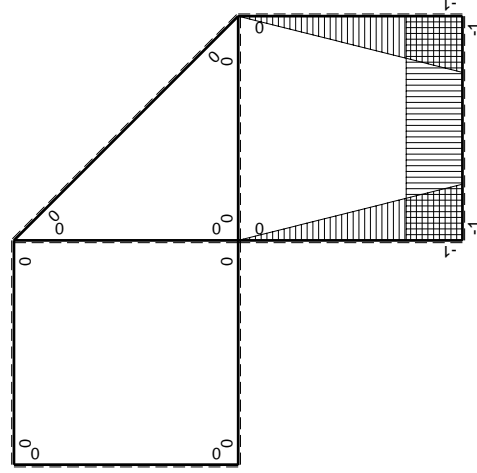


Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-3/2Fx	3/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				2Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

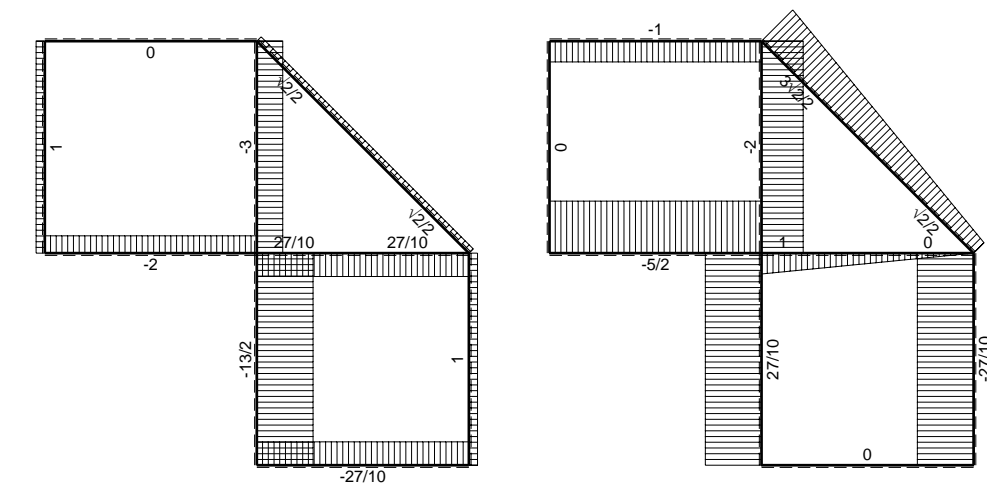
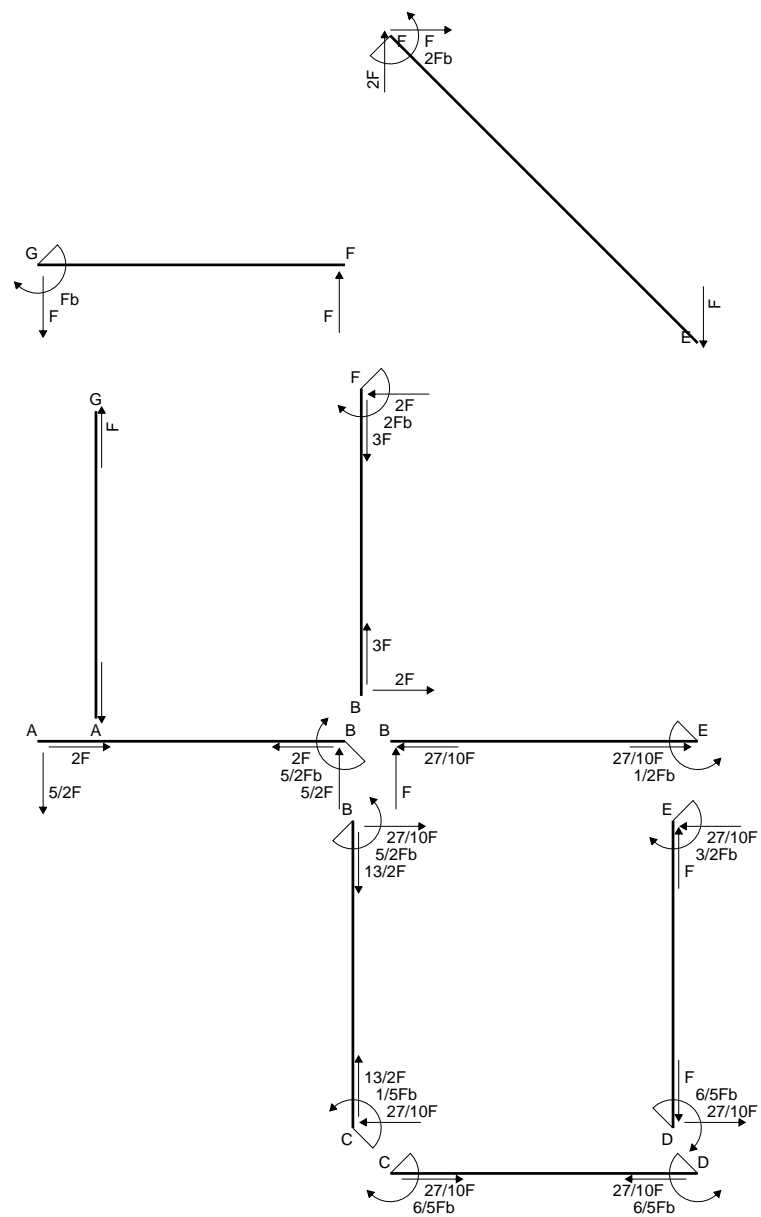
$$= (b + 1/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

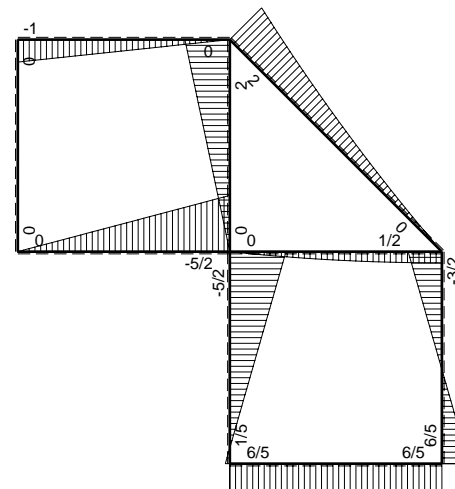
$$L_{ED}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

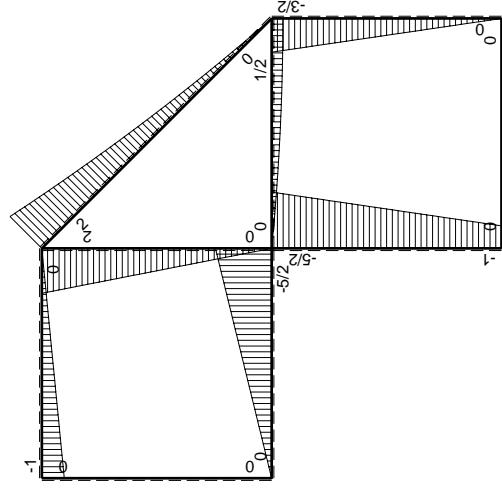
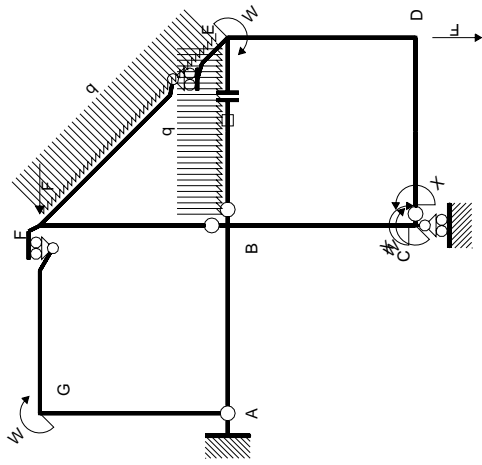


← (+) → F

↑ (+) ↓ F

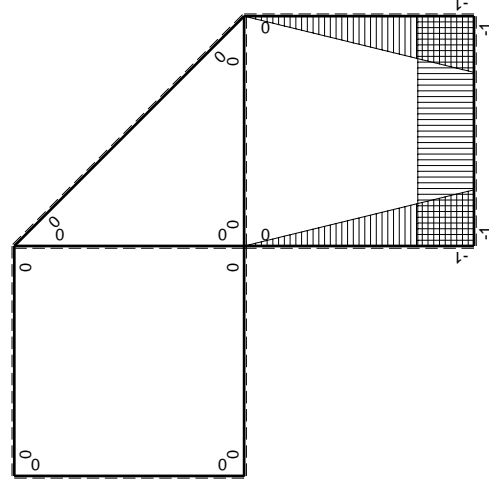


⊙ (+) ⊙ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-3/2Fx	3/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = l_{BE}$				Fb ² /EJ	
totali					2Fb ² /EJ	5/3Xb/EJ
iperstatica X=W _{cd}					-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

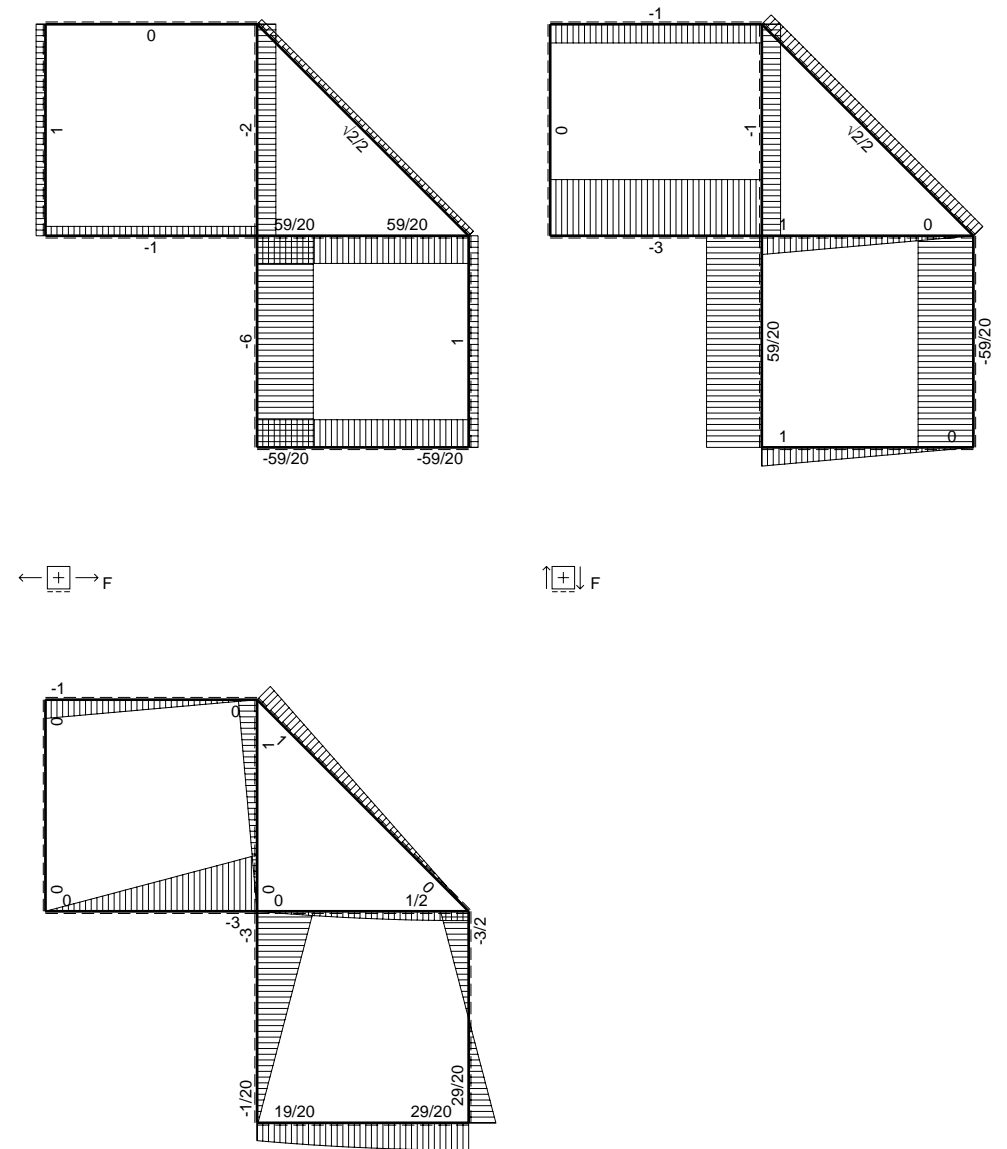
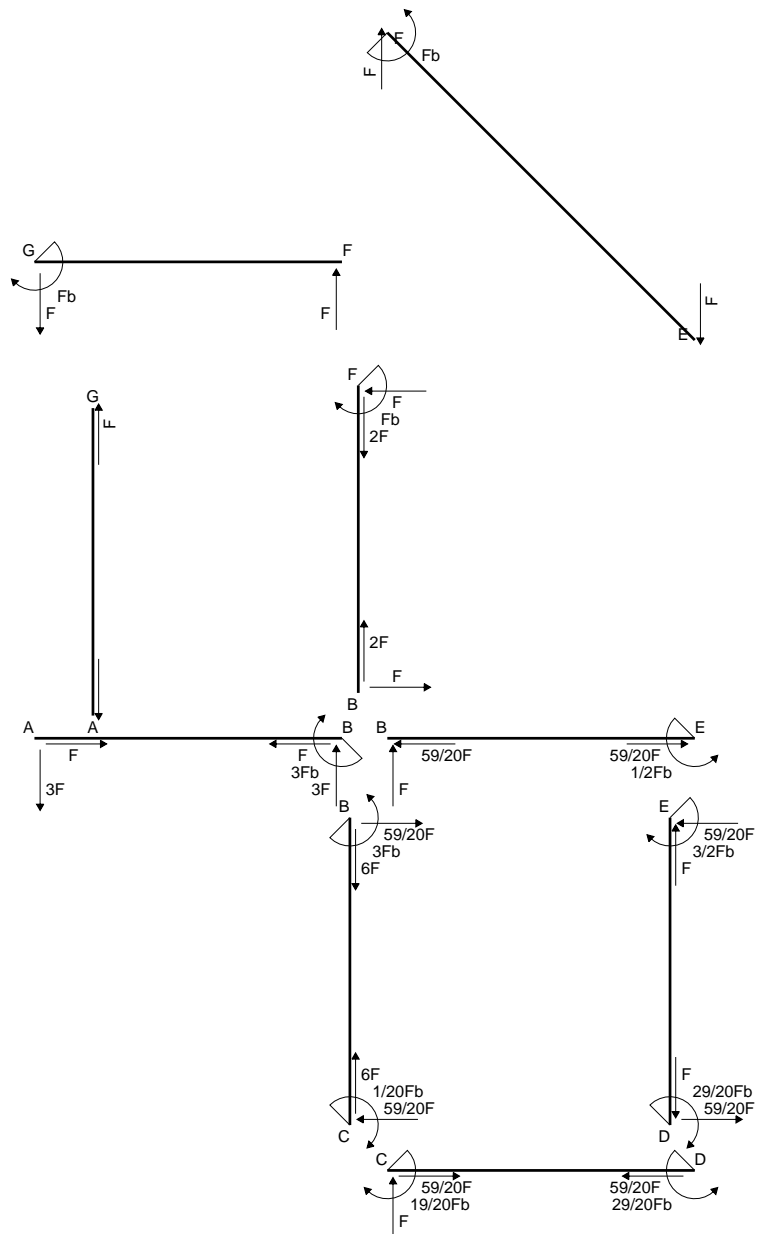
$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

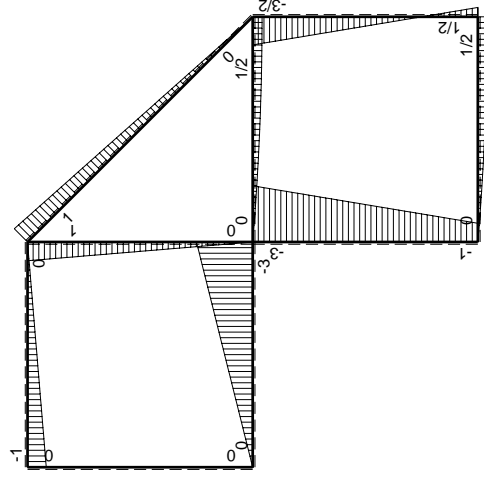
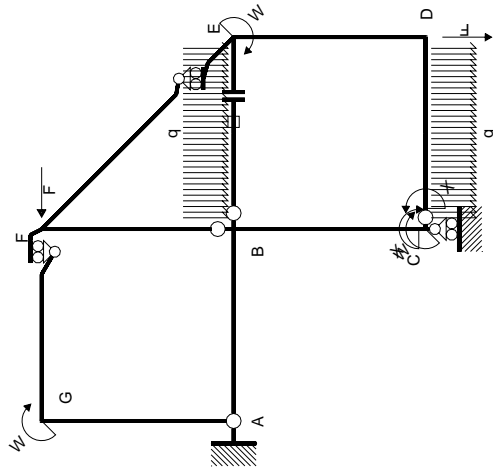
$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

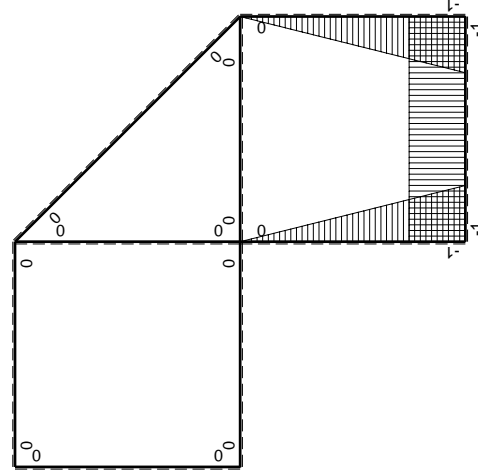


⊕ Fb



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1		
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-2Fx$	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$3/2Fb-2Fx$	$3/2Fx-2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$19/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$-19/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/2 x^2/b - 2/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/2 b - 2/3 b) \cdot Fb \cdot 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x + 1/2 x^2/b - 2/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/2 b - 2/3 b) \cdot Fb \cdot 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

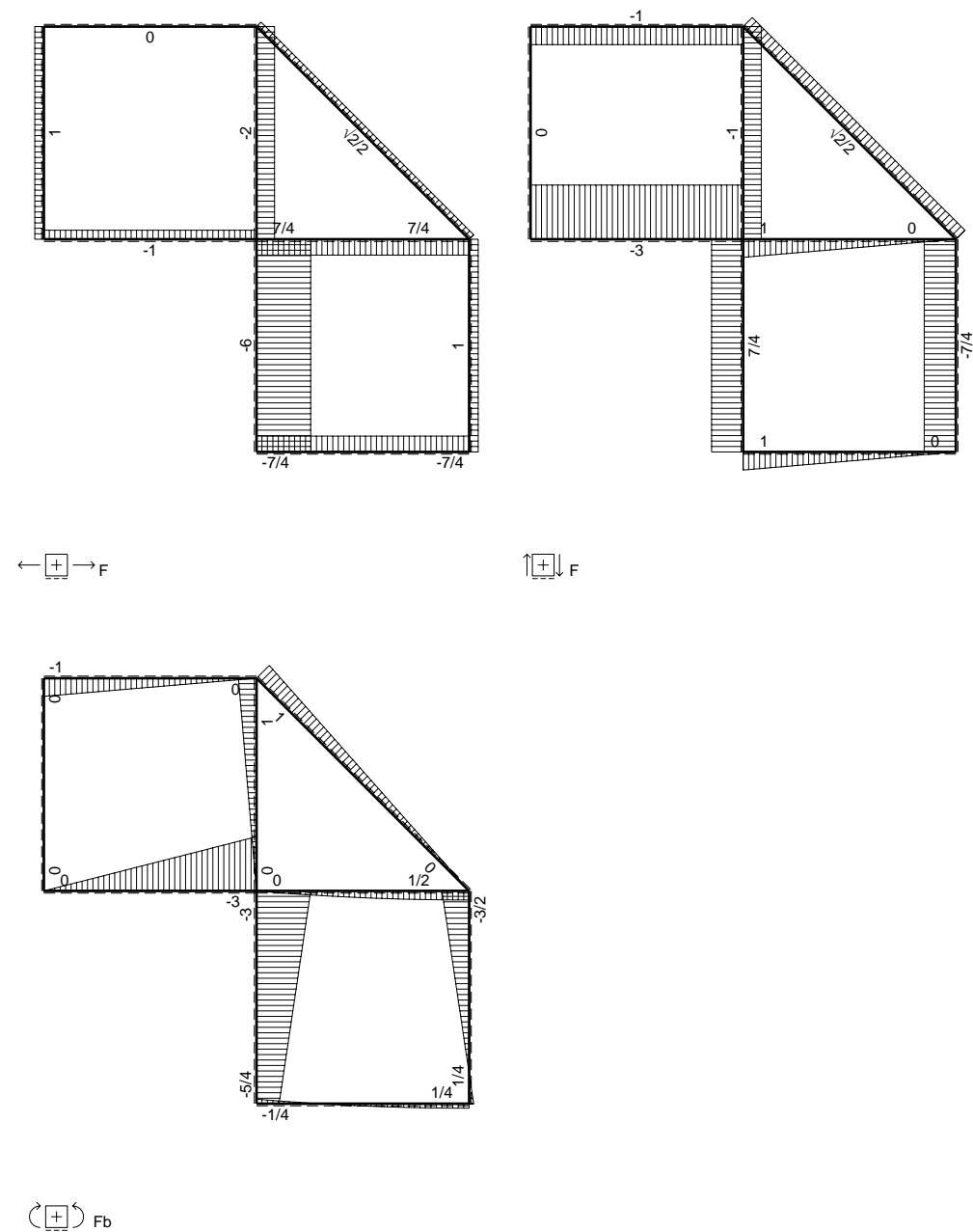
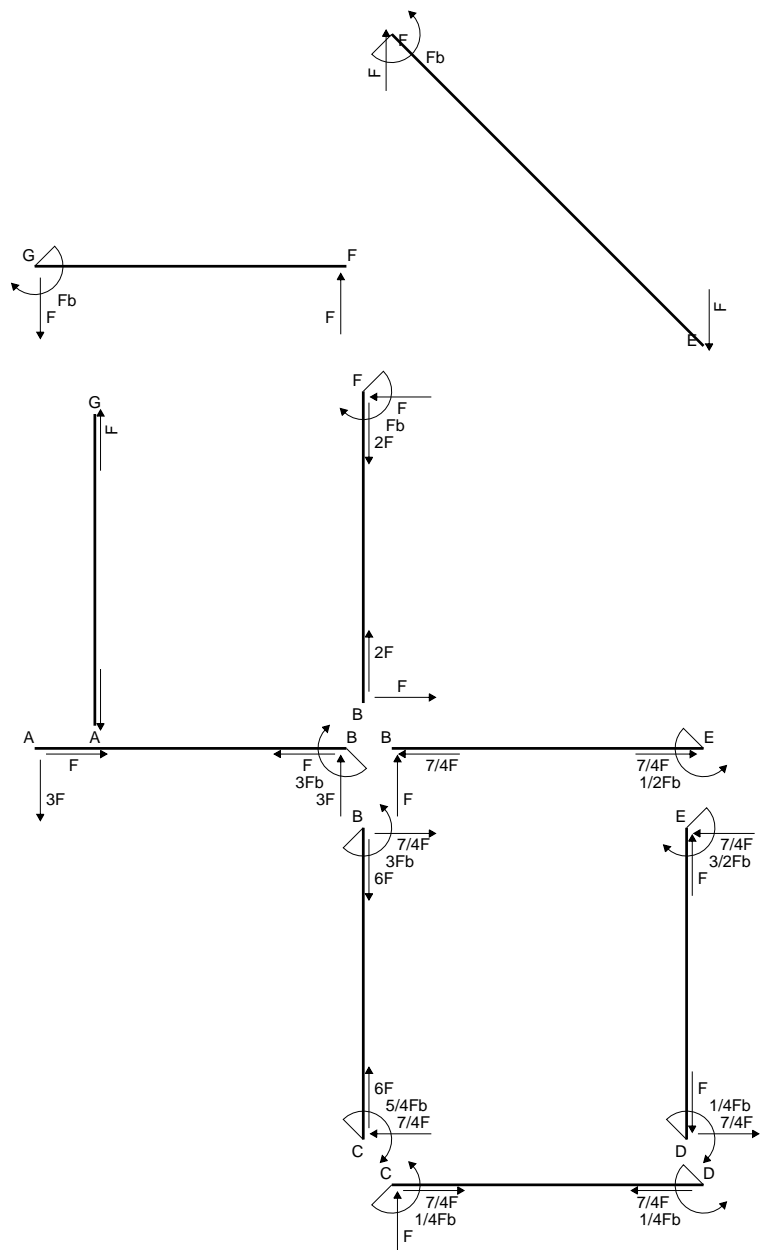
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

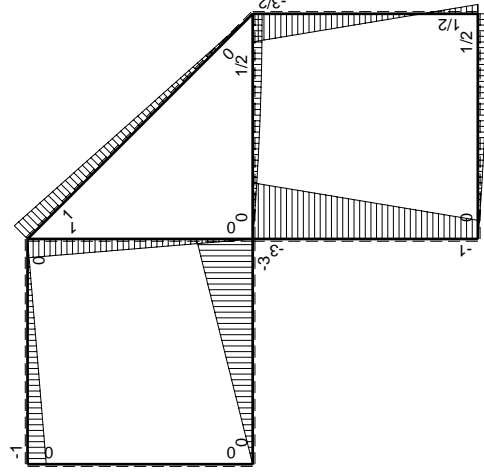
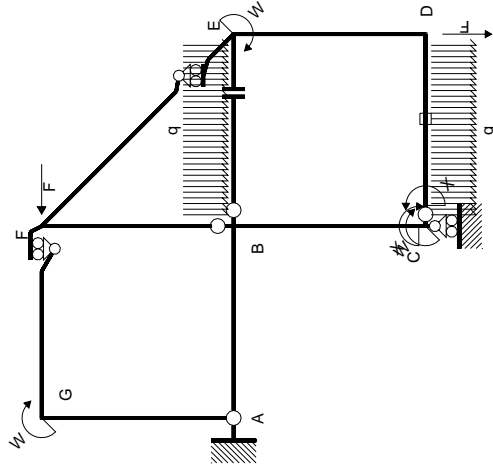
$$L_{DE}^{xo} = \int_0^b (-1/2 + 5/2 x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 5/4 x^2/b - 2/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 5/4 b - 2/3 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 2/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

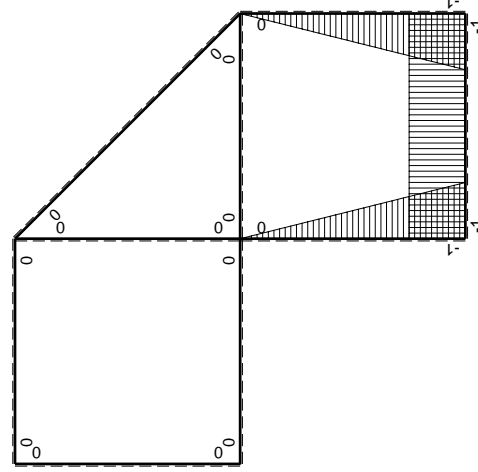
$$= (3/4 b - 2/3 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1		
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-2Fx$	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$3/2Fb-2Fx$	$3/2Fx-2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-5/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) Fb 1/EJ dx = [3/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) Fb 1/EJ dx = [x + 1/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

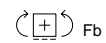
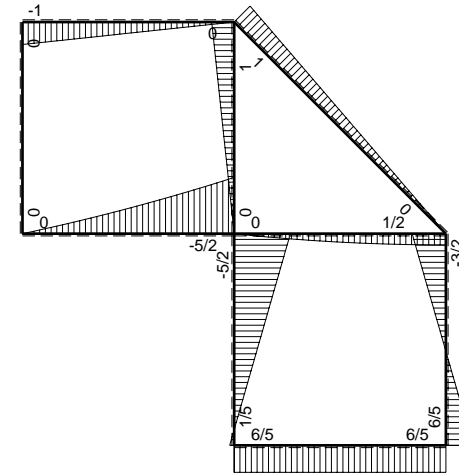
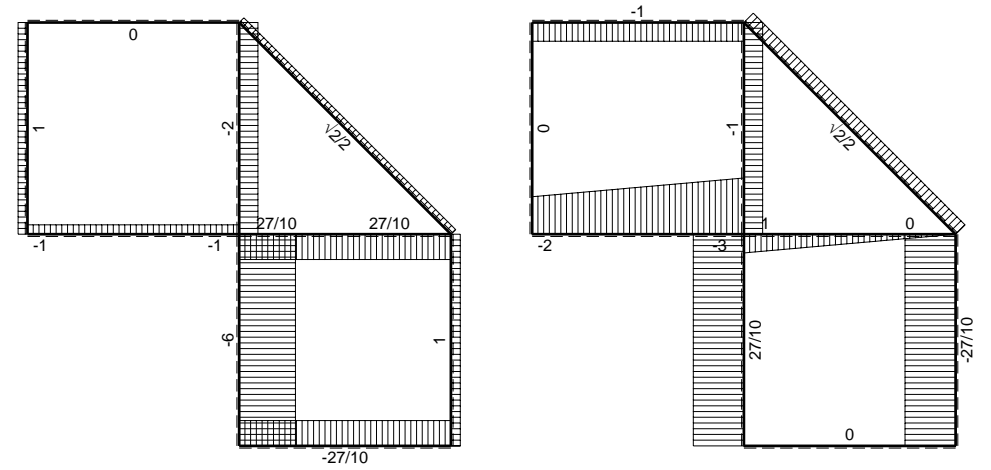
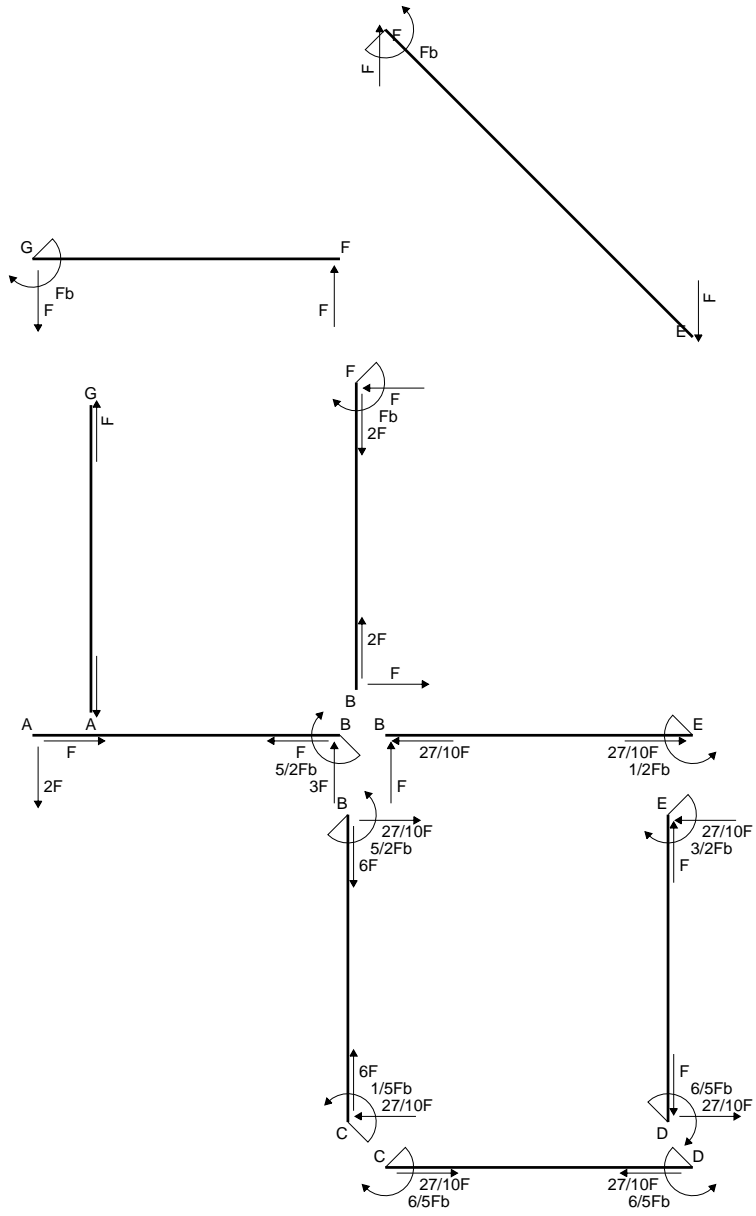
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

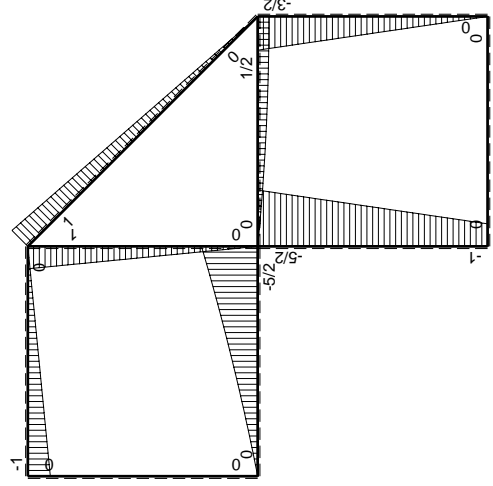
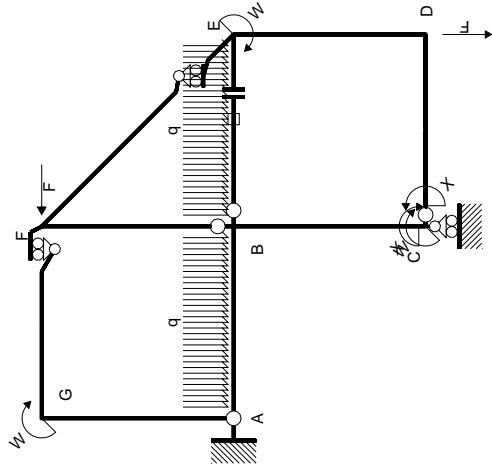
$$L_{DE}^{xo} = \int_0^b (-1/2 + 5/2 x/b - 2x^2/b^2) Fb 1/EJ dx = [-1/2 x + 5/4 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 5/4 b - 2/3 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 2x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

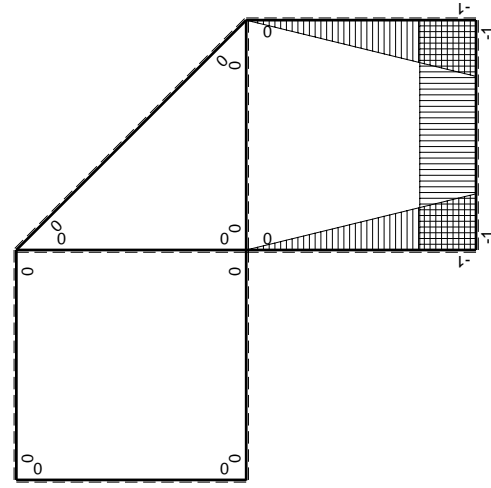
$$= (3/4 b - 2/3 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-3/2Fx$	$3/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$3/2Fb - 3/2Fx$	$3/2Fx - 3/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx - 1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb + 1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon} L_{BE}^{\epsilon}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-6/5Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

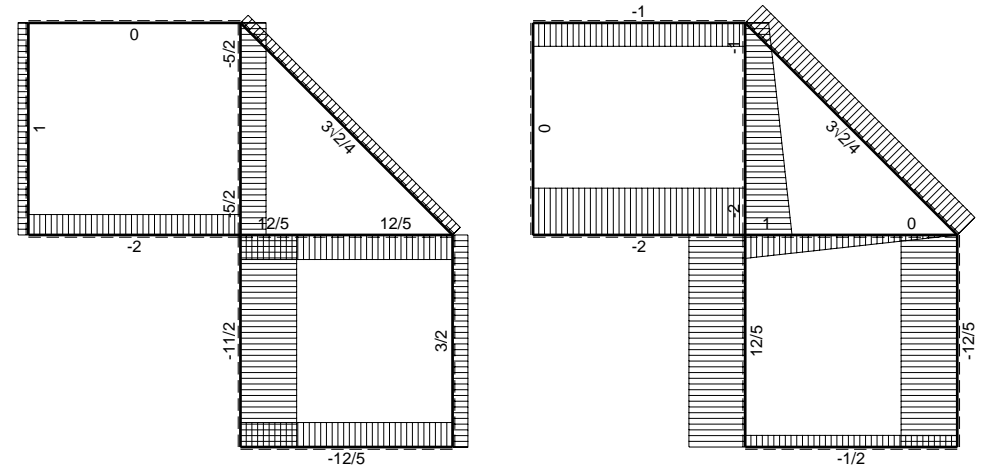
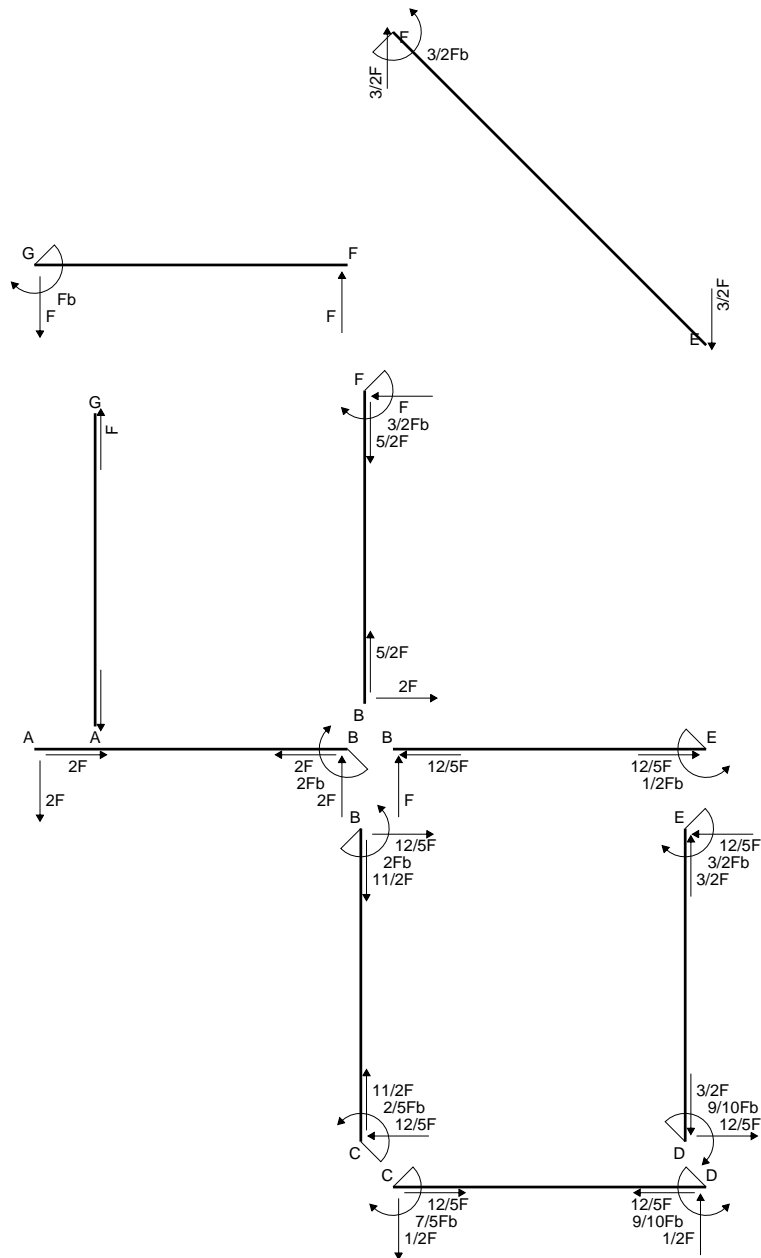
$$= (b + 1/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

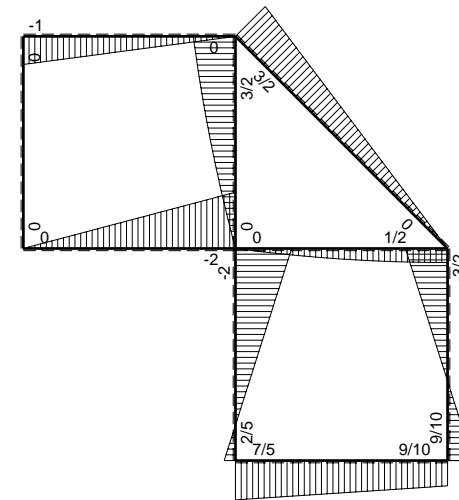
$$L_{ED}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

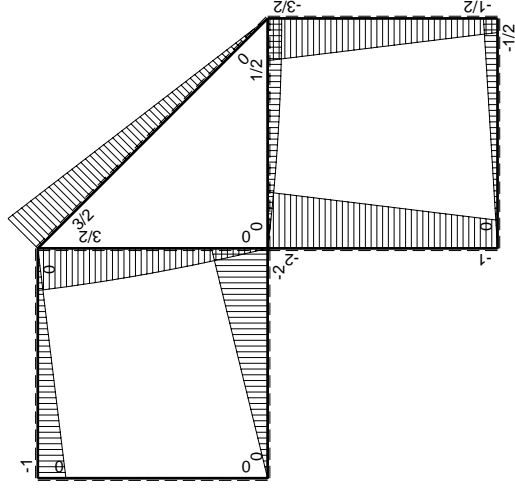
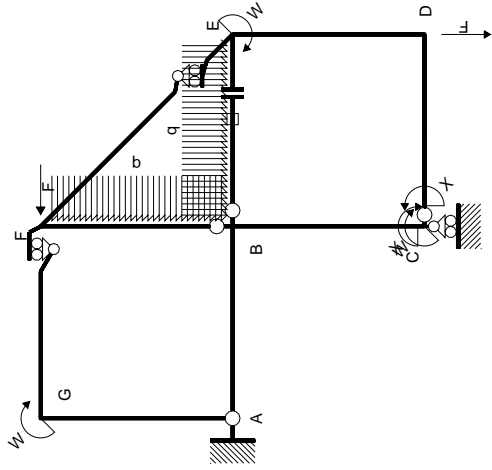


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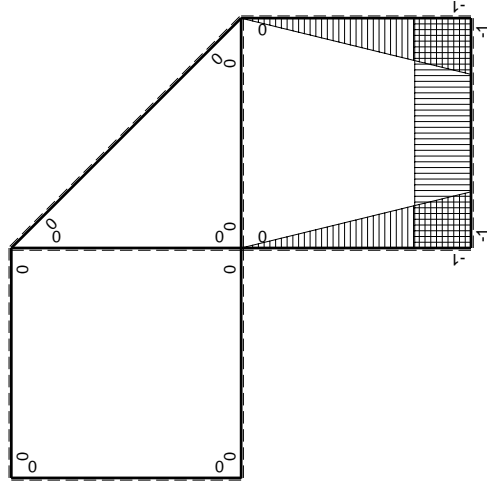


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx ² /b	1-2x/b+x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - N_{BE}^E - N_{BE}^E$				Fb ² /EJ	
	totali				7/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-7/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

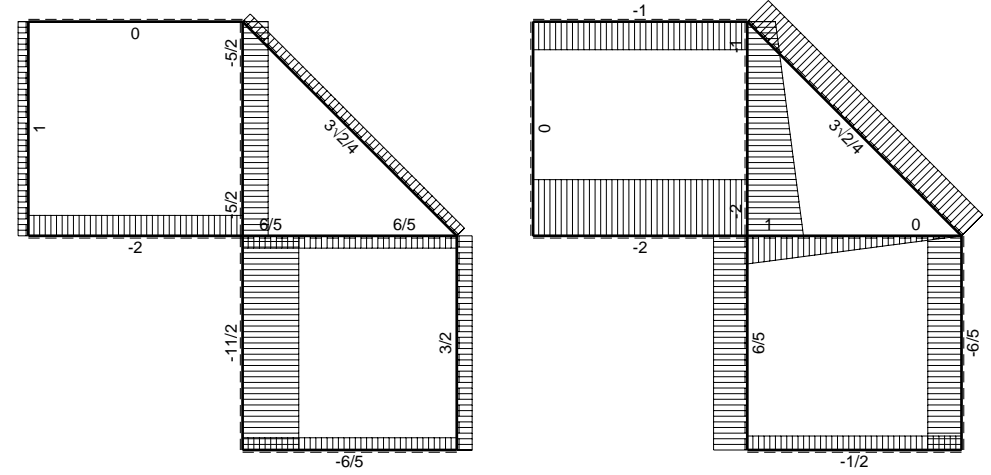
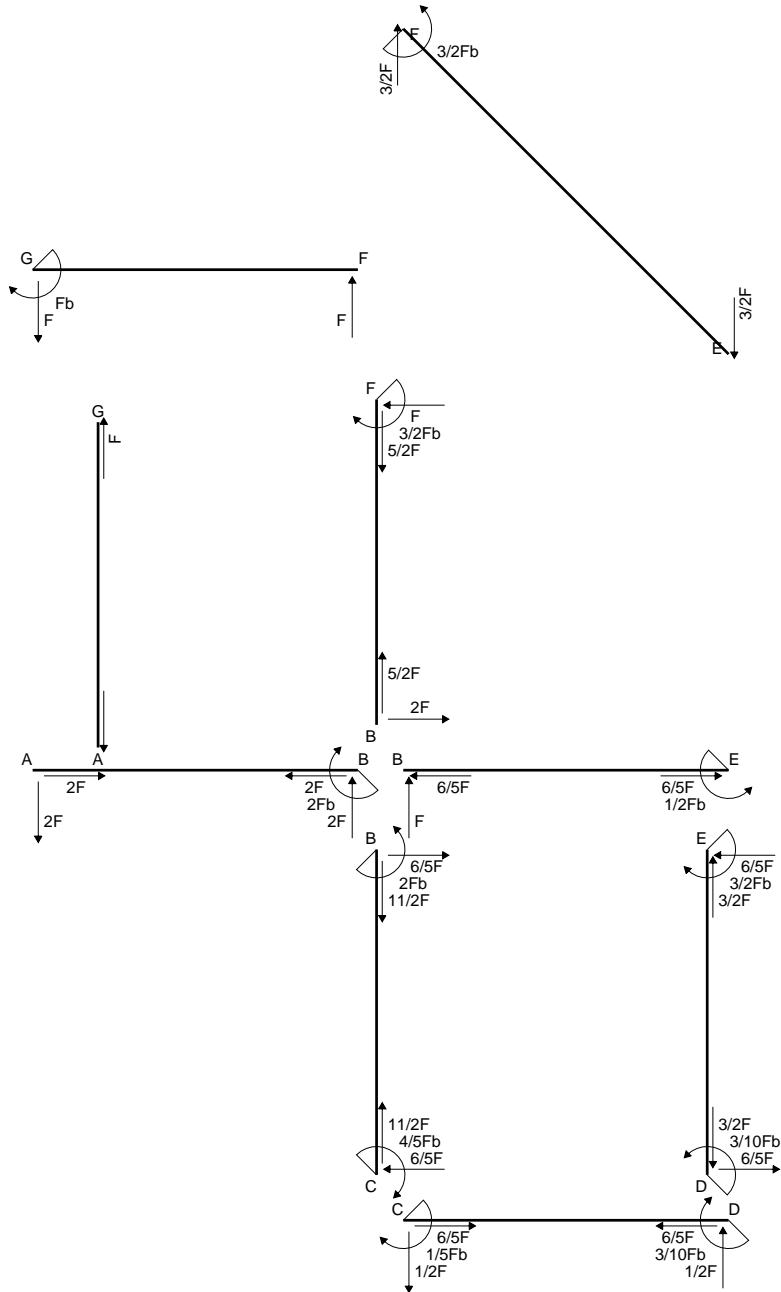
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x + 1/4 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b + 1/4 b - 1/3 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

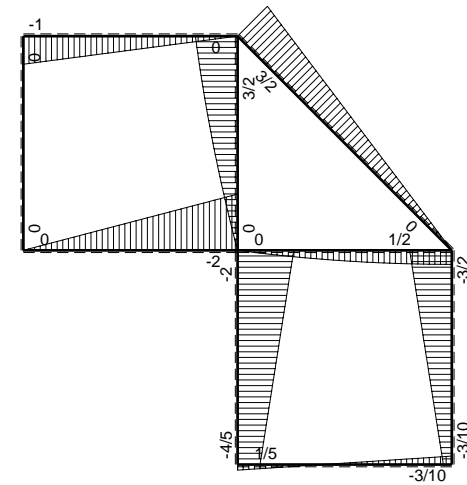
$$L_{ED}^{xo} = \int_0^b (3/2 x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/3 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

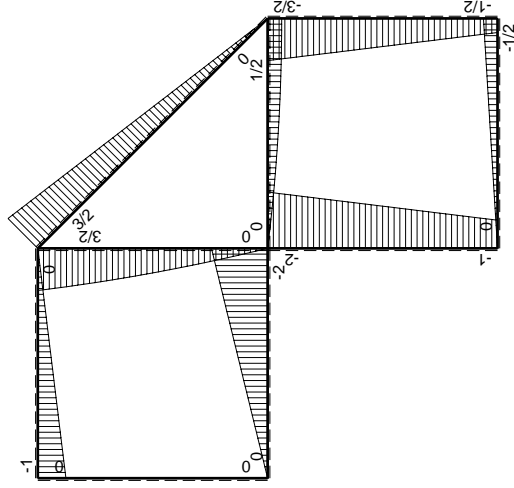
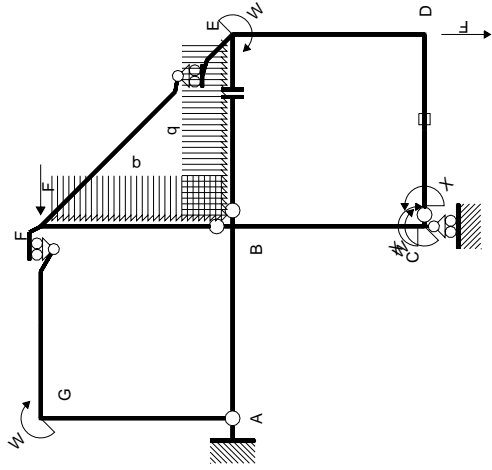


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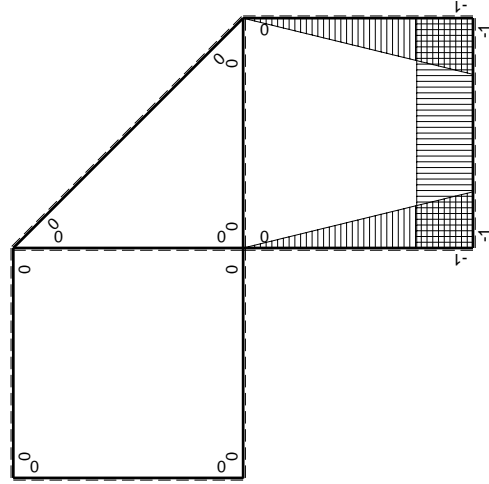


⊕ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx ² /b	1-2x/b+x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				1/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

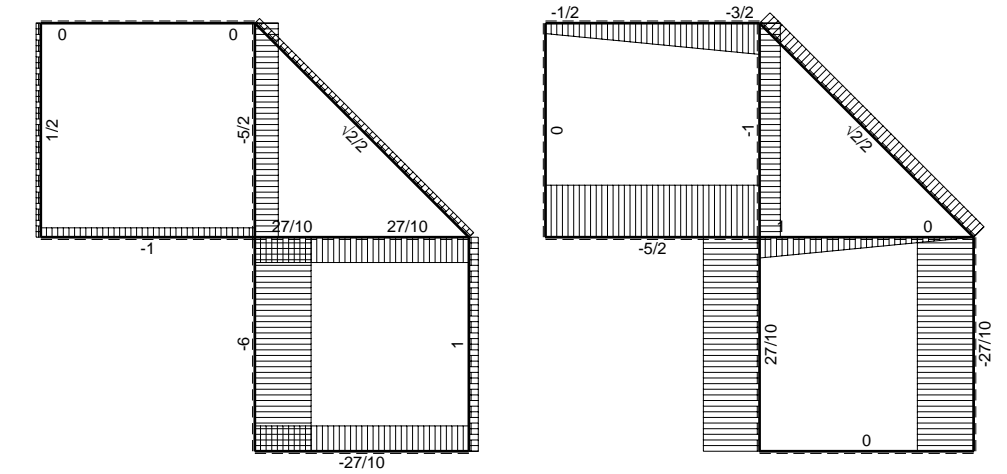
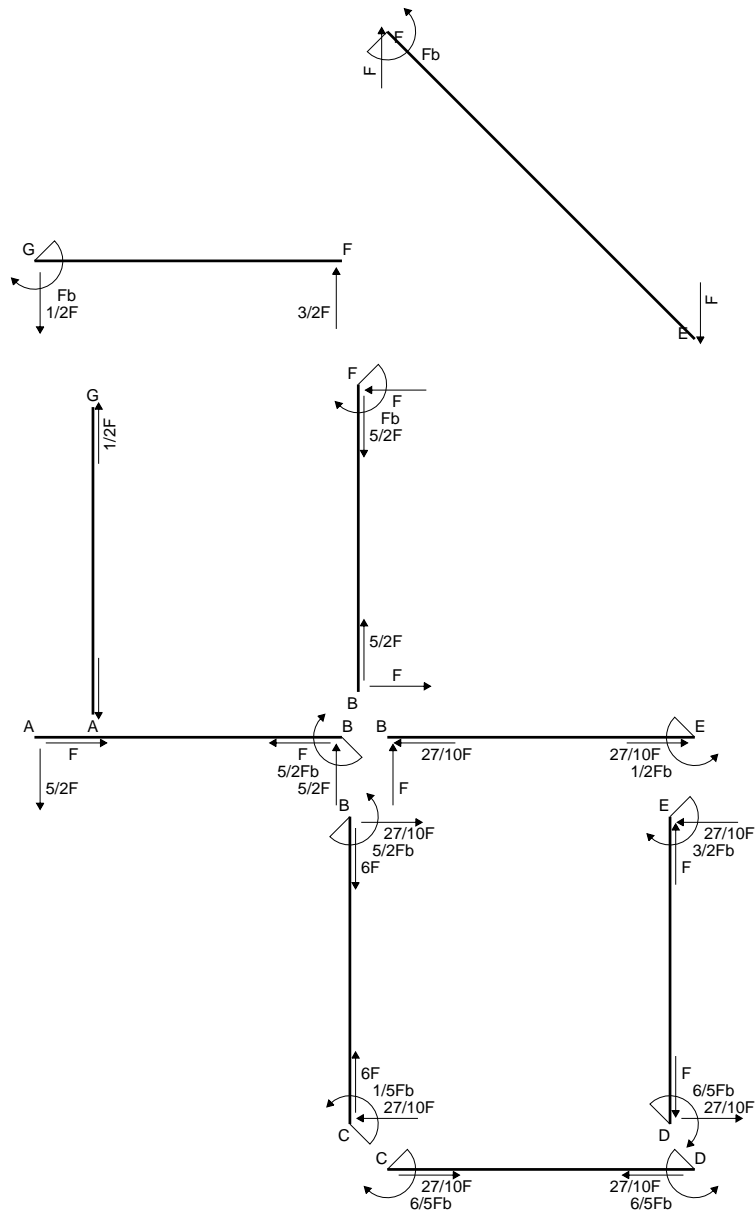
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x + 1/4 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b + 1/4 b - 1/3 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

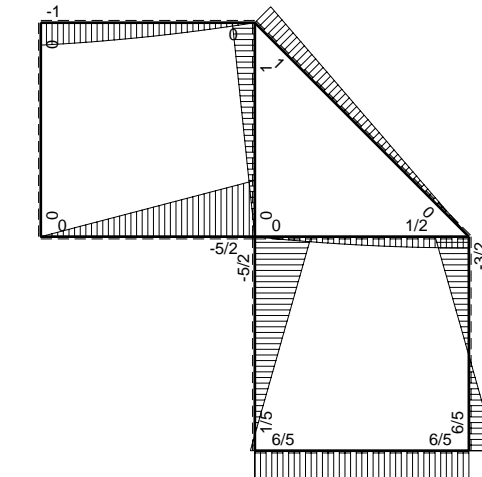
$$L_{ED}^{xo} = \int_0^b (3/2 x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/3 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

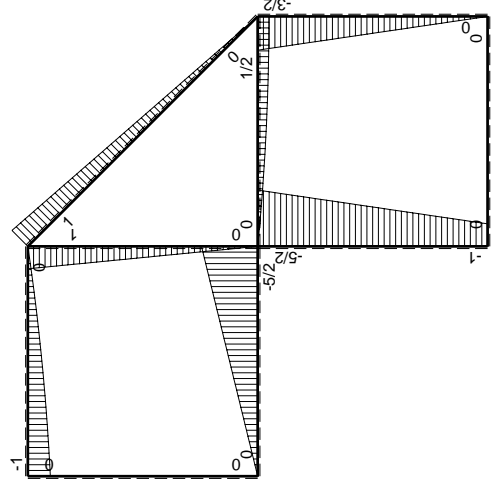
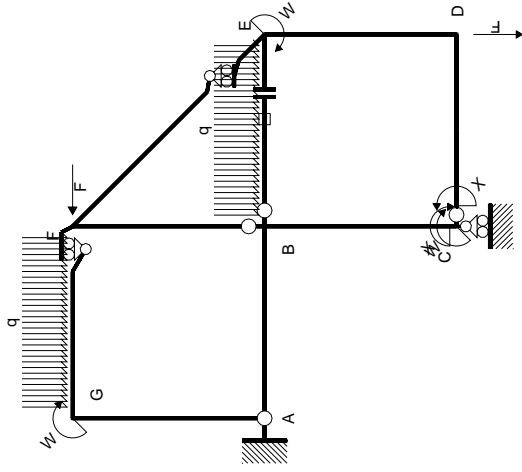


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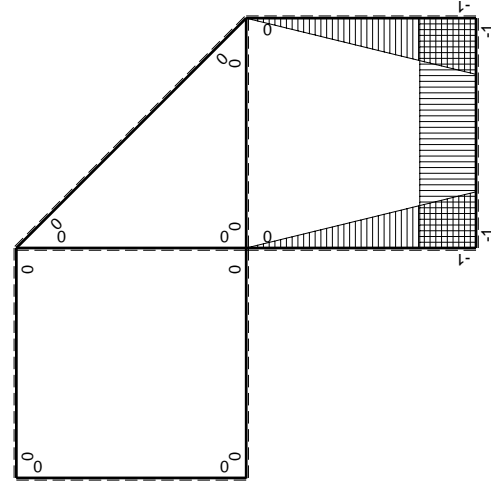


⊕ ⊖ F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-3/2Fx	3/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - N_{1, BE}^B$				Fb ² /EJ	
	totali				2Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \cdot b - 1/2 \cdot b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

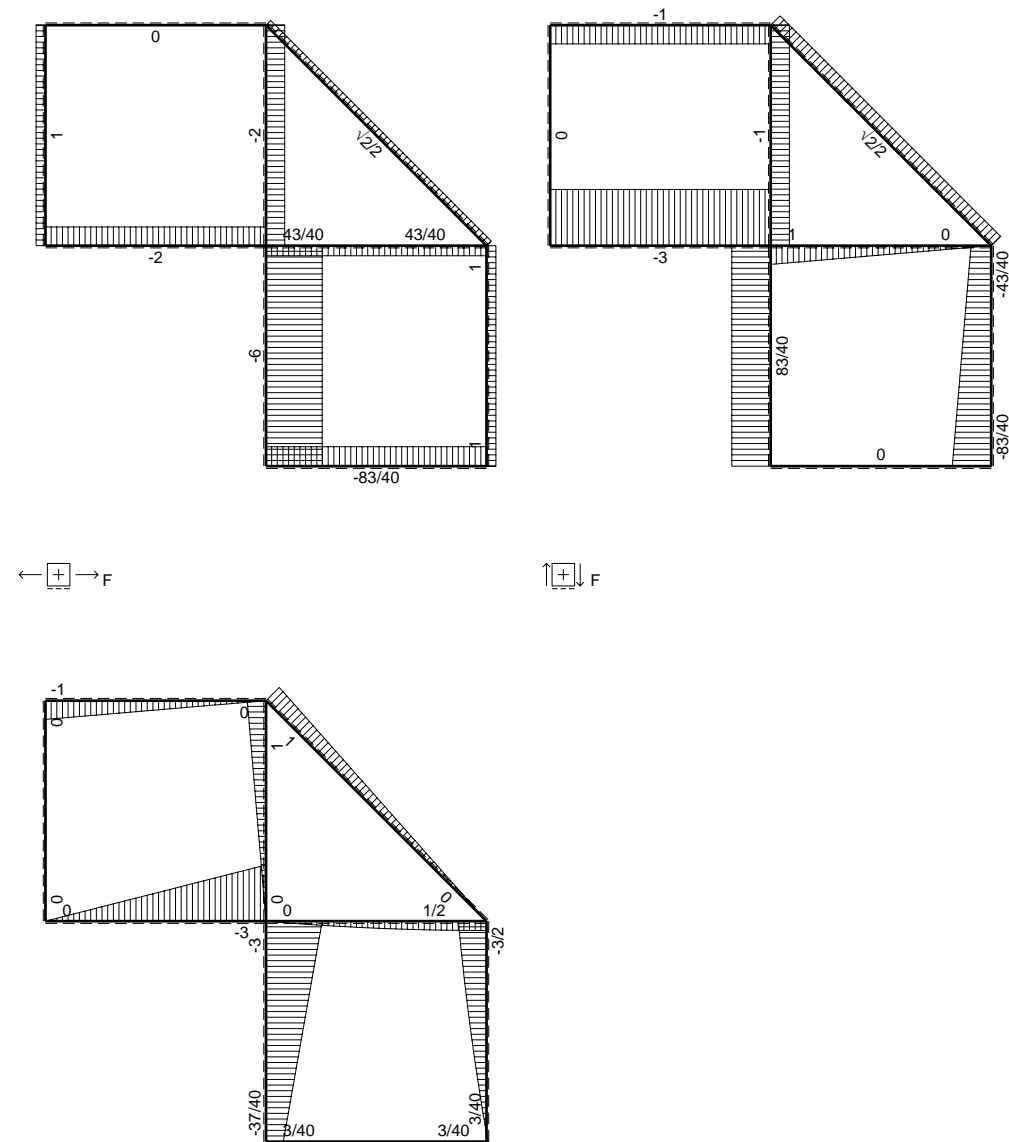
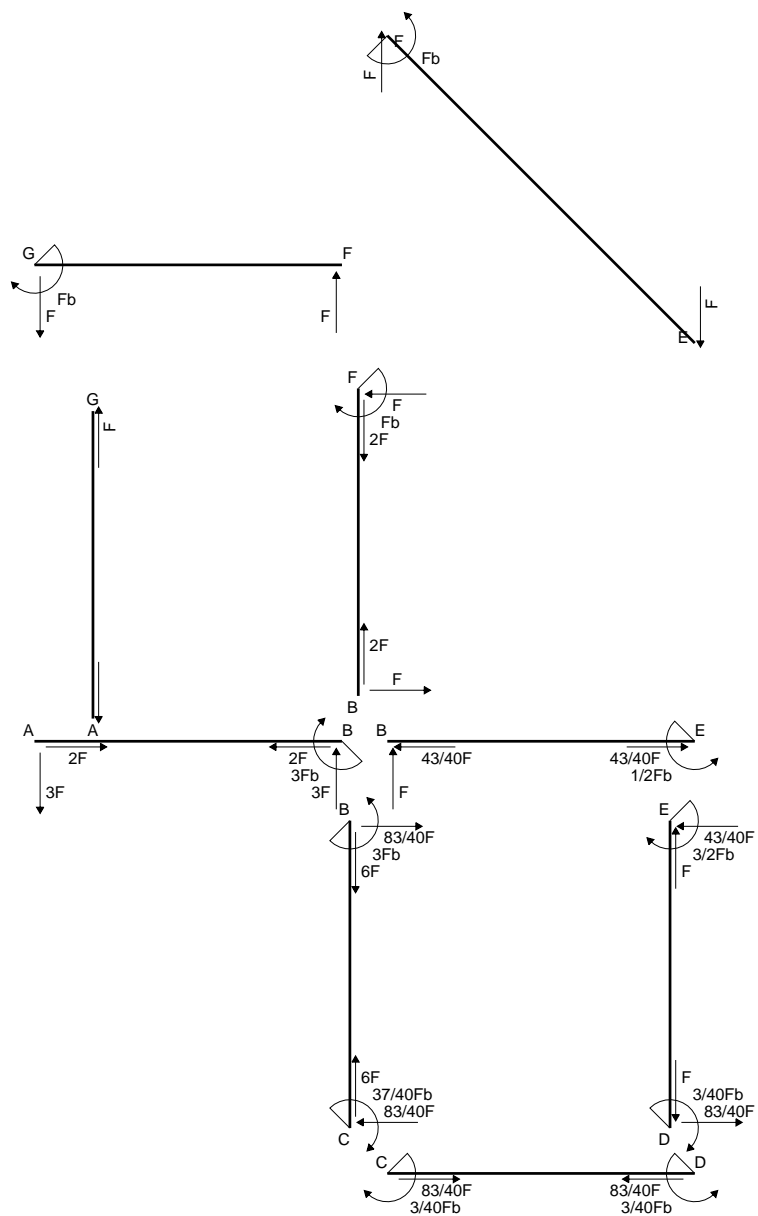
$$= (b + 1/4 \cdot b - 1/2 \cdot b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

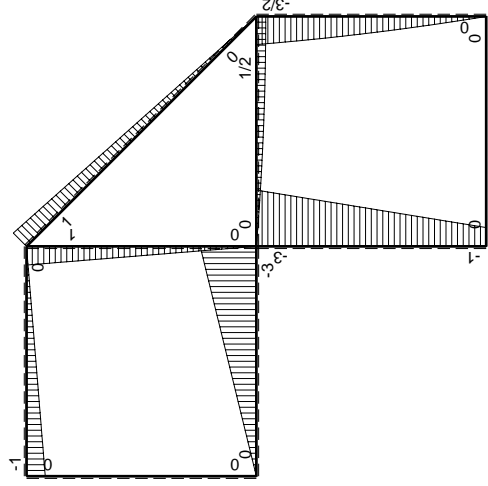
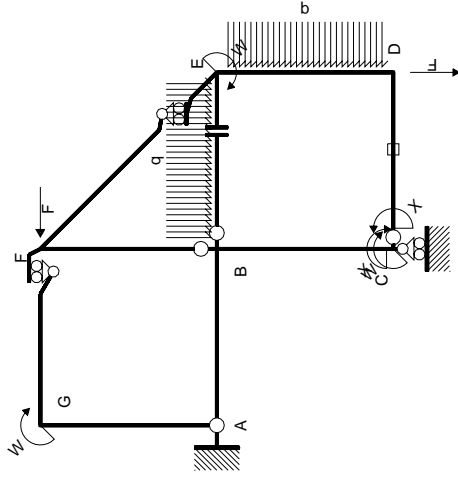
$$= (3/4 \cdot b - 1/2 \cdot b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/2 \cdot b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

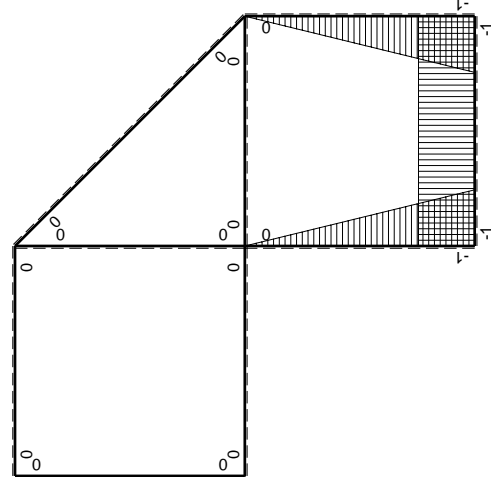


\oplus \ominus F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	3Fx-2Fx ² /b	x ² /b ²	5/6Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+2Fx	Fb+Fx-2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	Xb/EJ
DE b	-1+x/b	-2Fx+1/2qx ²	2Fx-5/2Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	7/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx-1/2qx ²	3/2Fx-Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				1/8Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-3/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) Fb 1/EJ dx = [3/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) Fb 1/EJ dx = [x + 1/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

