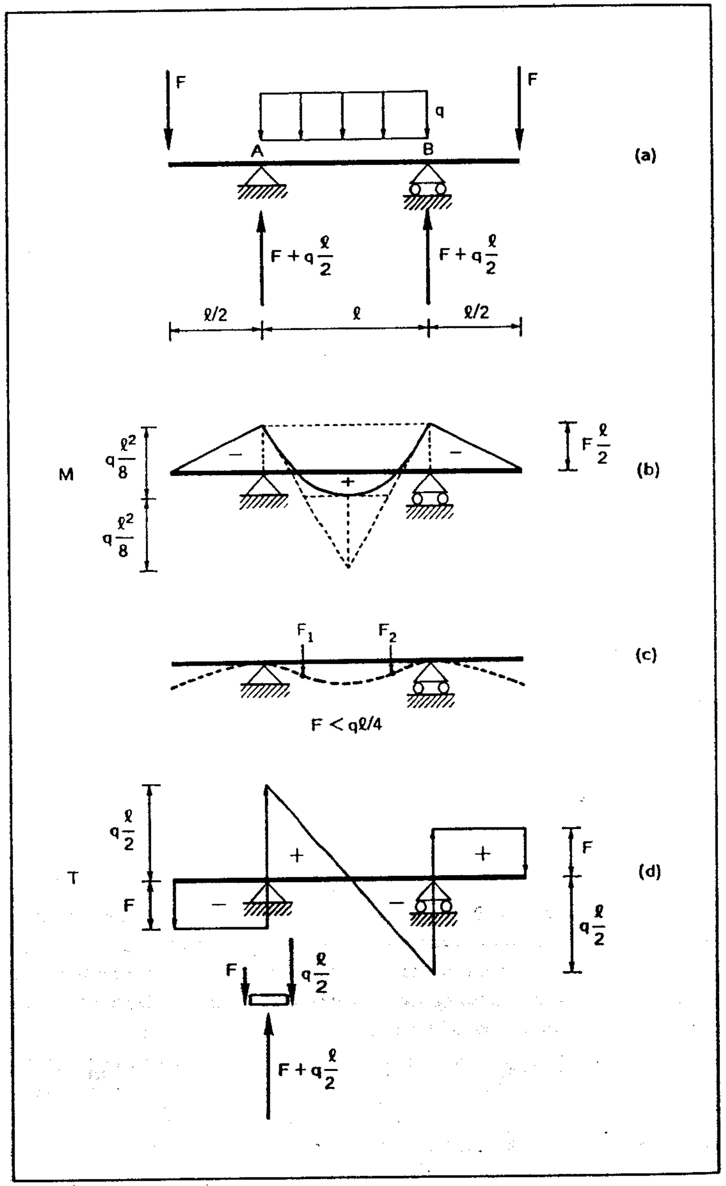
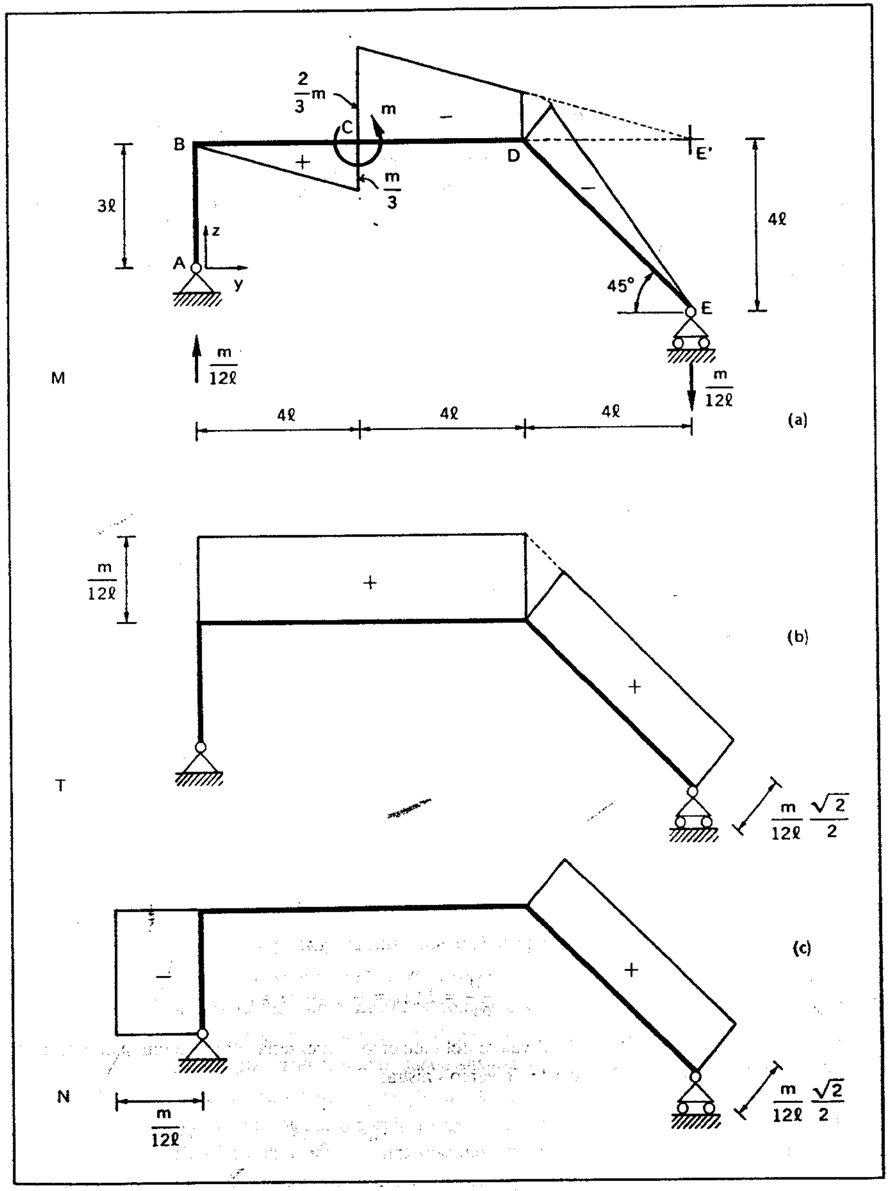
