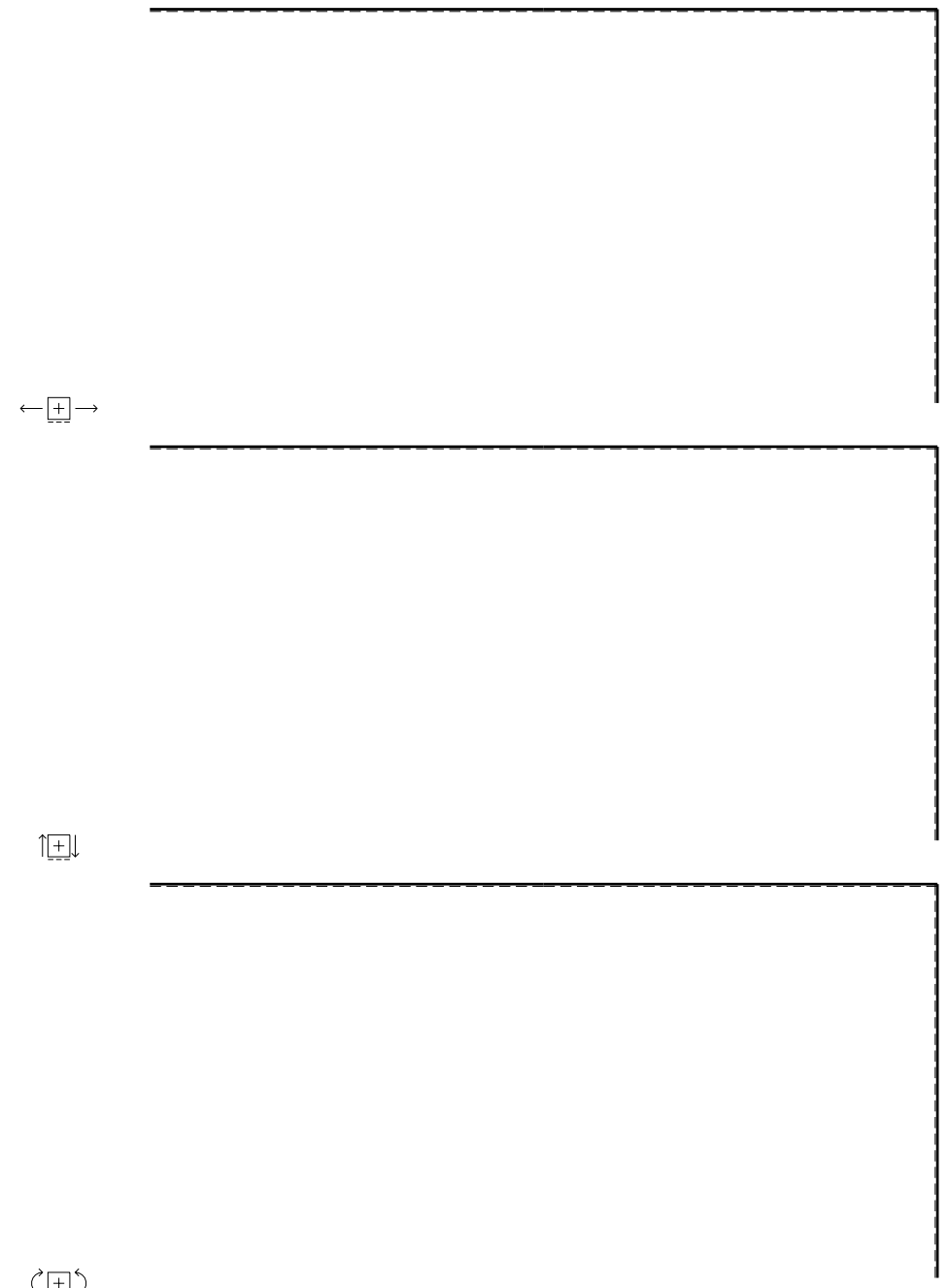


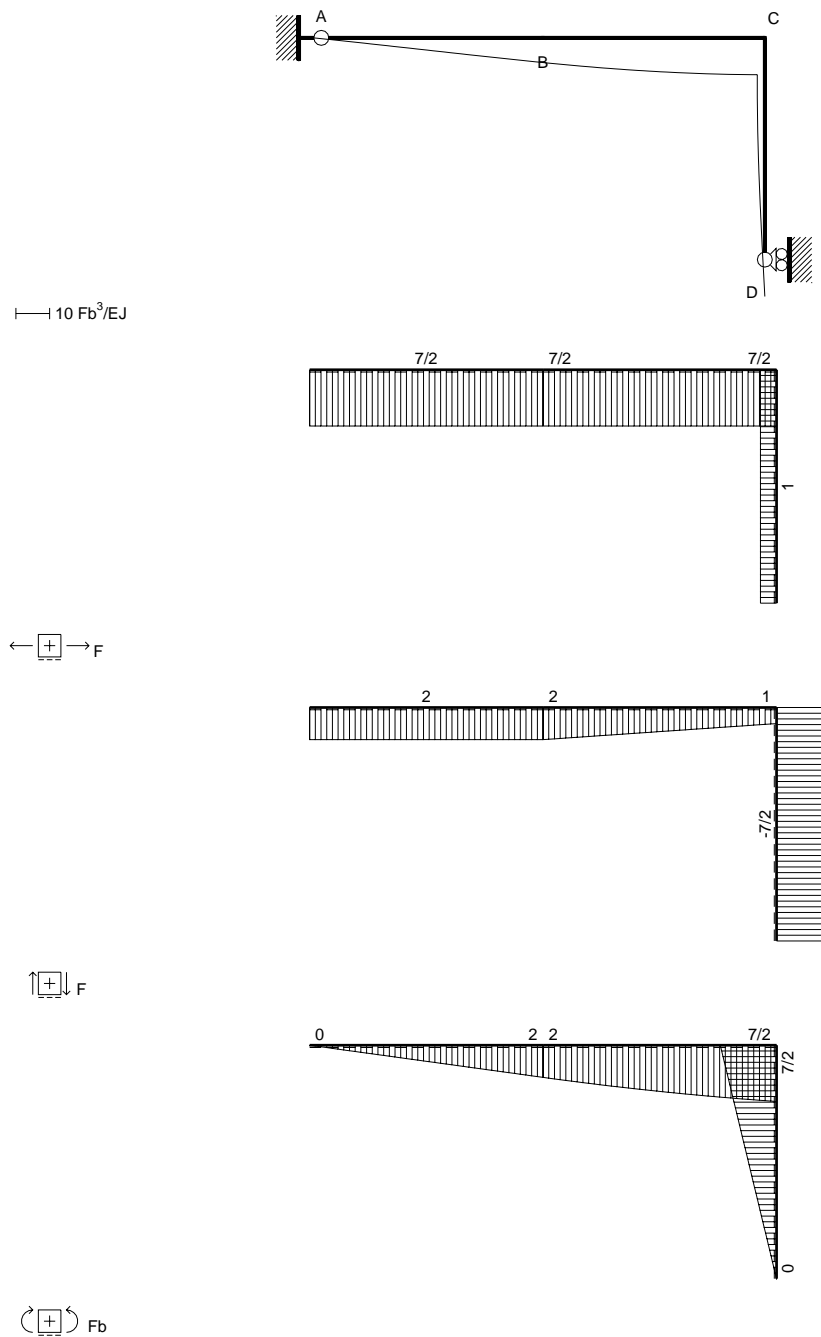
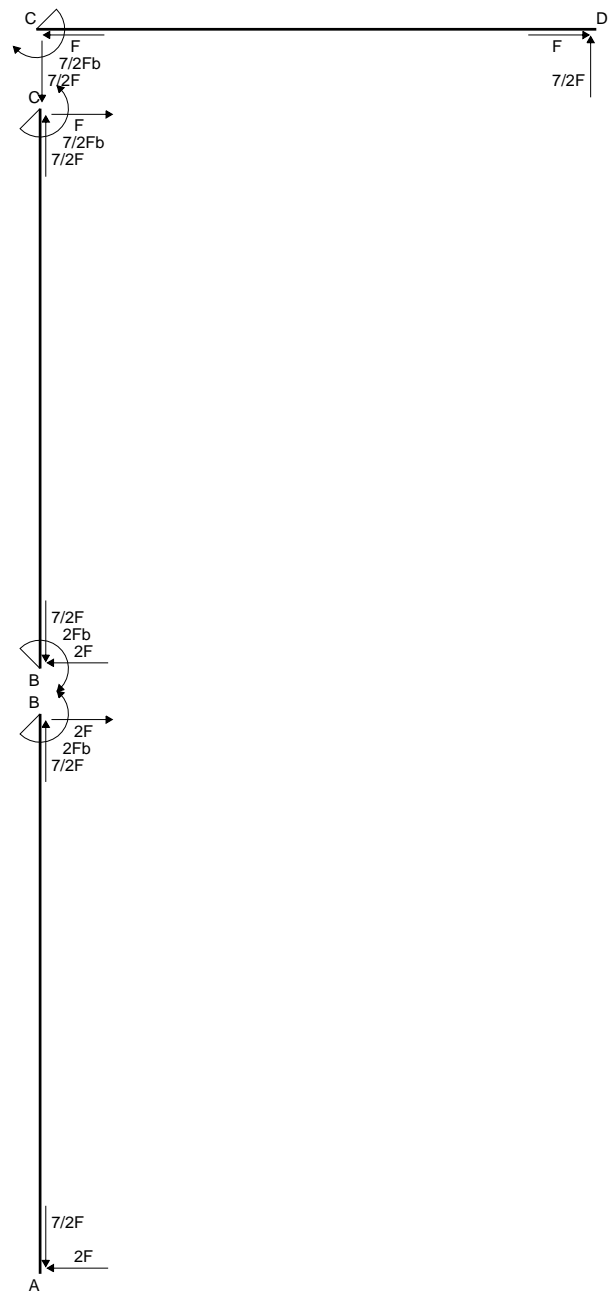
$V_D = -F$	$u_A = -\delta = -b^3 F/EJ$	$EJ_{CD} = EJ$
$q_{BC} = -q = -F/b$	$EJ_{AB} = EJ$	
$\theta_{AB} = -\theta = -\alpha T/b = -bF/EJ$	$EJ_{BC} = EJ$	



