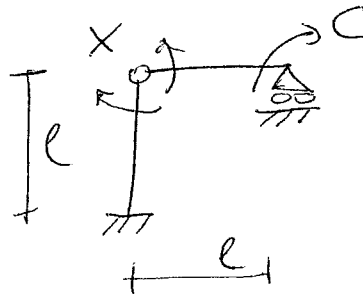
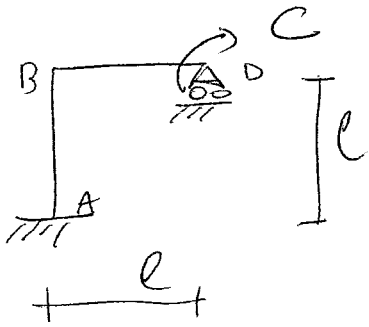
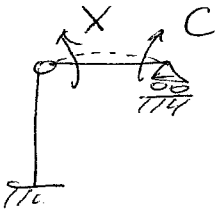


ESERCIZIO

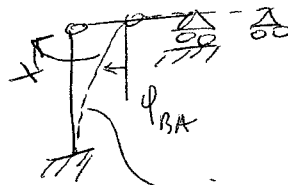
(TEMA 10) (NODI SPOTABILI)



S.P.
congruente:
 $\varphi_{BA} = \varphi_{BD}$



$$\varphi_{BD} = + \frac{Xl}{3EI} + \frac{Cl}{6EI}$$

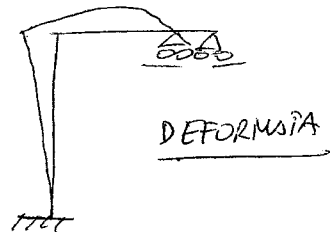
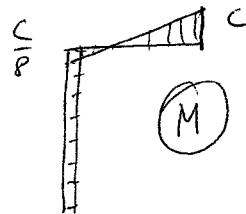
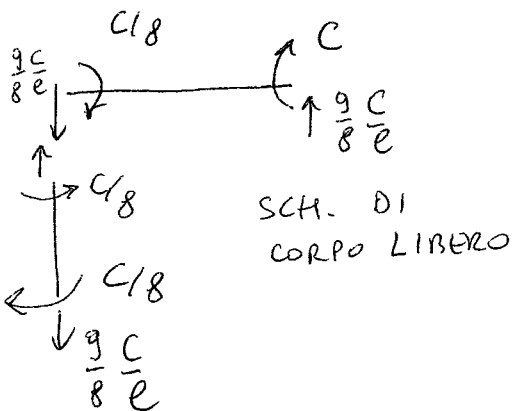
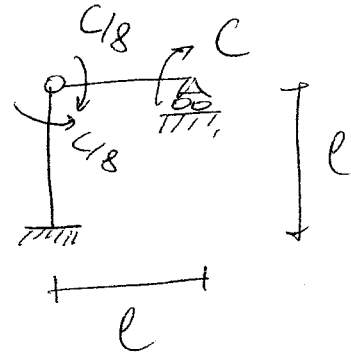


si comporta come
una mensola

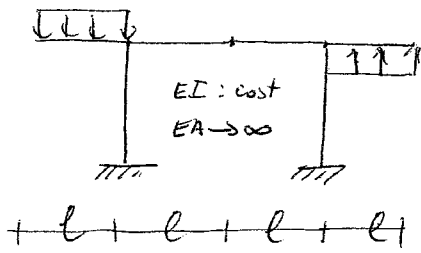
$$\varphi_{BA} = - \frac{Xl}{EI}$$

$$\varphi_{BD} = \varphi_{BA} : \frac{1}{3} + \frac{C}{6} = -X$$

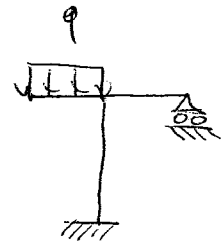
$$\frac{1}{3}X = -\frac{C}{6} \quad X = -\frac{C}{8}$$



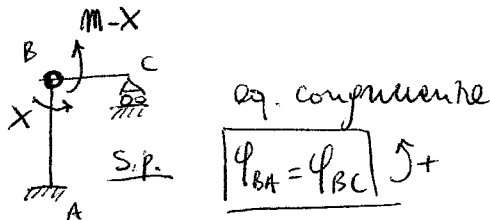
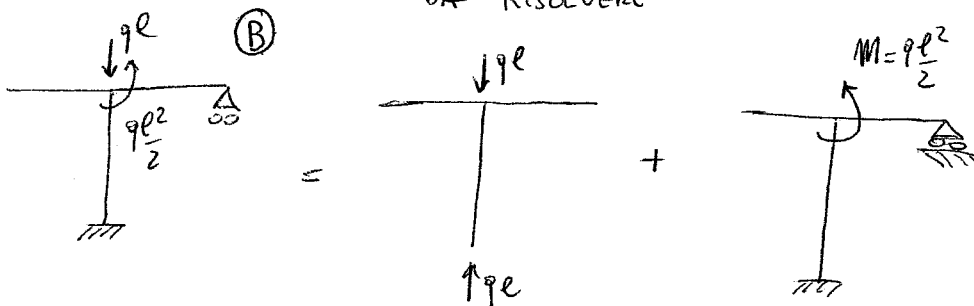
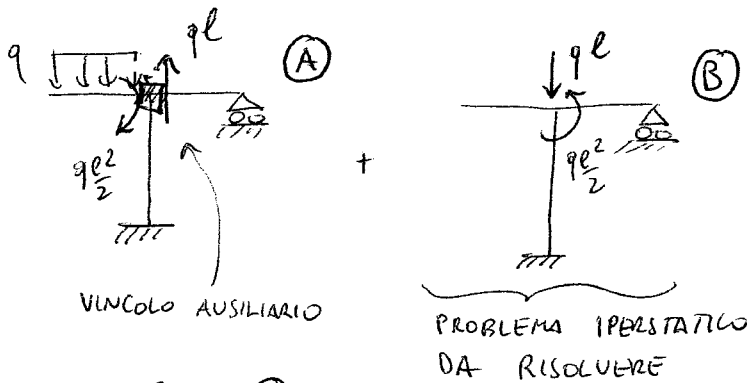
ESERCIZIO (TELAIO A NODI SPOSTABILI)



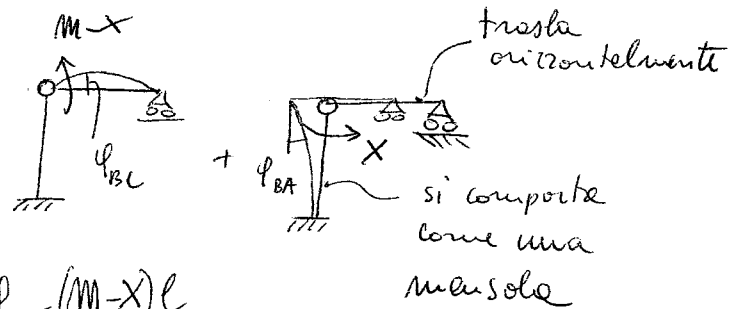
STR. SIMM. CARICATA
ANTISIMM.



STR. 4 V. STAT. INDET.
TELAIO A NODI SPOSTABILI



$$\phi_{BA} = \phi_{BC} \quad \uparrow +$$

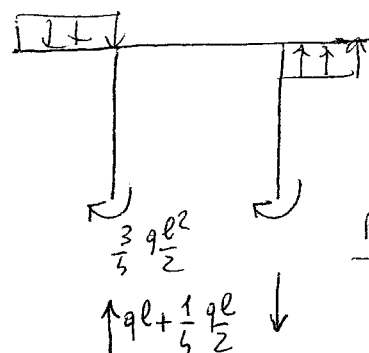
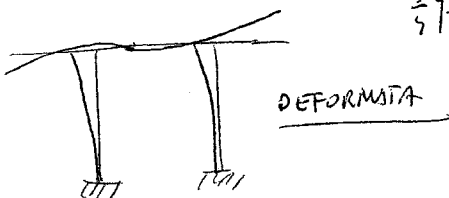
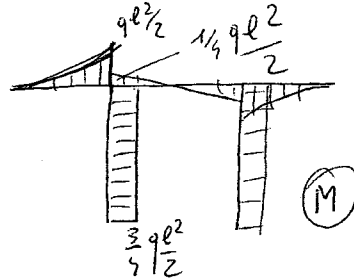
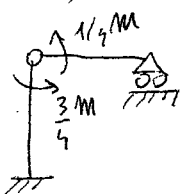


$$\phi_{BC} = \frac{(M-X)l}{3EI}$$

$$\phi_{BA} = -\frac{Xl}{EI}$$

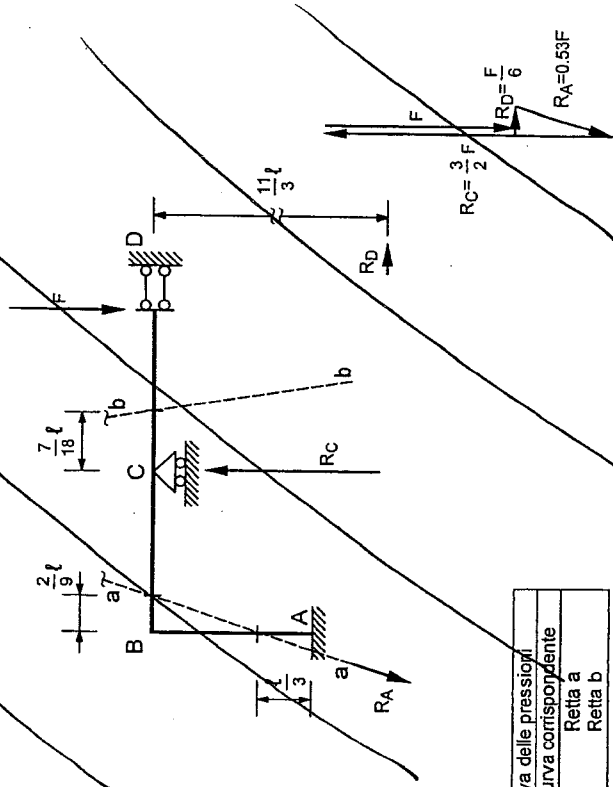
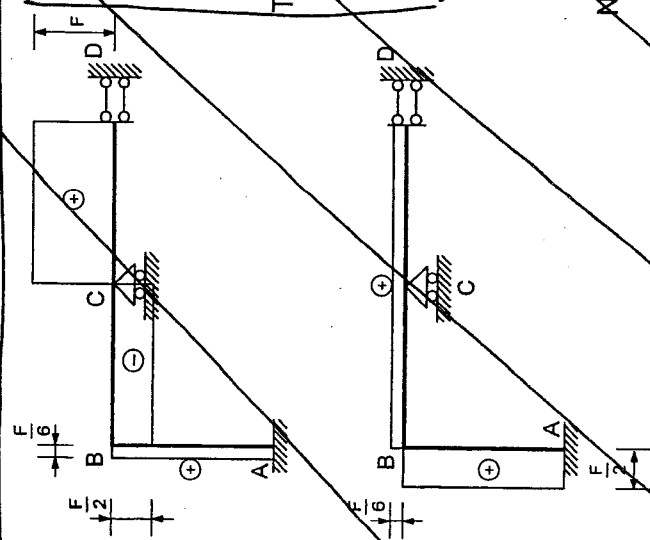
$$\phi_{BC} = \phi_{BA}$$

$$\frac{(M-X)l}{3EI} = \frac{Xl}{EI} \rightarrow M = \frac{4}{3}X \rightarrow X = \frac{3}{4}M$$



NEGLI ESERCIZI CHE SEGUONO NON È IN PROGRAMMA LA DETERMINAZIONE DELLA L.D.P. I CASI LIMITE DEI VINCOLI ELASTICI SONO UTILI PER

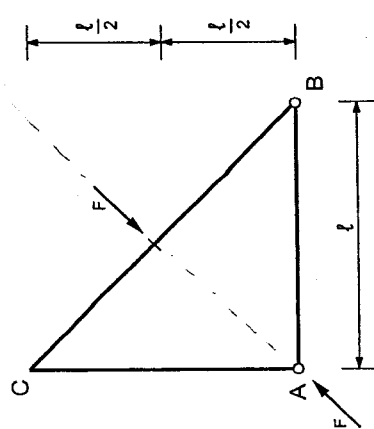
CAPIRE IL COMPORTAMENTO DELLA STRUTTURA IN UN TEMA D'ESAME K VERRÀ INDICATO NEL TESTO



Curva delle pressioni	
Tratto	Curva corrispondente
ABC	Retta a
CD	Retta b

1.3

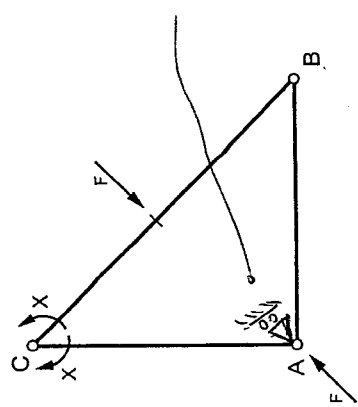
STRUTTURA AUTOEQUILIBRATA 1V. STAT. DET. (IPERSTATICA INTERNA)



Reticolare associata

S.P.