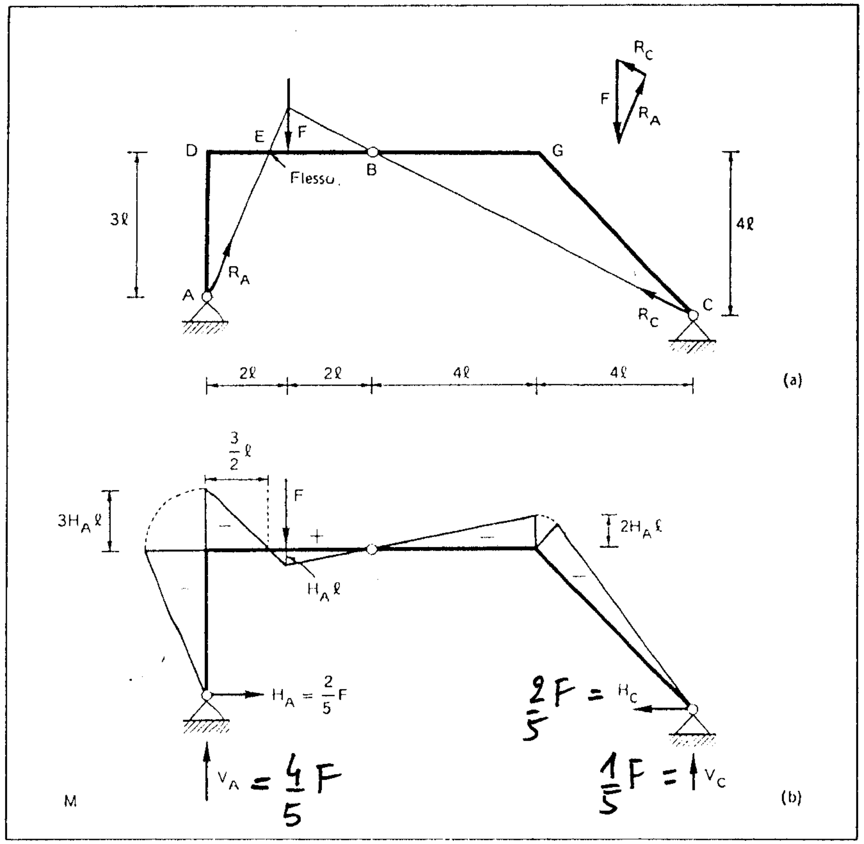
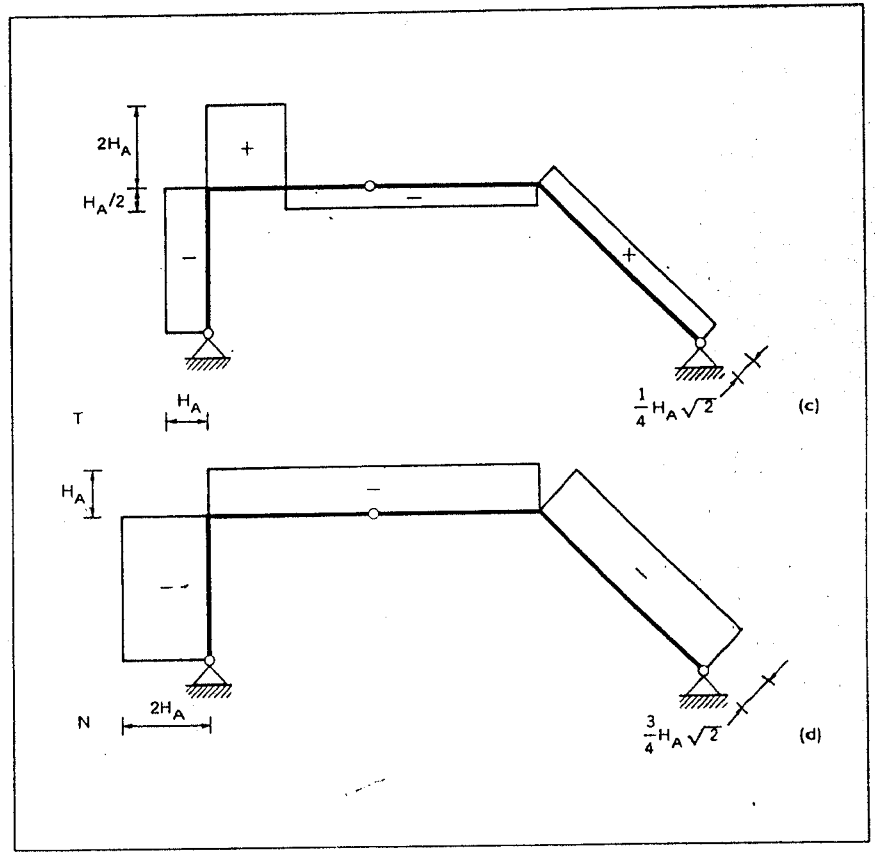