ANALISI STRUTTURE IPERSTATICHE  
METODO LINEA ELASTICA

- Riportare sul fronte:
- 1) Declassamento Scelto
  - 2) Reazioni calcolate
  - 3) Diagrammi finali delle azioni interne
- Sul retro:
- 4) Analisi cinematica
  - 5) Equazioni delle linee elastiche
  - 6) Condizioni al contorno

Carichi e deformazioni date hanno verso efficace in disegno.  
Calcolare reazioni vincolari della struttura e delle aste.  
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Esprimere la linea elastica delle aste. AB BC CD  
 $J_{YZ} - x_{YZ} - \theta_{YZ}$  riferimento locale asta YZ con origine in Y.  
Curvatura  $\theta$  asta AB positiva se convessa a destra con inizio A.  
Spostamento orizzontale assoluto u imposto al nodo A.



DEFORMATA ELASTICA

Costanti di integrazione: A B C D G H

$M_{AB}^0 = 0$   
 $M_{BC}^0 = -1/2 Fx^2/b$   
 $M_{CD}^0 = 0$

Relazioni di congruenza

$y'_{AB}(b) - y'_{BC}(0) = 0$   
 $y_{AB}(0) = 0$   
 $y_{CD}(0) + \delta = 0$   
 $y'_{BC}(b) - y'_{CD}(0) = 0$   
 $y_{BC}(0) - y_{AB}(b) = 0$   
 $y_{CD}(b) = 0$

$M_{AB} = 2Fx$   
 $EJy''_{AB} = M_{AB} + EJ\theta_{AB} = 2Fx - EJ\theta$   
 $EJy'_{AB} = Fx^2 - EJ\theta x + EJA$   
 $EJy_{AB} = 1/3Fx^3 - 1/2EJ\theta x^2 + EJA x + EJB$

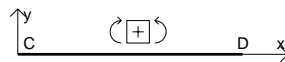
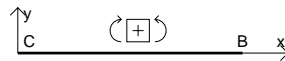
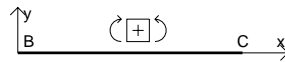
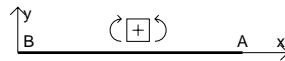
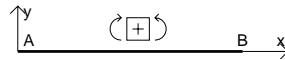
$M_{BA} = 2Fx - 2Fb$   
 $EJy''_{BA} = 2Fx - 2Fb + EJ\theta$   
 $EJy'_{BA} = Fx^2 - 2Fbx + EJ\theta x + EJA_0$   
 $EJy_{BA} = 1/3Fx^3 - Fbx^2 + 1/2EJ\theta x^2 + EJA_0 x + EJB_0$

$M_{BC} = 2Fx + 2Fb - 1/2qx^2$   
 $EJy''_{BC} = M_{BC} = 2Fx + 2Fb - 1/2qx^2$   
 $EJy'_{BC} = Fx^2 + 2Fbx - 1/6qx^3 + EJC$   
 $EJy_{BC} = 1/3Fx^3 + Fbx^2 - 1/24qx^4 + EJC x + EJD$

$M_{CB} = Fx - 7/2Fb + 1/2qx^2$   
 $EJy''_{CB} = Fx - 7/2Fb + 1/2qx^2$   
 $EJy'_{CB} = 1/2Fx^2 - 7/2Fbx + 1/6qx^3 + EJC_0$   
 $EJy_{CB} = 1/6Fx^3 - 7/4Fbx^2 + 1/24qx^4 + EJC_0 x + EJD_0$

$M_{CD} = -7/2Fx + 7/2Fb$   
 $EJy''_{CD} = M_{CD} = -7/2Fx + 7/2Fb$   
 $EJy'_{CD} = -7/4Fx^2 + 7/2Fbx + EJG$   
 $EJy_{CD} = -7/12Fx^3 + 7/4Fbx^2 + EJG x + EJH$

$M_{DC} = -7/2Fx$   
 $EJy''_{DC} = -7/2Fx$   
 $EJy'_{DC} = -7/4Fx^2 + EJG_0$   
 $EJy_{DC} = -7/12Fx^3 + EJG_0 x + EJH_0$



Condizioni al contorno

$$\begin{bmatrix} Ab & B & Cb & D & Gb & H \end{bmatrix} \begin{bmatrix} Fb^3/EJ & \alpha Tb & \delta \end{bmatrix} = \begin{bmatrix} -1 & 1 & 0 \\ -17/6 & 0 & 0 \\ 0 & 0 & 0 \\ 1/3 & -1/2 & 0 \\ 0 & 0 & -1 \\ -7/6 & 0 & 0 \end{bmatrix}$$

Condizioni al contorno

$Ab - Cb = -Fb^3/EJ + \alpha Tb$   
 $Cb - Gb = -17/6 Fb^3/EJ$   
 $B = 0$   
 $-Ab - B + D = 1/3 Fb^3/EJ - 1/2 \alpha Tb$   
 $H = -\delta$   
 $Gb + H = -7/6 Fb^3/EJ$

Costanti

$A = -3Fb^2/EJ$   
 $C = -3Fb^2/EJ$   
 $B = 0$   
 $D = -19/6 Fb^3/EJ$   
 $H = -Fb^3/EJ$   
 $G = -1/6 Fb^2/EJ$

Costanti

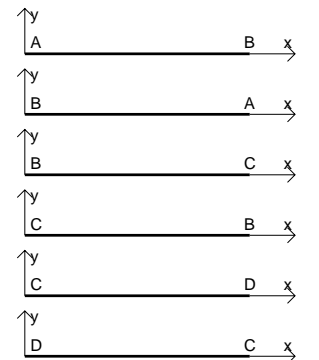
$B_0 = 19/6 Fb^3/EJ$   
 $A_0 = -3Fb^2/EJ$   
 $D_0 = 39/8 Fb^3/EJ$   
 $C_0 = -1/6 Fb^2/EJ$   
 $H_0 = 0$   
 $G_0 = 19/12 Fb^2/EJ$

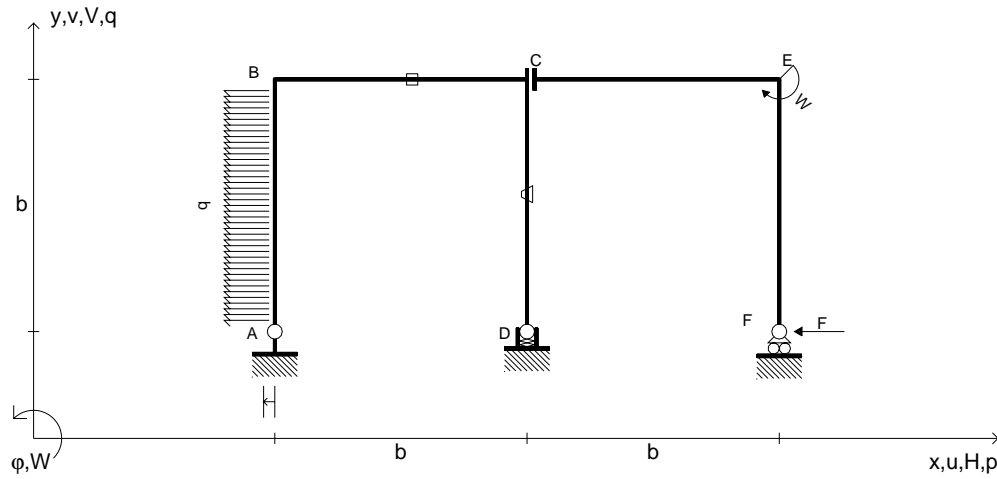
DEFORMATA (coordinate locali)

$AB \ y(x)EJ = -3xFb^2 - 1/2x^2Fb + 1/3x^3F$   
 $BA \ y(x)EJ = 19/6Fb^3 - 3xFb^2 - 1/2x^2Fb + 1/3x^3F$   
 $BC \ y(x)EJ = -19/6Fb^3 - 3xFb^2 + x^2Fb + 1/3x^3F - 1/24x^4q$   
 $CB \ y(x)EJ = 39/8Fb^3 - 1/6xFb^2 - 7/4x^2Fb + 1/6x^3F + 1/24x^4q$   
 $CD \ y(x)EJ = -Fb^3 - 1/6xFb^2 + 7/4x^2Fb - 7/12x^3F$   
 $DC \ y(x)EJ = 19/12xFb^2 - 7/12x^3F$

Soluzione

$$\begin{bmatrix} Ab \\ Cb \\ B \\ D \\ H \\ Gb \end{bmatrix} = \begin{bmatrix} -3 \\ -3 \\ 0 \\ -19/6 \\ -1 \\ -1/6 \end{bmatrix} \begin{bmatrix} Fb^3/EJ \end{bmatrix}$$