CARICATO INTRODOTTI PER BLOCCARE IL MOTO RIGIDO (NON REAGISCE, È SCARICATO)



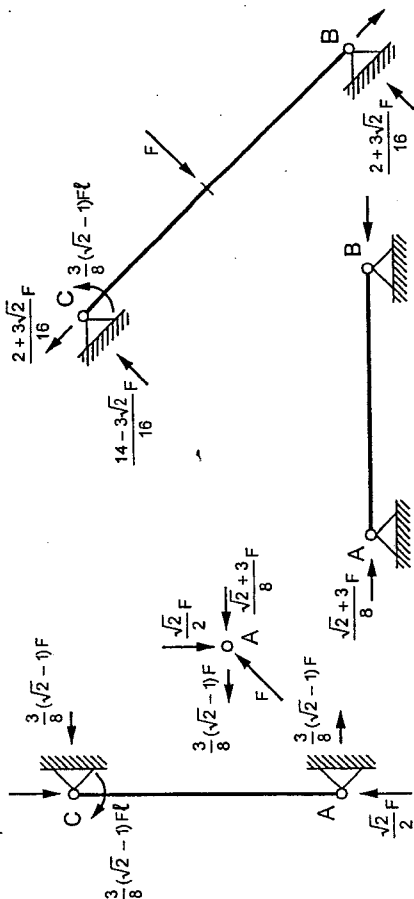
Telaio a nodi fissi.

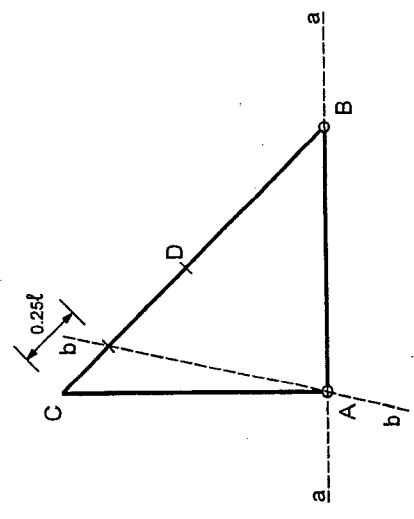
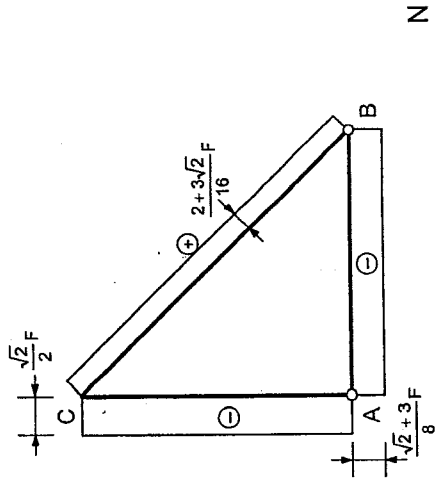
Equazione di congruenza angolare nel nodo C:

$$\varphi_{CA} = \varphi_{CB}, \quad -\frac{Xl}{3EI} = \frac{X\sqrt{2}l}{3EI} - \frac{F(\sqrt{2}l)^2}{16EI}$$

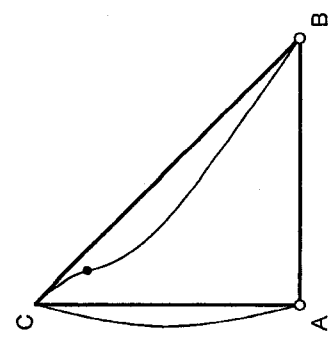
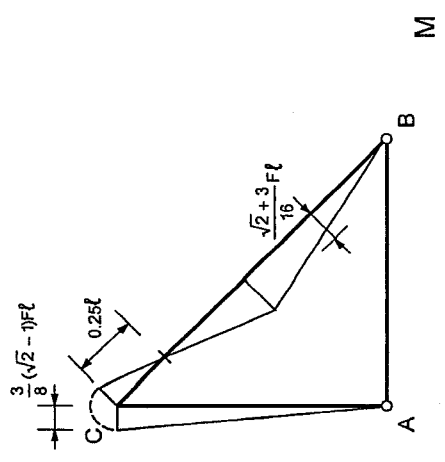
$$X = \frac{3}{8}(\sqrt{2} - 1)Fl$$

Schemi parziali

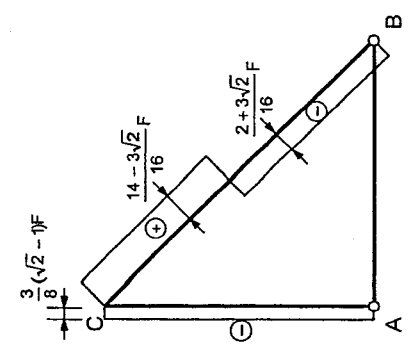




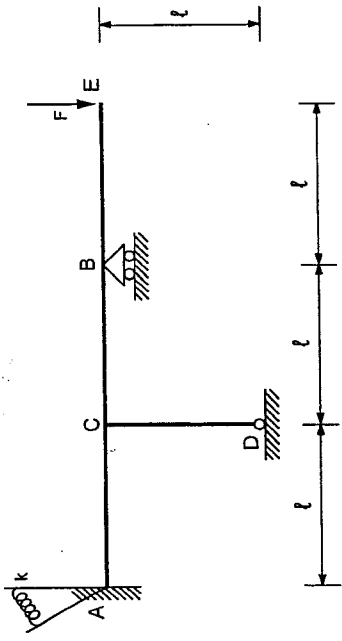
Curva delle pressioni		
Tratto	Curva corrispondente	
ABD	Retta a	
ACD	Retta b	



Deformata elastica

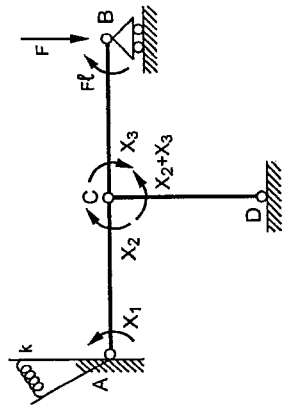


1.9



Reticolare associata

S.P.



Telaio a nodi fissi.

Equazioni di congruenza angolare nei nodi A e C:

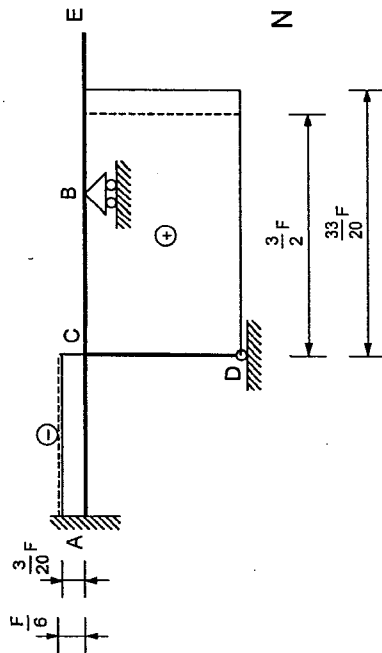
$$\begin{aligned} \varphi_{AC} &= -X_1/k, & \frac{X_1 l}{3EI} + \frac{X_2 l}{6EI} &= -\frac{X_1}{k}, & X_1 &= -\frac{F l}{2} \frac{k l + 18EI}{5k l + 18EI} \\ \varphi_{CA} &= \varphi_{CB}, & \frac{X_2 l}{3EI} - \frac{X_1 l}{6EI} &= -\frac{X_3 l}{3EI} + \frac{F l^2}{6EI}, & X_2 &= -F l \frac{k l + 3EI}{5k l + 18EI} \\ \varphi_{CA} &= \varphi_{CD}, & \frac{X_2 l}{3EI} - \frac{X_1 l}{6EI} &= \frac{(X_2 + X_3) l}{3EI}, & X_3 &= -\frac{F l}{4} \frac{7k l + 24EI}{5k l + 18EI} \end{aligned}$$

Quando la rigidità k dell'incastro angolare tende all'infinito si ottiene il seguente risultato:

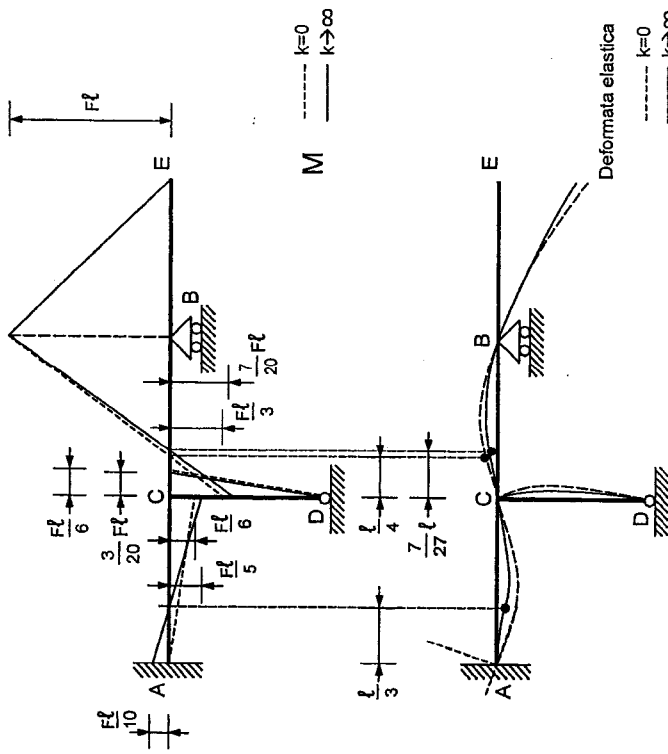
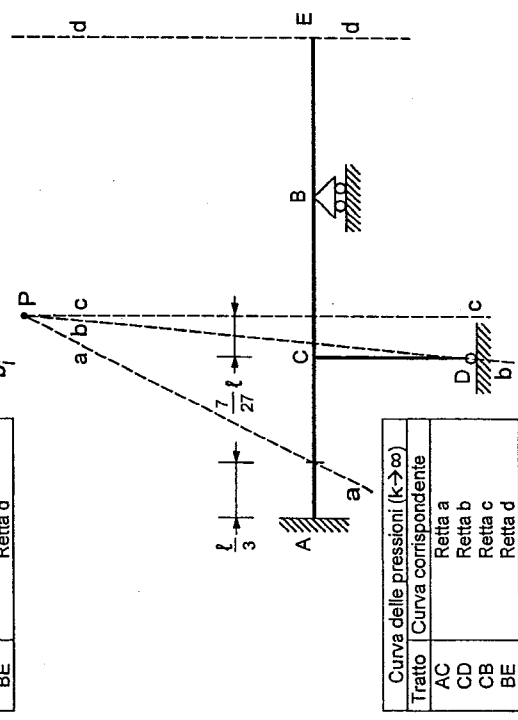
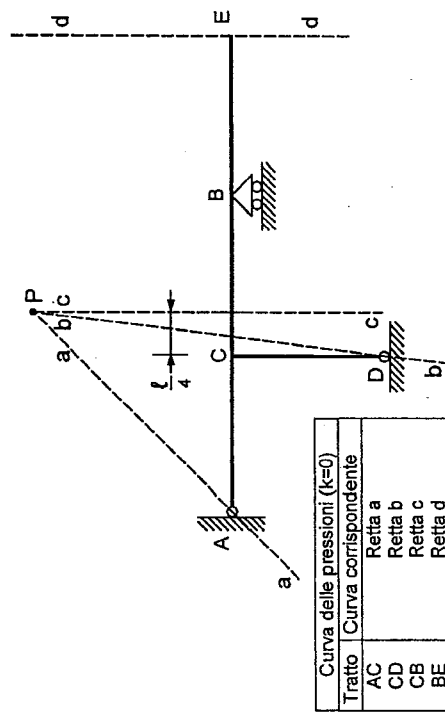
$$\lim_{k \rightarrow \infty} X_1 = -\frac{F l}{10}, \quad \lim_{k \rightarrow \infty} X_2 = -\frac{F l}{5}, \quad \lim_{k \rightarrow \infty} X_3 = \frac{7}{20} F l$$

Quando, invece, la rigidità k dell'incastro tende a zero si ottiene il seguente risultato:

$$\lim_{k \rightarrow 0} X_1 = 0, \quad \lim_{k \rightarrow 0} X_2 = -\frac{F l}{6}, \quad \lim_{k \rightarrow 0} X_3 = \frac{F l}{3}$$



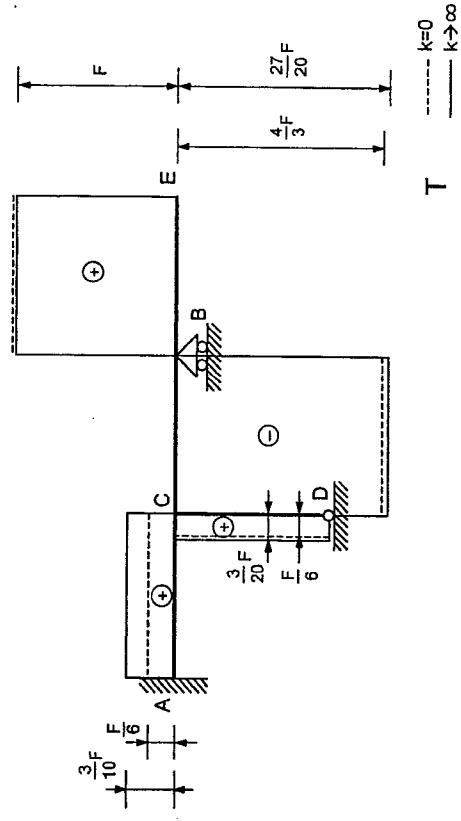
----- $k=0$
 ----- $k \rightarrow \infty$



----- $k=0$
 ----- $k \rightarrow \infty$

Deformata elastica

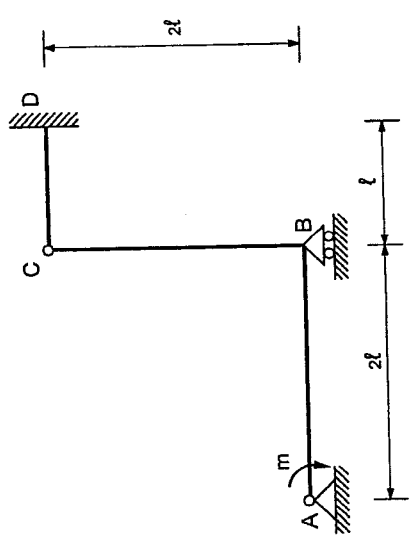
----- $k=0$
 ----- $k \rightarrow \infty$



----- $k=0$
 ----- $k \rightarrow \infty$

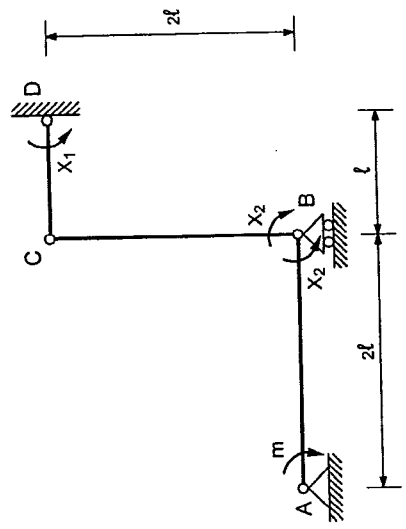
T

1.10



Reticolare associata

S.P.