F
q
A
B
F
(a)
F + q ℓ/2
F + q ℓ/2
ℓ/2
ℓ
ℓ/2
M
q ℓ²/8
q ℓ²/8
F ℓ/2
(b)
F₁
F₂
(c)
F < qℓ/4
T
q ℓ/2
F
F
q ℓ/2
(d)
F
q ℓ/2
F + q ℓ/2

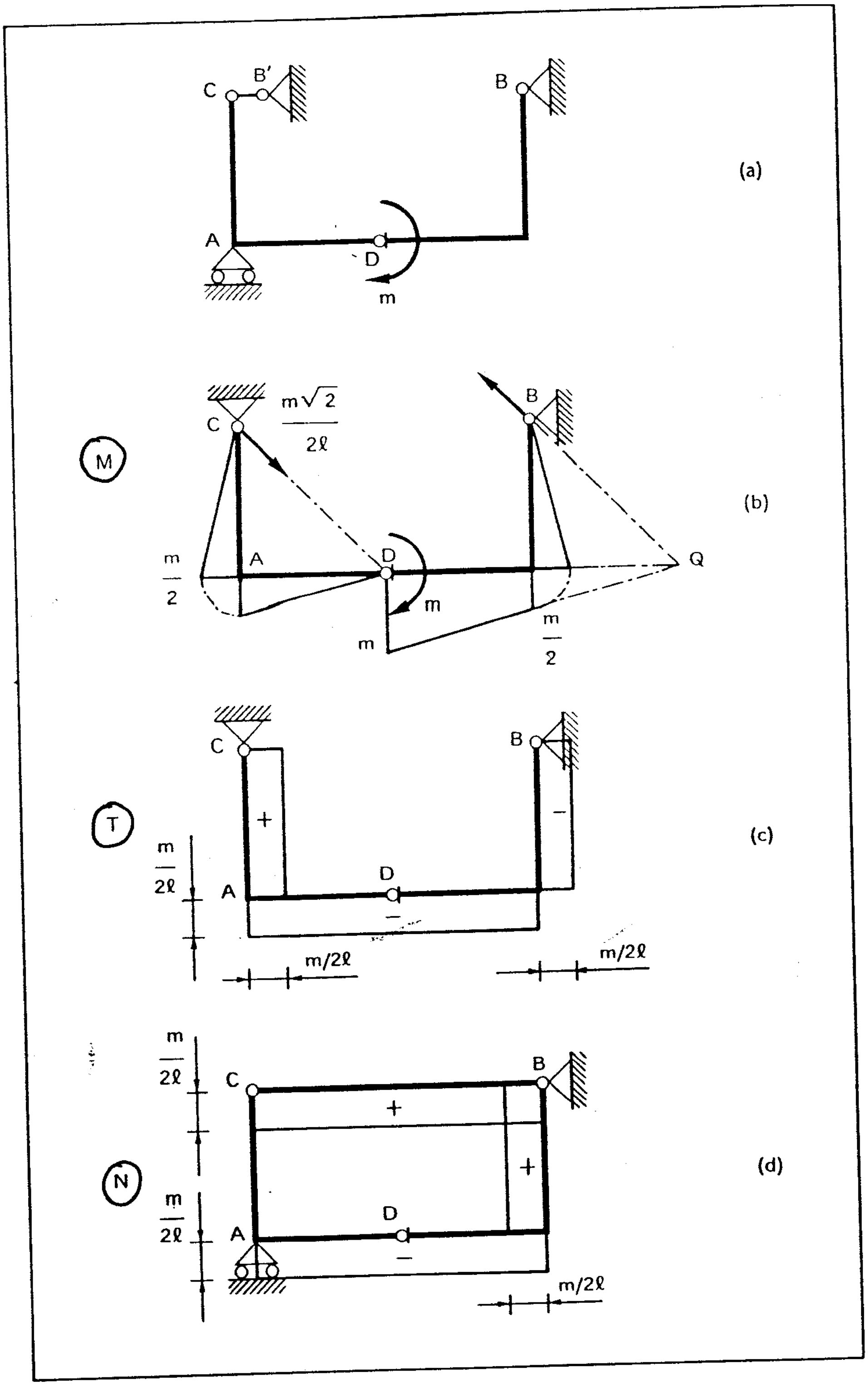

2/3 m
C
m
B
D
E'
m/3
3ℓ
4ℓ
z
A
y
45°
E
M
m/12ℓ
m/12ℓ
4ℓ
4ℓ
4ℓ
(a)
m/12ℓ
(b)
T
m/12ℓ √2/2
(c)
N
m/12ℓ
m/12ℓ √2/2



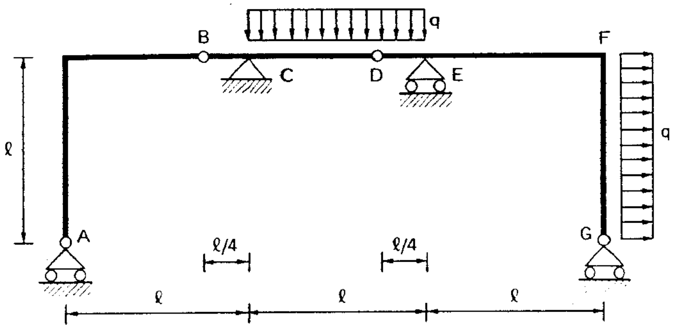
D
E
F
Flesso
B
G
A
C
R_A
R_C
3ℓ
4ℓ
2ℓ
2ℓ
4ℓ
4ℓ
(a)
$\frac{3}{2}\ell$
$3H_A\ell$
$H_A\ell$
$2H_A\ell$
$H_A = \frac{2}{5}F$
$\frac{2}{5}F = H_C$
$V_A = \frac{4}{5}F$
$\frac{1}{5}F = V_C$
M
(b)

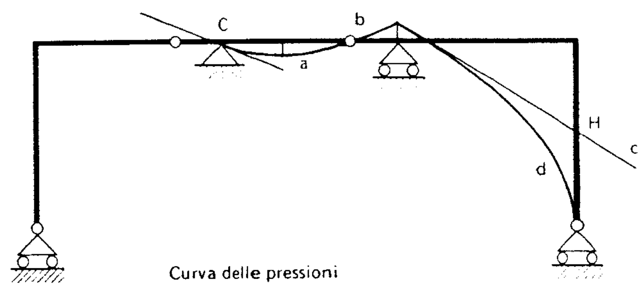


$2H_A$
$H_A/2$
H_A
T
$\frac{1}{4}H_A\sqrt{2}$
(c)
H_A
$2H_A$
N
$\frac{3}{4}H_A\sqrt{2}$
(d)

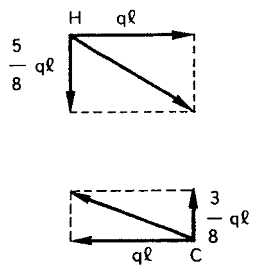


C
B′
B
(a)
A
D
m
M
m√2/2ℓ
(b)
m/2
Q
T
+
−
(c)
m/2ℓ
N
(d)