$H_A = -F$	$\theta_{CD} = -\theta = -\alpha T/b = -bF/EJ$	$EJ_{BC} = EJ$
$W_E = -W = -Fb$	$u_A = -\delta = -b^3 F/EJ$	$EJ_{CD} = EJ$
$p_{AB} = -q = -F/b$	$k_D = 4EJ/b^3$	$EJ_{CE} = EJ$
$\epsilon_{BC} = -\alpha T = -b^2 F/EJ$	$EJ_{AB} = EJ$	$EJ_{EF} = EJ$

ANALISI STRUTTURE IPERSTATICHE  
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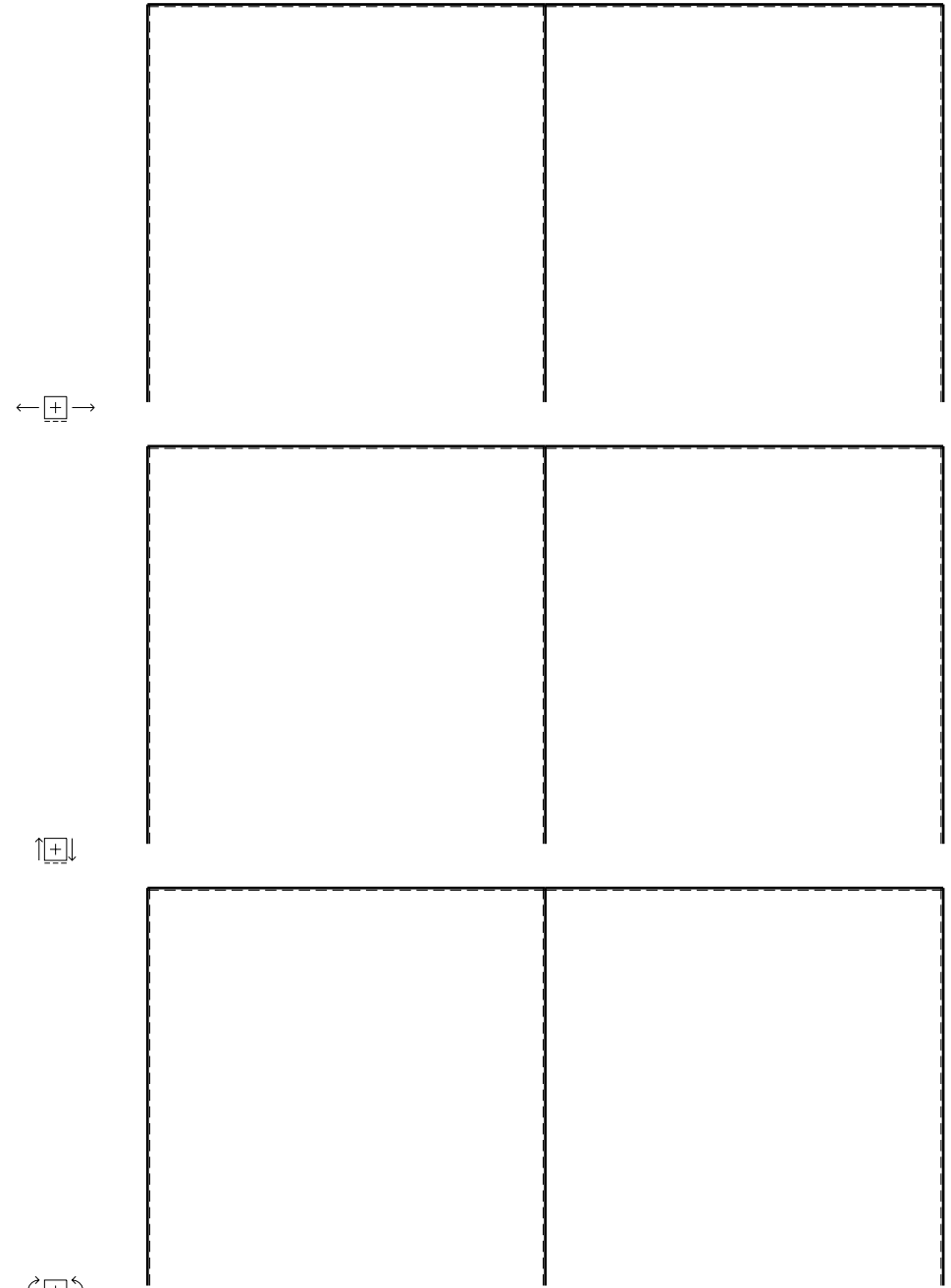
Esprimere la linea elastica delle aste. AB BC CD CE EF

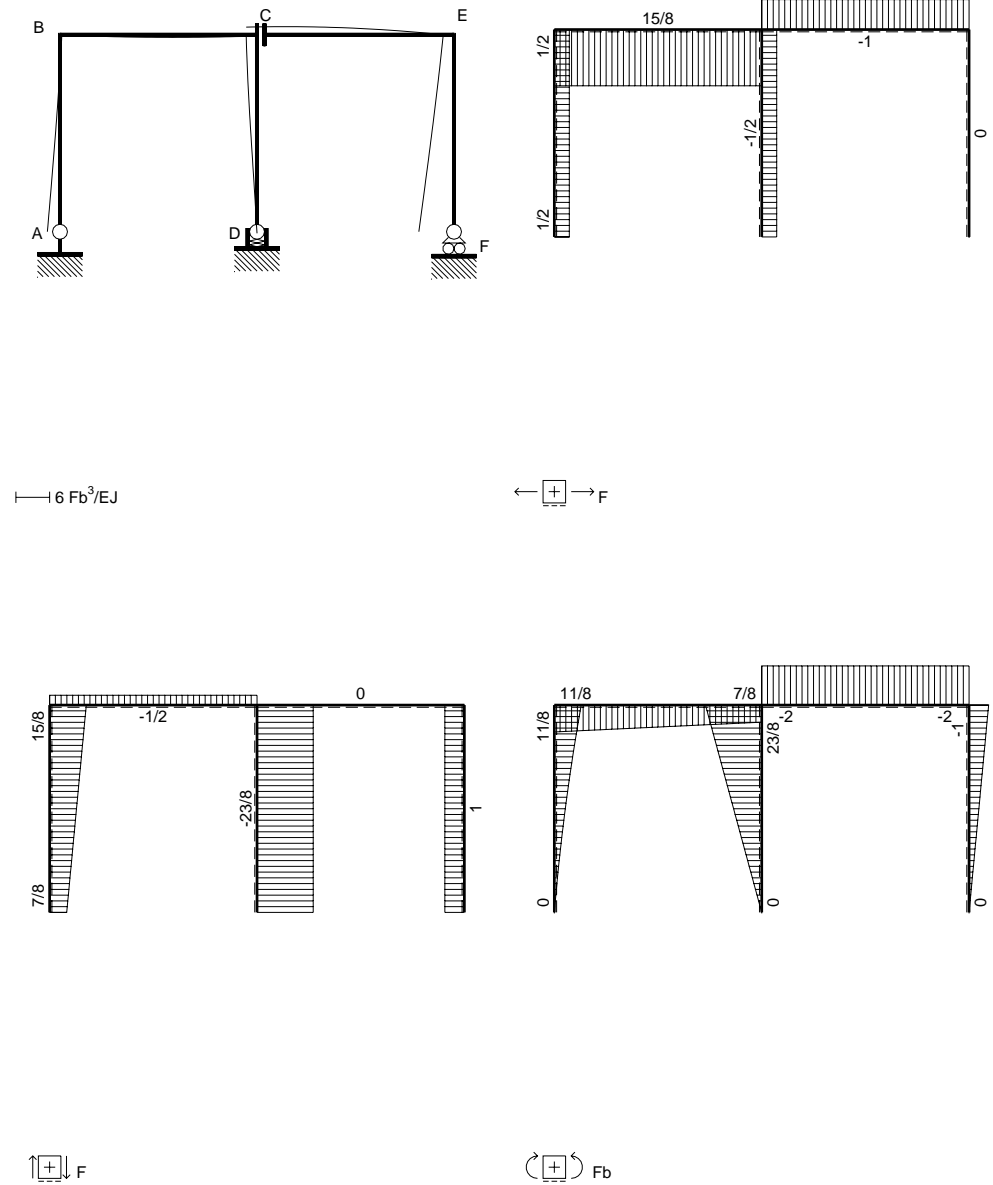
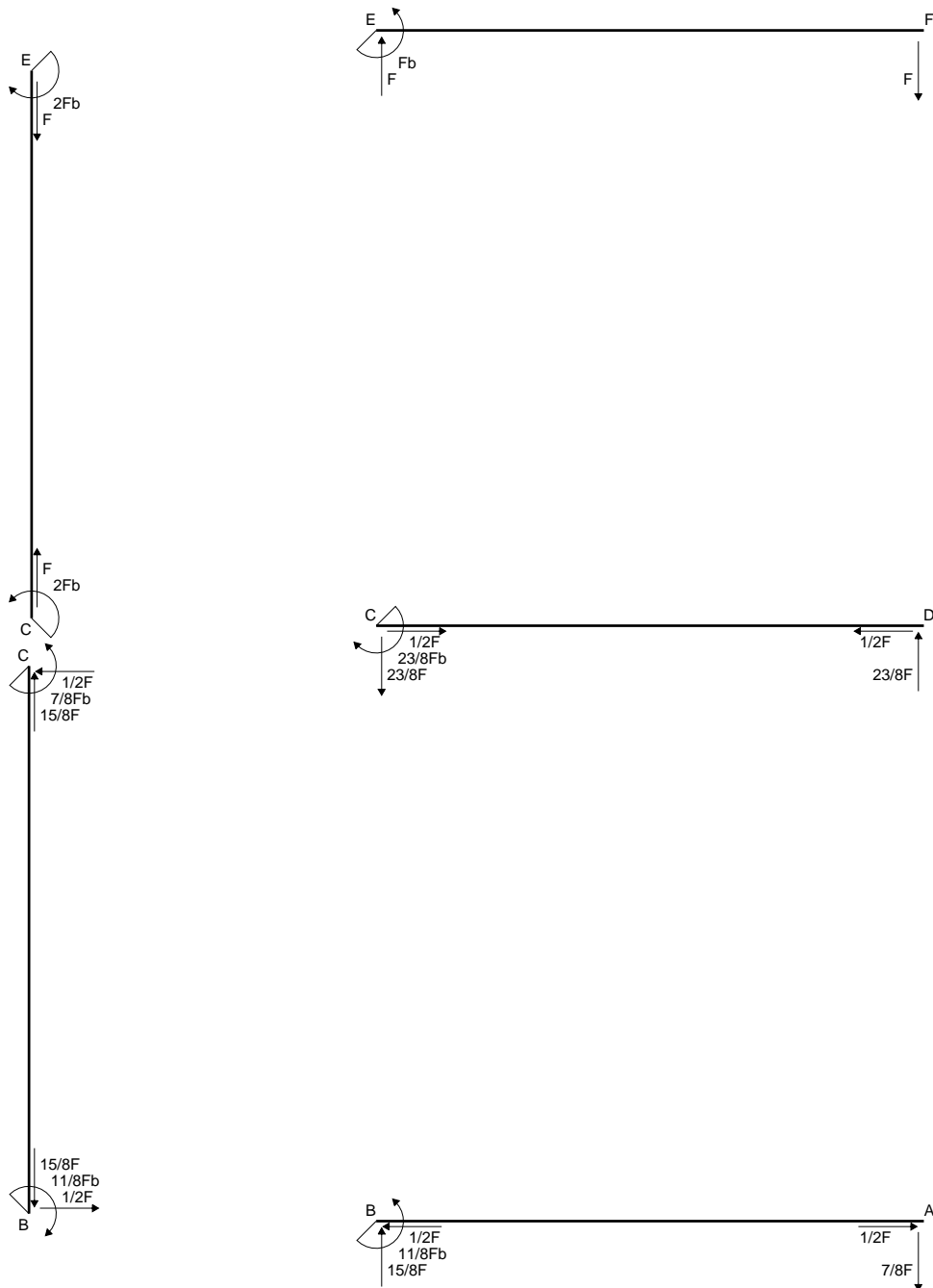
$J_{YZ} - x_{YZ} - \theta_{YZ}$  riferimento locale asta YZ con origine in Y.