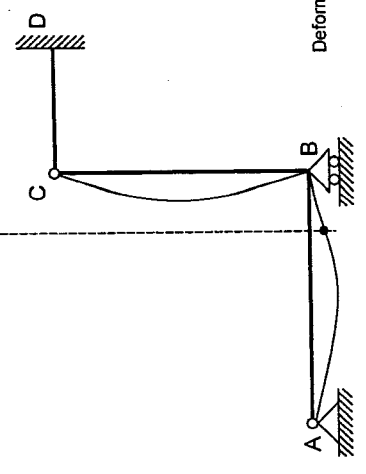
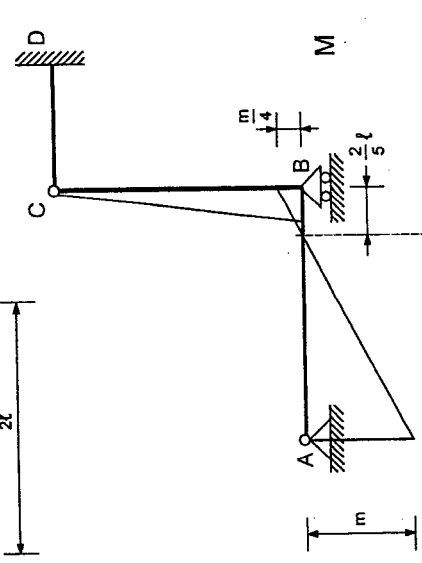
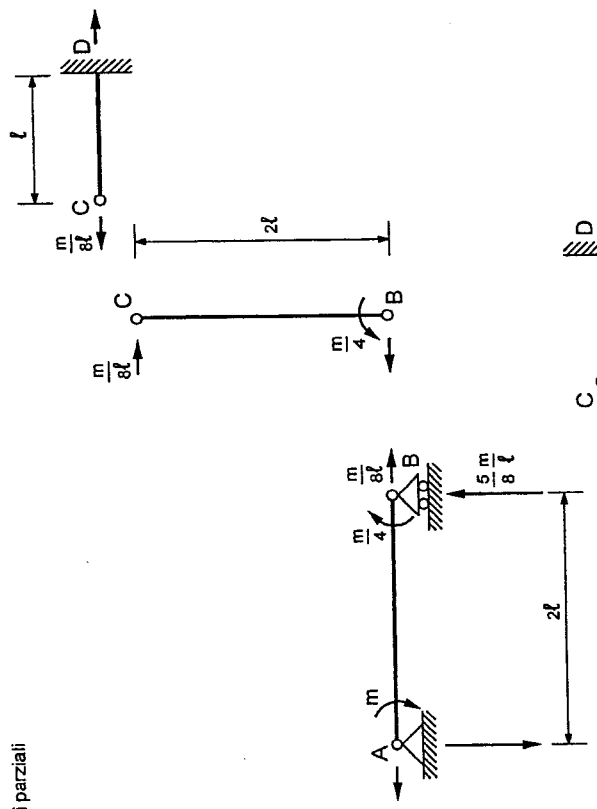


Telaio a nodi fissi.

Equazioni di congruenza angolare nei nodi D e B:

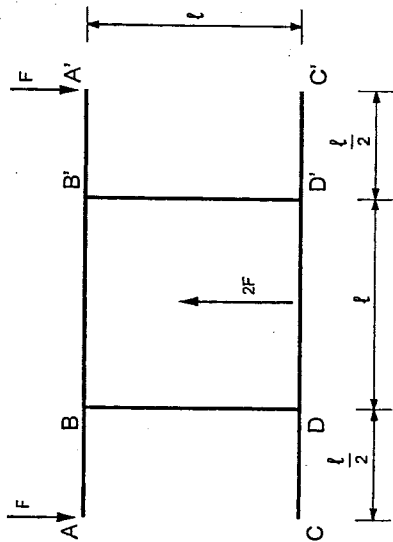
$$\begin{aligned} \varphi_{DC} &= 0, & X_1 \frac{l}{3EI} &= 0, & X_1 &= 0 \\ \varphi_{BA} &= \varphi_{BC}, & X_2 \frac{2l}{3EI} + \frac{m2l}{6EI} &= -\frac{X_2 2l}{3EI}, & X_2 &= -\frac{m}{4} \end{aligned}$$

Schemi parziali



Deformata elastica

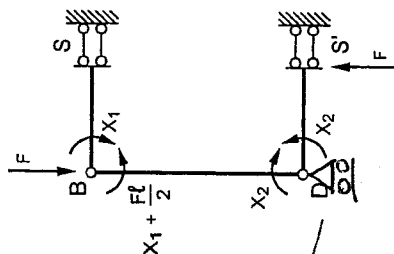
3.2



La struttura è simmetrica con carico simmetrico.

~~Retecolare associata~~

S.P.



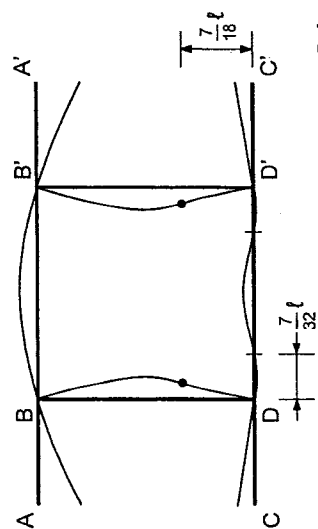
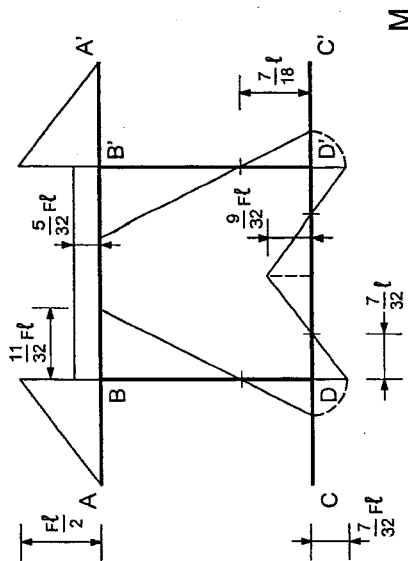
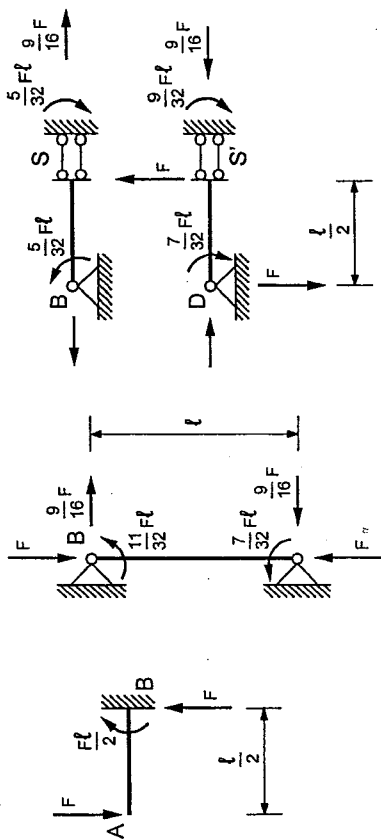
CARRELLO INTRODOTTI
PER BILANCIARE
IL MOMENTO RIGIDO
(E' SCARICO)

Telaio a nodi fissi.

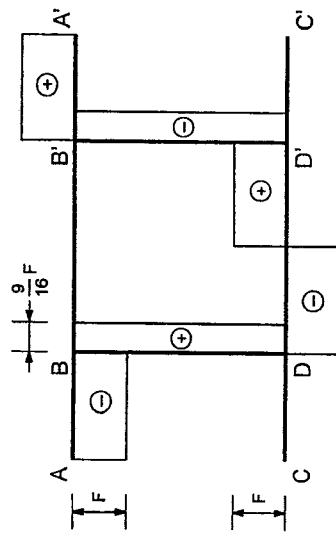
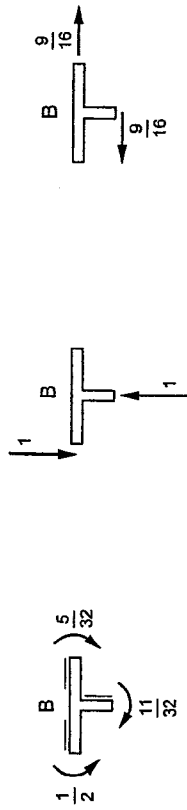
Equazioni di congruenza angolare nei nodi B e D:

$$\begin{aligned} \varphi_{BD} = \varphi_{BS} &= \frac{(X_1 + \frac{F}{2})l}{3EI} + \frac{X_2 l}{6EI} = -\frac{X_1 l}{2EI}, & X_1 = -\frac{5Fl}{32} \\ \varphi_{DB} = \varphi_{DS} &= -\frac{(X_1 + \frac{F}{2})l}{6EI} - \frac{X_2 l}{3EI} = \frac{X_2 l}{2EI} + \frac{Fl^2}{8EI}, & X_2 = -\frac{7Fl}{32} \end{aligned}$$

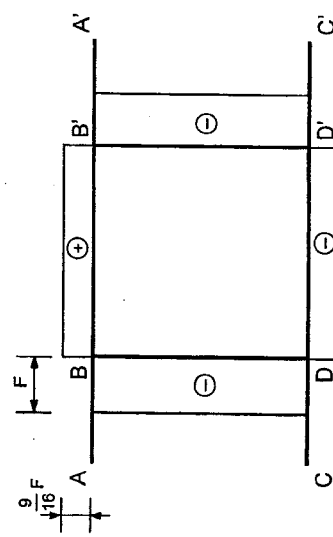
Schemi parziali



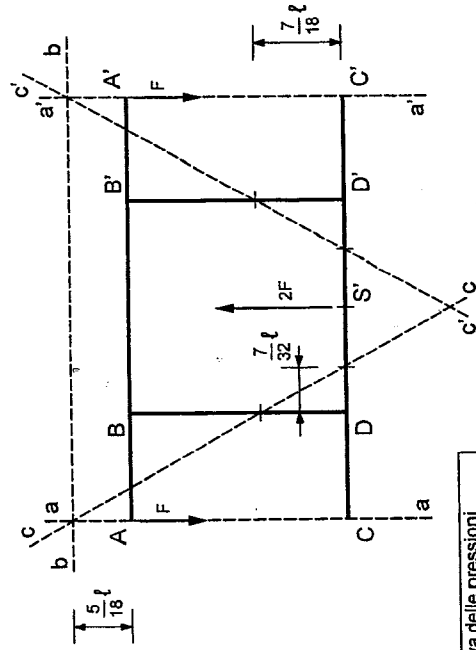
Deformata elastica



T

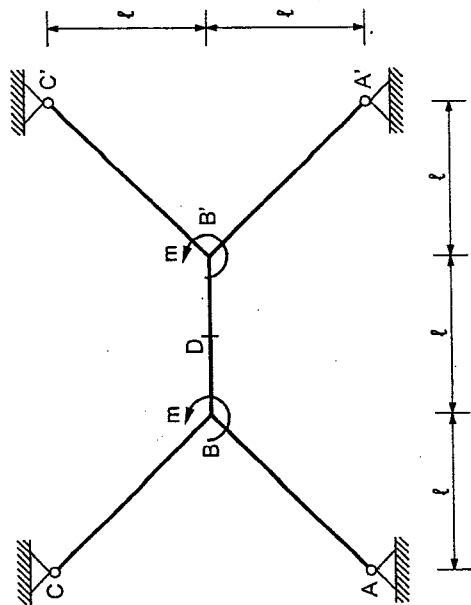


N



Curva delle pressioni	
Tratto	Curva corrispondente
AB	Retta a
BB'	Retta b
BDS'	Retta c
A'B'	Retta a'
B'D'S	Retta c'
CD-C'D'	Non definita

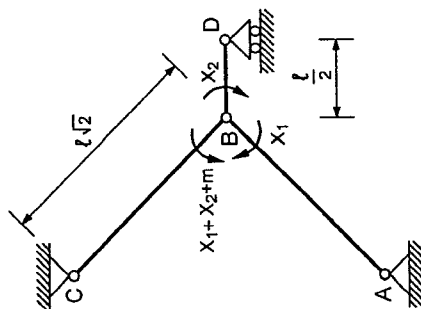
3.8



La struttura è a simmetria assiale con carico antisimmetrico ed a simmetria polare con carico simmetrico.

