

# ESERCITAZIONE DEL 18-10-2011

Mechanica  
dei Solidi:

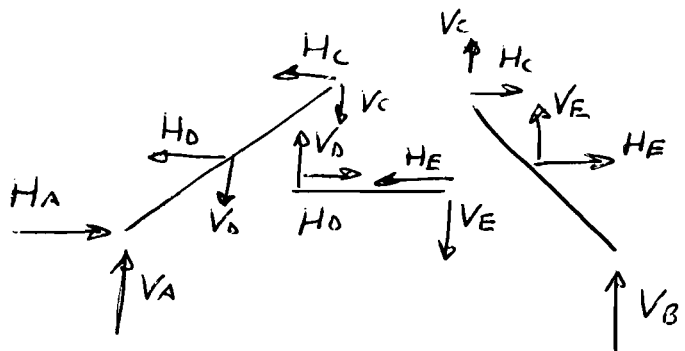
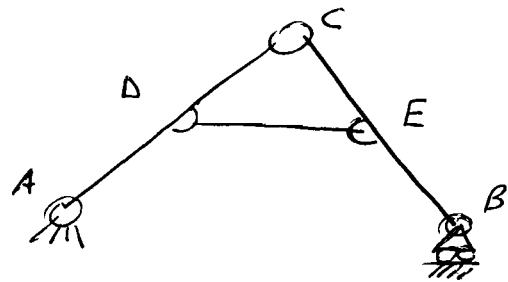
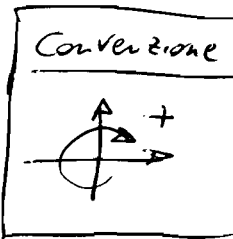
"CALCOLO DELLE REAZIONI VINCOLARI  
IN STRUTTURE ISOSTATICHE".

Bov. 53

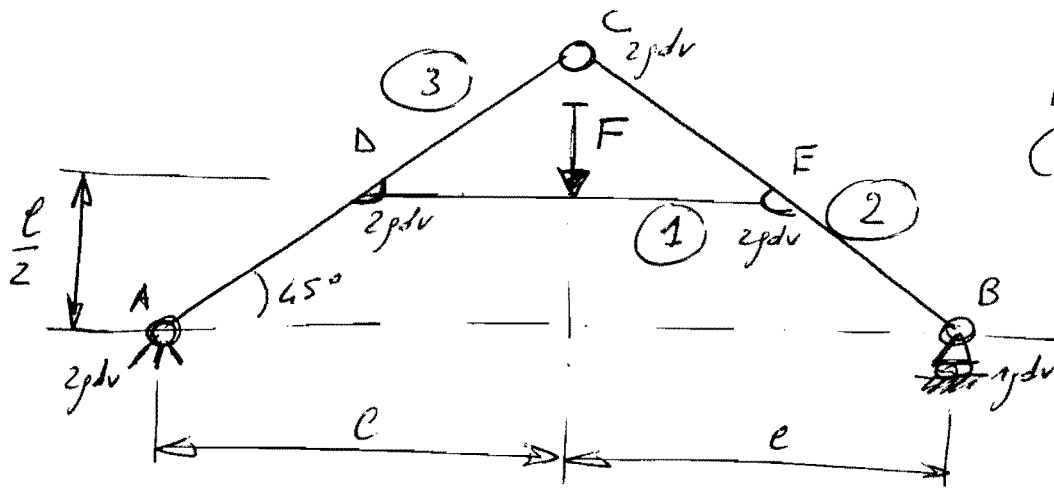
SIMBOLOGIA:

Equazioni di equilibrio:

$$\begin{cases} \sum X = 0 \\ \sum Y = 0 \\ \sum M_P = 0 \end{cases}$$



# ESERCIZIO 1:

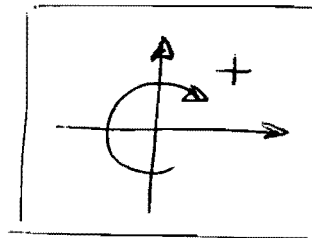


$9 q d v l = 9 q d v$   
 $\downarrow$   
 ISOSTATICA  
 (Arco A 3  
 cerniere come  
 Appendice ISOSTATICA)