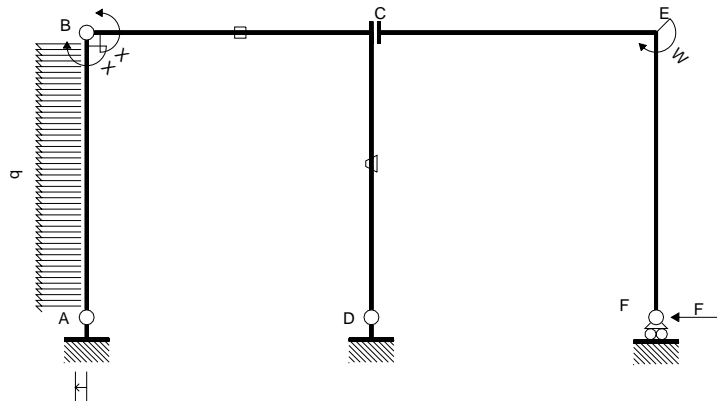
Elongazione termica specifica  $\epsilon$  assegnata su asta BC.

Curvatura  $\theta$  asta CD positiva se convessa a destra con inizio C.

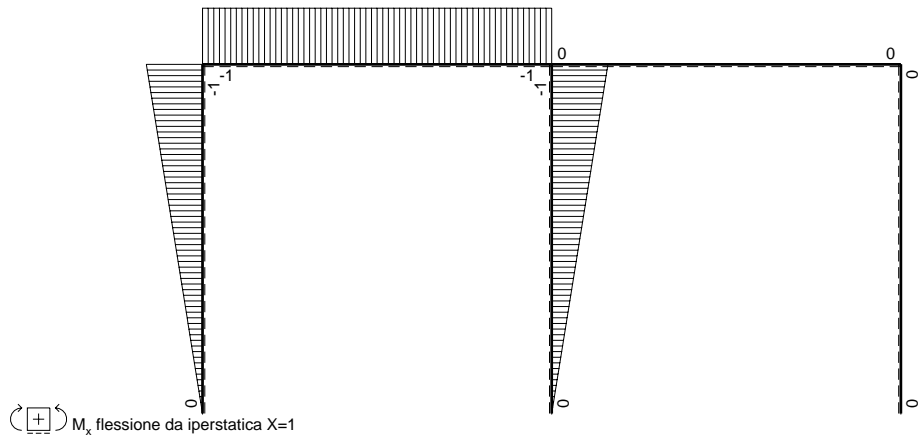
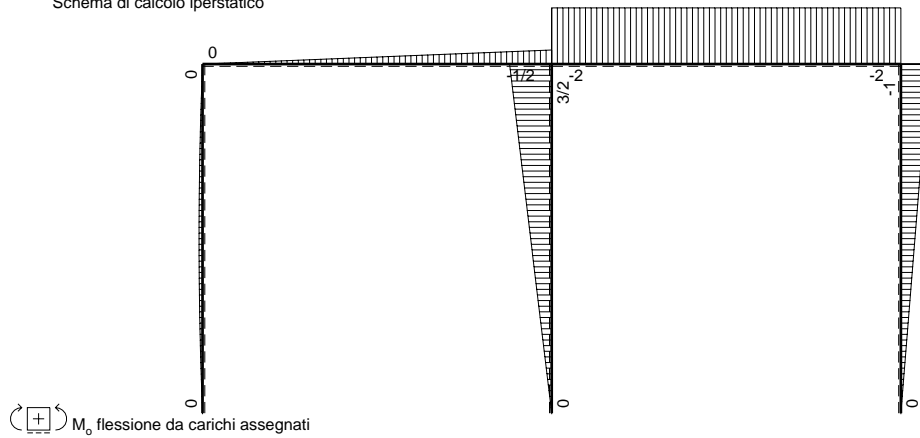
Spostamento orizzontale assoluto u imposto al nodo A.







Schema di calcolo iperstatico



DEFORMATA ELASTICA Iperstatiche  $X = W_{BC}$

Costanti di integrazione:  $\varphi_{AB} K_{AB} \varphi_{BC} K_{BC} \varphi_{CD} K_{CD} \varphi_{CE} K_{CE} \varphi_{EF} K_{EF}$

$$\begin{aligned} M_{AB}^0 &= -1/2 Fx + 1/2 Fx^2/b & M_{AB}^1 &= -x/b \\ M_{BC}^0 &= -1/2 Fx & M_{BC}^1 &= -1 \\ M_{CD}^0 &= +3/2 Fb - 3/2 Fx & M_{CD}^1 &= -1 + x/b \\ M_{CE}^0 &= -2 Fb & M_{CE}^1 &= 0 \\ M_{EF}^0 &= -Fb + Fx & M_{EF}^1 &= 0 \end{aligned}$$

Relazioni di congruenza

$$\begin{aligned} y'_{AB}(b) - y'_{BC}(0) &= 0 & y'_{BC}(b) - y'_{CE}(0) &= 0 \\ y'_{CD}(0) - y'_{CE}(0) &= 0 & y'_{CE}(b) - y'_{EF}(0) &= 0 \\ y_{AB}(0) - \delta &= 0 & y_{BC}(0) &= 0 \\ y_{BC}(b) + 1/4 V_D b^3/EJ &= 0 & y_{CD}(0) + y_{AB}(b) + \alpha T b &= 0 \\ y_{CD}(b) &= 0 & y_{CE}(b) &= 0 \\ y_{EF}(0) + y_{AB}(b) + \alpha T b &= 0 & & \end{aligned}$$

$$\begin{aligned} M_{AB} &= M_{AB}^0 + X M_{AB}^1 = -1/2 Fx + 1/2 q x^2 - Xx/b \\ EJ y''_{AB} &= M_{AB} = -1/2 Fx + 1/2 q x^2 - Xx/b \\ EJ y'_{AB} &= -1/4 Fx^2 + 1/6 q x^3 - 1/2 Xx^2/b + EJA \\ EJ y_{AB} &= -1/12 Fx^3 + 1/24 q x^4 - 1/6 Xx^3/b + EJA x + EJB \end{aligned}$$