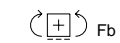
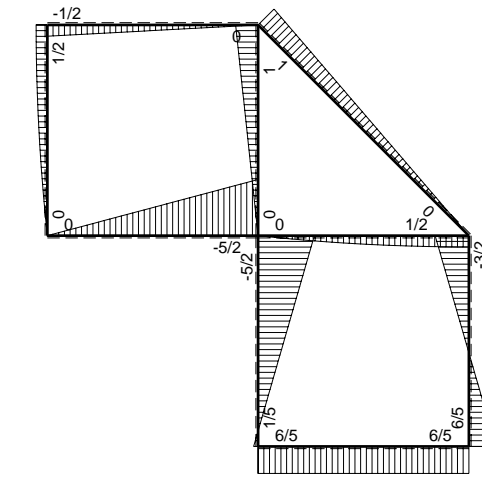
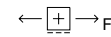
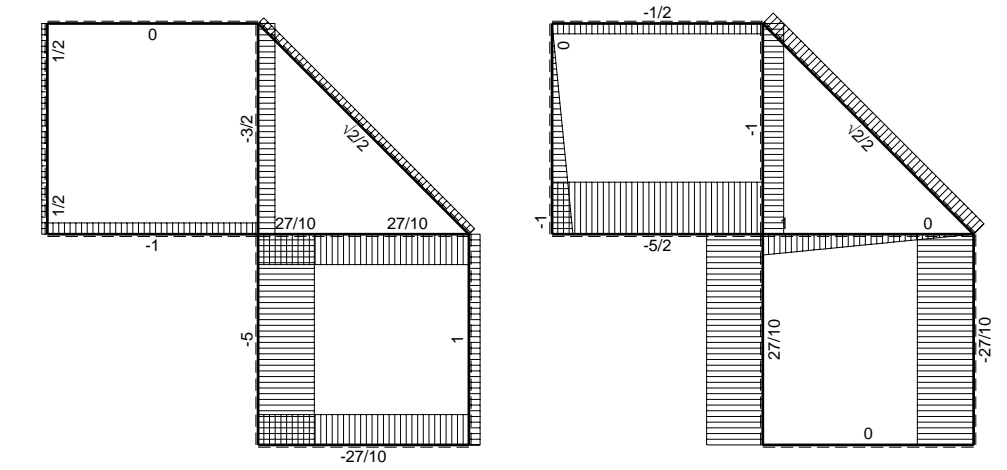
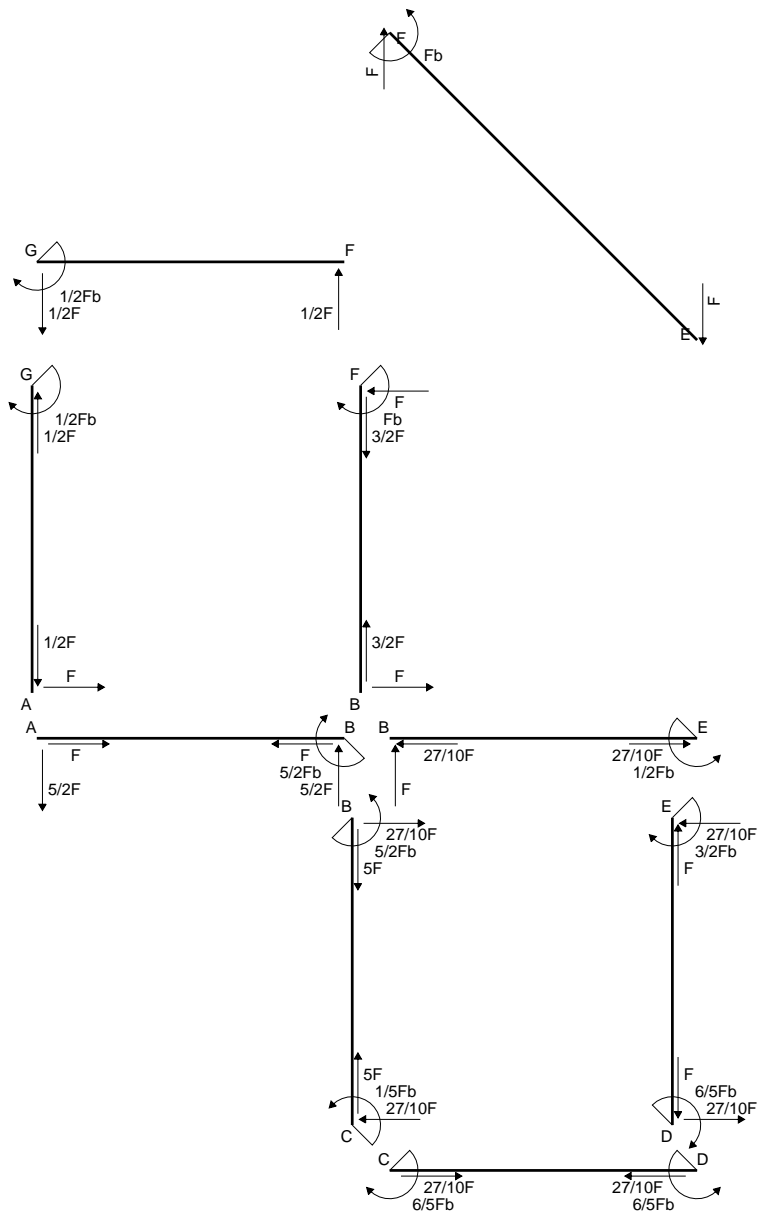
$$= (b + 1/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

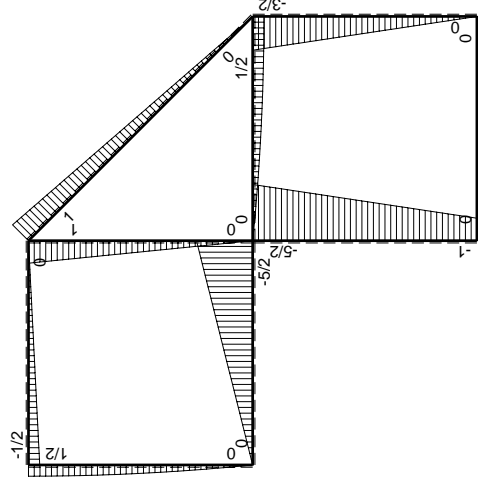
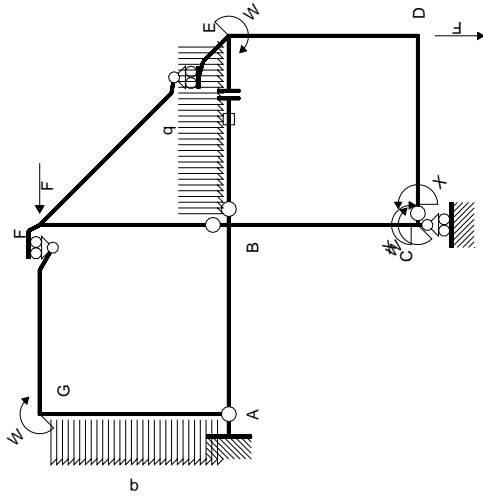
$$L_{DE}^{xo} = \int_0^b (2x/b - 5/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [x^2/b - 5/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 5/6 b + 1/8 b) Fb 1/EJ = 7/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

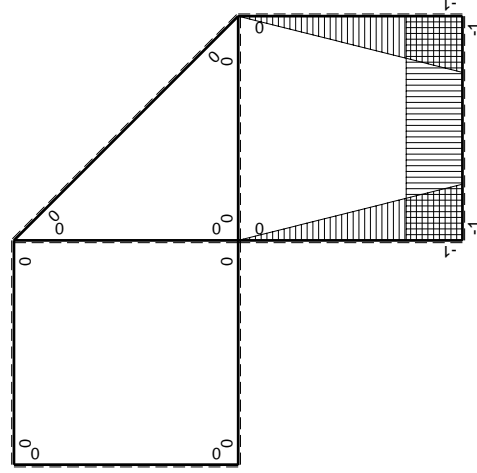
$$= (3/4 b - 1/3 b - 1/8 b) Fb 1/EJ = 7/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-3/2Fx	3/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				2Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

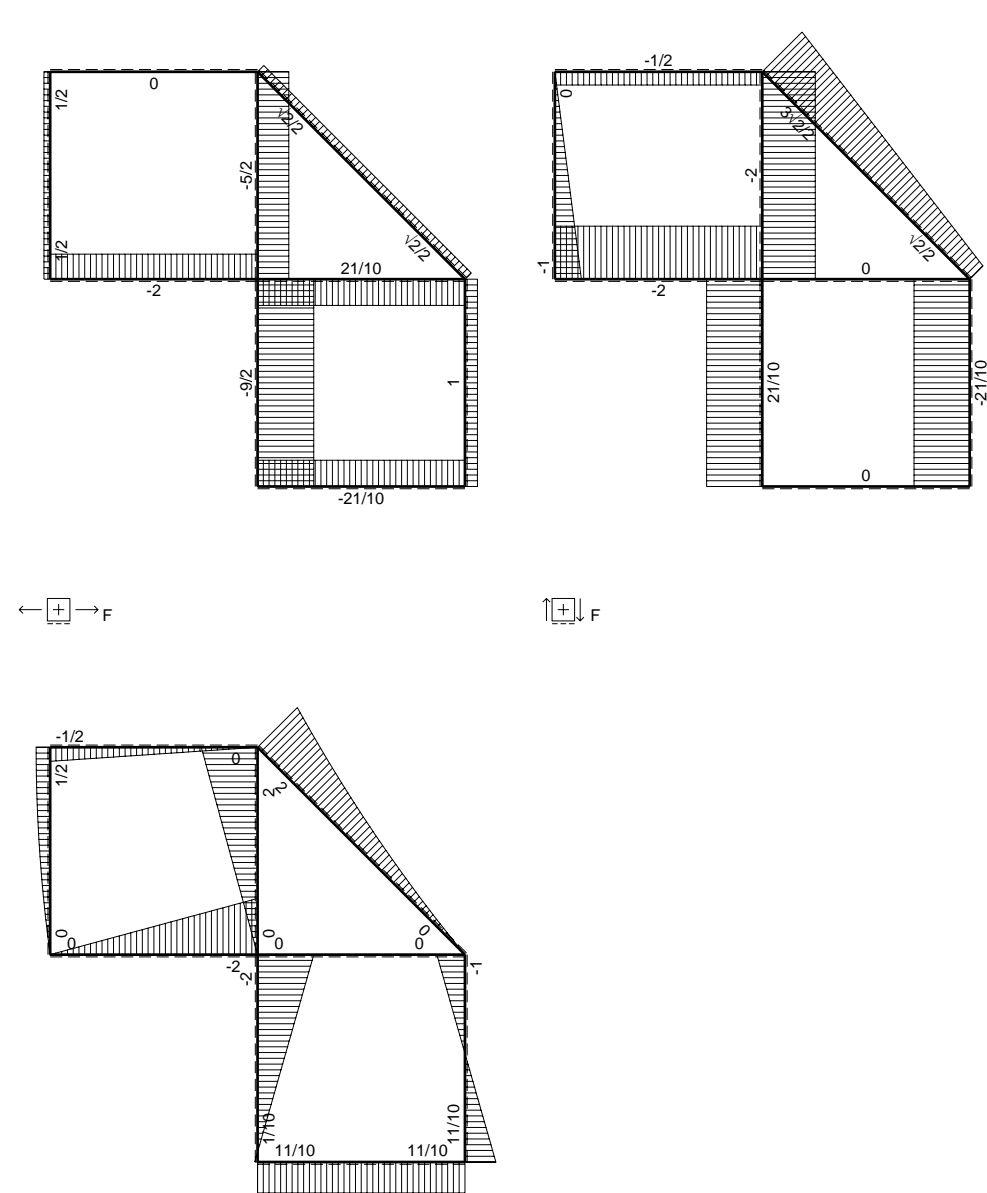
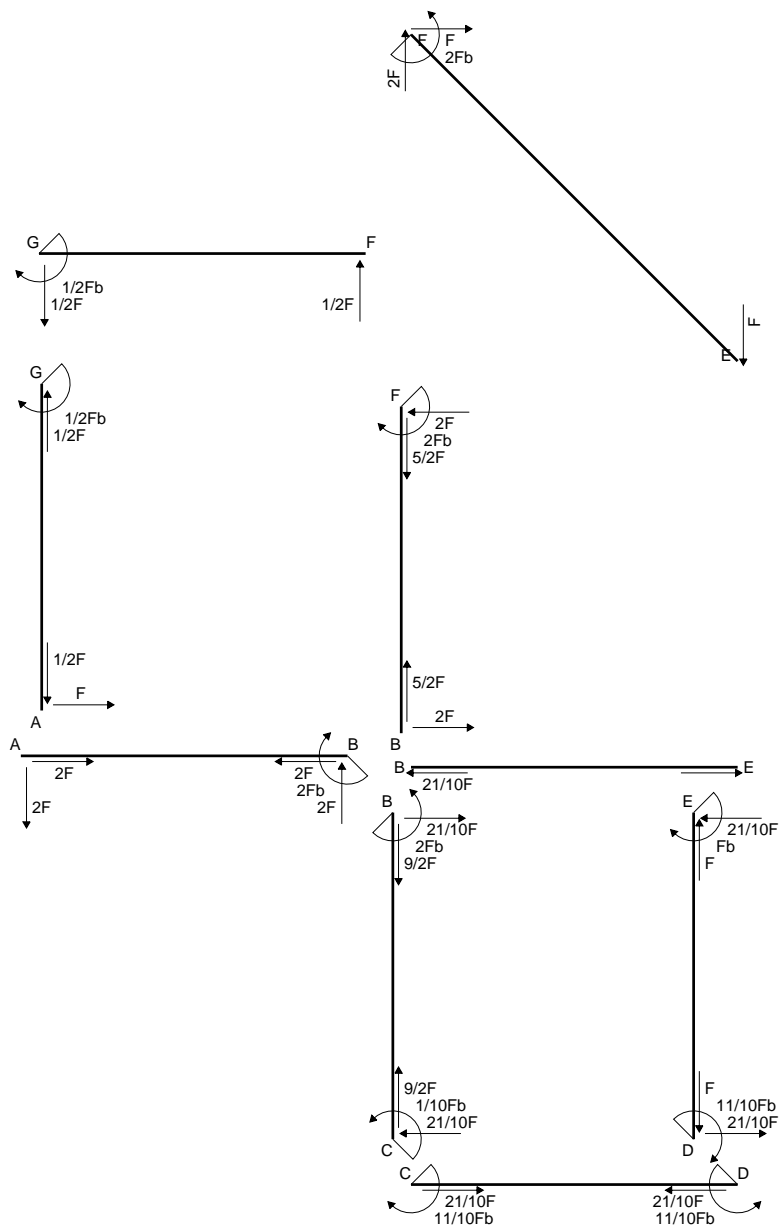
$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

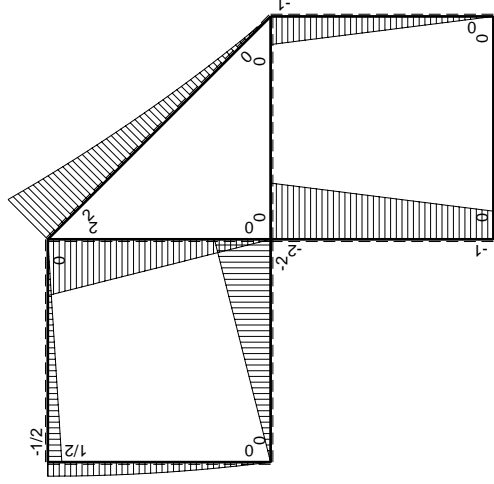
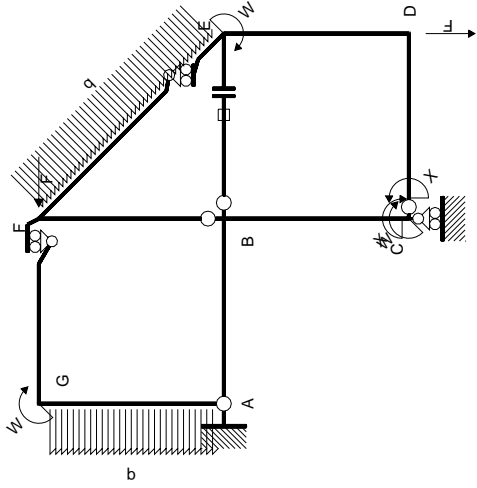
$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

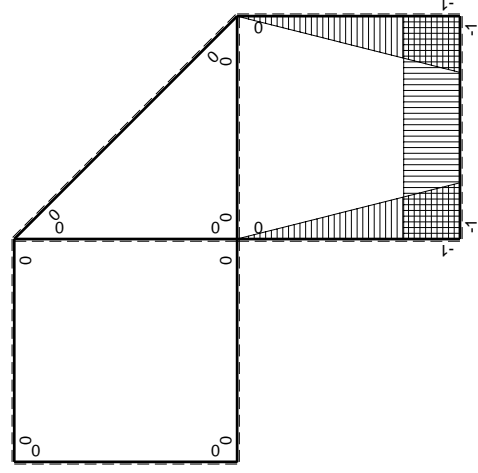


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	$1/2Fb-1/2Fx$	0	0	0	0
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$					$-11/10Fb$

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

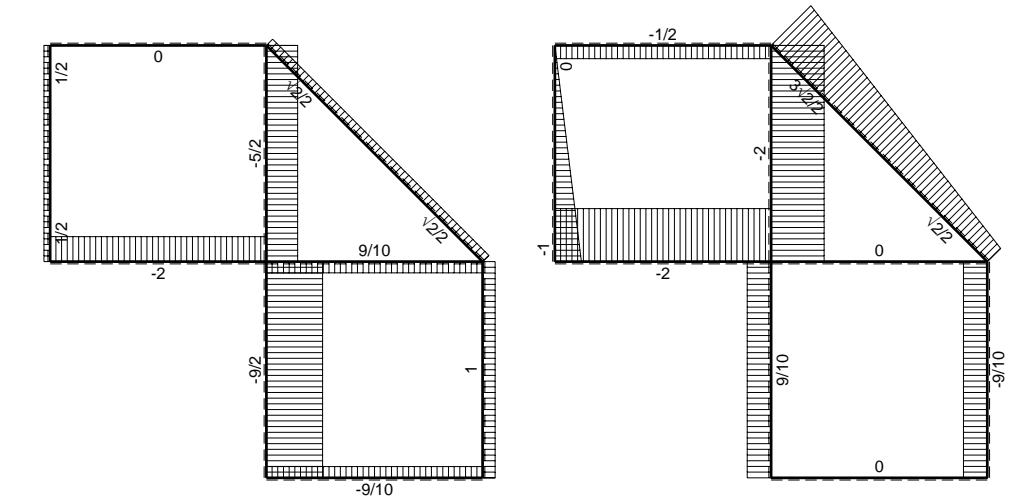
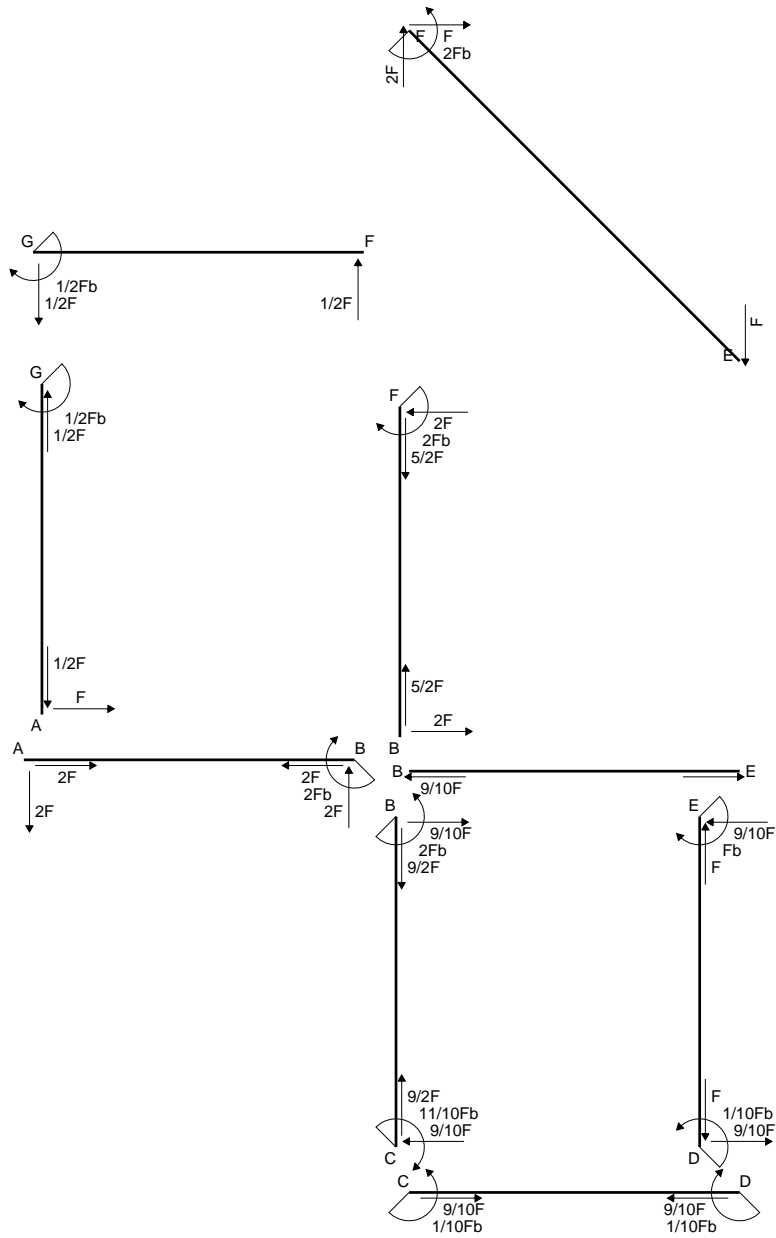
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

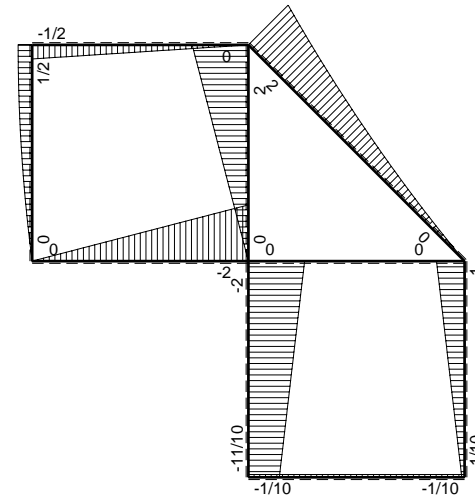
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

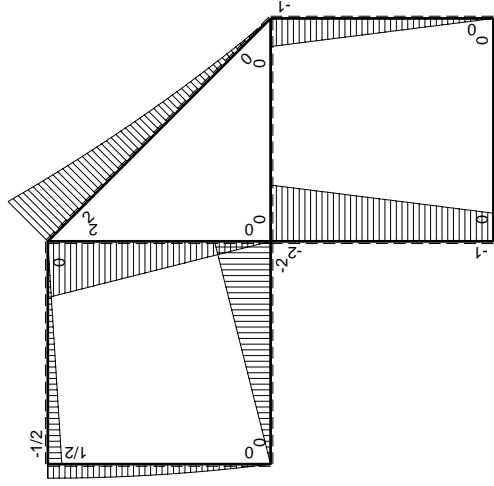
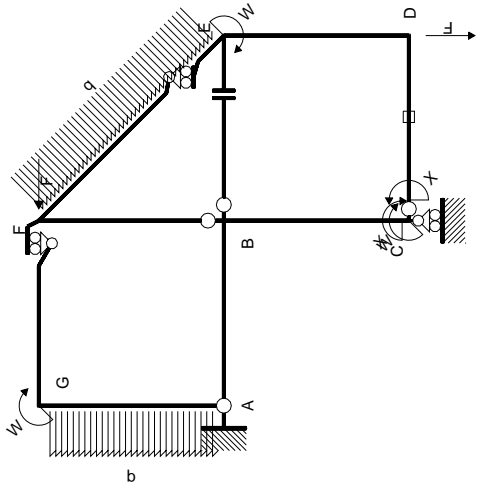


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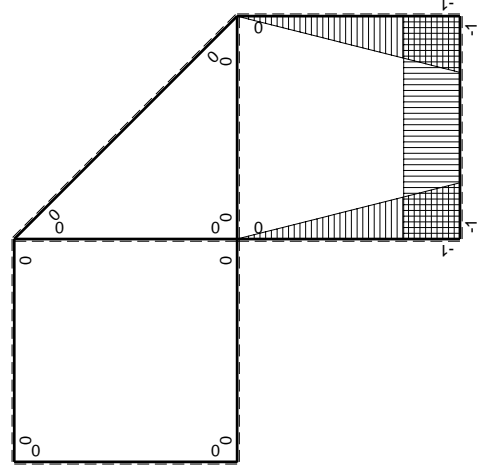


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

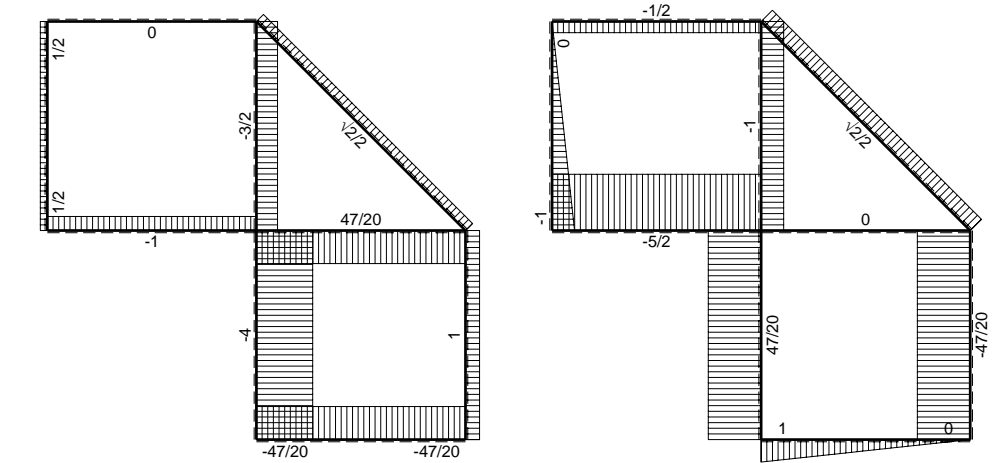
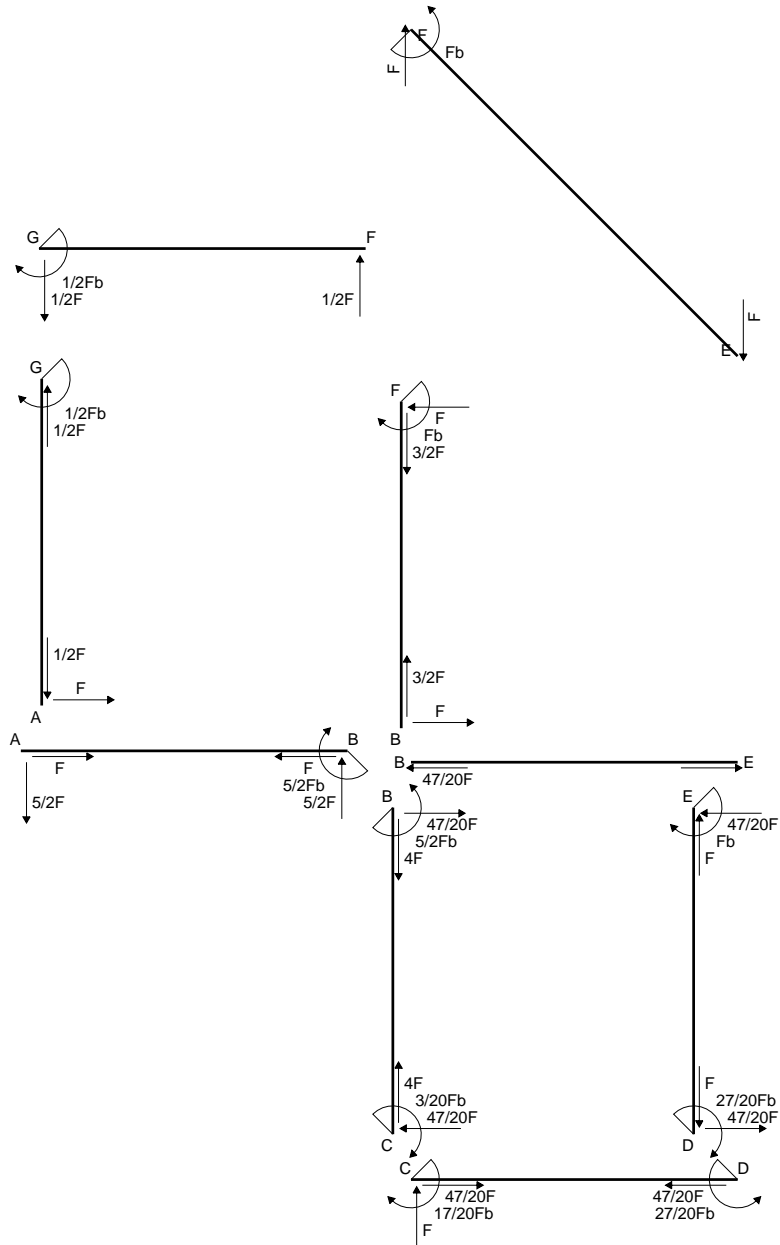
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

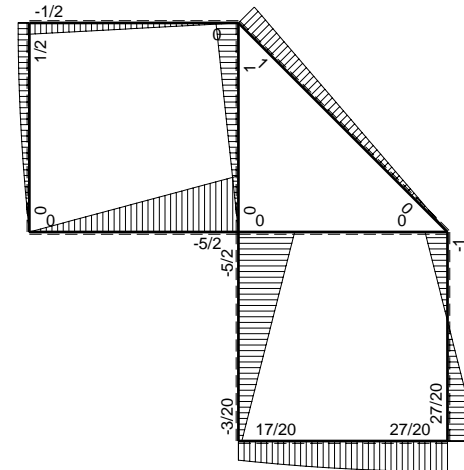
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

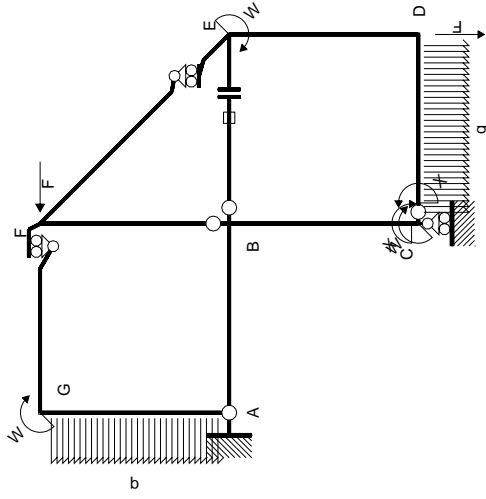


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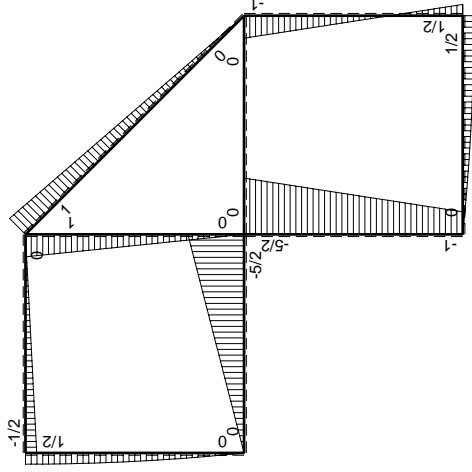
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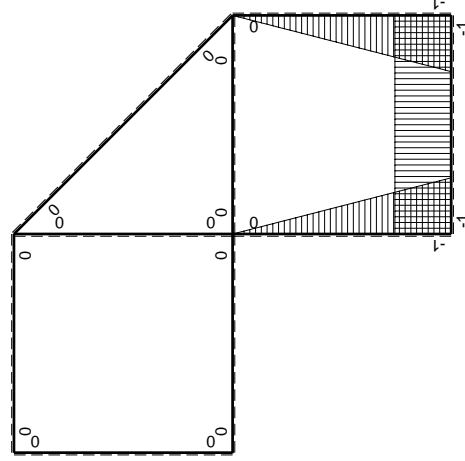
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0/EJdx$	$\int X M_x M_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				17/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-17/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

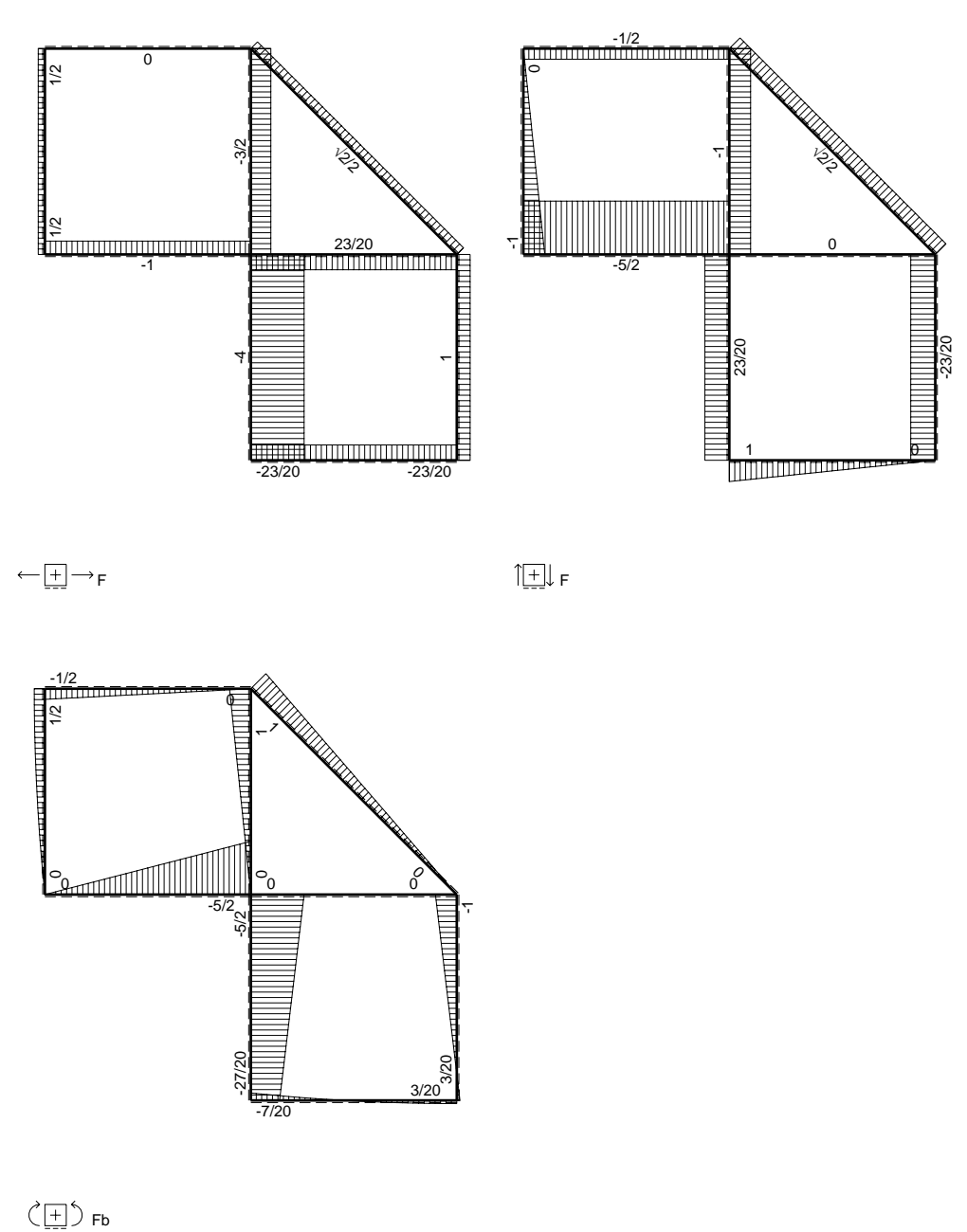
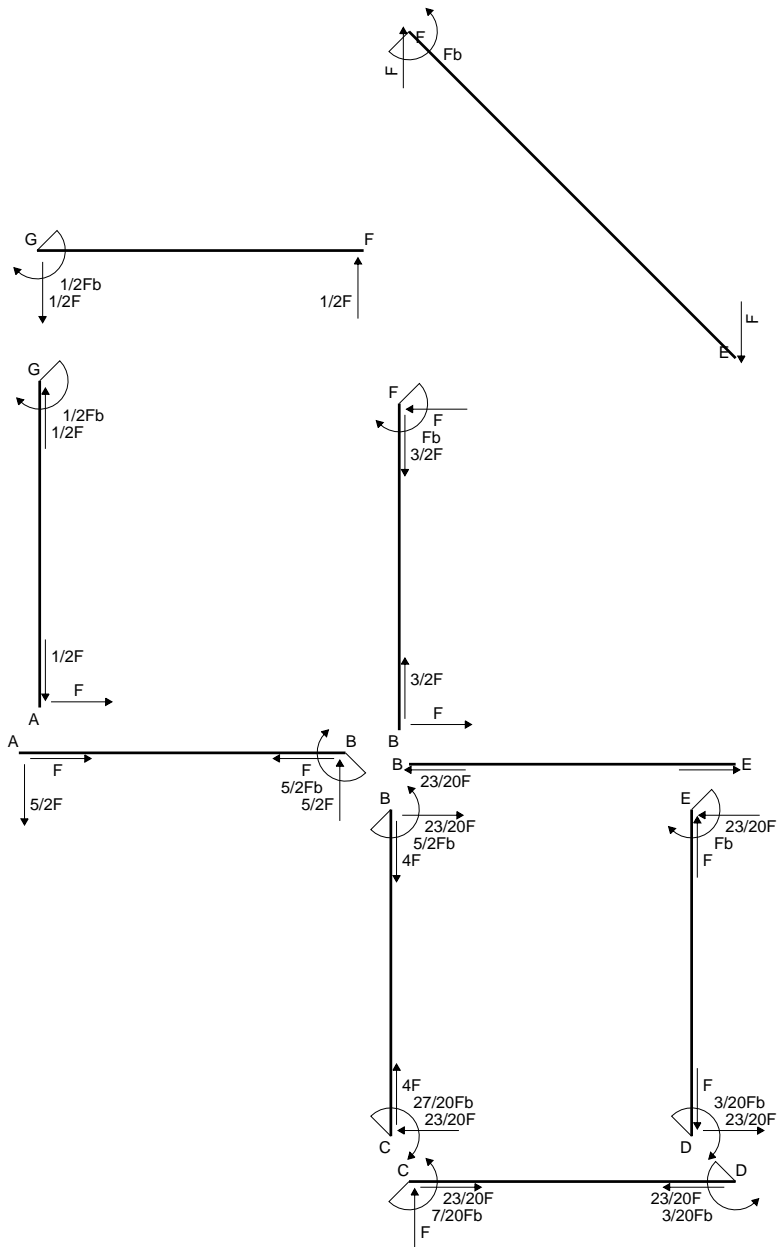
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

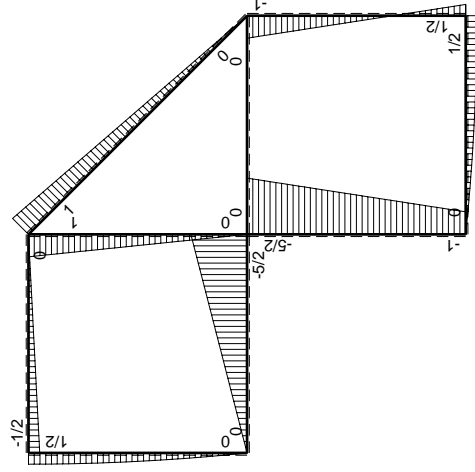
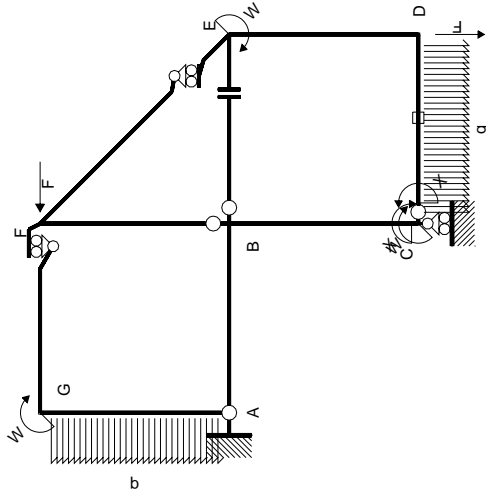
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

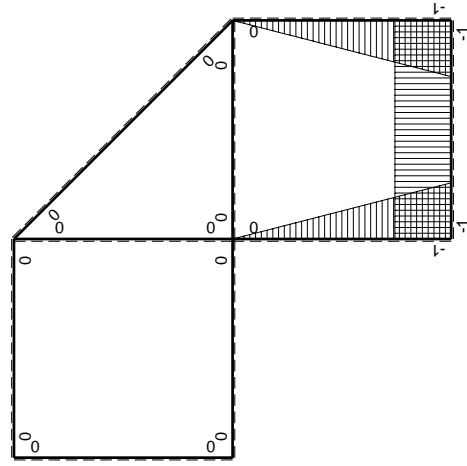
$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	-Fb ² /EJ	5/3Xb/EJ
	totali				-7/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				7/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

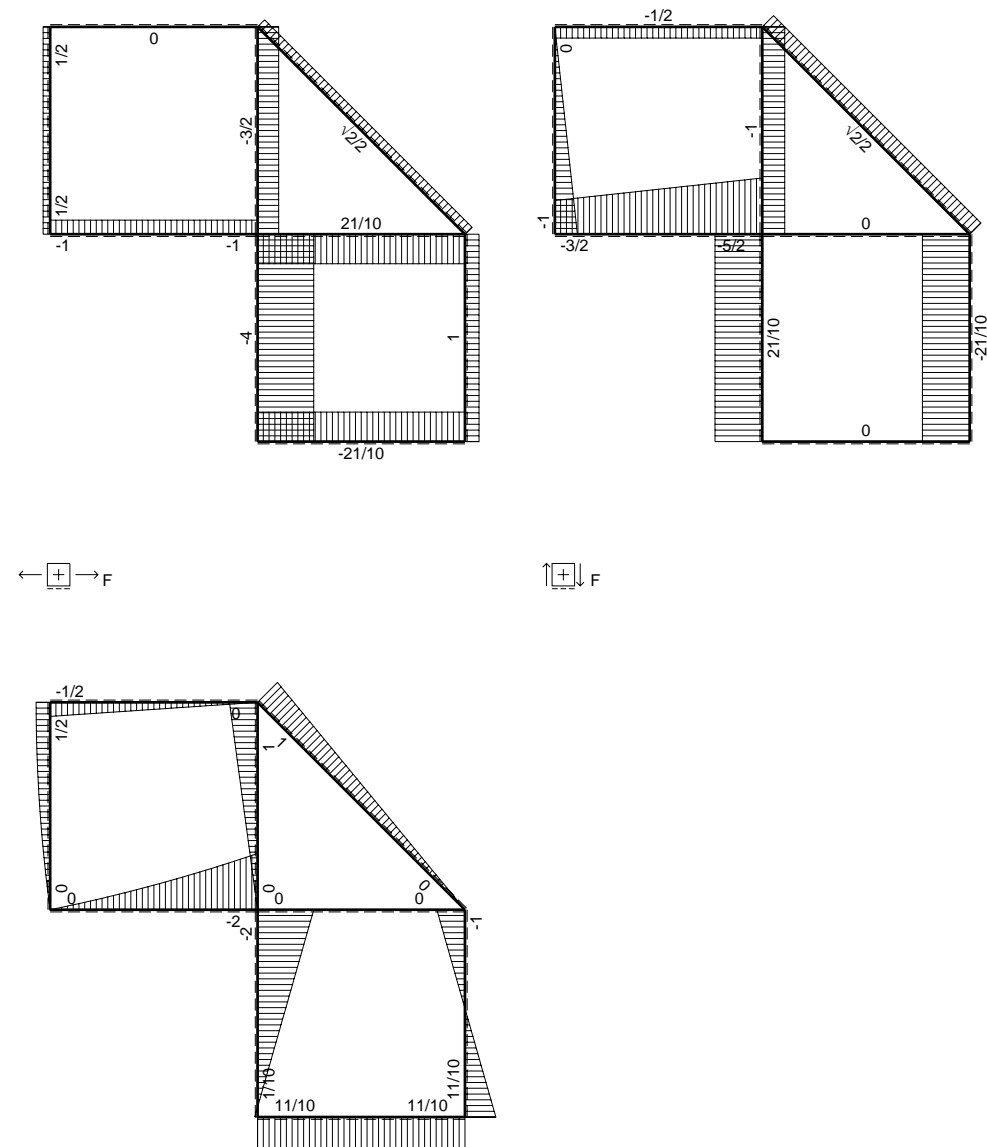
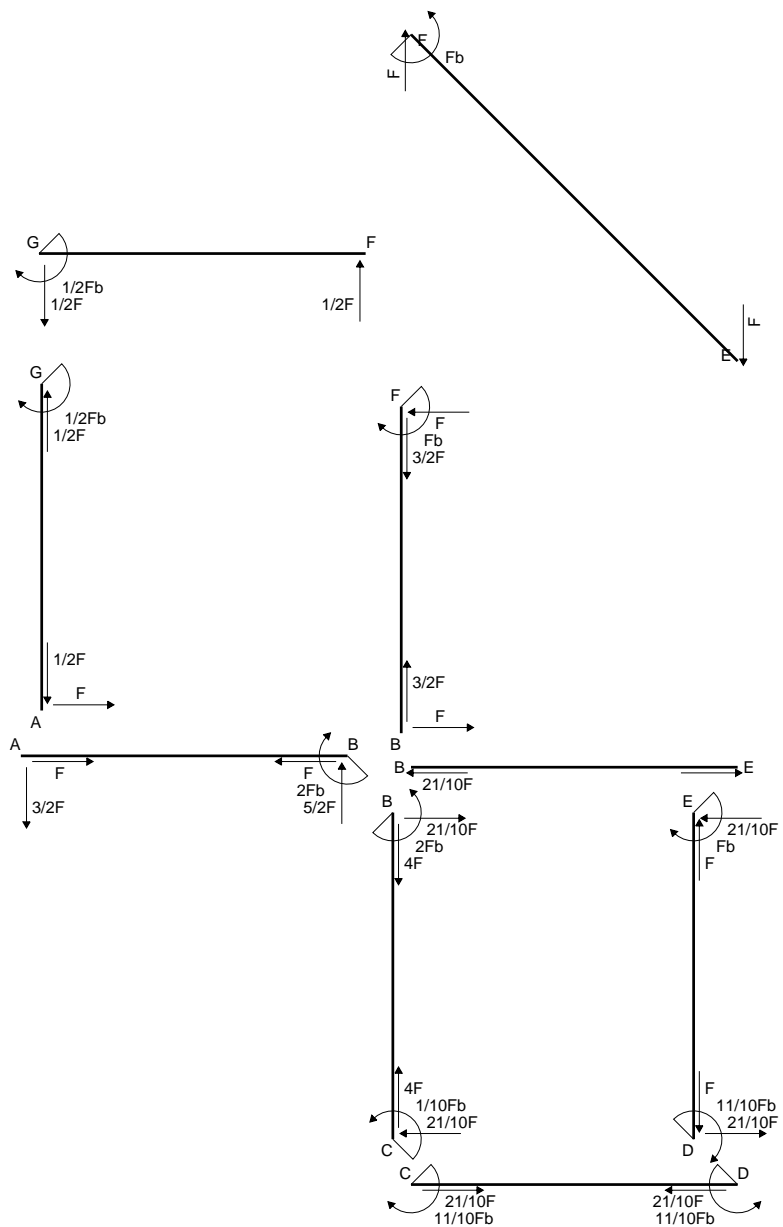
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

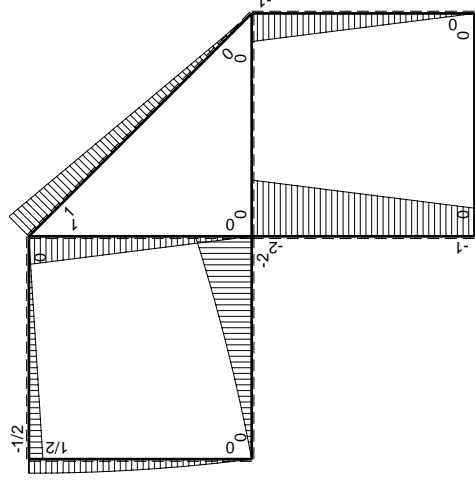
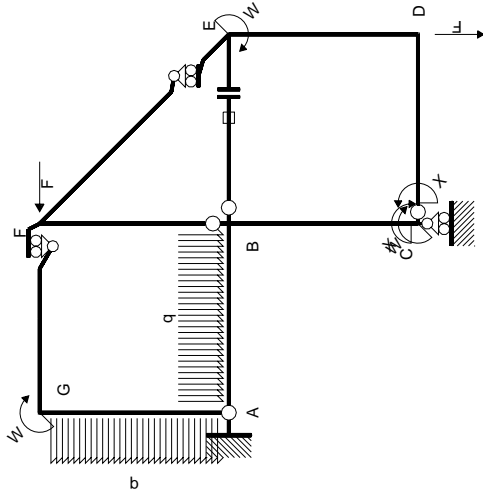
$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$

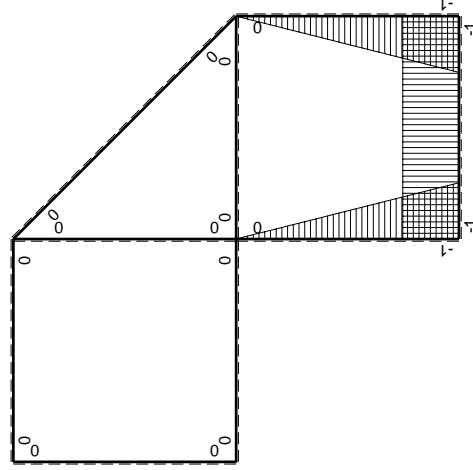


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	0
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-1/2Fx$	0	0	0	0
GF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
GA b	0	$1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$-Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$-11/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

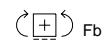
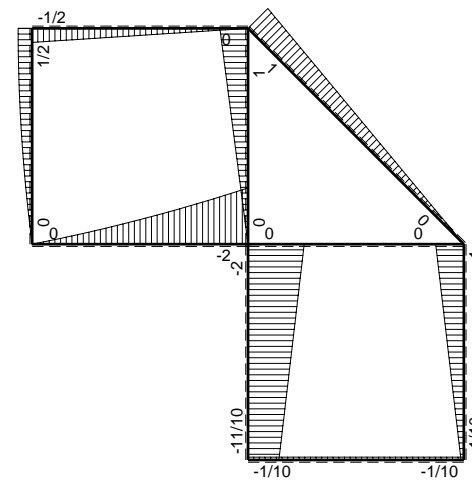
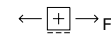
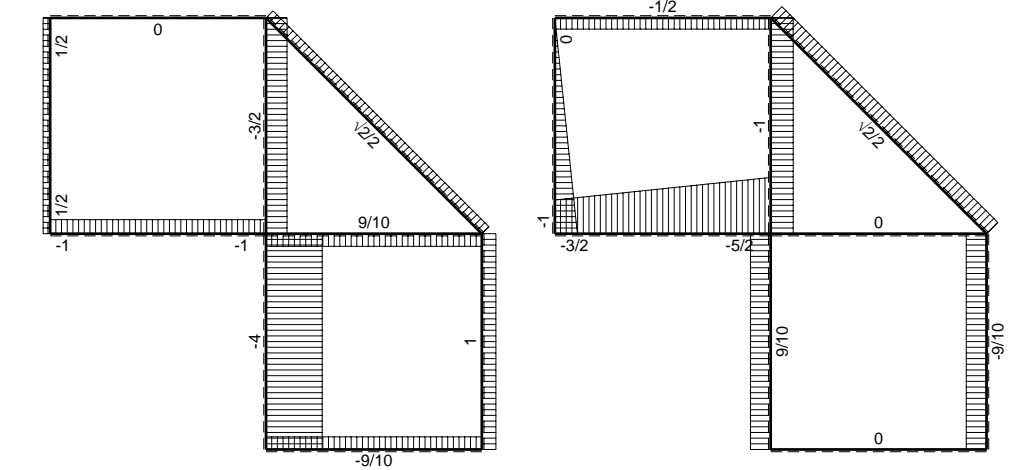
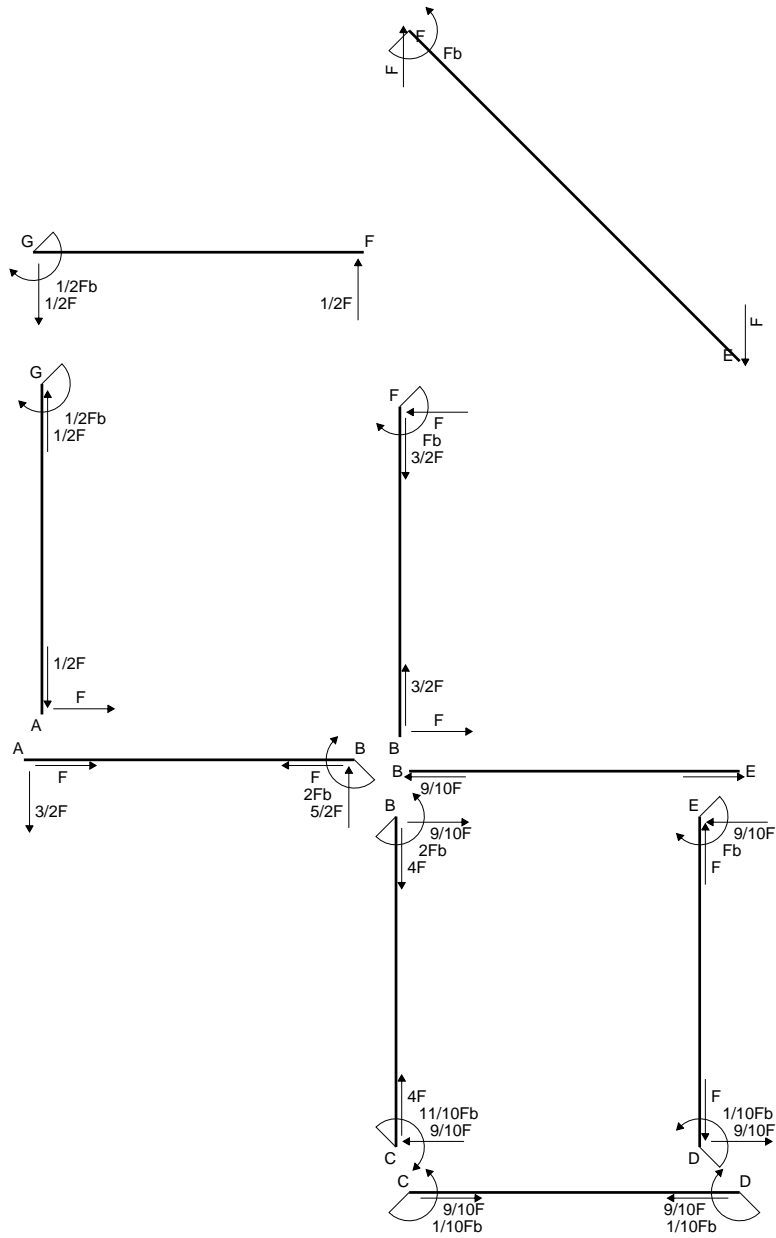
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

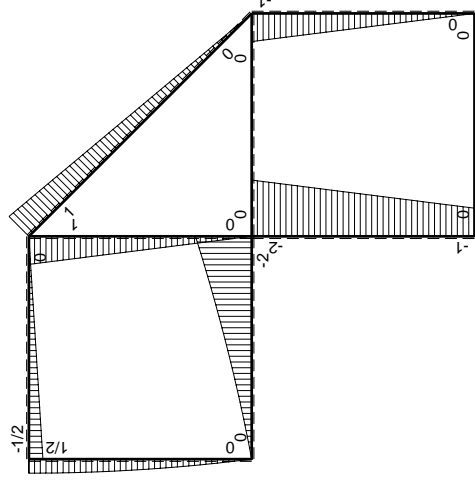
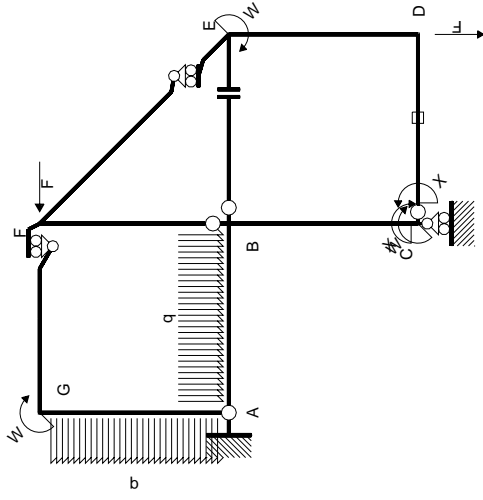
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

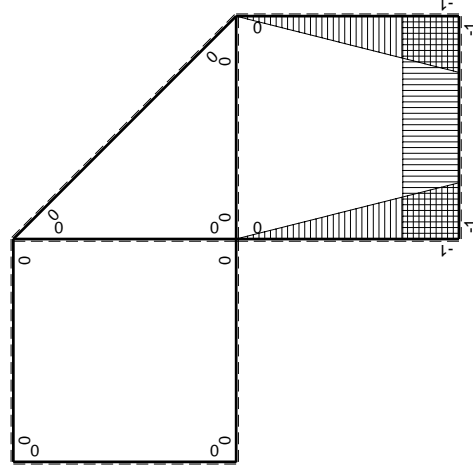
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-1/2Fx$	0	0	0	0
GF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
GA b	0	$1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$-Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

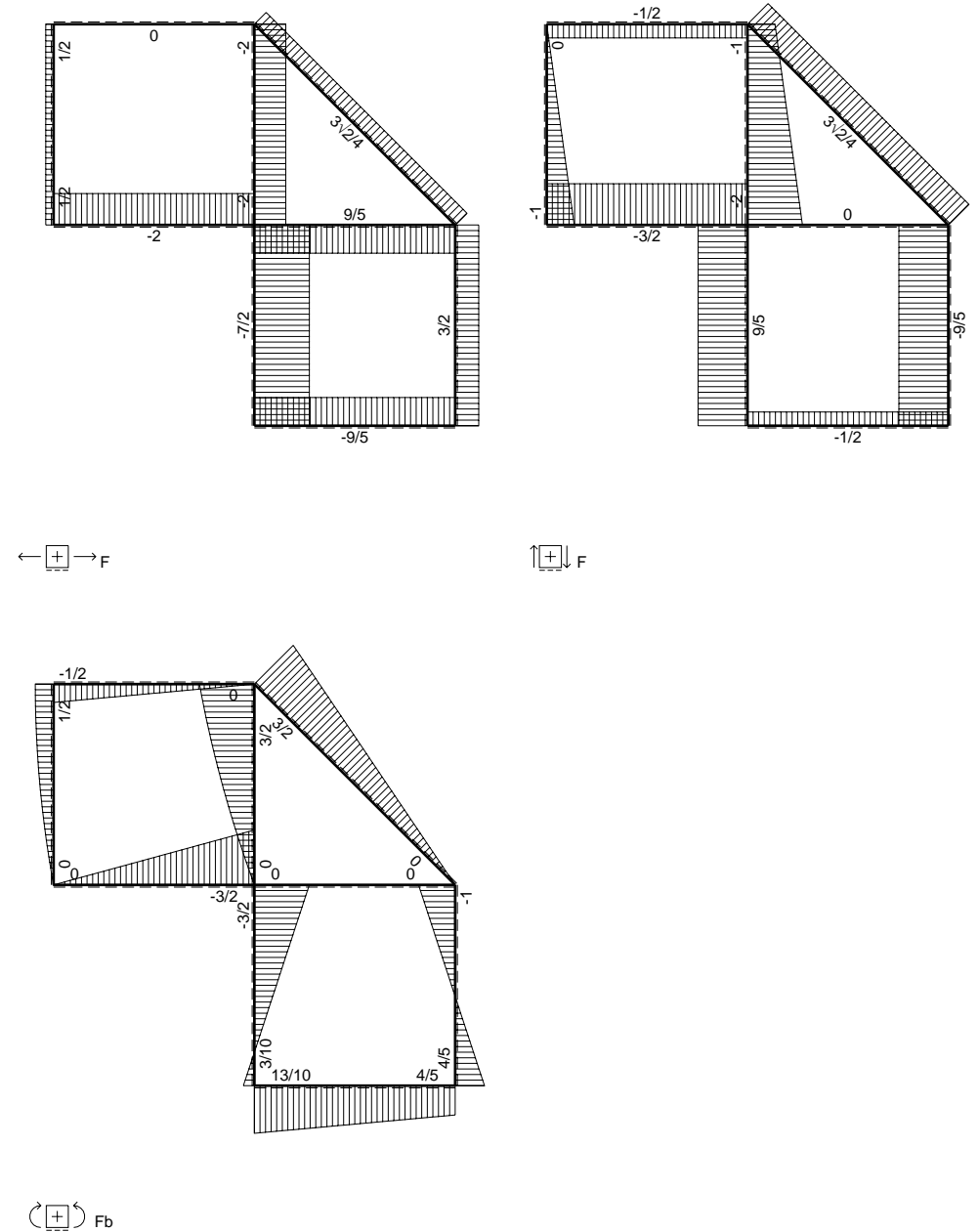
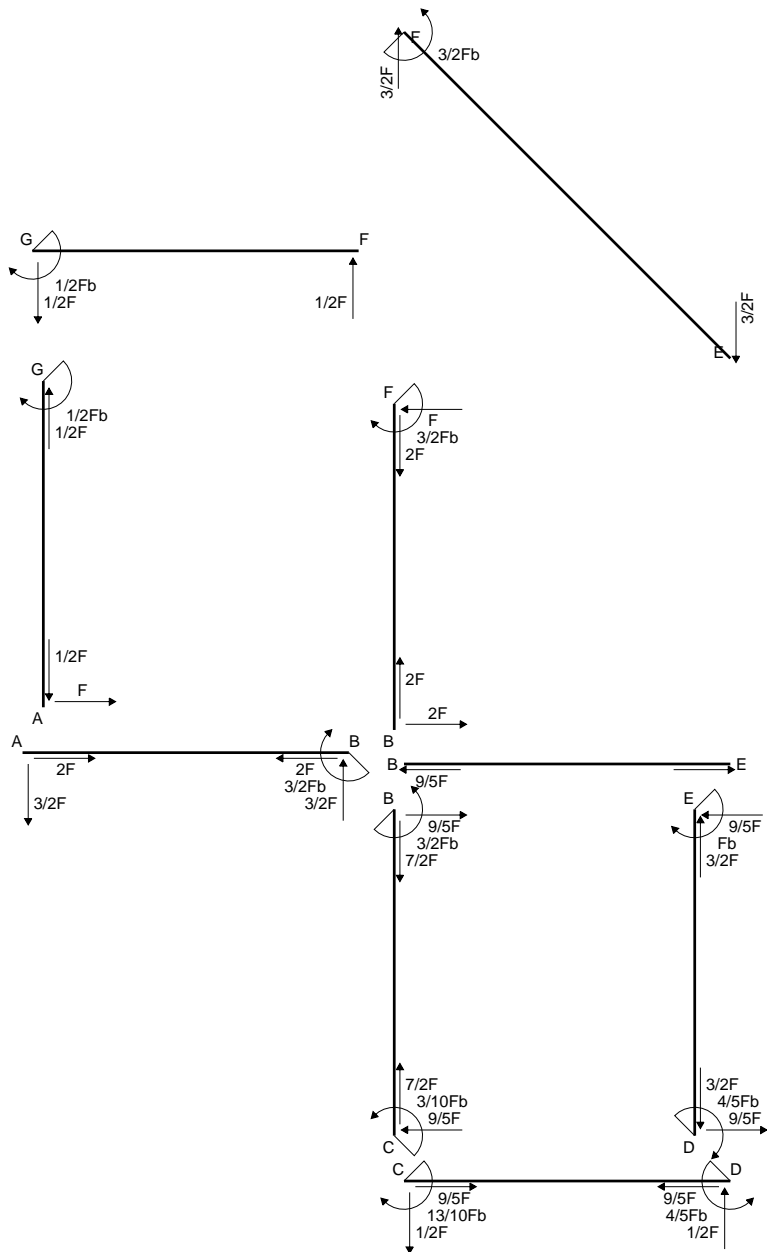
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

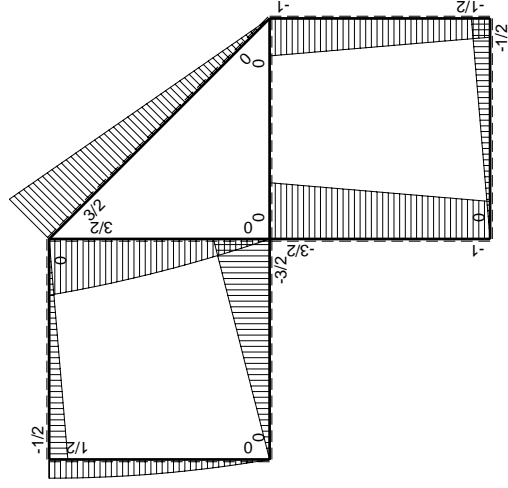
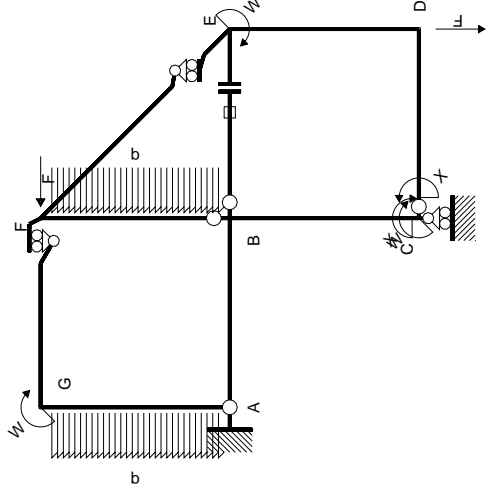
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

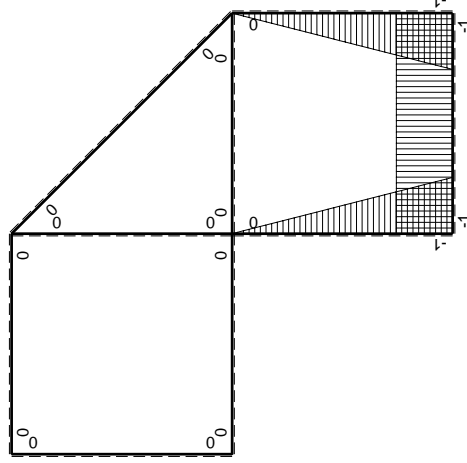
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE} - BE}$				Fb ² /EJ	
	totali				13/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-13/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

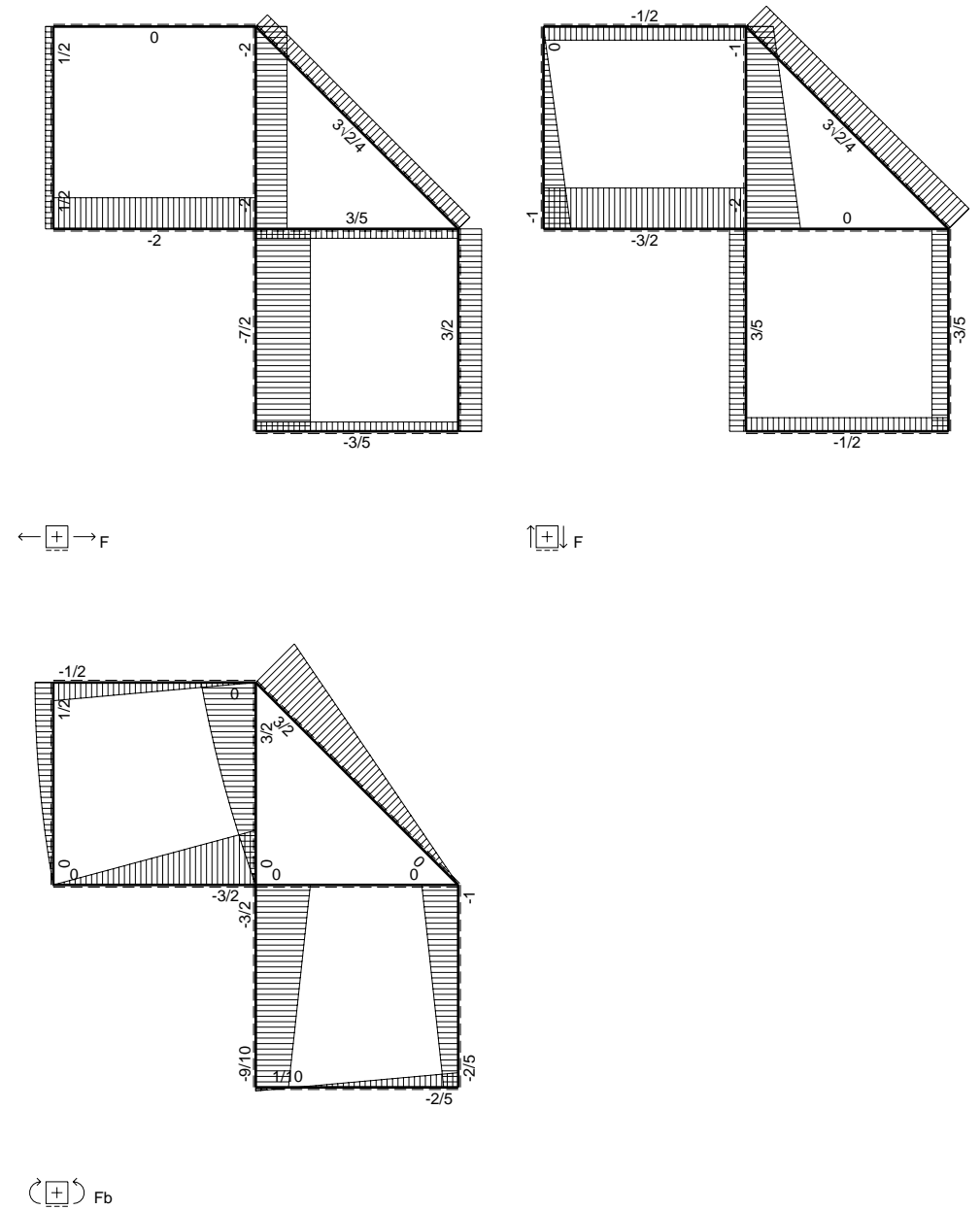
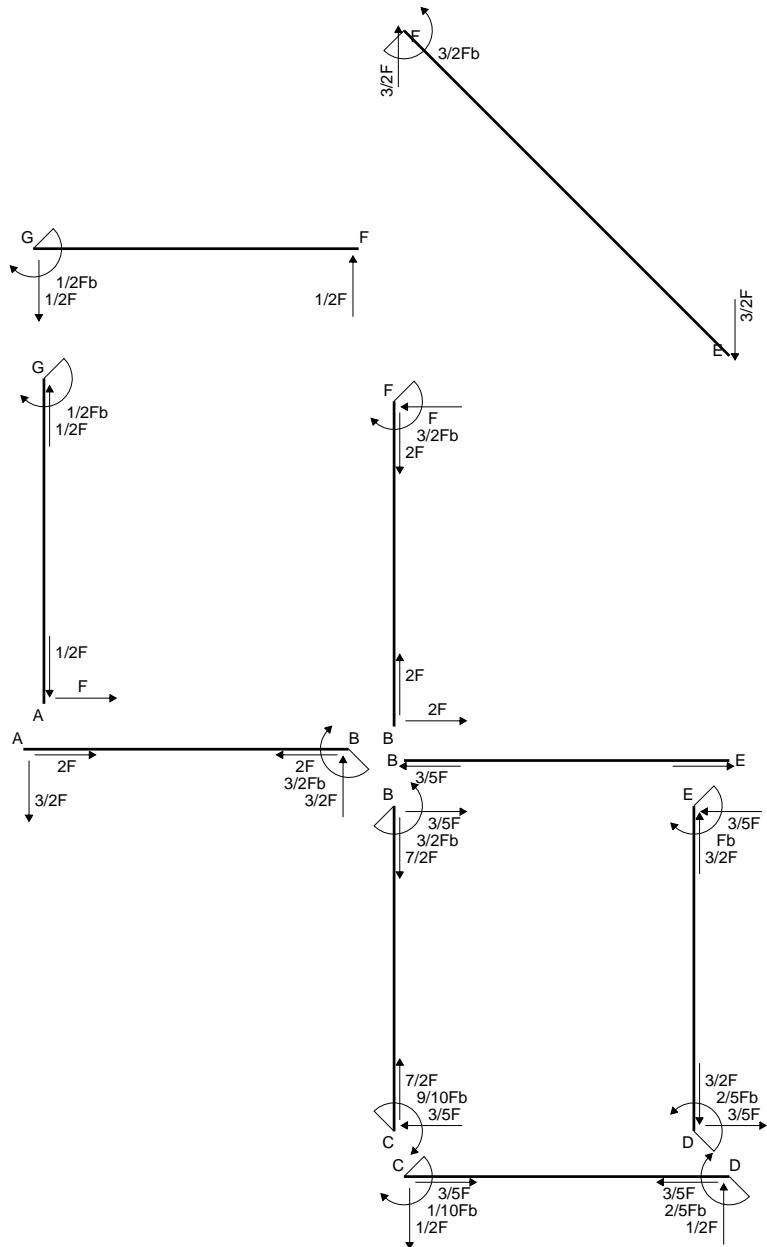
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