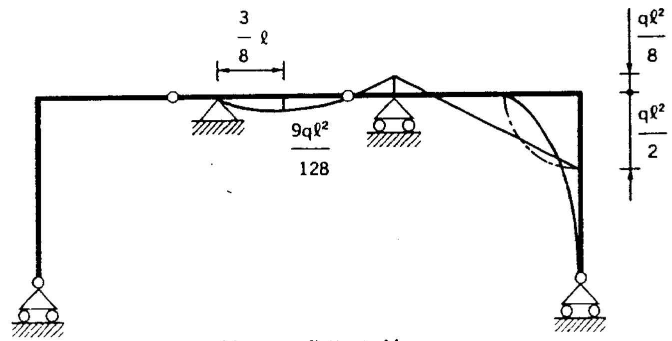




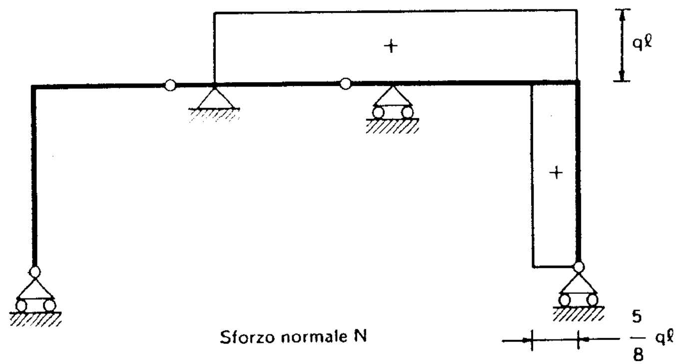
Curva delle pressioni



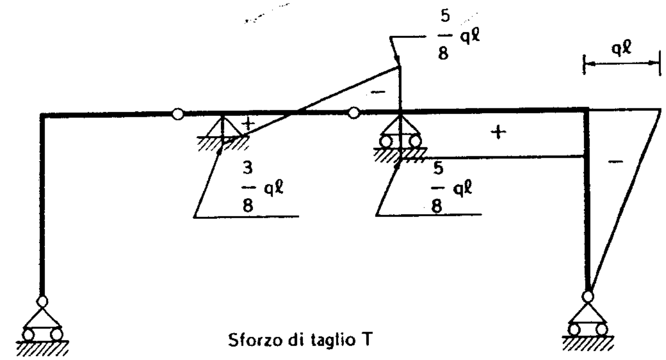
Curva delle pressioni	
Tratto	Curva corrispondente
CD	Parabola a
DE	Parabola b
EF	Retta c
FG	Parabola d



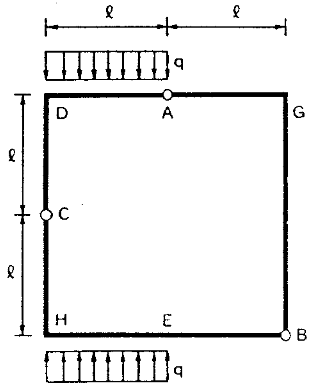
Momento flettente M



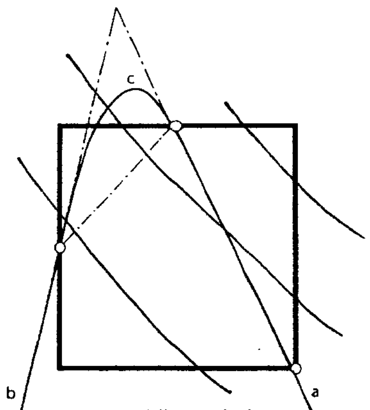
Sforzo normale N



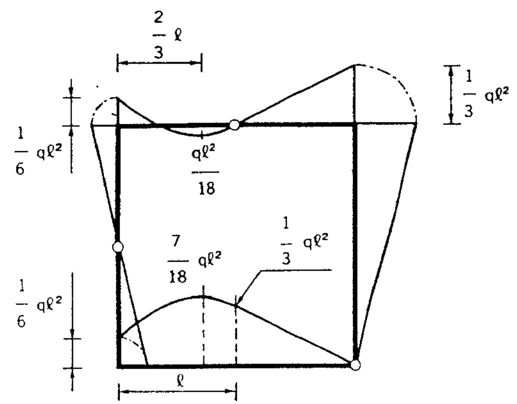
Sforzo di taglio T



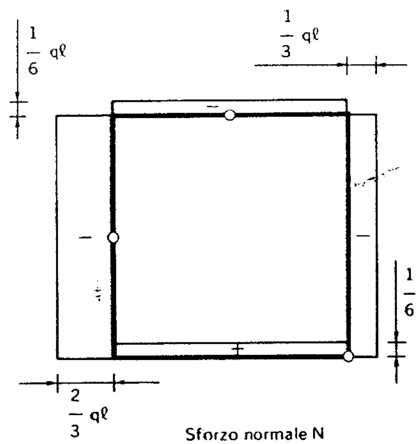
Curva delle pressioni	
Tratto	Curva corrispondente
AB	Retta a
DCH	Retta b
AD	Parabola c
BE	Retta a
HE	Parabola c