Reticolare associata

S.p.

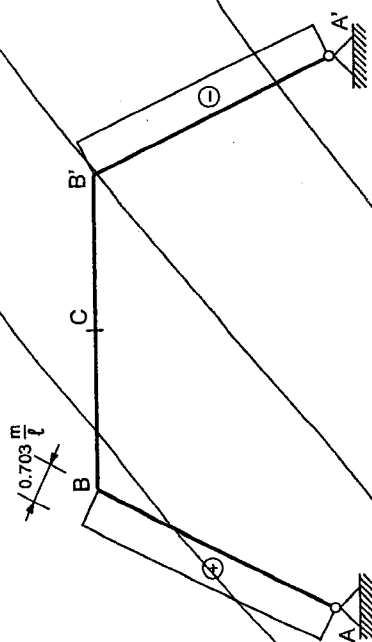


Telaio a nodi fissi.

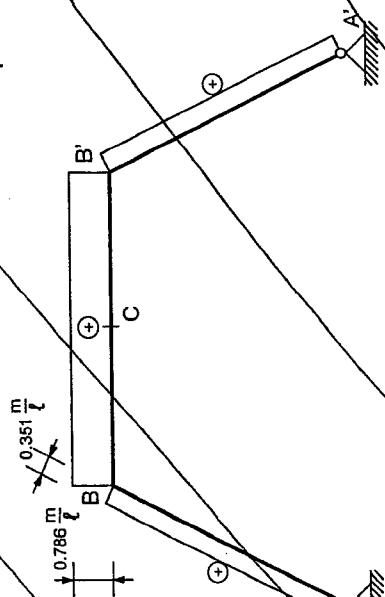
Equazioni di congruenza angolare nel nodo B:

$$\varphi_{BC} = \varphi_{BA}, \quad \frac{(X_1 + X_2 + m)\sqrt{2}l}{3EI} = -\frac{X_1\sqrt{2}l}{3EI}, \quad X_1 = -\frac{(\sqrt{2}-1)}{2}m = -0.207m$$

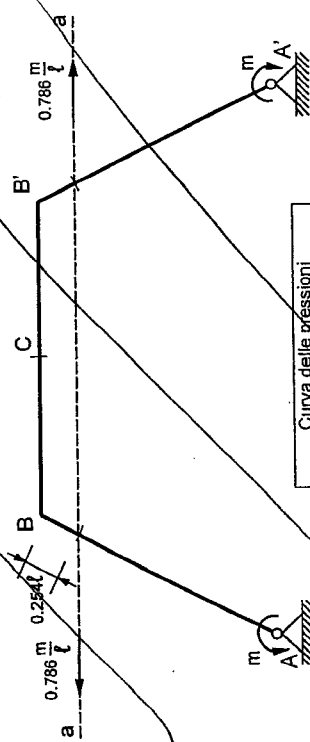
$$\varphi_{DC} = \varphi_{DA}, \quad \frac{(X_1 + X_2 + m)\sqrt{2}l}{3EI} = -\frac{X_2l}{6EI}, \quad X_2 = -(2-\sqrt{2})m = -0.585m$$



T

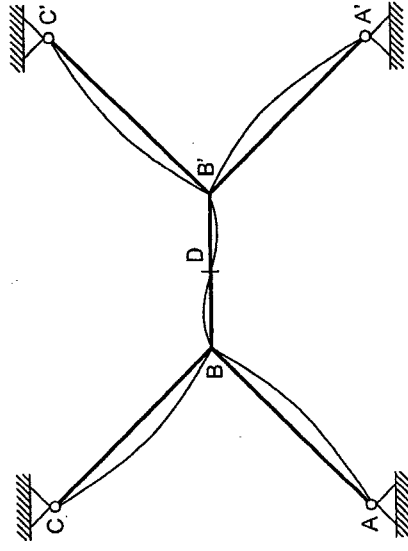
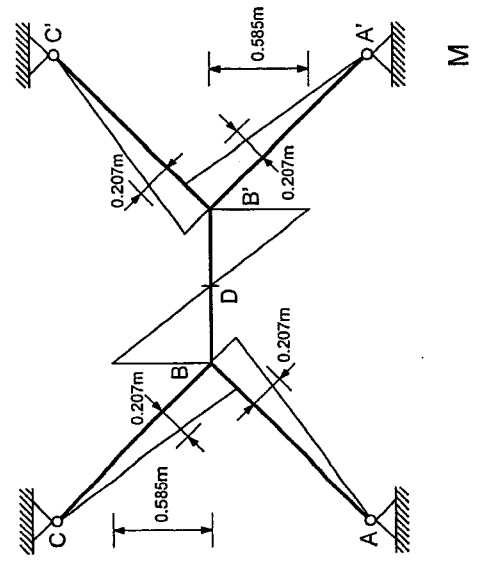
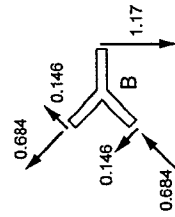
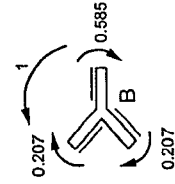
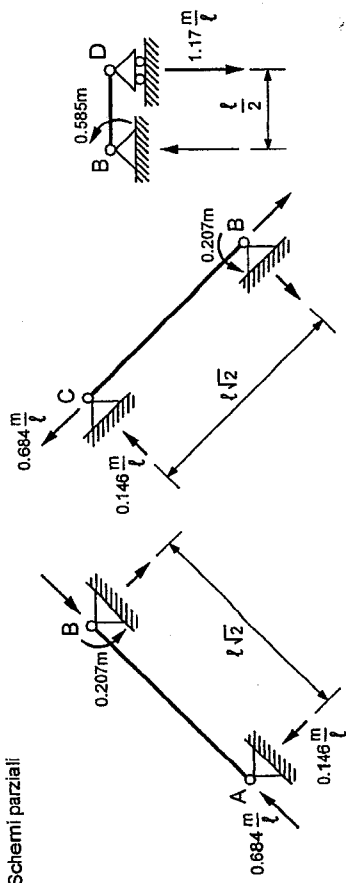


N

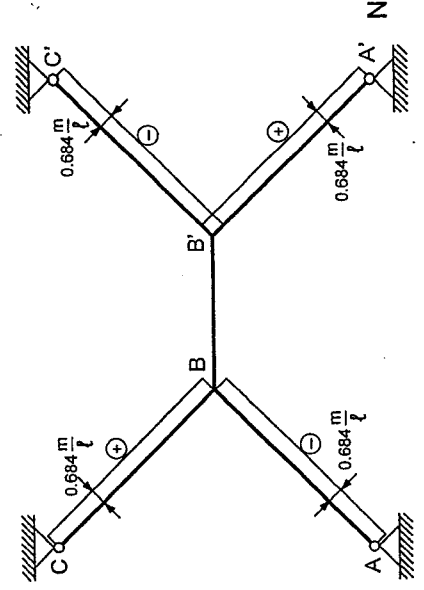
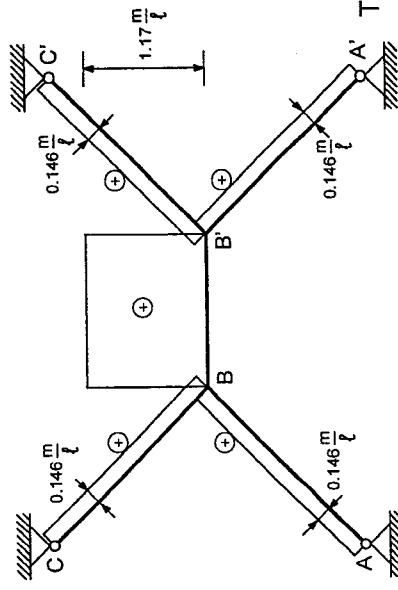


Curva delle pressioni	
Tratto	Curva corrispondente
ABBA'	Retta a

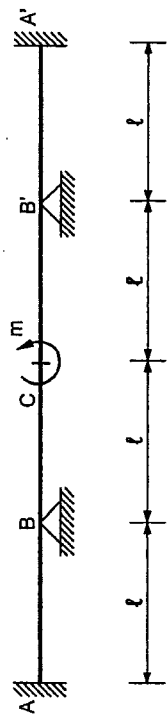
Schemi parziali



Deformata elastica



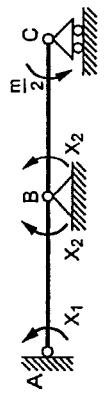
4.8



La struttura è simmetrica con carico antisimmetrico.

Reticolare associata

S.P.

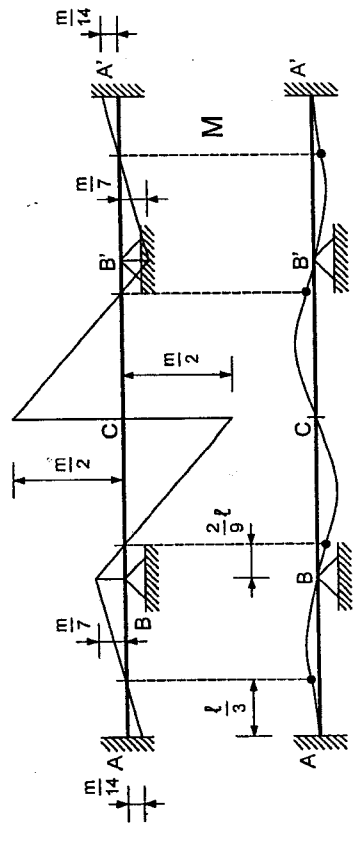
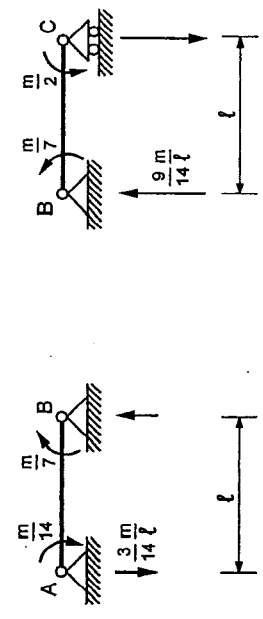


La trave è a nodi fissi e quindi le equazioni sono solo di congruenza.

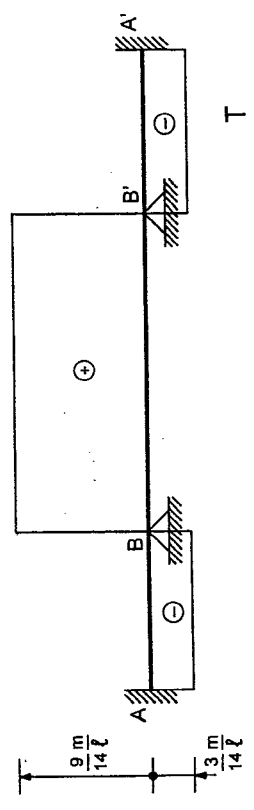
Equazioni di congruenza angolare nei nodi A e B:

$$\begin{aligned} \varphi_{AB} &= 0, & X_1 l + \frac{X_2 l}{6EI} &= 0, & X_1 &= -\frac{m}{14} \\ \varphi_{BA} &= \varphi_{BC}, & -\frac{X_1 l}{6EI} - \frac{X_2 l}{3EI} &= \frac{X_2 l}{3EI} - \frac{m}{12EI}, & X_2 &= \frac{m}{7} \end{aligned}$$

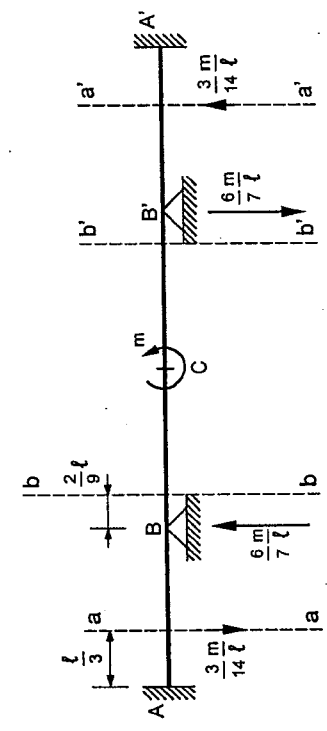
Schemi parziali



Deformata elastica

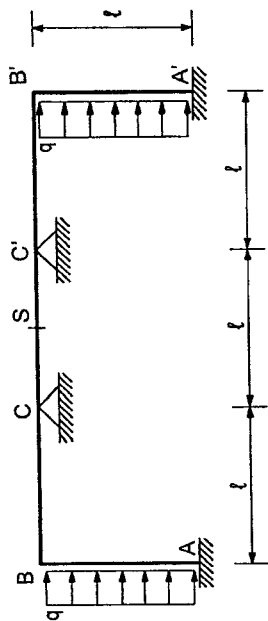


N=0



Curva delle pressioni	
Tratto	Curva corrispondente
AB	Retta a
BC	Retta b
CB'	Retta b'
B'A'	Retta a'

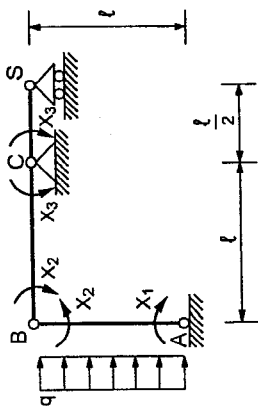
4.22



La struttura è simmetrica con carico antisimmetrico.

Reazione associata

S.P.