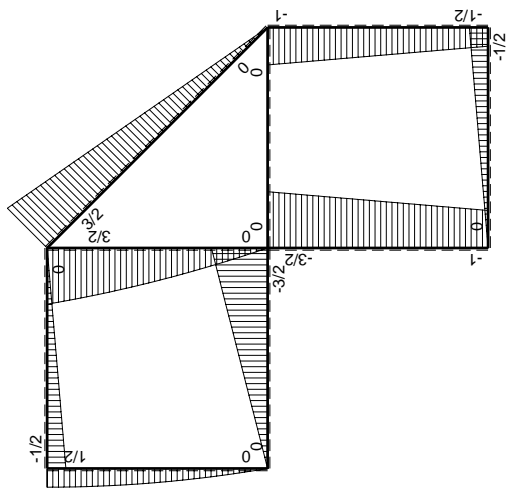
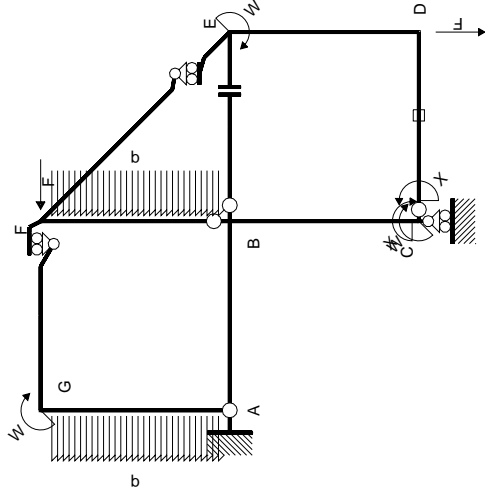
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

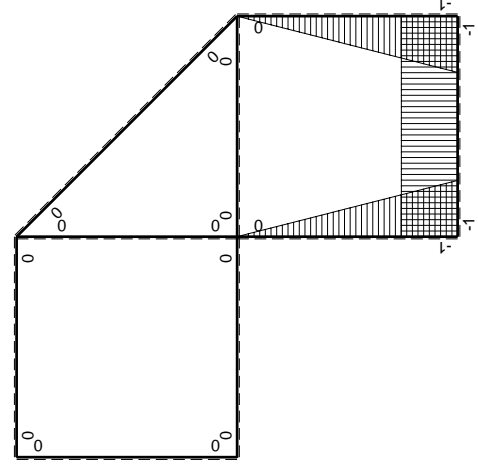
$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta N _{1,cd} ε _{cd} L _{cd}				-Fb ² /EJ	
	totali				1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

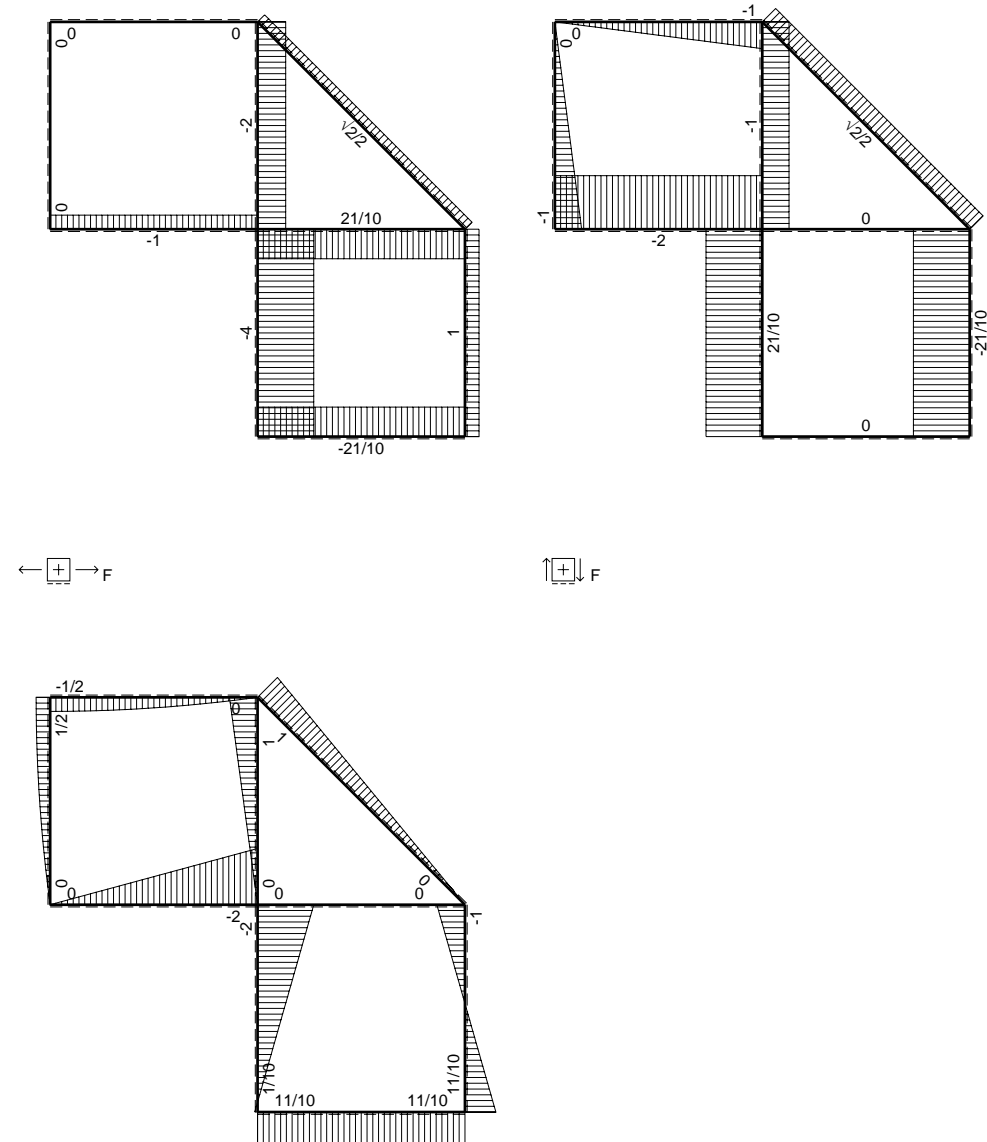
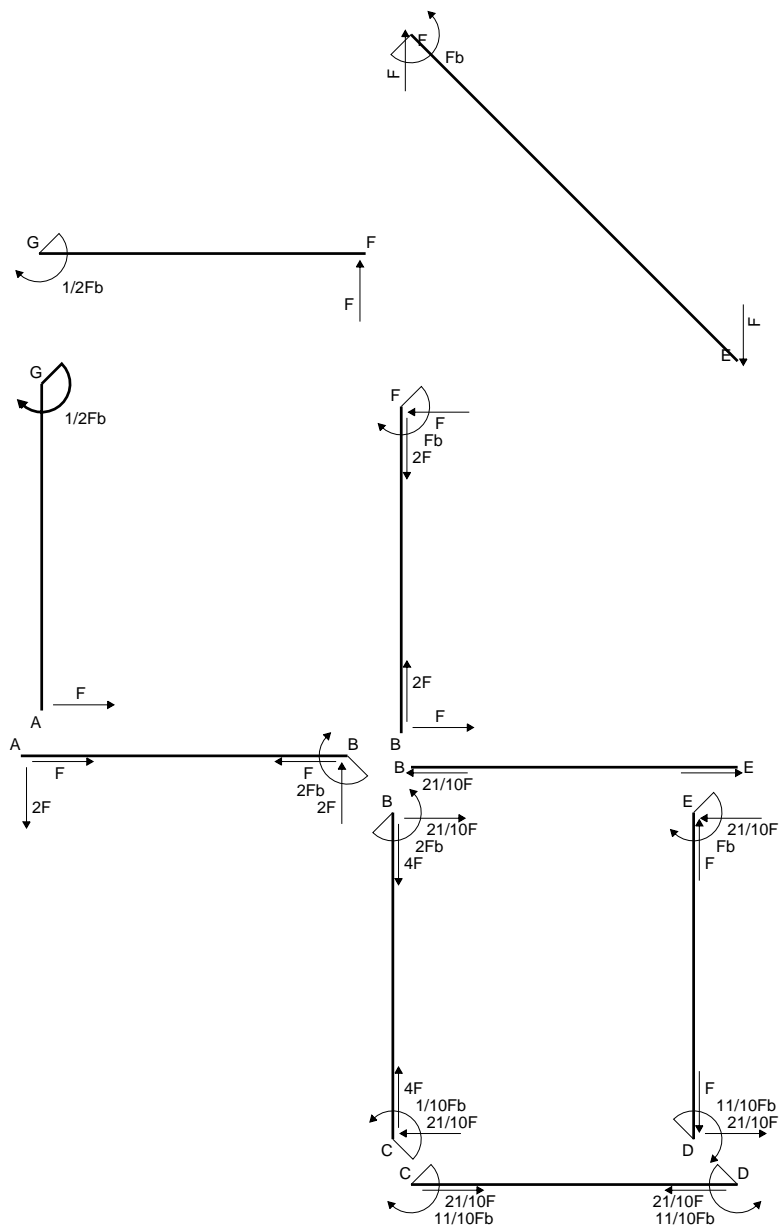
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

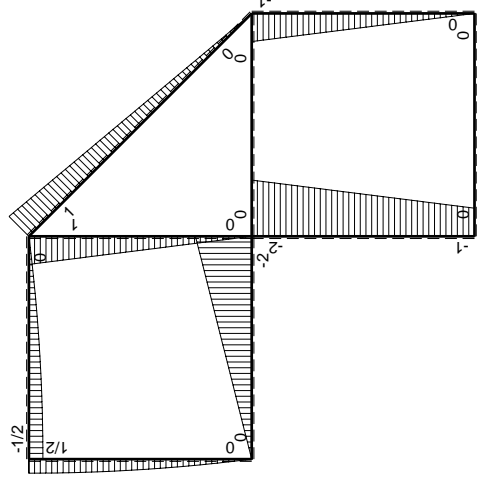
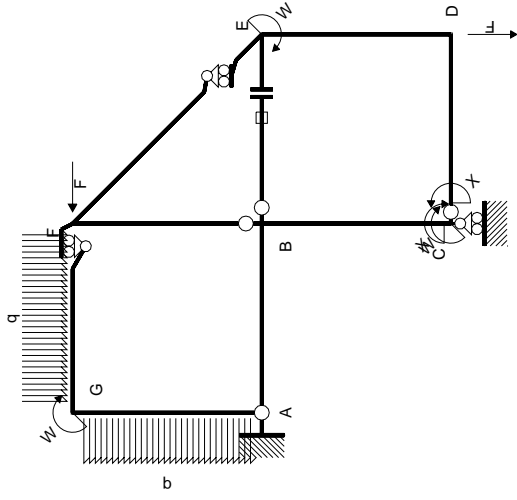
$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

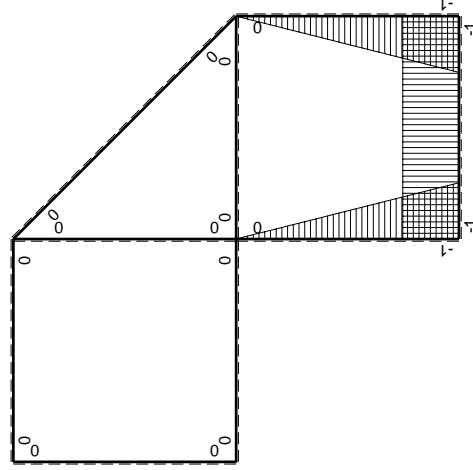


$\left[\begin{matrix} + \\ + \end{matrix} \right] F_b$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{CD}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx+1/2qx ²	0	0	0	0
GF b	0	1/2Fb-1/2qx ²	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

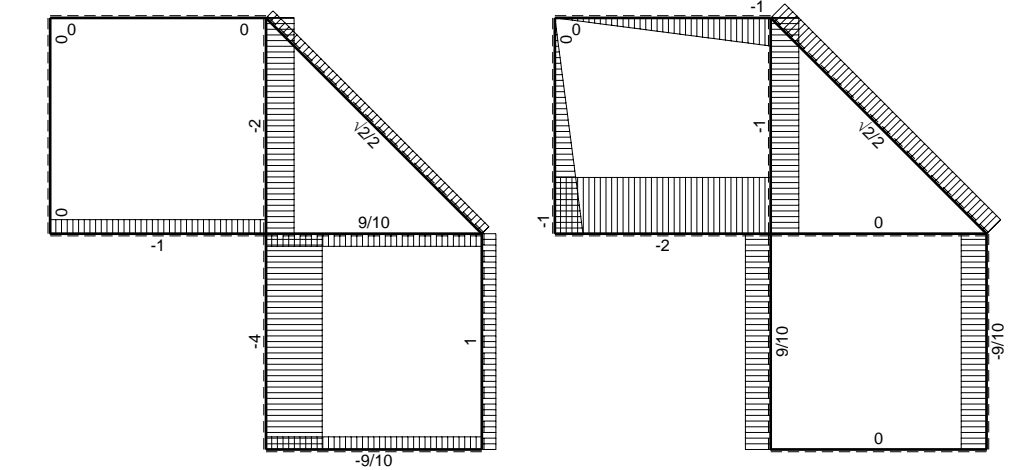
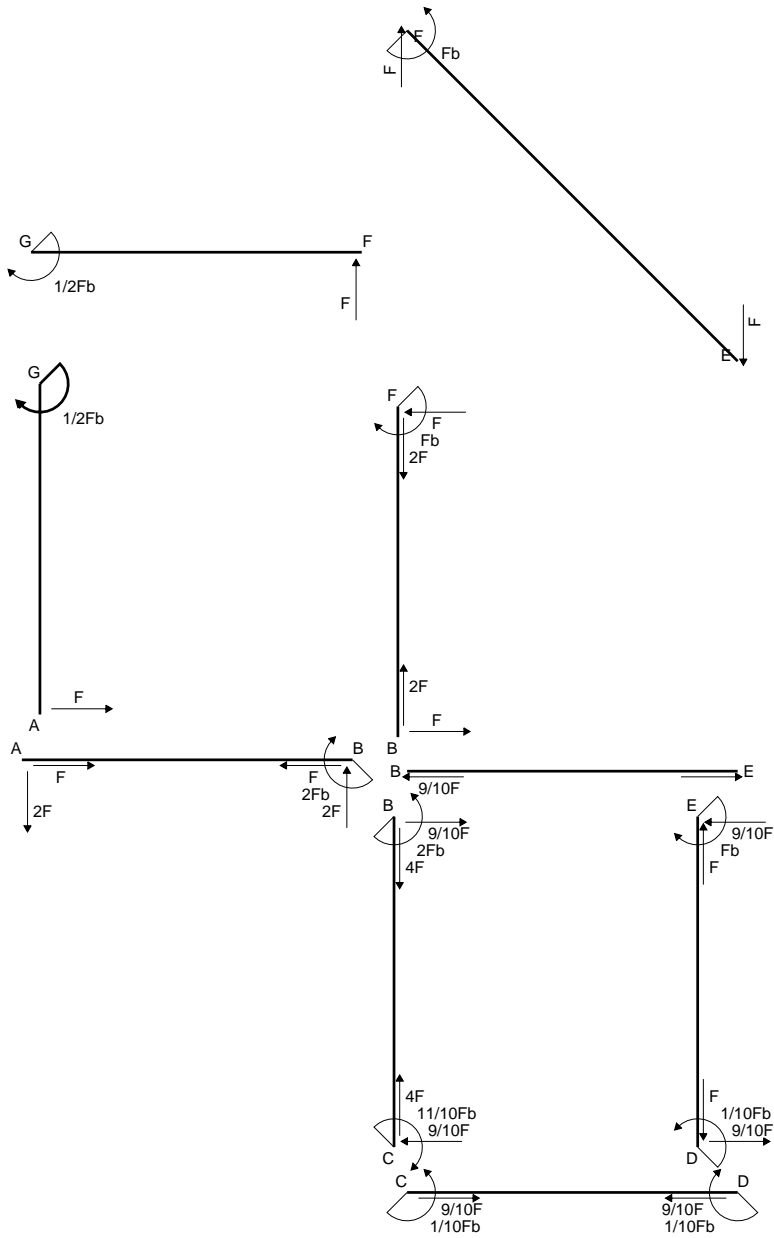
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

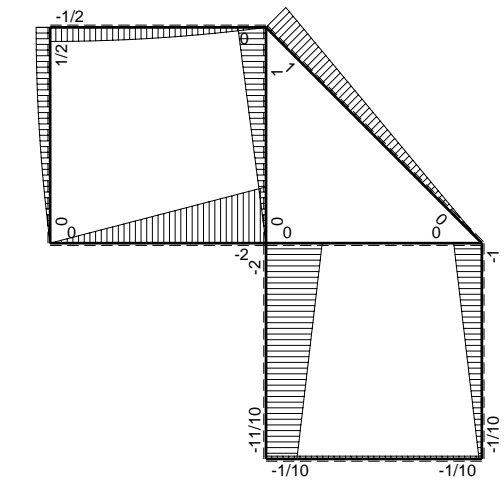
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

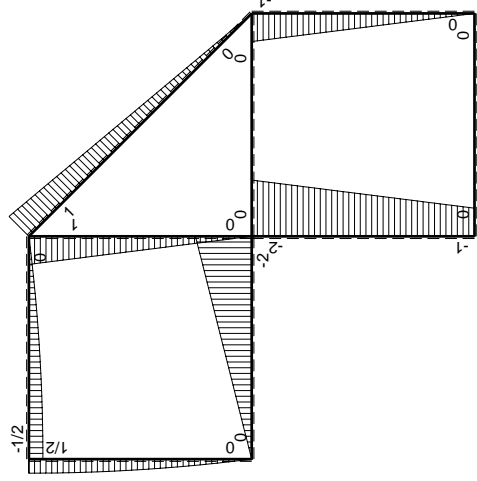
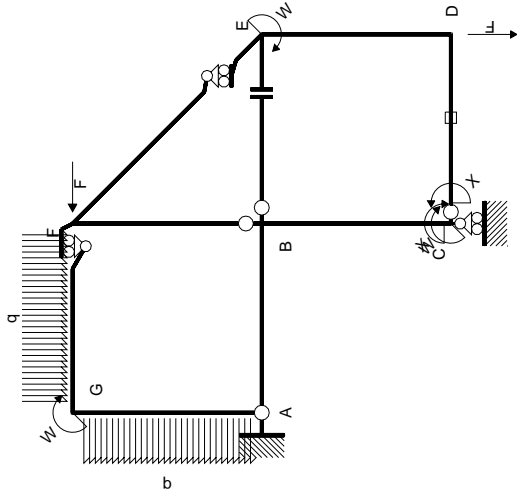


← ⊕ → F

↑ ⊕ ↓ F

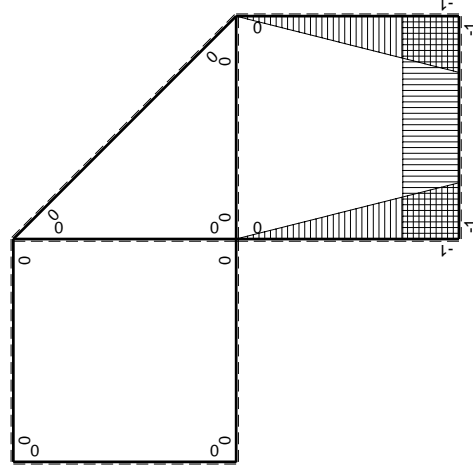


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx+1/2qx ²	0	0	0	0
GF b	0	1/2Fb-1/2qx ²	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

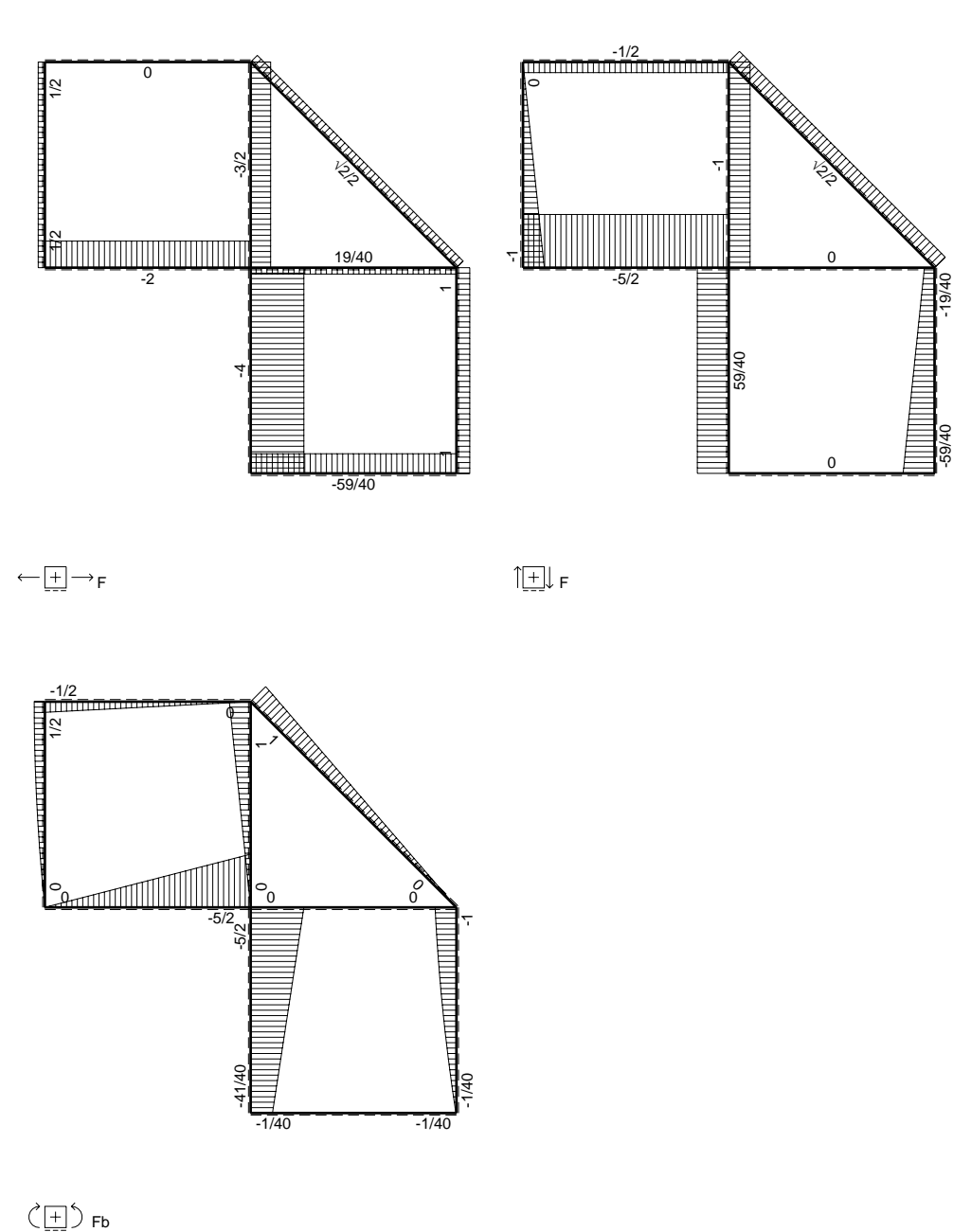
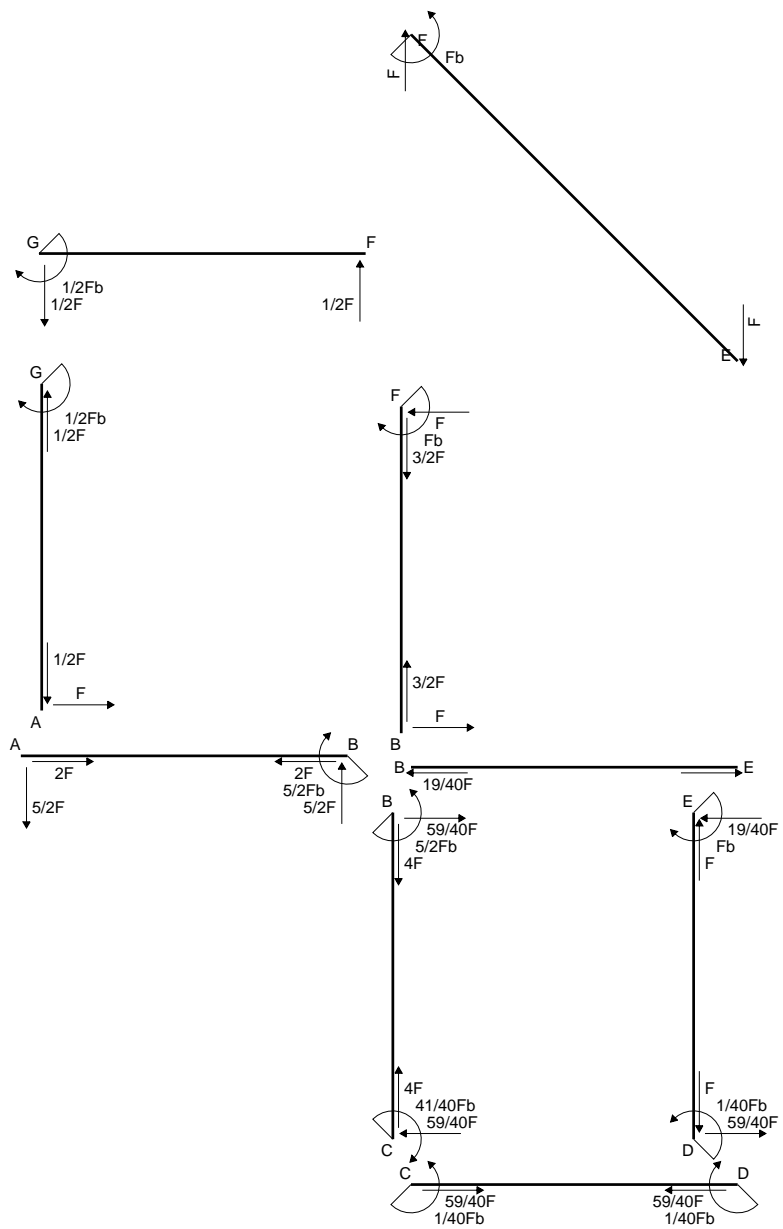
$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

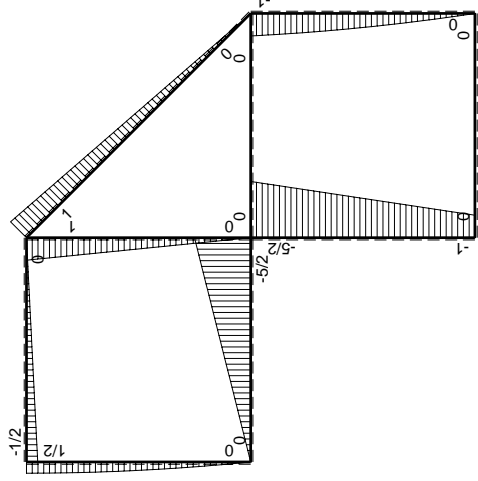
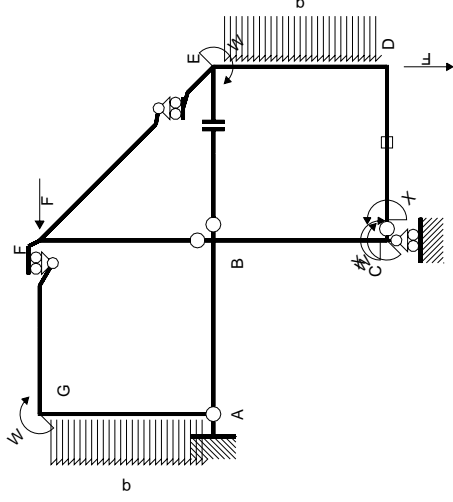
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

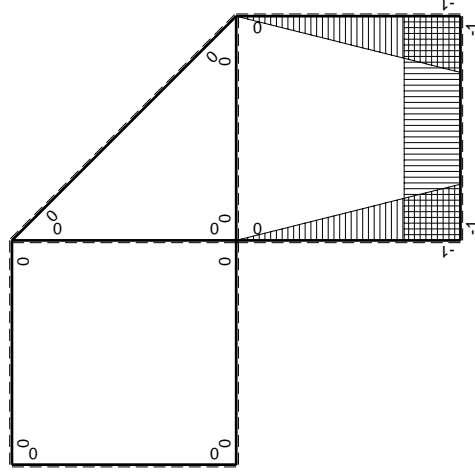
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-5/2Fx$	0	0	0	0
BA b	0	$5/2Fb-5/2Fx$	0	0	0	0
BC b	$-x/b$	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-1/2Fx$	0	0	0	0
GF b	0	$1/2Fb-1/2Fx$	0	0	0	0
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$1/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

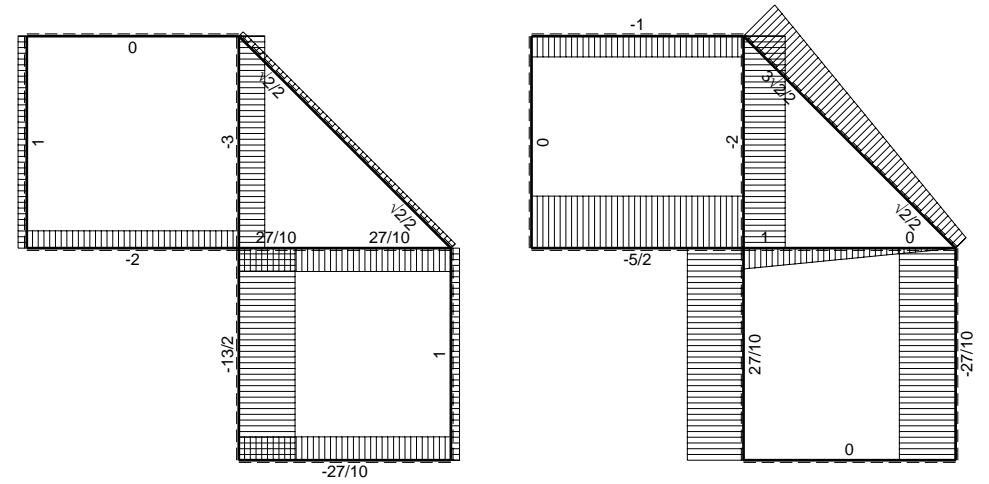
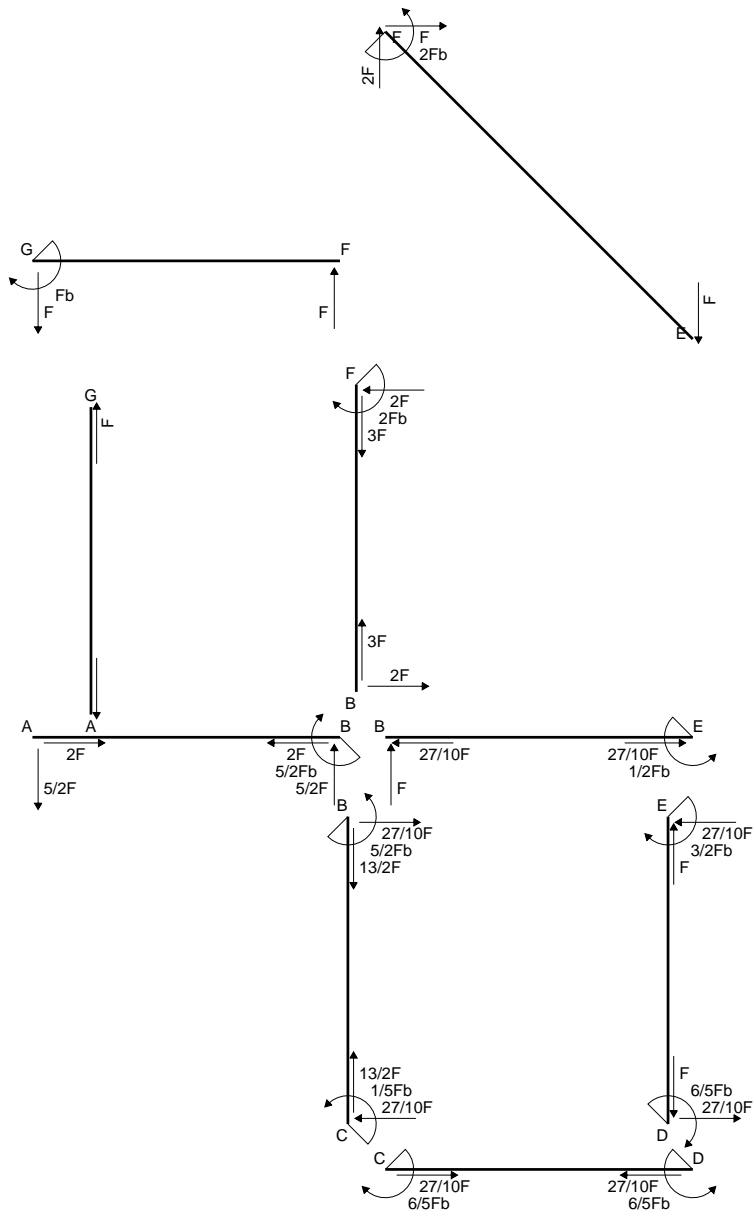
$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (3/4 b - 2/3 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

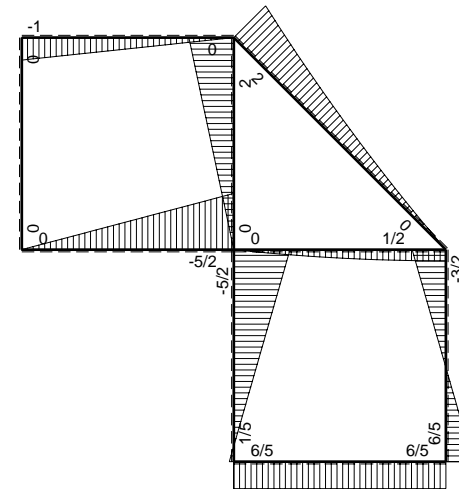
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b - 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

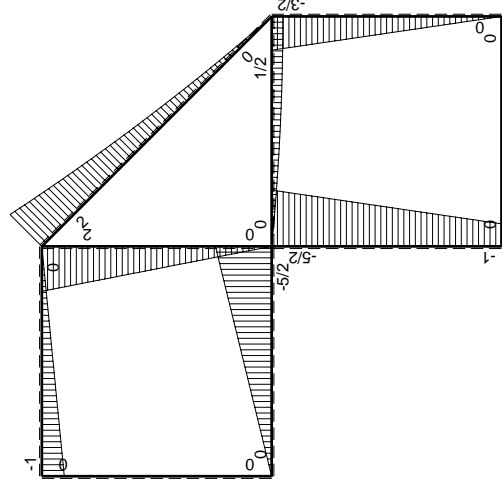
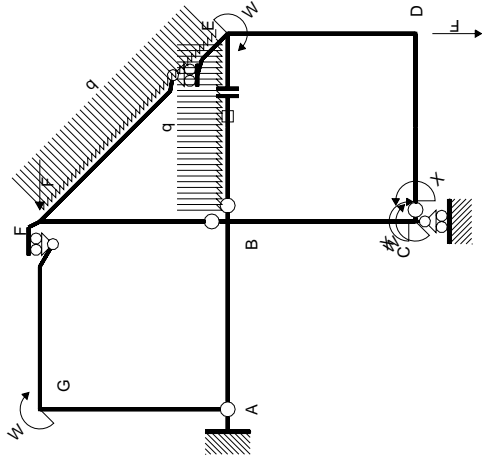


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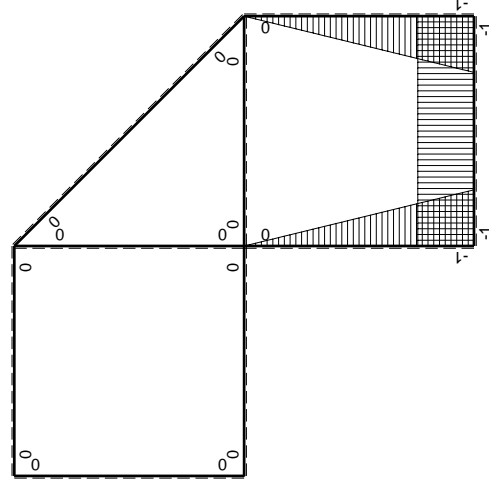


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-3/2Fx	3/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = l_{BE}$				Fb ² /EJ	
	totali				2Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

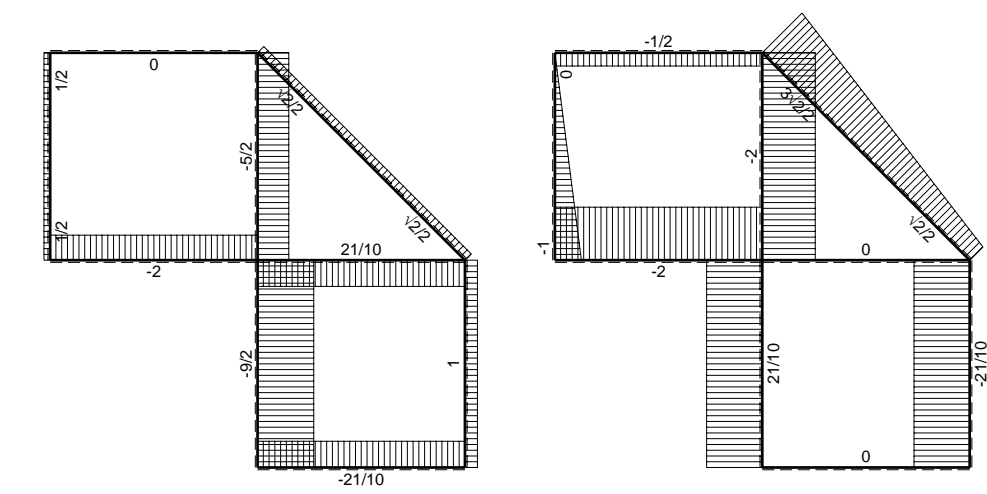
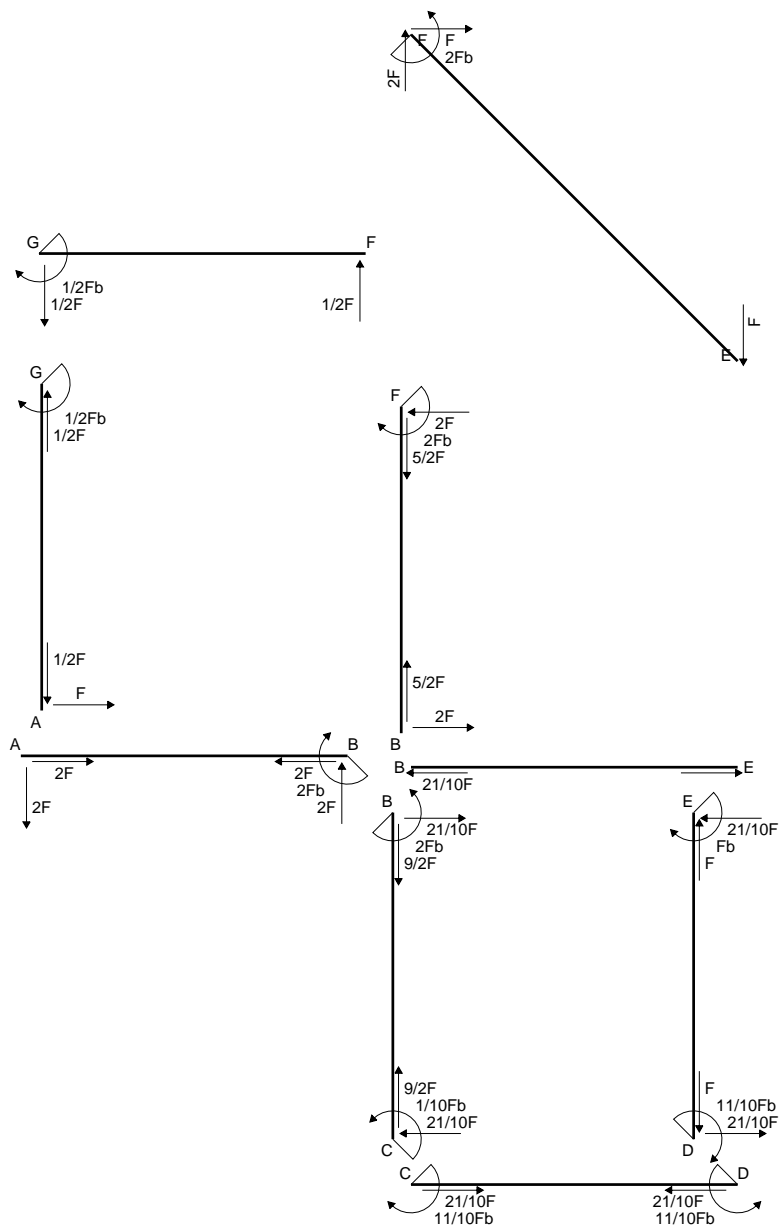
$$= (b + 1/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

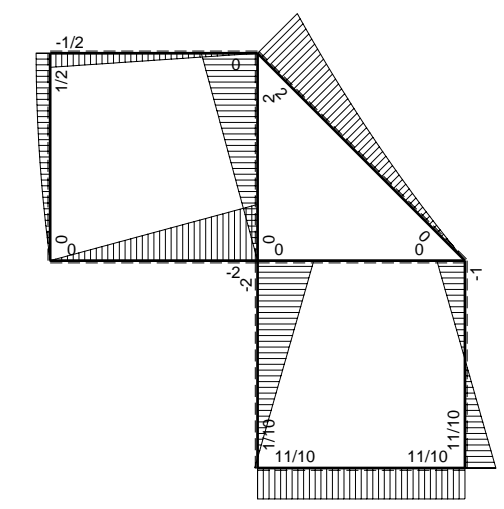
$$L_{ED}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

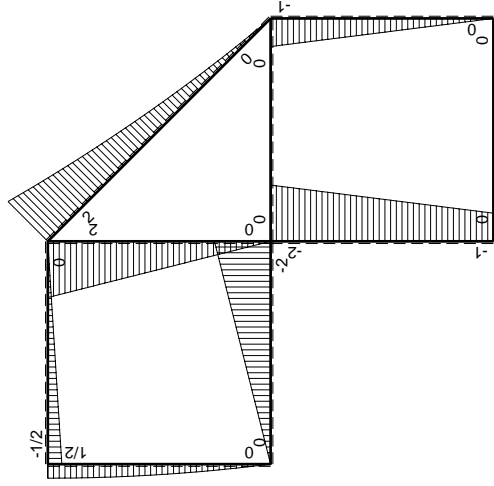
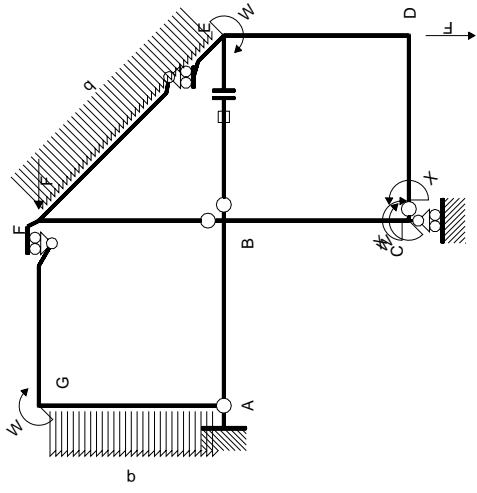


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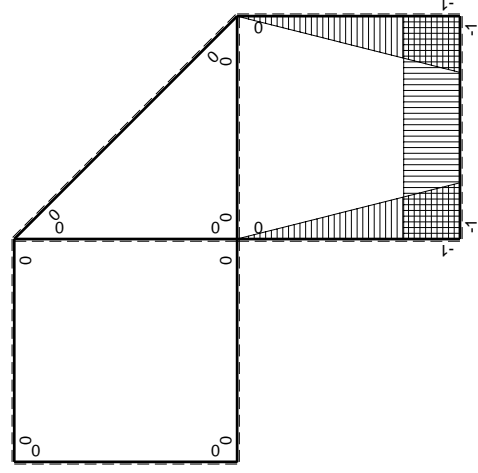


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

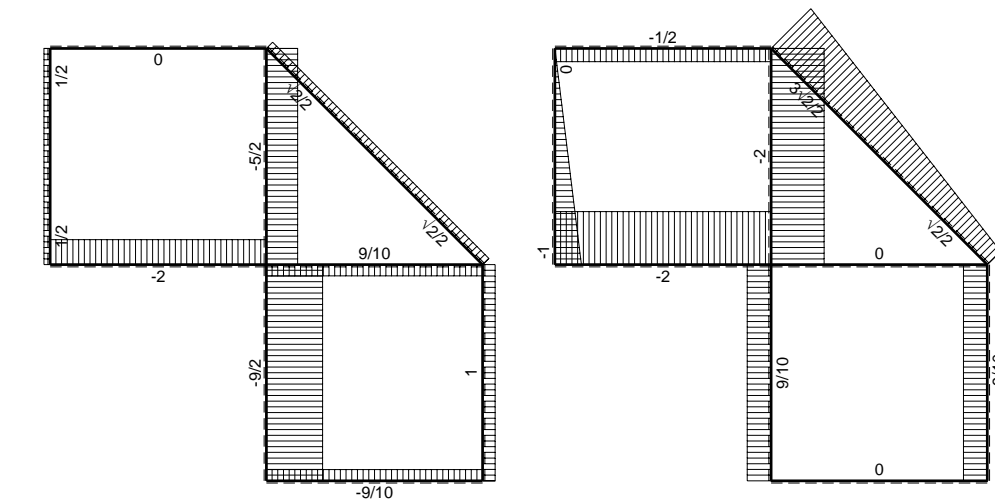
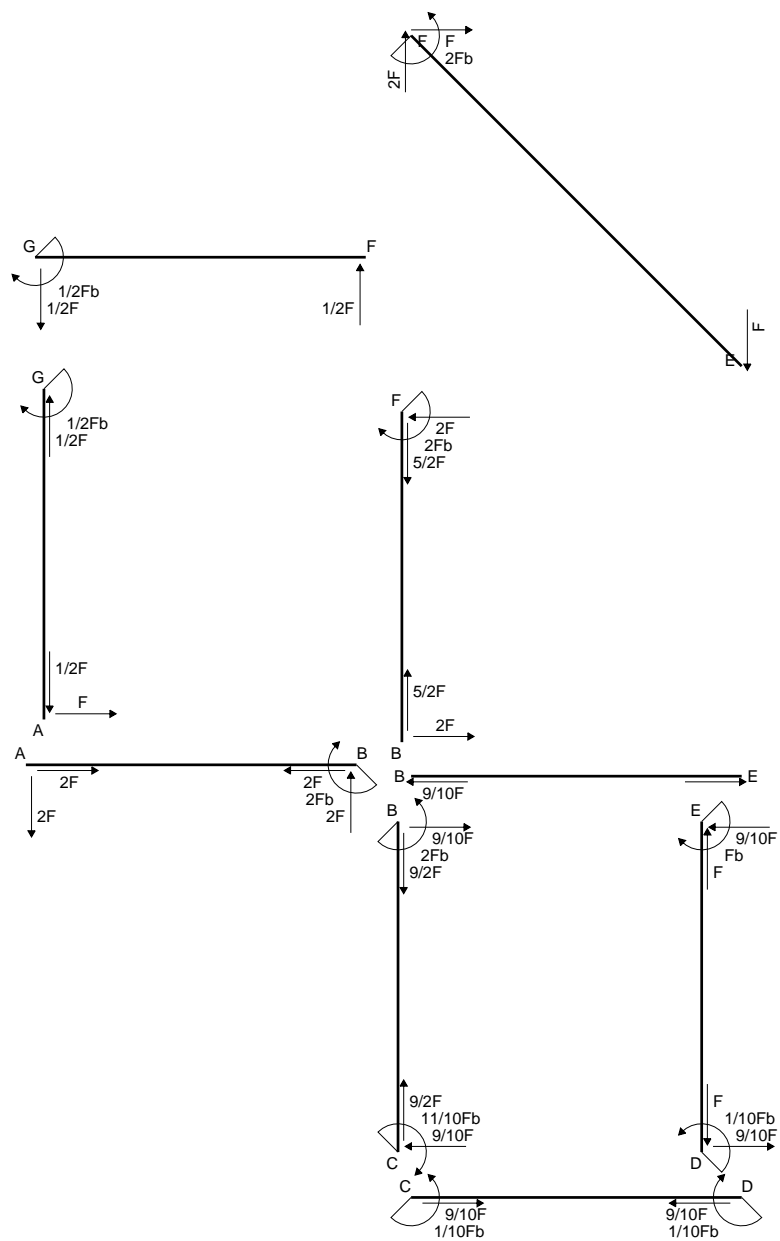
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

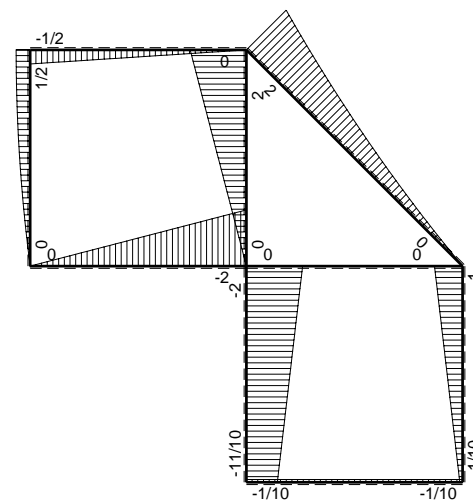
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

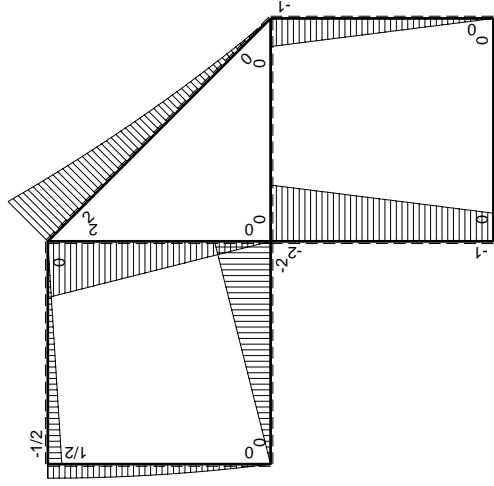
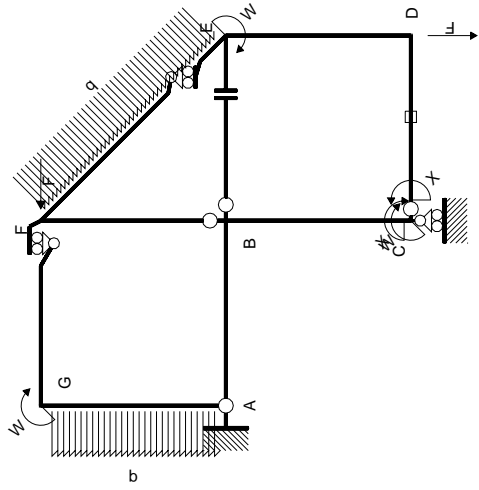


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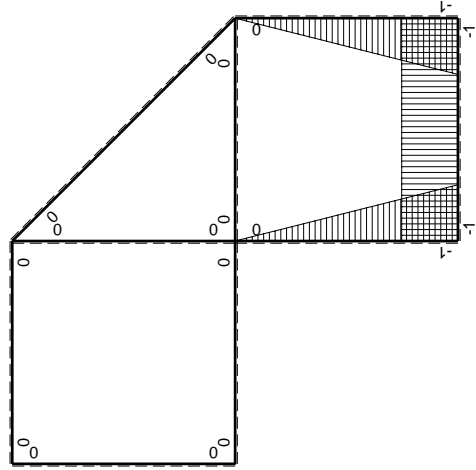


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

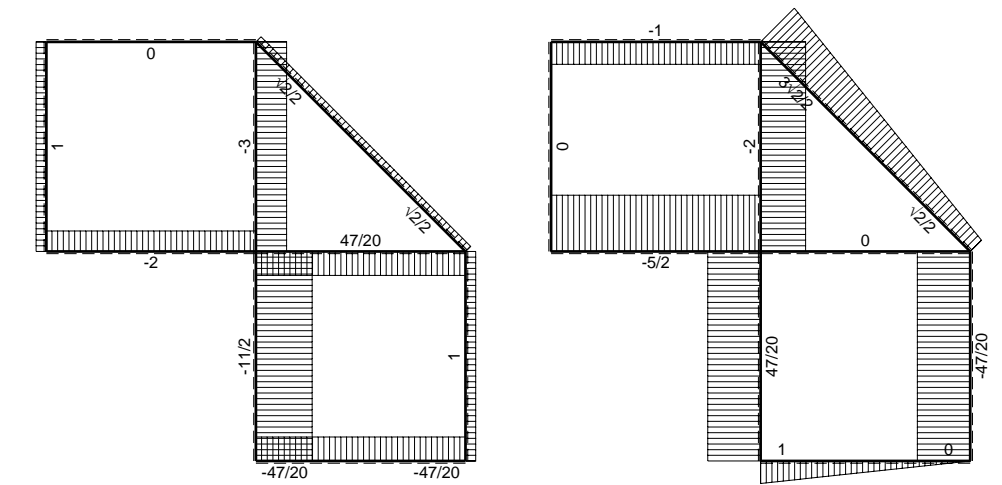
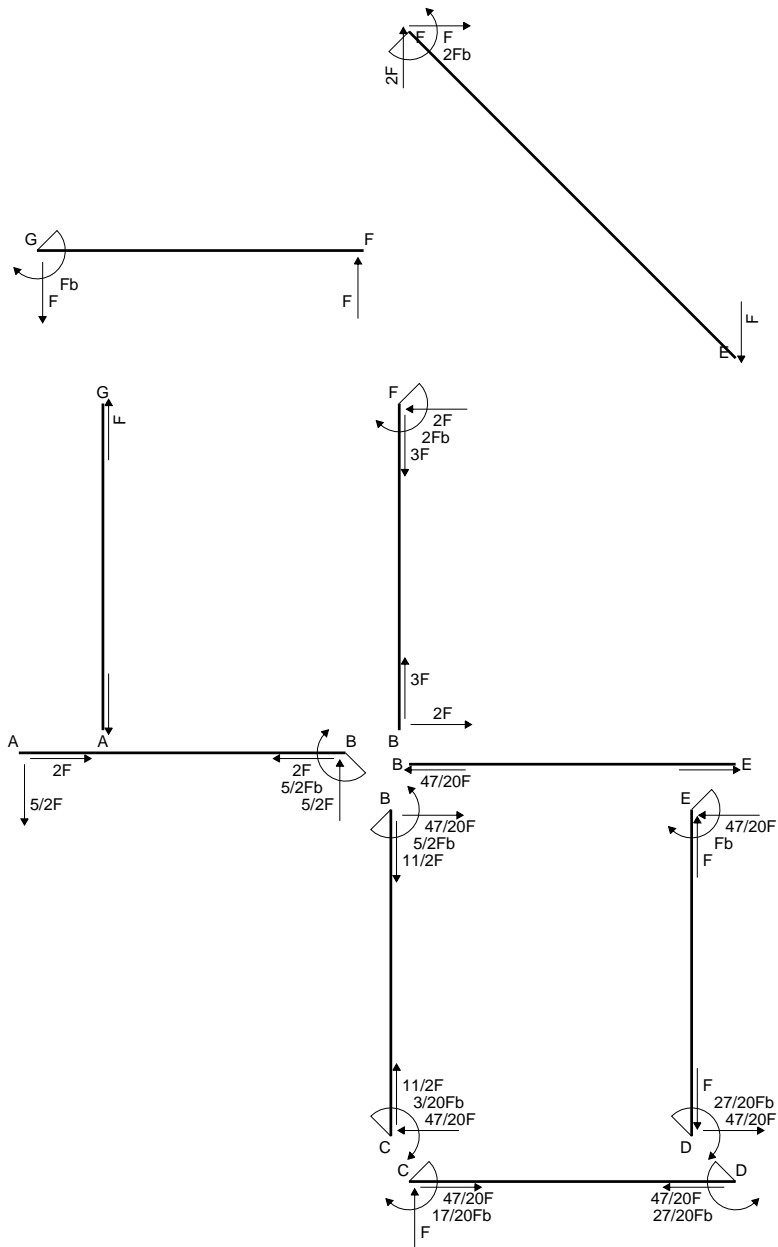
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

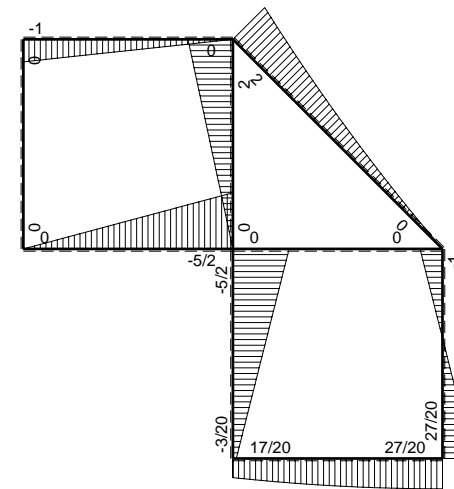
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

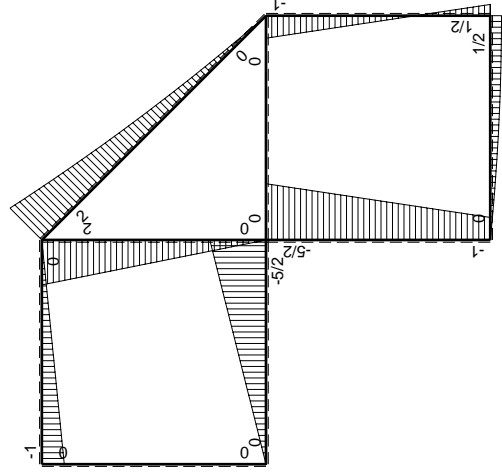
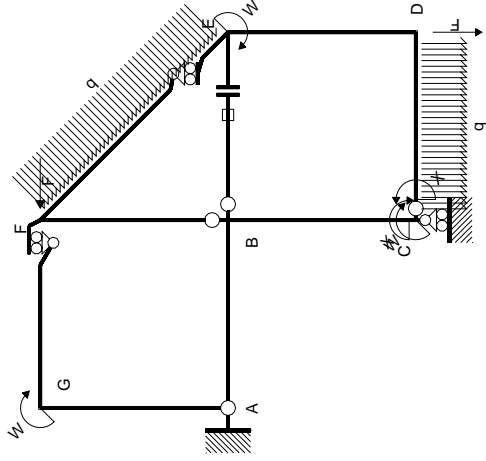


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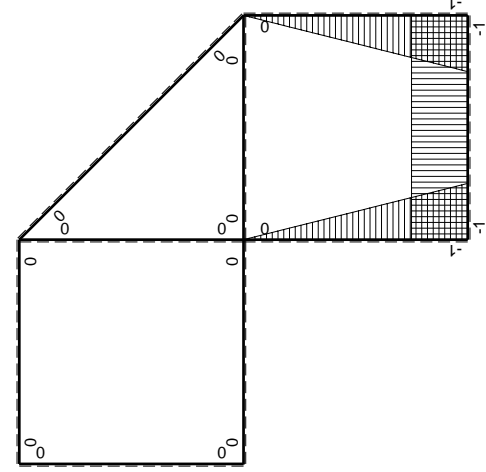


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				17/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-17/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

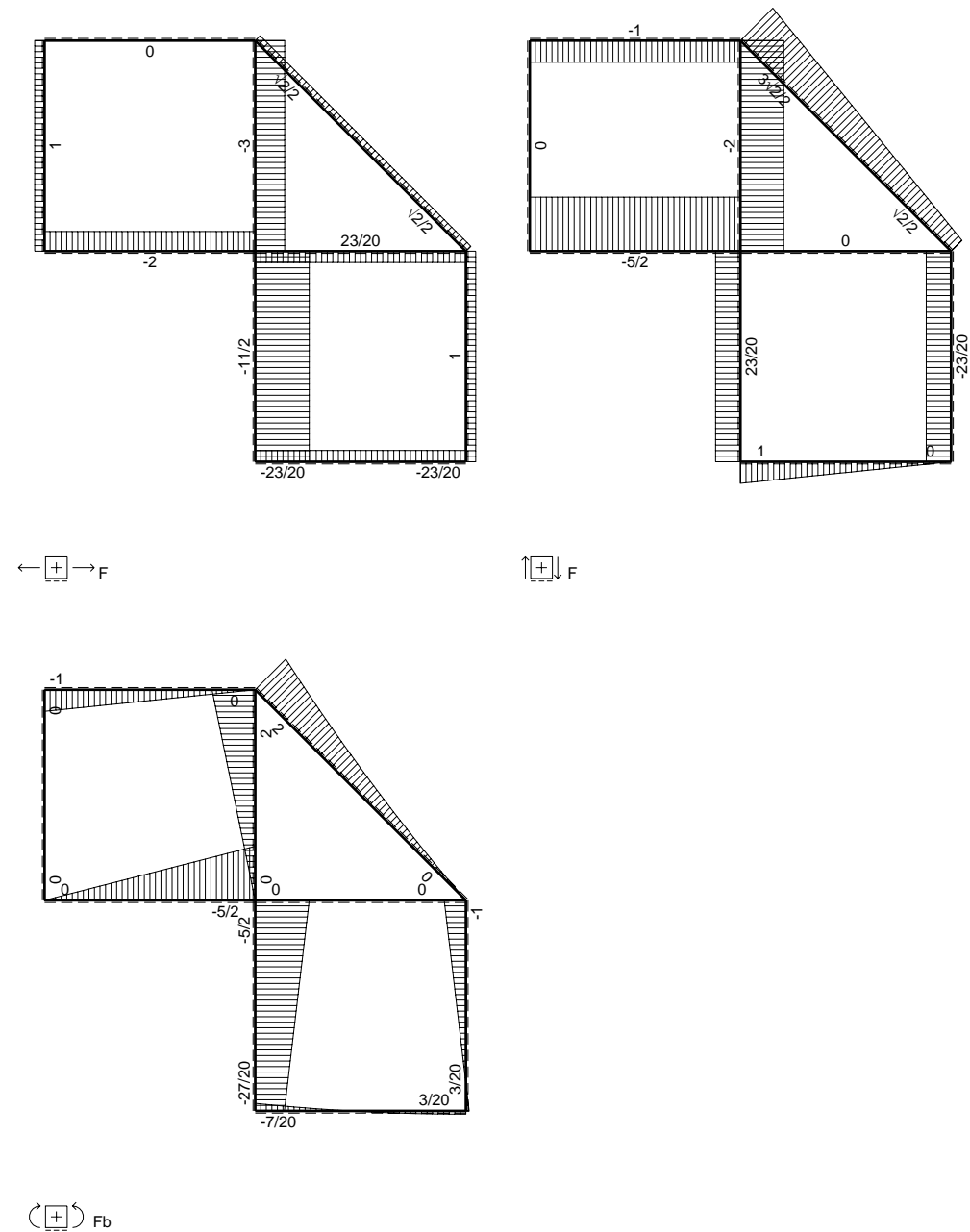
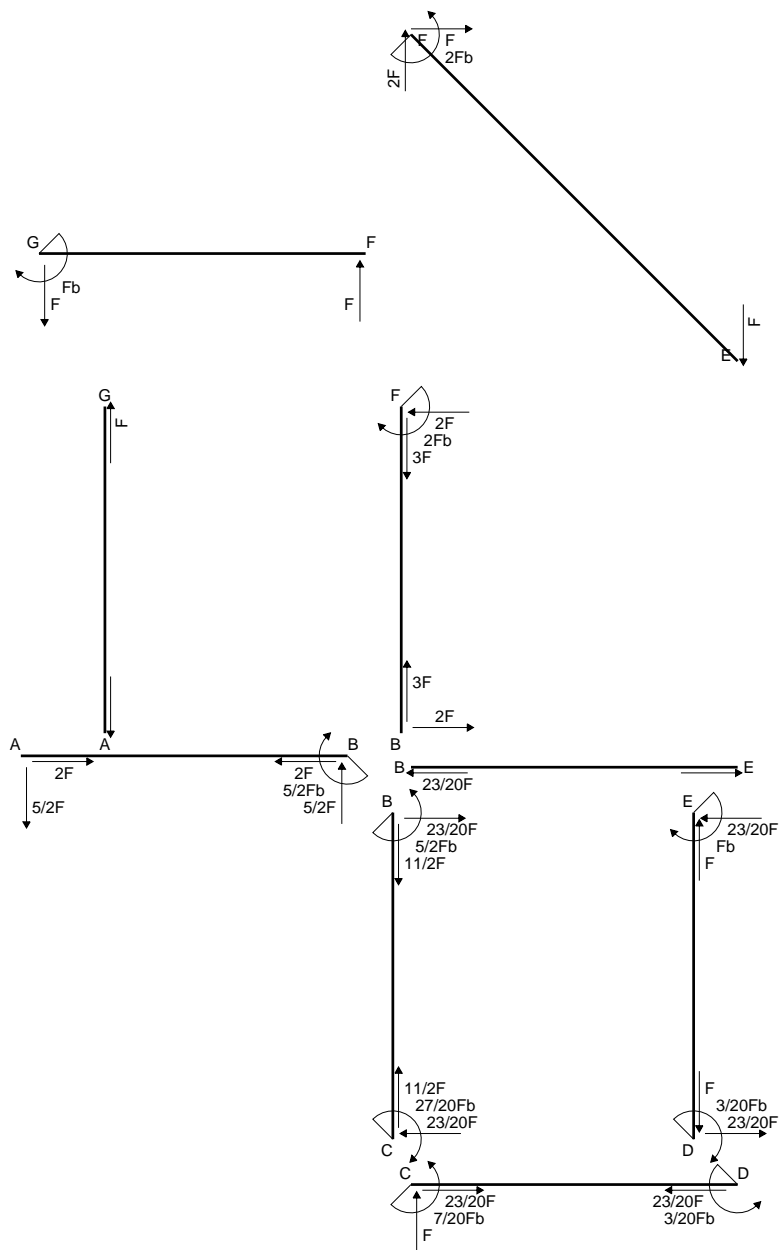
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

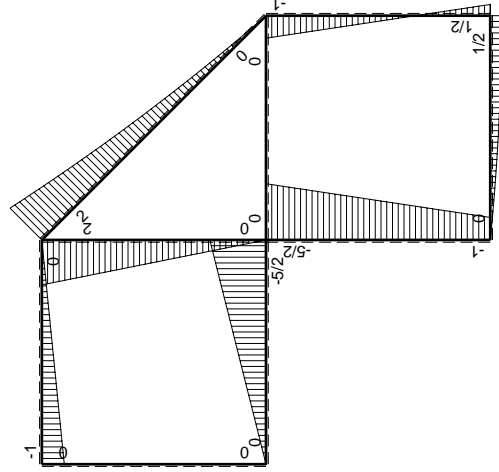
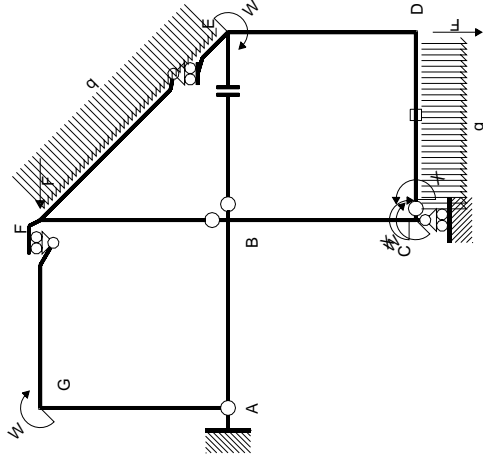
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

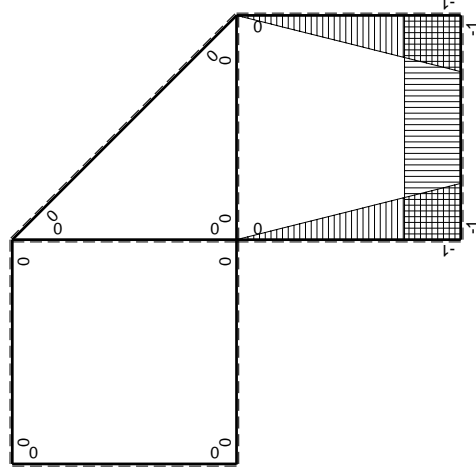
$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-7/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				7/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - 1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + 1/4 x^2/b - 1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= \left[-1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -4/3 \cdot Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= \left[-1/2 x + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