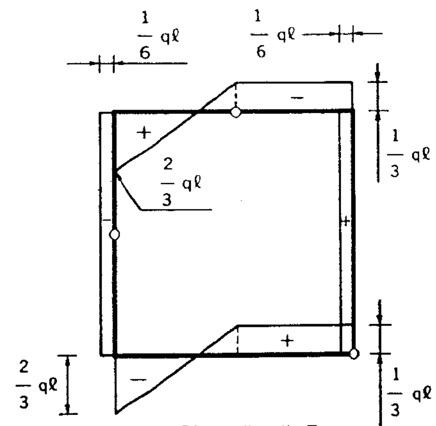
Curva delle pressioni



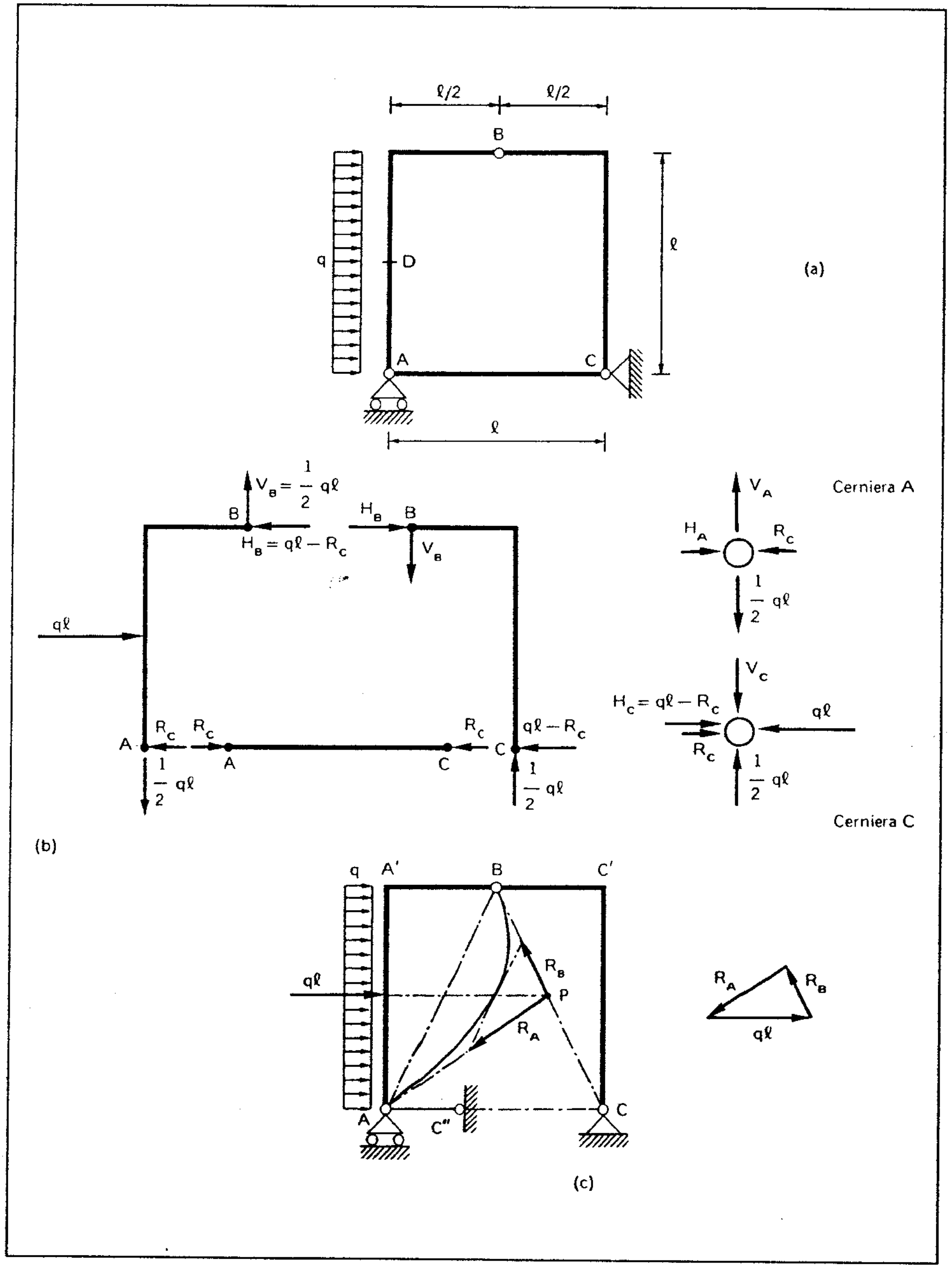
Momento flettente M



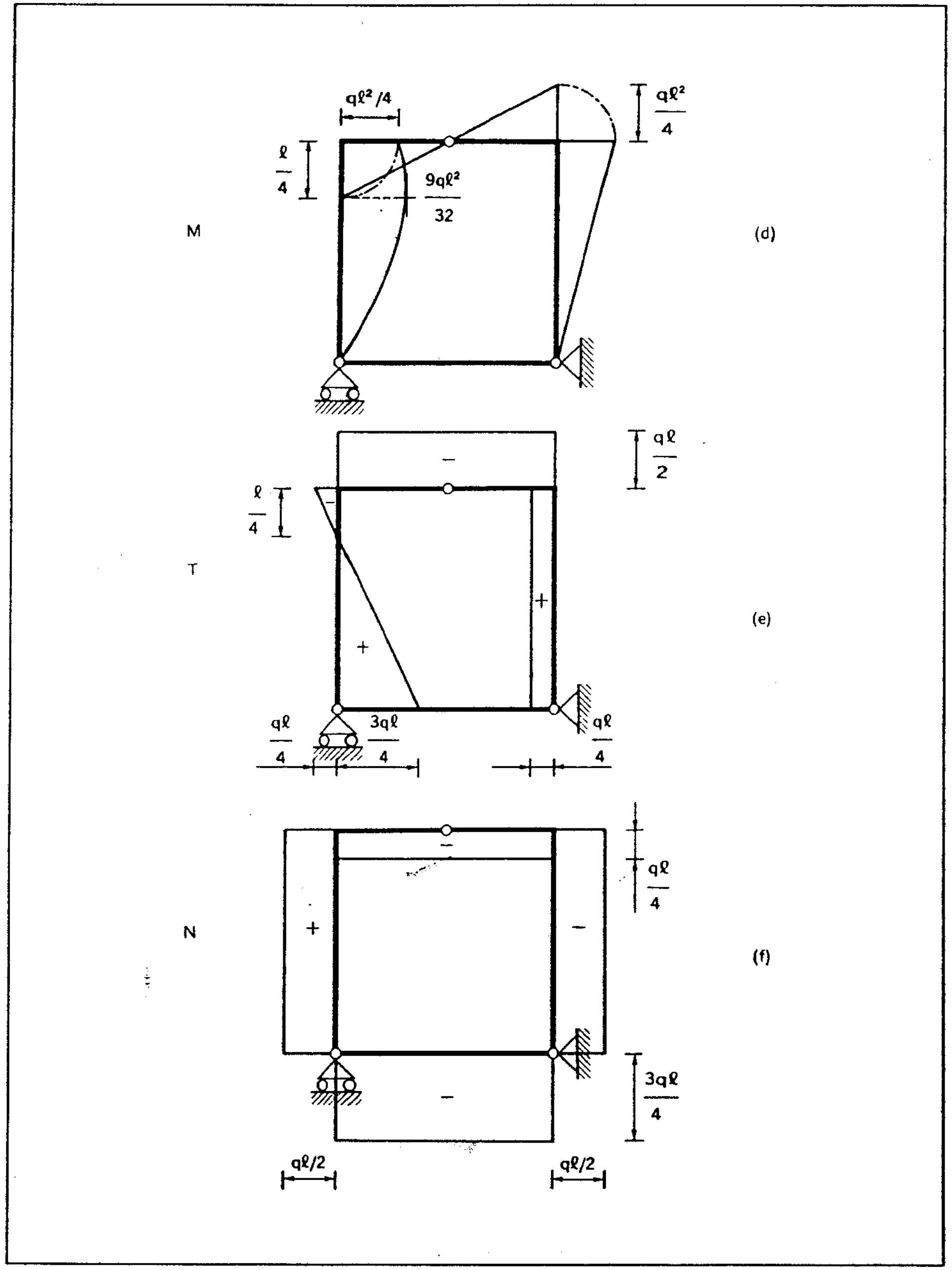
Sforzo normale N



Sforzo di taglio T

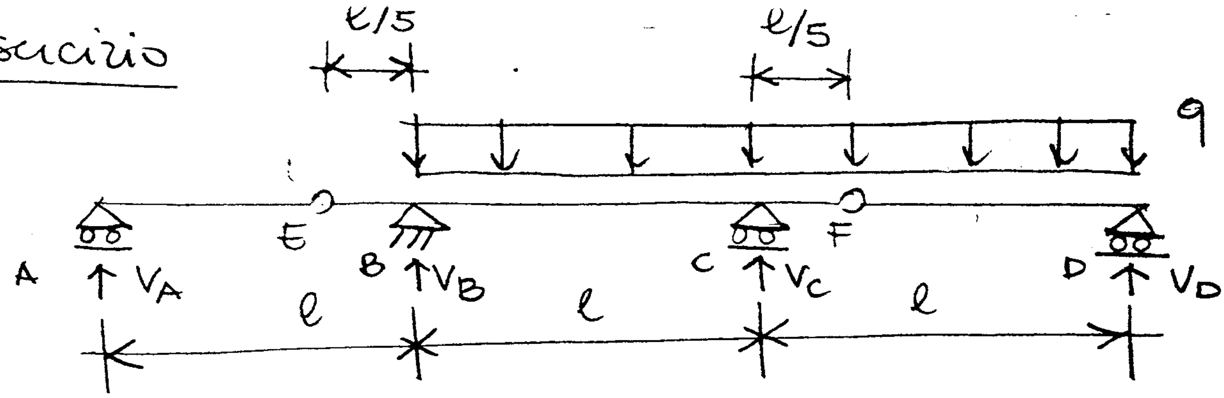


ℓ/2
ℓ/2
B
q
D
ℓ
(a)
A
C
ℓ
$V_B = \frac{1}{2} q\ell$
B
$H_B = q\ell - R_C$
H_B
B
V_B
V_A
Cerniera A
H_A
R_C
$\frac{1}{2} q\ell$
qℓ
V_C
$H_C = q\ell - R_C$
qℓ
R_C
$\frac{1}{2} q\ell$
Cerniera C
A
R_C
R_C
A
C
R_C
C
$q\ell - R_C$
$\frac{1}{2} q\ell$
$\frac{1}{2} q\ell$
(b)
q
A'
B
C'
qℓ
R_B
P
R_A
A
C''
C
(c)
R_A
R_B
qℓ



$q\ell^2/4$
$\frac{q\ell^2}{4}$
$\frac{\ell}{4}$
$\frac{9q\ell^2}{32}$
M
(d)
$\frac{q\ell}{2}$
$\frac{\ell}{4}$
T
(e)