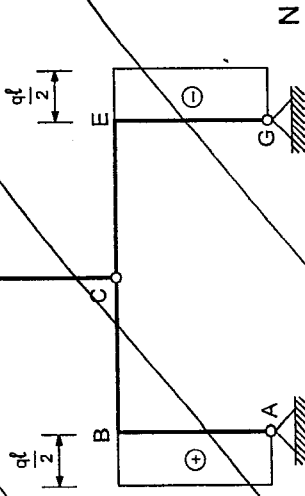
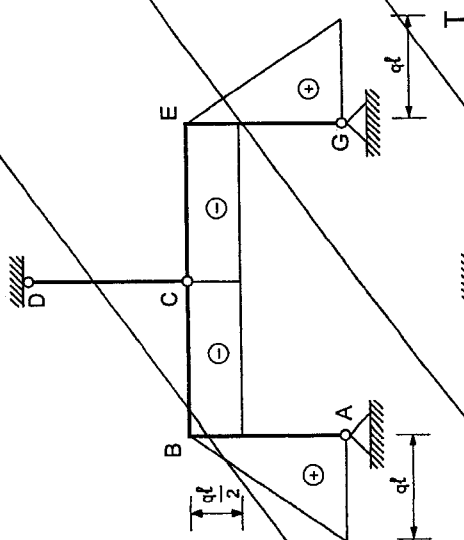
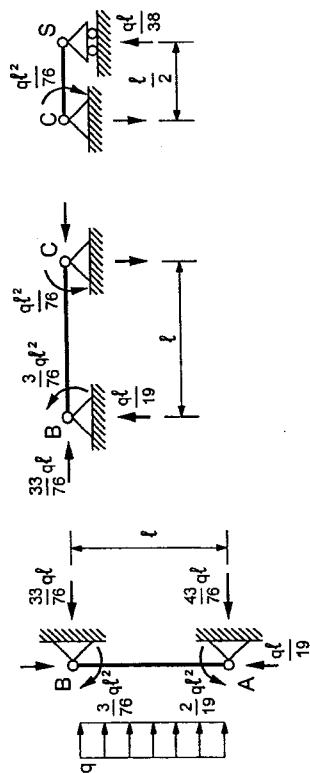


Telaio a nodi fissi.

Equazioni di congruenza angolare nei nodi A, B e C:

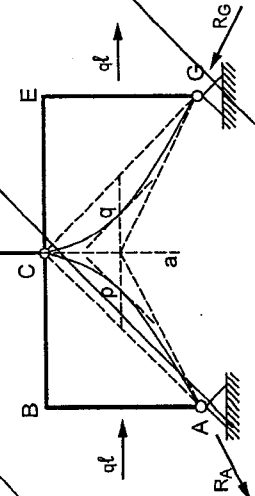
$$\begin{aligned} \varphi_{AB} &= 0, & -\frac{X_1 l}{3EI} - \frac{X_2 l}{6EI} - \frac{ql^3}{24EI} &= 0, & X_1 &= -\frac{2}{19} \frac{ql^2}{EI} \\ \varphi_{BA} &= \varphi_{BC}, & \frac{X_1 l}{6EI} + \frac{X_2 l}{3EI} + \frac{ql^3}{24EI} &= -\frac{X_2 l}{3EI} - \frac{X_3 l}{6EI}, & X_2 &= -\frac{3}{76} \frac{ql^2}{EI} \\ \varphi_{CB} &= \varphi_{CS}, & \frac{X_2 l}{6EI} + \frac{X_3 l}{3EI} &= -\frac{X_3 l}{6EI}, & X_3 &= \frac{ql^2}{76EI} \end{aligned}$$

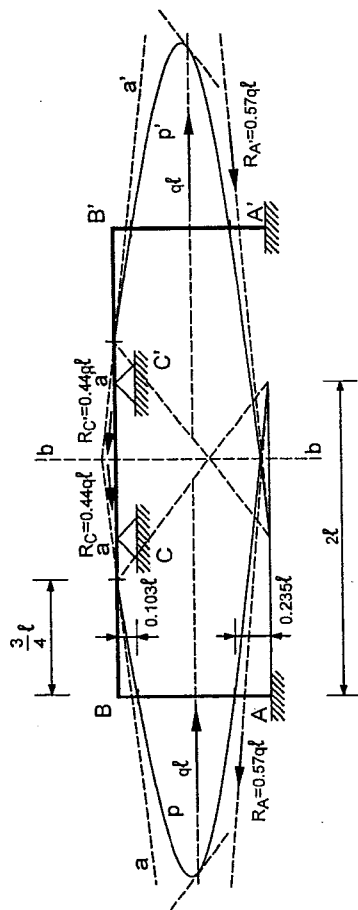
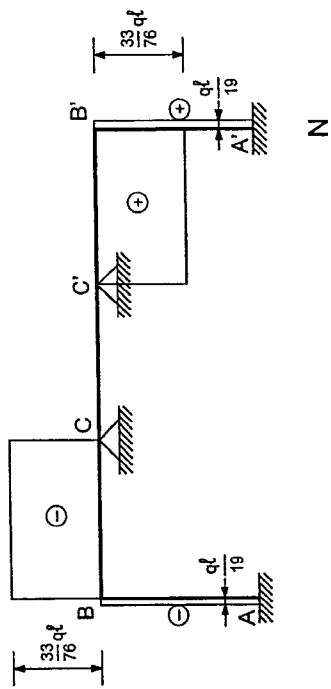
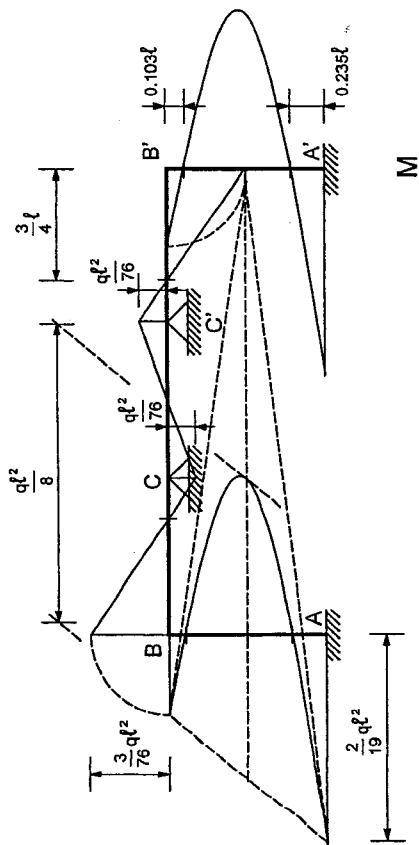
Schemi parziali



Tratto	Curva delle pressioni
AB	Parabola p
BCE	Retta a
EG	Parabola q
CD	Non definibile

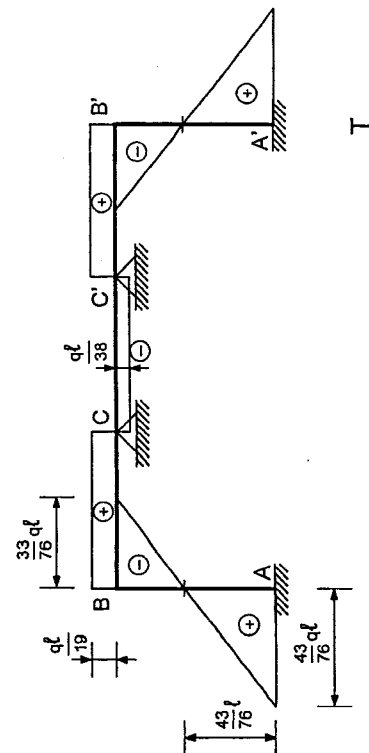
$$\begin{aligned} R_G &= \frac{\sqrt{5}}{2} ql \\ R_A &= \frac{\sqrt{5}}{2} ql \end{aligned}$$





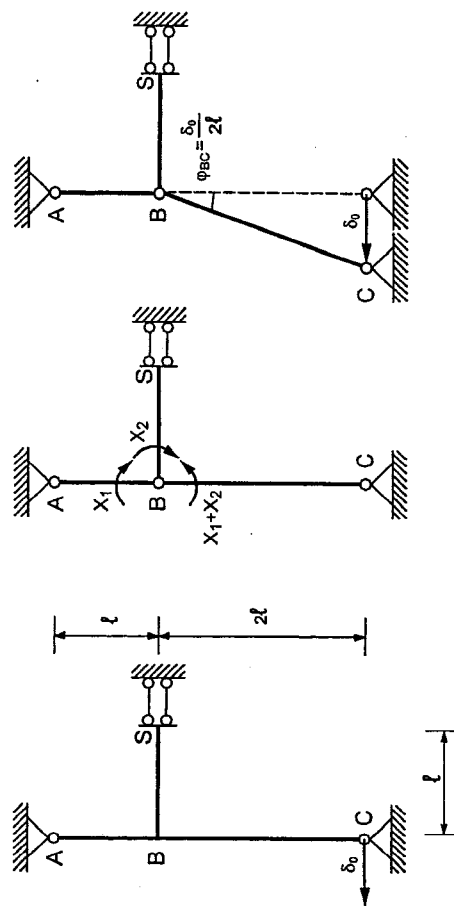
Tratto	Curva delle pressioni
AB	Parabola p
BC	Retta a
CC'	Retta b
C'B'	Retta a'
B'A'	Parabola p'

Deformata elastica



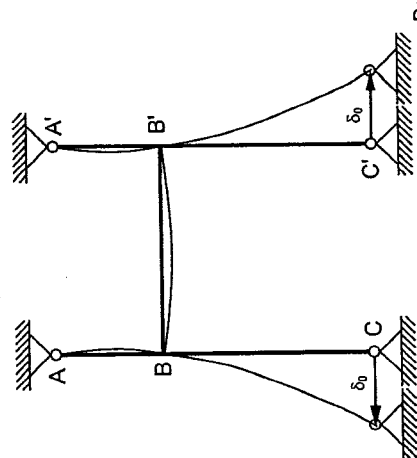
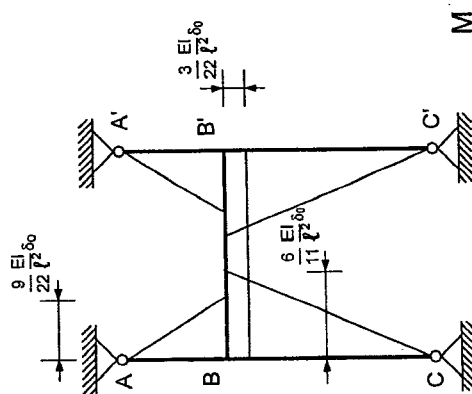
The diagram shows a rectangular frame with a total height of 2ℓ and a total width of 2ℓ . The left vertical edge is fixed to a wall at points A (bottom) and A' (top). The right vertical edge is supported by rollers at points C (bottom) and C' (top). The horizontal distance from the left wall to the right edge is 2ℓ . The horizontal distance from the left wall to the vertical member BC is ℓ . The vertical distance from the bottom support C to the top support C' is 2ℓ . The horizontal member A'B' is at the top, and the horizontal member AC is at the bottom. The vertical member BC connects the two horizontal members. The points are labeled A, B, C at the bottom and A', B', C' at the top. The horizontal distance from the left wall to point B is ℓ , and from point B to point C is ℓ . The vertical distance from the bottom support C to the top support C' is 2ℓ . The horizontal member A'B' is at the top, and the horizontal member AC is at the bottom. The vertical member BC connects the two horizontal members. The points are labeled A, B, C at the bottom and A', B', C' at the top. The horizontal distance from the left wall to point B is ℓ , and from point B to point C is ℓ . The vertical distance from the bottom support C to the top support C' is 2ℓ .

~~Reticolare-associata~~ S. I.

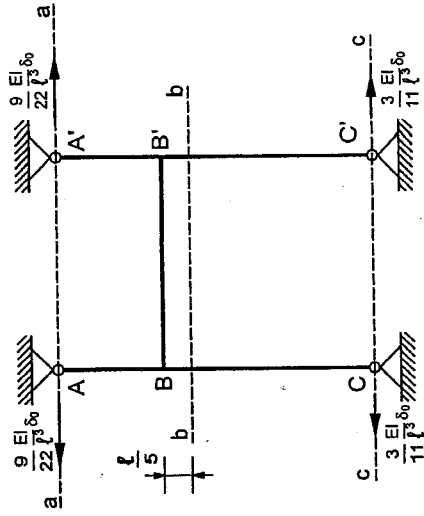
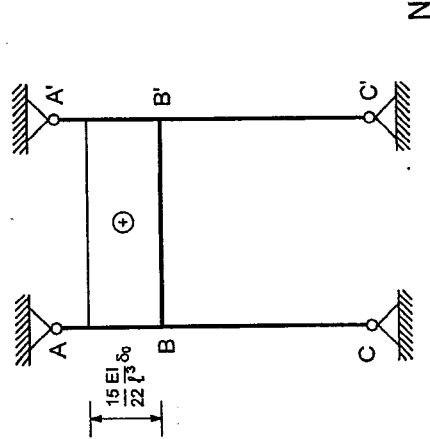
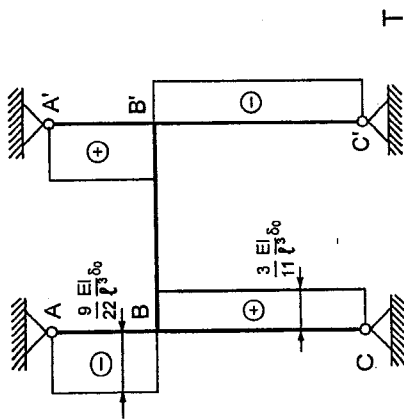
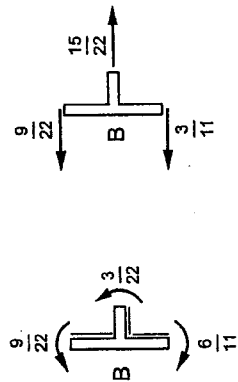


Equazioni di congruenza angolare nel nodo B:

$$\begin{aligned} \varphi_{BA} &= \varphi_{BC}, & \frac{X_1 l}{3EI} &= \frac{(X_1 + X_2) l}{3EI} - \frac{\delta_0}{2l}, & X_1 &= \frac{9 \delta_0 EI}{22 l^2} \\ \varphi_{BA} &= \varphi_{BS}, & \frac{X_1 l}{3EI} &= \frac{X_2 l}{EI}, & X_2 &= \frac{3 \delta_0 EI}{22 l^2} \end{aligned}$$

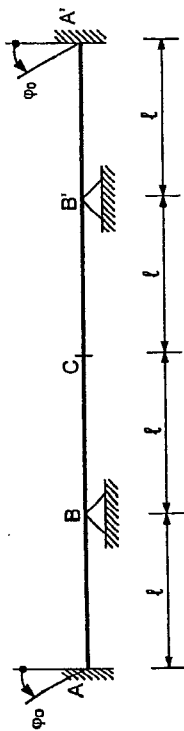


Defomata elastica



Curva delle pressioni	
Tratto	Curva corrispondente
AB	Retta a
A'B'	Retta a
BB'	Retta b
CB	Retta c
C'B'	Retta c

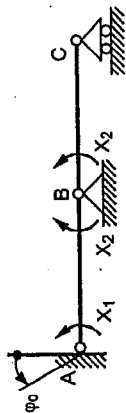
5.24



La struttura è simmetrica con carico antisimmetrico.