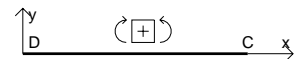
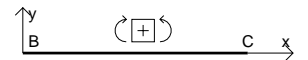
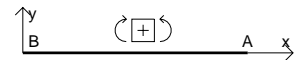
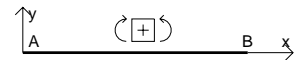
$$\begin{aligned} M_{BA} &= 1/2 Fx - 1/2 q x^2 - Xx/b + X \\ EJ y''_{BA} &= 1/2 Fx - 1/2 q x^2 - Xx/b + X \\ EJ y'_{BA} &= 1/4 Fx^2 - 1/6 q x^3 - 1/2 Xx^2/b + Xx + EJA_0 \\ EJ y_{BA} &= 1/12 Fx^3 - 1/24 q x^4 - 1/6 Xx^3/b + 1/2 Xx^2 + EJA_0 x + EJB_0 \end{aligned}$$

$$\begin{aligned} M_{BC} &= M_{BC}^0 + X M_{BC}^1 = -1/2 Fx - X \\ EJ y''_{BC} &= M_{BC} = -1/2 Fx - X \\ EJ y'_{BC} &= -1/4 Fx^2 - Xx + EJC \\ EJ y_{BC} &= -1/12 Fx^3 - 1/2 Xx^2 + EJC x + EJD \end{aligned}$$

$$\begin{aligned} M_{CB} &= -1/2 Fx + 1/2 Fb + X \\ EJ y''_{CB} &= -1/2 Fx + 1/2 Fb + X \\ EJ y'_{CB} &= -1/4 Fx^2 + 1/2 Fbx + Xx + EJC_0 \\ EJ y_{CB} &= -1/12 Fx^3 + 1/4 Fbx^2 + 1/2 Xx^2 + EJC_0 x + EJD_0 \end{aligned}$$

$$\begin{aligned} M_{CD} &= M_{CD}^0 + X M_{CD}^1 = -3/2 Fx + 3/2 Fb + Xx/b - X \\ EJ y''_{CD} &= M_{CD} + EJ \theta_{CD} = -3/2 Fx + 3/2 Fb - EJ \theta + Xx/b - X \\ EJ y'_{CD} &= -3/4 Fx^2 + 3/2 Fbx - EJ \theta x + 1/2 Xx^2/b - Xx + EJG_0 \\ EJ y_{CD} &= -1/4 Fx^3 + 3/4 Fbx^2 - 1/2 EJ \theta x^2 + 1/6 Xx^3/b - 1/2 Xx^2 + EJG_0 x + EJH_0 \end{aligned}$$

$$\begin{aligned} M_{DC} &= -3/2 Fx + Xx/b \\ EJ y''_{DC} &= -3/2 Fx + EJ \theta + Xx/b \\ EJ y'_{DC} &= -3/4 Fx^2 + EJ \theta x + 1/2 Xx^2/b + EJG_0 \\ EJ y_{DC} &= -1/4 Fx^3 + 1/2 EJ \theta x^2 + 1/6 Xx^3/b + EJG_0 x + EJH_0 \end{aligned}$$



$$M_{CE} = M_{CE}^0 + XM_{CE}^1 = -2Fb$$

$$EJy''_{CE} = M_{CE} = -2Fb$$

$$EJy'_{CE} = -2Fbx + EJ R_0$$

$$EJy_{CE} = -Fbx^2 + EJ R_0 x + EJS_0$$

$$M_{EC} = 2Fb$$

$$EJy''_{EC} = 2Fb$$

$$EJy'_{EC} = 2Fbx + EJ R_0$$

$$EJy_{EC} = Fbx^2 + EJ R_0 x + EJS_0$$

$$M_{EF} = M_{EF}^0 + XM_{EF}^1 = Fx - Fb$$

$$EJy''_{EF} = M_{EF} = Fx - Fb$$

$$EJy'_{EF} = 1/2Fx^2 - Fbx + EJ\phi_{EF}$$

$$EJy_{EF} = 1/6Fx^3 - 1/2Fbx^2 + EJ\phi_{EF}x + EJK_{EF}$$

$$M_{FE} = Fx$$

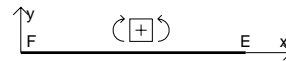
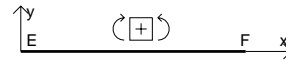
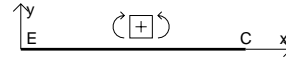
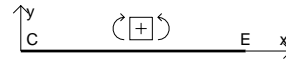
$$EJy''_{FE} = Fx$$

$$EJy'_{FE} = 1/2Fx^2 + EJ\phi_{FE}$$

$$EJy_{FE} = 1/6Fx^3 + EJ\phi_{FE}x + EJK_{FE}$$

Condizioni al contorno

	$\phi_{AB}b$	$K_{AB}$	$\phi_{BC}b$	$K_{BC}$	$\phi_{CD}b$	$K_{CD}$	$\phi_{CE}b$	$K_{CE}$	$\phi_{EF}b$	$K_{EF}$	$Xb^2/EJ$
$y'_{BA}$	1	0	-1	0	0	0	0	0	0	0	-1/2
$y'_{CB}$	0	0	1	0	0	0	-1	0	0	0	-1
$y'_{CD}$	0	0	0	0	1	0	-1	0	0	0	0
$y'_{EC}$	0	0	0	0	0	0	1	0	-1	0	0
$y_{AB}$	0	1	0	0	0	0	0	0	0	0	0
$y_{BC}$	0	0	0	1	0	0	0	0	0	0	0
$y_{CB}$	0	0	1	1	0	0	0	0	0	0	-1/2
$y_{CD}$	1	1	0	0	0	1	0	0	0	0	-1/6
$y_{DC}$	0	0	0	0	1	1	0	0	0	0	-1/3
$y_{EC}$	0	0	0	0	0	0	1	1	0	0	0
$y_{EF}$	1	1	0	0	0	0	0	0	0	1	-1/6



Condizioni al contorno

$Fb^3/EJ$	$\alpha Tb$	$\delta$
1/12	0	0
1/4	0	0
0	0	0
2	0	0
0	0	1
0	0	0
-1/24	0	0
1/24	-1	0
-1/2	1/2	0
1	0	0
1/24	-1	0

Condizioni al contorno

$$\phi_{AB}b - \phi_{BC}b - 1/2Xb^2/EJ = 1/12Fb^3/EJ$$

$$\phi_{BC}b - \phi_{CE}b - Xb^2/EJ = 1/4Fb^3/EJ$$

$$\phi_{CD}b - \phi_{CE}b = 0$$

$$\phi_{CE}b - \phi_{EF}b = 2Fb^3/EJ$$

$$K_{AB} = \delta$$

$$K_{BC} = 0$$

$$\phi_{BC}b + K_{BC} - 1/2Xb^2/EJ = -1/24Fb^3/EJ$$

$$\phi_{AB}b + K_{AB} + K_{CD} - 1/6Xb^2/EJ = 1/24Fb^3/EJ - \alpha Tb$$

$$\phi_{CD}b + K_{CD} - 1/3Xb^2/EJ = -1/2Fb^3/EJ + 1/2\alpha Tb$$

$$\phi_{CE}b + K_{CE} = Fb^3/EJ$$

$$\phi_{AB}b + K_{AB} + K_{EF} - 1/6Xb^2/EJ = 1/24Fb^3/EJ - \alpha Tb$$

DEFORMATA (coordinate locali)

$$AB \ y(x)EJ = Fb^3 - 4/3xFb^2 + 7/48x^3F + 1/24x^4q$$

$$BA \ y(x)EJ = 7/48Fb^3 - 35/48xFb^2 - 11/16x^2Fb + 5/16x^3F - 1/24x^4q$$

$$BC \ y(x)EJ = -35/48xFb^2 + 11/16x^2Fb - 1/12x^3F$$

$$CB \ y(x)EJ = 1/8Fb^3 + 19/48xFb^2 - 7/16x^2Fb - 1/12x^3F$$

$$CD \ y(x)EJ = -41/48Fb^3 + 19/48xFb^2 + 15/16x^2Fb - 23/48x^3F$$

$$DC \ y(x)EJ = 5/6xFb^2 + 1/2x^2Fb - 23/48x^3F$$

$$CE \ y(x)EJ = 29/48Fb^3 + 19/48xFb^2 - x^2Fb$$

$$EC \ y(x)EJ = -77/48xFb^2 + x^2Fb$$

Soluzione

	$[Fb^3/EJ]$
$\phi_{AB}b$	-4/3
$\phi_{BC}b$	-35/48
$\phi_{CD}b$	19/48
$\phi_{CE}b$	19/48
$K_{AB}$	1
$K_{BC}$	0
$\phi_{EF}b$	-77/48
$K_{CD}$	-41/48
$Xb^2/EJ$	-11/8
$K_{CE}$	29/48
$K_{EF}$	-41/48

Costanti

$$\phi_{AB} = -4/3Fb^2/EJ$$

$$\phi_{BC} = -35/48Fb^2/EJ$$

$$\phi_{CD} = 19/48Fb^2/EJ$$

$$\phi_{CE} = 19/48Fb^2/EJ$$

$$K_{AB} = Fb^3/EJ$$

$$K_{BC} = 0$$

$$\phi_{EF} = -77/48Fb^2/EJ$$

$$K_{CD} = -41/48Fb^3/EJ$$

$$X = -11/8Fb$$

$$K_{CE} = 29/48Fb^3/EJ$$

$$K_{EF} = -41/48Fb^3/EJ$$

Costanti

$$B_0 = 7/48Fb^3/EJ$$

$$A_0 = -35/48Fb^2/EJ$$

$$D_0 = 1/8Fb^3/EJ$$

$$C_0 = 19/48Fb^2/EJ$$

$$H_0 = 0$$

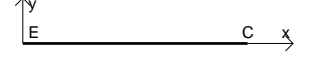
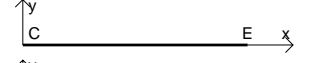
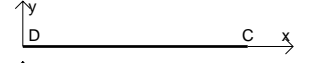
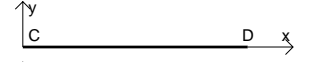
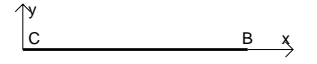
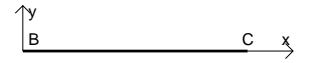
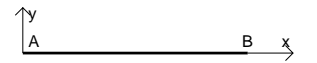
$$G_0 = 5/6Fb^2/EJ$$