$\frac{q\ell}{4}$
$\frac{3q\ell}{4}$
$\frac{q\ell}{4}$
$\frac{q\ell}{4}$
N
(f)
$\frac{3q\ell}{4}$
qℓ/2
qℓ/2

Esercizio



e.e.g:

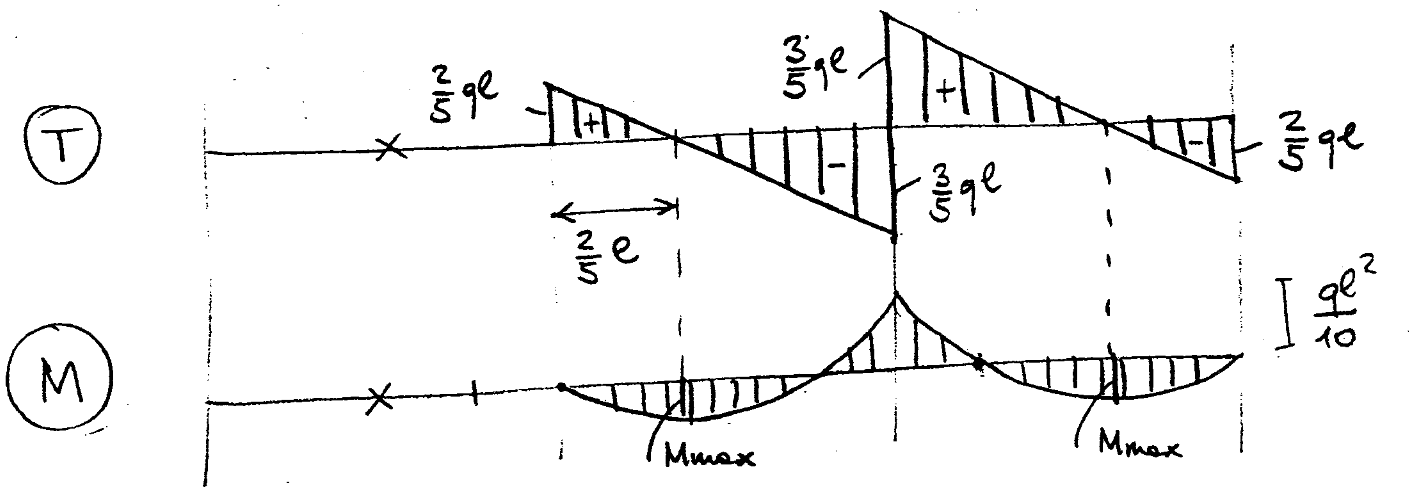
$$\text{©}\begin{cases} H_B = 0 \\ \cancel{V_A} + V_B + V_C + V_D = 2ql \\ V_D l - V_B l - \cancel{V_A 2l} = 0 \end{cases}$$

e e a

$$\begin{cases} M_{EA} = -V_A \frac{4}{5} l = 0 & \Rightarrow V_A = 0 \\ M_{FD} = V_D \frac{4}{5} l - \frac{q}{2}\left(\frac{4}{5} l\right)^2 = 0 & \Rightarrow V_D = \frac{2}{5} ql = V_B \end{cases}$$

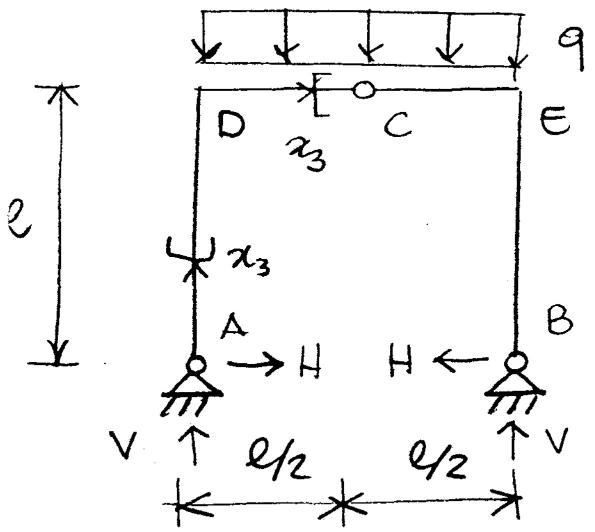
per cui:

$$V_C = 2ql - \frac{4}{5} ql = \frac{6}{5} ql$$



$$M_{max} = \frac{4}{25} ql^2 - \frac{q}{2} \frac{4}{25} l^2 = \frac{2}{25} ql^2$$