Equazioni di Equilibrio:

$$\begin{cases} \sum X = 0 \\ \sum Y = 0 \\ \sum M_p = 0 \end{cases}$$

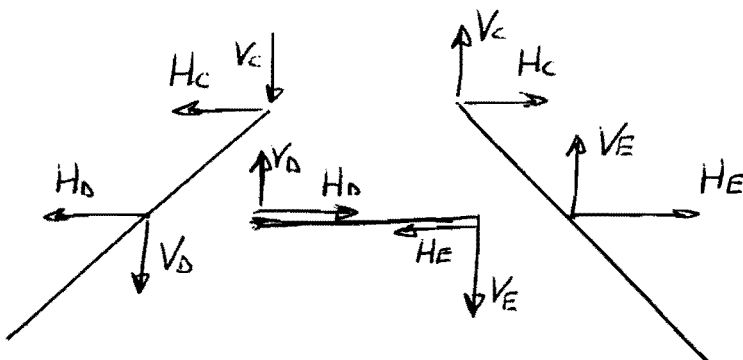
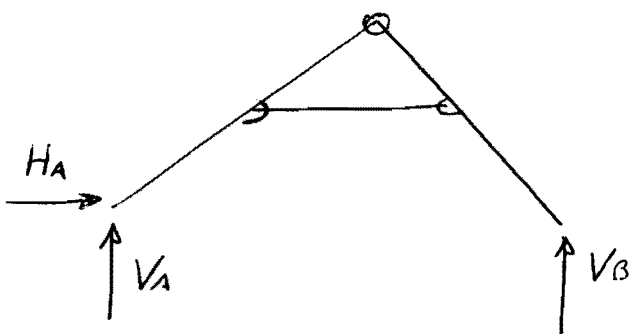
Convenzione di Segno



FASE 1: Individuare le Forze in gioco:

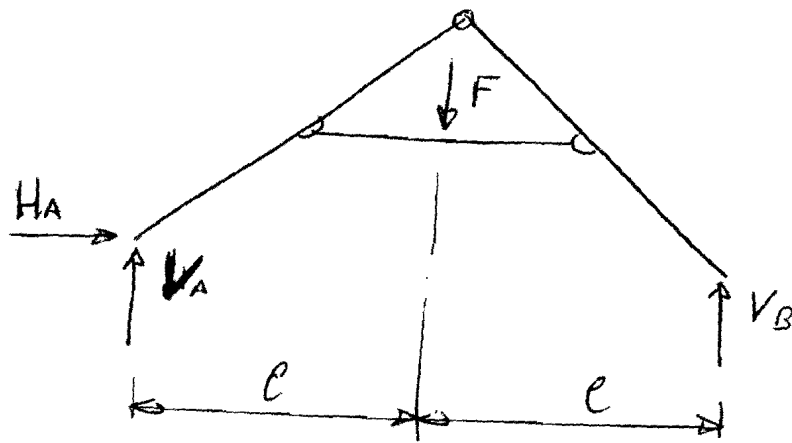
A Terra:

Interne:



Forze Agenti sulla struttura = Reazioni Vincolari a Terra + Reazioni Interne + Carichi esterni.

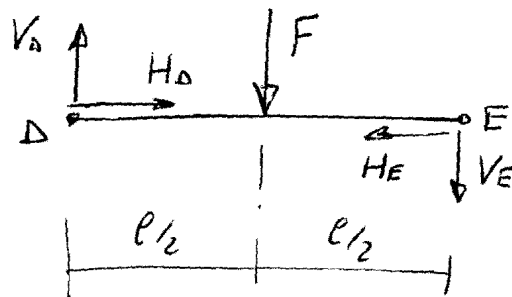
FASE 2 : Scrittura delle equazioni di equilibrio  
Globali :



$$\begin{cases} \sum X = 0 \\ \sum Y = 0 \\ \sum M_A = 0 \end{cases} \begin{cases} H_A = 0 \\ V_A + V_B - F = 0 \\ -V_B \cdot 2l + F \cdot l = 0 \end{cases} \begin{cases} " \\ " \\ V_B \cdot 2l = F \cdot l \end{cases} \begin{cases} " \\ " \\ V_B = \frac{F}{2} \end{cases}$$

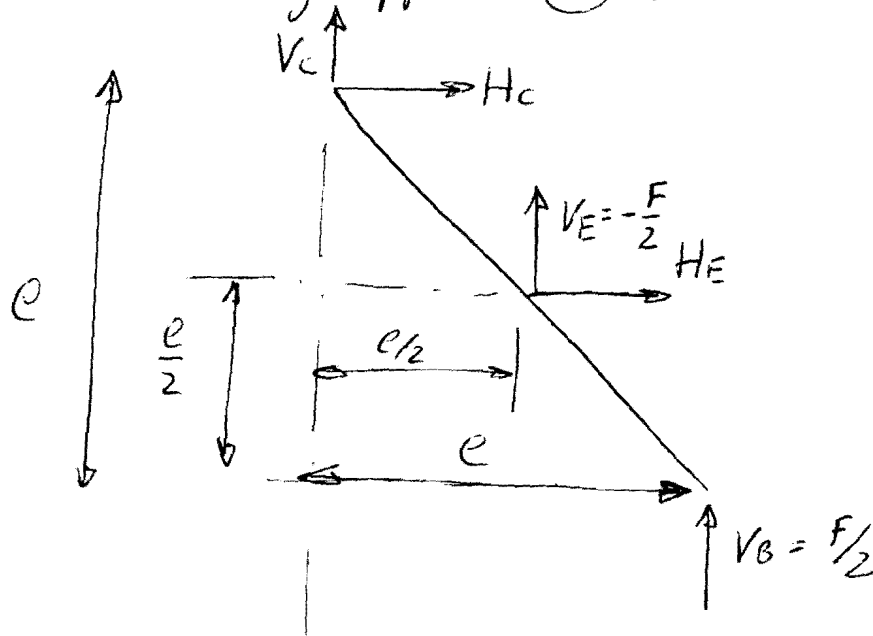
$$\begin{cases} H_A = 0 \\ V_A = F - V_B = F - \frac{F}{2} = \frac{F}{2} \\ V_B = \frac{F}{2} \end{cases}$$