$$S_0 = 0$$

$$R_0 = -77/48Fb^2/EJ$$

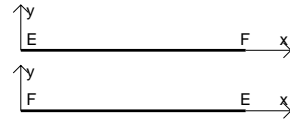
$$K_{FE} = 67/24Fb^3/EJ$$

$$\phi_{FE} = -101/48Fb^2/EJ$$



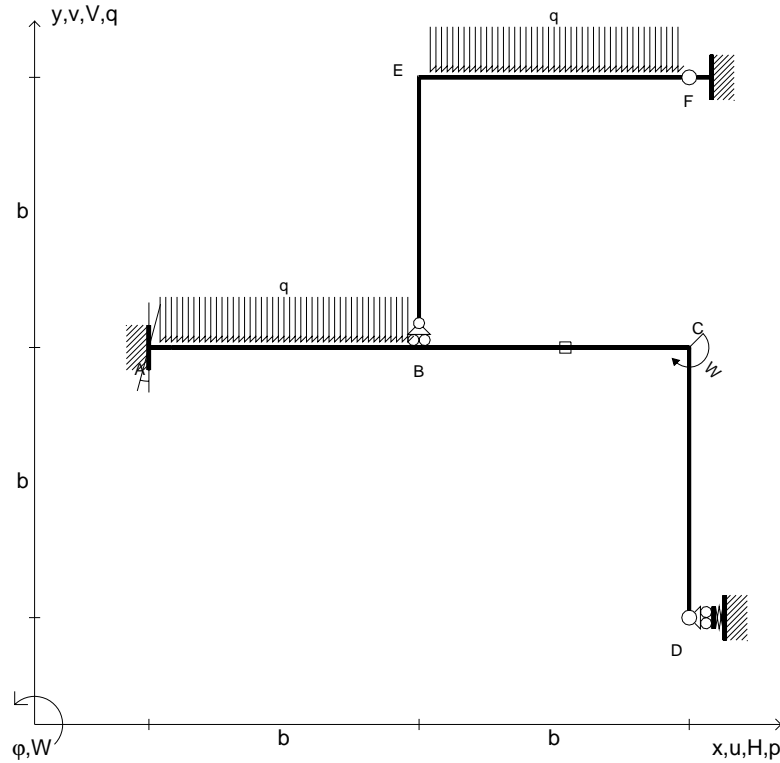
$$EF y(x)EJ = -41/48Fb^3 - 77/48xFb^2 - 1/2x^2Fb + 1/6x^3F$$

$$FE y(x)EJ = 67/24Fb^3 - 101/48xFb^2 + 1/6x^3F$$





$W_C = -W = -Fb$   
 $q_{AB} = -q = -F/b$   
 $q_{EF} = -q = -F/b$   
 $\varepsilon_{BC} = -\alpha T = -b^2 F/EJ$   
 $\phi_A = -\delta/b = -b^2 F/EJ$   
 $k_D = 4EJ/b^3$   
 $EJ_{AB} = EJ$   
 $EJ_{BC} = EJ$   
 $EJ_{CD} = EJ$   
 $EJ_{BE} = EJ$   
 $EJ_{EF} = EJ$



ANALISI STRUTTURE IPERSTATICHE  
 METODO LINEA ELASTICA

Riportare sul fronte:

- 1) Declassamento Scelto
- 2) Reazioni calcolate
- 3) Diagrammi finali delle azioni interne

Sul retro:

- 4) Analisi cinematica
- 5) Equazioni delle linee elastiche
- 6) Condizioni al contorno

Carichi e deformazioni date hanno verso efficace in disegno.

Calcolare reazioni vincolari della struttura e delle aste.

Tracciare i diagrammi quotati delle azioni interne nelle aste.

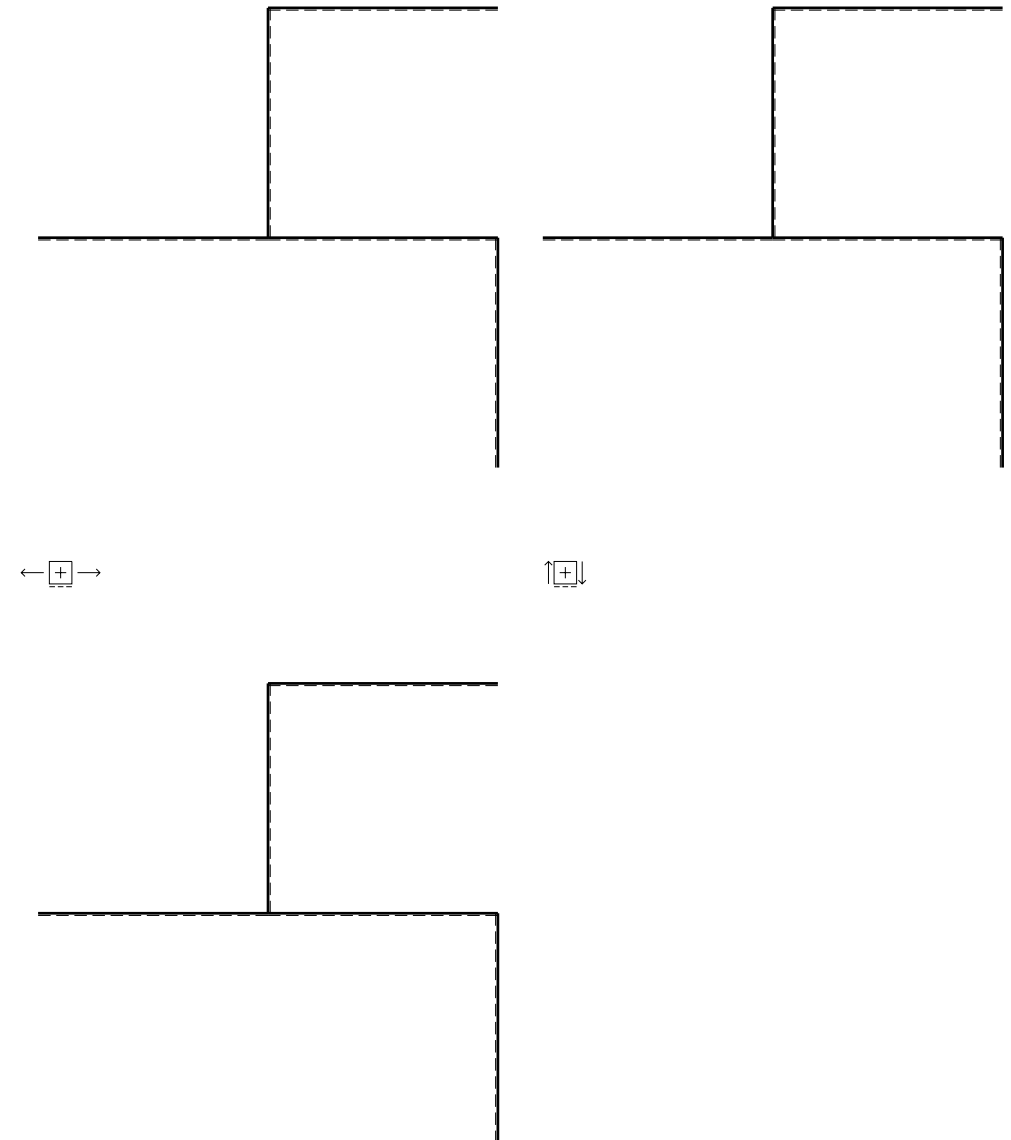
Esprimere la linea elastica delle aste. AB BC CD BE EF