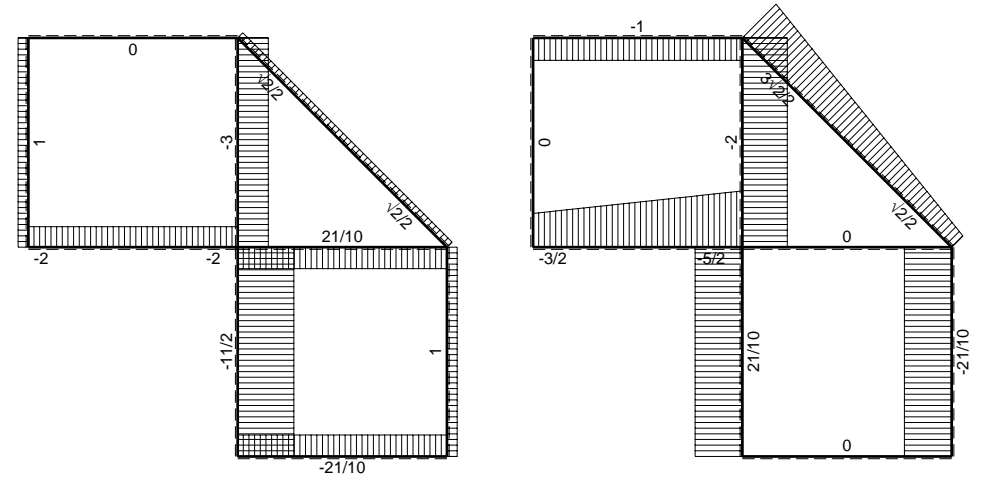
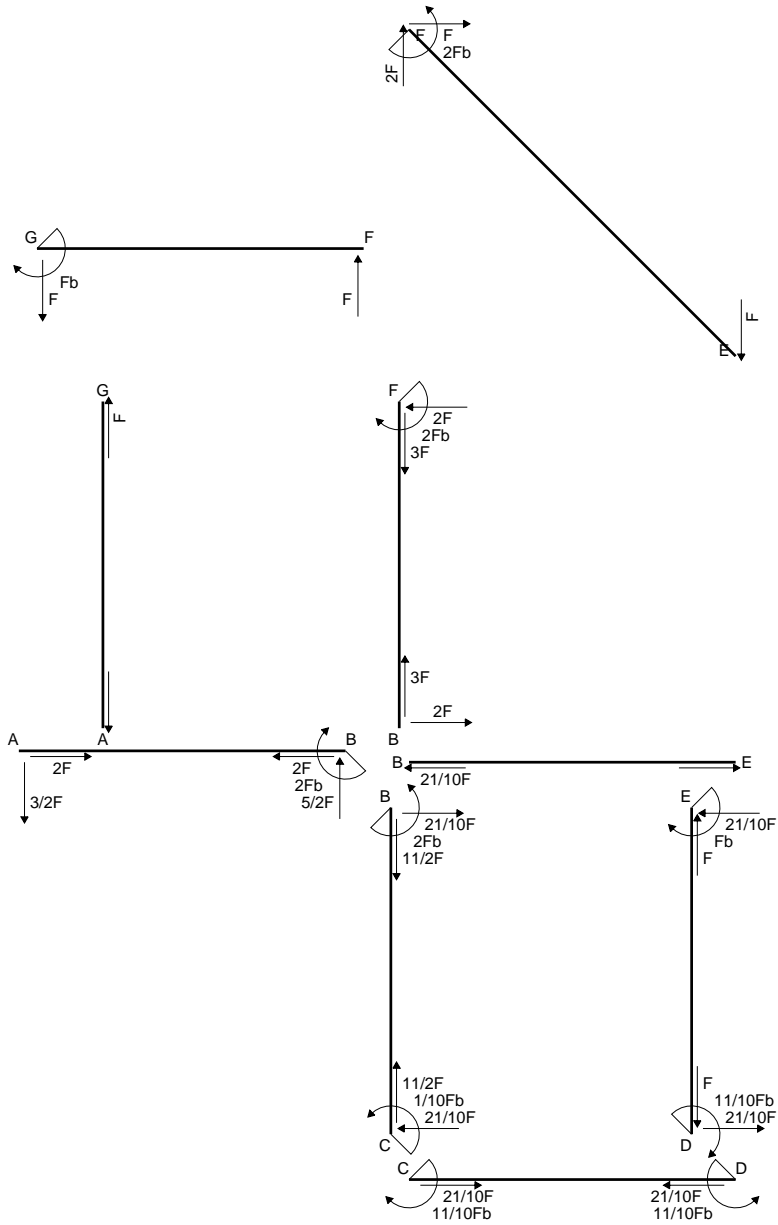
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -4/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-1/2 x + x^2/b - 1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

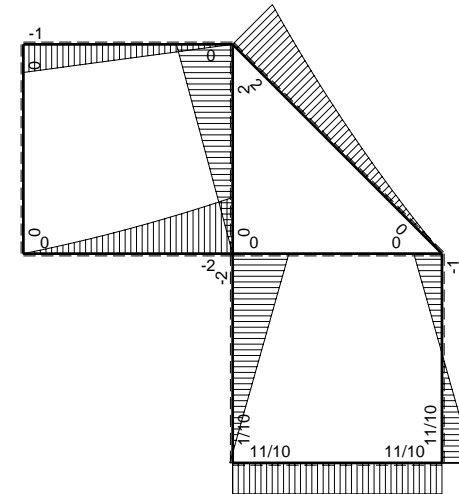
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

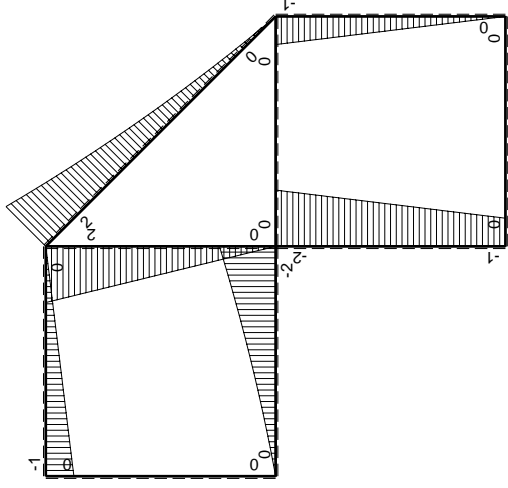
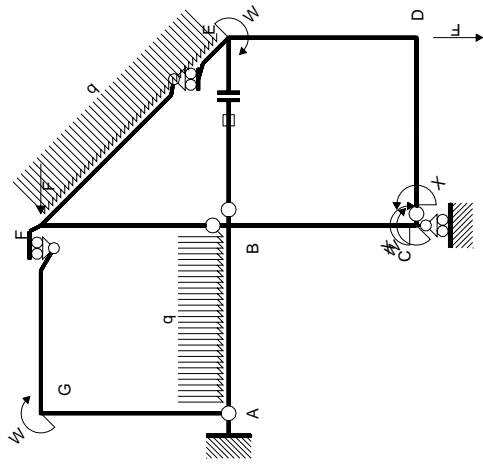


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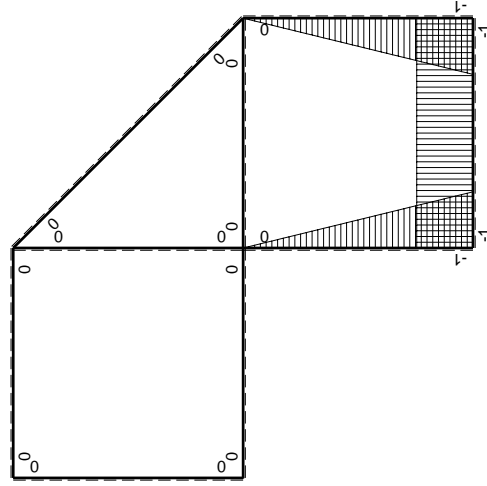


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Schema di calcolo iperstatico

M₀ flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	-x/b	$-2Fb + Fx$	$2Fx - Fx^2 / b$	x^2 / b^2	$2/3Fb^2 / EJ$	$1/3Xb / EJ$
CB b	1-x/b	$Fb + Fx$	$Fb - Fx^2 / b$	$1 - 2x/b + x^2 / b^2$		
CD b	-1	0	0	1	0	Xb / EJ
DC b	1	0	0	1	0	0
DE b	-1+x/b	-Fx	$Fx - Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	$1/6Fb^2 / EJ$	$1/3Xb / EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2 / b$	x^2 / b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$2Fb - 2Fx$	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta N _{1, BE-E} L _{BE}				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}					-11/10Fb

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

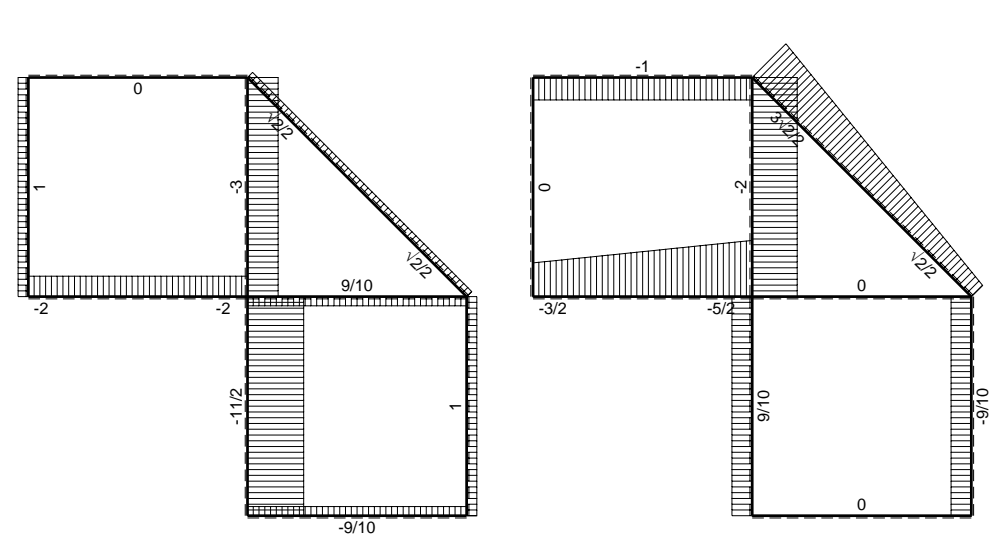
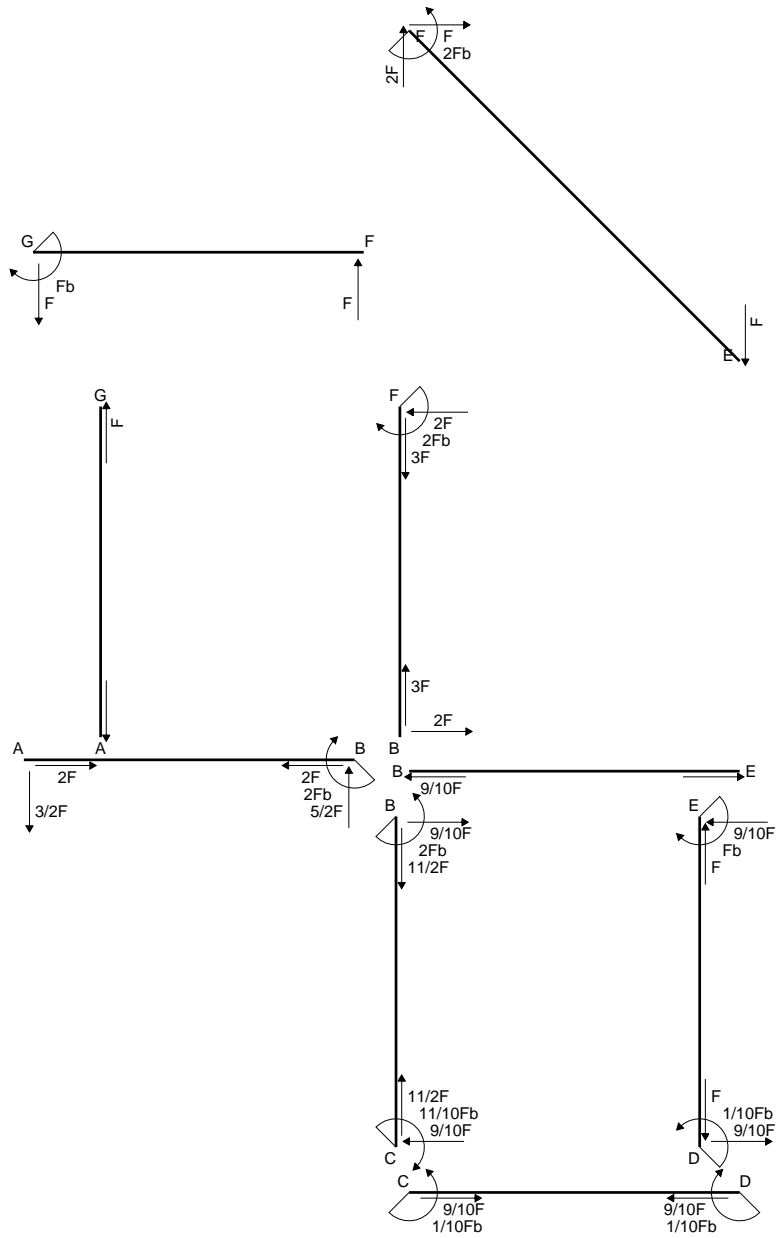
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

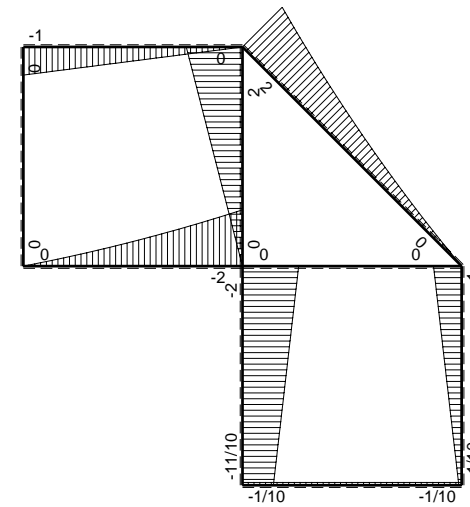
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

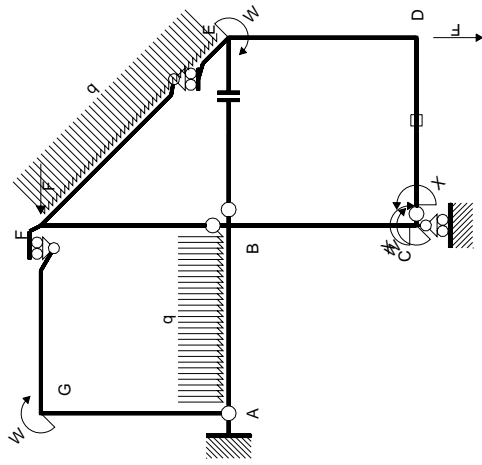


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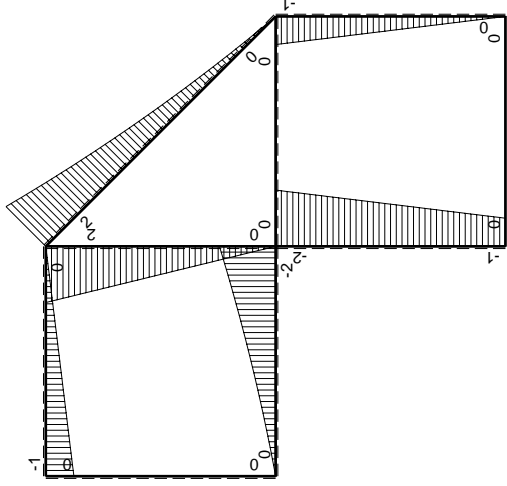
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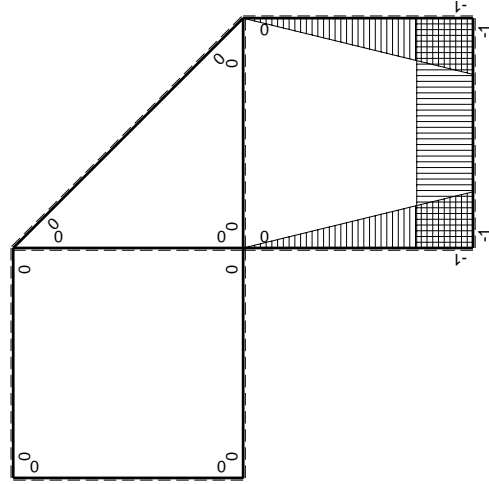
⊕ ⊖ F_b



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	0
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	$-Fx$	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$2Fb - 2Fx$	0	0	0	0
BF b	0	$-2Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

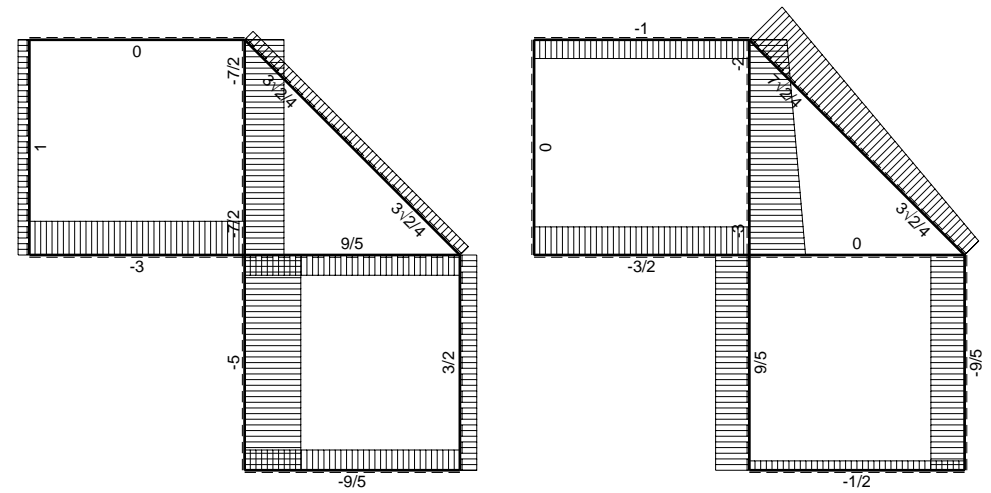
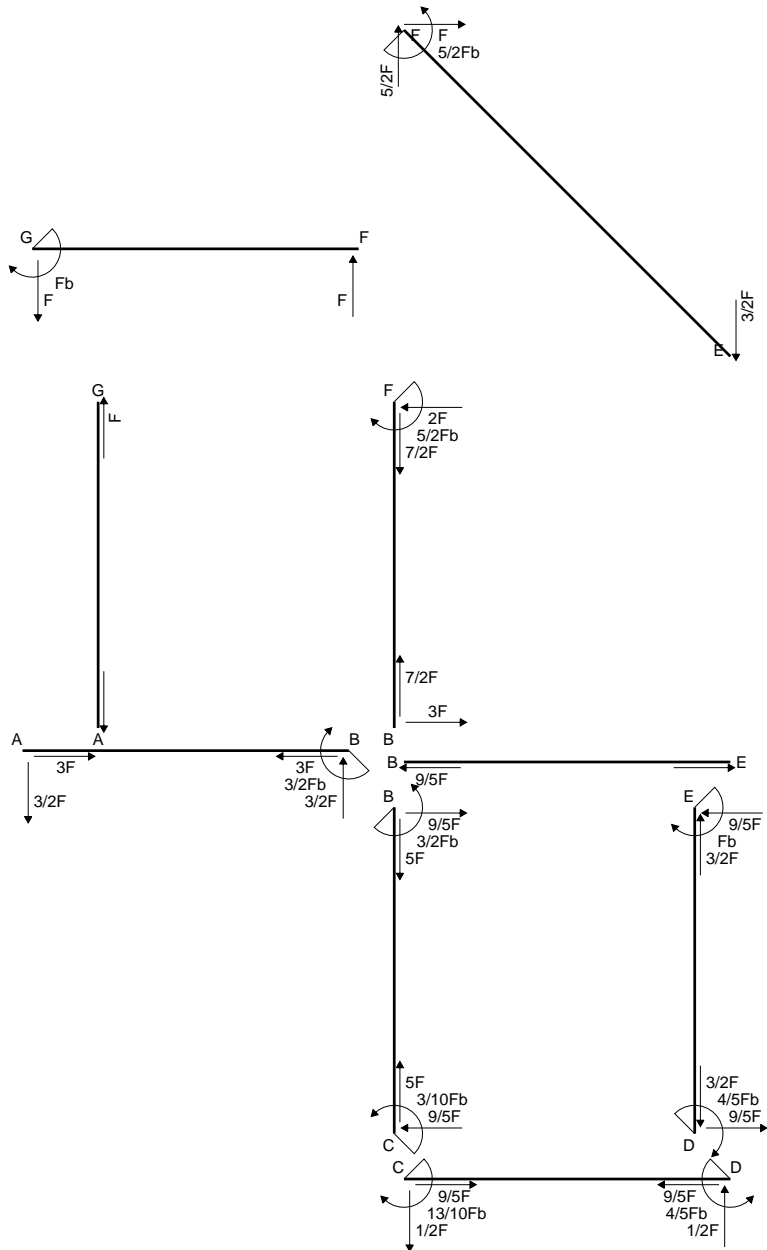
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

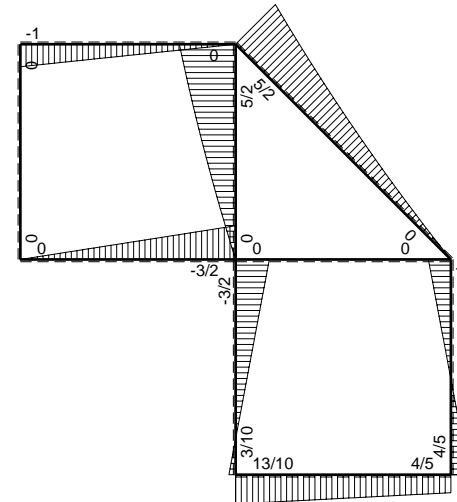
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

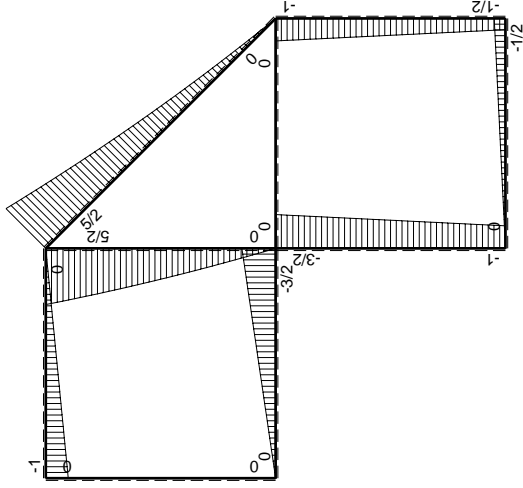
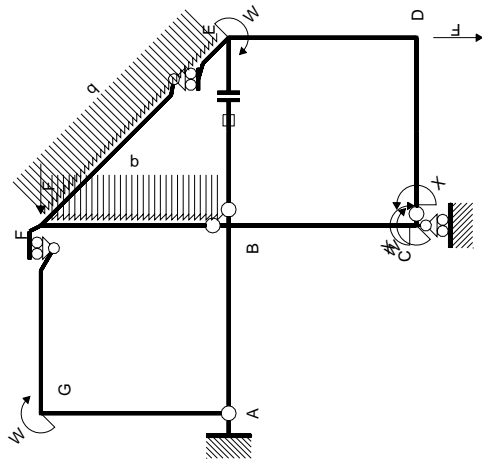


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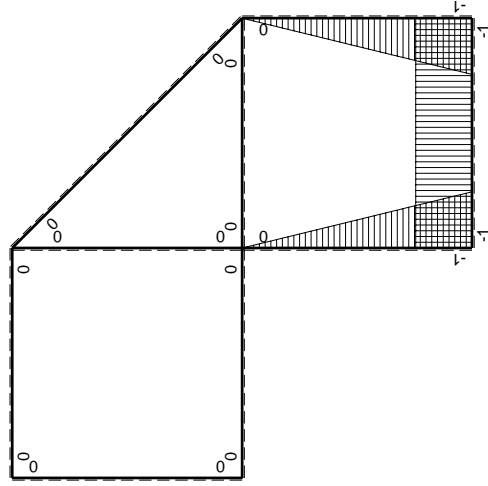


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF $\sqrt{2}b$	0	3\sqrt{2}4Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^E$				Fb ² /EJ	
	totali				13/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-13/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

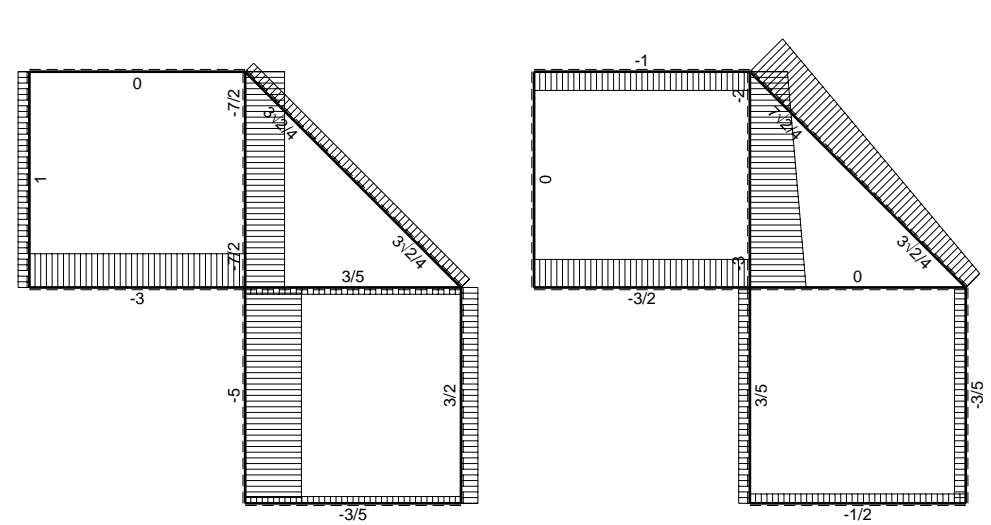
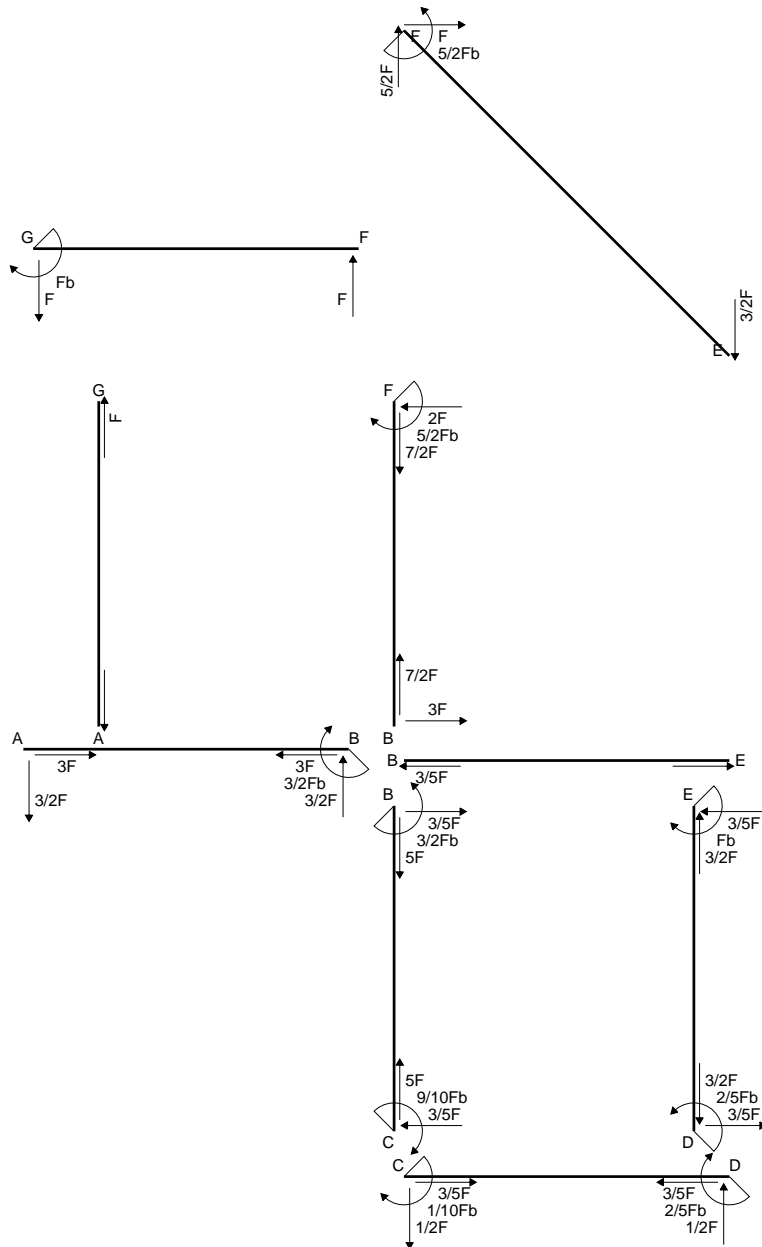
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

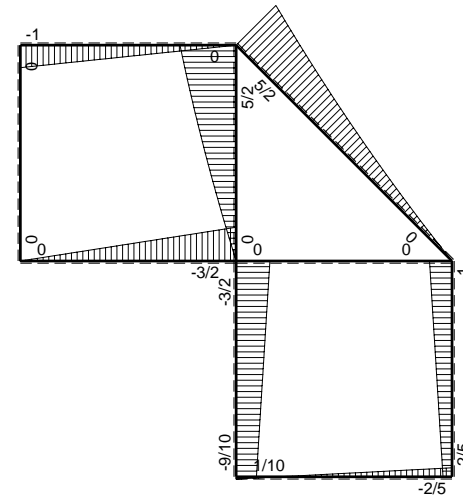
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

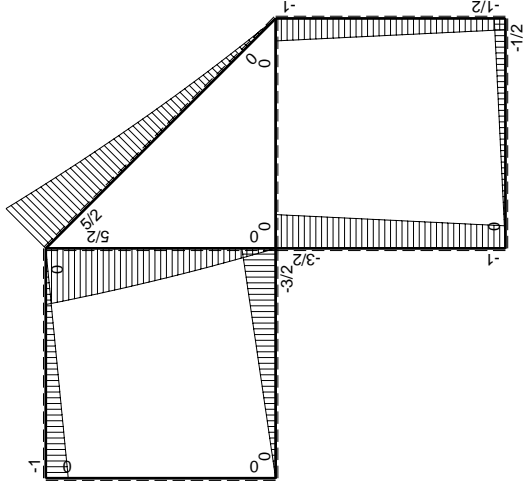
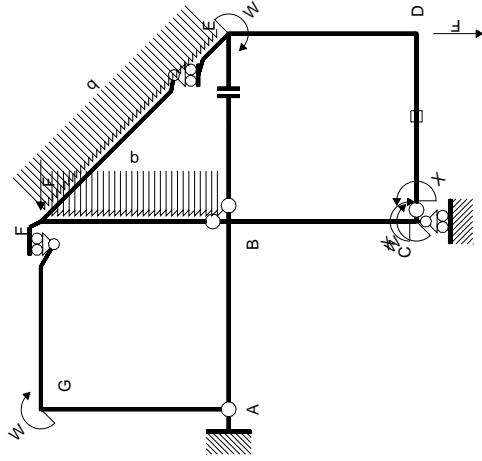


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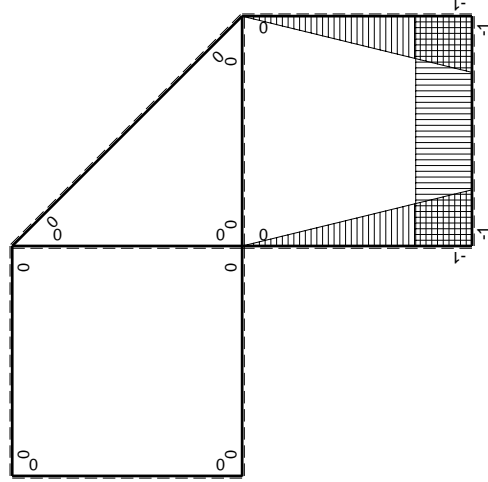


⊙ (+) ⊙ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	-Fb ² /EJ	
	totali				1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

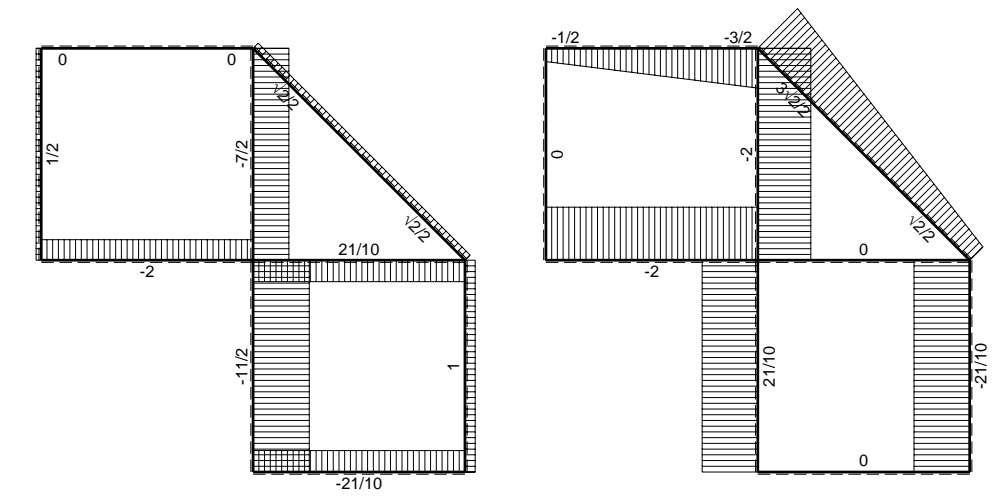
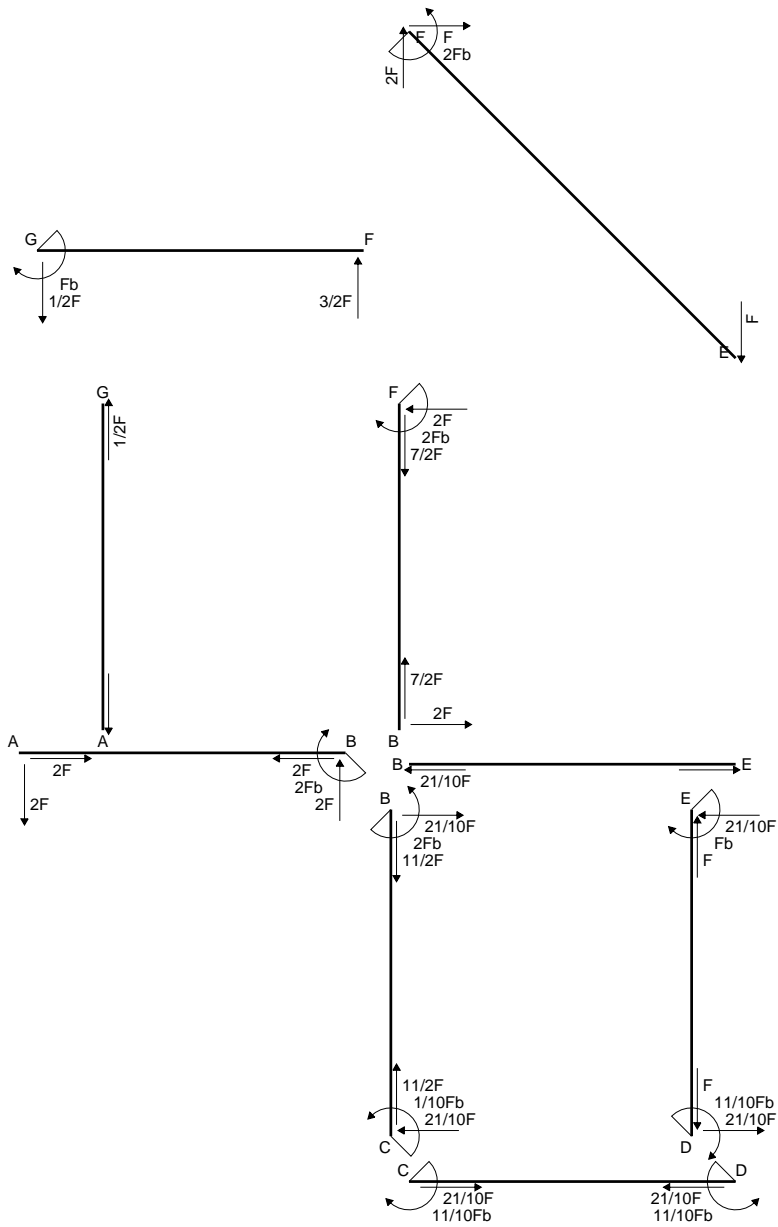
$$= (1/2 b - 1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

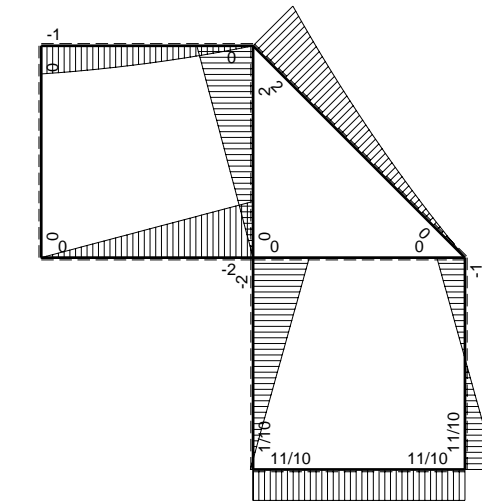
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

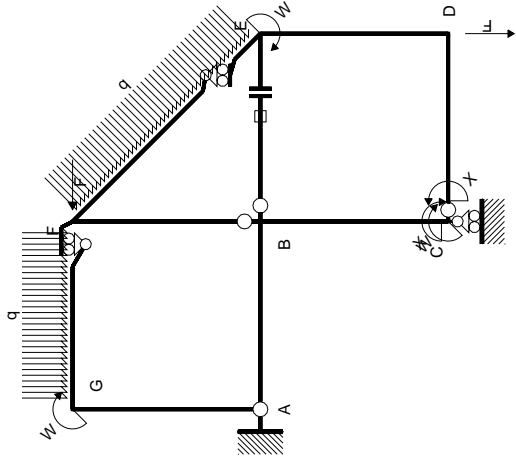


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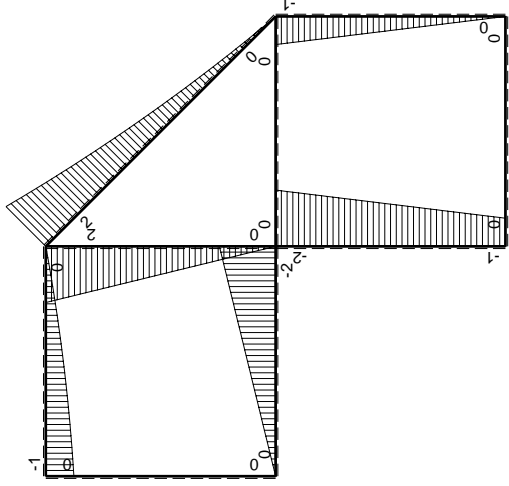
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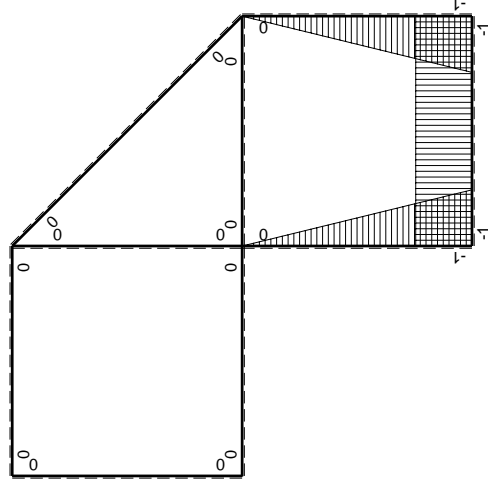
⊙ (+) ⊙ F_b



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/l	-Fx	Fx-Fx ² /l	1-2x/l+b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/l	Fb-Fx	Fx-Fx ² /l	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx+1/2qx^2$	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

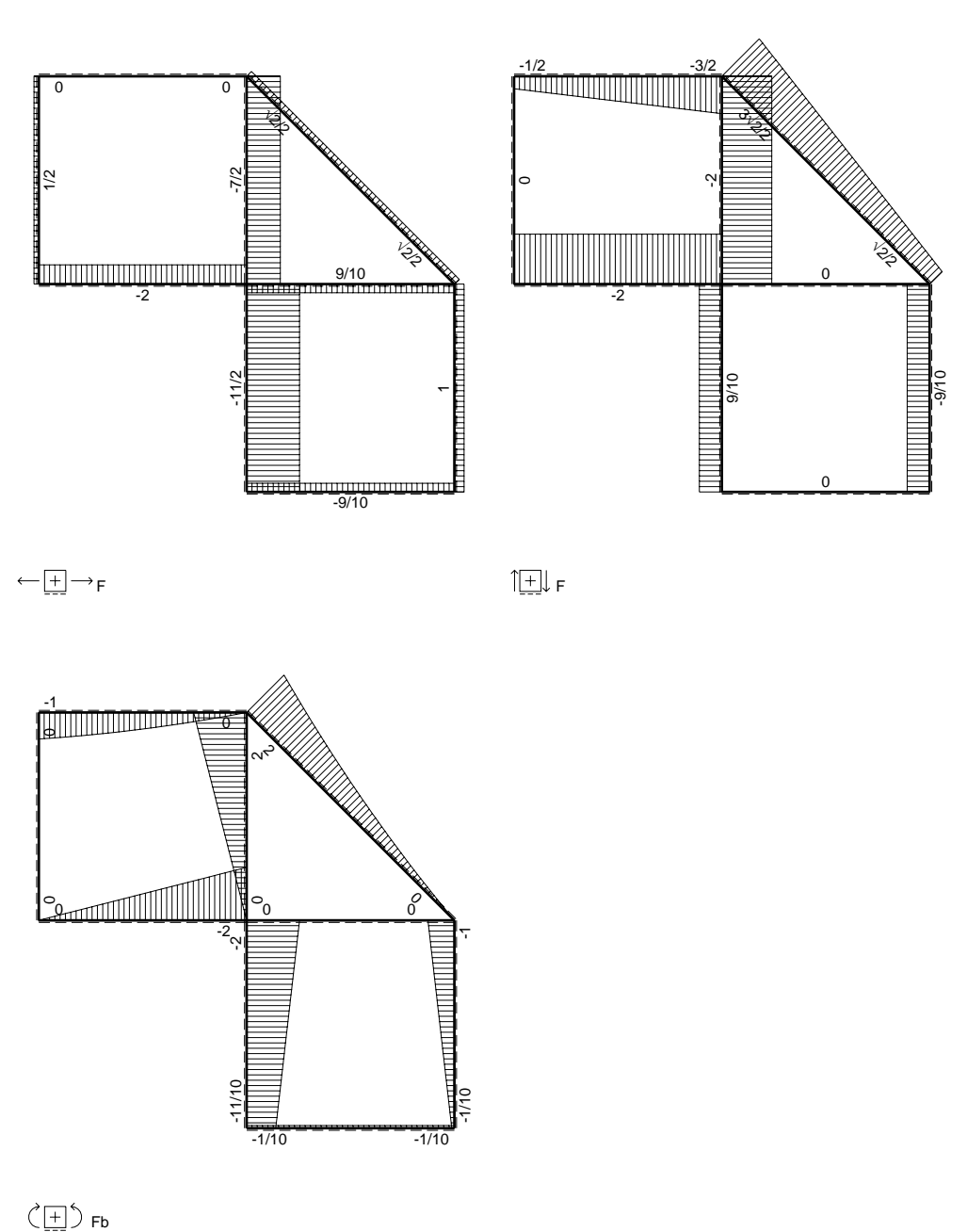
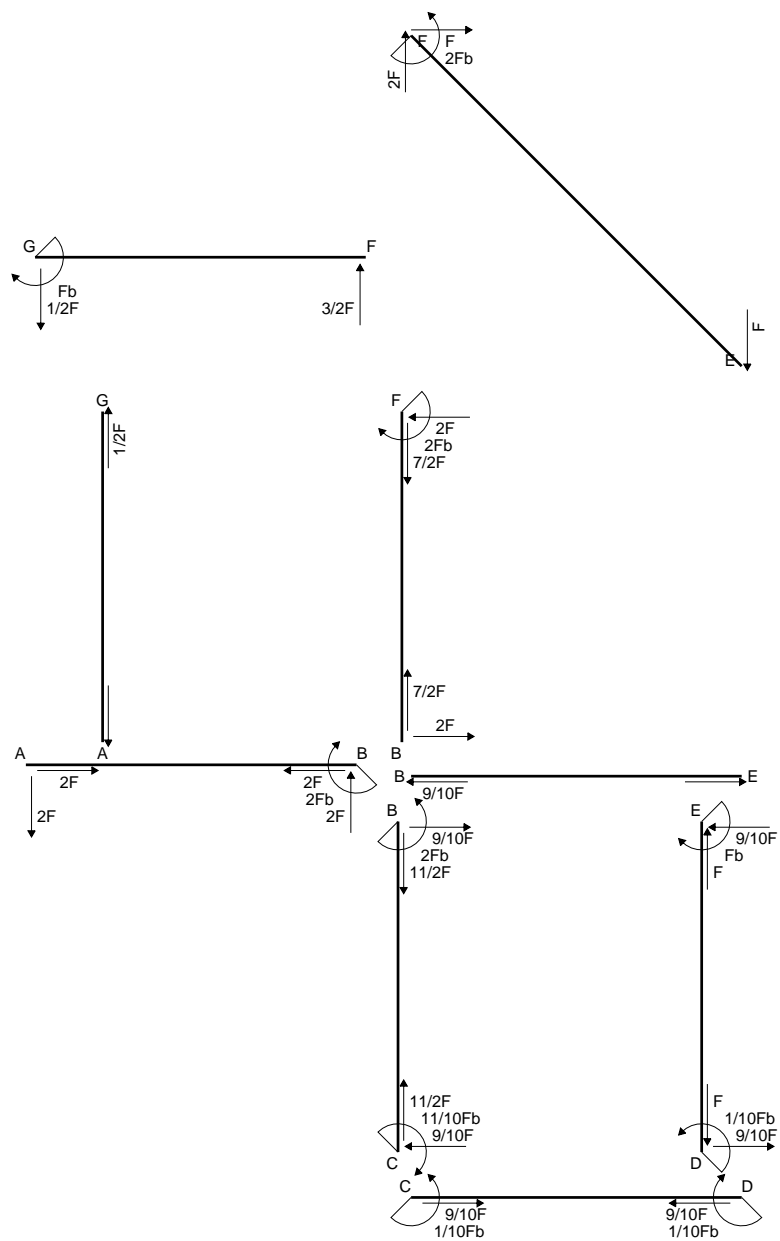
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

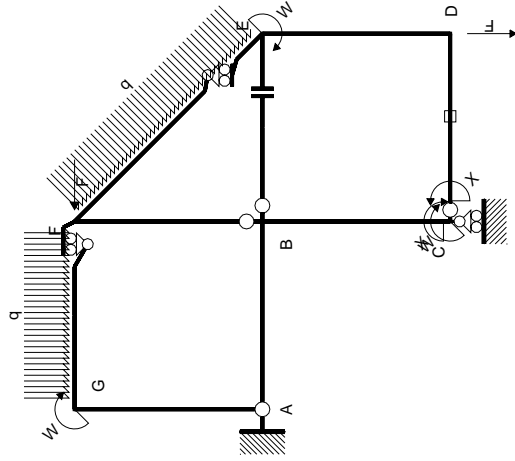
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

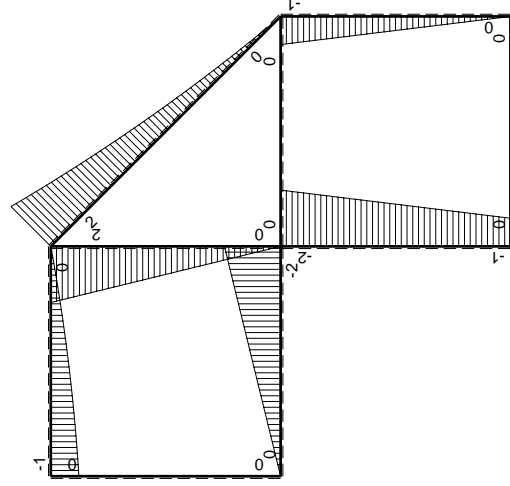
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

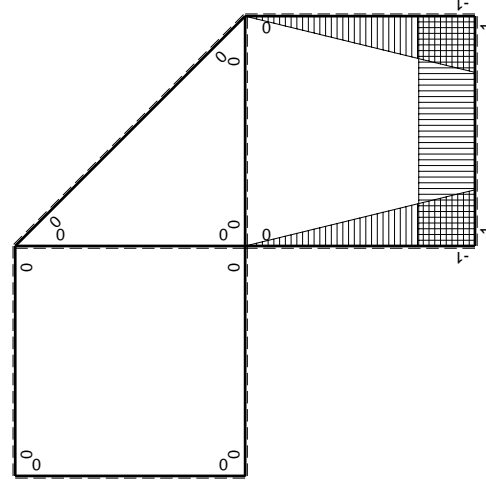




Schema di calcolo iperstatico



M₀ flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M _x /EJdx
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta N _{1,cd} ε _{cd} L _{cd}				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

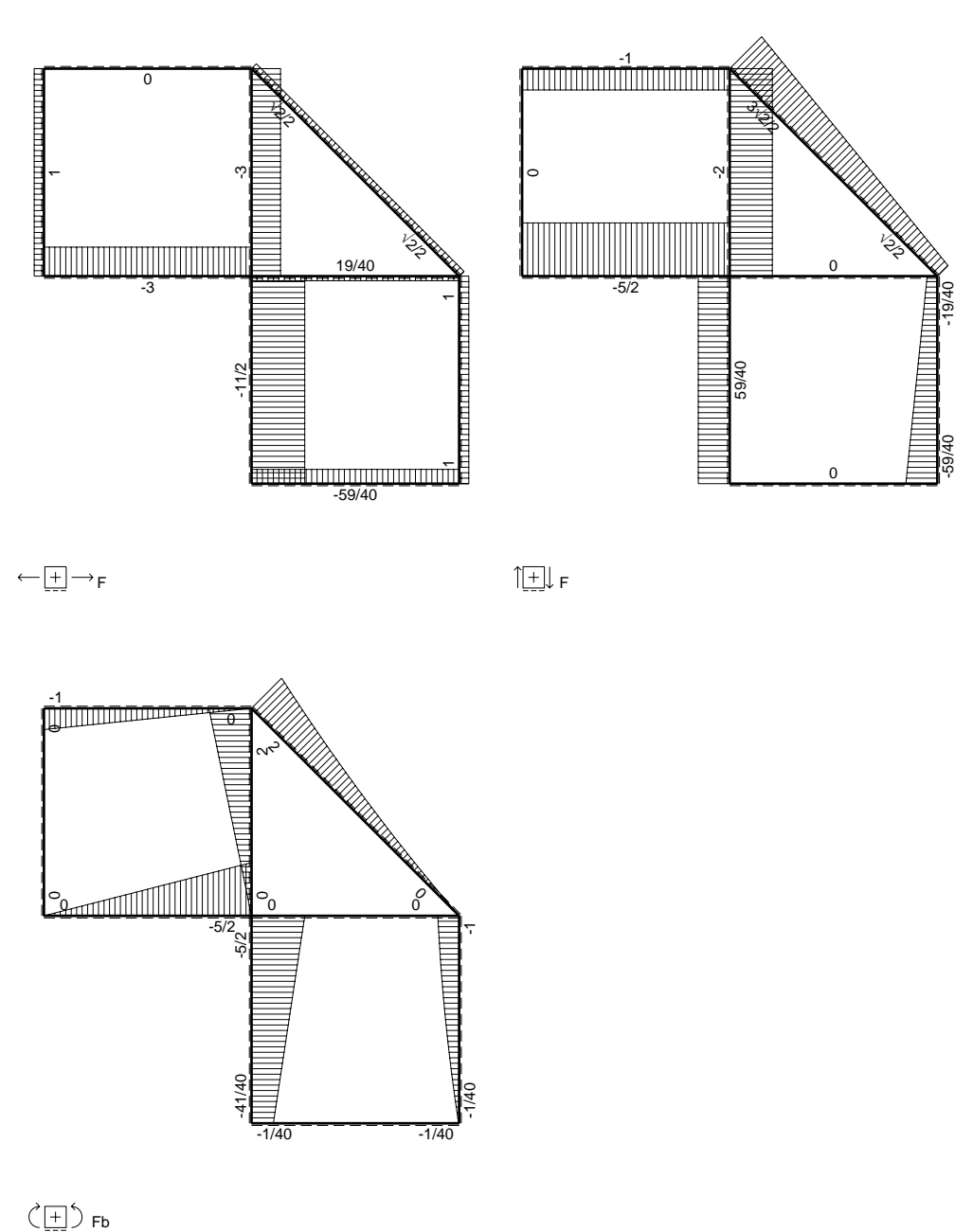
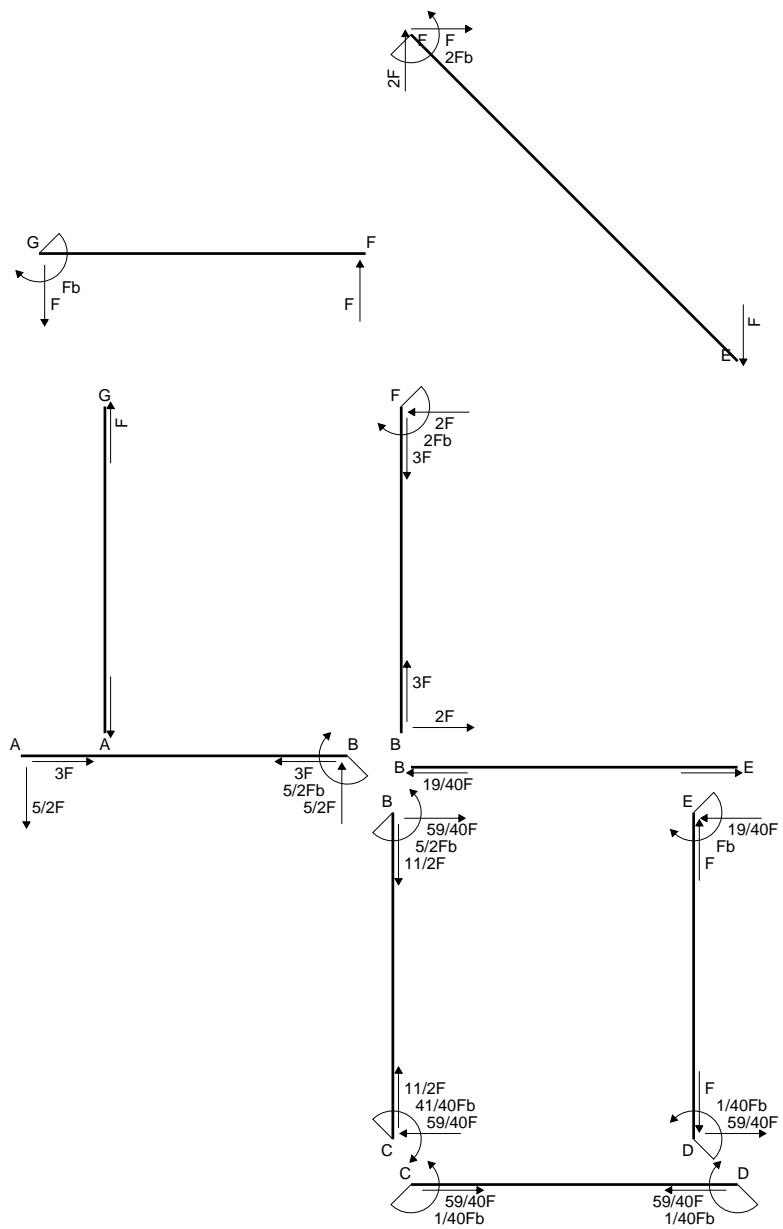
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

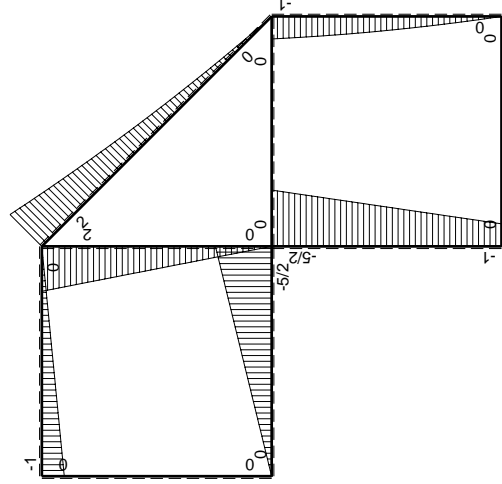
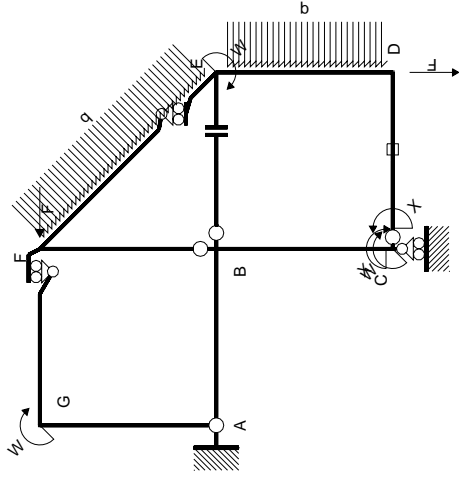
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$





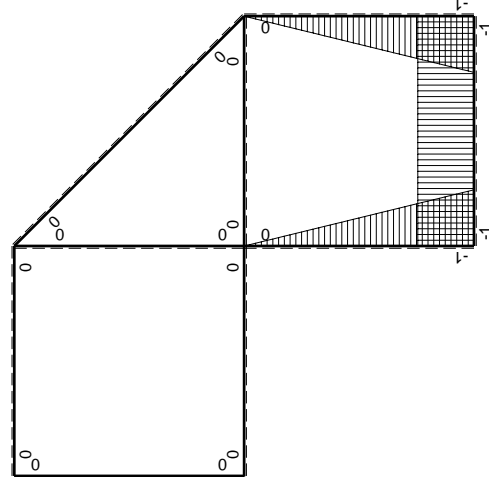
Schema di calcolo iperstatico

(+) M_0 flessione da carichi assegnati

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-3/2Fx+1/2qx ²	3/2Fx-2Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	5/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx-1/2qx ²	Fx-1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/24Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				1/40Fb	

Sviluppi di calcolo iperstatica



(+) M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

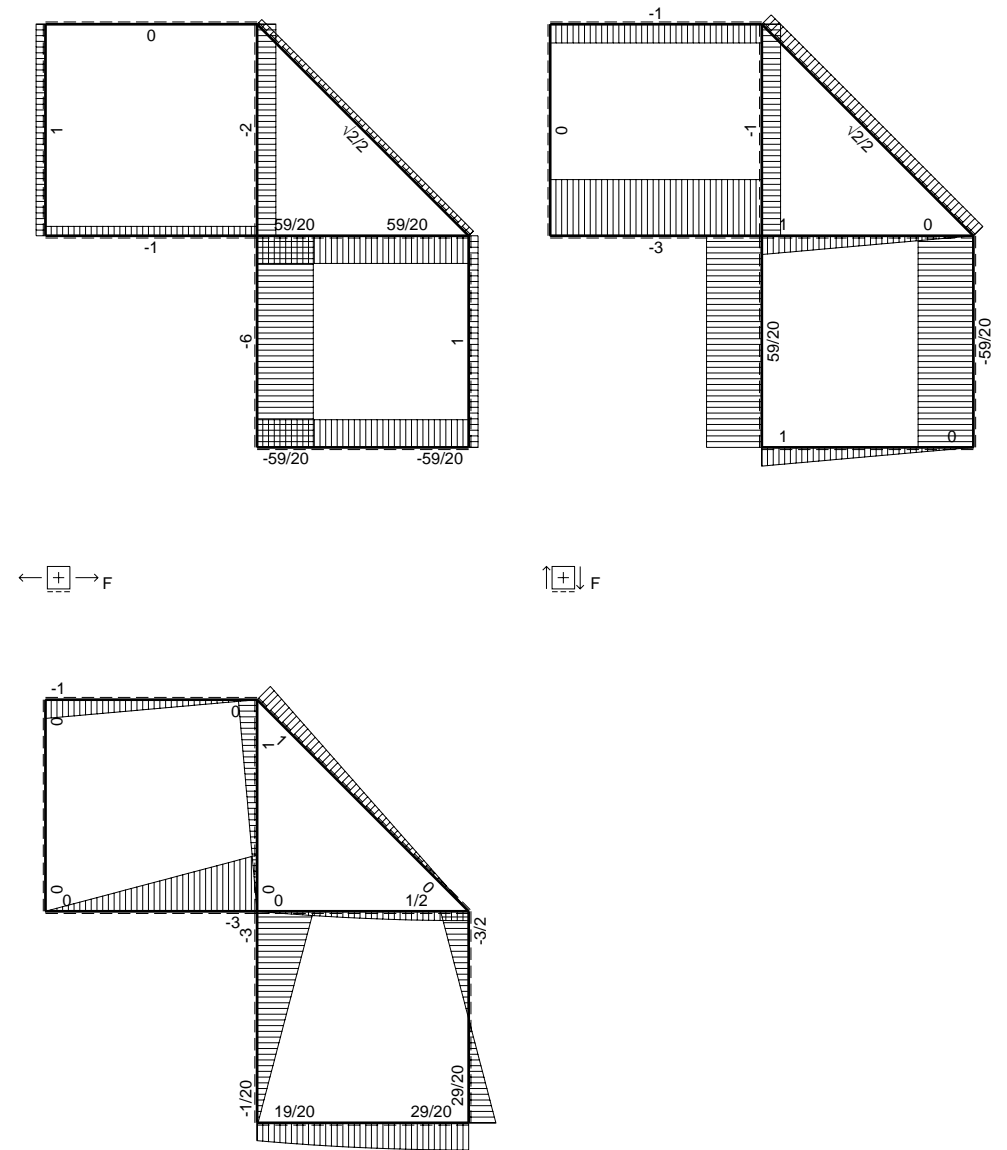
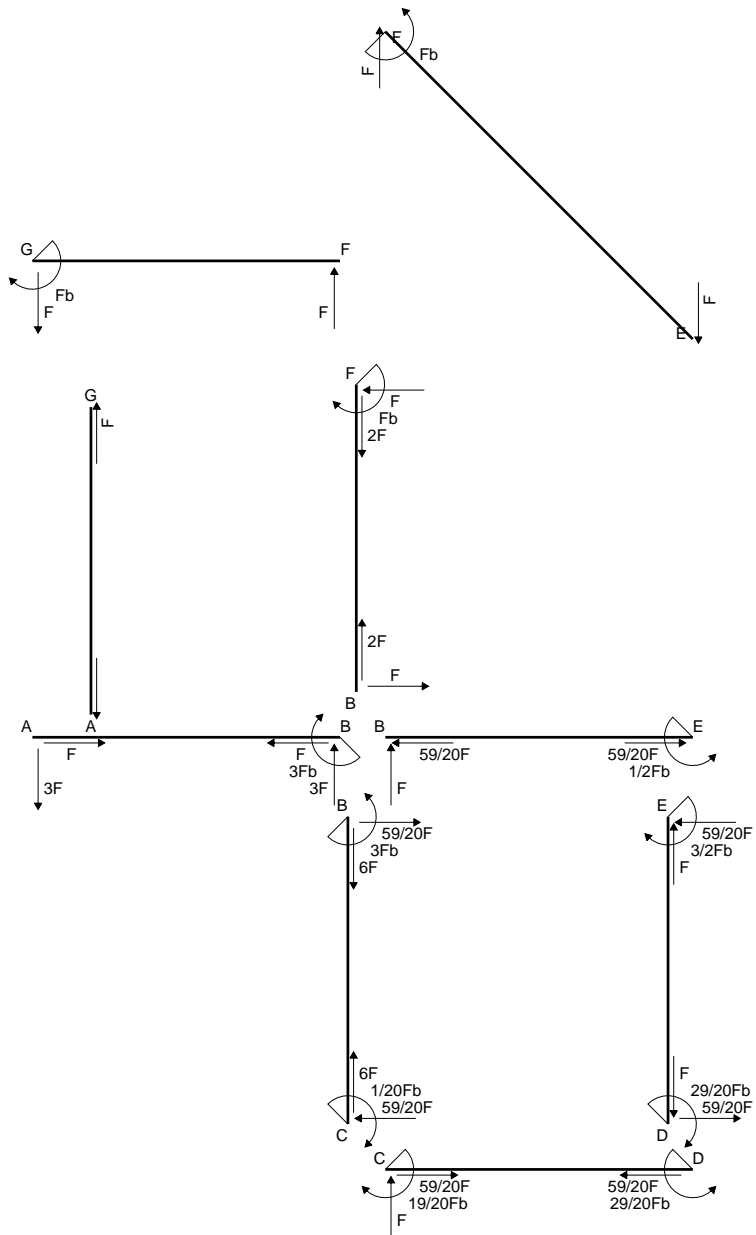
$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

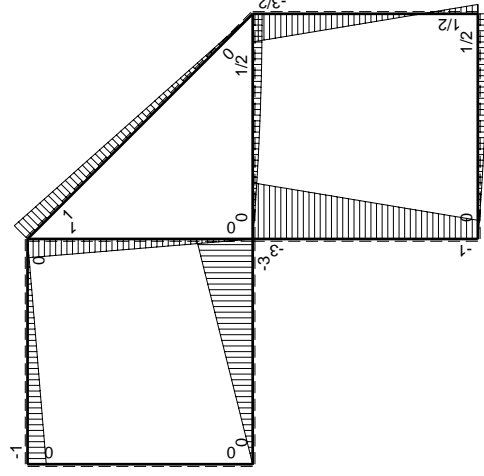
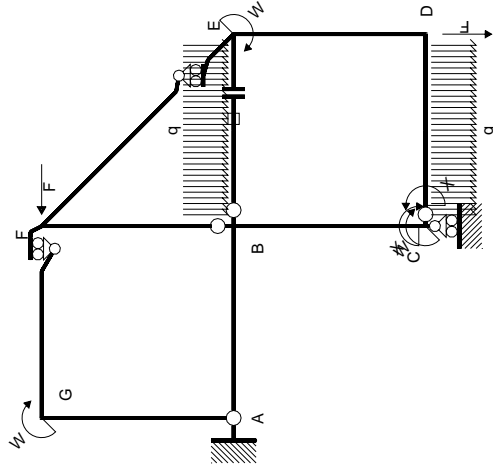
$$= (3/4 b - 2/3 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b - 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

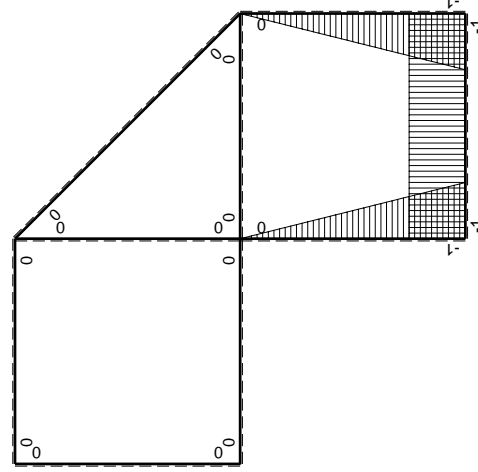


\oplus F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	$1/2Fb-2Fx$	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$3/2Fb-2Fx$	$3/2Fx-2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1BE} \epsilon_{BE} = L_{BE}$				Fb^2/EJ	
	totali				$19/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$-19/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{2} x^2/b - \frac{2}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/2 b - 2/3 b) \cdot Fb \cdot 1/EJ = 5/6 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{2} x^2/b - \frac{2}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/2 b - 2/3 b) \cdot Fb \cdot 1/EJ = 5/6 \cdot Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-\frac{1}{2} x^2/b + \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 \cdot Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-\frac{1}{2} x + \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

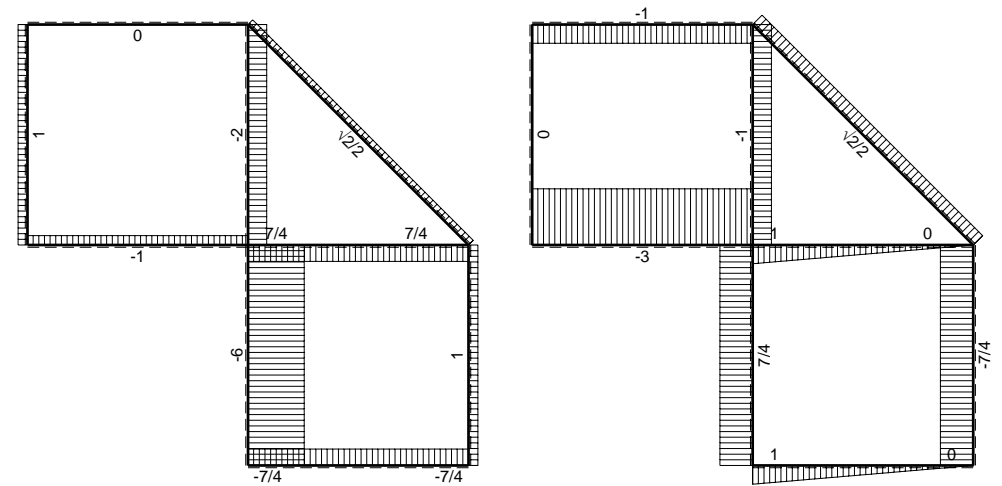
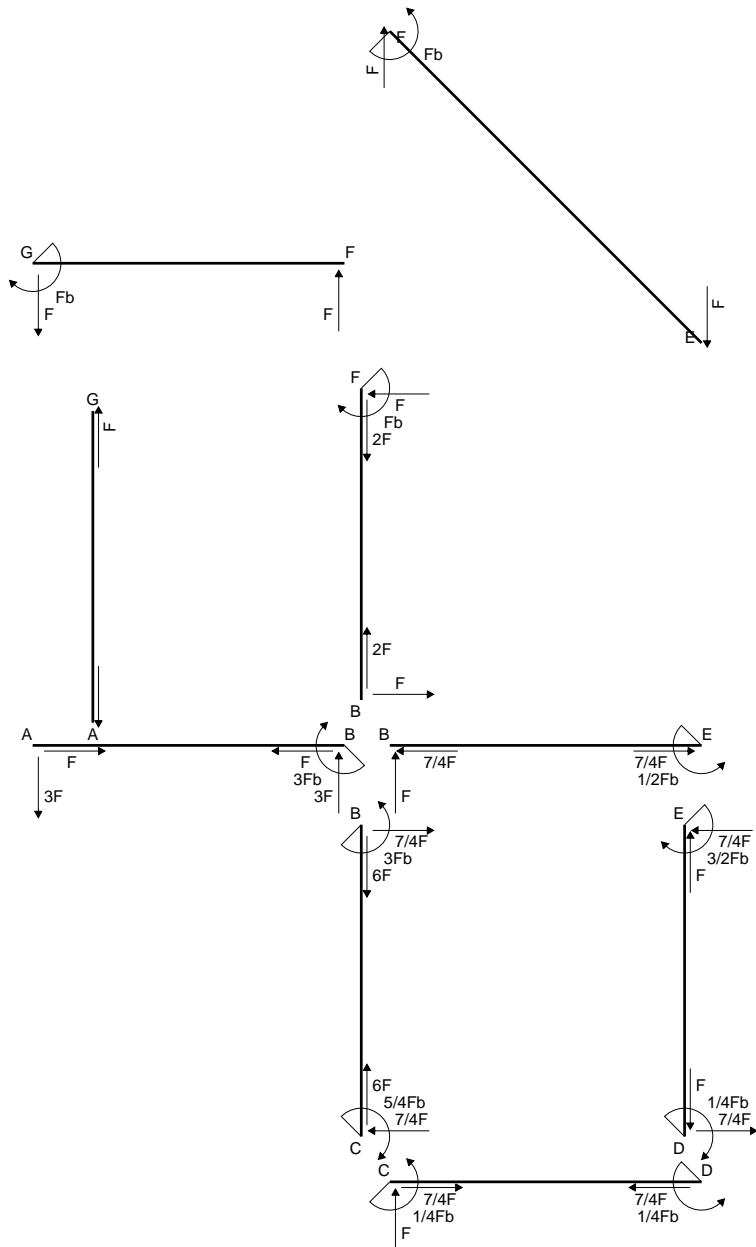
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 5/2 x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-\frac{1}{2} x + \frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 5/4 b - 2/3 b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