FASE 3 : Scrittura delle equazioni di equilibrio  
per l'ASTA (1) :



$$\begin{cases} \sum X = 0 \\ \sum Y = 0 \\ \sum M_D = 0 \end{cases} \begin{cases} H_D - H_E = 0 \\ V_D - V_E - F = 0 \\ F \cdot \frac{l}{2} + V_E \cdot l = 0 \end{cases} \begin{cases} H_D - H_E = 0 \\ V_D = F + V_E = F - \frac{F}{2} = \frac{F}{2} \\ V_E = -\frac{F}{2} \end{cases}$$

FASE 4 : Scrivere equazioni di equilibrio per il gruppo (2) :



$$V_E = -\frac{F}{2}$$

$$V_B = \frac{F}{2}$$

$$\begin{cases} \sum X = 0 \\ \sum Y = 0 \\ \sum M_C = 0 \end{cases} \begin{cases} H_C + H_E = 0 \\ V_C + V_E + \frac{F}{2} = 0 \\ -V_E \cdot \frac{e}{2} - H_E \cdot \frac{e}{2} - V_B \cdot e = 0 \end{cases}$$

~~$H_C = -H_E$~~   
 ~~$V_C = 0$~~   
 ~~$\frac{F}{2} - \frac{F}{2} = H_E \frac{e}{2}$~~

$$\begin{cases} H_C = -H_E \\ V_C - \frac{F}{2} + \frac{F}{2} = 0 \\ \frac{F}{2} \frac{e}{2} - H_E \cdot \frac{e}{2} - \frac{F}{2} e = 0 \end{cases} \begin{cases} H_C = -H_E \\ V_C = 0 \\ \frac{F}{4} - \frac{F}{2} = H_E \frac{e}{2} \end{cases} \begin{cases} H_C = -H_E \\ V_C = 0 \\ -\frac{F}{4} = H_E \frac{e}{2} \end{cases}$$

$$\begin{cases} H_C = -H_E = \frac{F}{2} \\ V_C = 0 \\ H_E = -\frac{F}{2} \end{cases}$$

Nota  $H_E$ , posso utilizzare la 1° equazione di equilibrio scritta per il gruppo (1) per valutare  $H_D$  :

$$H_D - H_E = 0$$

→

$$H_D = H_E = -\frac{F}{2}$$

Ho attempt :