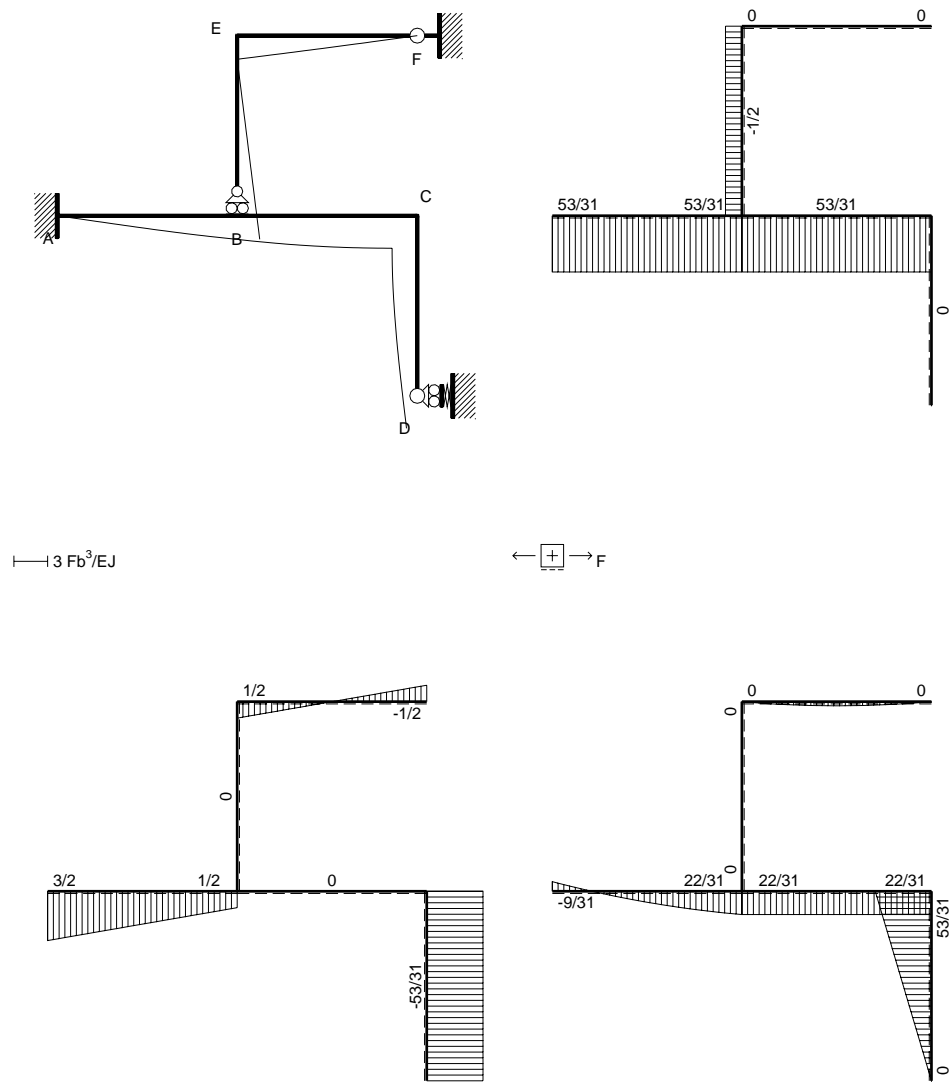
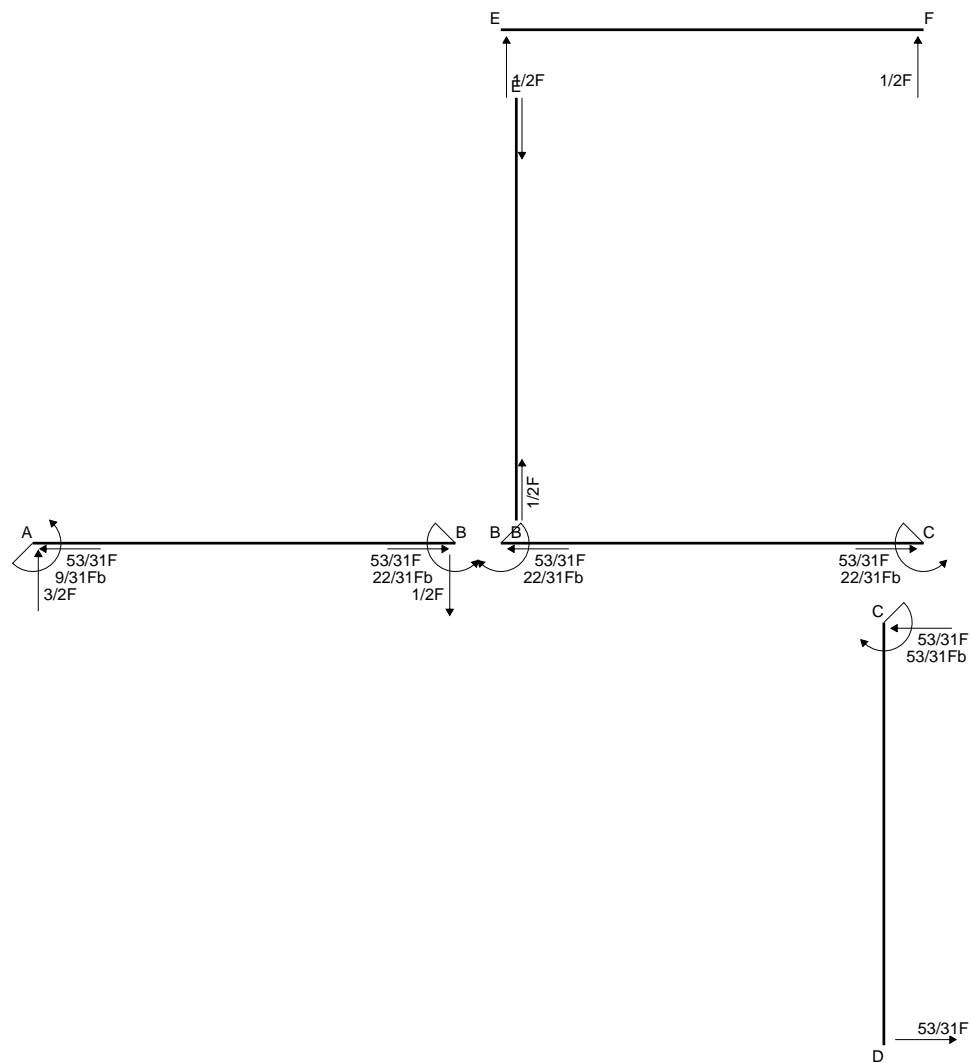
Carichi di aste curve misurati in proiezione sugli assi x,y.

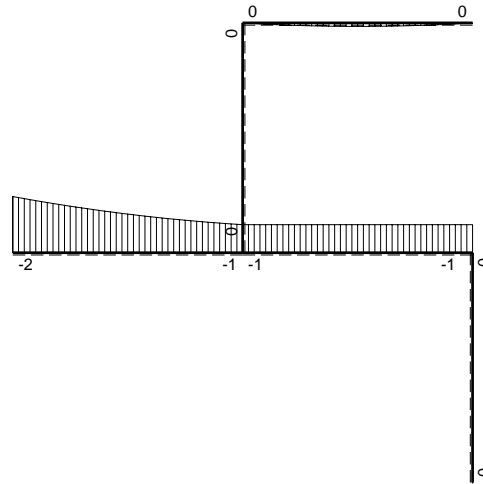
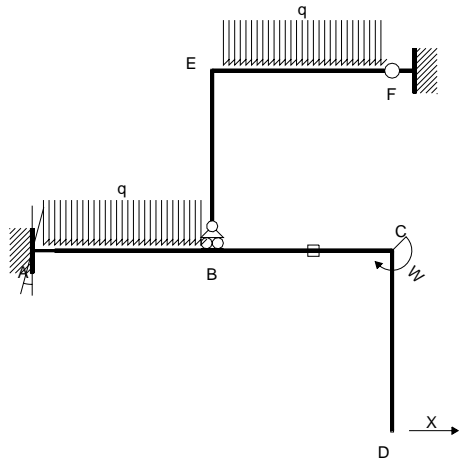
$J_{YZ} - x_{YZ} - \theta_{YZ}$  riferimento locale asta YZ con origine in Y.

Elongazione termica specifica  $\varepsilon$  assegnata su asta BC.

Rotazione assoluta  $\phi$  imposta al nodo A.

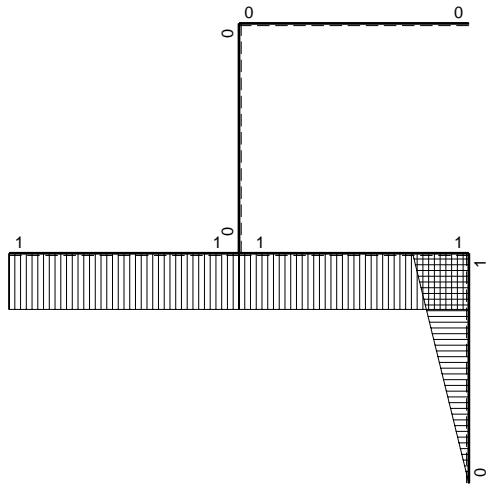






Schema di calcolo iperstatico

$(\oplus)$   $M_0$  flessione da carichi assegnati



$(\oplus)$   $M_x$  flessione da iperstatica X=1

DEFORMATA ELASTICA Iperstatiche  $X = H_D$

Costanti di integrazione:  $\varphi_{AB} K_{AB} \varphi_{BC} K_{BC} \varphi_{CD} K_{CD} \varphi_{BE} K_{BE} \varphi_{EF} K_{EF}$