Portale a 3 cerniere



Struttura simmetrica
carico simmetrico

$$V_A = V_B = V$$

$$H_A = H_B = H$$

equilibrio globale:

$$2V - q\ell = 0 \quad \Rightarrow V = \frac{q\ell}{2}$$

le altre due eq. e.g. sono identicamente verificate, ho bisogno di una eq. ausiliaria per determinare H

$$M_{CA} = H\ell - V\frac{\ell}{2} + q\frac{\ell}{2}\cdot\frac{\ell}{4} = 0$$

da cui

$$H = \frac{V}{2} - \frac{q\ell}{8} = \frac{q\ell}{8}$$

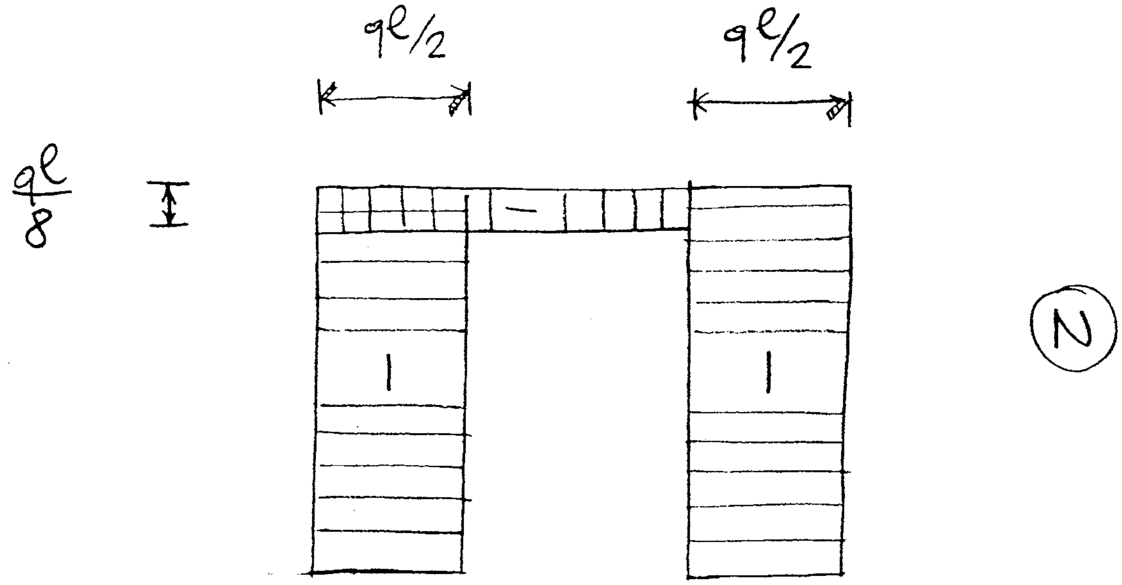
AD : $0 \leq x_3 \leq \ell$

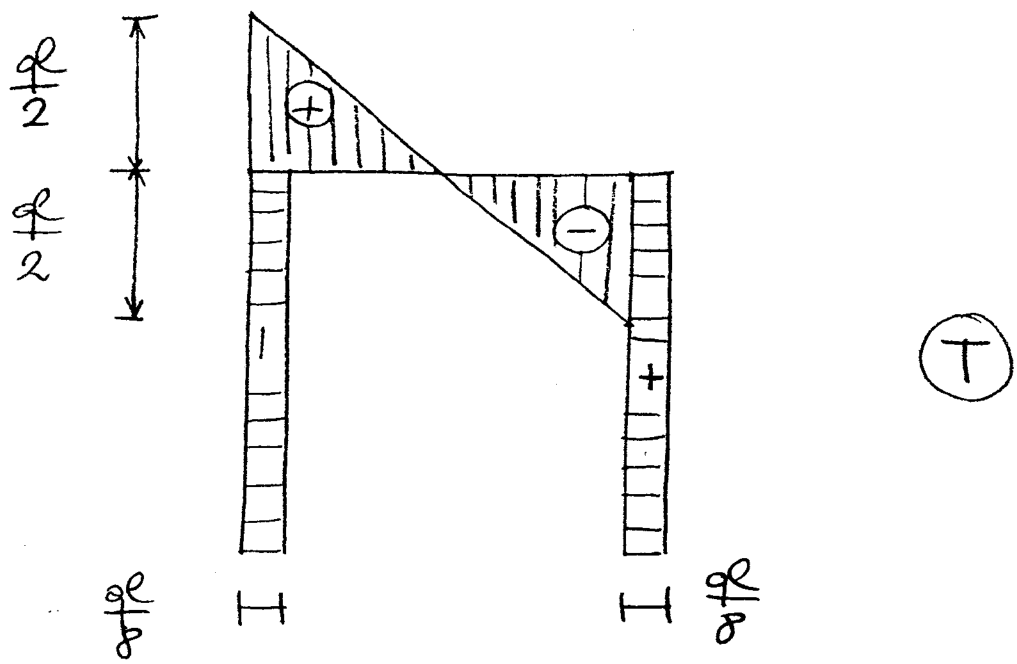
$$\begin{cases} N = -\dfrac{q\ell}{2} \\ T = -\dfrac{q\ell}{8} \\ M = -\dfrac{q\ell}{8}x_3 \qquad \begin{cases} M_A = 0 \\ M_D = -\dfrac{q\ell^2}{8} \end{cases} \end{cases}$$