Retiela associata

S.p.

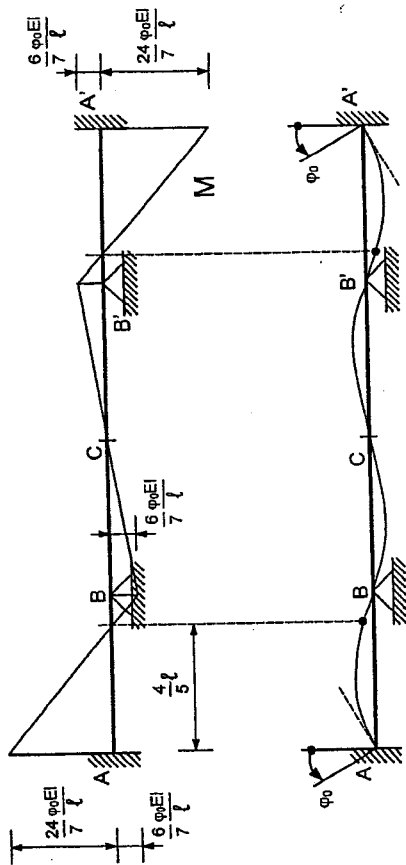
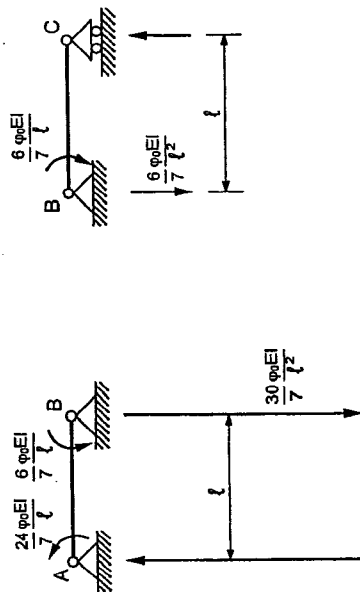


La trave è a nodi fissi e quindi le equazioni sono solo di congruenza.

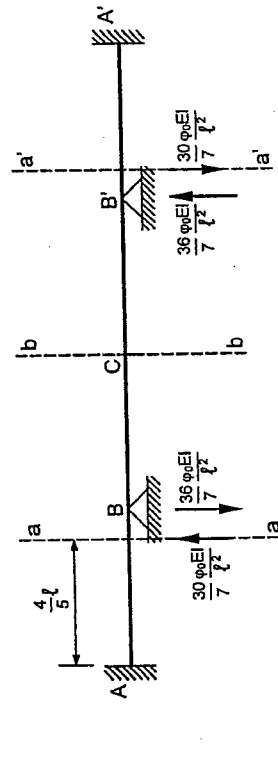
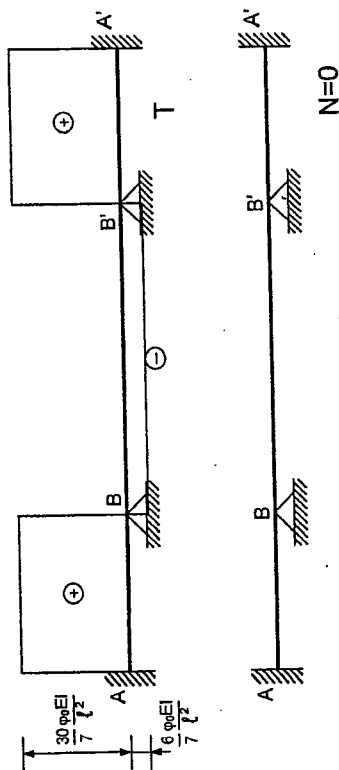
Equazioni di congruenza angolare nei nodi A e B:

$$\begin{aligned} \varphi_{AB} &= \varphi_0, & X_1 \frac{l}{3EI} + \frac{X_2 l}{6EI} &= \varphi_0, & X_1 &= \frac{24 \varphi_0 EI}{7 l} \\ \varphi_{BA} &= \varphi_{BC}, & \frac{X_1 l}{6EI} - \frac{X_2 l}{3EI} &= \frac{X_2 l}{3EI}, & X_2 &= -\frac{6 \varphi_0 EI}{7 l} \end{aligned}$$

Schemi parziali

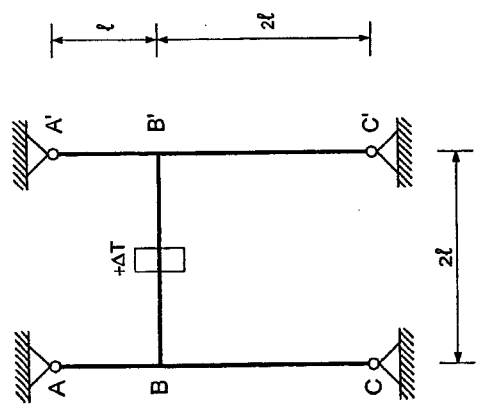


Deformata elastica

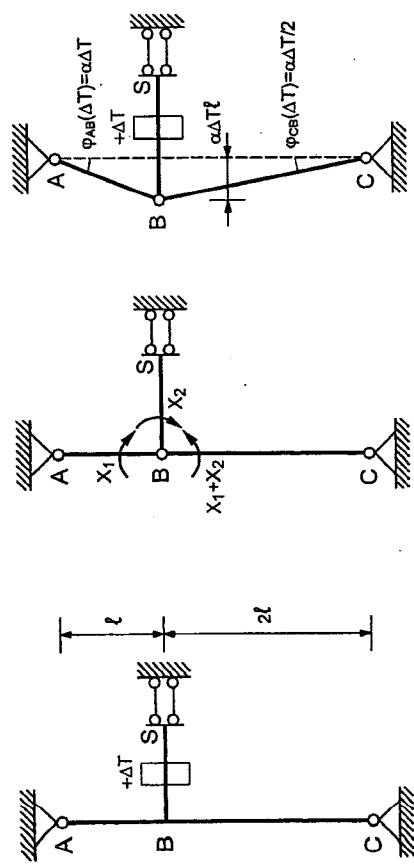


Curva delle pressioni	
Tratto	Curva corrispondente
AB	Retta a
BCB'	Retta b
B'A'	Retta a'

6.1



La struttura è simmetrica con carico simmetrico.
Reticolare associata

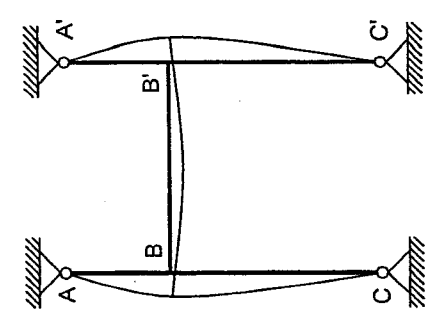
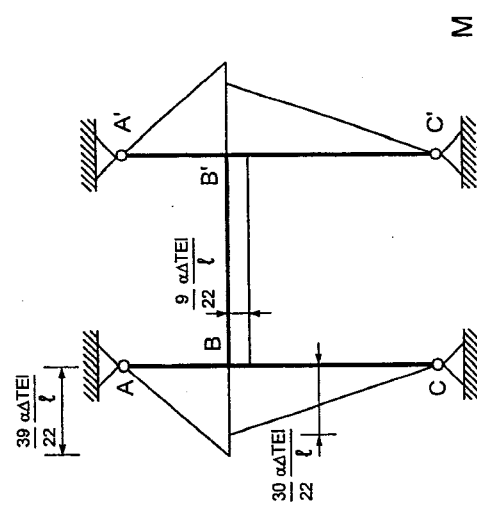
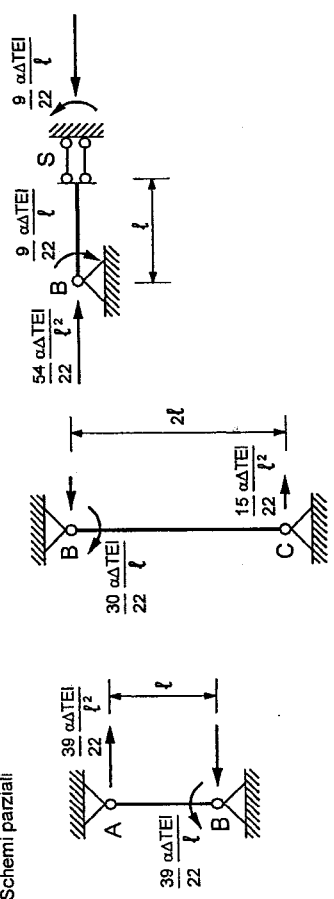


Telaio a nodi fissi.

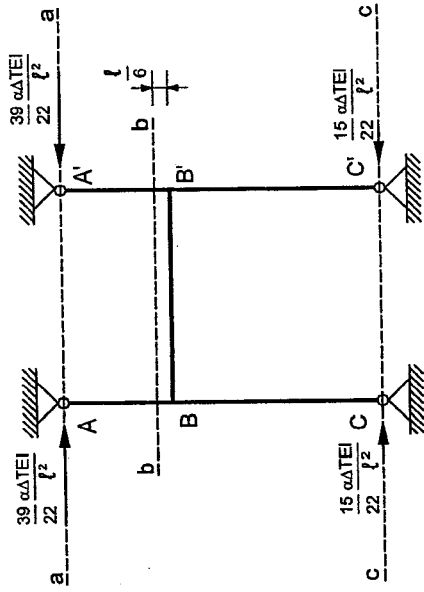
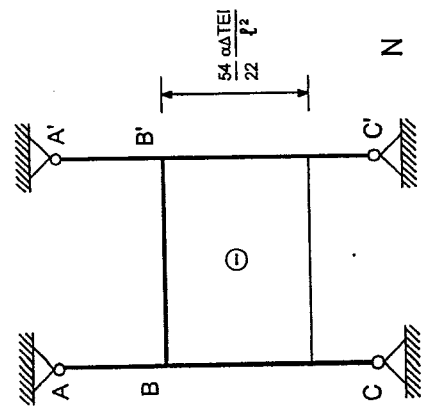
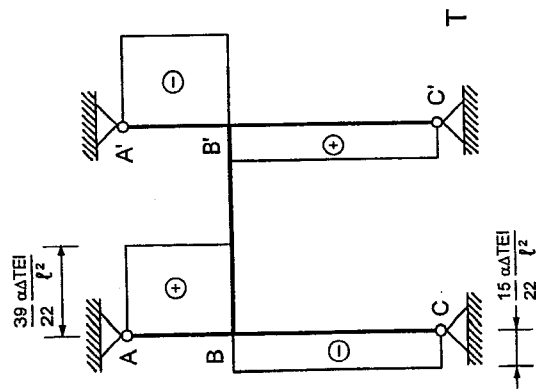
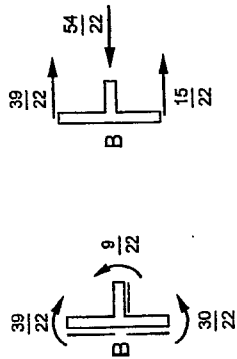
Equazioni di congruenza angolare nel nodo B:

$$\begin{aligned} \varphi_{BA} &= \varphi_{BC}, & -\frac{X_1 l}{3EI} - \alpha \Delta T &= \frac{(X_1 + X_2) 2l}{3EI} + \frac{\alpha \Delta T}{2}, & X_1 &= -\frac{39 \alpha \Delta T EI}{22 l} \\ \varphi_{BA} &= \varphi_{BS}, & -\frac{X_1 l}{3EI} - \alpha \Delta T &= -\frac{X_2 l}{EI}, & X_2 &= \frac{9 \alpha \Delta T EI}{22 l} \end{aligned}$$