$$V_A = V_B = \frac{F}{2}$$

$$H_A = 0$$

$$V_E = V_D = -\frac{F}{2}$$

$$H_E = -\frac{F}{2}$$

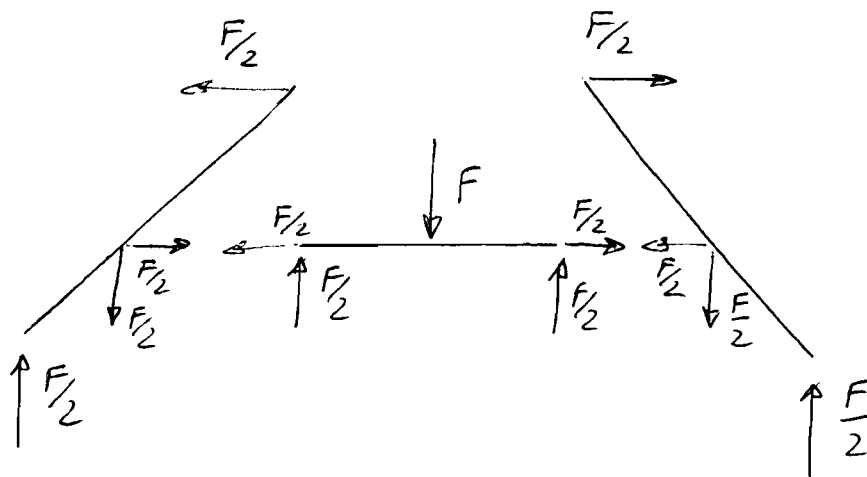
$$H_D = -\frac{F}{2}$$

$$H_C = \frac{F}{2}$$

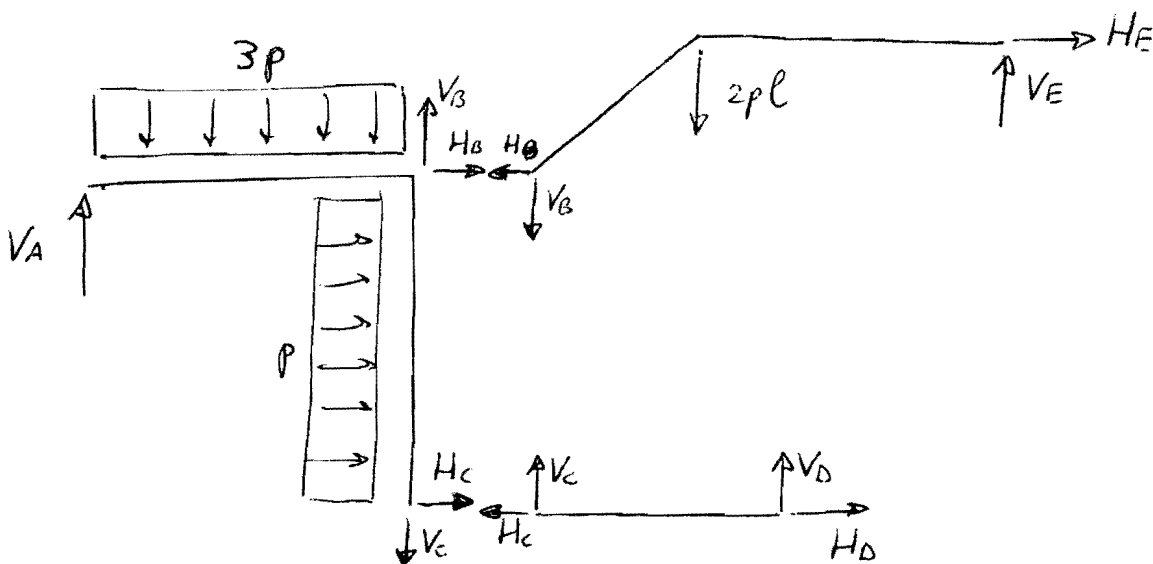
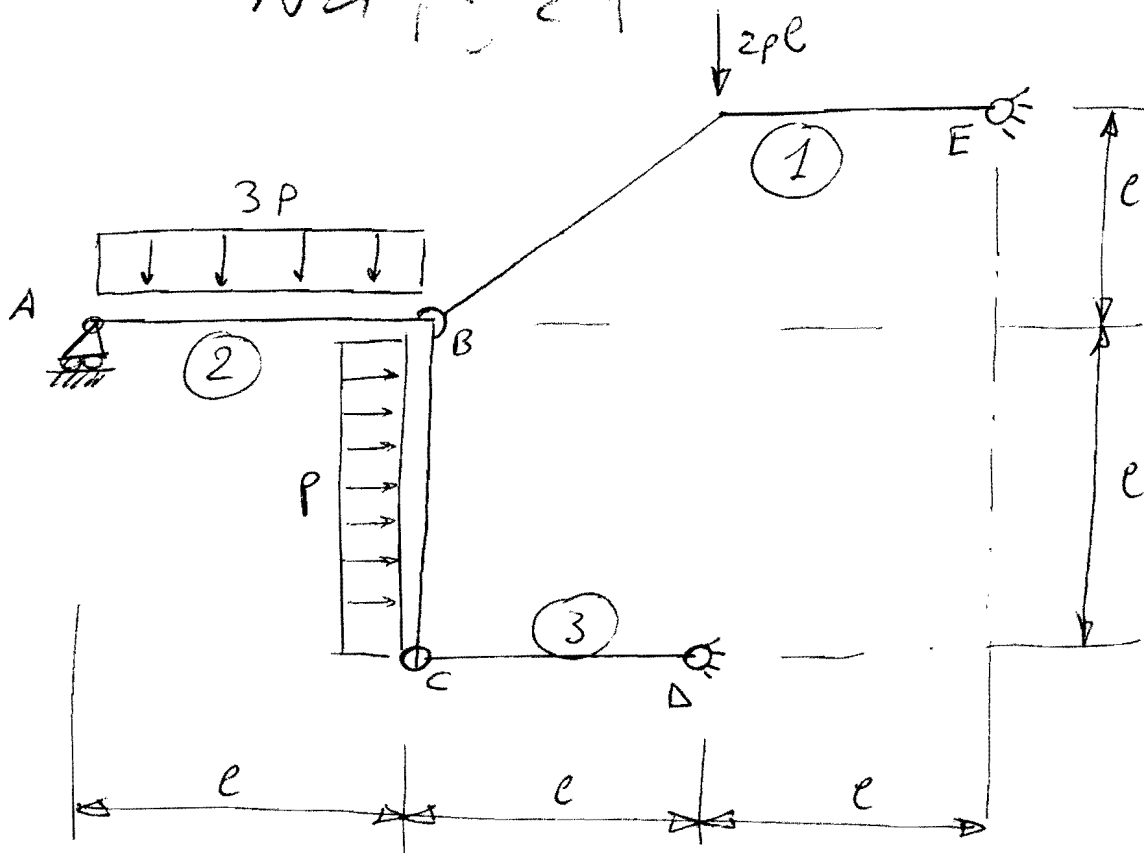
$$V_C = 0$$