$$M_{AB}^0 = -2 Fb + 3/2 Fx - 1/2 Fx^2/b$$

$$M_{BC}^0 = -Fb$$

$$M_{CD}^0 = 0$$

$$M_{BE}^0 = 0$$

$$M_{EF}^0 = +1/2 Fx - 1/2 Fx^2/b$$

$$M_{AB}^1 = +b$$

$$M_{BC}^1 = +b$$

$$M_{CD}^1 = +b - x$$

$$M_{BE}^1 = 0$$

$$M_{EF}^1 = 0$$

Relazioni di congruenza

$$y'_{AB}(0) + \delta/b = 0$$

$$y'_{BC}(b) - y'_{CD}(0) = 0$$

$$y_{AB}(0) = 0$$

$$y_{CD}(0) + \alpha T_b = 0$$

$$y_{BE}(b) = 0$$

$$y_{EF}(b) = 0$$

$$y'_{AB}(b) - y'_{BC}(0) = 0$$

$$y'_{BE}(b) - y'_{EF}(0) = 0$$

$$y_{AB}(b) - y_{BC}(0) = 0$$

$$y_{CD}(b) + 1/4 H_D b^3/EJ = 0$$

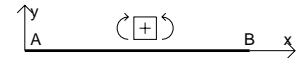
$$y_{EF}(0) - y_{BC}(0) = 0$$

$$M_{AB} = M_{AB}^0 + X M_{AB}^1 = 3/2 Fx - 2Fb - 1/2 qx^2 + Xb$$

$$EJ y''_{AB} = M_{AB} = 3/2 Fx - 2Fb - 1/2 qx^2 + Xb$$

$$EJ y'_{AB} = 3/4 Fx^2 - 2Fbx - 1/6 qx^3 + Xbx + EJA$$

$$EJ y_{AB} = 1/4 Fx^3 - Fbx^2 - 1/24 qx^4 + 1/2 Xbx^2 + EJA x + EJB$$

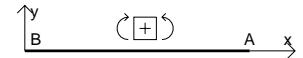


$$M_{BA} = 1/2 Fx + Fb + 1/2 qx^2 - Xb$$

$$EJ y''_{BA} = M_{BA} = 1/2 Fx + Fb + 1/2 qx^2 - Xb$$

$$EJ y'_{BA} = 1/4 Fx^2 + Fbx + 1/6 qx^3 - Xbx + EJA_0$$

$$EJ y_{BA} = 1/12 Fx^3 + 1/2 Fbx^2 + 1/24 qx^4 - 1/2 Xbx^2 + EJA_0 x + EJB_0$$

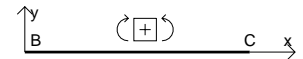


$$M_{BC} = M_{BC}^0 + X M_{BC}^1 = -Fb + Xb$$

$$EJ y''_{BC} = M_{BC} = -Fb + Xb$$

$$EJ y'_{BC} = -Fbx + Xbx + EJC$$

$$EJ y_{BC} = -1/2 Fbx^2 + 1/2 Xbx^2 + EJC x + EJD$$

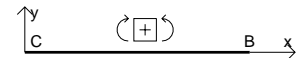


$$M_{CB} = Fb - Xb$$

$$EJ y''_{CB} = Fb - Xb$$

$$EJ y'_{CB} = Fbx - Xbx + EJC_0$$

$$EJ y_{CB} = 1/2 Fbx^2 - 1/2 Xbx^2 + EJC_0 x + EJD_0$$

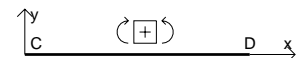


$$M_{CD} = M_{CD}^0 + X M_{CD}^1 = -Xx + Xb$$

$$EJ y''_{CD} = M_{CD} = -Xx + Xb$$

$$EJ y'_{CD} = -1/2 Xx^2 + Xbx + EJG$$

$$EJ y_{CD} = -1/6 Xx^3 + 1/2 Xbx^2 + EJG x + EJH$$

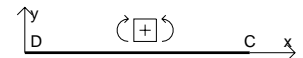


$$M_{DC} = -Xx$$

$$EJ y''_{DC} = -Xx$$

$$EJ y'_{DC} = -1/2 Xx^2 + EJG_0$$

$$EJ y_{DC} = -1/6 Xx^3 + EJG_0 x + EJH_0$$



$$M_{BE} = M_{BE}^o + XM_{BE}^1 = 0$$

$$EJy''_{BE} = M_{BE} = 0$$

$$EJy'_{BE} = EJR$$

$$EJy_{BE} = EJR \cdot x + EJS$$

$$M_{EB} = 0$$

$$EJy''_{EB} = 0$$

$$EJy'_{EB} = EJR_o$$

$$EJy_{EB} = EJR_o \cdot x + EJS_o$$

$$M_{EF} = M_{EF}^o + XM_{EF}^1 = 1/2Fx - 1/2qx^2$$

$$EJy''_{EF} = M_{EF} = 1/2Fx - 1/2qx^2$$

$$EJy'_{EF} = 1/4Fx^2 - 1/6qx^3 + EJ\varphi_{EF}$$

$$EJy_{EF} = 1/12Fx^3 - 1/24qx^4 + EJ\varphi_{EF}x + EJK_{EF}$$

$$M_{FE} = -1/2Fx + 1/2qx^2$$

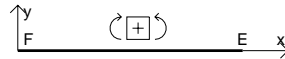
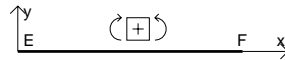
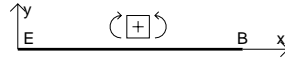
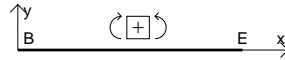
$$EJy''_{FE} = -1/2Fx + 1/2qx^2$$

$$EJy'_{FE} = -1/4Fx^2 + 1/6qx^3 + EJ\varphi_{FE}$$

$$EJy_{FE} = -1/12Fx^3 + 1/24qx^4 + EJ\varphi_{FE}x + EJK_{FE}$$

Condizioni al contorno

	$\varphi_{AB}b$	$K_{AB}$	$\varphi_{BC}b$	$K_{BC}$	$\varphi_{CD}b$	$K_{CD}$	$\varphi_{BE}b$	$K_{BE}$	$\varphi_{EF}b$	$K_{EF}$	$Xb^3/EJ$	
$y'_{AB}$	1	0	0	0	0	0	0	0	0	0	0	=
$y'_{BA}$	1	0	-1	0	0	0	0	0	0	0	1	
$y'_{CB}$	0	0	1	0	-1	0	0	0	0	0	1	
$y'_{EB}$	0	0	0	0	0	0	1	0	-1	0	0	
$y_{AB}$	0	1	0	0	0	0	0	0	0	0	0	
$y_{BA}$	1	1	0	-1	0	0	0	0	0	0	1/2	
$y_{CD}$	0	0	0	0	0	1	0	0	0	0	0	
$y_{DC}$	0	0	0	0	1	1	0	0	0	0	7/12	
$y_{EB}$	0	0	0	0	0	0	1	1	0	0	0	
$y_{EF}$	0	0	0	-1	0	0	0	0	0	1	0	
$y_{FE}$	0	0	0	0	0	0	0	0	1	1	0	



Condizioni al contorno

$[Wb^2/EJ$	$\alpha Tb$	$\delta$
0	0	-1
17/12	0	0
1	0	0
0	0	0
0	0	0
19/24	0	0
0	-1	0
0	0	0
0	0	0
0	0	0
-1/24	0	0

Condizioni al contorno

$$\varphi_{AB}b = -\delta$$

$$\varphi_{AB}b - \varphi_{BC}b + Xb^3/EJ = 17/12Wb^2/EJ$$

$$\varphi_{BC}b - \varphi_{CD}b + Xb^3/EJ = Wb^2/EJ$$

$$\varphi_{BE}b - \varphi_{EF}b = 0$$

$$K_{AB} = 0$$

$$\varphi_{AB}b + K_{AB} - K_{BC} + 1/2Xb^3/EJ = 19/24Wb^2/EJ$$

$$K_{CD} = -\alpha Tb$$

$$\varphi_{CD}b + K_{CD} + 7/12Xb^3/EJ = 0$$

$$\varphi_{BE}b + K_{BE} = 0$$

$$-K_{BC} + K_{EF} = 0$$

$$\varphi_{EF}b + K_{EF} = -1/24Wb^2/EJ$$

Costanti

$$B_o = 697/744Fb^3/EJ$$

$$A_o = -263/372Fb^2/EJ$$

$$D_o = 959/744Fb^3/EJ$$

$$C_o = 1/372Fb^2/EJ$$

$$H_o = 53/124Fb^3/EJ$$

$$G_o = 319/372Fb^2/EJ$$

$$S_o = 0$$

$$R_o = 111/124Fb^2/EJ$$

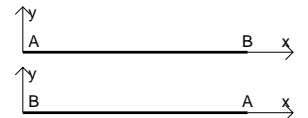
$$K_{FE} = 0$$

$$\varphi_{FE} = 91/93Fb^2/EJ$$

DEFORMATA (coordinate locali)

$$AB \ y(x)EJ = -x^2Fb^2 - 9/62x^2Fb + 1/4x^3F - 1/24x^4q$$

$$BA \ y(x)EJ = 697/744Fb^3 - 263/372x^2Fb^2 - 11/31x^2Fb + 1/12x^3F + 1/24x^4q$$



Soluzione

$[Fb^3/EJ$	
$\varphi_{AB}b$	-1
$\varphi_{BC}b$	-263/372
$\varphi_{CD}b$	1/372
$\varphi_{BE}b$	111/124
$K_{AB}$	0
$K_{BC}$	-697/744
$K_{CD}$	-1
$Xb^3/EJ$	53/31
$\varphi_{EF}b$	111/124
$K_{EF}$	-697/744
$K_{BE}$	-111/124

Costanti

$$\varphi_{AB} = -Fb^2/EJ$$

$$\varphi_{BC} = -263/372Fb^2/EJ$$

$$\varphi_{CD} = 1/372Fb^2/EJ$$

$$\varphi_{BE} = 111/124Fb^2/EJ$$

$$K_{AB} = 0$$

$$K_{BC} = -697/744Fb^3/EJ$$

$$K_{CD} = -Fb^3/EJ$$

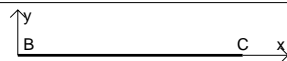
$$X = 53/31F$$

$$\varphi_{EF} = 111/124Fb^2/EJ$$

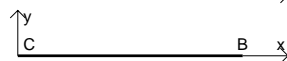
$$K_{EF} = -697/744Fb^3/EJ$$

$$K_{BE} = -111/124Fb^3/EJ$$

$$BC \ y(x)_{EJ} = -697/744Fb^3 - 263/372xFb^2 + 11/31x^2Fb$$



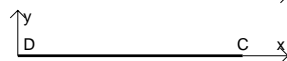
$$CB \ y(x)_{EJ} = 959/744Fb^3 + 1/372xFb^2 - 11/31x^2Fb$$



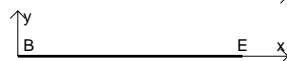
$$CD \ y(x)_{EJ} = -Fb^3 + 1/372xFb^2 + 53/62x^2Fb - 53/186x^3F$$



$$DC \ y(x)_{EJ} = 53/124Fb^3 + 319/372xFb^2 - 53/186x^3F$$



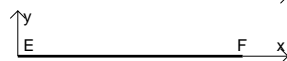
$$BE \ y(x)_{EJ} = -111/124Fb^3 + 111/124xFb^2$$



$$EB \ y(x)_{EJ} = 111/124xFb^2$$



$$EF \ y(x)_{EJ} = -697/744Fb^3 + 111/124xFb^2 + 1/12x^3F - 1/24x^4q$$



$$FE \ y(x)_{EJ} = 91/93xFb^2 - 1/12x^3F + 1/24x^4q$$