Schemi parziali

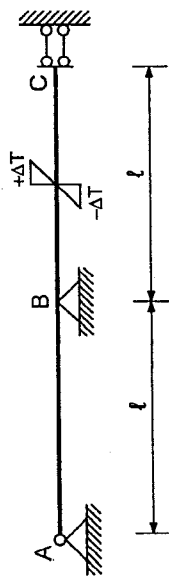


Deformata termoelastica

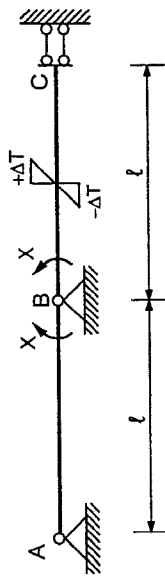


Curva delle pressioni	
Tratto	Curva corrispondente
AB	Retta a
A'B'	Retta a
BB'	Retta b
CB	Retta c
C'B'	Retta c

6.7



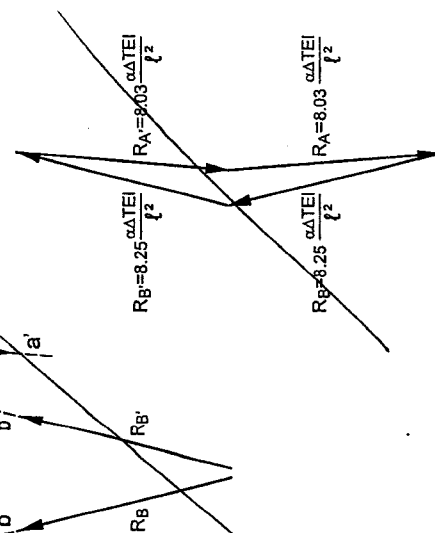
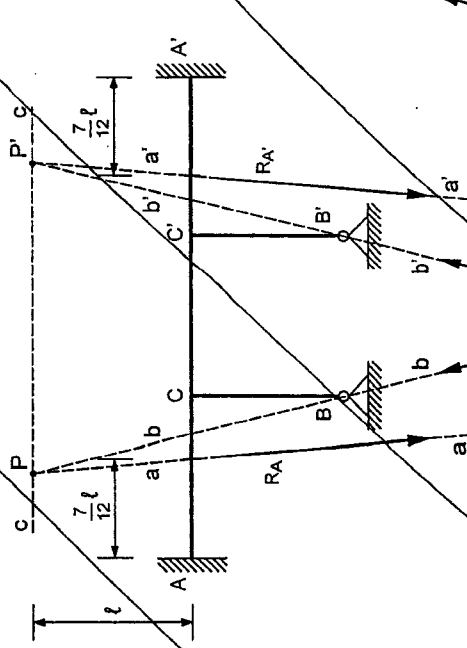
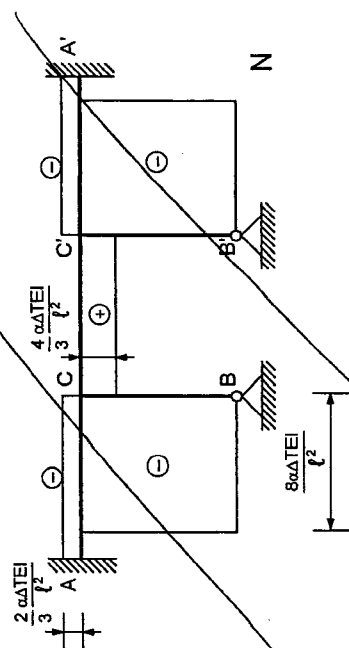
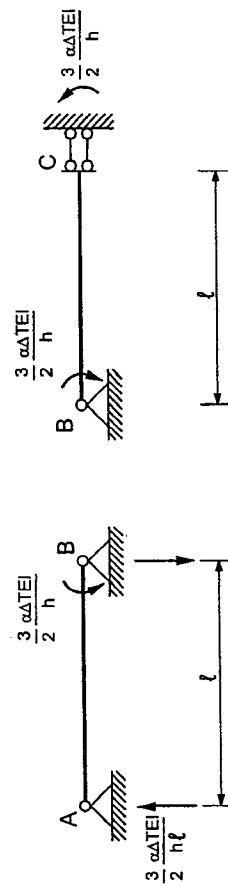
Reticolare associata



Equazione di congruenza angolare nel nodo B:

$$\varphi_{BA} = \varphi_{BC}, \quad -\frac{Xl}{3EI} = \frac{Xl}{EI} + \frac{2\alpha\Delta Tl}{h}, \quad X = -\frac{3\alpha\Delta Tl}{2h}$$

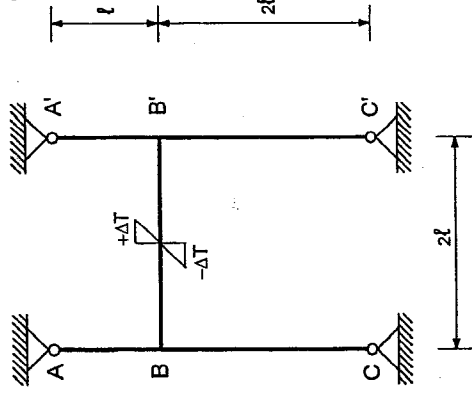
Schemi parziali



Curva delle pressioni	
Traito	Curva corrispondente
AC	Retta a
CB	Retta b
CC'	Retta c
C'B'	Retta b'
CA'	Retta a'

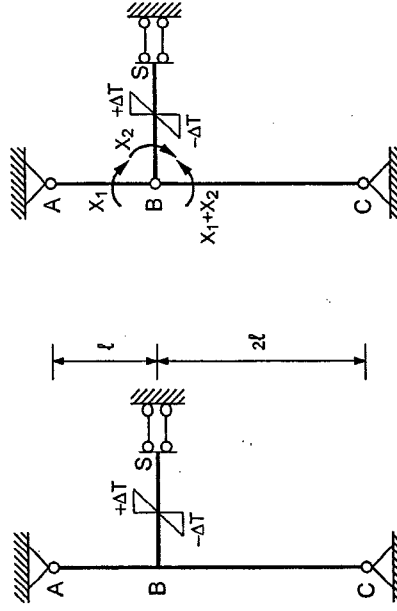
DI QUESTO ES.
C'E' SOLO QUESTA
PAGINA.

6.8



La struttura è simmetrica con carico simmetrico.

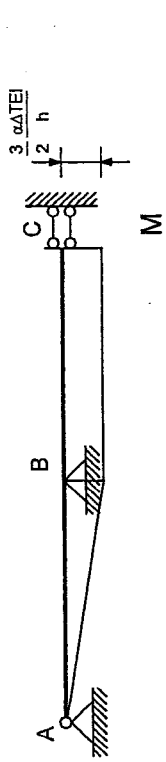
Reticolare associata



Telaio a nodi fissi.

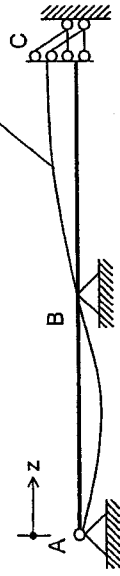
Equazioni di congruenza angolare nel nodo B:

$$\begin{aligned} \varphi_{BA} &= \varphi_{BC}, \\ \varphi_{BA} &= \varphi_{BC}, \end{aligned} \quad \begin{aligned} -\frac{X_1 l}{3EI} &= \frac{(X_1 + X_2) 2l}{3EI}, \\ -\frac{X_1 l}{3EI} &= -\frac{X_2 l}{EI} + \frac{2\alpha \Delta T l}{h}, \end{aligned} \quad \begin{aligned} X_1 &= -\frac{12 \alpha \Delta T EI}{11 h}, \\ X_2 &= \frac{18 \alpha \Delta T EI}{11 h} \end{aligned}$$

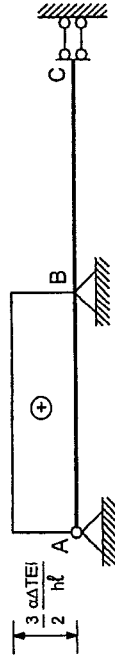


Curvatura termoelastica

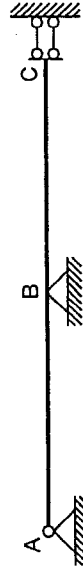
$$\chi(z) = \frac{3 \alpha \Delta T}{2 h} \frac{2 \alpha \Delta T}{h} - \frac{1 \alpha \Delta T}{2 h}$$



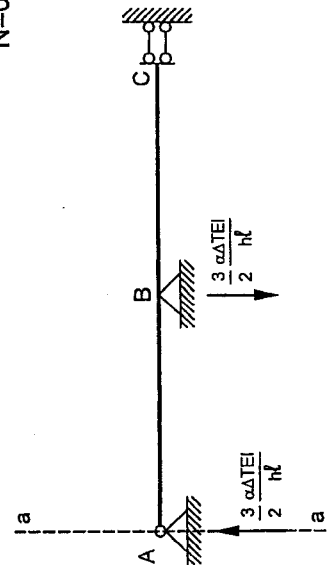
Deformata termoelastica



T

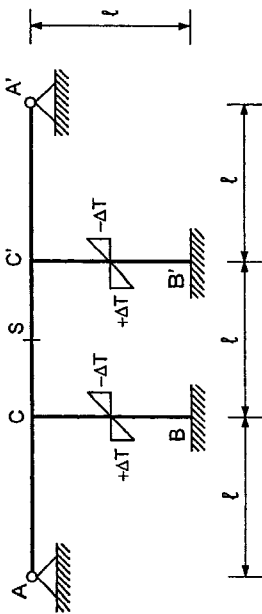


N=0



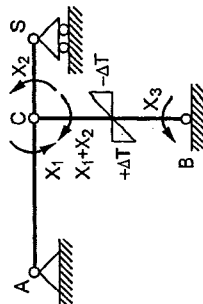
Curva delle pressioni	
Tratto	Curva corrispondente
AB	Retta a
BC	Retta impropria

6.20



La struttura è simmetrica con carico antisimmetrico.

Reticolo associato

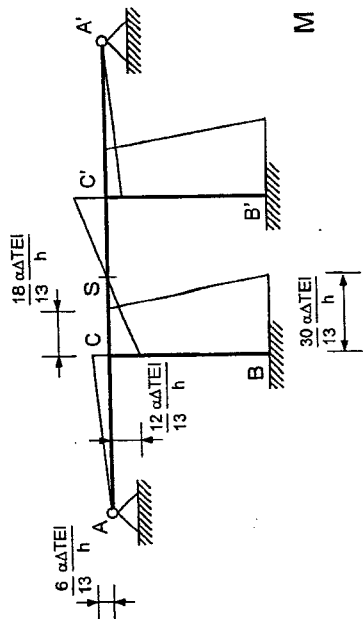
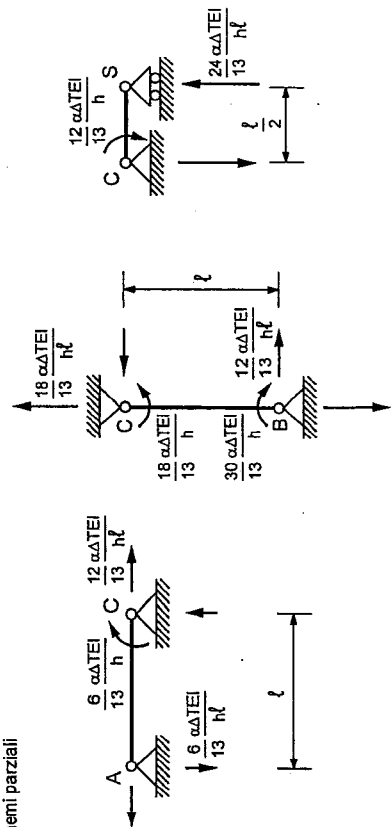


Telaio a nodi fissi.