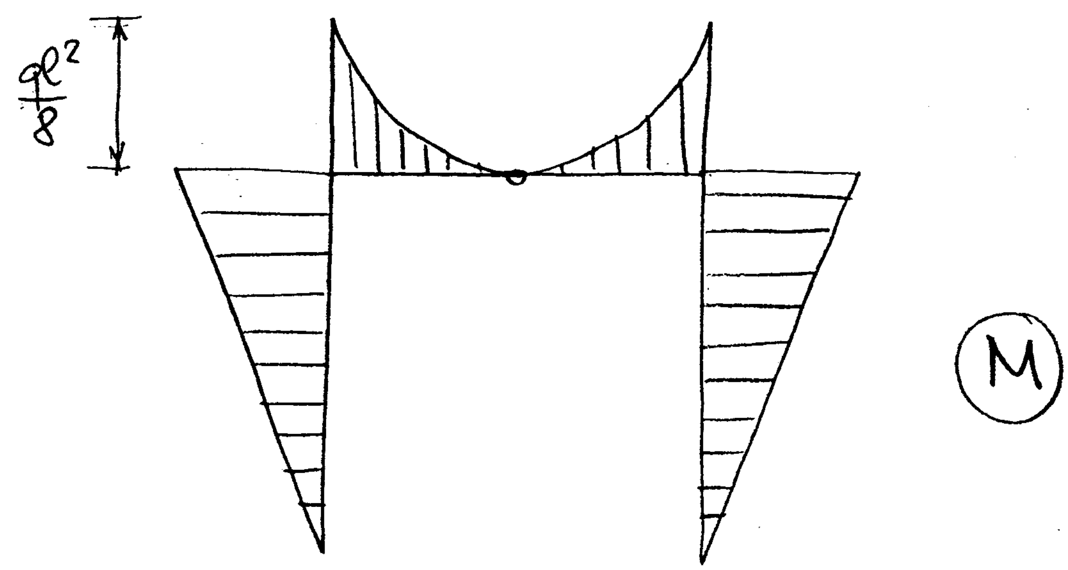
DE : $0 \leq x_3 \leq \ell$

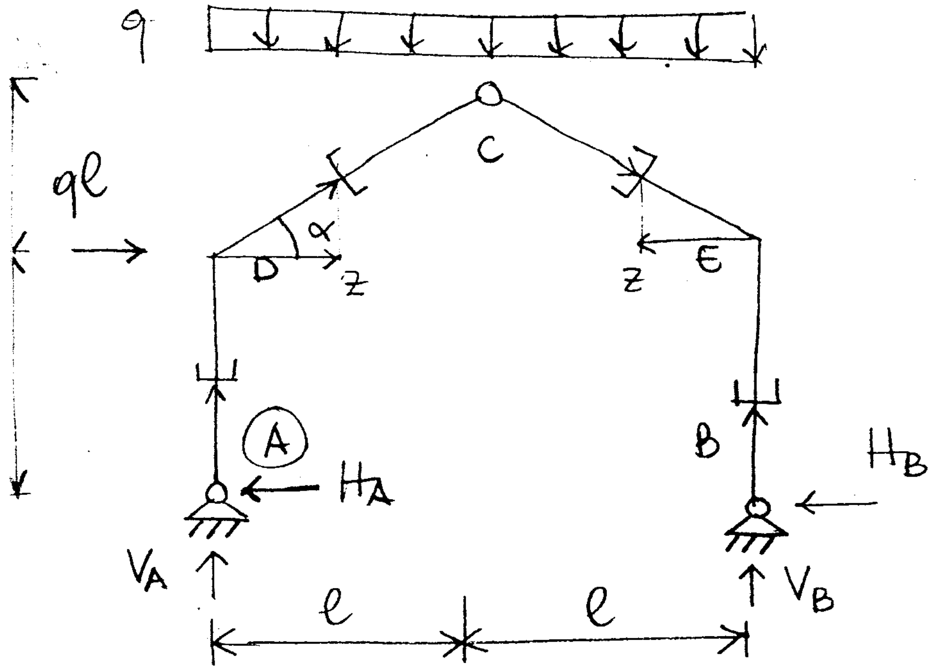
$$\begin{cases} N = -\dfrac{q\ell}{8} \\ T = \dfrac{q\ell}{2} - qx_3 \qquad \begin{cases} T_D = \dfrac{q\ell}{2} \\ T_E = -\dfrac{q\ell}{2} \end{cases} \\ M = \dfrac{q\ell}{2}x_3 - \dfrac{qx_3^2}{2} - \dfrac{q\ell^2}{8} \qquad \begin{cases} M_A = \dfrac{q\ell^2}{8} \\ M_E = -\,'' \end{cases} \end{cases}$$

le azioni interne sono continue nel tratto DE poiché non agiscono forze o coppie concentrate.


ql/2
ql/2
ql/8
–
N


ql/2
ql/2
+
–
+
ql/8
ql/8
T


ql²/8
M



$$L = \sqrt{l^2 + \frac{l^2}{4}} = \frac{\sqrt{5}}{2}\, l$$

$$tg\,\alpha = \frac{1}{2}$$

$$\cos\alpha = \frac{l}{L} = \frac{2}{\sqrt{5}}$$

$$\sin\alpha = \frac{l}{2L} = \frac{1}{\sqrt{5}}$$

eeg:

$$\begin{cases} H_A + H_B - ql = 0 \\ V_A + V_B - 2ql = 0 \\ V_B\, 2l - ql^2 - 2ql^2 = 0 \end{cases} \Rightarrow \boxed{\begin{array}{l} V_A = \dfrac{ql}{2} \\ V_B = \dfrac{3}{2} ql \end{array}}$$

eea:

$$M_{CB} = V_B\, l - H_B \frac{3}{2} l - \frac{ql^2}{2} = 0$$

da cui

$$\boxed{\begin{array}{l} H_B = \dfrac{2}{3} ql \\ H_A = ql - H_B = \dfrac{ql}{3} \end{array}}$$

<u>AD</u> $(0 \leq x_3 \leq l)$

$$N = -\frac{ql}{2}$$

$$T = \frac{ql}{3}$$

$$M = \frac{ql}{3} x_3$$

<u>BE</u> $(0 \leq x_3 \leq l)$

$$\begin{cases} N = -\frac{3}{2} ql \\ T = \frac{2}{3} ql \\ M = \frac{2}{3} ql\, x_3 \end{cases}$$

DC $(0 \leq x_3 \leq L)$ $\quad z = x_3 \cos\alpha$

$$\begin{cases} N = q\left(z - \frac{\ell}{2}\right)\sin\alpha - \frac{2}{3}q\ell\cos\alpha = \frac{q\ell}{\sqrt{5}}\left(\frac{z}{\ell} - \frac{11}{6}\right) \\ T = q\left(-z + \frac{\ell}{2}\right)\cos\alpha - \frac{2}{3}q\ell\sin\alpha = \frac{q\ell}{\sqrt{5}}\left(-2\frac{z}{\ell} + \frac{1}{3}\right) \\ M = \cancel{\frac{q\ell}{2}z} + \frac{q\ell}{3}\left(\ell + \frac{z}{2}\right) - \cancel{q\ell\frac{z}{2}} - \frac{qz^2}{2} \end{cases}$$

EC $(0 \leq x_3 \leq L)$ $\quad z' = (\ell - x_3)\cos\alpha$

$$\begin{cases} N = \left(-\frac{3}{2}\ell + z'\right)q\sin\alpha - \frac{2}{3}q\ell\cos\alpha = \frac{q\ell}{\sqrt{5}}\left(\frac{z'}{\ell} - \frac{17}{6}\right) \\ T = \left(-\frac{3}{2}\ell + z'\right)q\cos\alpha + \frac{2}{3}q\ell\sin\alpha = \frac{q\ell}{\sqrt{5}}\left(2\frac{z'}{\ell} - \frac{7}{3}\right) \\ M = \frac{3}{2}q\ell z' - \frac{2}{3}q\ell\left(\ell + \frac{z'}{2}\right) \end{cases}$$