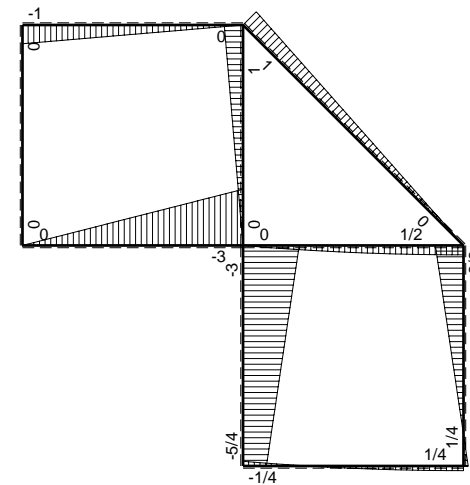
$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{2}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 2/3 b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

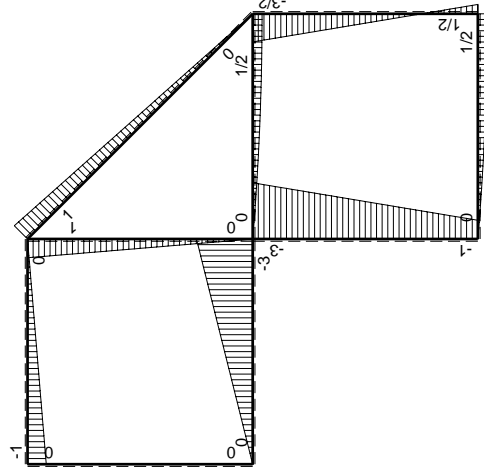
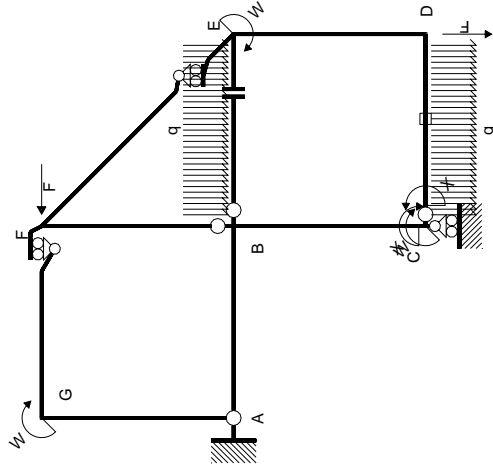


← ⊕ → F

↑ ⊕ ↓ F

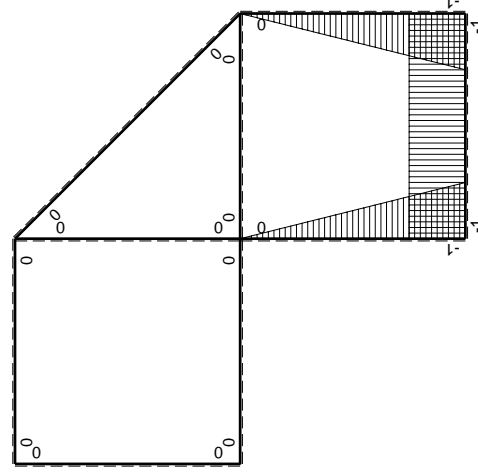


⊕ ⊖ F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1		
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-2Fx$	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$3/2Fb-2Fx$	$3/2Fx-2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				$-Fb^2/EJ$	
	totali				$-5/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) Fb 1/EJ dx = [3/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) Fb 1/EJ dx = [x + 1/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

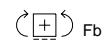
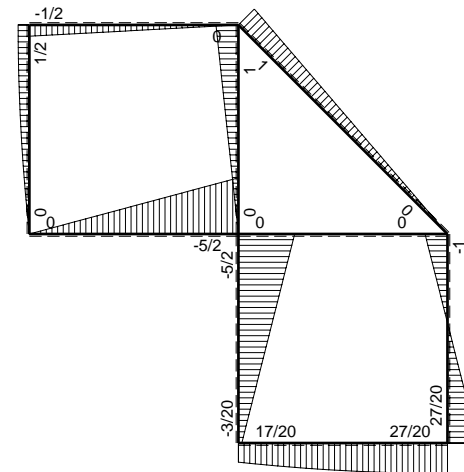
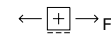
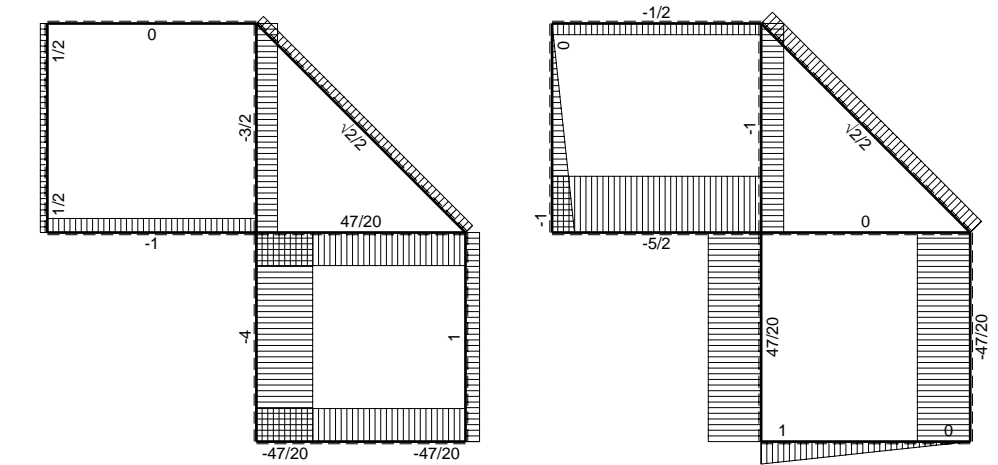
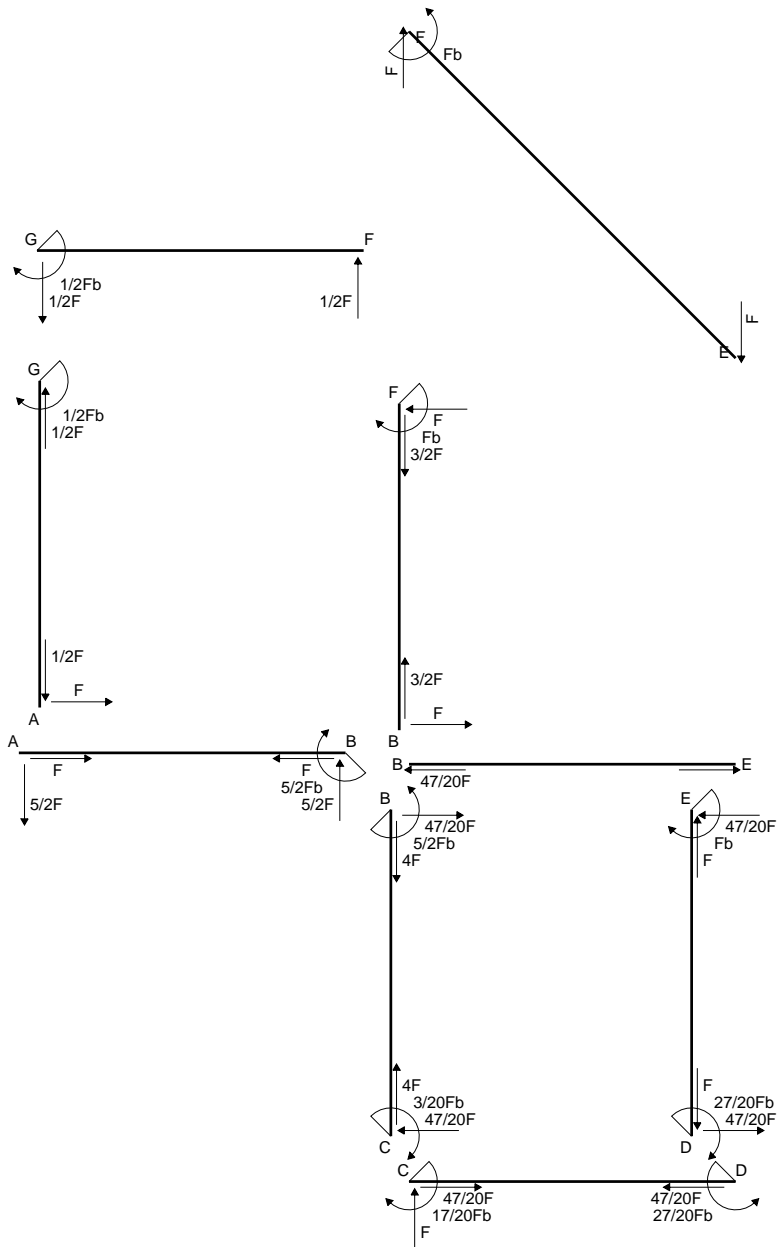
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

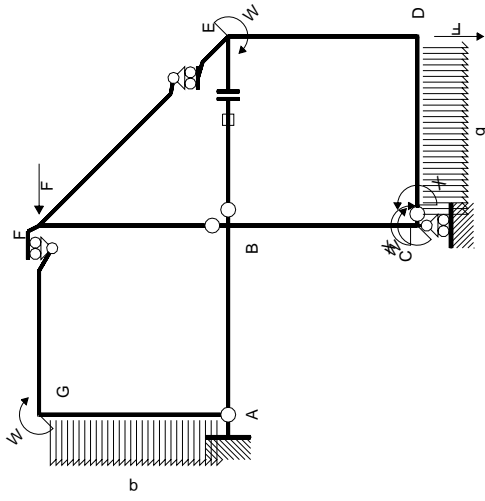
$$L_{DE}^{xo} = \int_0^b (-1/2 + 5/2 x/b - 2x^2/b^2) Fb 1/EJ dx = [-1/2 x + 5/4 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 5/4 b - 2/3 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

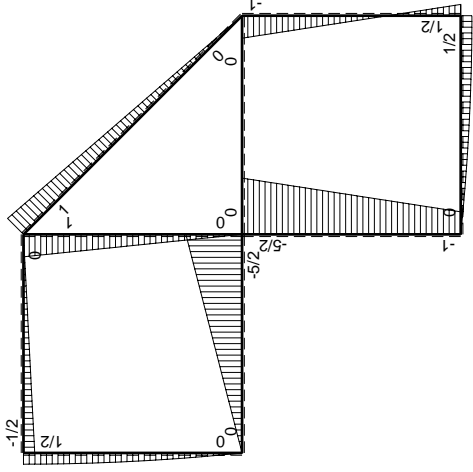
$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 2x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 2/3 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

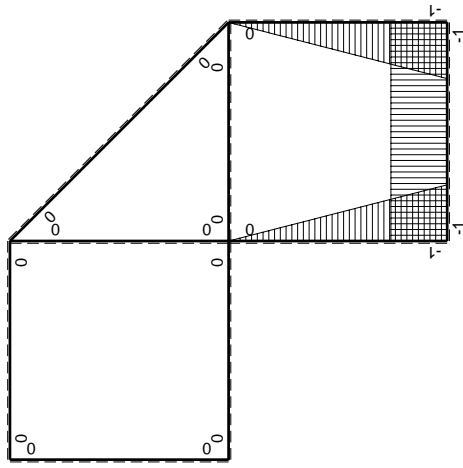




Schema di calcolo iperstatico



M₀ flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M _x /EJdx
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta N _{1, BE} ε _{BE} -l _{BE}				Fb ² /EJ	
	totali				17/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-17/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

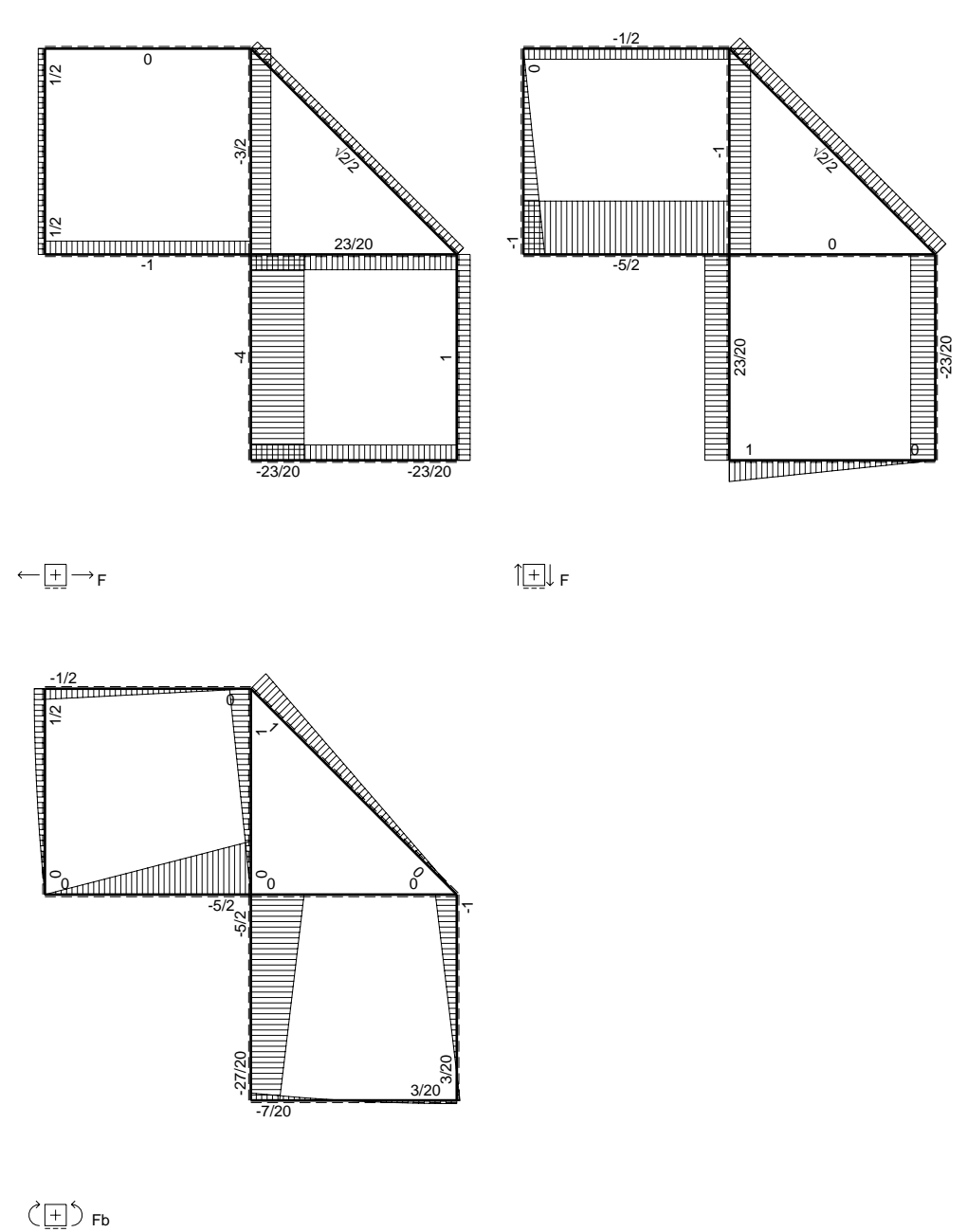
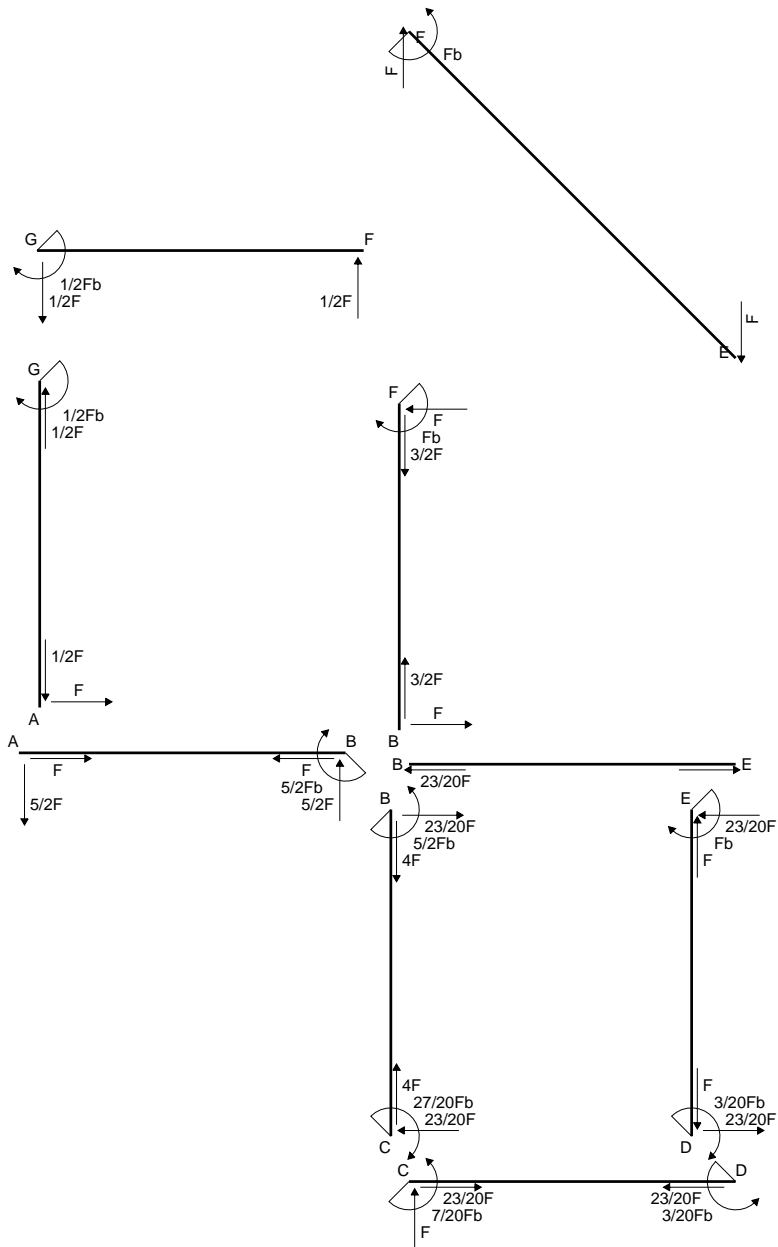
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

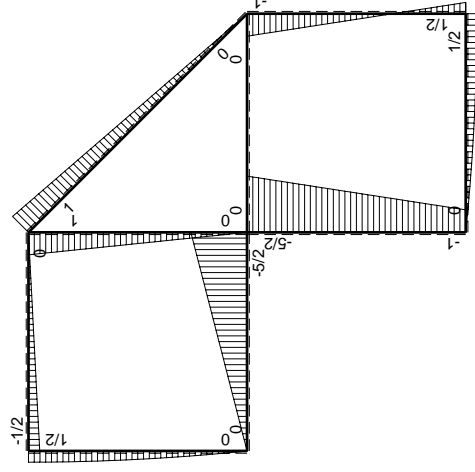
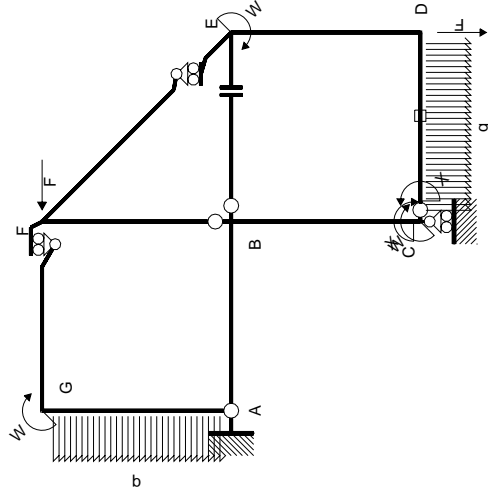
$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

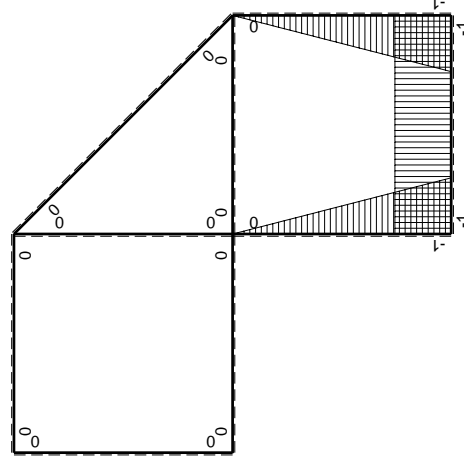


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta N _{1,cd} ε _{cd} L _{cd}				-Fb ² /EJ	
	totali				-7/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				7/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

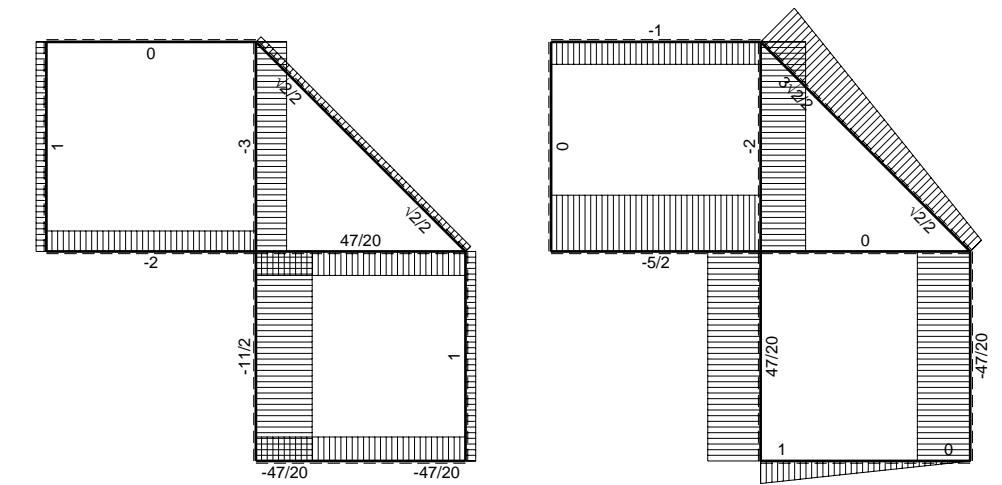
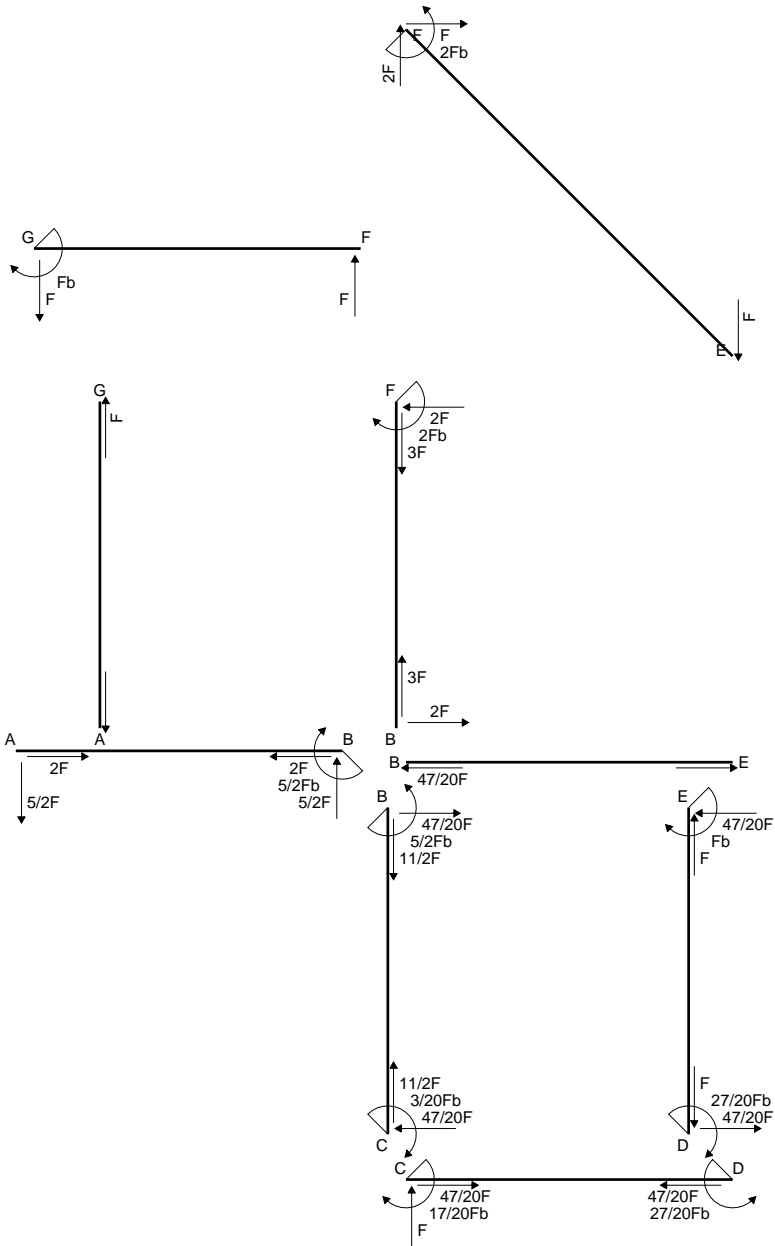
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

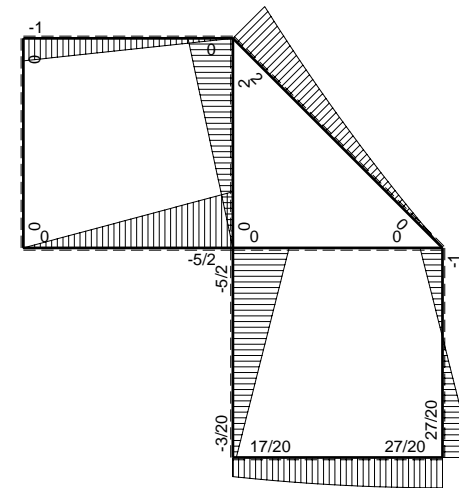
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$

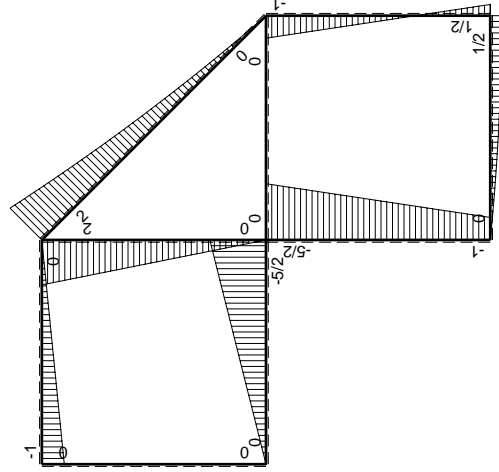
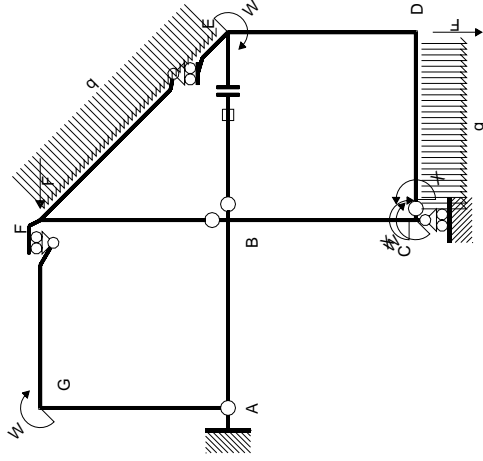


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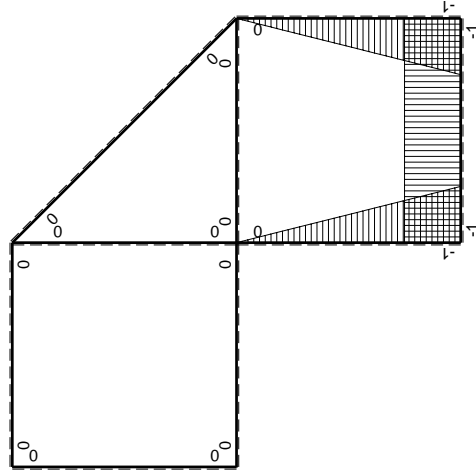


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				17/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-17/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-\frac{1}{2} x^2/b + \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 \, b + 1/6 \, b) \cdot Fb \cdot 1/EJ = -1/3 \, Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-\frac{1}{2} x + \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

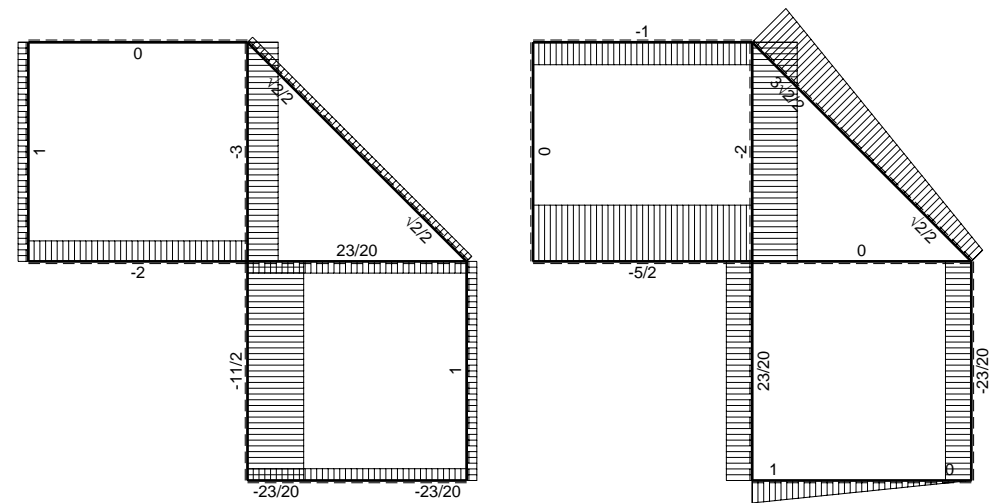
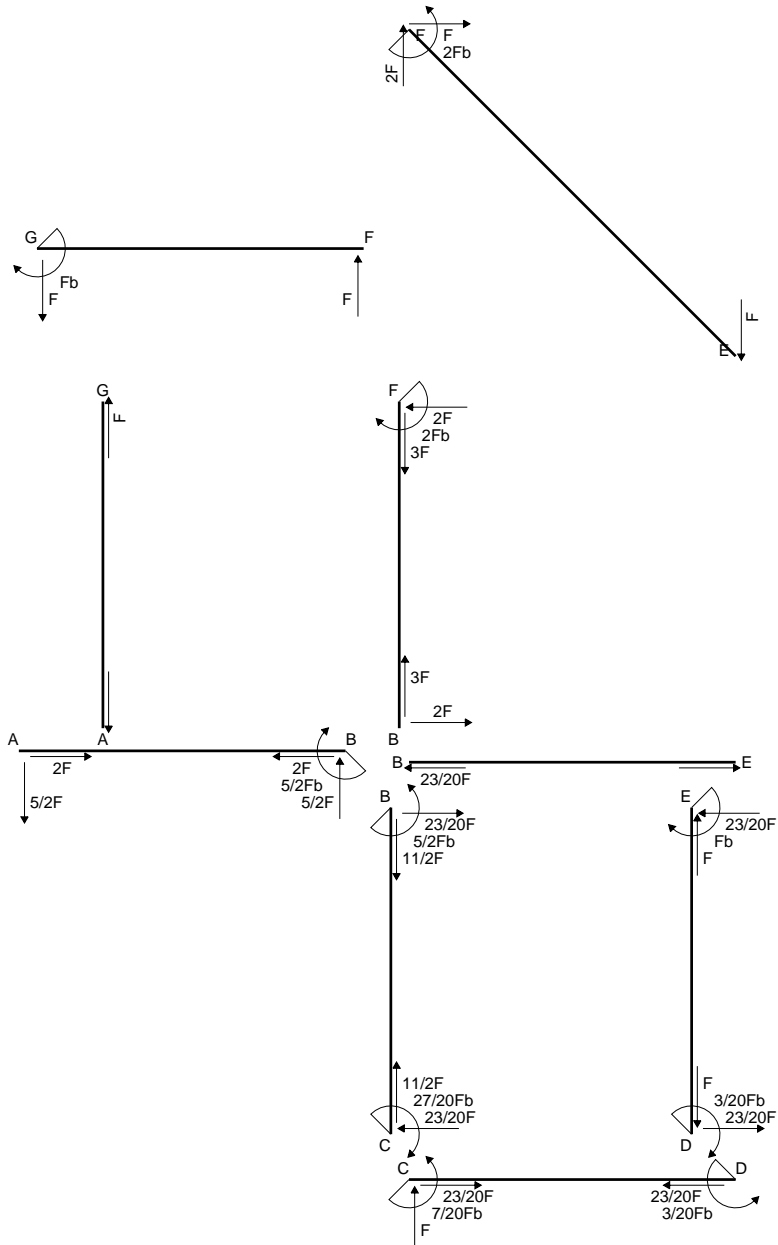
$$= (-1/2 \, b + 1/6 \, b) \cdot Fb \cdot 1/EJ = -1/3 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-\frac{1}{2} x + x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 \, b + b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 0$$

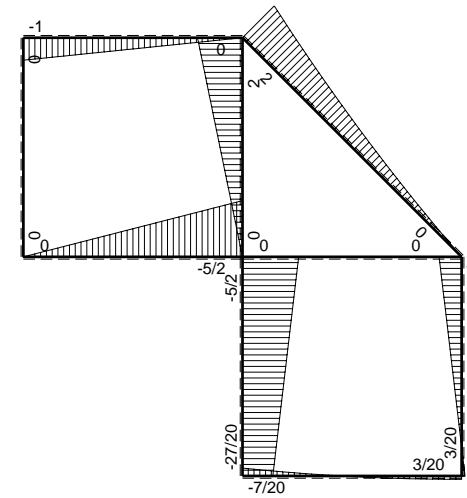
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 0$$

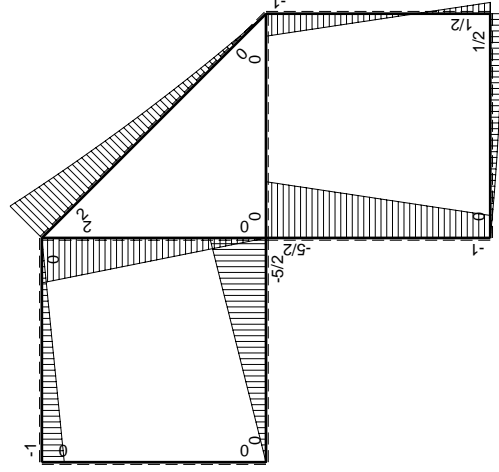
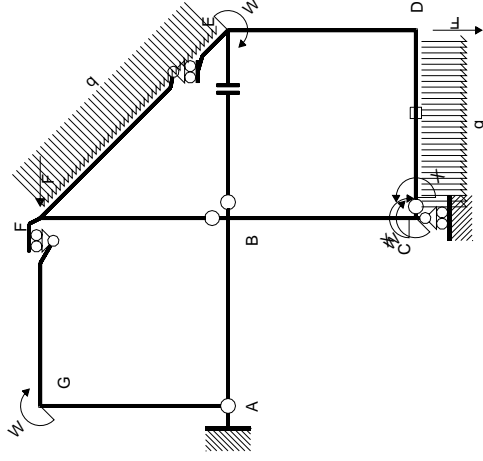


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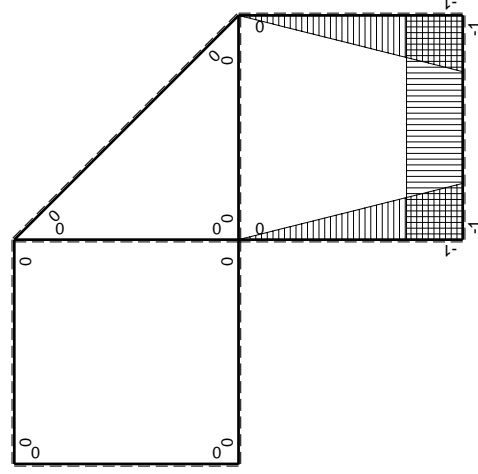


⊙ (+) ⊙ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-7/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				7/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

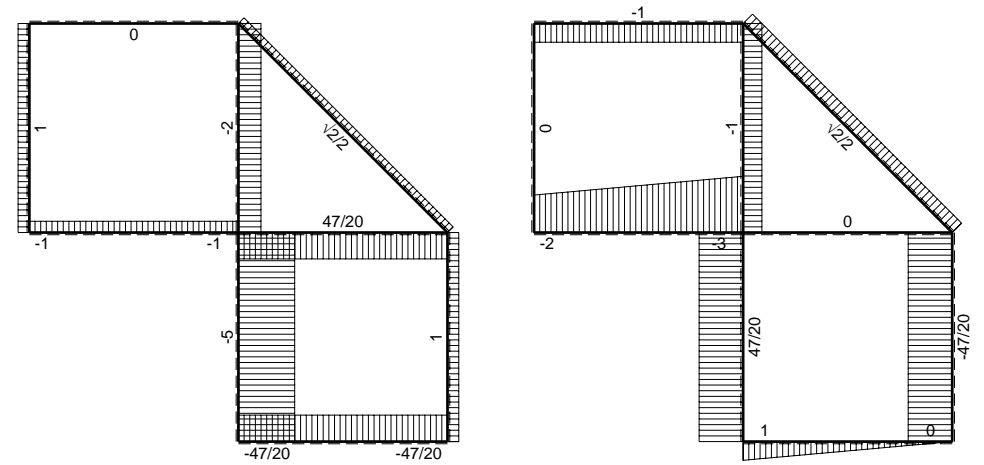
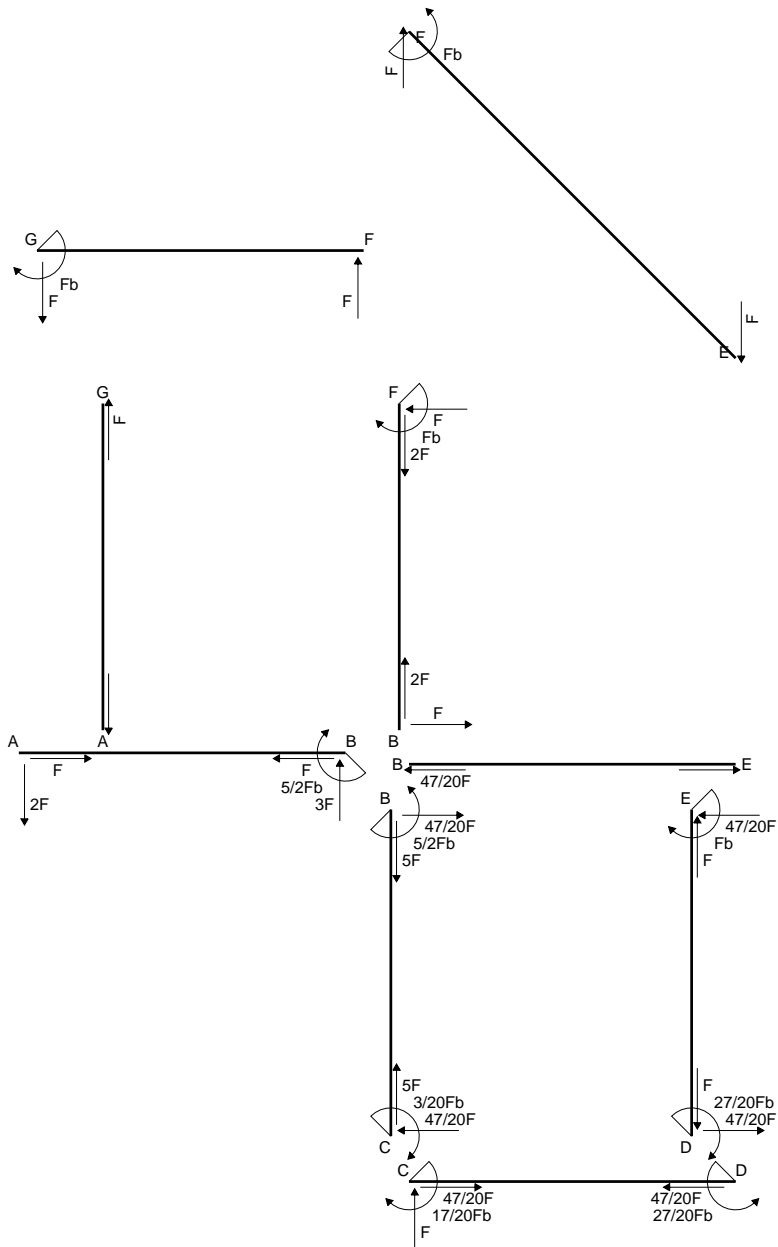
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

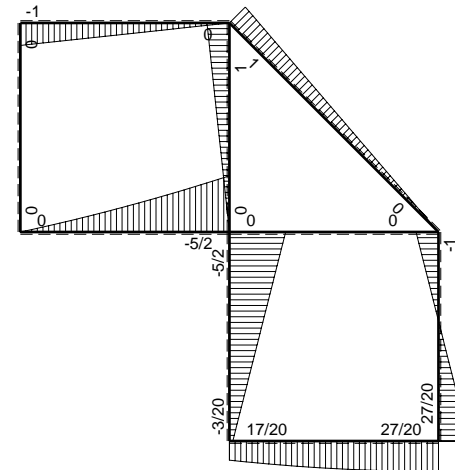
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$

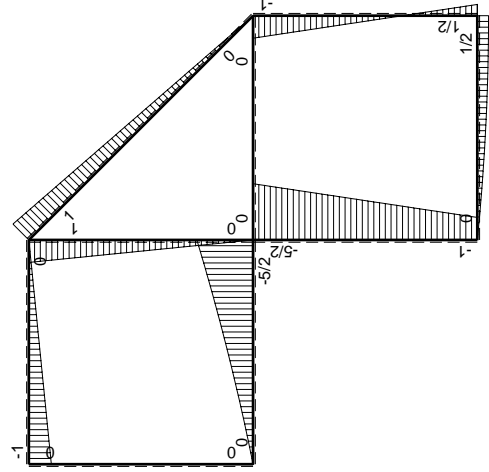
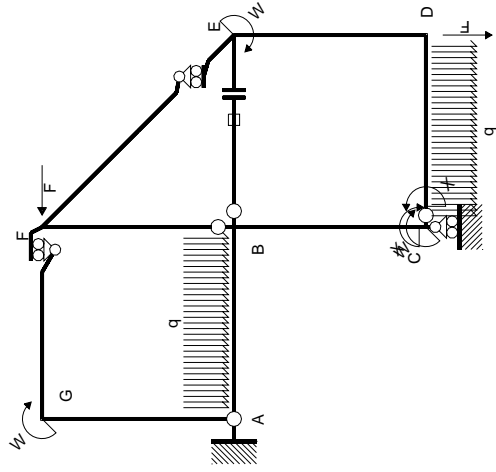


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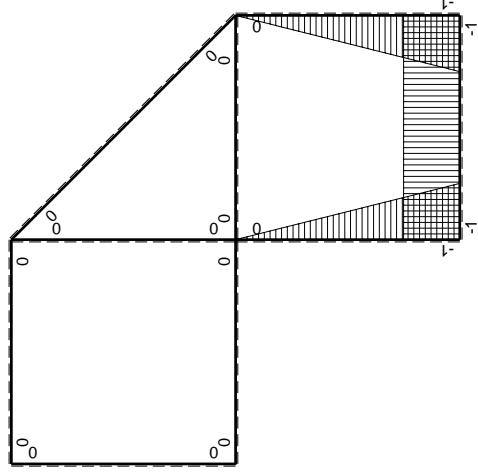


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1		
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1		
DE b	$-1+x/b$	$1/2Fb - 3/2Fx$	$-1/2Fb + 2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	$Fb - 3/2Fx$	$Fx - 3/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-17/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

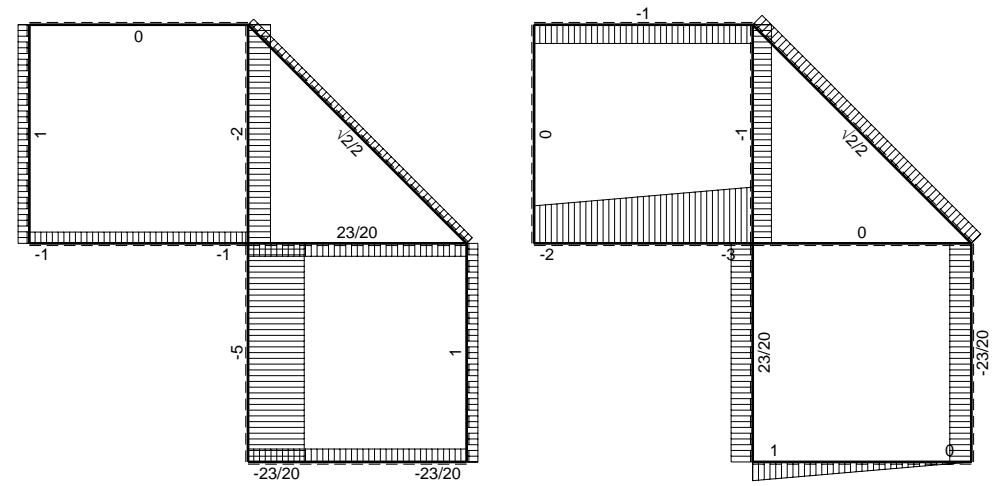
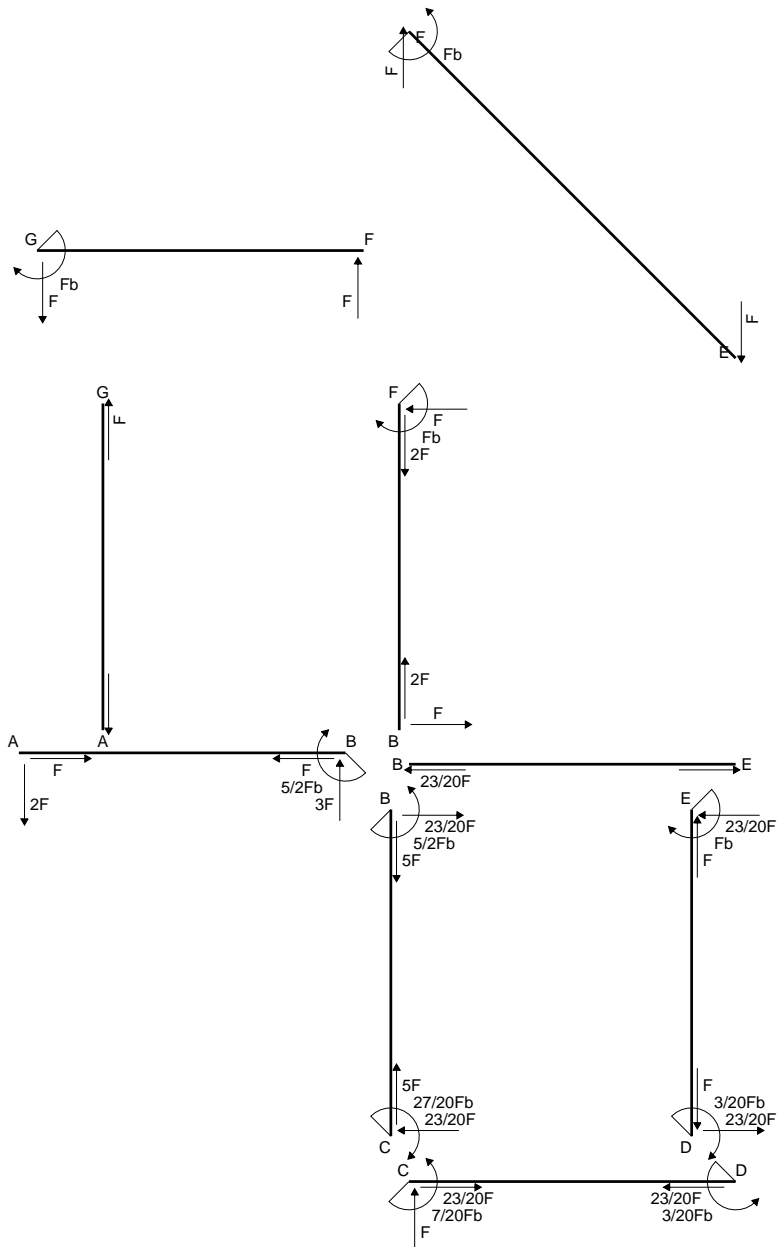
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

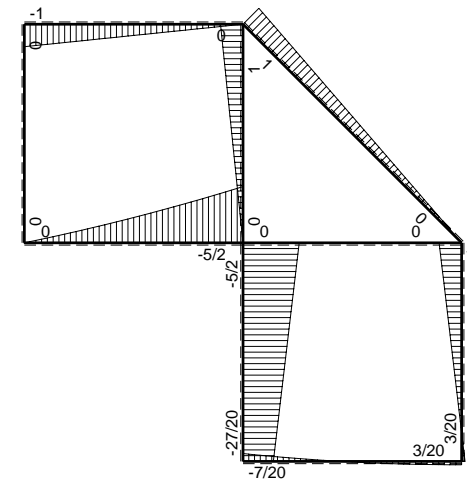
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

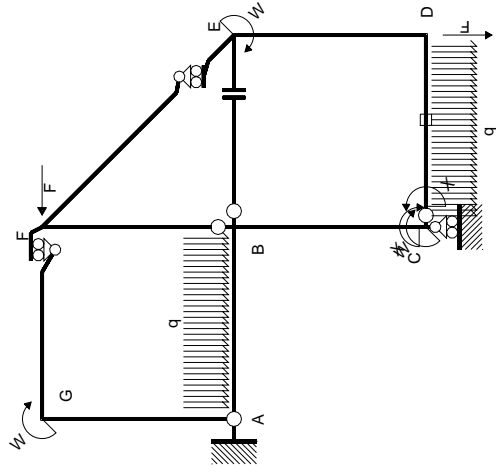


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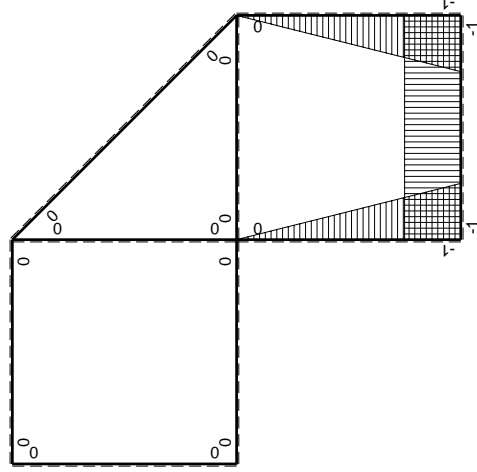
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Schema di calcolo iperstatico



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1		
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1		
DE b	$-1 + x/b$	$1/2Fb - 3/2Fx$	$-1/2Fb + 2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	$Fb - 3/2Fx$	$Fx - 3/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$7/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

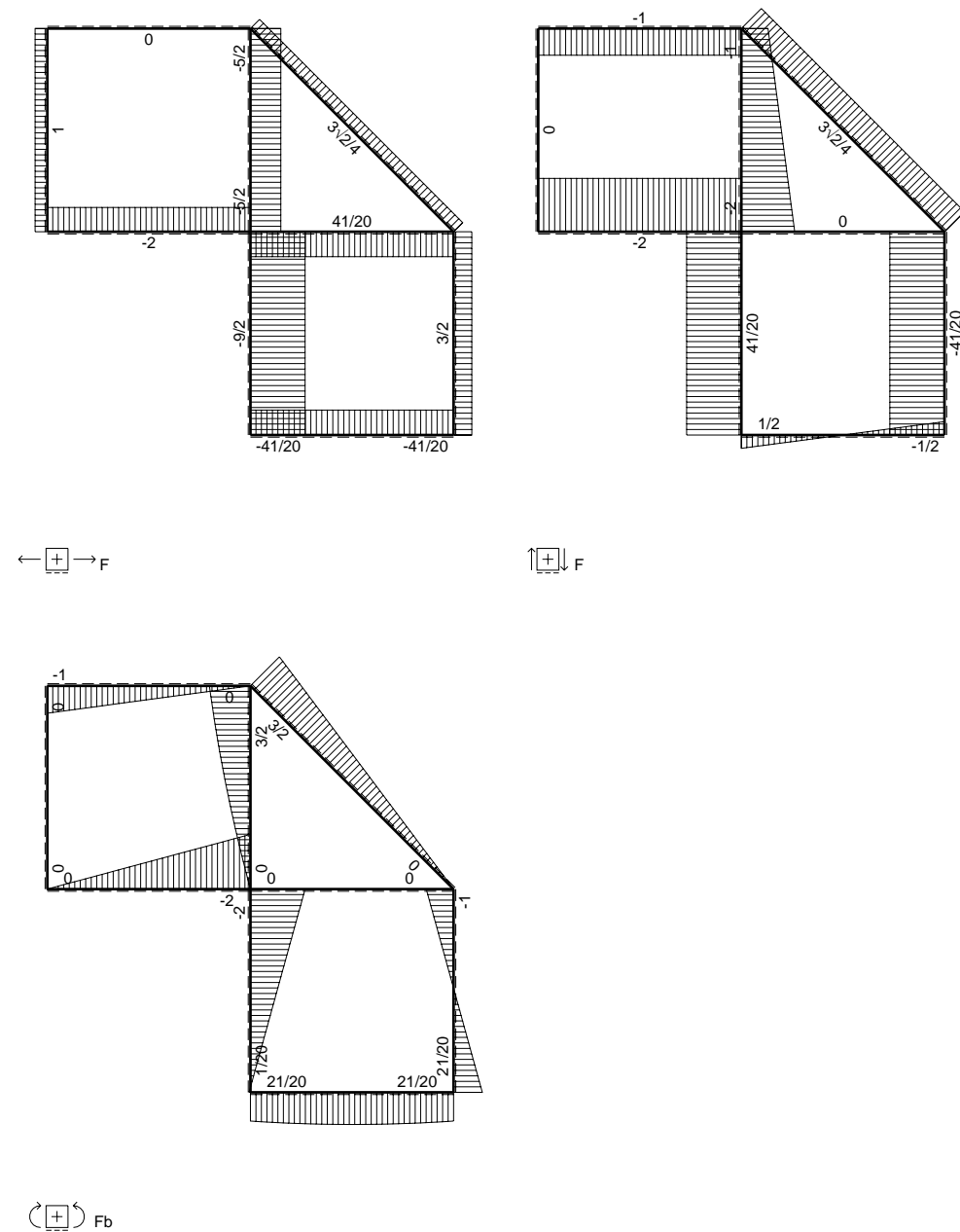
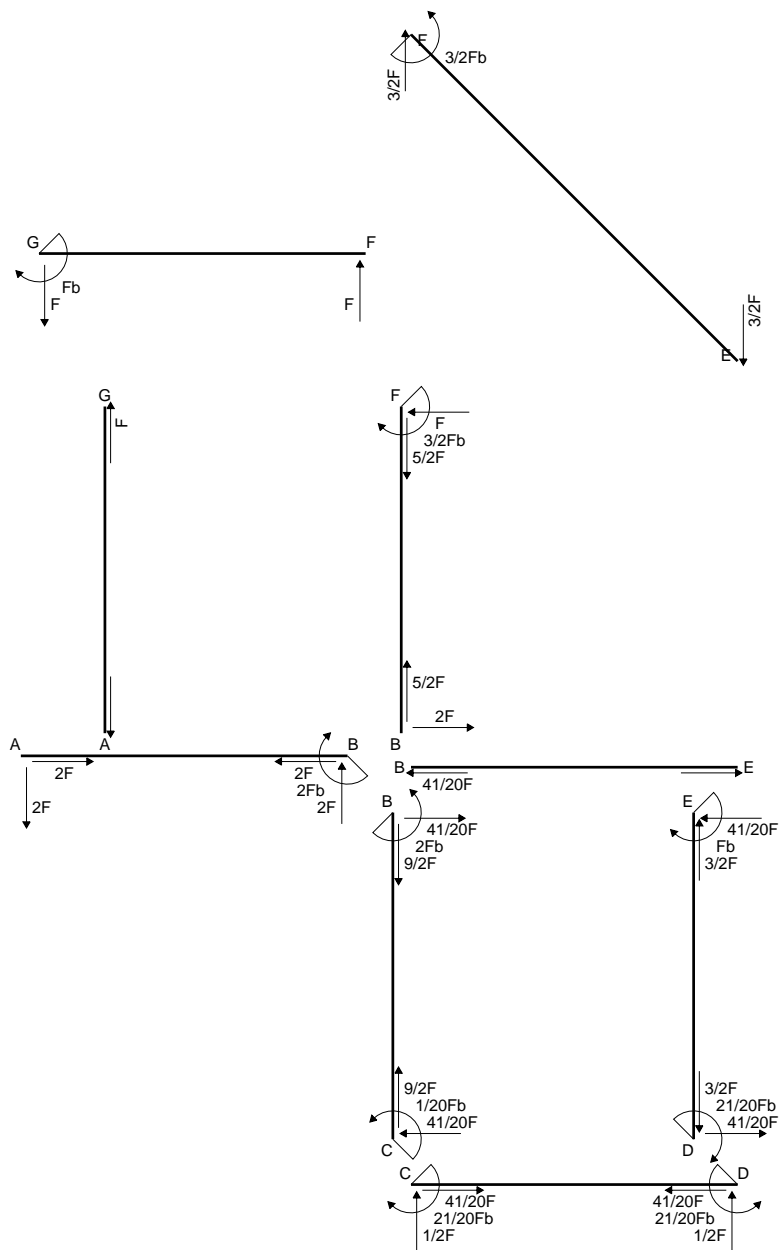
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

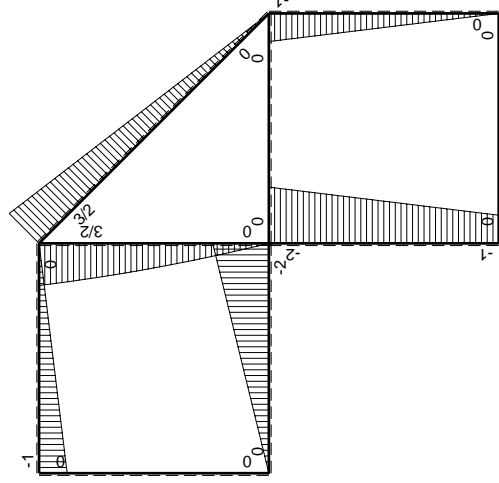
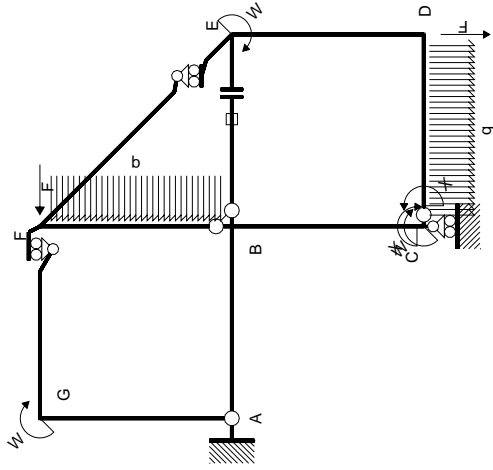
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

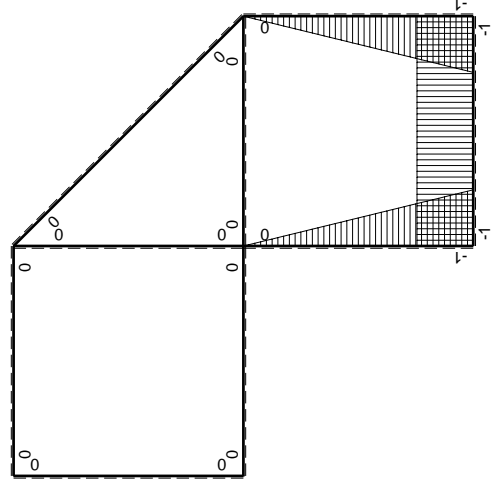
$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CD b	-1	1/2Fx-1/2qx ²	-1/2Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fx+1/2qx ²	-1/2Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF $\sqrt{2}b$	0	3 $\sqrt{2}$ /4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				7/4Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-21/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/6 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

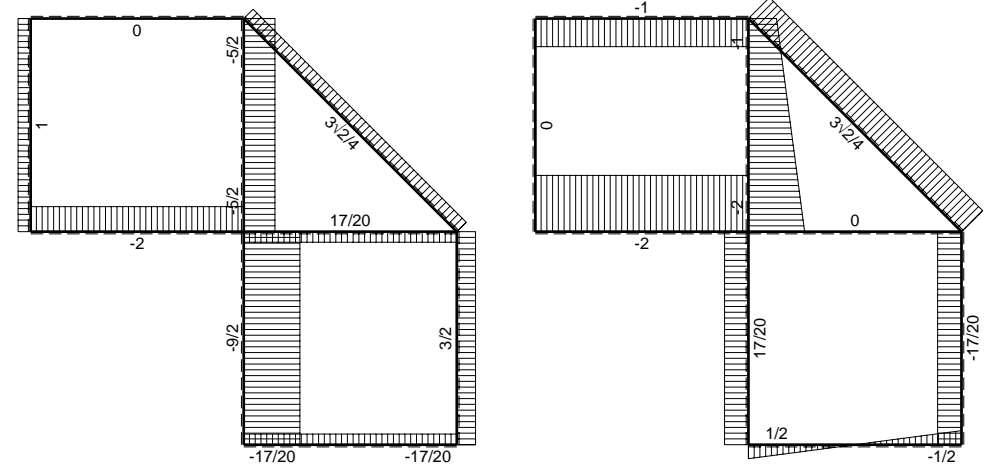
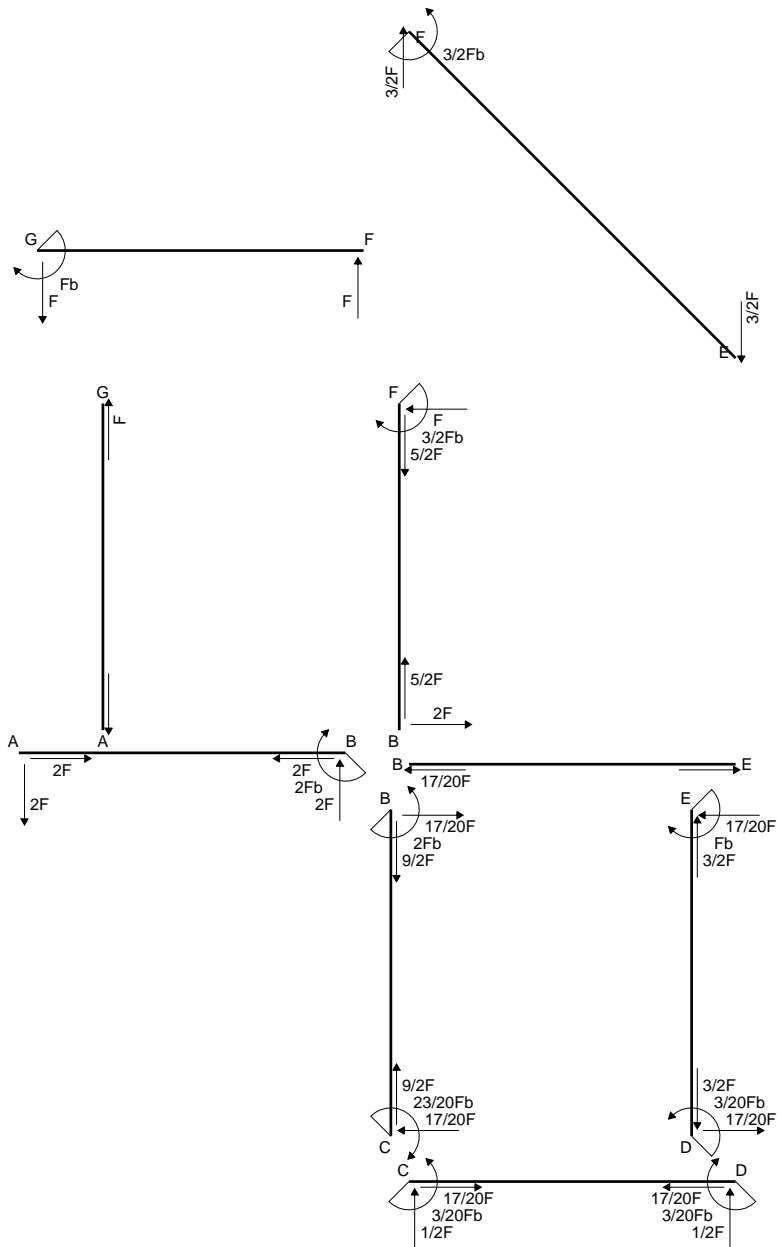
$$= (-1/4 b + 1/6 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

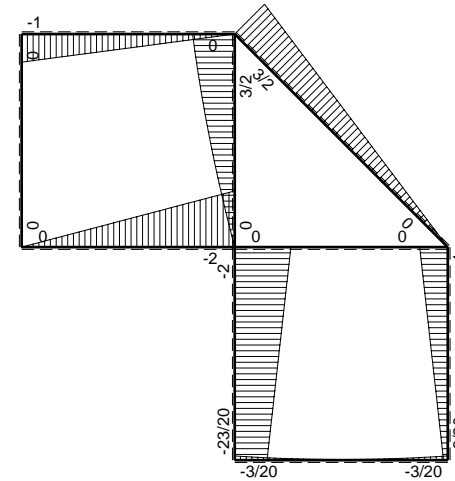
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

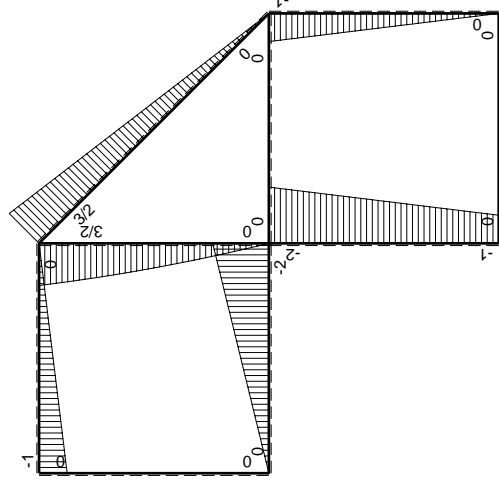
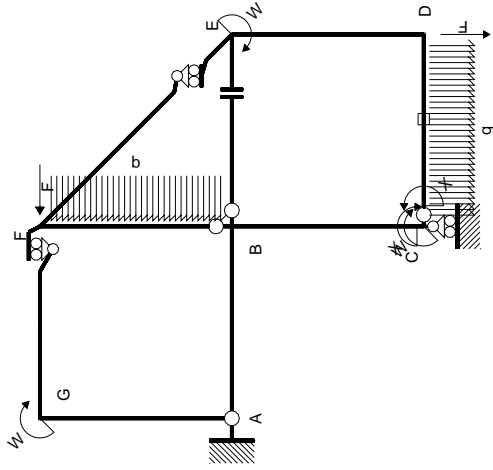


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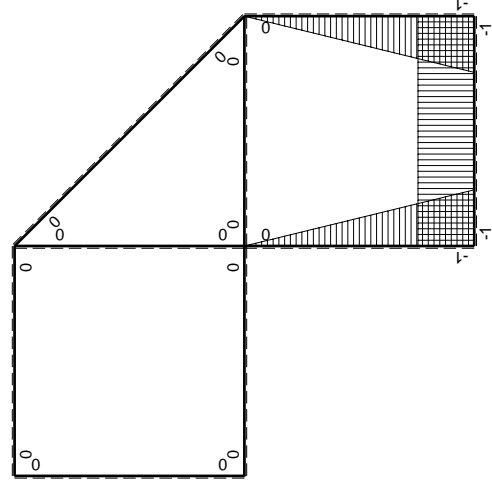


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CD b	-1	1/2Fx-1/2qx ²	-1/2Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fx+1/2qx ²	-1/2Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF $\sqrt{2}b$	0	3\sqrt{2}/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	-Fb ² /EJ	
	totali				-1/4Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				3/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/4 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -13/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

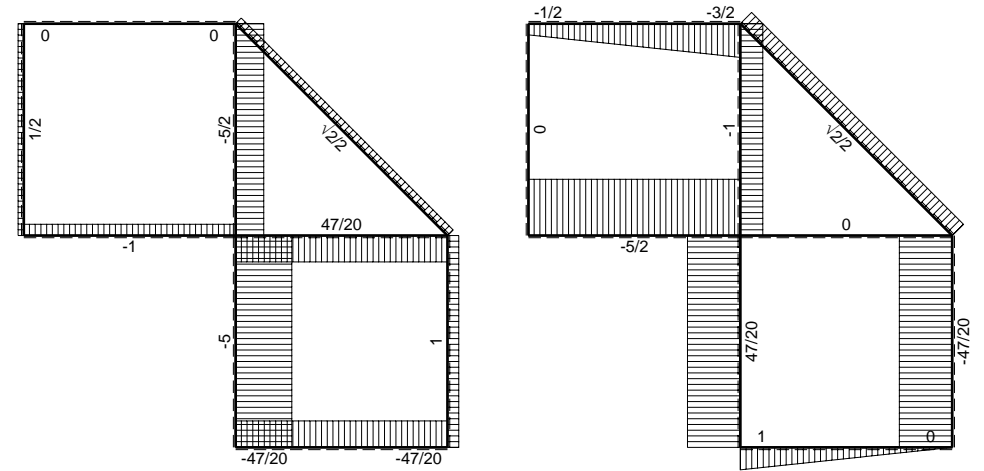
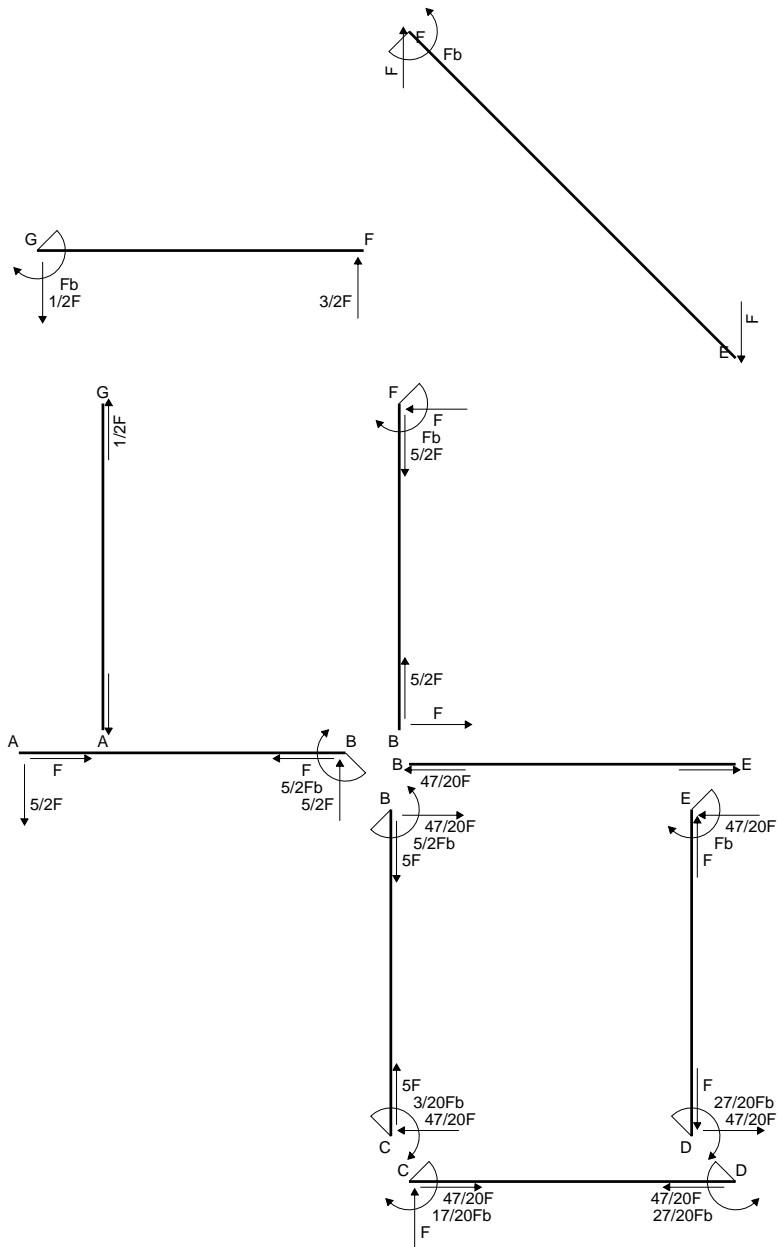
$$= (-1/4 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -13/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