Equazioni di congruenza angolare nei nodi B e C:

$$\begin{aligned} \varphi_{CA} &= \varphi_{CS}, & X_1 \ell &= \frac{X_2 \ell}{3EI}, & X_1 &= -\frac{6 \alpha \Delta T \ell}{13 h} \\ \varphi_{CA} &= \varphi_{CS}, & X_1 \ell &= -\frac{(X_1 + X_2) \ell}{3EI} - \frac{X_3 \ell}{6EI} - \frac{\alpha \Delta T \ell}{h}, & X_2 &= -\frac{12 \alpha \Delta T \ell}{13 h} \\ \varphi_{BC} &= 0, & (X_1 + X_2) \ell &+ \frac{X_3 \ell}{3EI} + \frac{\alpha \Delta T \ell}{h} = 0, & X_3 &= -\frac{30 \alpha \Delta T \ell}{13 h} \end{aligned}$$

Schemi parziali

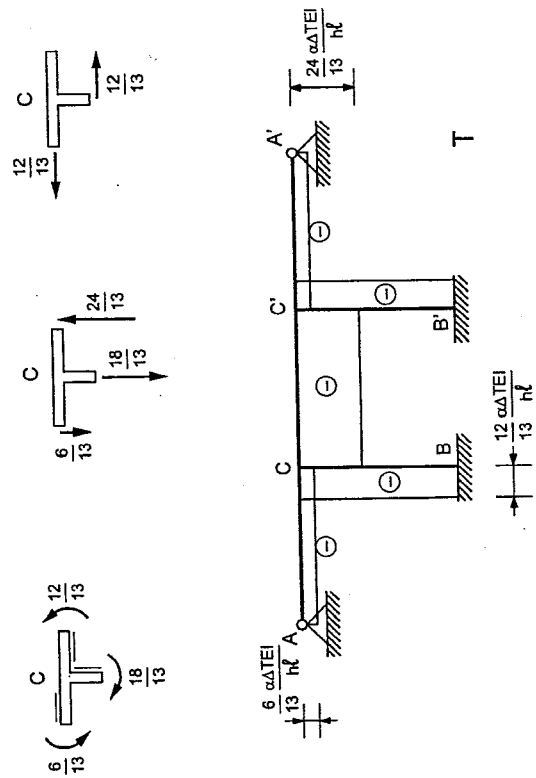


Curvatura termoelastica:

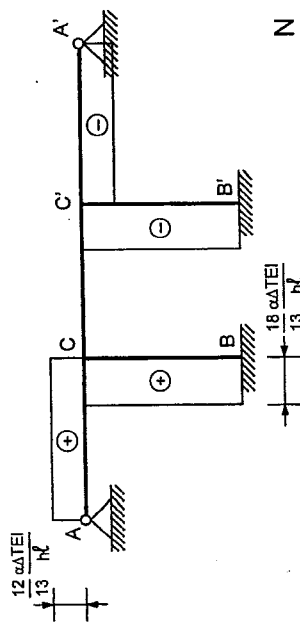
$$\chi(z) = -\frac{2 \alpha \Delta T}{h} + \frac{30 \alpha \Delta T}{13 h} - \frac{12 \alpha \Delta T}{13 h} \frac{z}{\ell}, \quad 0 \leq z \leq \ell$$

$$\chi\left(\frac{\ell}{3}\right) = 0 \quad (\text{Flesso termoelastico})$$

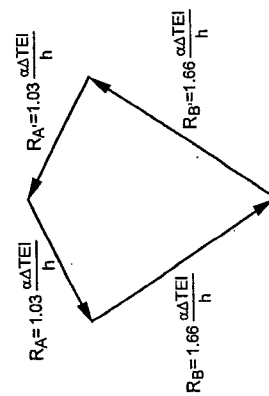
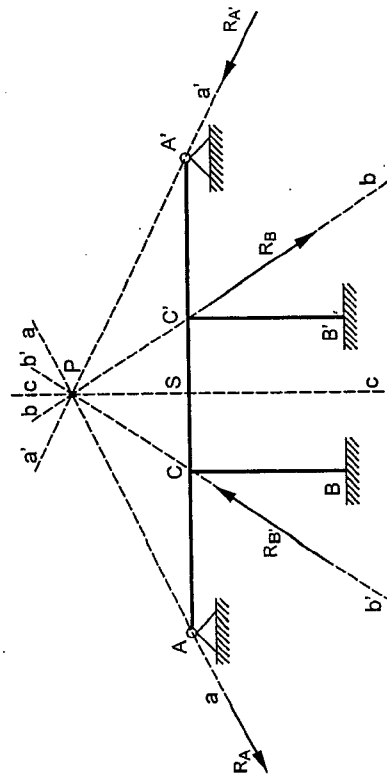
Deformata termoelastica



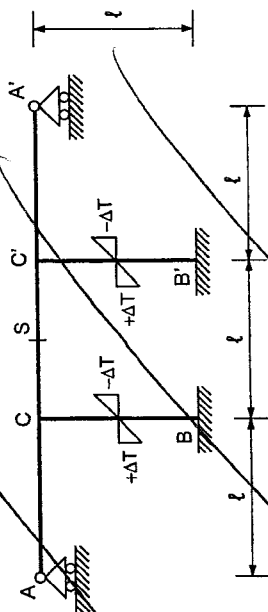
6.21



N

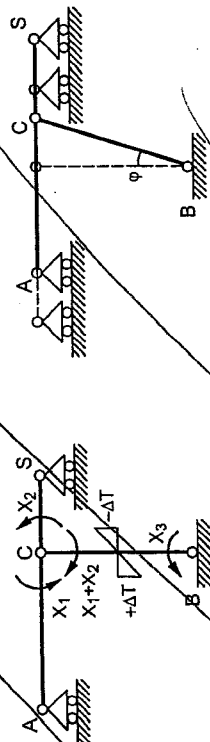


Curva delle pressioni	
Tratto	Curva corrispondente
AC	Retta a
CB	Retta b
CC'	Retta c
C'B'	Retta b'
C'A'	Retta a'



La struttura è simmetrica con carico antisimmetrico.

Reticolare associata

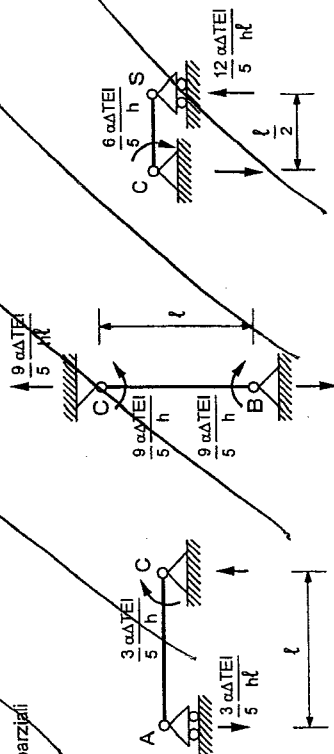


Telaio a nodi spostabili.

Equazioni di congruenza angolare nei nodi B e C, associate ad un'equazione di equilibrio espressa tramite il P.L.V.:

$$\begin{aligned} \varphi_{CA} &= \varphi_{CS}, & X_1 l &= \frac{X_2 l}{3EI}, & X_1 &= -\frac{3 \alpha \Delta T EI}{5 h} \\ \varphi_{CA} &= \varphi_{CB}, & X_1 l &= -\frac{(X_1 + X_2) l}{3EI} - \frac{X_3 l}{6EI} - \frac{\alpha \Delta T l}{h} - \varphi, & X_2 &= -\frac{6 \alpha \Delta T EI}{5 h} \\ \varphi_{BC} &= 0, & \frac{(X_1 + X_2) l}{6EI} + \frac{X_3 l}{3EI} + \frac{\alpha \Delta T l}{h} - \varphi &= 0, & X_3 &= -\frac{9 \alpha \Delta T EI}{5 h} \\ \text{P.L.V.,} & & (X_1 + X_2) \varphi - X_3 \varphi &= 0, & \varphi &= \frac{\alpha \Delta T l}{10 h} \end{aligned}$$

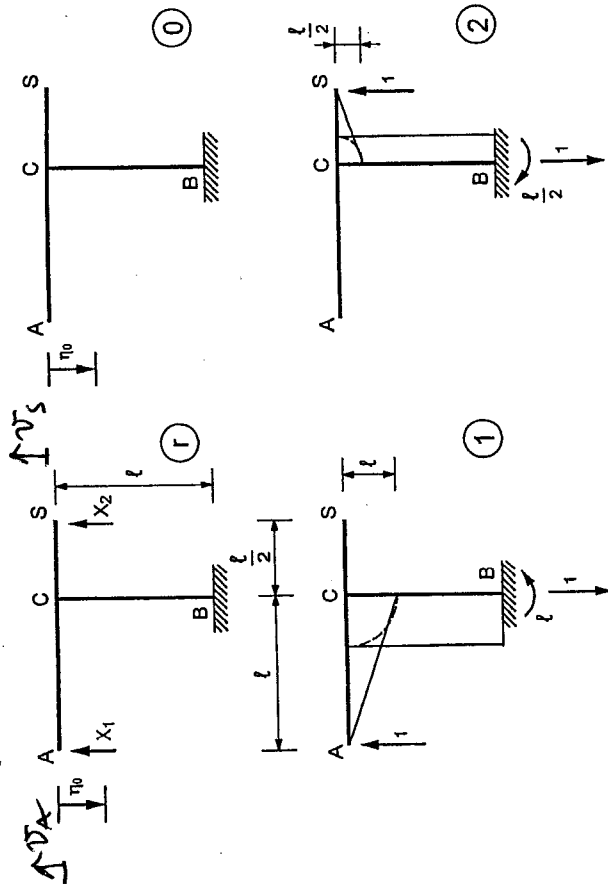
Schemi parziali



7.8 (v. 5.14)

STR. PRINCIPALE

eq di congruenza:
 $v_A = -\eta_0$, $v_S = 0$



Poiché il momento reale M_r è fornito dalla combinazione lineare dei momenti parziali M_i :

$$M_r = M_0 + \sum X_i M_i$$

nel caso considerato, essendo $M_0 = 0$, si ha:

$$M_r = X_1 M_1 + X_2 M_2$$

Dai diagrammi dei momenti si ricava la seguente tabella.

Tratto	$\int_s M_1^2 ds$	$\int_s M_2^2 ds$	$\int_s M_1 M_2 ds$
AC	$\frac{l^3}{3}$	0	0
CB	l^3	$\frac{l^3}{4}$	$-\frac{l^3}{2}$
CS	0	$\frac{l^3}{24}$	0
Totale	$\frac{4l^3}{3}$	$\frac{7l^3}{24}$	$-\frac{l^3}{2}$

Equazioni risolventi:

$$\int_s \frac{M_r M_1}{EI} ds = \int_s \frac{M_1 M_0}{EI} ds + X_1 \int_s \frac{M_1^2}{EI} ds + X_2 \int_s \frac{M_1 M_2}{EI} ds = -\eta_0$$

$$\int_s \frac{M_r M_2}{EI} ds = \int_s \frac{M_2 M_0}{EI} ds + X_1 \int_s \frac{M_1 M_2}{EI} ds + X_2 \int_s \frac{M_2^2}{EI} ds = 0$$

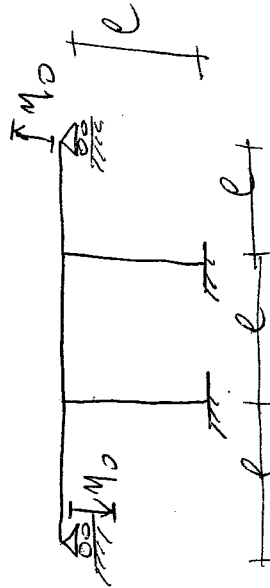
$$X_1 \frac{4}{3} l^3 - X_2 \frac{l^3}{2} = -\eta_0 EI$$

$$-X_1 \frac{l^3}{2} + X_2 \frac{7}{24} l^3 = 0$$

Dalla risoluzione del sistema si ottiene:

$$X_1 = \frac{21}{10} \frac{EI}{l^3} \eta_0, \quad X_2 = \frac{18}{5} \frac{EI}{l^3} \eta_0$$

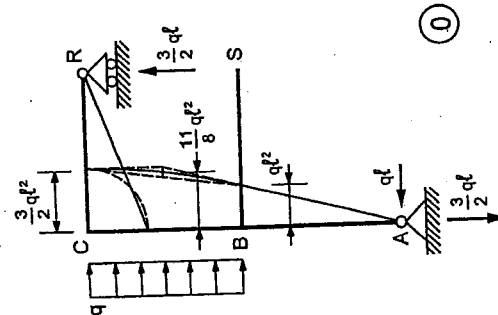
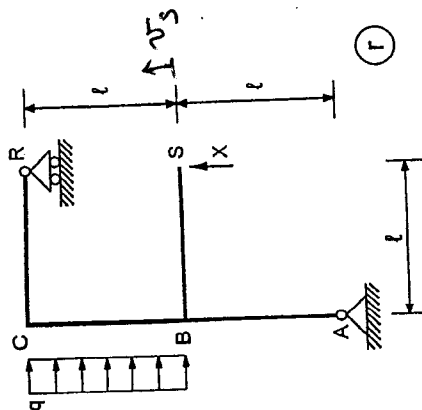
TESTO ESERCIZIO



RISOLVERE CON P.L.V.
 (SCHEMA ANTISIMMETRICO)

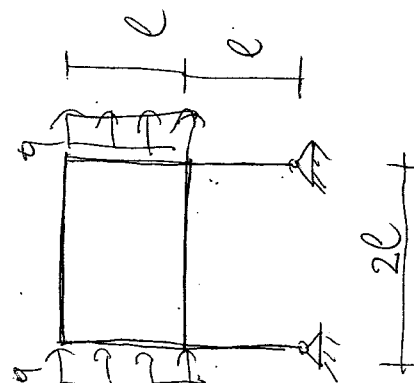
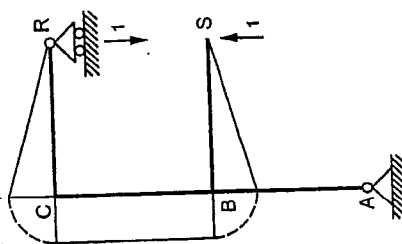
SOLUZIONE

7.9 (v. 4.25)



STRUTTURA PRINCIPALE
eq di congruenza: $\delta_3 = 0$

TESTO ESERCIZIO



RISOLVERE CON P.L.V.
(SCHEMA ANTISIMMETRICO)

Poiché il momento reale M_r è fornito dalla combinazione lineare dei momenti parziali M_i :

$$M_r = M_0 + \sum X_i M_i,$$

nel caso considerato si ha:

$$M_r = M_0 + X M_1.$$

Dai diagrammi dei momenti si ricava la seguente tabella.

Tratto	$\int_s M_1^2 ds$	$\int_s M_0 M_1 ds$
AB	0	0
SB	$\frac{l^3}{3}$	0
BC	$\frac{l^3}{3}$	$-\frac{4}{3} q l^4$
CR	$\frac{l^3}{3}$	$-\frac{q l^4}{2}$
Totale	$\frac{5}{3} l^3$	$-\frac{11}{6} q l^4$

Equazione risolvente:

$$\int_s \frac{M_r M_1}{EI} ds = \int_s \frac{M_r M_0}{EI} ds + X \int_s \frac{M_1^2}{EI} ds = -\frac{11 q l^4}{6 EI} + X \frac{5 l^3}{3 EI} = 0,$$

$$X = \frac{11}{10} q l$$