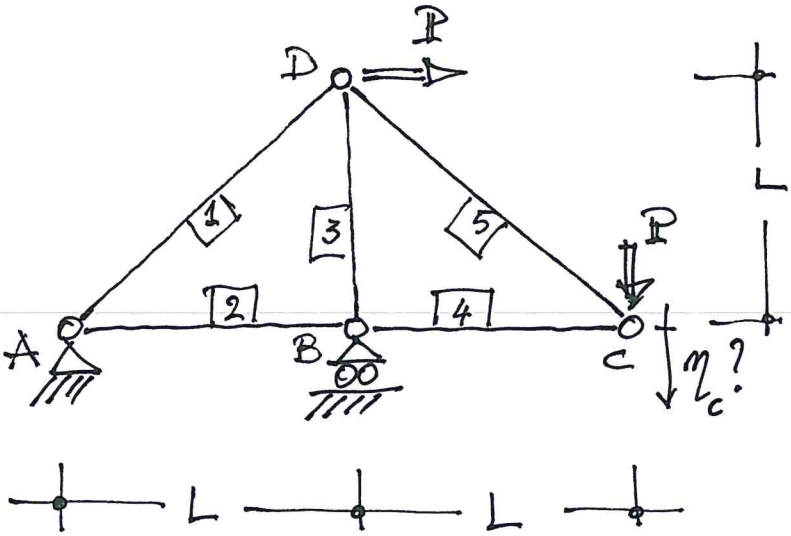
ESAMI 25.01.2017 - MECCANICA delle STRUTTURE
Corso P. FUSCHI - AA. 2016-17 - SOLUZIONE

QUESITO n. 2

DETERMINARE LO SPOSTAMENTO VERTICALE DEL NODO C DELLA STRUTTURA RETICOLARE IN FIGURA CON IL PLV (Metodo della forza Unitaria)

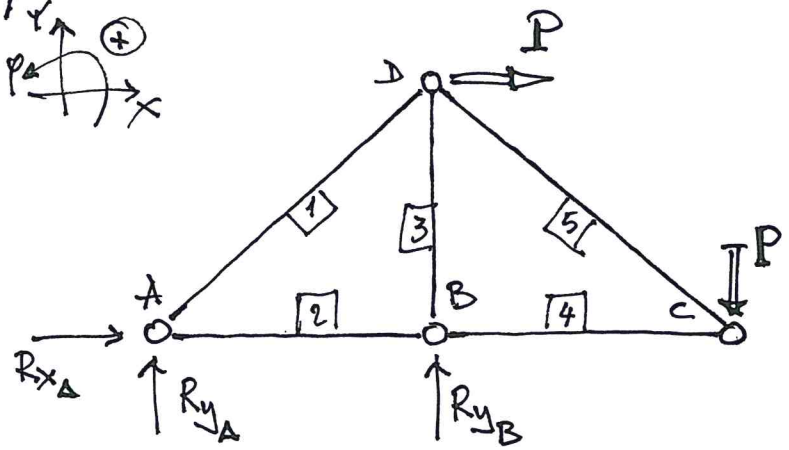
STRUTTURA REALE



EA = cost.

Sulla quale si valutano gli spost. generalizzati reali e la CD congruente espresse tramite la CS associata ai carichi reali!

➡ Calcoliamo RV e CS (solo sforzi normali) sulla struttura reale. Si ha:



$$\sum F_x = 0 \quad R_{x_A} + P = 0 \Rightarrow \boxed{R_{x_A} = -P}$$

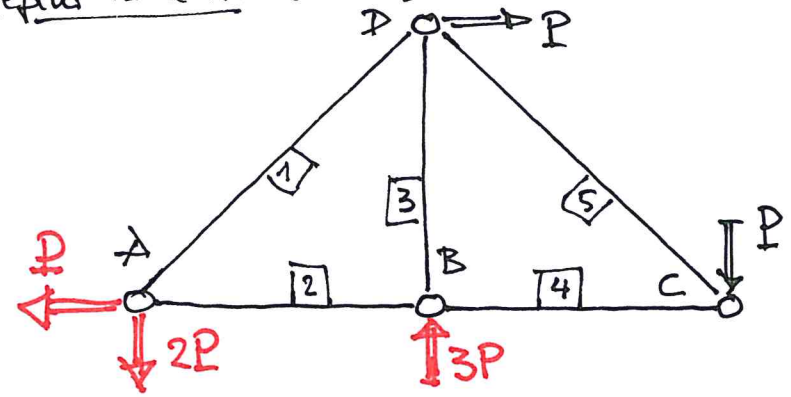
$$\sum F_y = 0 \quad R_{y_A} + R_{y_B} - P = 0$$

$$\sum M_A = 0 \quad R_{y_B} \cdot L - P \cdot L - P \cdot 2L = 0$$

$$\boxed{R_{y_B} = 3P}$$

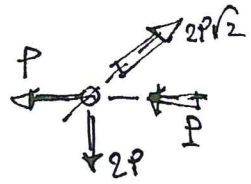
$$\boxed{R_{y_A} = P - R_{y_B} = P - 3P = -2P}$$

