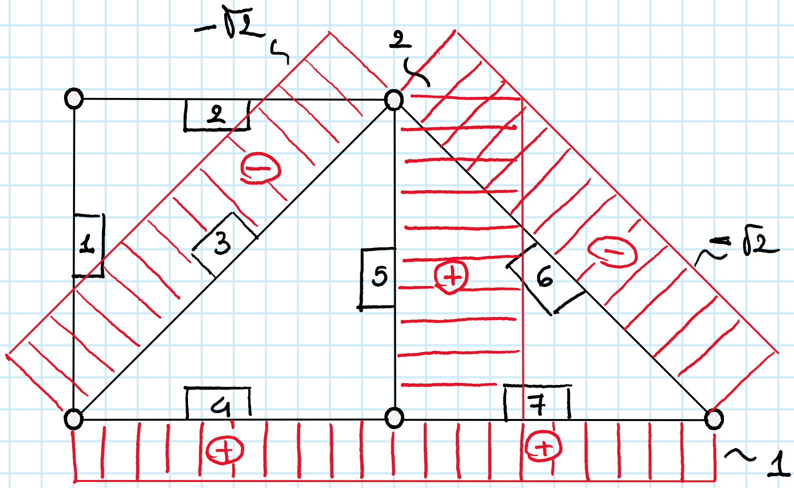
NODO C



NODO D



ok!



$$\underline{L_{ve}} = X \cdot \underbrace{\eta_c^{(r)}}_{\emptyset} + \sum_j R_j^{(f)} \cdot \eta_j^{(r)} =$$

$$= \underbrace{V_A^{(1)}}_{-1} \cdot \underbrace{\eta_A^{\circ}}_{\eta_A^{\circ}} + \underbrace{V_B^{(1)}}_{+2} \; \underbrace{\eta_B^{(r)}}_{\to\, -\varepsilon_B V_B^{(r)}} \qquad V_B^{(r)} \to \underbrace{V_B^{(0)}}_{-2p} + \underbrace{V_B^{(1)}}_{+2} X$$

$$= \underbrace{-\eta_A^{\circ} - 2\varepsilon(-2p+2X)}$$

$$\underline{L_{vi}} = \int_{Str} N^{(f)} \frac{N^{(r)}}{EA} \, dStr + \int_{Str} N^{(f)} \underbrace{\lambda^{(r)}}_{\downarrow\, +\alpha\Delta T \text{ nell'asta } 5} dStr =$$

$$= \sum_i N_i^{(f)} \left[\frac{N_i^{(r)} L_i}{EA} + \alpha \Delta T L_i \right] = \qquad \text{con } N_i^{(r)} = N_i^{(0)} + N_i^{(1)} X$$

$$= \sum_{i=1}^{7} N_i^{(1)} \frac{N_i^{(0)} L_i}{EA} + \left\{ \sum_{i=1}^{7} \frac{[N_i^{(1)}]^2}{EA} \right\} X + N_5^{(1)} \alpha \Delta T L_5 =$$

$$= N_3^{(1)} \frac{N_3^{(0)} L_3}{EA} + N_4^{(1)} \frac{N_4^{(0)} L_4}{EA} + N_5^{(1)} \frac{N_5^{(0)} L_5}{EA} + N_7^{(1)} \frac{N_7^{(0)} L_7}{EA} +$$

$$+ \left\{ [N_3^{(1)}]^2 L_3 + [N_4^{(1)}]^2 L_4 + [N_5^{(1)}]^2 L_5 + [N_6^{(1)}]^2 L_6 + [N_7^{(1)}]^2 L_7 \right\} \frac{X}{EA} + N_5^{(1)} \alpha \Delta T L_5 =$$

$$= \frac{1}{EA} \left\{ -\sqrt{2} \left(\sqrt{2} p \cdot \sqrt{2} L \right) + 1(-p \cdot L) + 2(-2p \cdot L) + 1(-p \cdot L) \right\} +$$

$$+ \frac{X}{EA} \left\{ [-\sqrt{2}]^2 \sqrt{2} L + [1]^2 L + [2]^2 L + [-\sqrt{2}]^2 \sqrt{2} L + [1]^2 L \right\} + 2 \alpha \Delta T L =$$

$$= \frac{1}{EA}\left\{-2\sqrt{2}PL - PL - 4PL - PL\right\} + \frac{X}{EA}\left\{2\sqrt{2}L + L + 4L + 2\sqrt{2}L + L\right\} + 2L\alpha\Delta T =$$

$$\underbrace{= \frac{PL}{EA}\left\{-2\sqrt{2} - 6\right\} + \frac{XL}{EA}\left\{4\sqrt{2} + 6\right\} + 2L\alpha\Delta T}$$

$$\alpha_{ve} = \alpha_{vi}$$

$$-\eta_A^\circ - 2\varepsilon(-2P + 2X) = \frac{PL}{EA}\left\{-2\sqrt{2} - 6\right\} + \frac{XL}{EA}\left\{4\sqrt{2} + 6\right\} + 2L\alpha\Delta T$$

$$-\frac{2LP\sqrt{2}}{EA} - \frac{L}{EA}\left[2\sqrt{2} + 3\right](-2P + 2X) = \frac{PL}{EA}(-2\sqrt{2} - 6) + \frac{XL}{EA}(4\sqrt{2} + 6) + 6\frac{PL}{EA}$$

$$-\frac{2\sqrt{2}PL}{EA} + \frac{PL}{EA}(4\sqrt{2} + 6) - \frac{XL}{EA}(4\sqrt{2} + 6) = \frac{PL}{EA}(-2\sqrt{2} - 6) + \frac{XL}{EA}(4\sqrt{2} + 6) + 6\frac{PL}{EA}$$

$$4\frac{XL}{EA}(2\sqrt{2} + 3) = \frac{PL}{EA}\left(-\cancel{2\sqrt{2}} + 4\sqrt{2} + 6 + \cancel{2\sqrt{2}} + \cancel{6} - \cancel{6}\right)$$

$$4\frac{XL}{EA}(2\sqrt{2} + 3) = 2\frac{PL}{EA}(2\sqrt{2} + 3)$$

$X = \frac{P}{2}$ Positivo, ok!