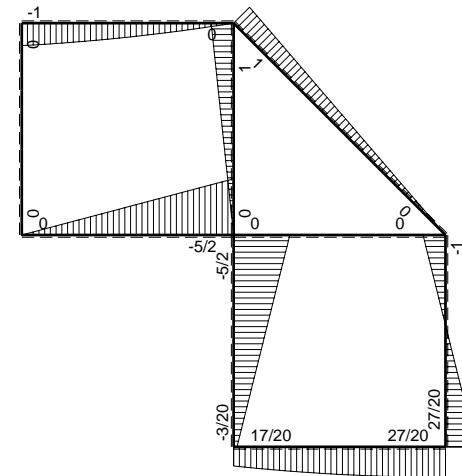
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

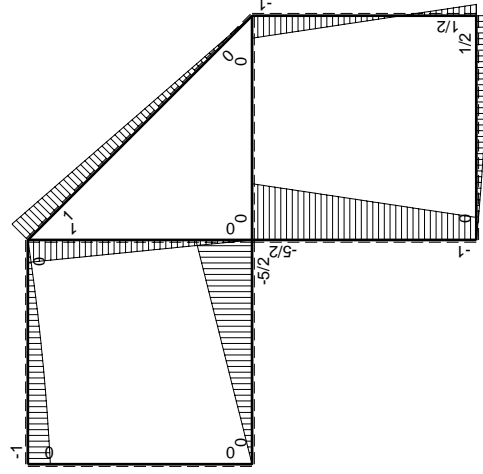
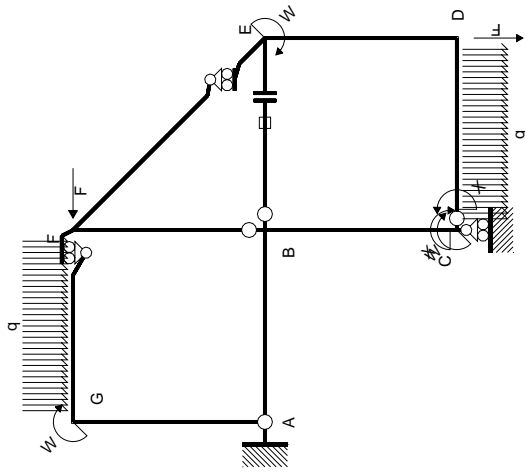


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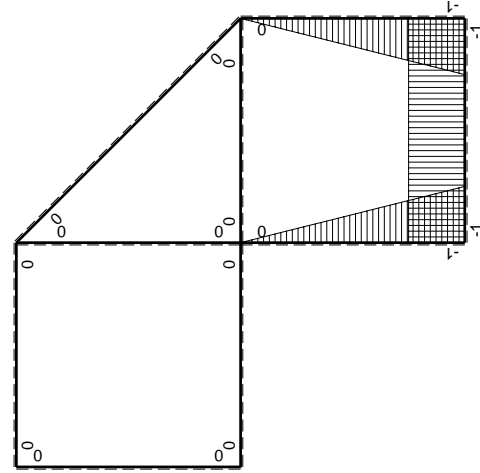


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				17/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-17/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

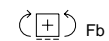
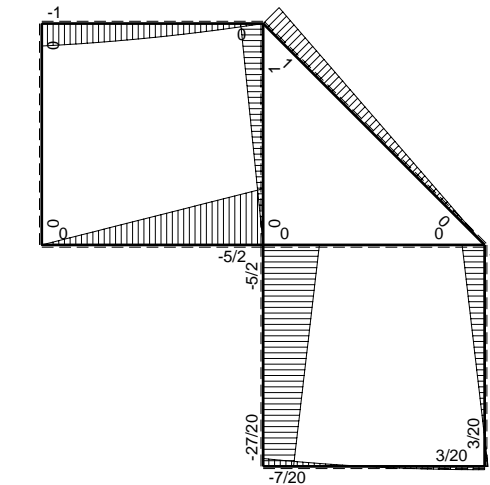
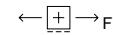
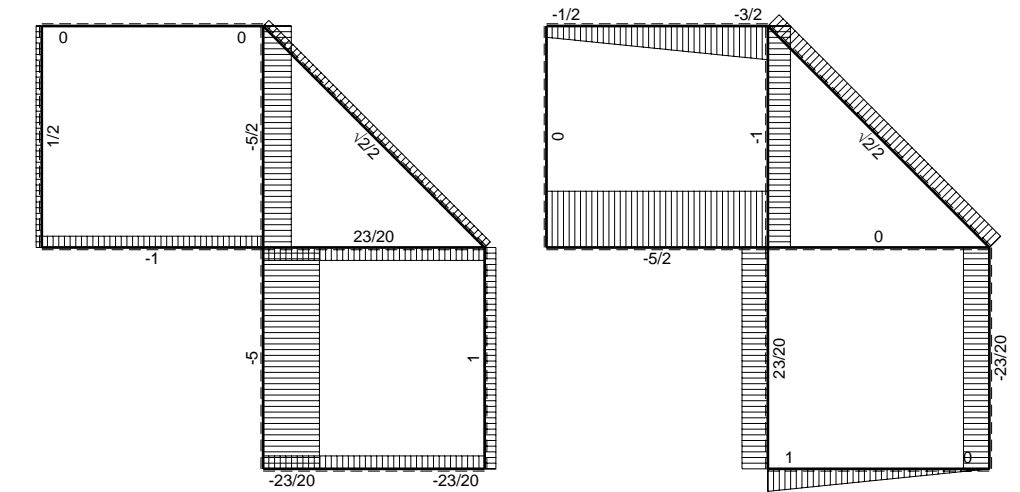
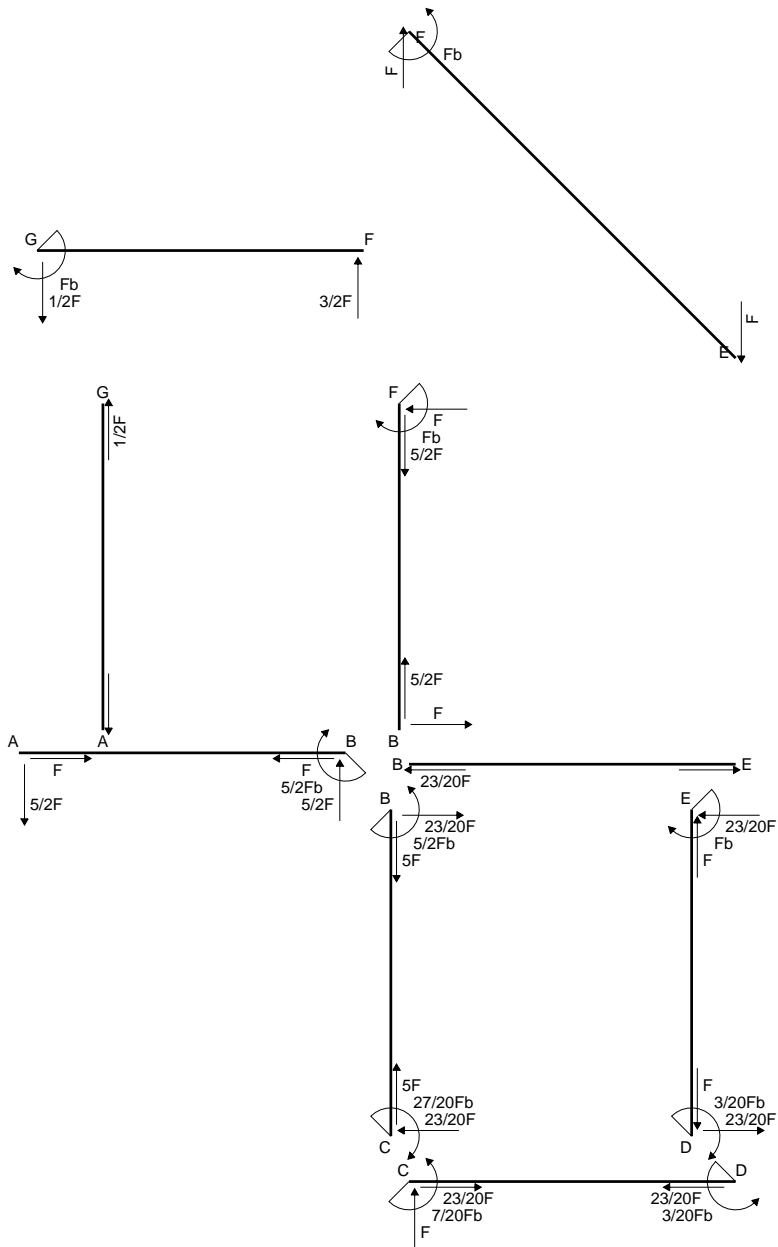
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

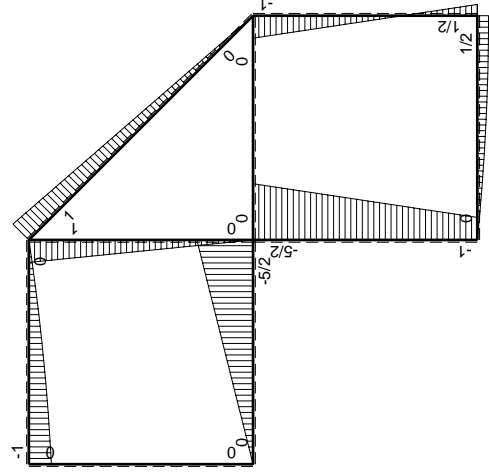
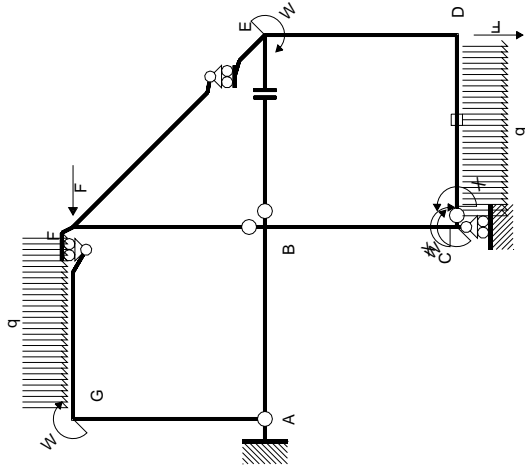
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

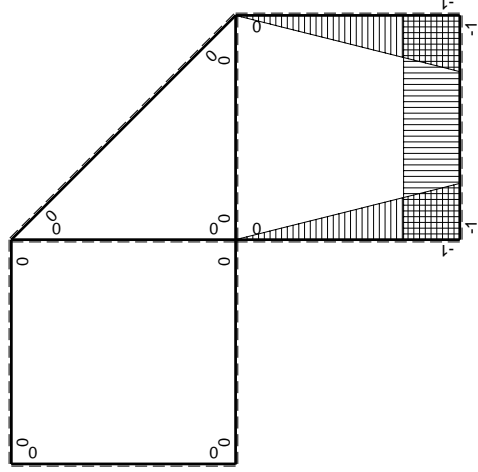
$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-7/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				7/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

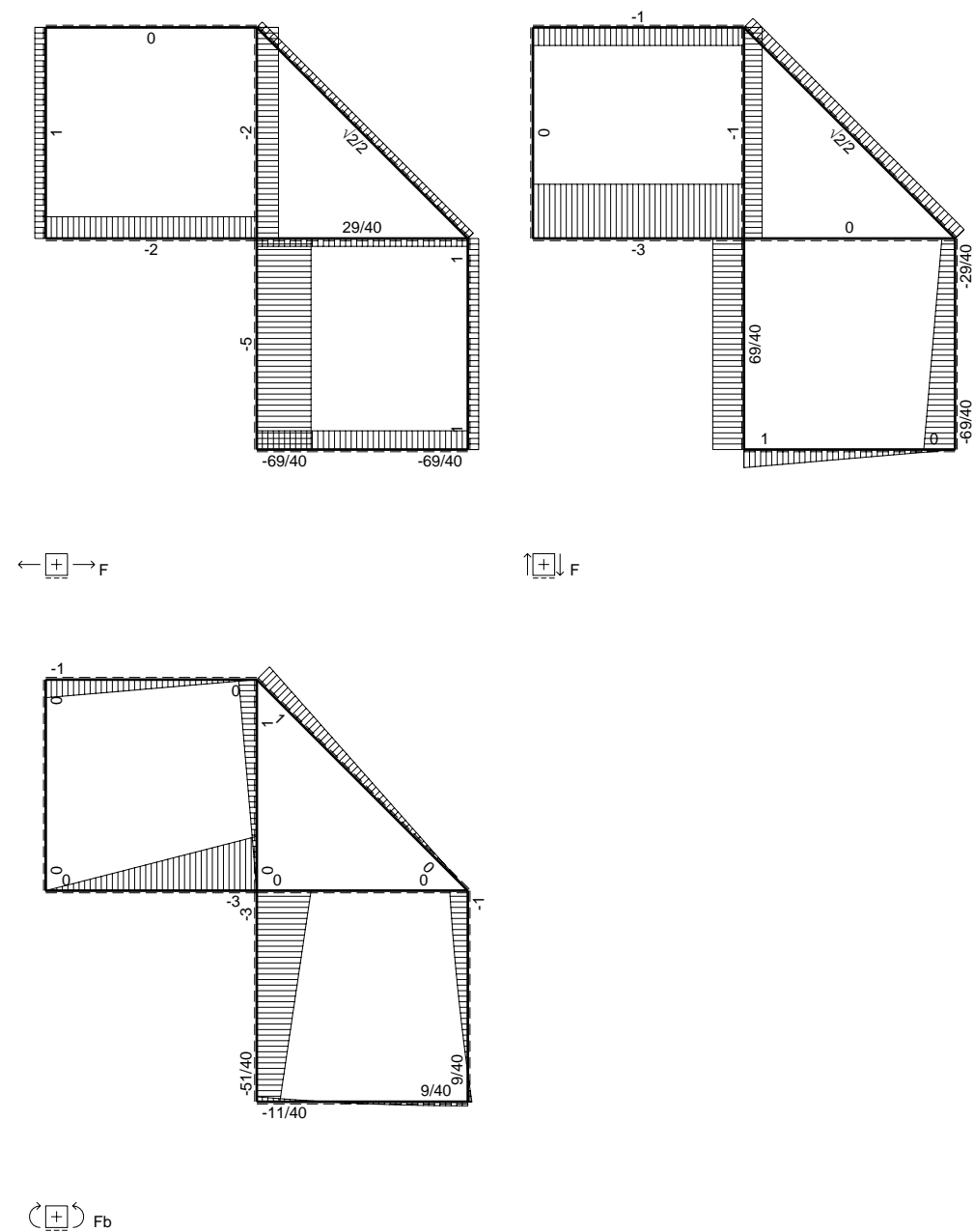
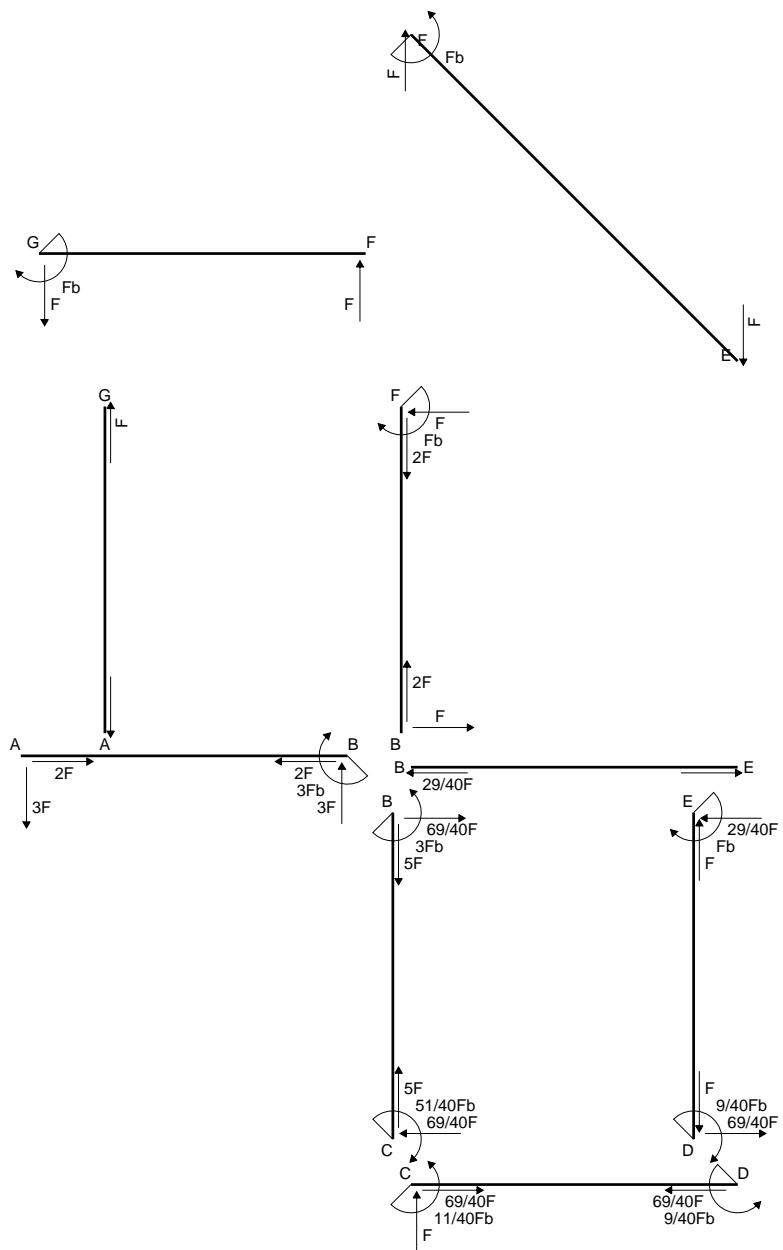
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

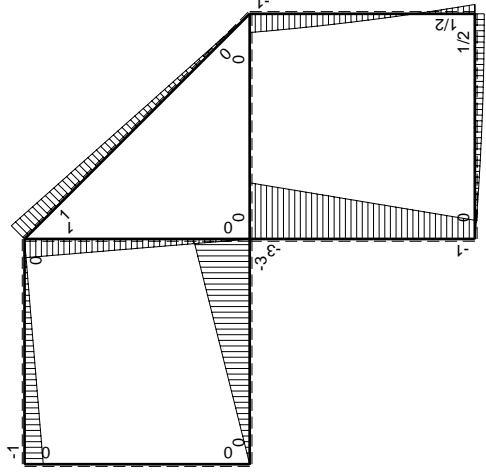
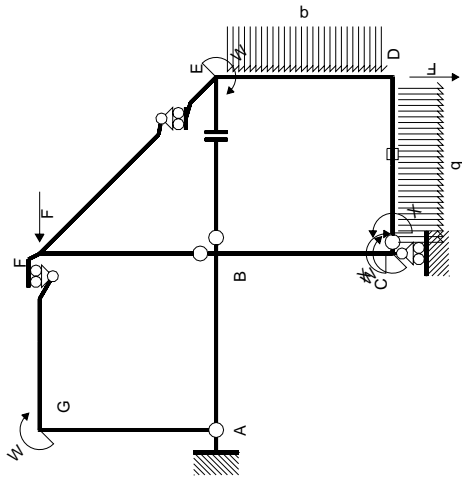
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

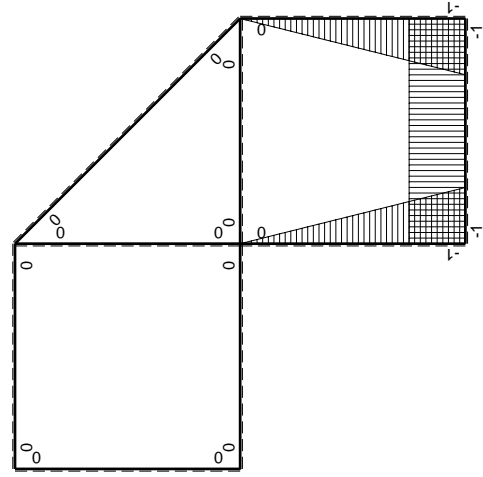
$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-2Fx+1/2qx^2$	$-1/2Fb+5/2Fx-5/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-Fx-1/2qx^2$	$Fx-Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-11/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$11/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{2} x^2/b - \frac{2}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/2 b - 2/3 b) \cdot Fb \cdot 1/EJ = 5/6 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{2} x^2/b - \frac{2}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/2 b - 2/3 b) \cdot Fb \cdot 1/EJ = 5/6 \cdot Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= \left[-\frac{1}{2} x^2/b + \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -4/3 \cdot Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= \left[-\frac{1}{2} x + \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -4/3 \cdot Fb^2/EJ$$

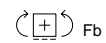
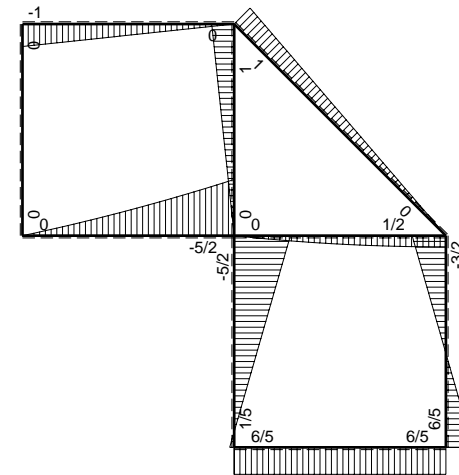
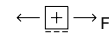
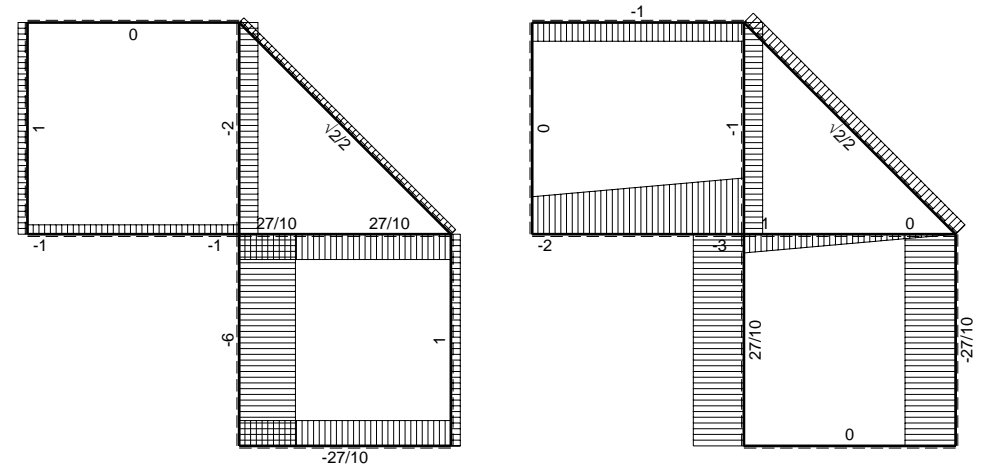
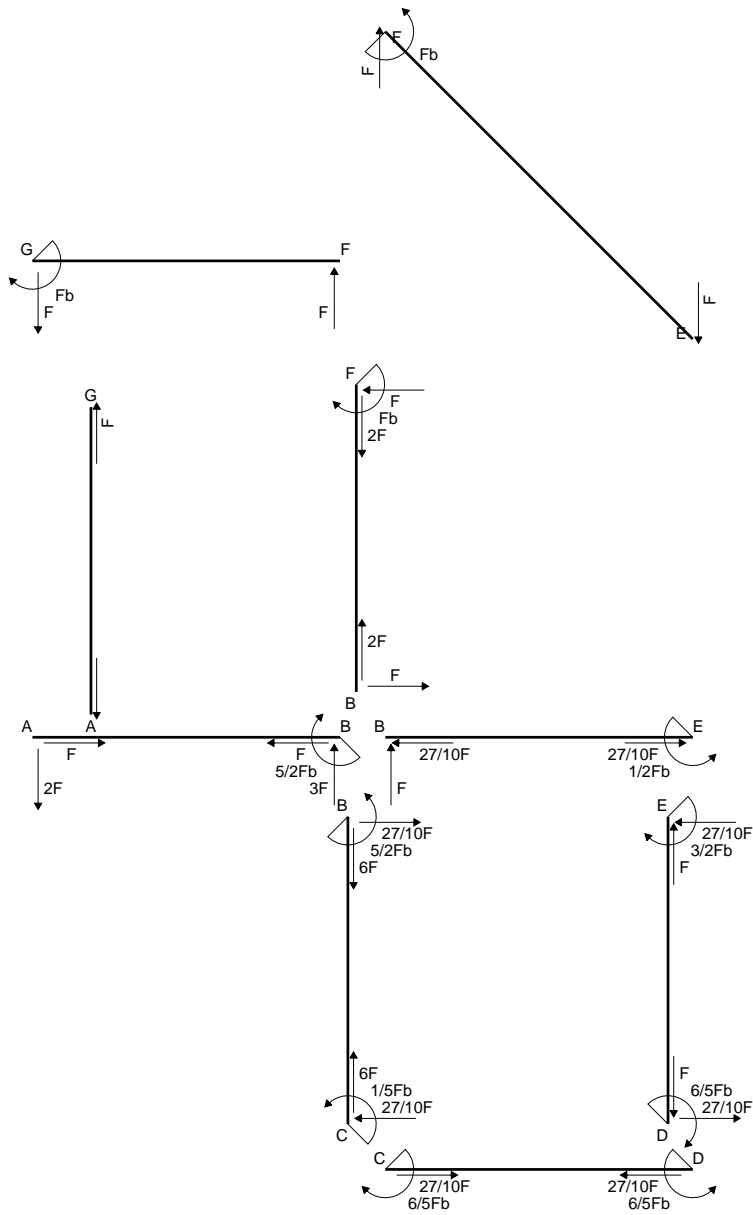
$$L_{DE}^{xo} = \int_0^b (-1/2 + 5/2 x/b - 5/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

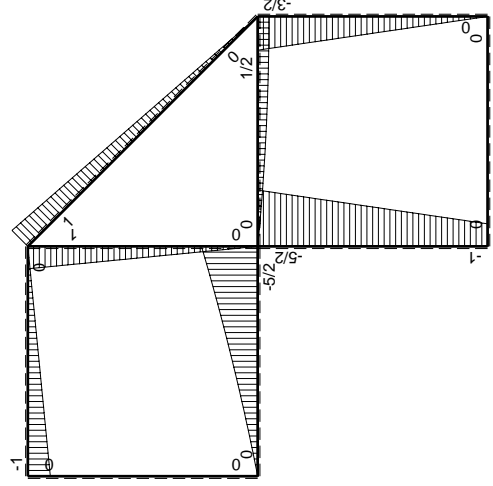
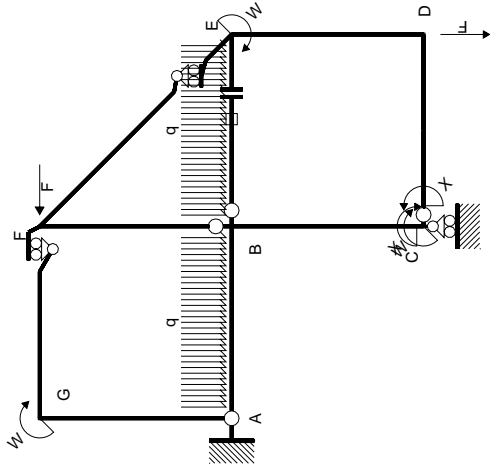
$$= \left[-\frac{1}{2} x + \frac{5}{4} x^2/b - \frac{5}{6} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 5/4 b - 5/6 b + 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

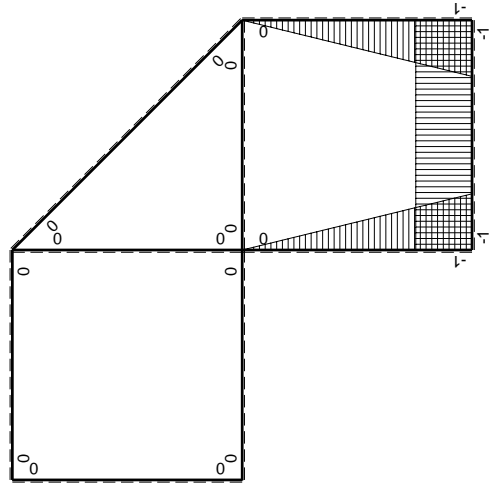
$$= (1/2 b - 1/3 b - 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-3/2Fx$	$3/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$3/2Fb - 3/2Fx$	$3/2Fx - 3/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx - 1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb + 1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^{E-BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

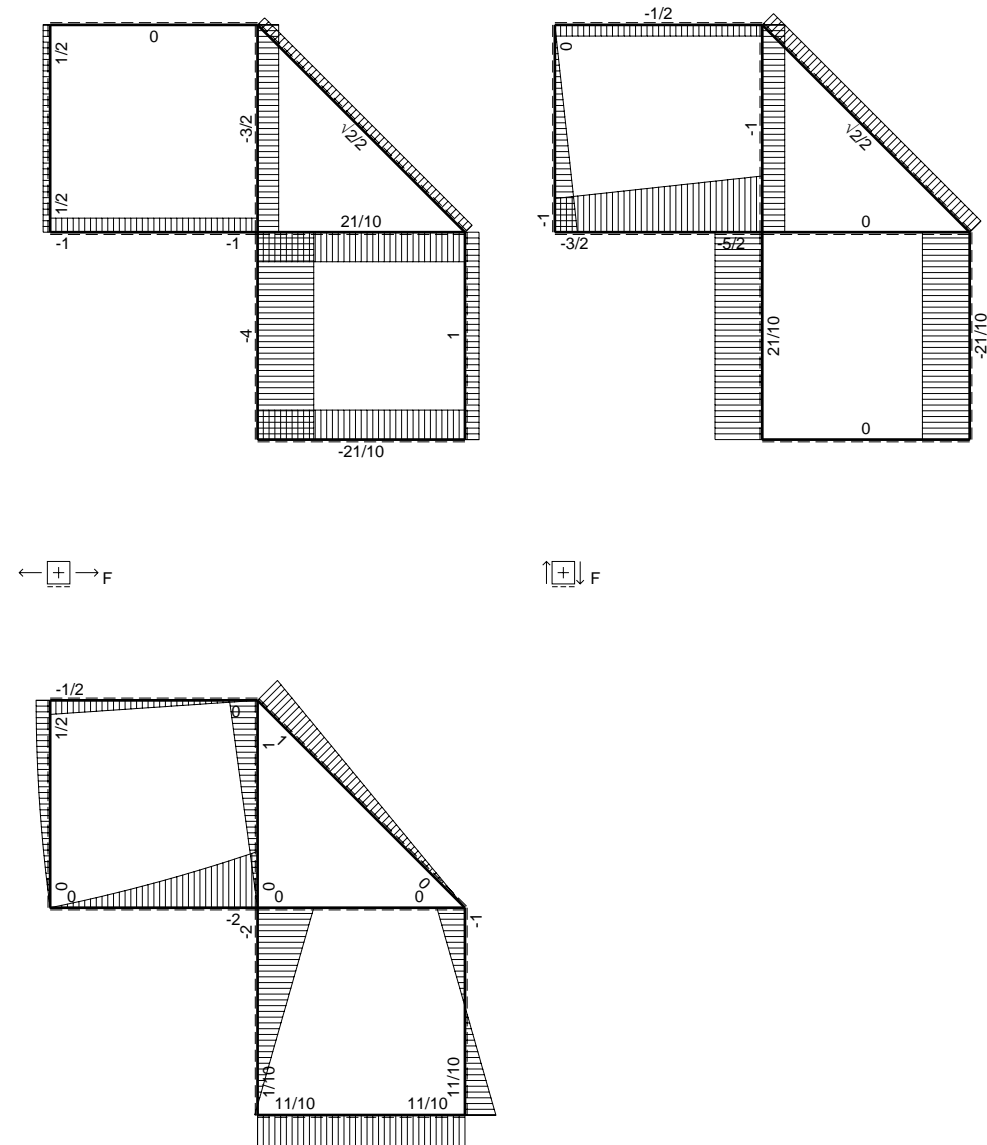
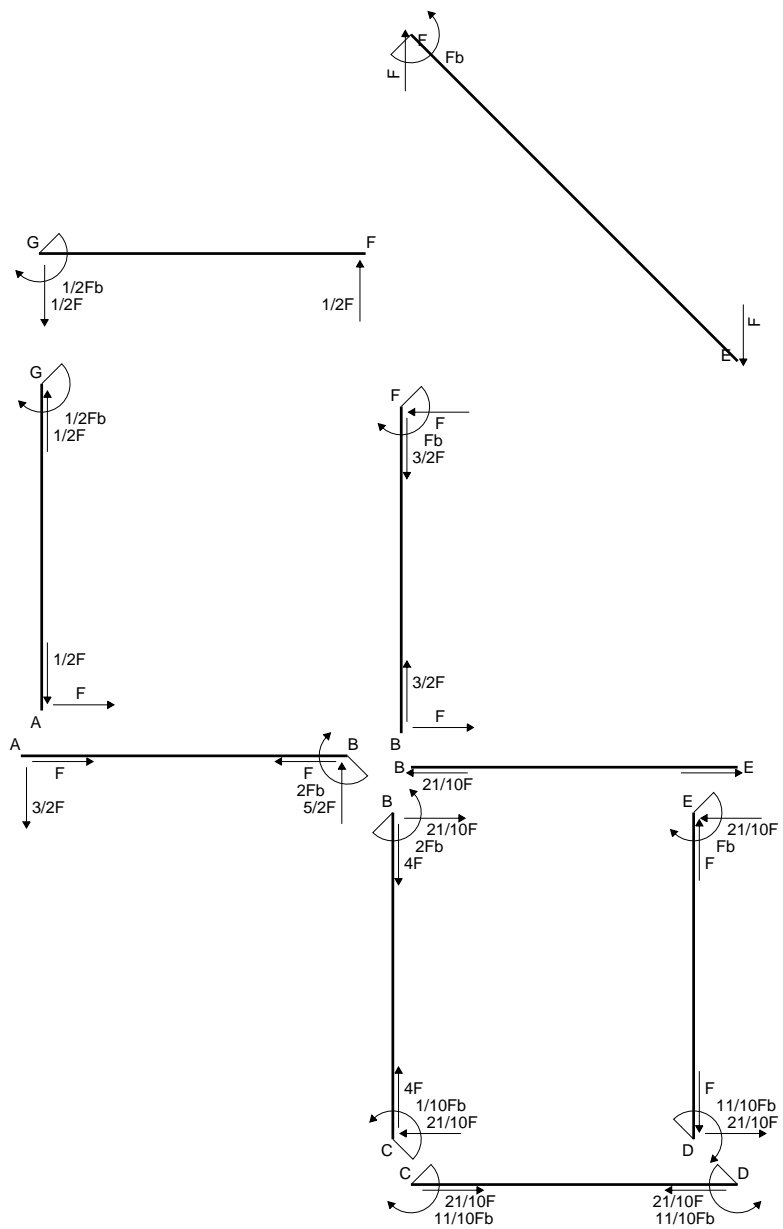
$$= (b + 1/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 3/4 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

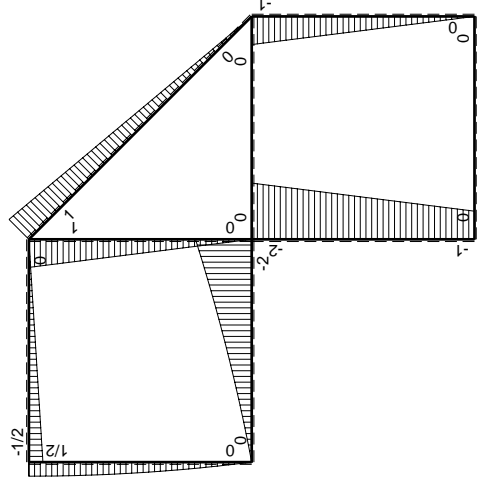
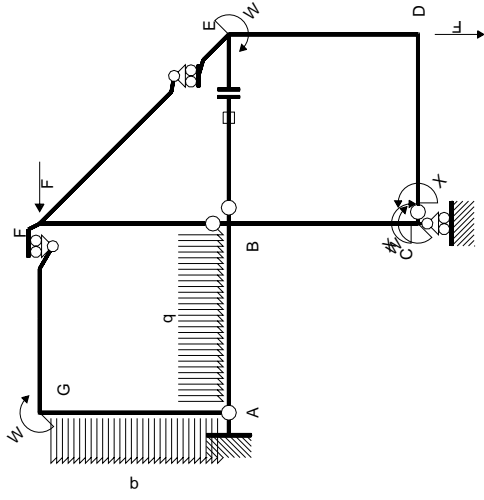
$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 \, x/b - 3/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/2 \, b) \cdot Fb \cdot 1/EJ = 1/4 \, Fb^2/EJ$$

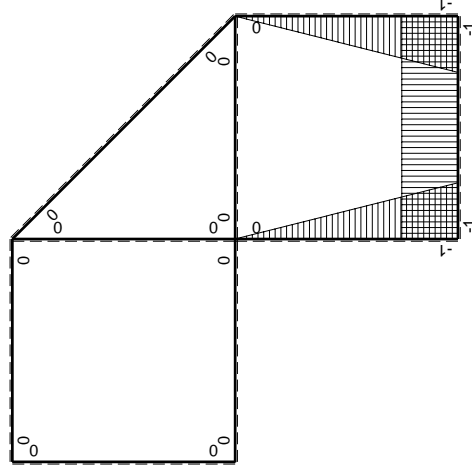


$\curvearrowright \boxed{+} \curvearrowleft Fb$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-1/2Fx$	0	0	0	0
GF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
GA b	0	$1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$-Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}					$-11/10Fb$

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

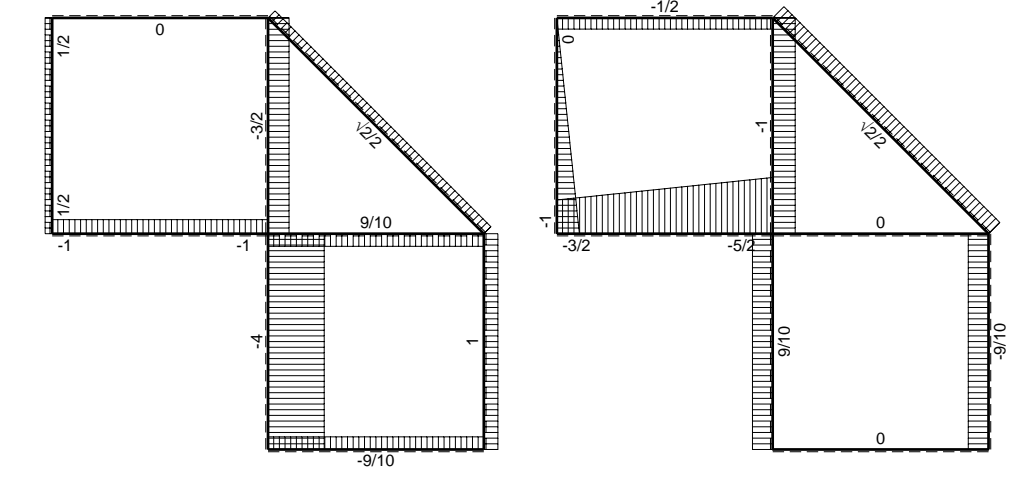
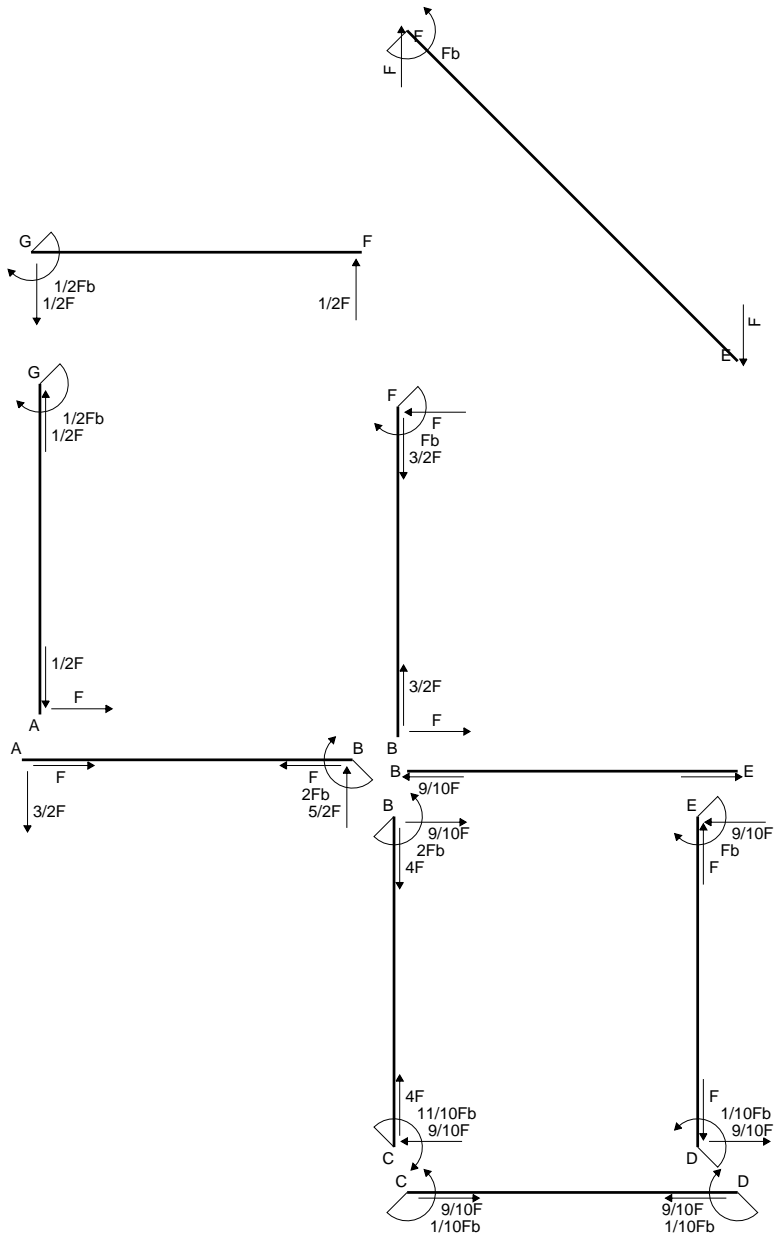
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

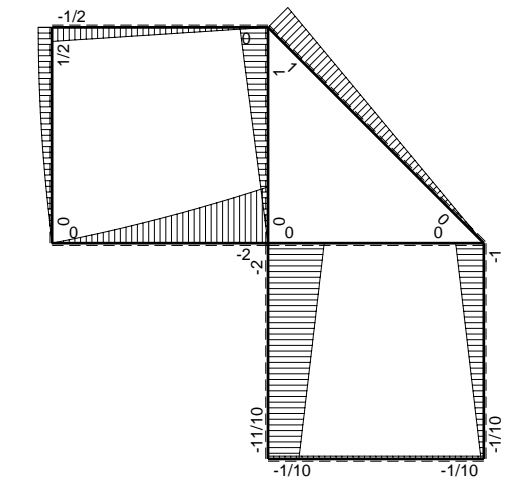
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

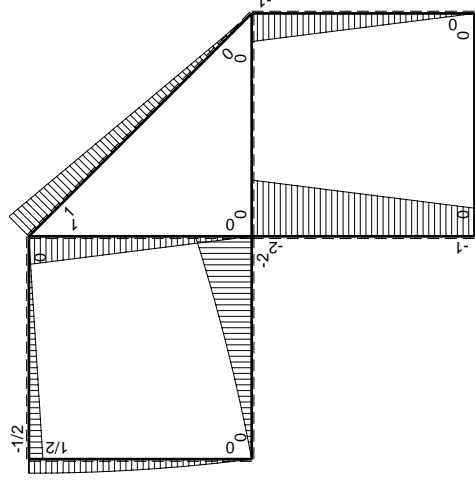
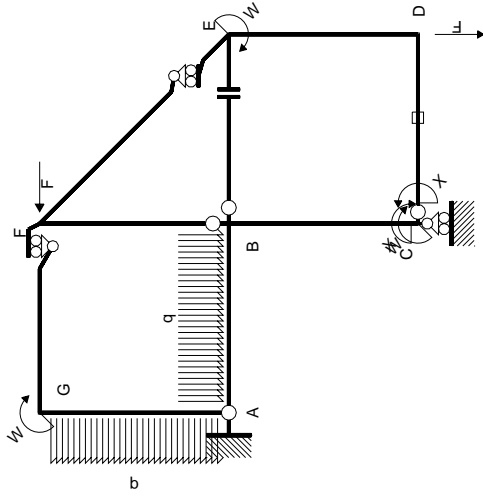


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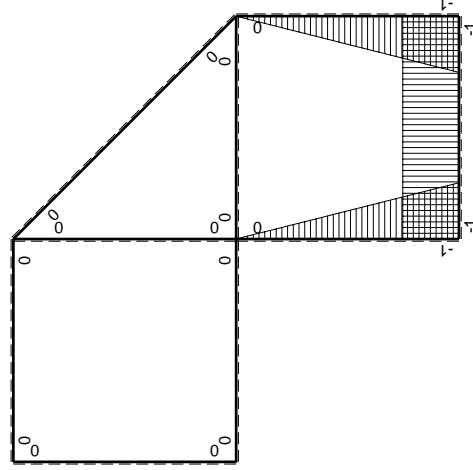


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-1/2Fx$	0	0	0	0
GF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
GA b	0	$1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$-Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

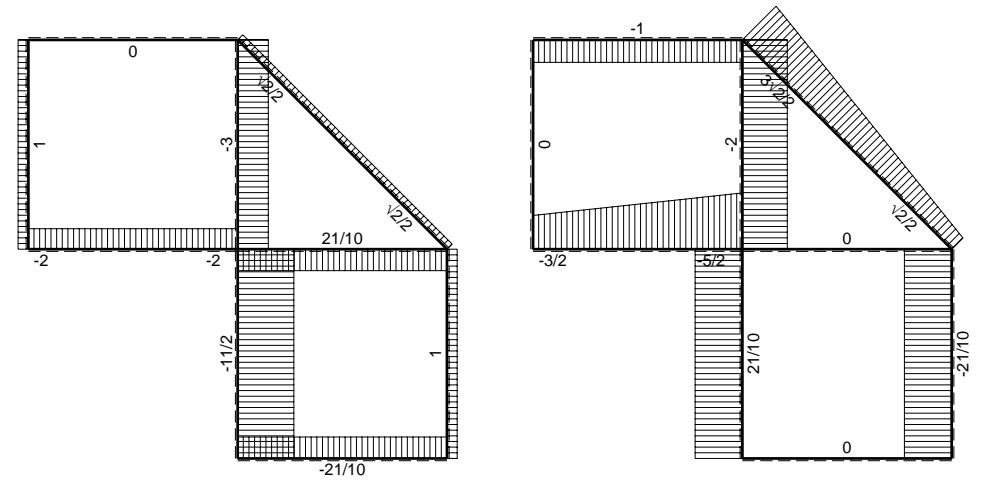
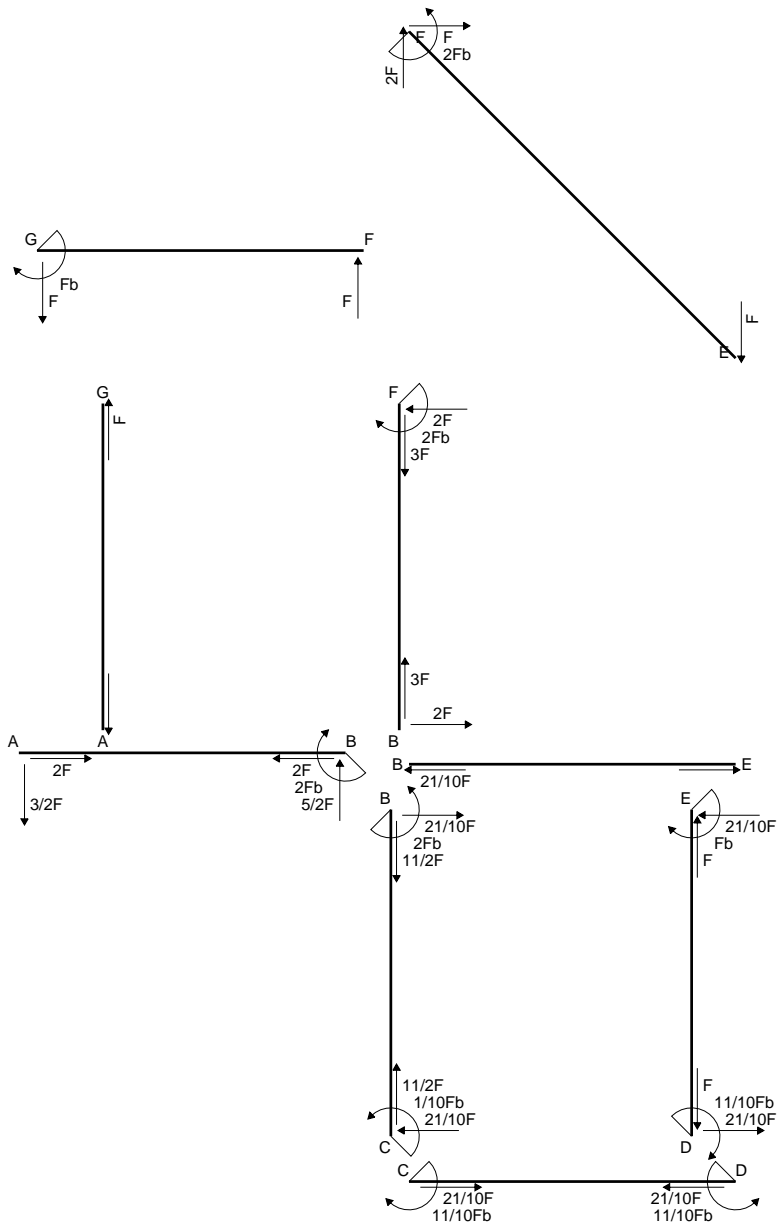
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

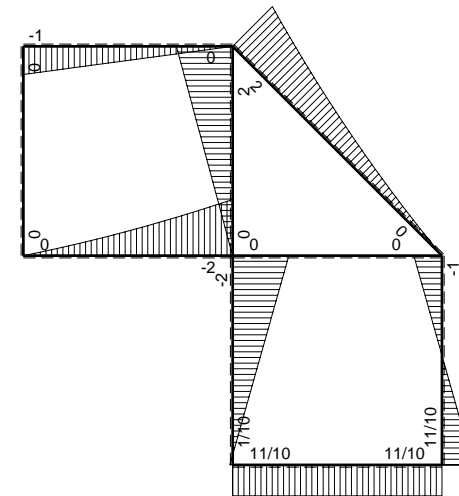
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

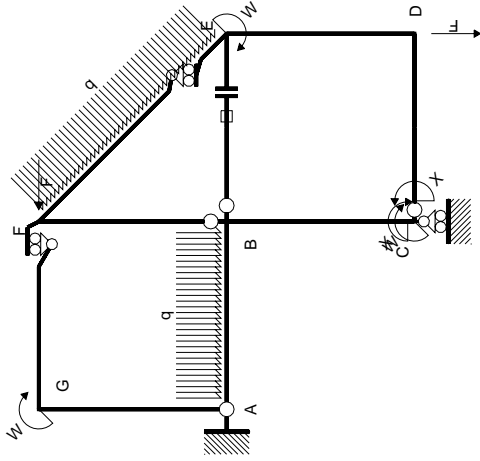


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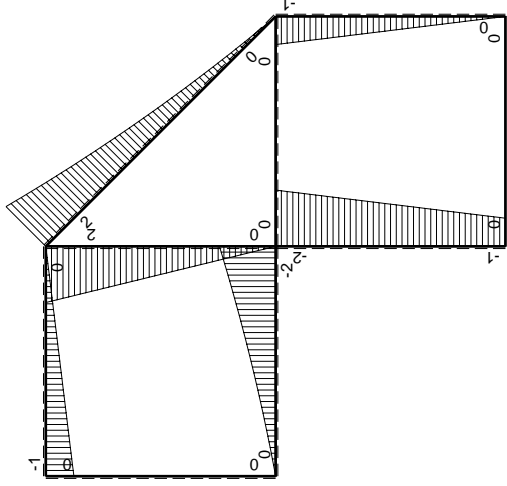
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⊕ ⊖ F_b



Schema di calcolo iperstatico

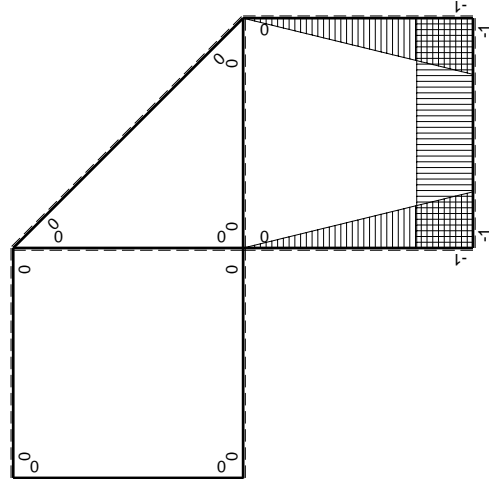


M_0 flessione da carichi assegnati

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	-Fx	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$2Fb - 2Fx$	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\varepsilon_{BE}} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$					$-11/10Fb$

Sviluppi di calcolo iperstatica



M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

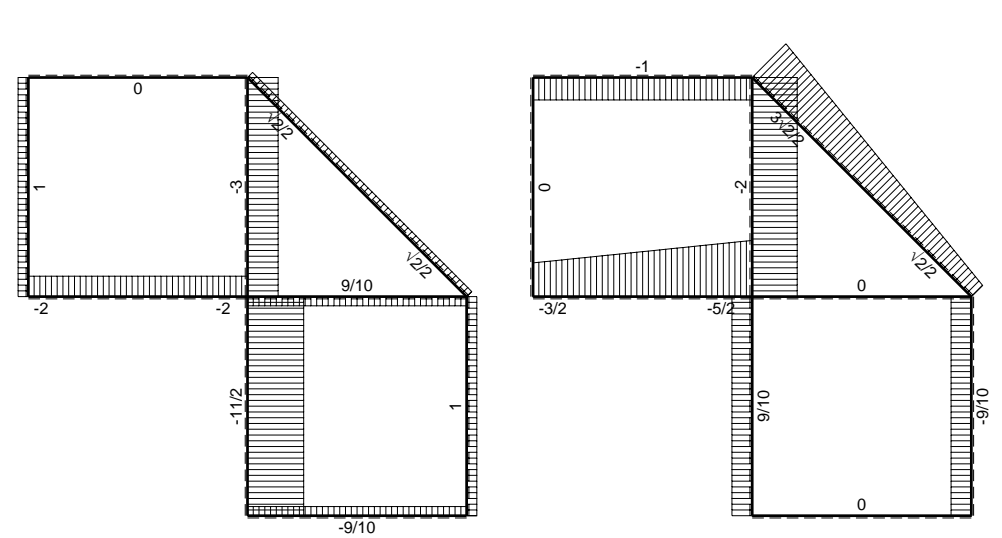
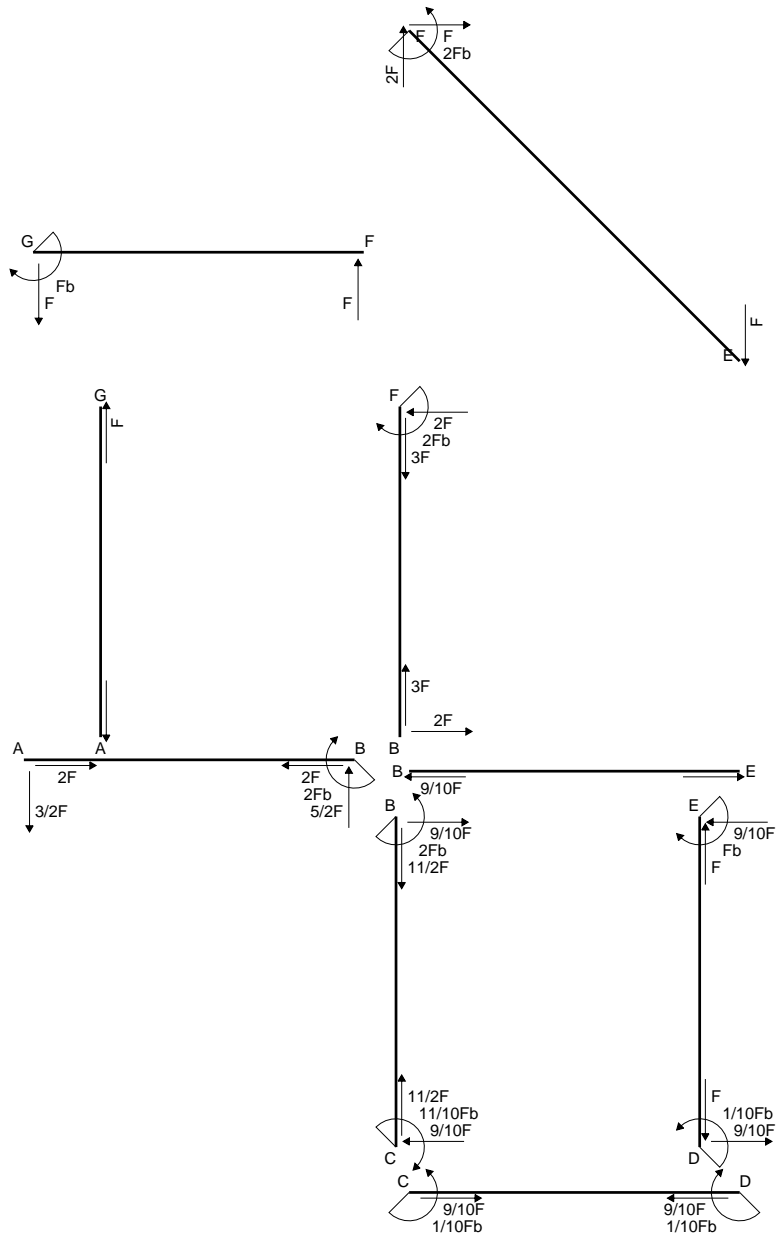
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

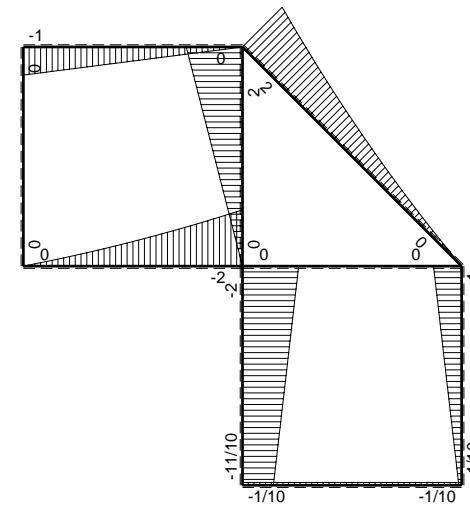
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

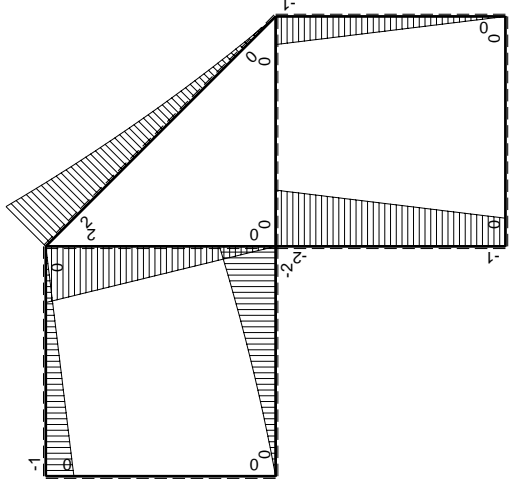
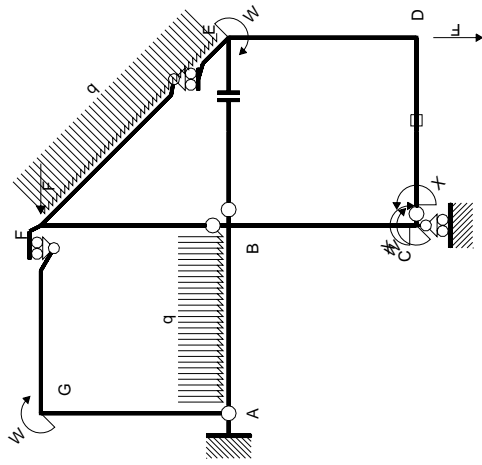


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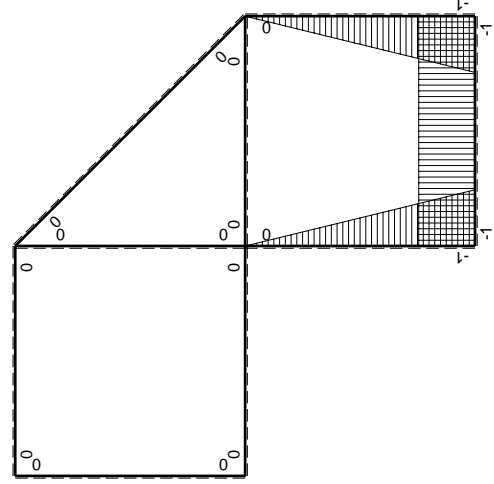


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	$-Fx$	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$2Fb - 2Fx$	0	0	0	0
BF b	0	$-2Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

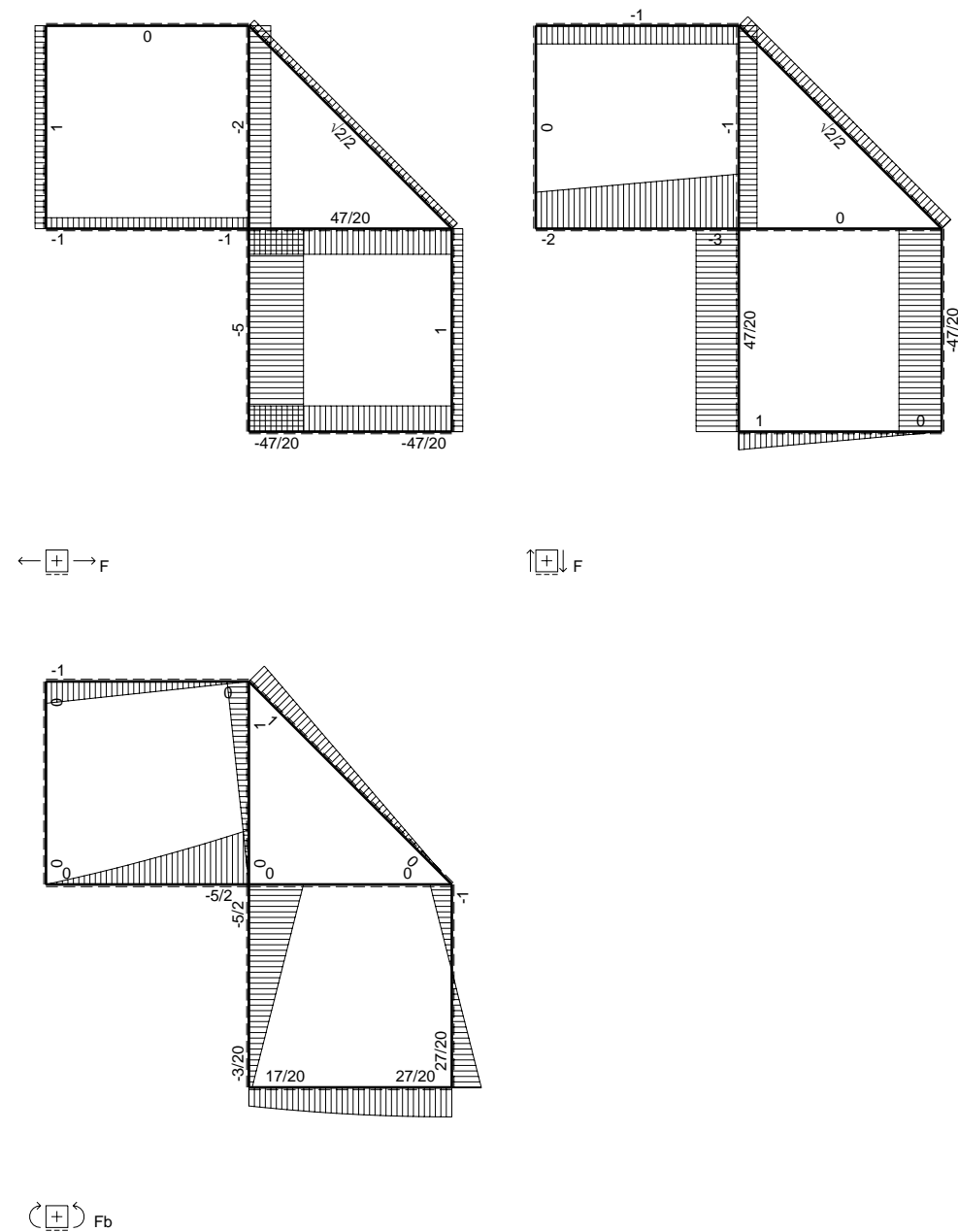
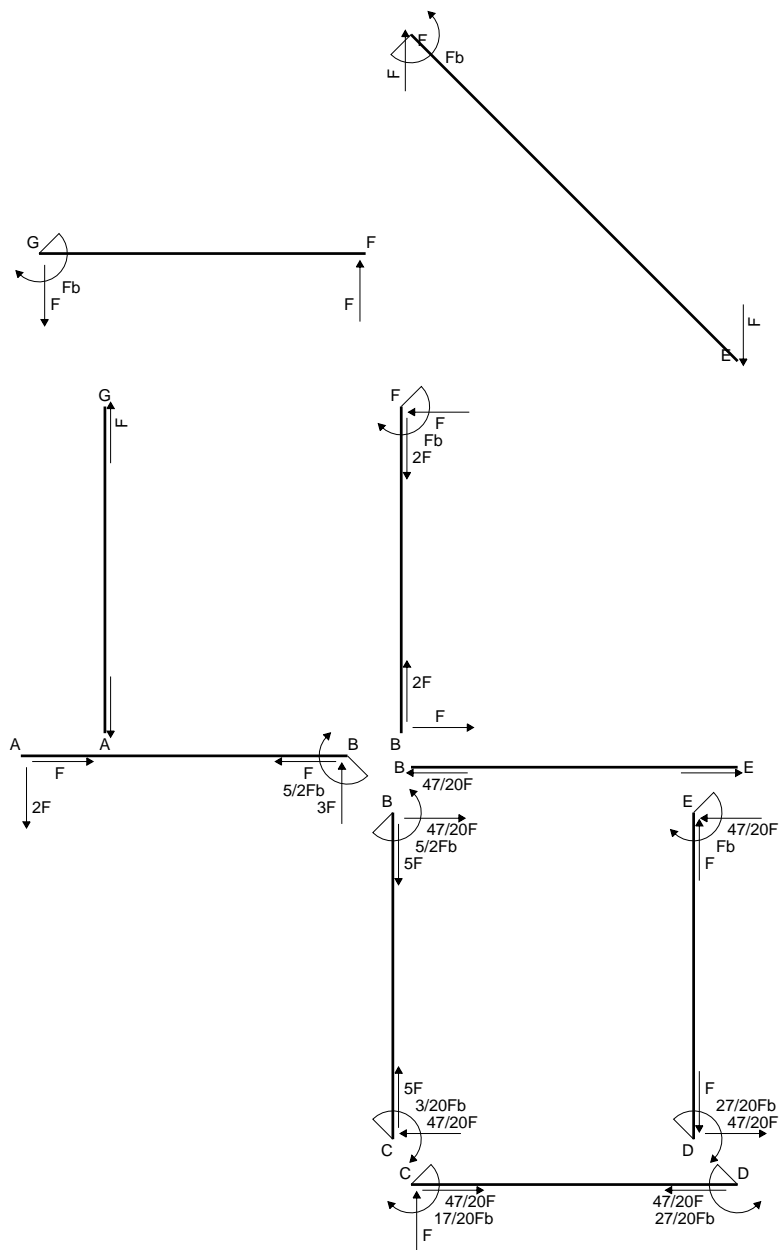
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

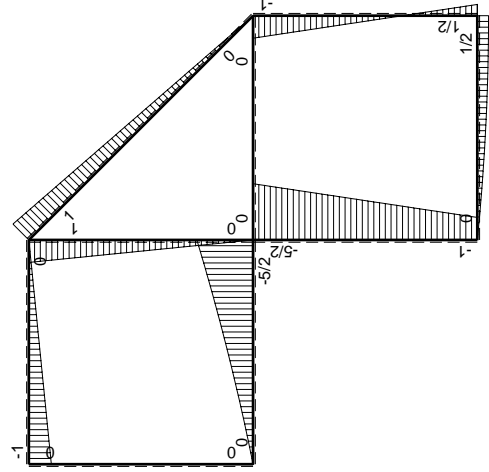
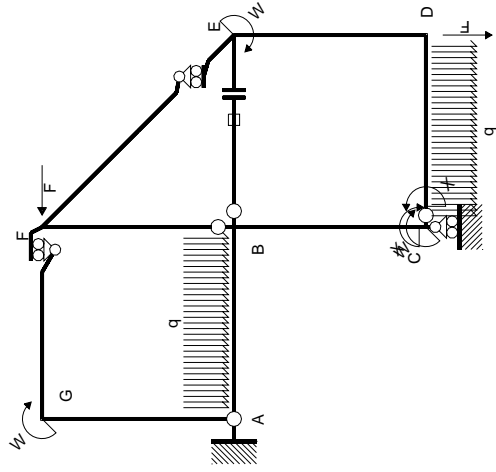
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