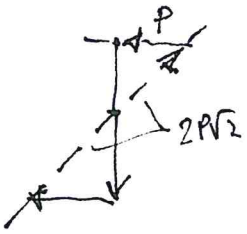
Le RV sul sistema reale sono:

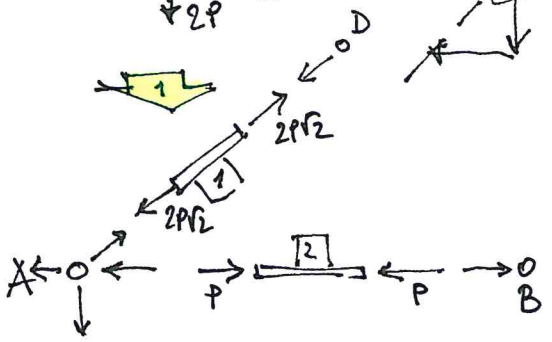


Applicando il metodo dell'equilibrio ai nodi si calcola: PUSCHI PISANO

NODO A

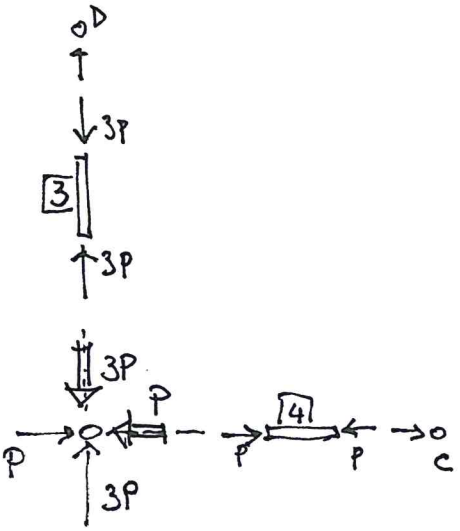






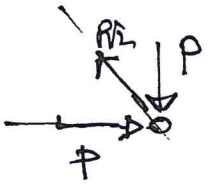
2

NODO B



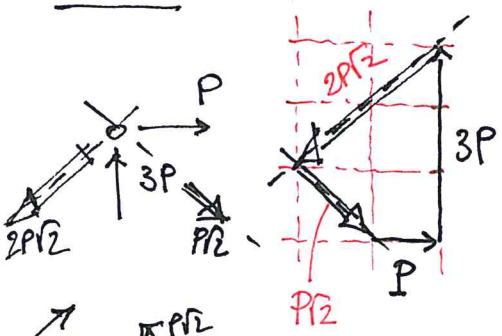
3

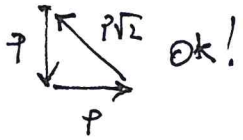
NODO D

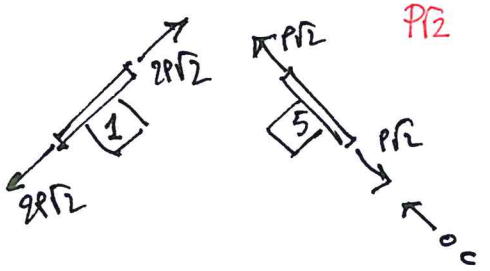


VERIFICA NODO C

4







Sul sistema reale si ha quindi:

ASTA	SFORZO	COMPORTAMENTO MECCANICO
1	$2P\sqrt{2}$	TIRANTE
2	$-P$	PUNTONE
3	$-3P$	PUNTONE
4	$-P$	PUNTONE
5	$P\sqrt{2}$	TIRANTE