Overview :

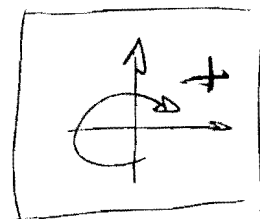
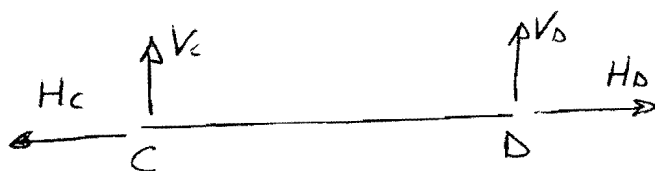


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OSSERVAZIONI:

- 1) CD è una bicella, e come tale può solo trasmettere forze assiali.



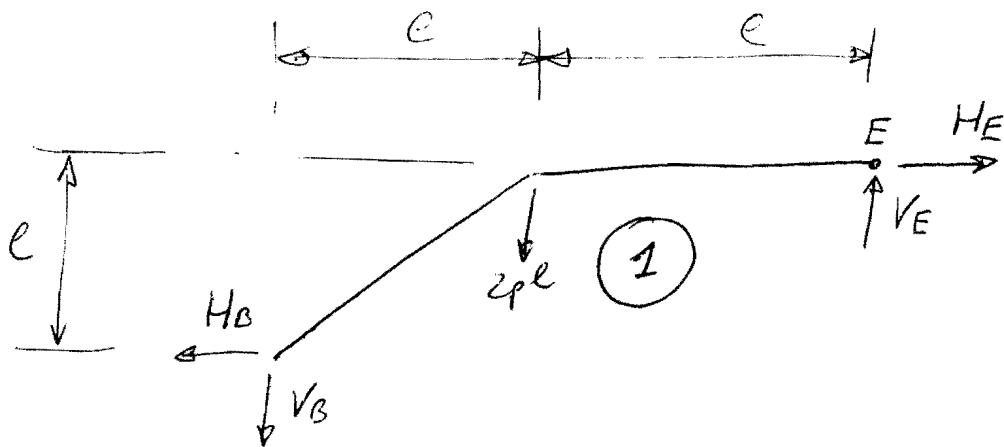
$$\sum M_c = 0$$

$$-V_d \cdot e = 0 \rightarrow V_d = 0 \rightarrow \sum Y = 0 \rightarrow V_c = -V_d = 0$$

2) Se  $V_C$  e  $V_S$  sono nulle, sulle aste  
 (1) e (2) Agiscono 4 Forze incognite  
 (4 per (1) e 4 per (2)). Se scrivo il  
 sistema delle equazioni di equilibrio per (1)  
 o per (2) ottengo 3 equazioni, quindi al  
 max potrei risolvere 3 incognite; Devo  
 dunque scrivere un sistema di 4 equazioni.  
~~Ma~~ Mi occorre una equazione Auxiliaria

### FASE 1:

Come equazione Auxiliaria per risolvere il  
 gruppo (2) utilizzo l'equazione di  
 equilibrio alla rotazione di (1) rispetto ad E