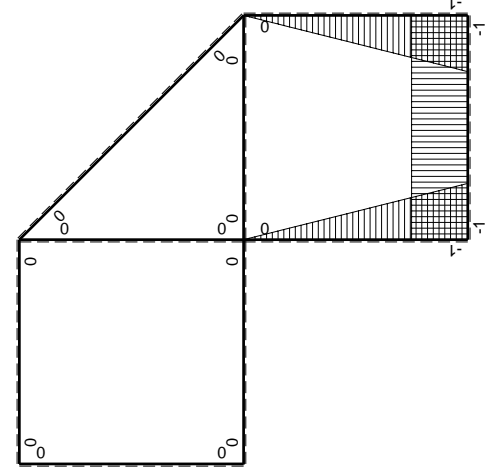


$\left[\oplus \right] F_b$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1		
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1		
DE b	$-1+x/b$	$1/2Fb - 3/2Fx$	$-1/2Fb + 2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	$Fb - 3/2Fx$	$Fx - 3/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-17/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

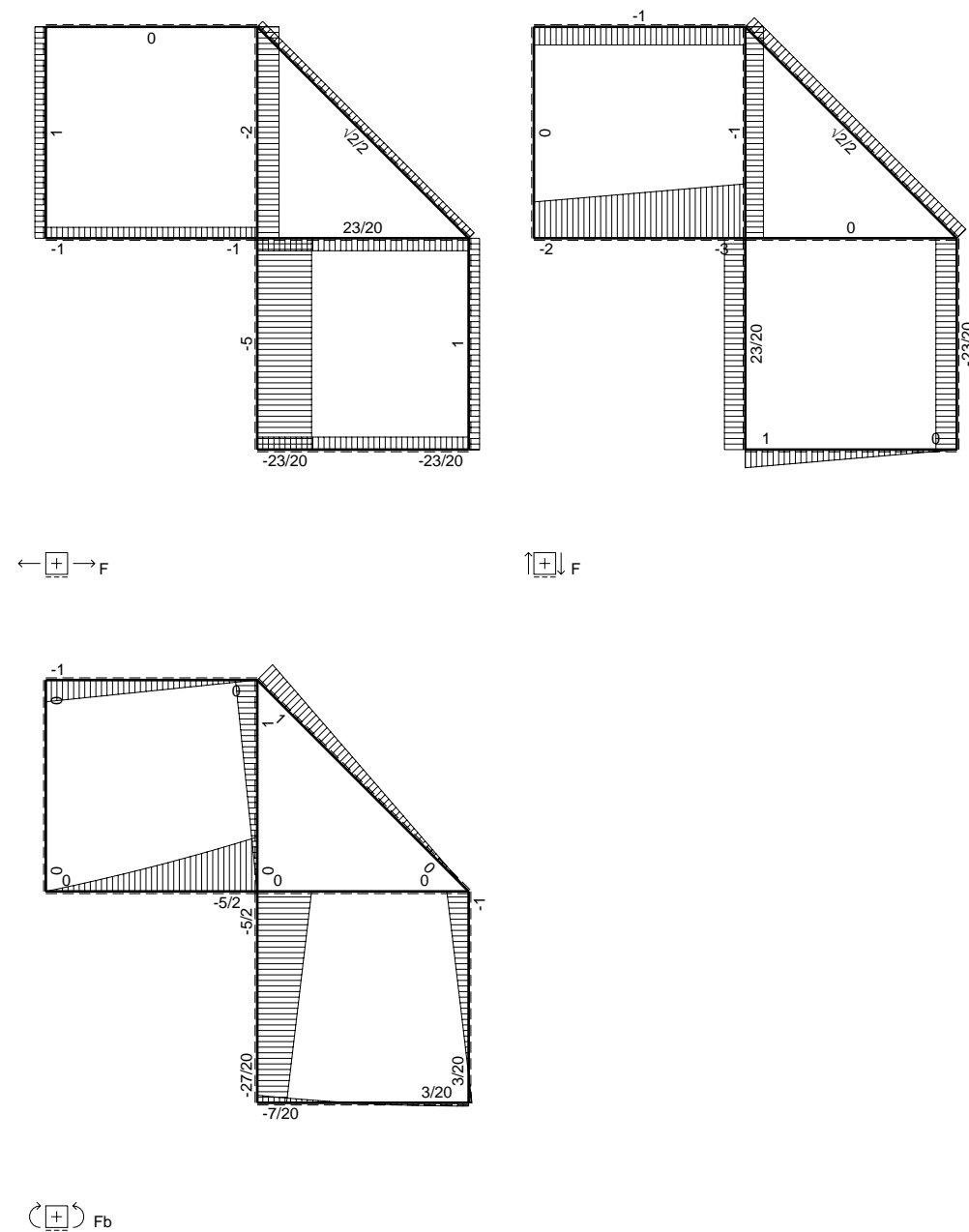
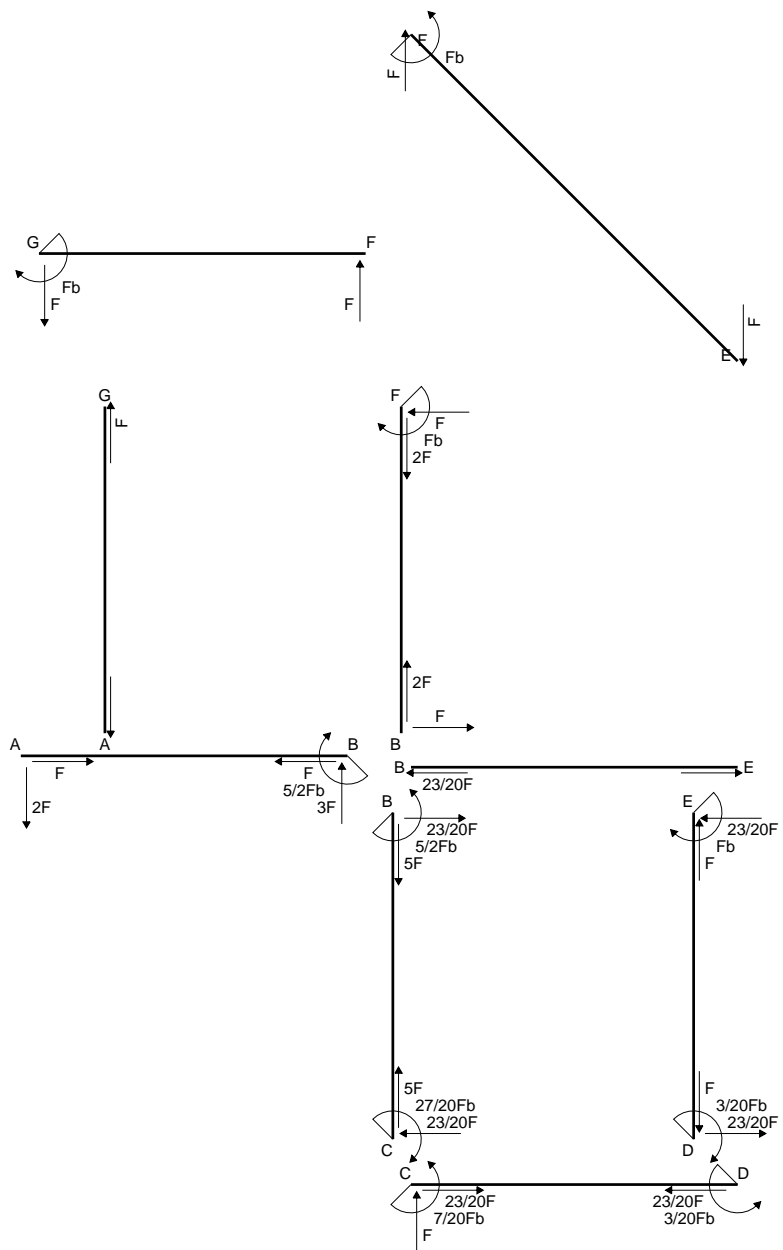
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

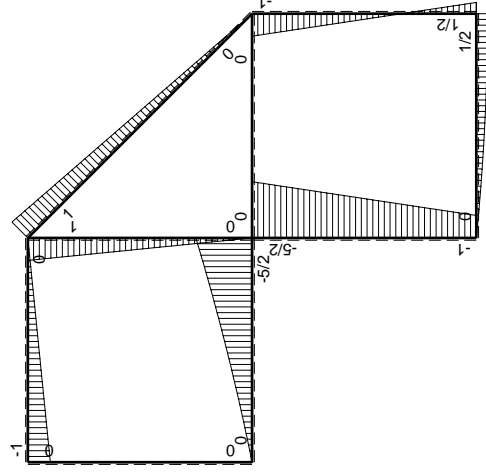
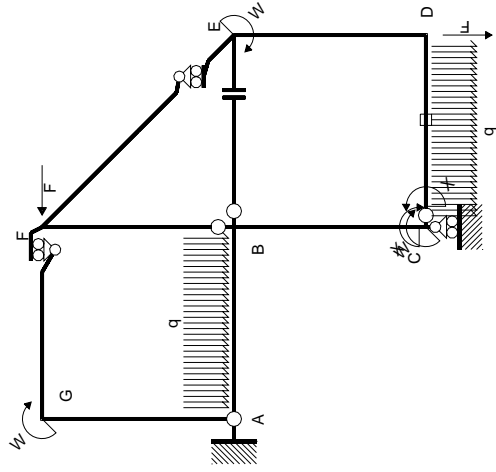
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

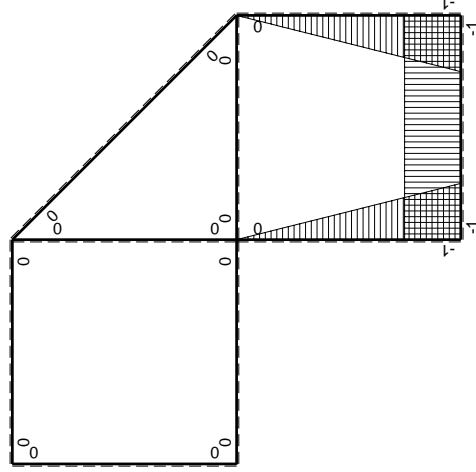
$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1		
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1		
DE b	$-1 + x/b$	$1/2Fb - 3/2Fx$	$-1/2Fb + 2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	$Fb - 3/2Fx$	$Fx - 3/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$7/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

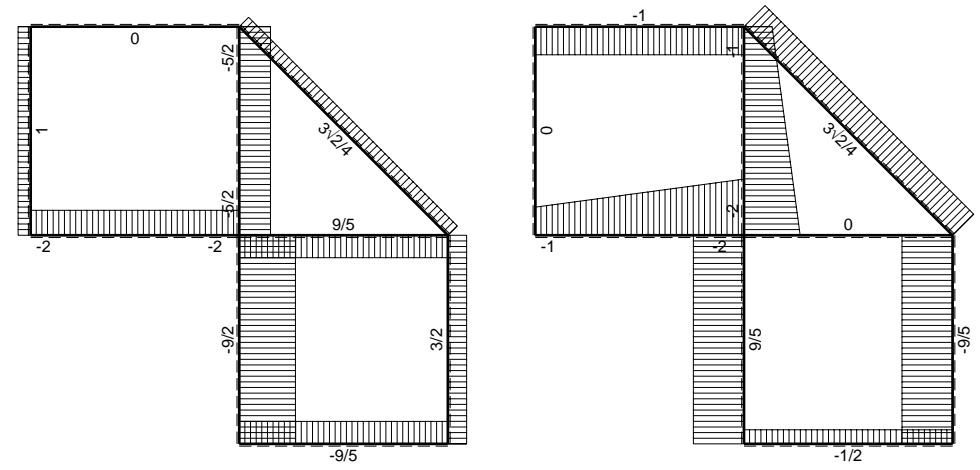
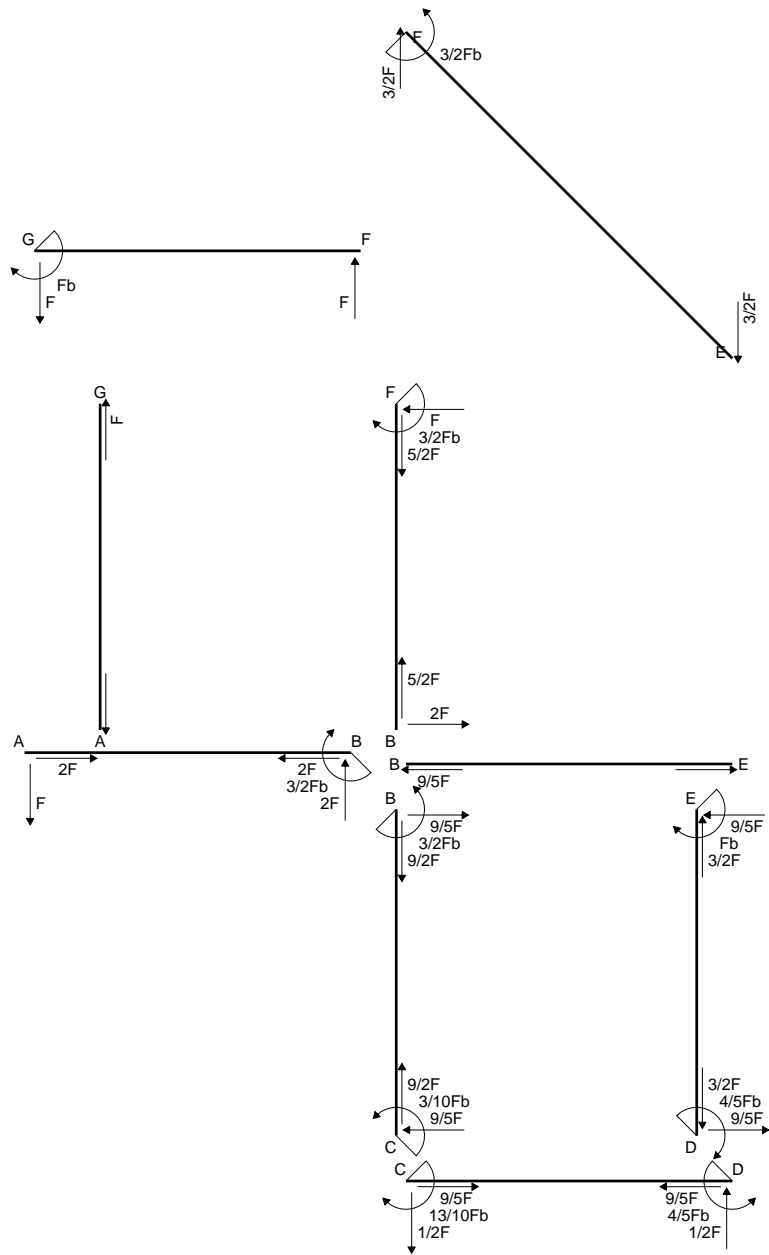
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

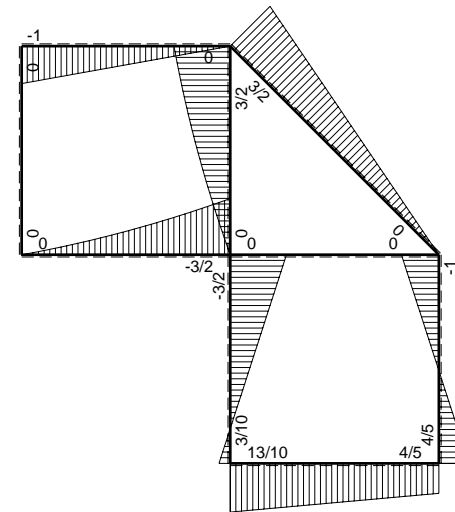
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$

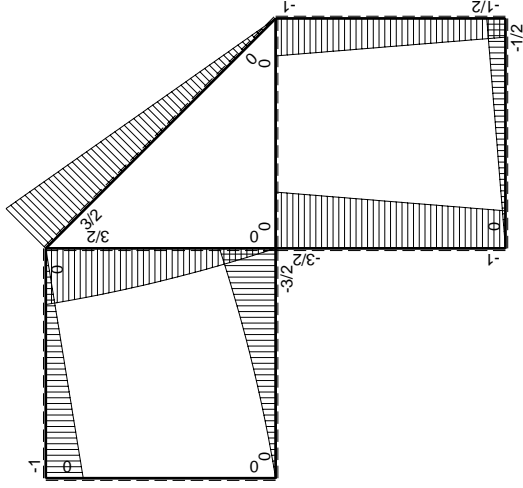
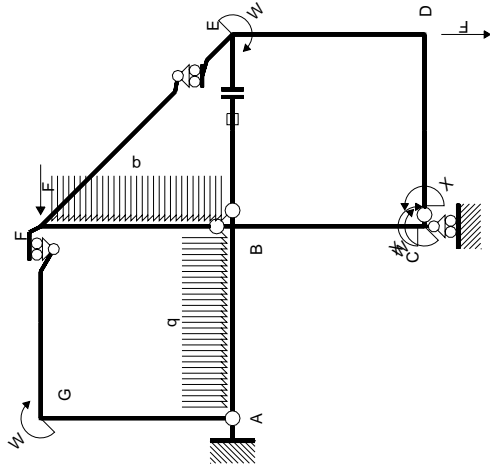


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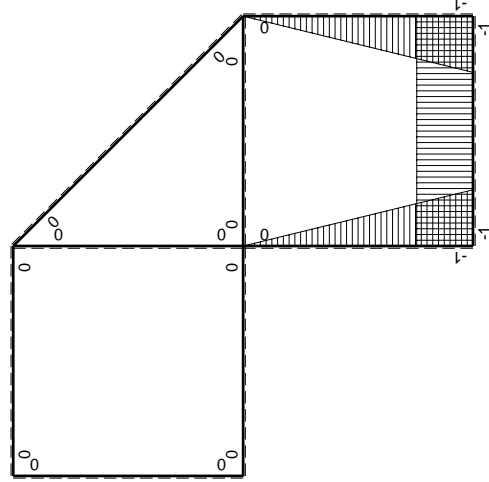


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/4Fb^2/EJ$	Xb/EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$-1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - 1/2Fx$	$Fx - 1/2Fx^2/b$	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-Fx$	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$3/2Fb - Fx - 1/2qx^2$	0	0	0	0
BF b	0	$-2Fx + 1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^{E-BE}$				Fb^2/EJ	
	totali				$13/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-13/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

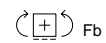
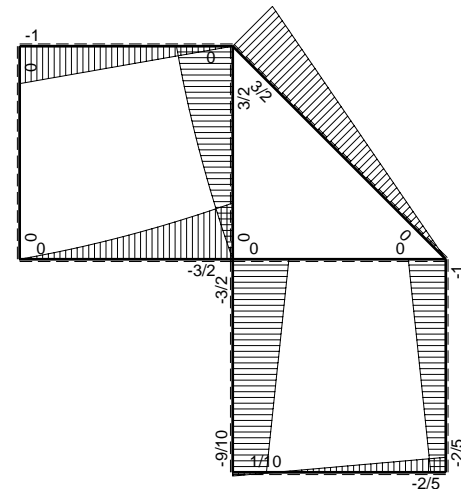
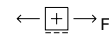
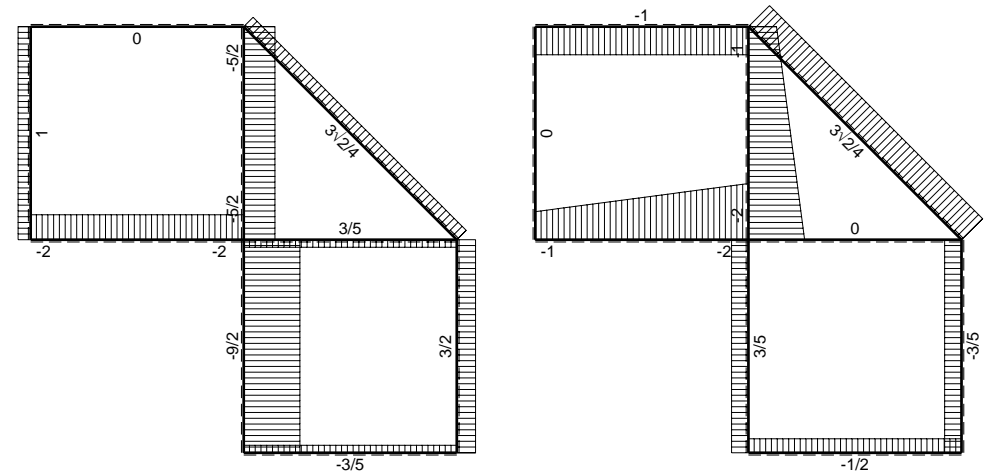
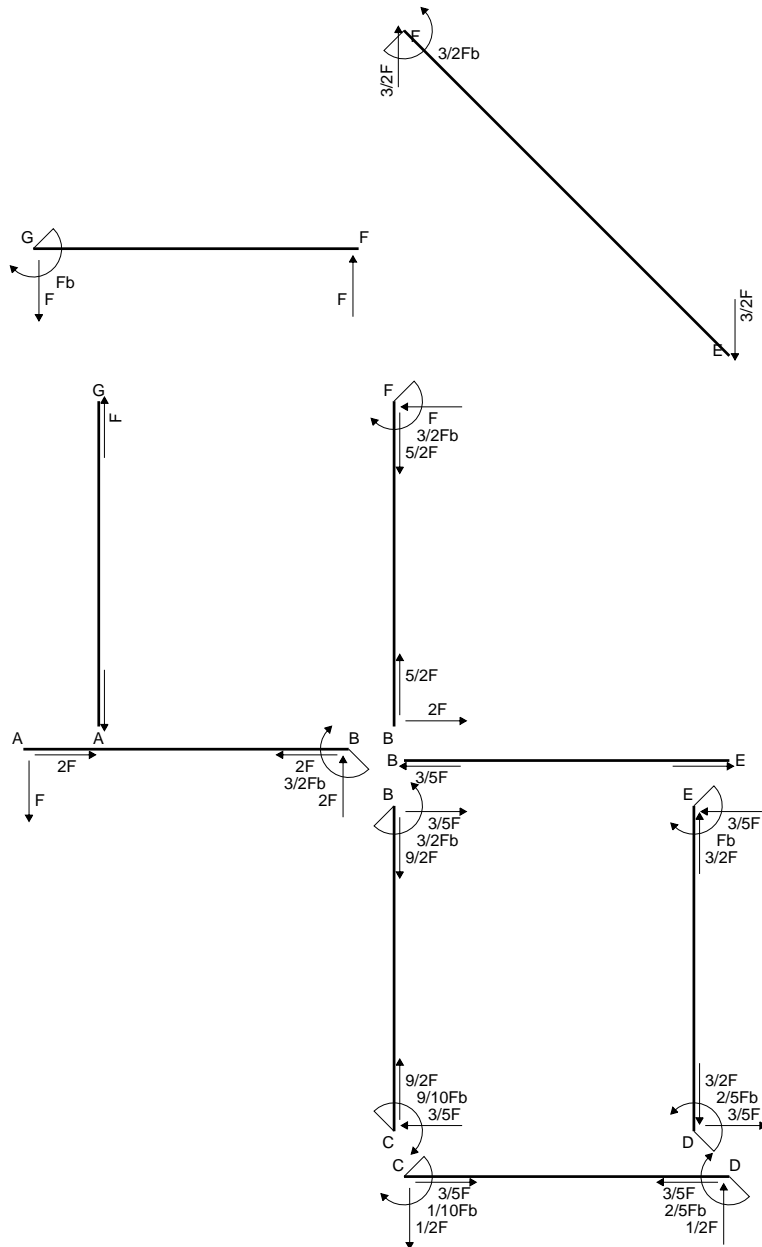
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

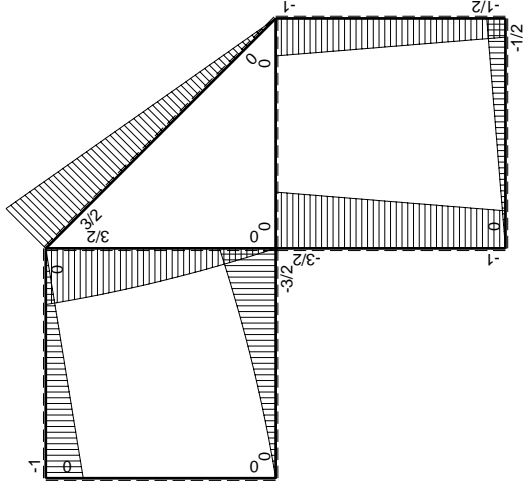
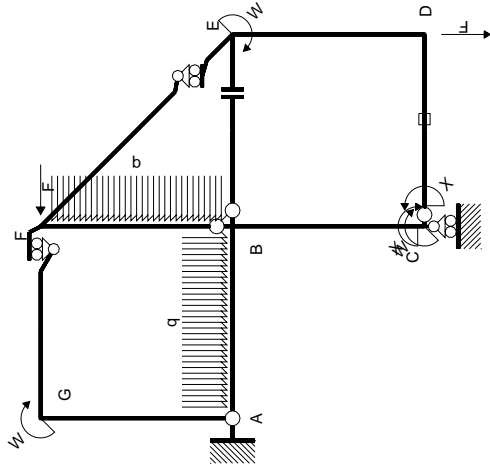
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

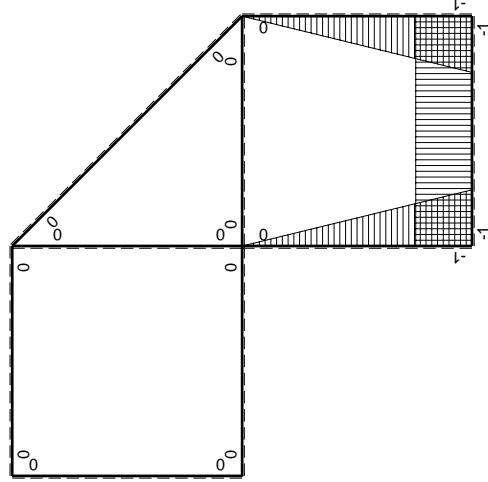
$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/4Fb^2/EJ$	Xb/EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$-1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - 1/2Fx$	$Fx - 1/2Fx^2/b$	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-Fx$	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$3/2Fb - Fx - 1/2qx^2$	0	0	0	0
BF b	0	$-2Fx + 1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$-1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

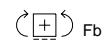
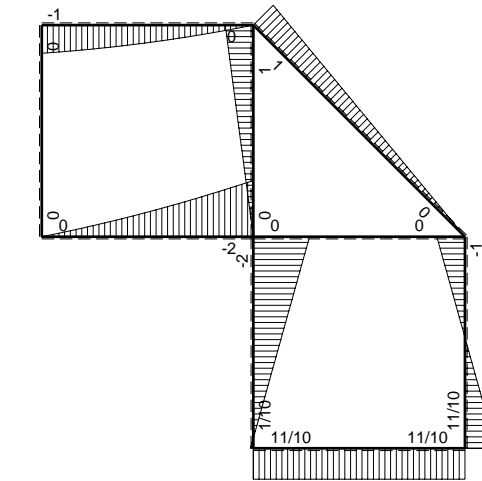
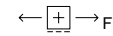
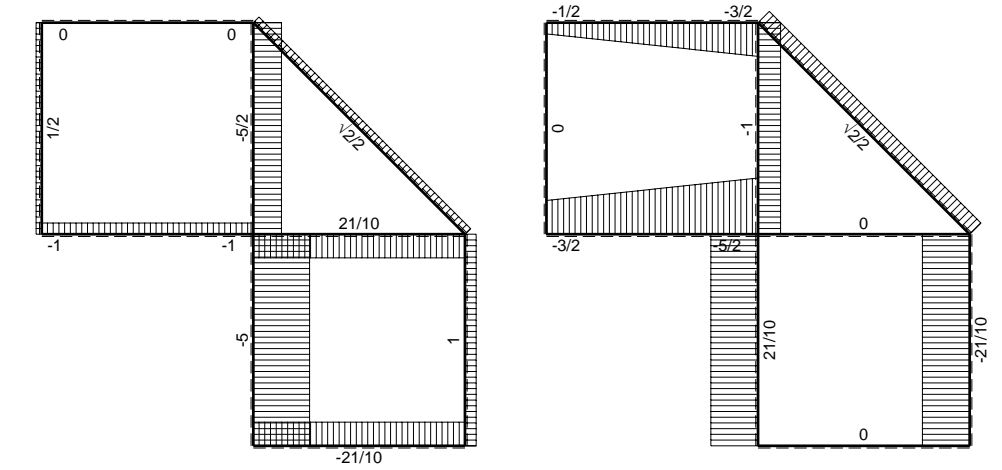
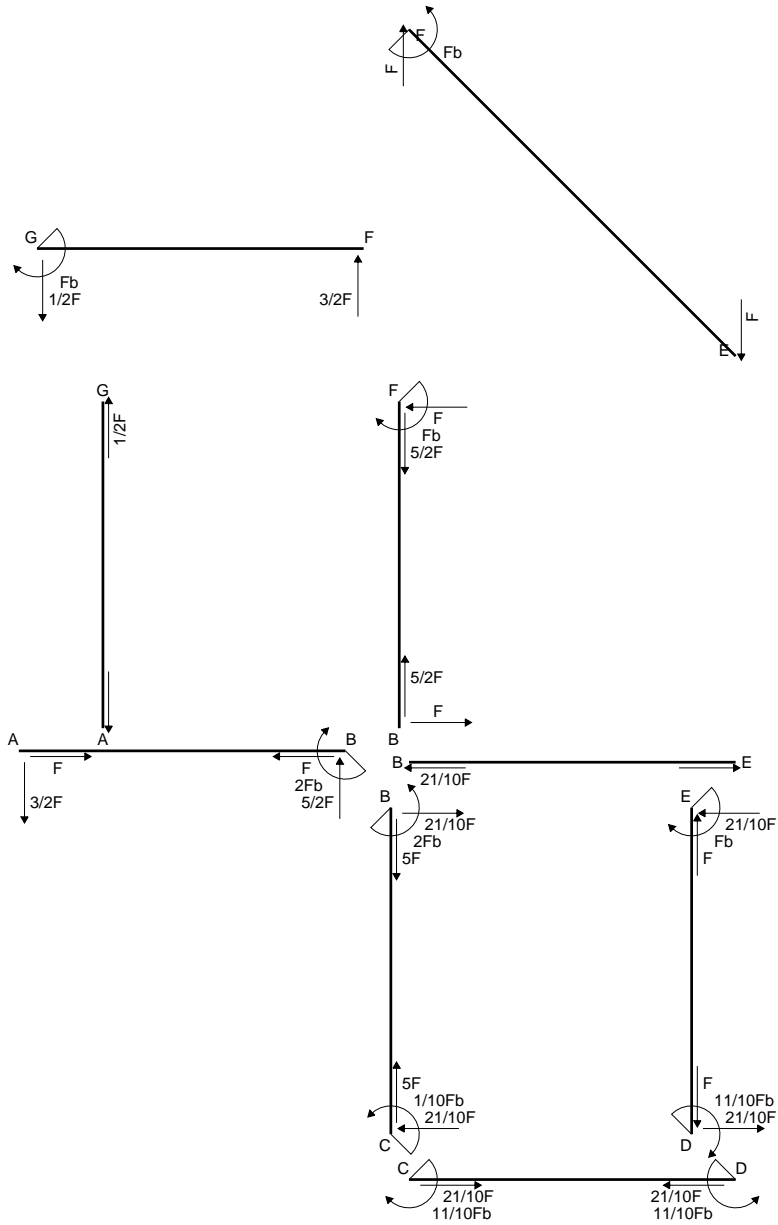
$$= (1/2 b - 1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

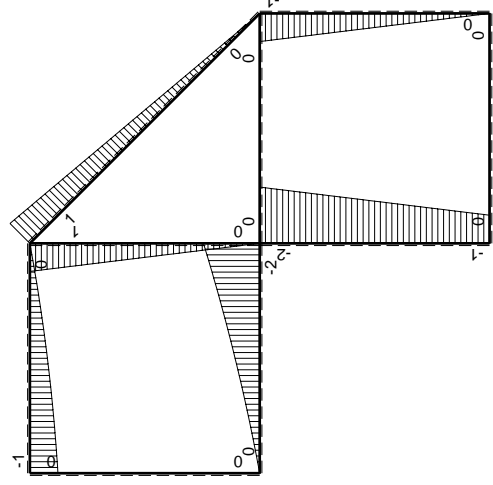
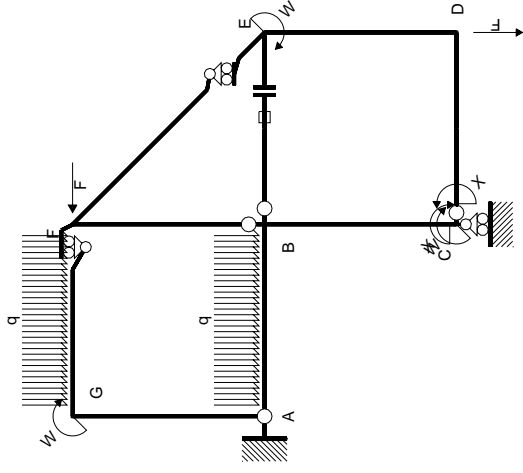
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

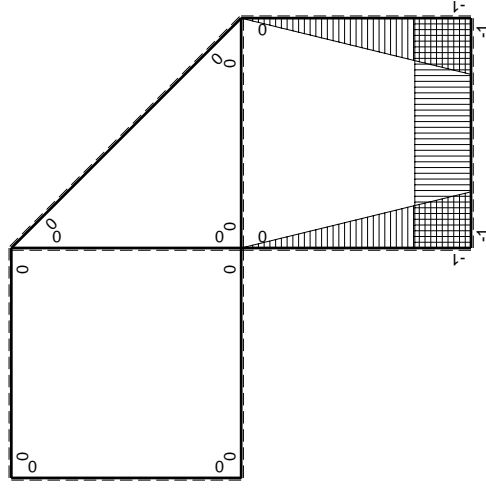
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$Fb - 1/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-11/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

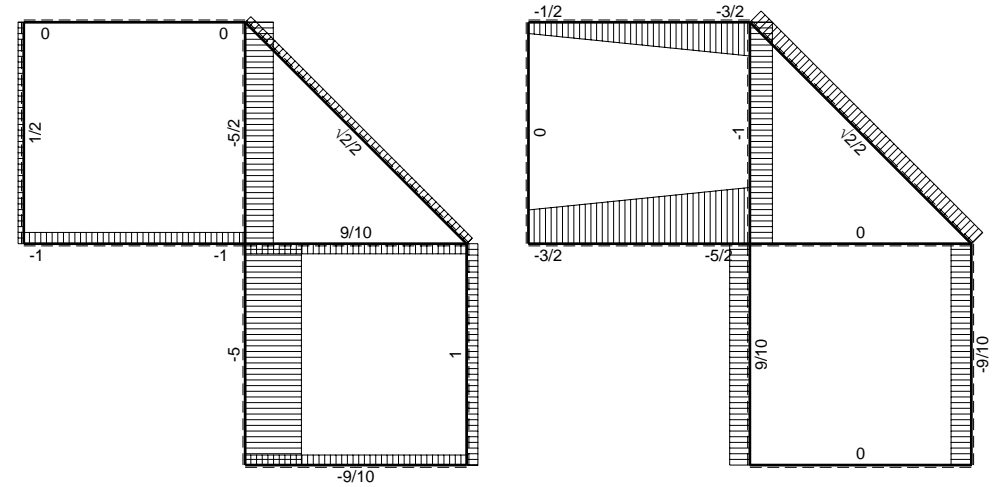
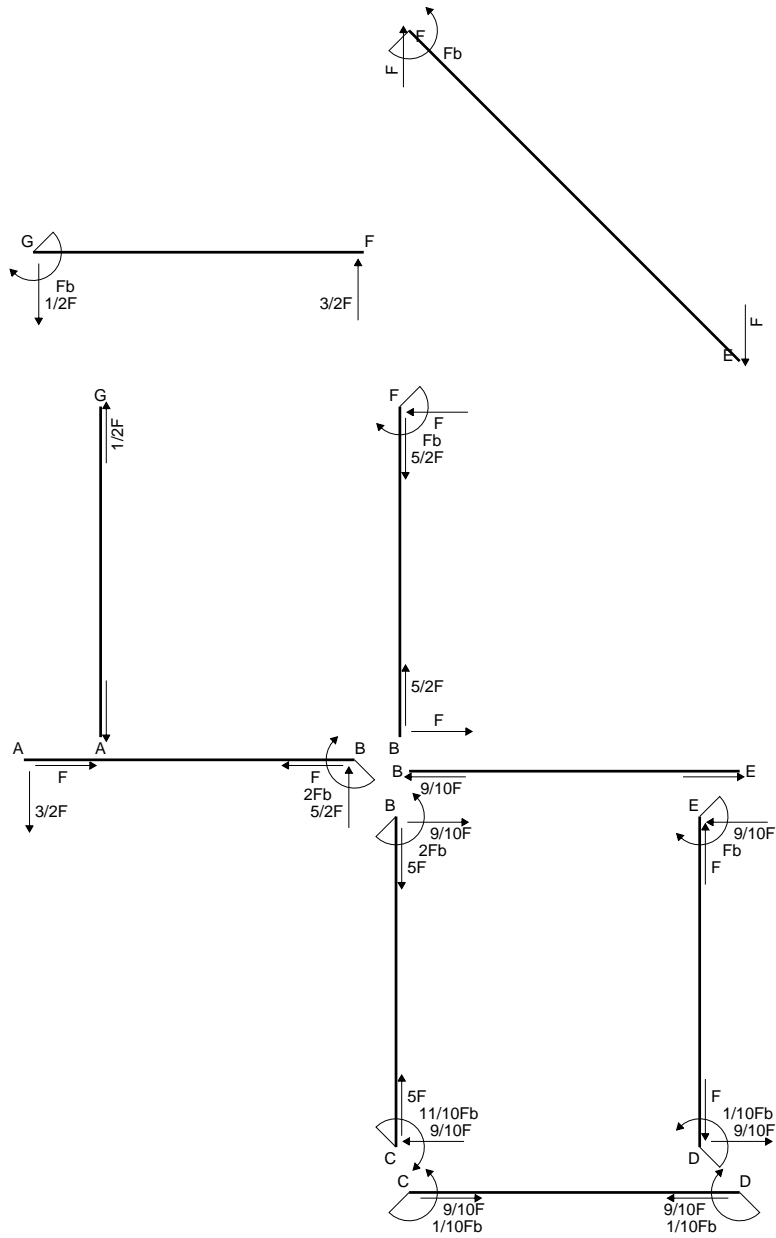
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

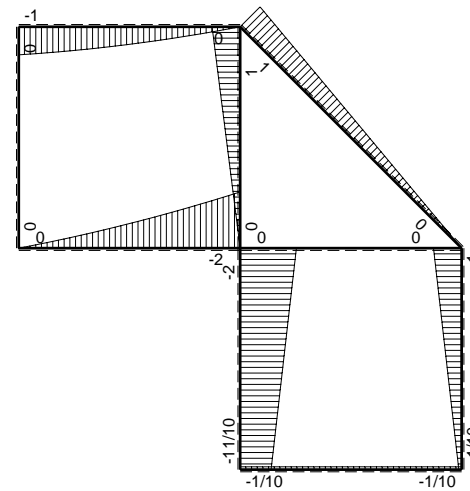
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

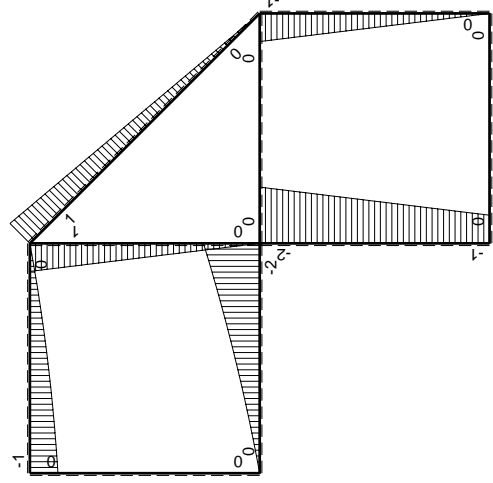
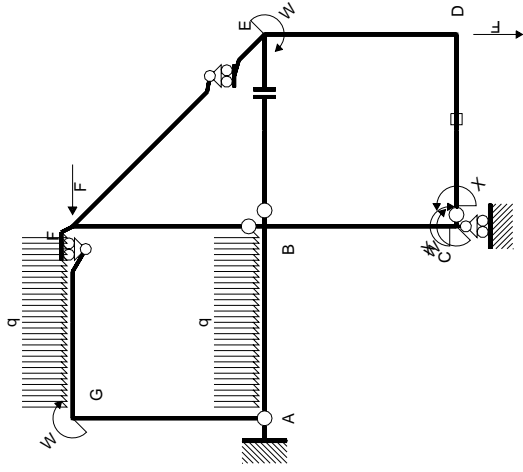


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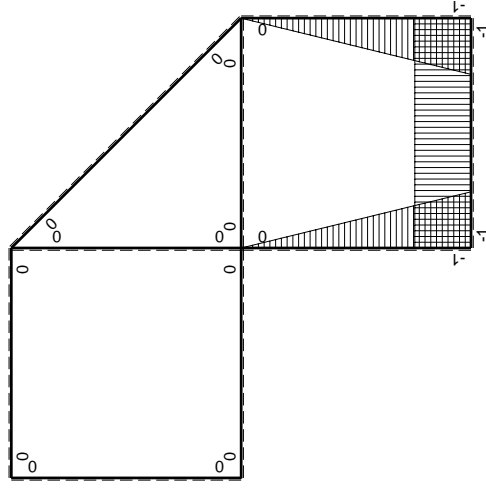


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$Fb - 1/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

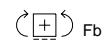
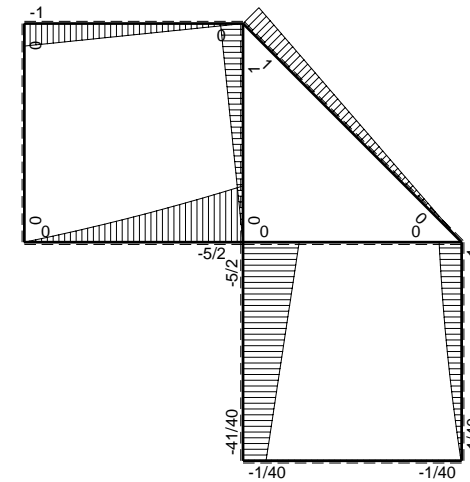
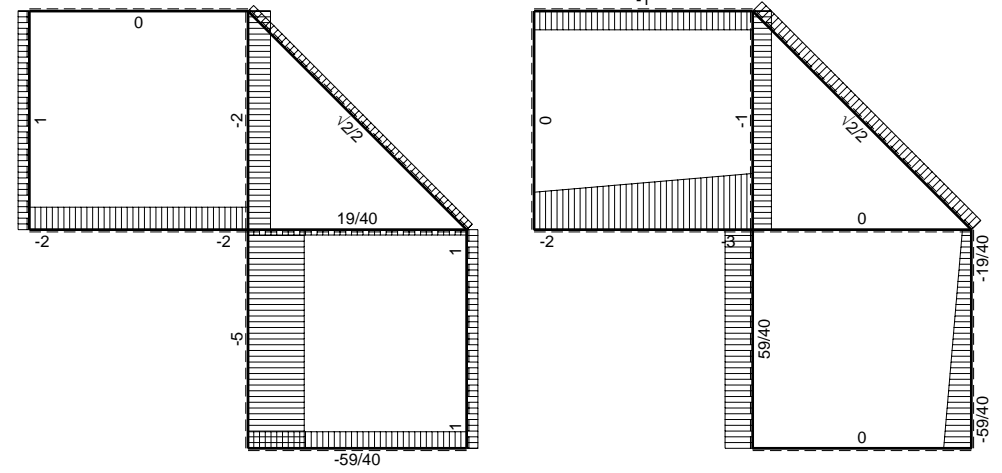
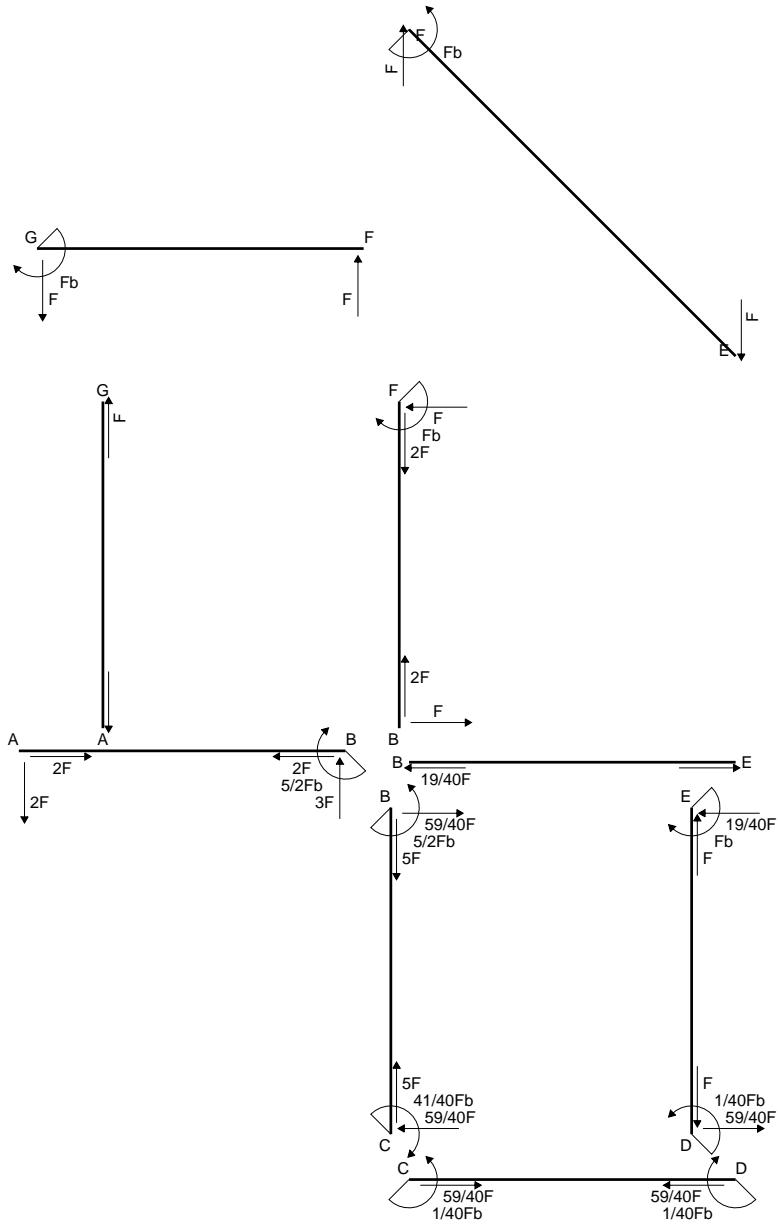
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

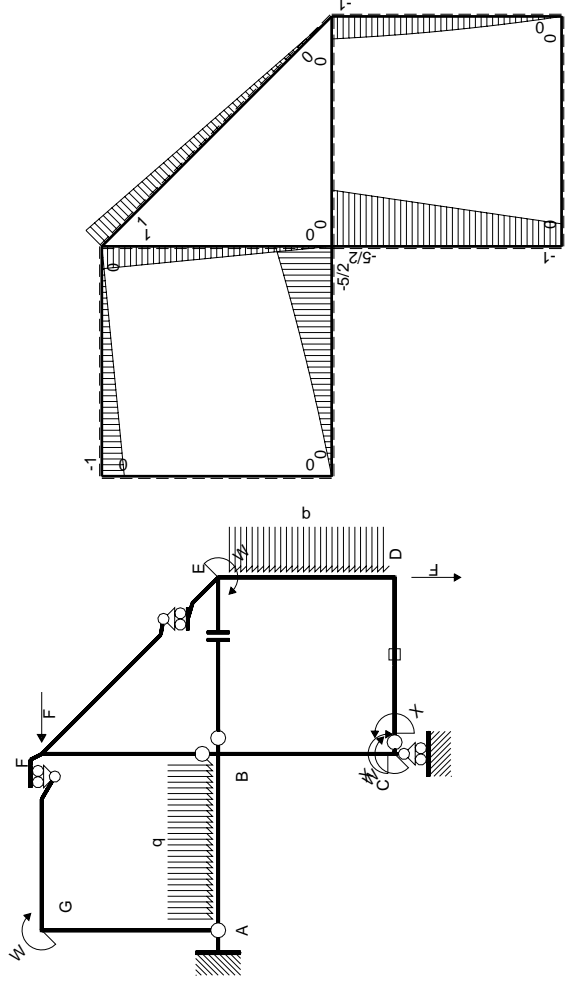
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

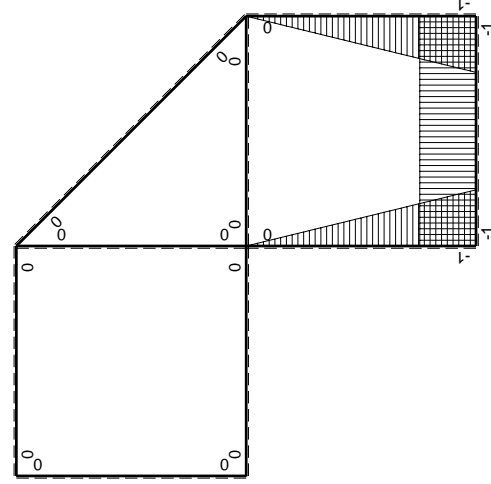
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-3/2Fx + 1/2qx^2$	$3/2Fx - 2Fx^2/b + 1/2qx^3/b$	$1 - 2x/b + x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - 1/2Fx - 1/2qx^2$	$Fx - 1/2Fx^2/b - 1/2qx^3/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$1/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

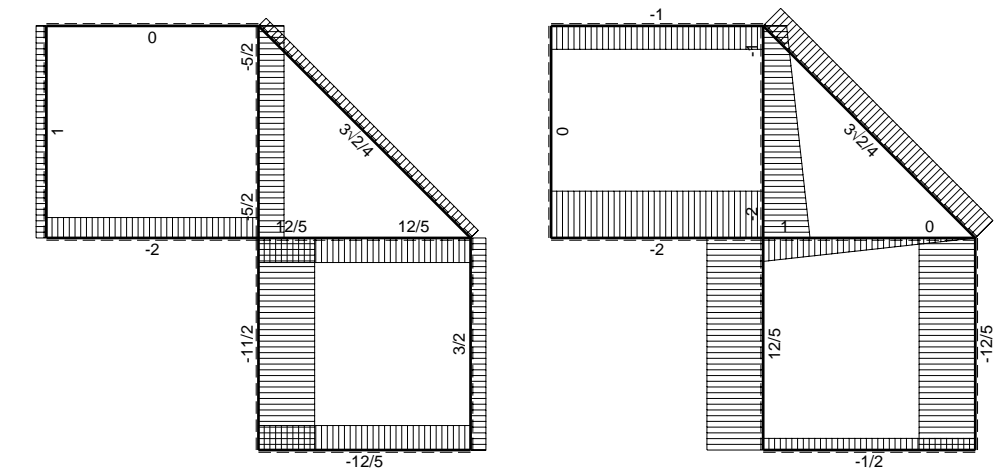
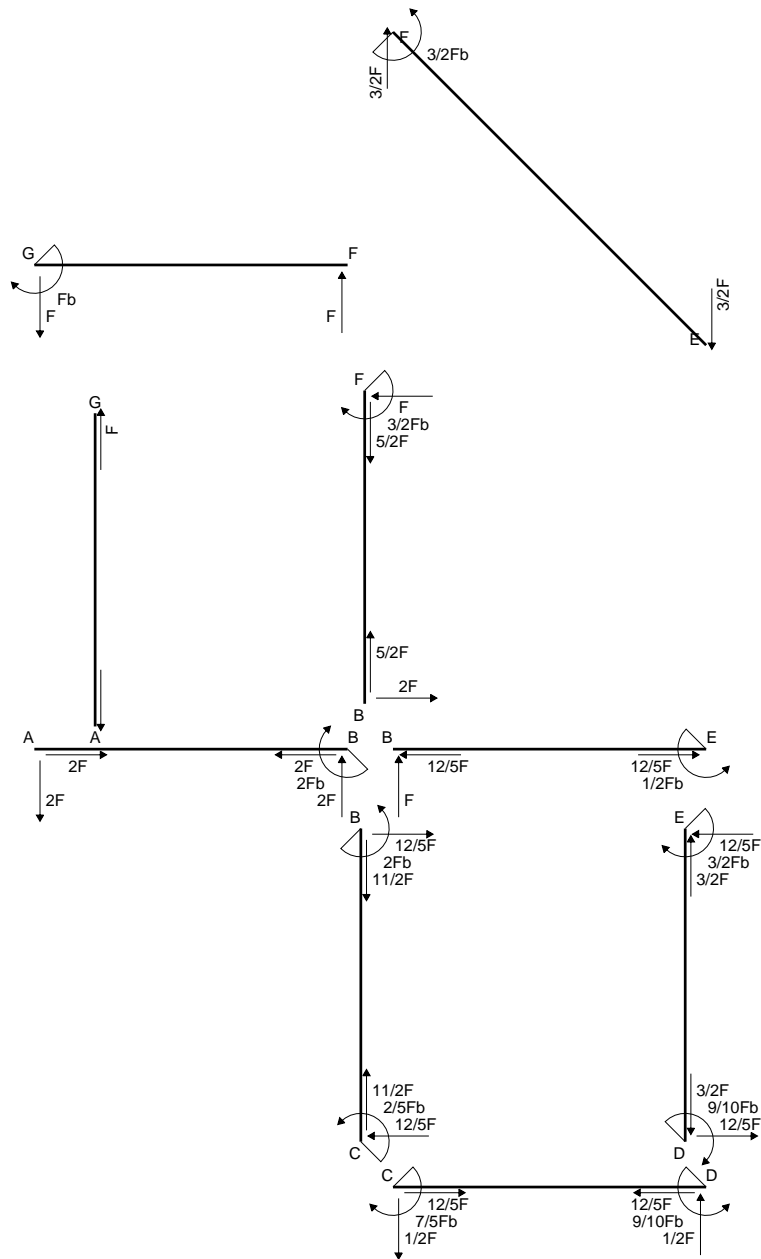
$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 2/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 5/24 Fb^2/EJ$$

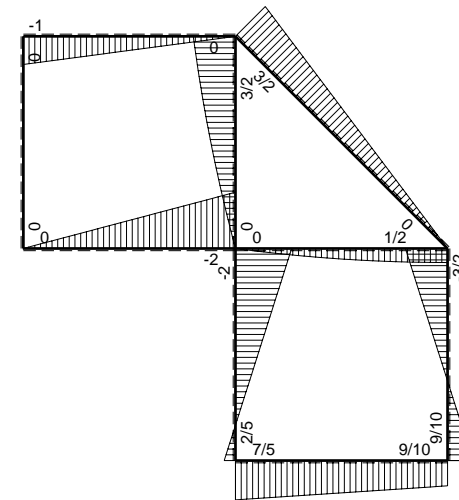
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 5/24 Fb^2/EJ$$

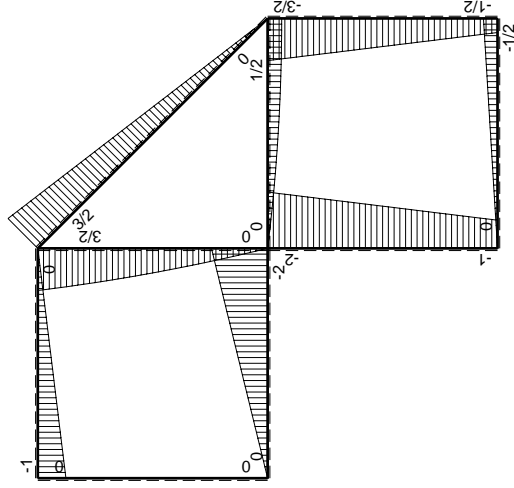
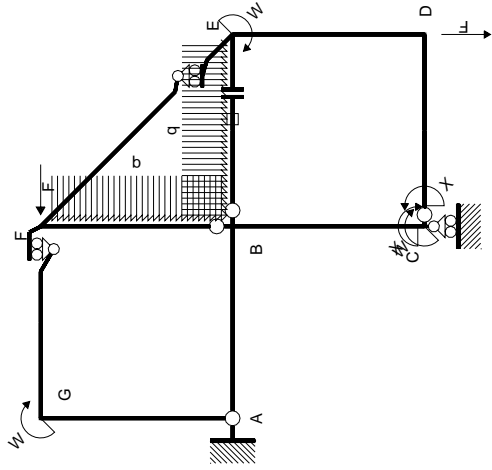


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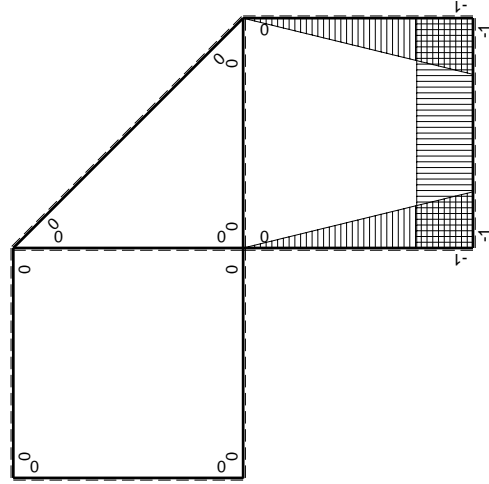


⊙ (+) ⊙ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx ² /b	1-2x/b+x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - N_{BE}^E - N_{BE}^E$				Fb ² /EJ	
	totali				7/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-7/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

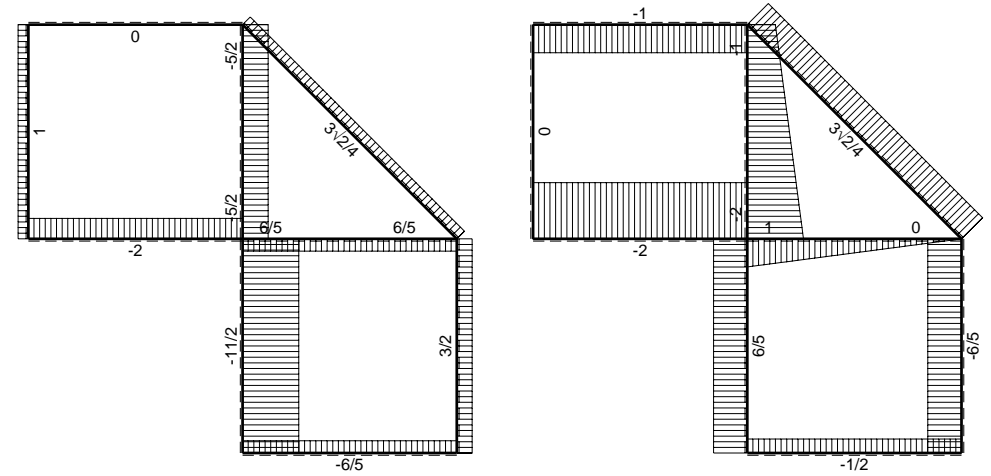
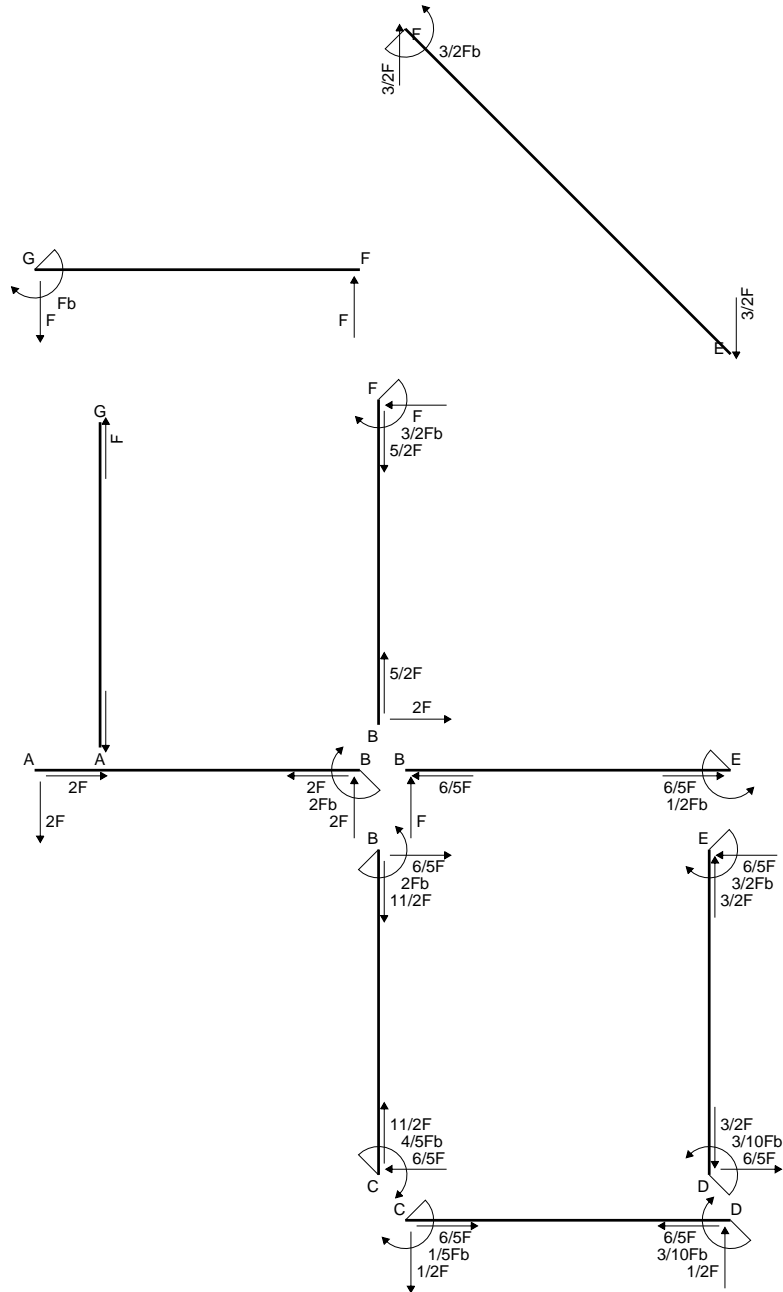
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x + 1/4 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b + 1/4 b - 1/3 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

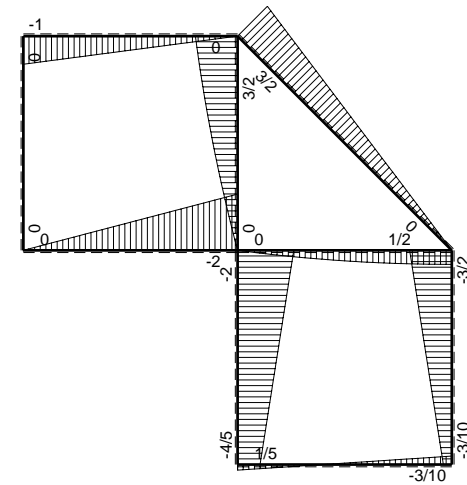
$$L_{ED}^{xo} = \int_0^b (3/2 x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/3 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

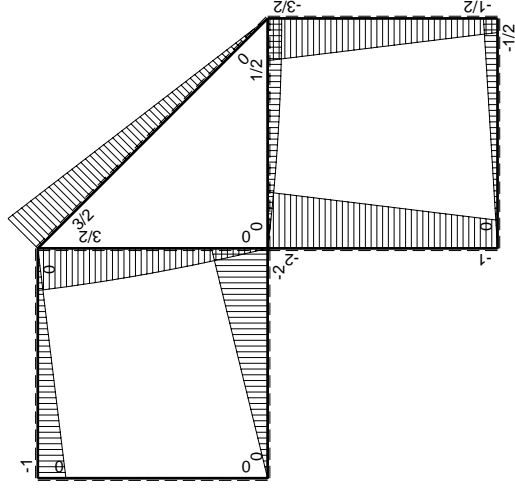
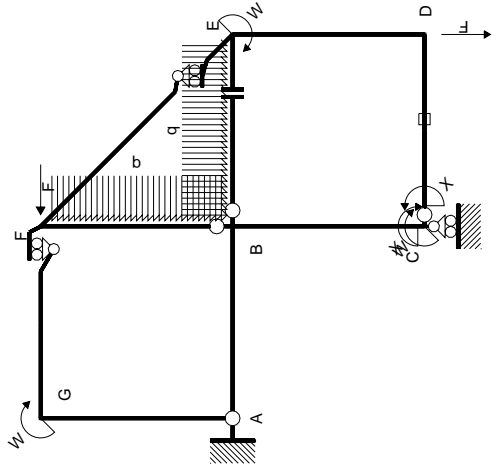


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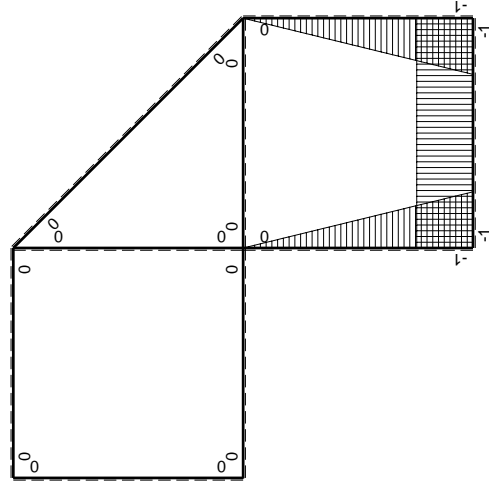


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx ² /b	1-2x/b+x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				1/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

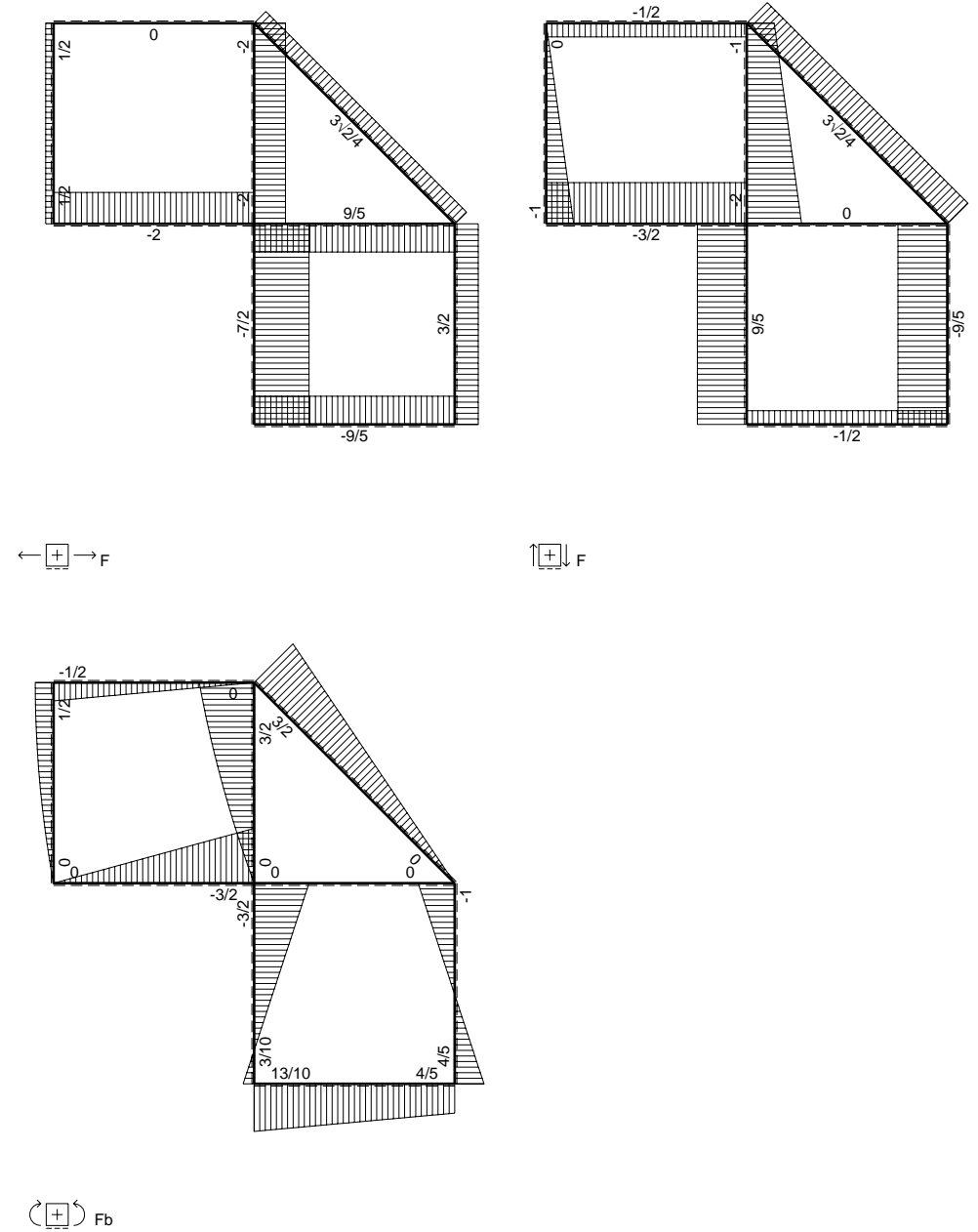
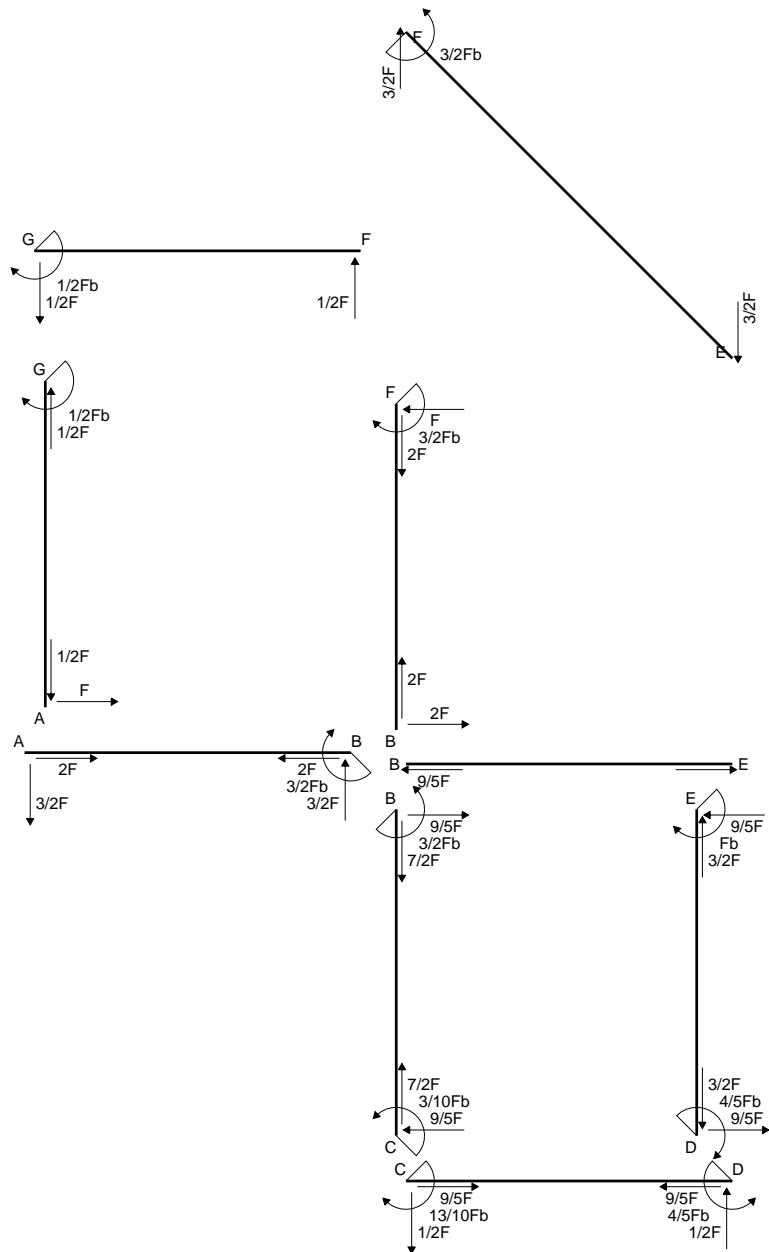
$$= (1/2 b - 1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