$N_i^{(r)}$ REALI! DA CUI LE CD REALI

$$\frac{N_i^{(r)} L_i}{EA_i}$$

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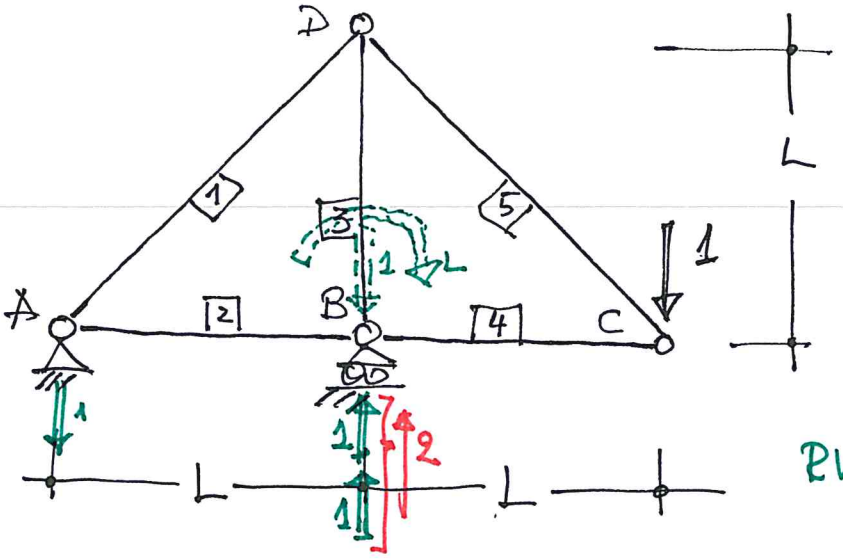
Per calcolare lo spostamento verticale del nodo C si assume come sistema fittizio o lavorante quello riportato nella figura seguente nella quale si considera una forza unitaria applicata in C e diretta verso il basso !

STRUTTURA FITTIZIA O SISTEMA LAVORANTE

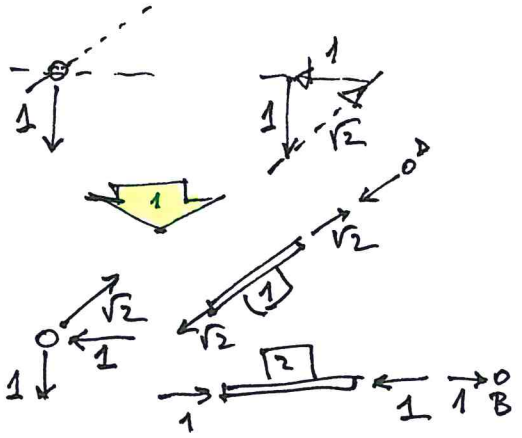
Usato per definire forze e CS equilibrate



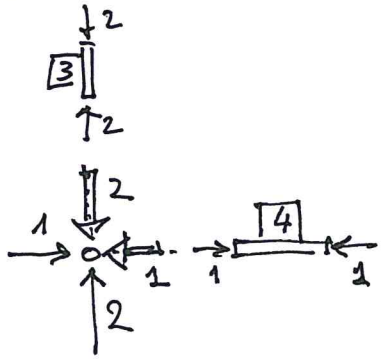
PV per via grafica!

Applicando il metodo dell'equilibrio ai nodi si calcola:

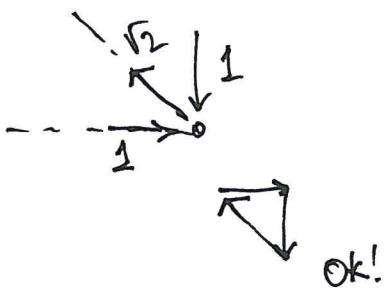
NODO A



2 NODO B

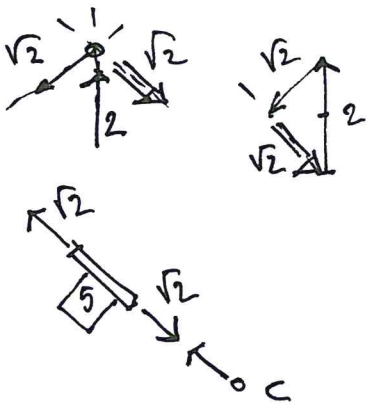


3 NODO D



ok!

VERIFICA NODO C 4



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Sul sistema labile si ha in definitiva:

ASTA	SFORZO	COMPORTAMENTO MECCANICO
1	$\sqrt{2}$	TIRANTE
2	-1	PUNTONE
3	-2	PUNTONE
4	-1	PUNTONE
5	$\sqrt{2}$	TIRANTE

$\Rightarrow N_i^{(f)}$

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

$$1 \cdot \eta_C = \sum_{i=1}^{5} N_i^{(f)} \frac{N_i^{(r)} L_i}{EA} =$$

$$= \sqrt{2} \cdot \left[\frac{2P\sqrt{2} \cdot L\sqrt{2}}{EA} \right] + [-1] \left[\frac{-P \cdot L}{EA} \right] + [-2] \left[\frac{-3P \cdot L}{EA} \right] +$$

$$+ [-1] \cdot \left[\frac{-P \cdot L}{EA} \right] + \sqrt{2} \left[\frac{P\sqrt{2} \cdot L\sqrt{2}}{EA} \right] =$$

$$= \frac{PL}{EA} \left[4\sqrt{2} + 1 + 6 + 1 + 2\sqrt{2} \right] = \frac{PL}{EA} \left[6\sqrt{2} + 8 \right]$$

positivo → concorde alla $F = 1$ → VERSO IL BASSO!