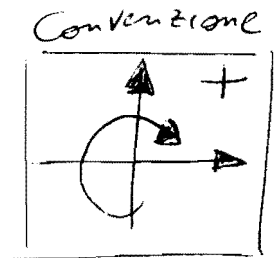
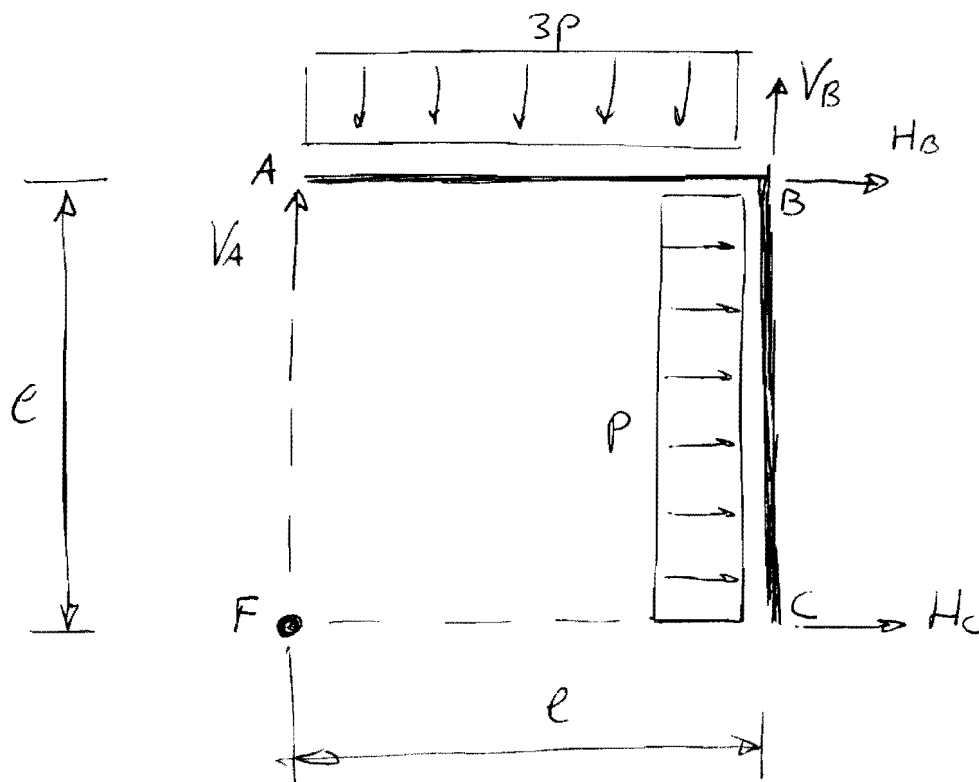
eq. Auxiliaria:  
 PER (2):

$$\sum M_E = 0 \rightarrow -2pl^2 - 2 \cdot V_B \cdot l + H_B \cdot l = 0$$

$$\boxed{H_B = 2pl + 2V_B}$$

## FASE 2:

Scrivo il Sistema Risolutivo del gruppo (2),  
utilizzando l'eq. ausiliaria.



$$\begin{cases} \sum X = 0 \\ \sum Y = 0 \\ \sum M_F = 0 \\ H_B = 2pl + 2V_B \end{cases} \begin{cases} H_C + H_B + pl = 0 \\ V_A + V_B - 3pl = 0 \\ 3pl \frac{e^2}{2} + pl \frac{e^2}{2} - V_B \cdot e + H_B \cdot e = 0 \\ H_B = 2pl + 2V_B \end{cases}$$

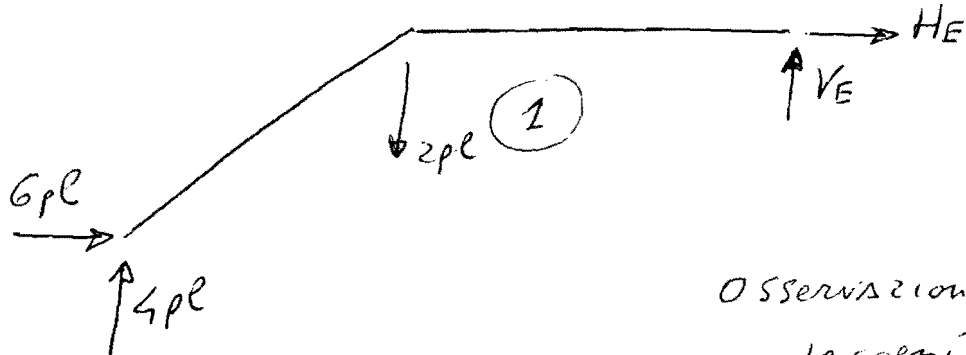
$$\begin{cases} \Rightarrow \\ \Rightarrow \\ \frac{3}{2}pl + \frac{1}{2}pl - V_B + 2pl + 2V_B = 0 \\ H_B = 2pl + 2V_B \end{cases} \begin{cases} \Rightarrow \\ \Rightarrow \\ 2pl + V_B + 2pl = 0 \\ \Rightarrow \end{cases}$$

$$\begin{cases} \Rightarrow \\ \Rightarrow \\ V_B = -4pl \\ H_B = 2pl - 8pl = -6pl \end{cases} \begin{cases} H_C = -pl - H_B = -pl + 6pl = 5pl \\ V_A = 3pl - V_B = 3pl + 4pl = 7pl \\ V_B = -4pl \\ H_B = -6pl \end{cases}$$

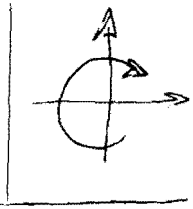


### FASE 3:

Spunto la Risoluzione Appena effettuata  
per ~~R~~ volutore HE e VE:



Convenzioni



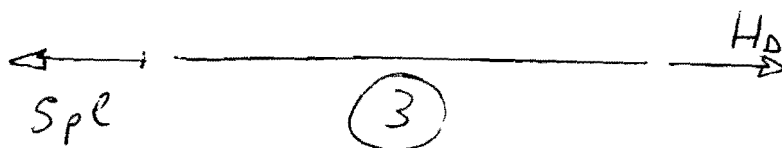
Osservazione: 2  
incognite, mi  
servono solo  
2 equazioni:

$$\begin{cases} \sum X = 0 \\ \sum Y = 0 \end{cases} \begin{cases} 6pl + HE = 0 \\ 4pl - 2pl + VE = 0 \end{cases}$$

$$\begin{cases} HE = -6pl \\ VE = 2pl - 4pl = -2pl \end{cases}$$

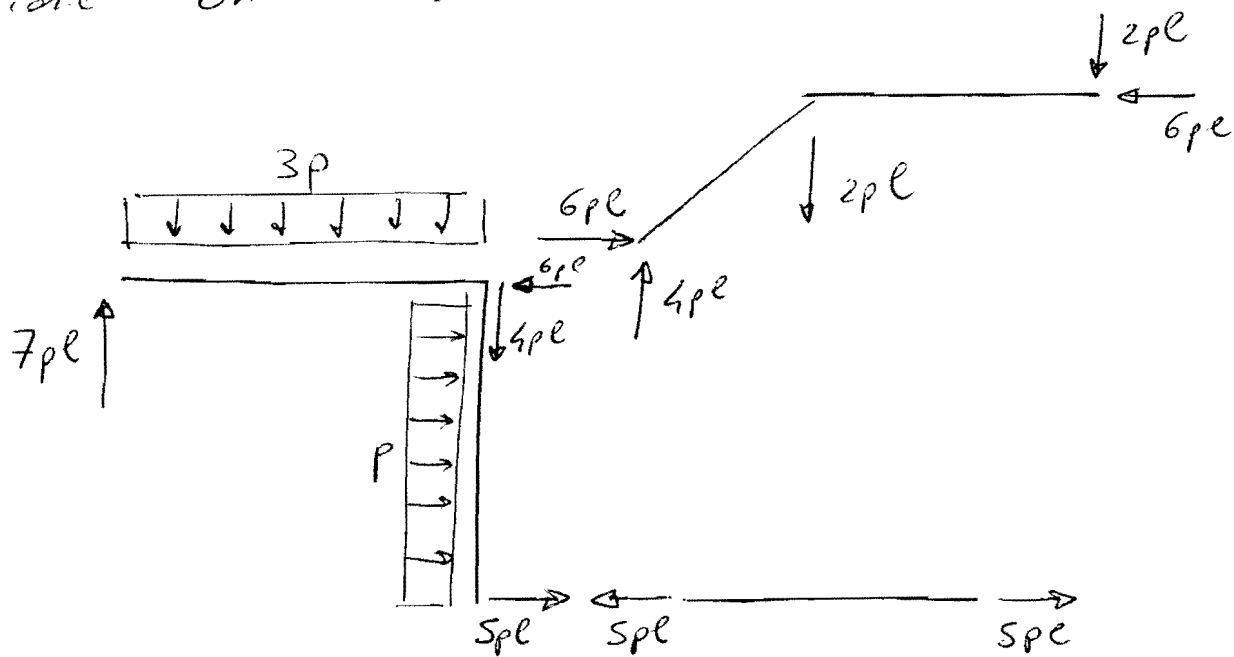
### FASE 4:

"Risolvo" LA biella

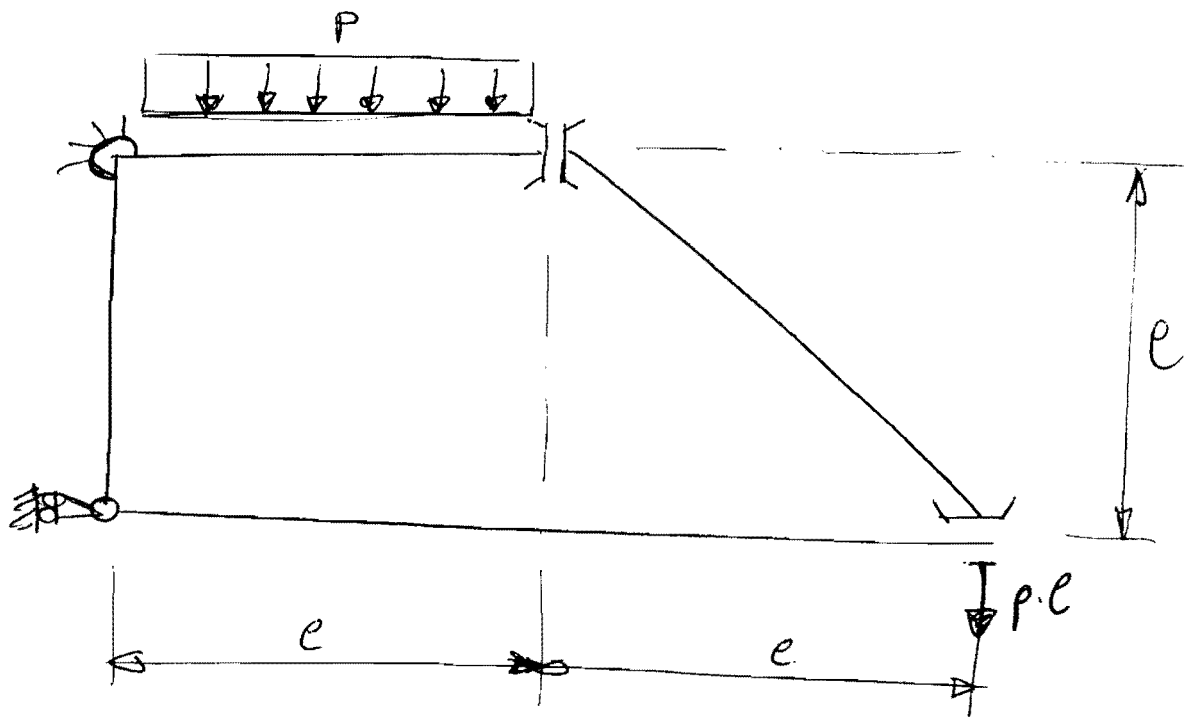


$$\begin{aligned} \sum X = 0 & : HD - 5pl = 0 \\ HD & = 5pl \end{aligned}$$

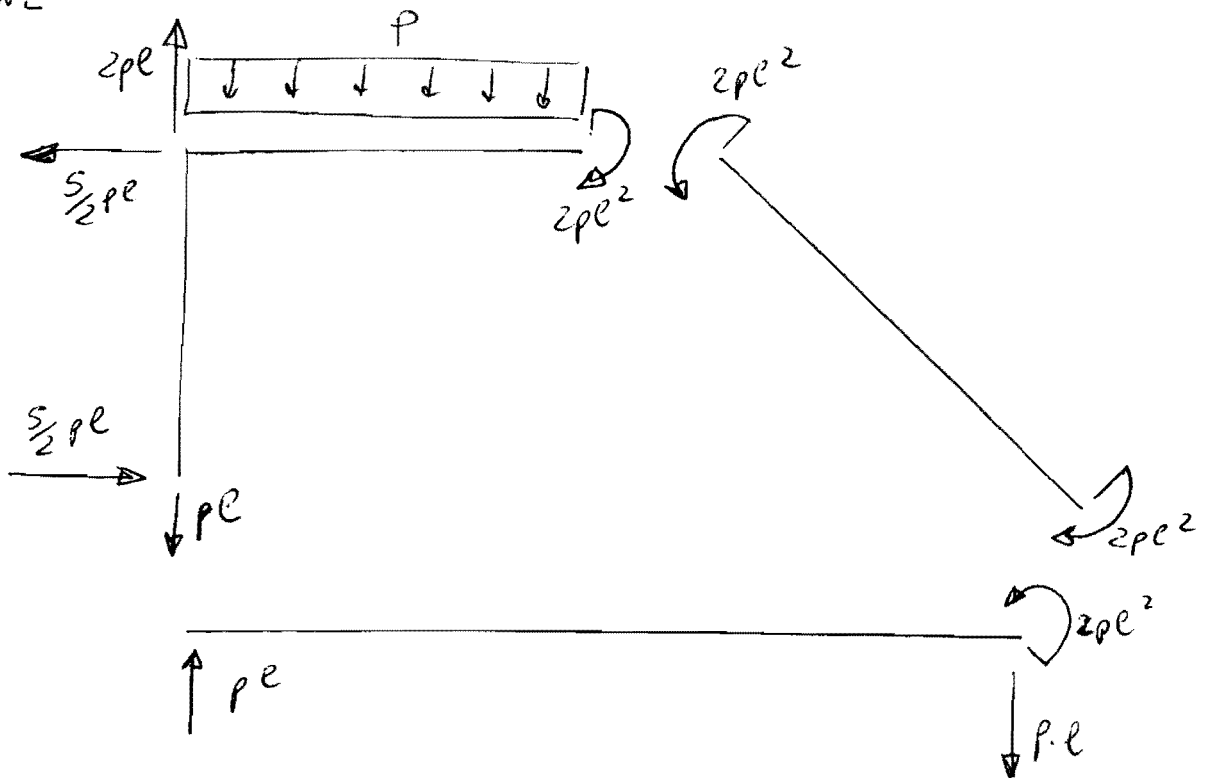
Soluzione ottenuta :



# ESERCIZIO 3:



SOLUZIONE



Ricorda di

Spremere perché l'asta obliqua non trasmette forze.