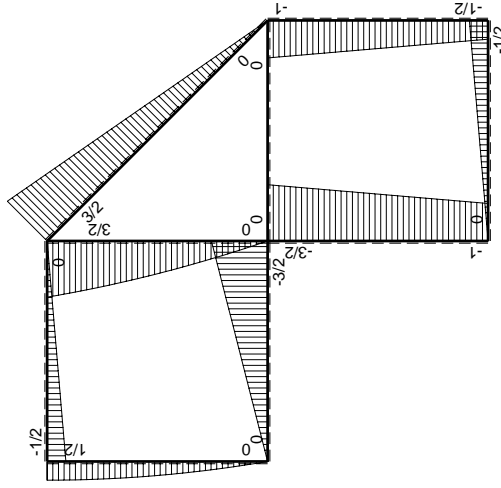
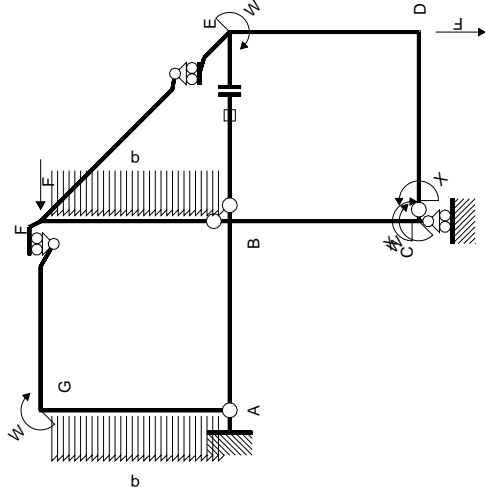
$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x + 1/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b + 1/4 b - 1/3 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

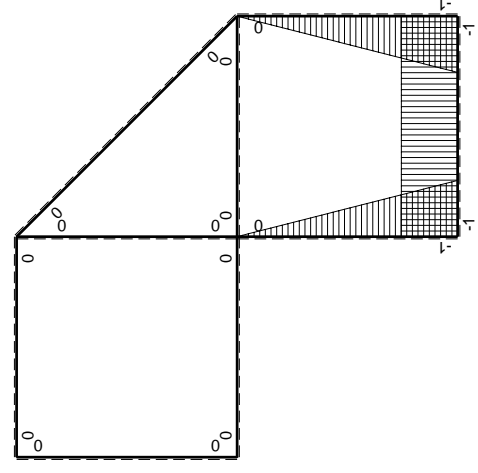
$$= (3/4 b - 1/3 b) Fb 1/EJ = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/3Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta N _{1, BE} E _{BE} L ⁻ BE				Fb ² /EJ	
	totali				13/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-13/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

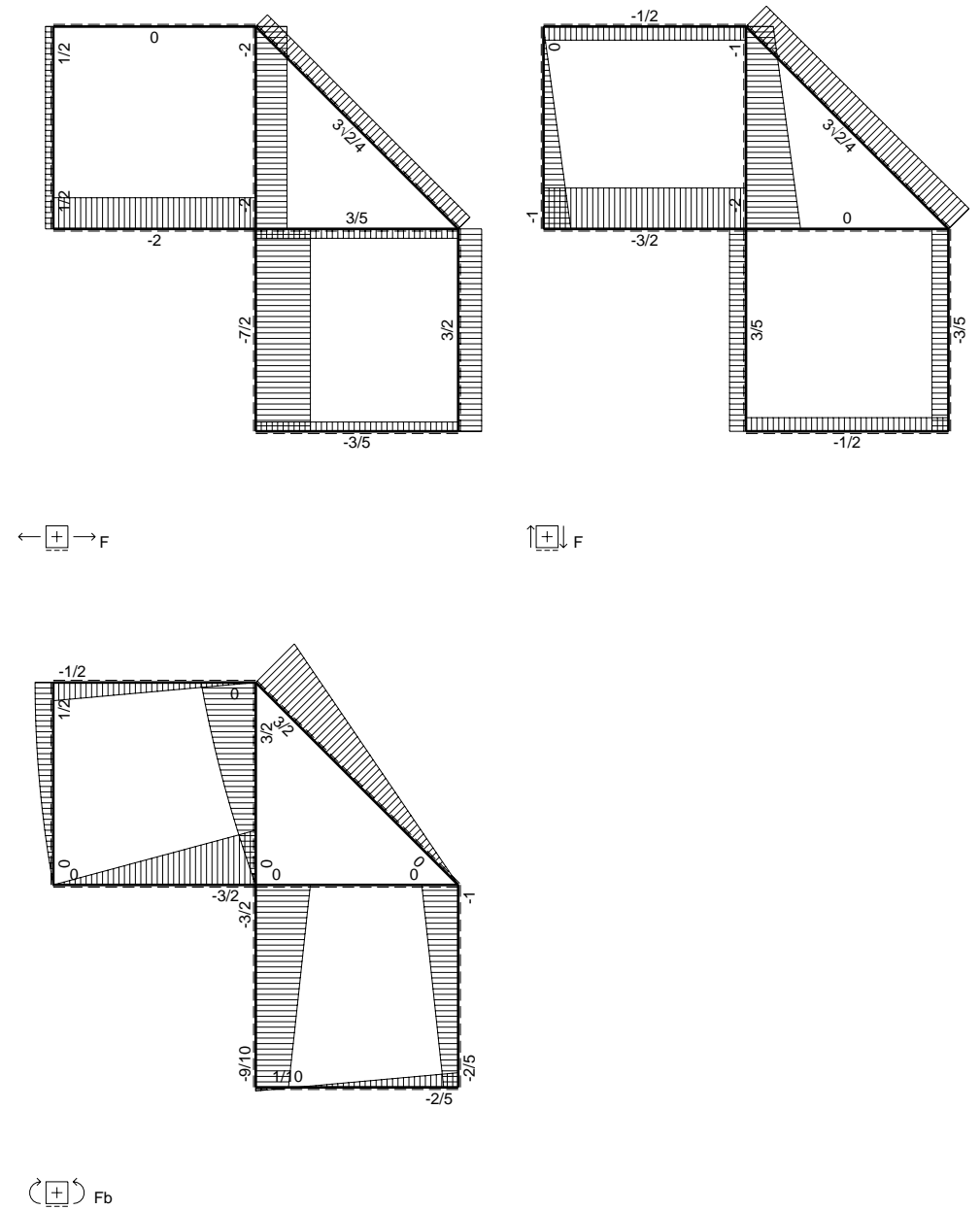
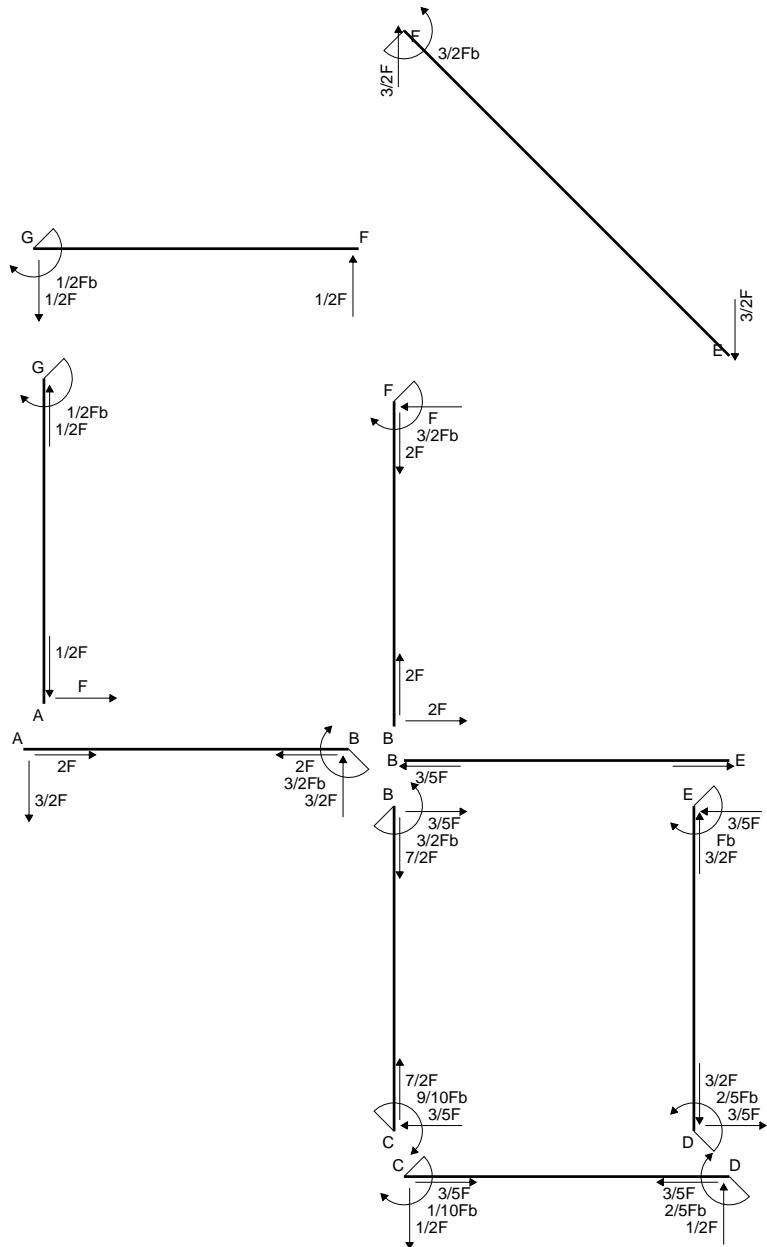
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

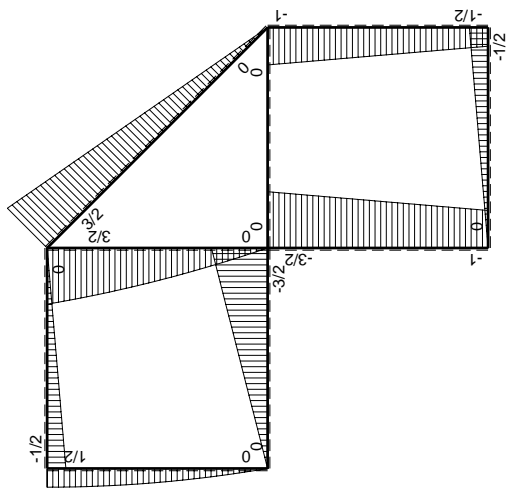
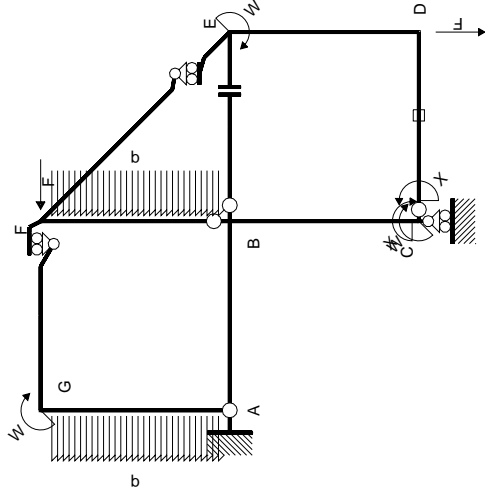
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

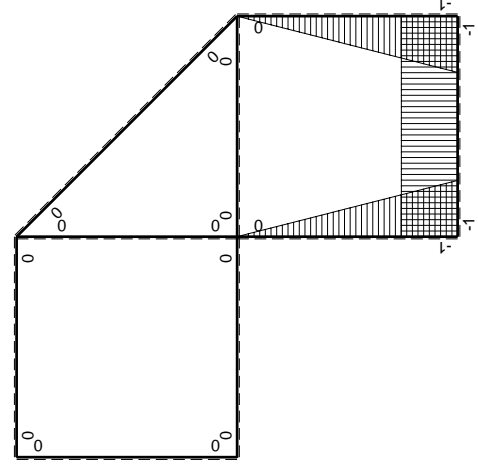
$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

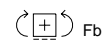
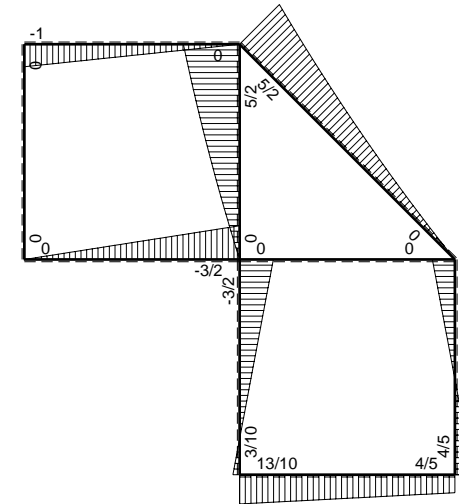
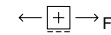
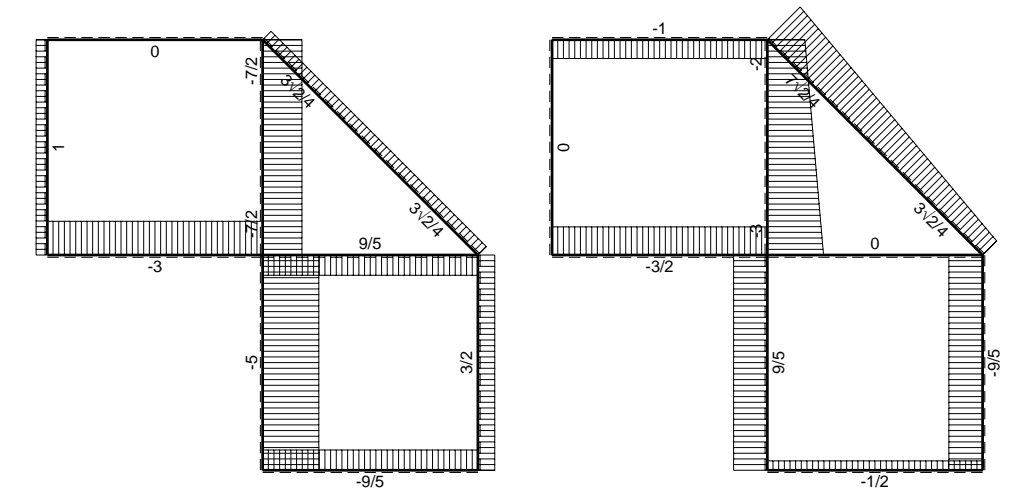
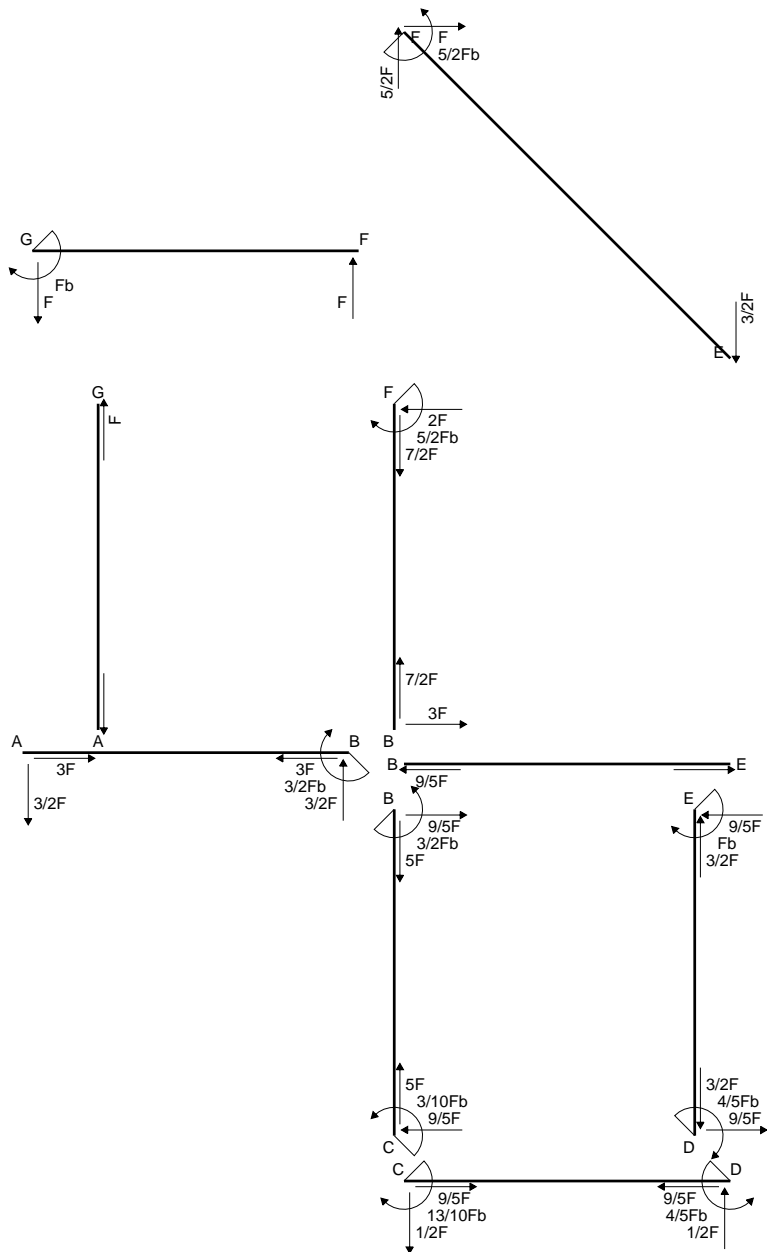
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

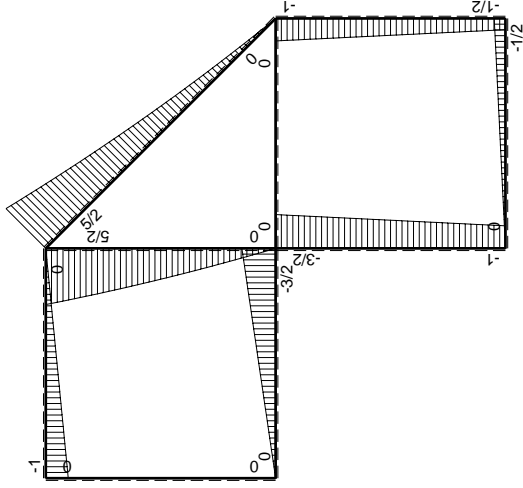
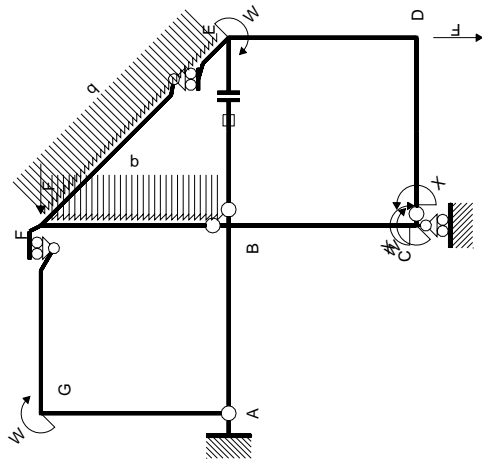
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

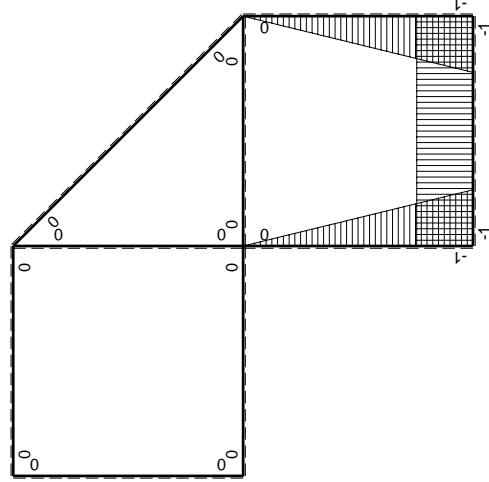
$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF $\sqrt{2}b$	0	3\sqrt{2}4Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE} - BE}$				Fb ² /EJ	
	totali				13/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-13/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

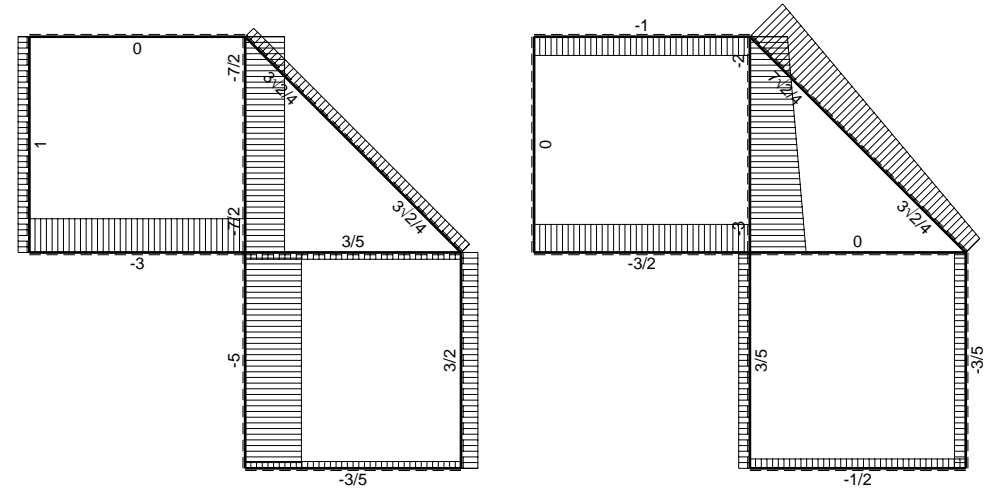
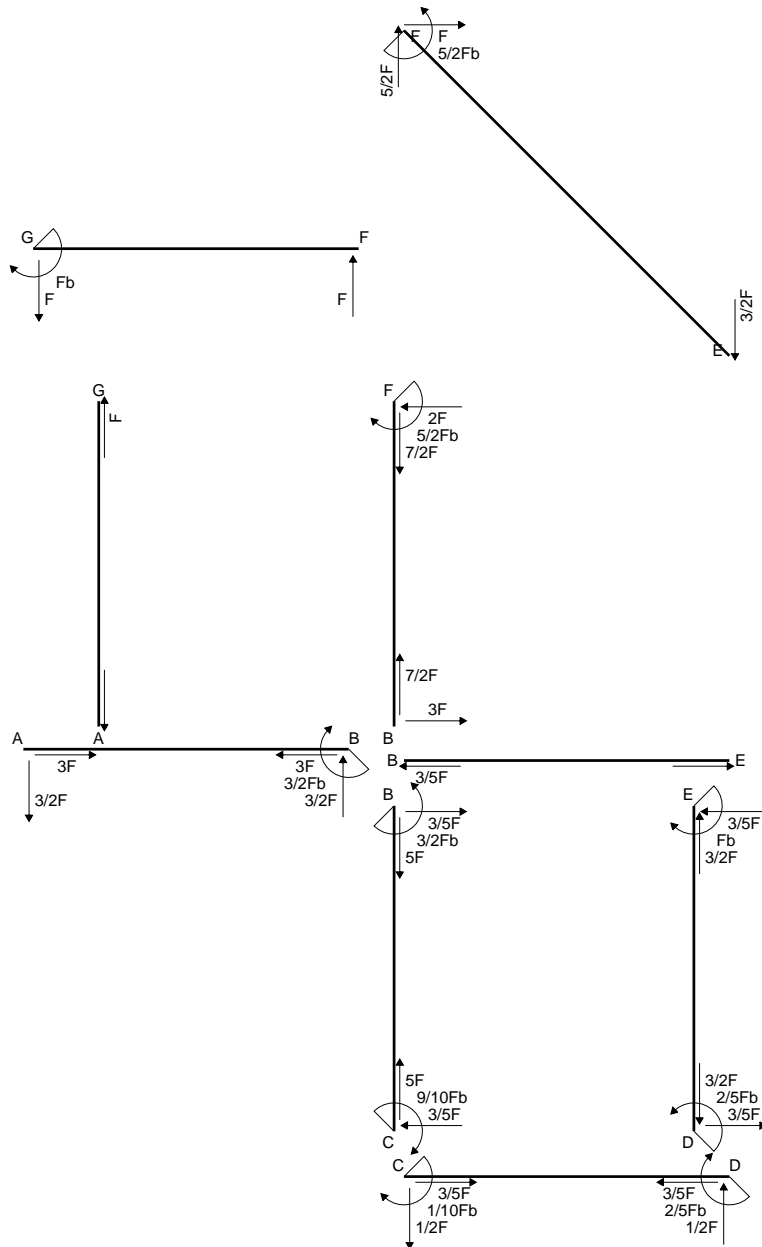
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

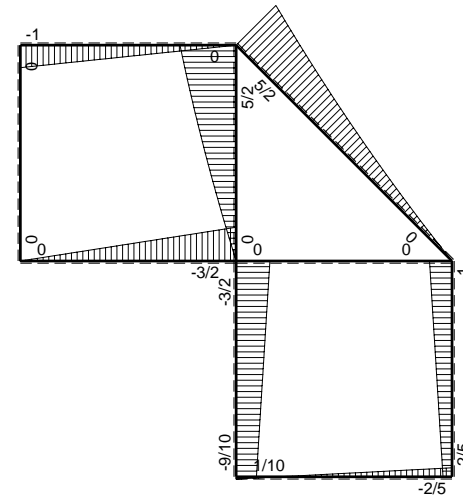
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

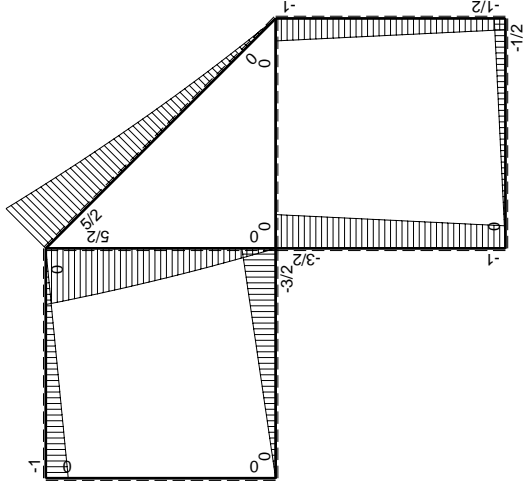
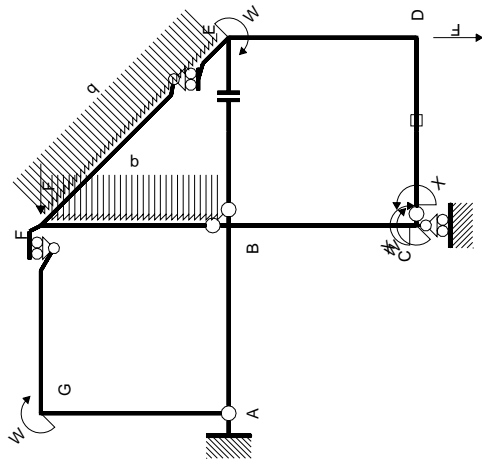


← ⊕ → F

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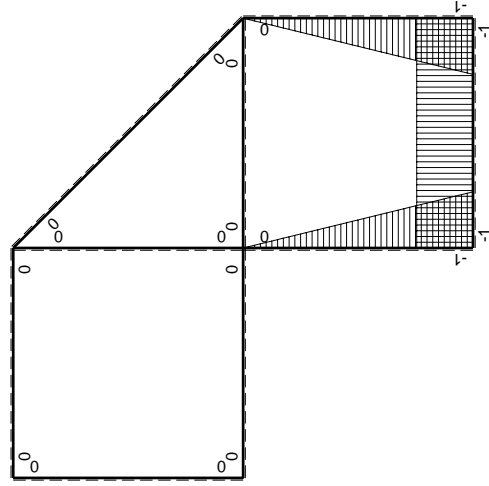


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	-Fb ² /EJ	
	totali				1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

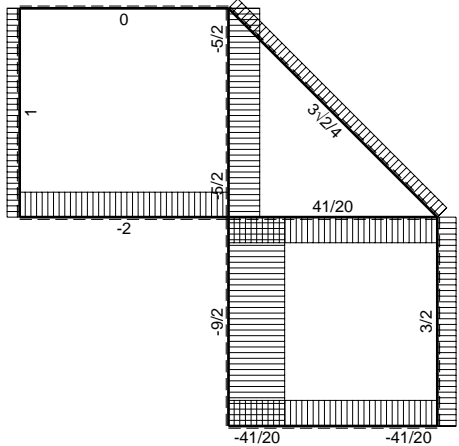
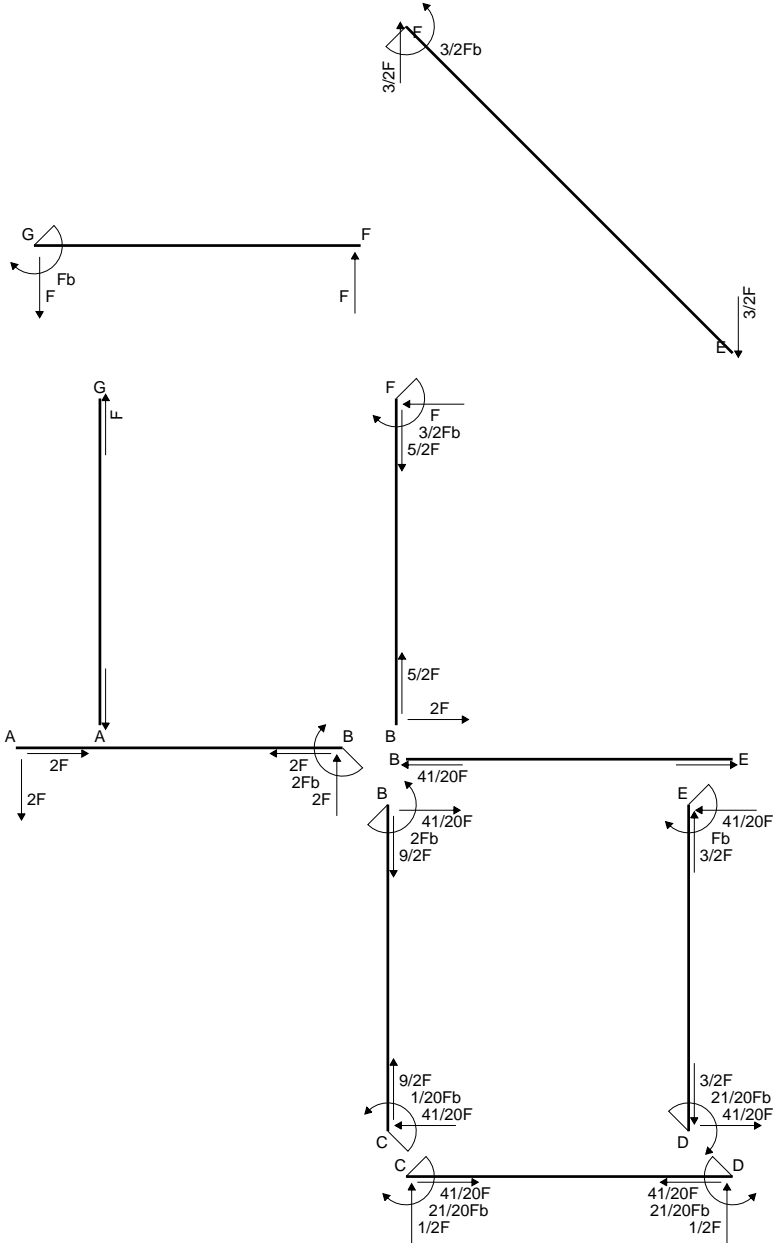
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

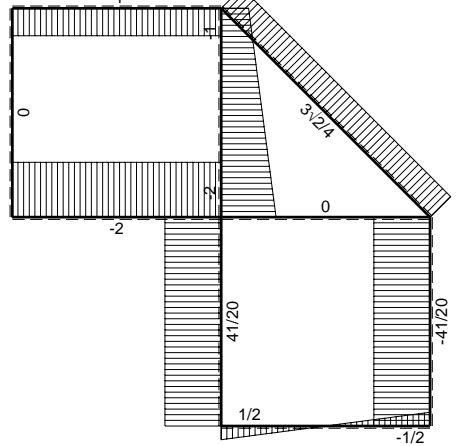
$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

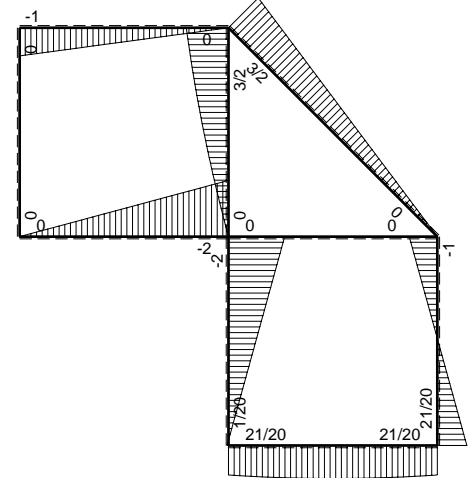
$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$



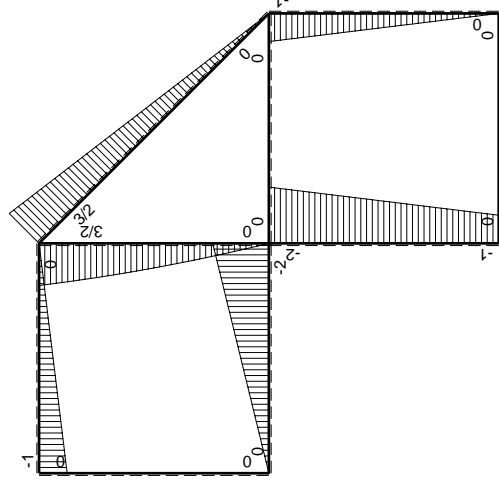
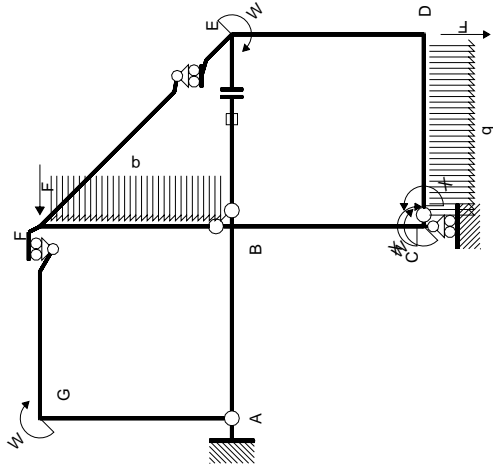
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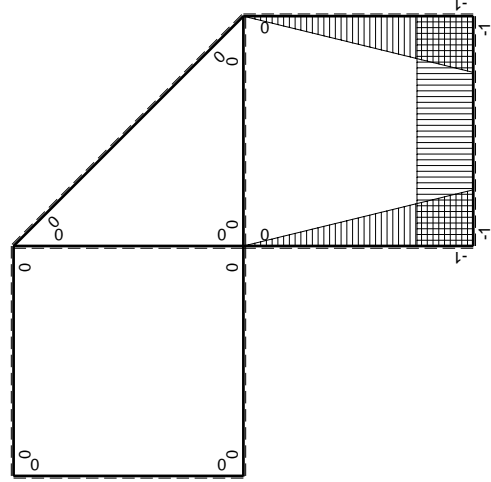


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CD b	-1	1/2Fx-1/2qx ²	-1/2Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fx+1/2qx ²	-1/2Fx+1/2Fx ² /b	1	1/6Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	3\sqrt{2}/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				7/4Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-21/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

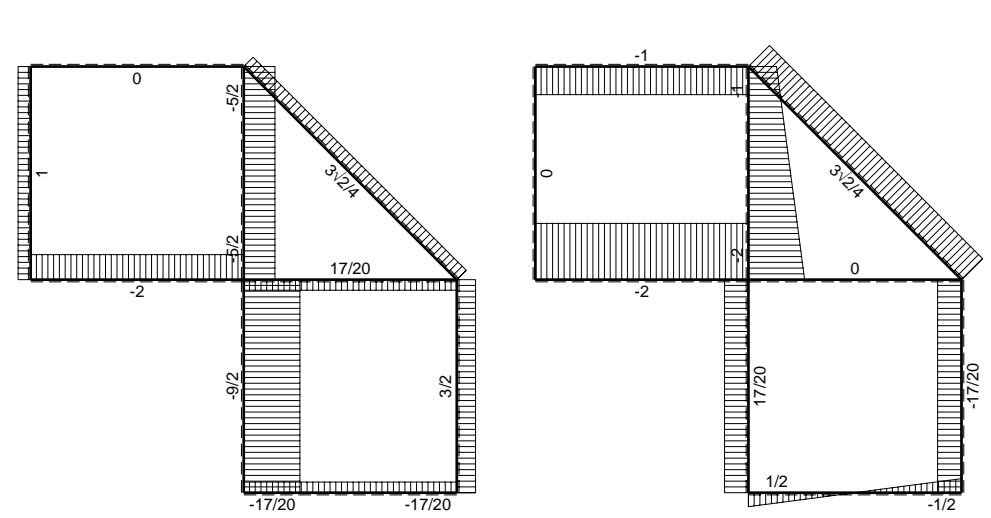
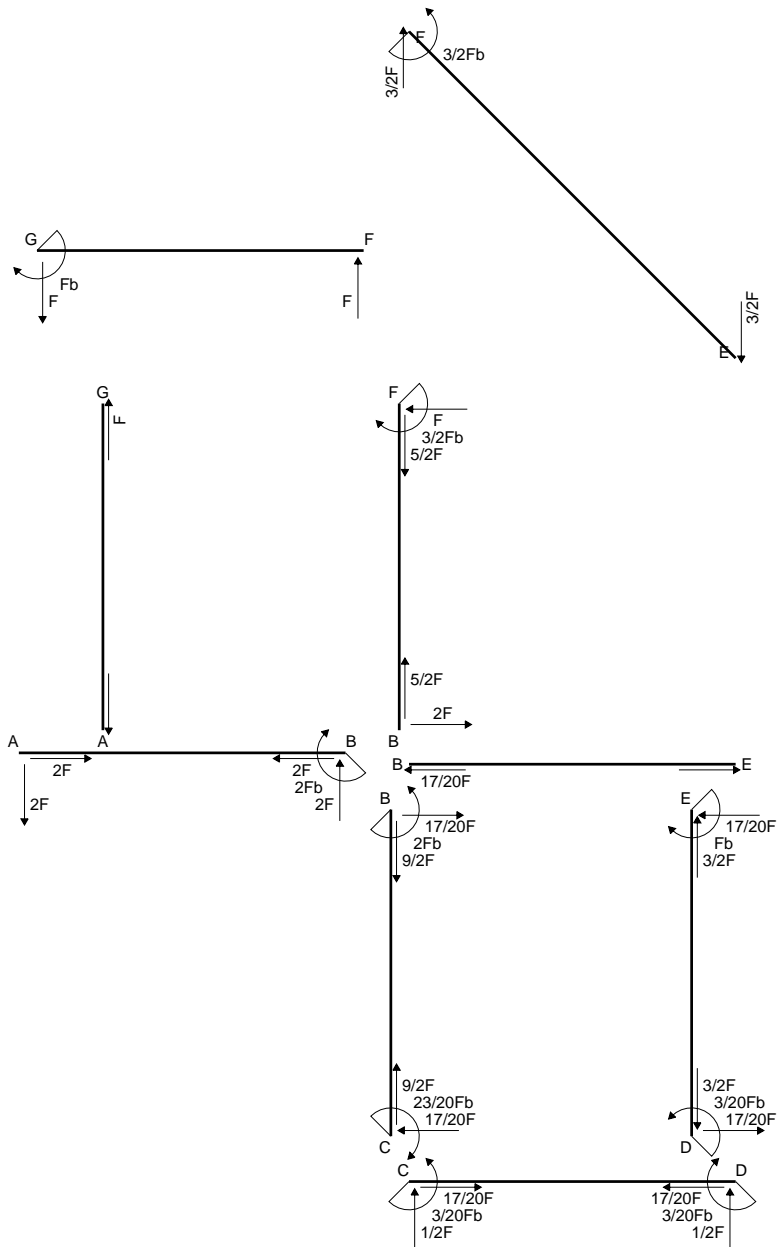
$$= (-1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

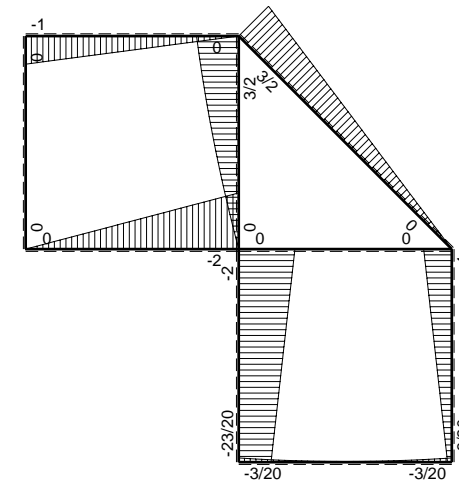
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

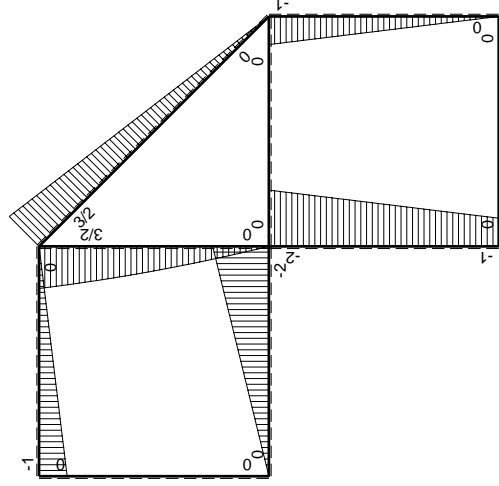
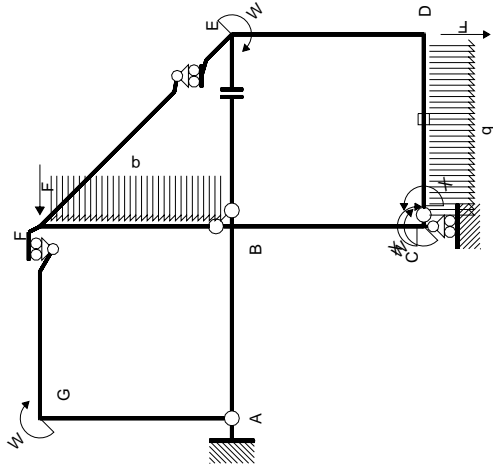


← (+) → F

↑ (+) ↓ F

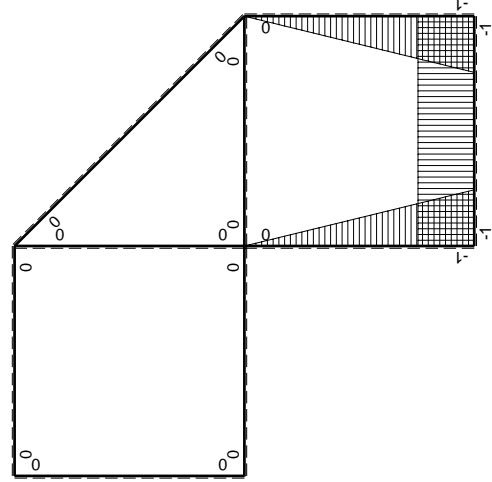


⊙ (+) ⊙ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CD b	-1	1/2Fx-1/2qx ²	-1/2Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fx+1/2qx ²	-1/2Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	-Fb ² /EJ	
	totali				-1/4Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				3/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/4 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -13/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

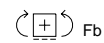
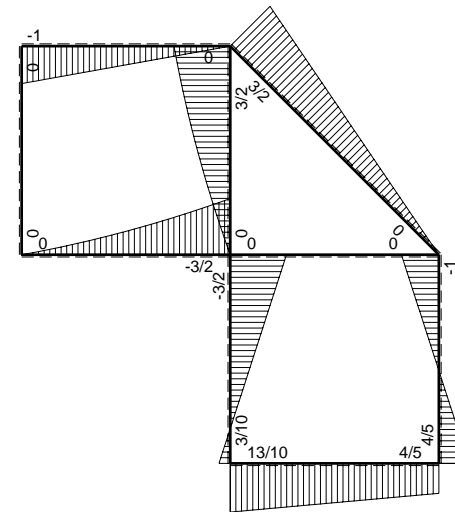
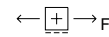
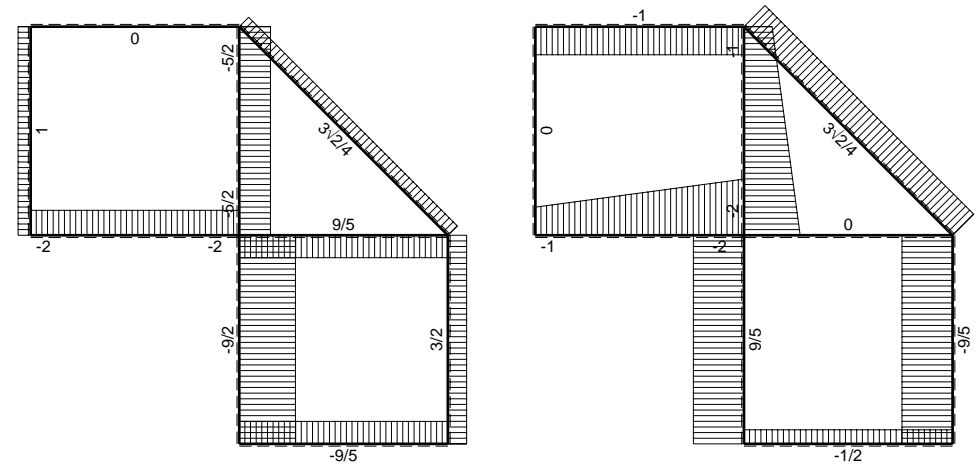
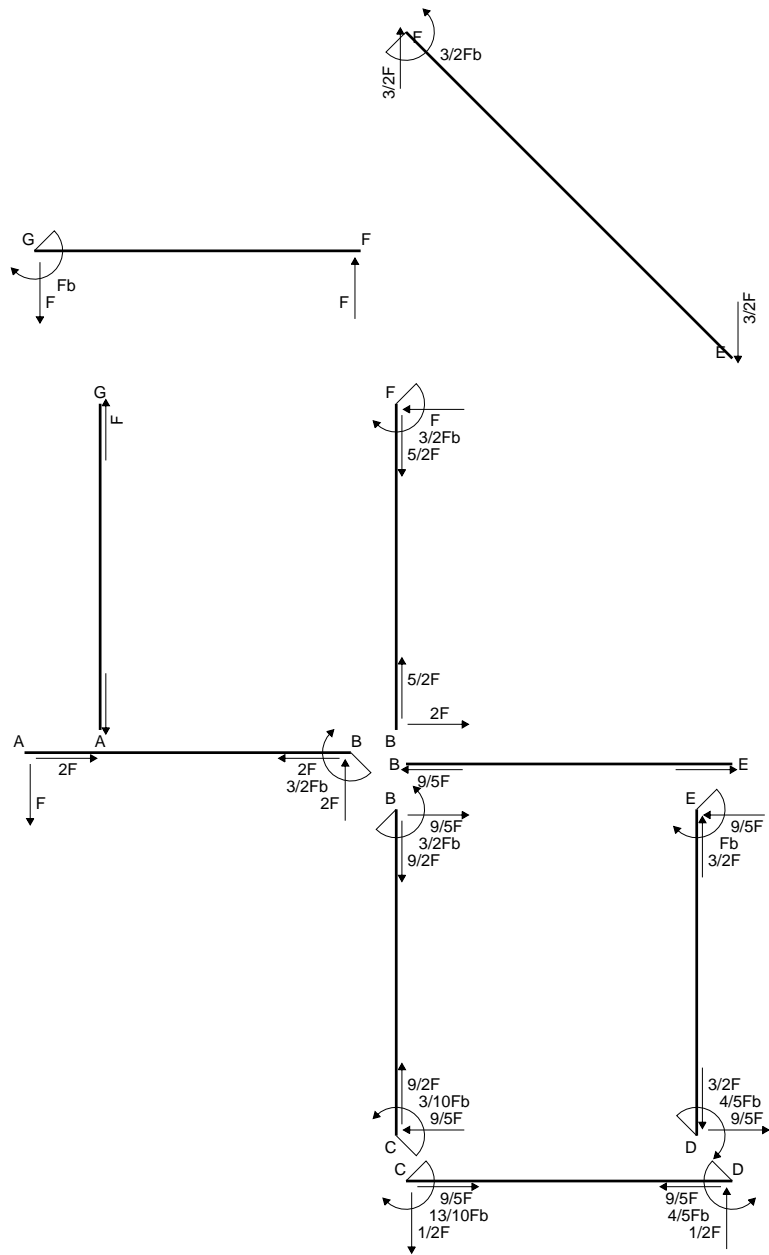
$$= (-1/4 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -13/12 Fb^2/EJ$$

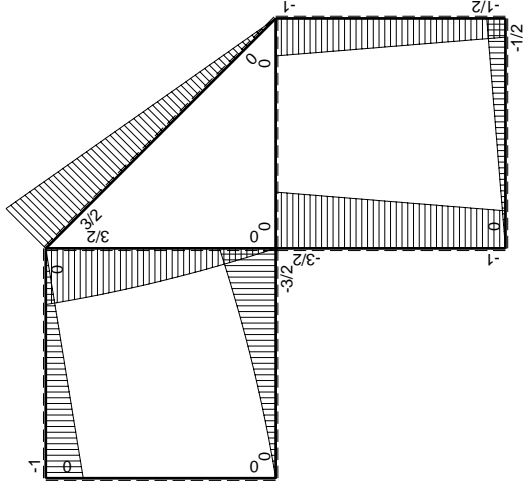
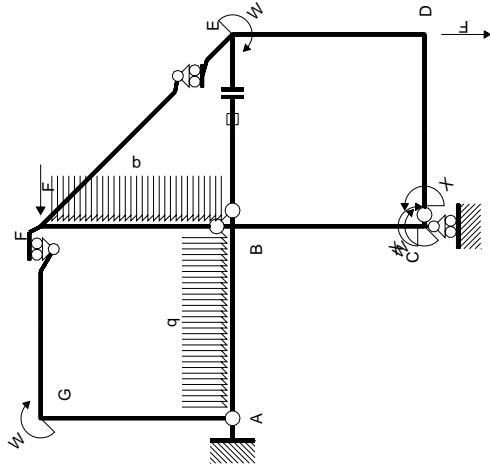
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

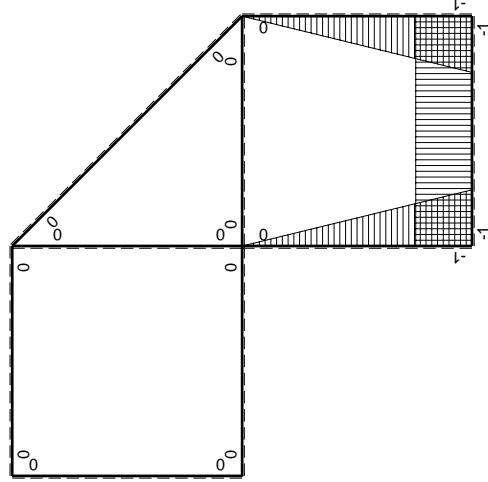
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2 / b$	x^2 / b^2	$7/12Fb^2 / EJ$	$1/3Xb / EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	$1/4Fb^2 / EJ$	Xb / EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2 / EJ$	Xb / EJ
DC b	1	$1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2 / EJ$	Xb / EJ
DE b	$-1+x/b$	$-1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	$1/3Fb^2 / EJ$	$1/3Xb / EJ$
ED b	x/b	$Fb - 1/2Fx$	$Fx - 1/2Fx^2 / b$	x^2 / b^2	$1/3Fb^2 / EJ$	$1/3Xb / EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$3/2Fb - Fx - 1/2qx^2$	0	0	0	0
BF b	0	$-2Fx + 1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2 / EJ	
	totali				$13/6Fb^2 / EJ$	$5/3Xb / EJ$
	iperstatica X=W _{cd}				$-13/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

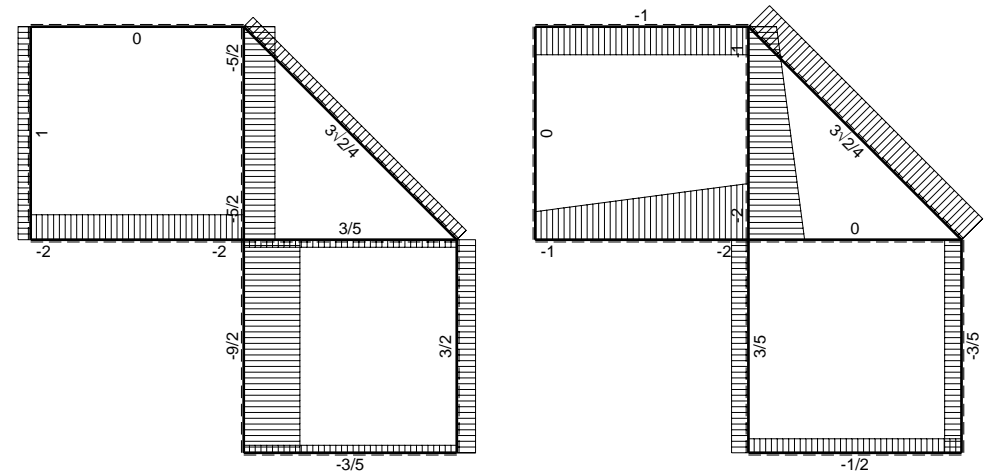
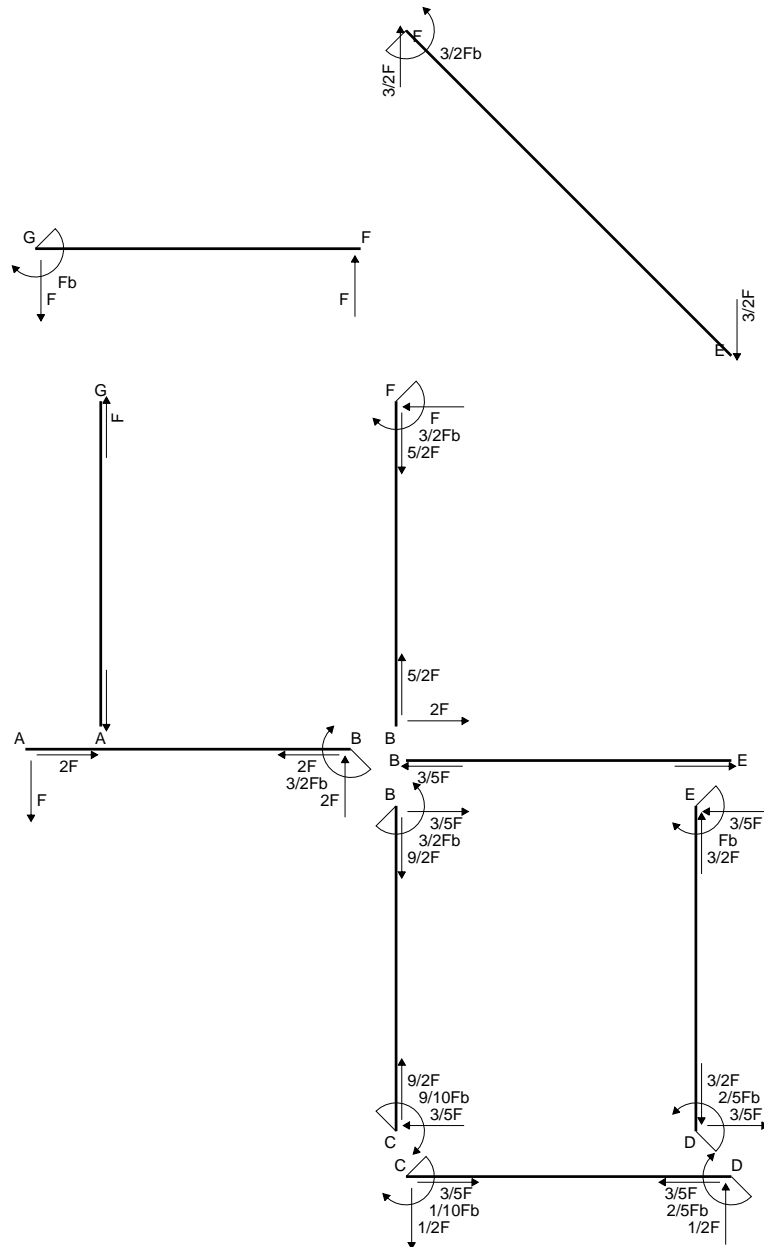
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

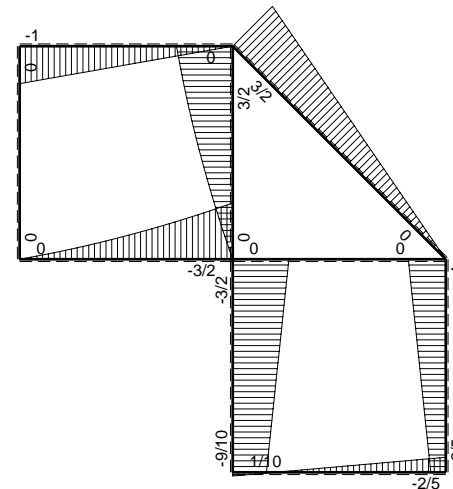
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

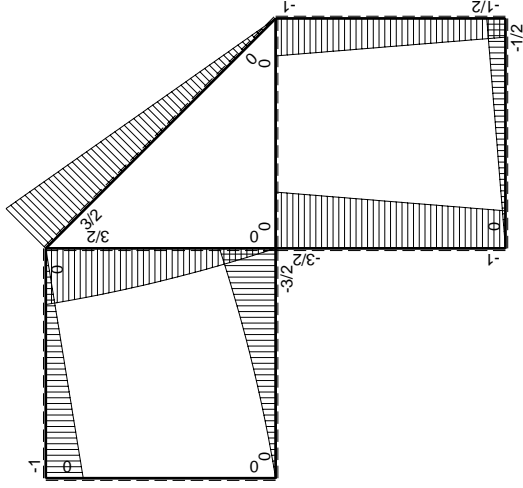
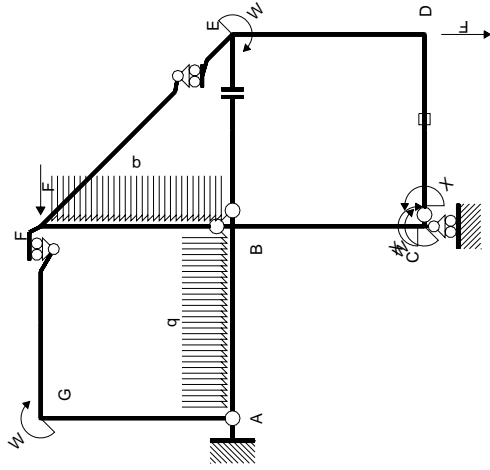


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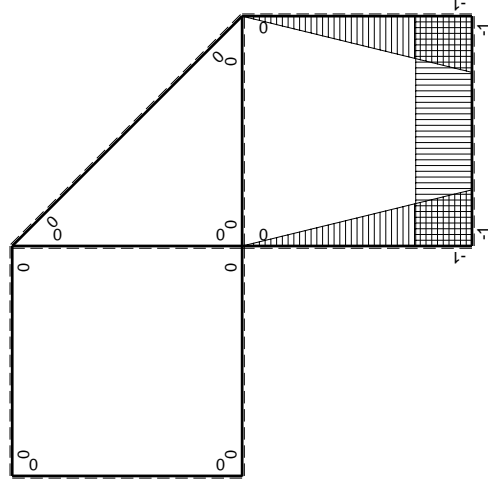


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2 / b$	x^2 / b^2	$7/12Fb^2 / EJ$	$1/3Xb / EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	$1/4Fb^2 / EJ$	Xb / EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2 / EJ$	Xb / EJ
DC b	1	$1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2 / EJ$	Xb / EJ
DE b	$-1+x/b$	$-1/2Fb - 1/2Fx$	$1/2Fb - 1/2Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	$1/3Fb^2 / EJ$	$1/3Xb / EJ$
ED b	x/b	$Fb - 1/2Fx$	$Fx - 1/2Fx^2 / b$	x^2 / b^2	$1/3Fb^2 / EJ$	$1/3Xb / EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-Fx$	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$3/2Fb - Fx - 1/2qx^2$	0	0	0	0
BF b	0	$-2Fx + 1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2 / EJ$	
	totali				$1/6Fb^2 / EJ$	$5/3Xb / EJ$
	iperstatica $X=W_{cd}$				$-1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = \left[\frac{1}{4} x^2/b \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 \cdot Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = \left[\frac{1}{2} x - \frac{1}{4} x^2/b \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

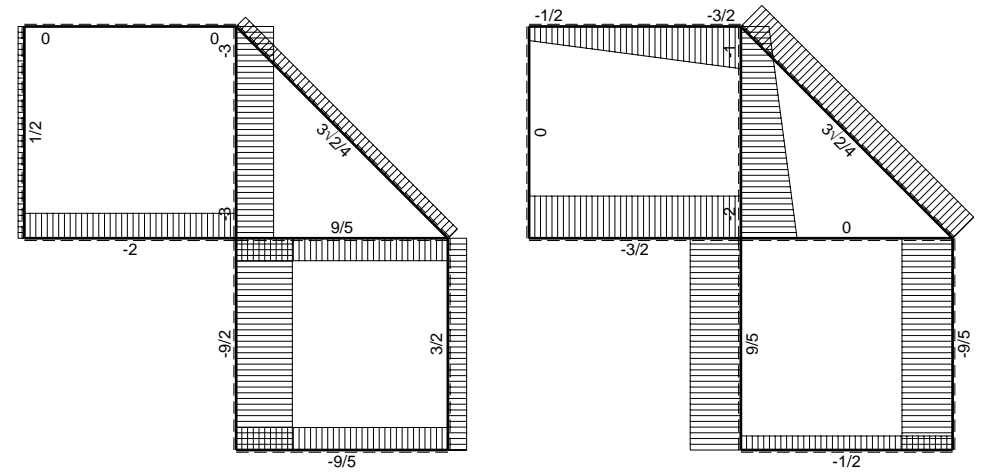
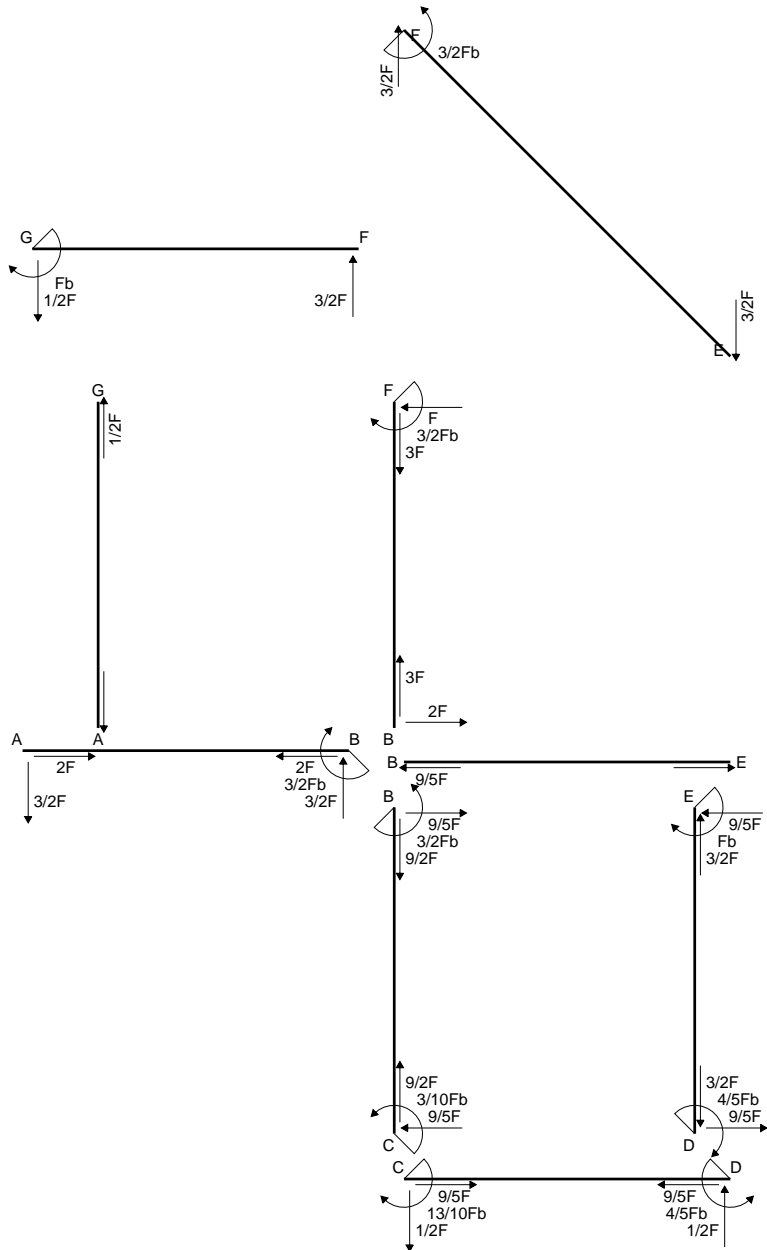
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

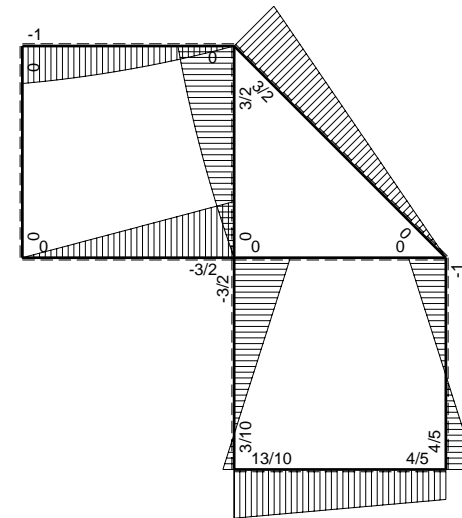
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

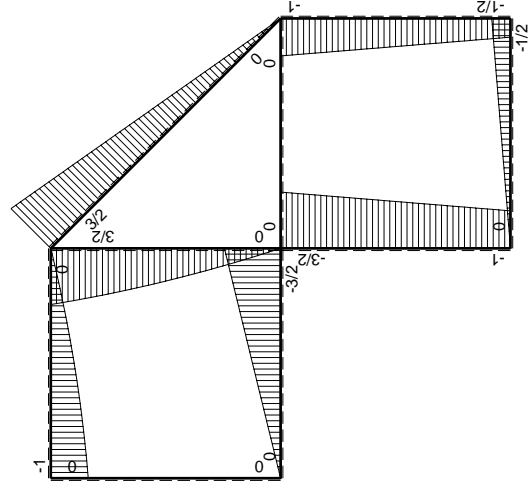
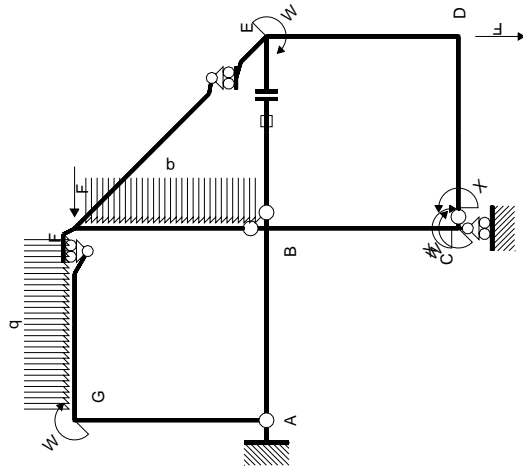


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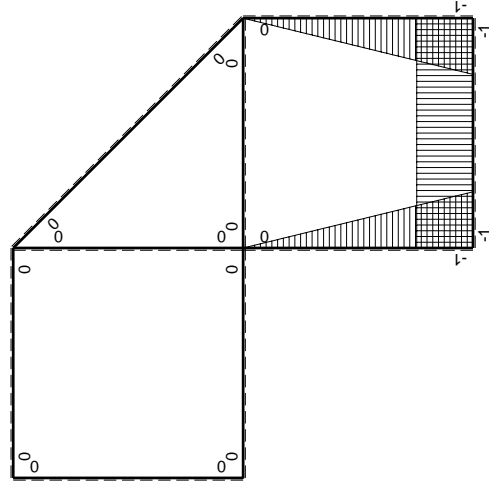


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/3Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - BE$				Fb ² /EJ	
	totali				13/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-13/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

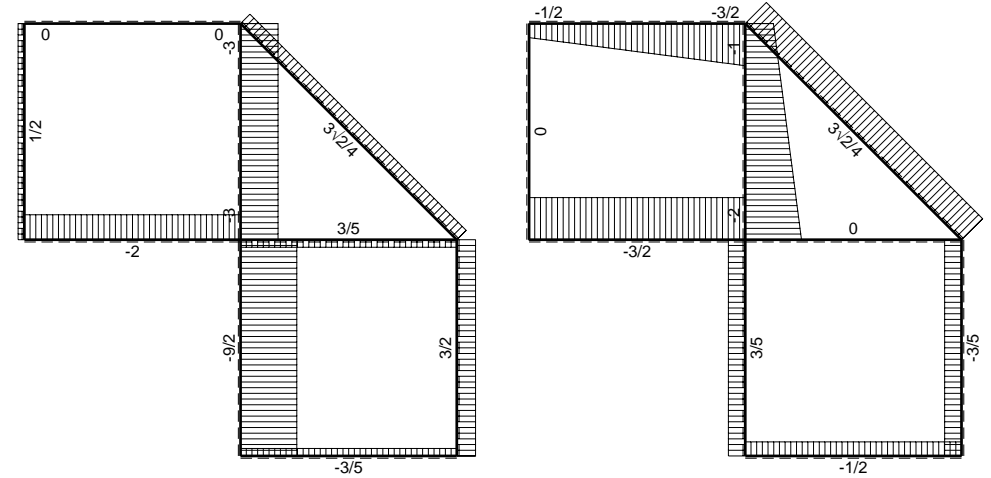
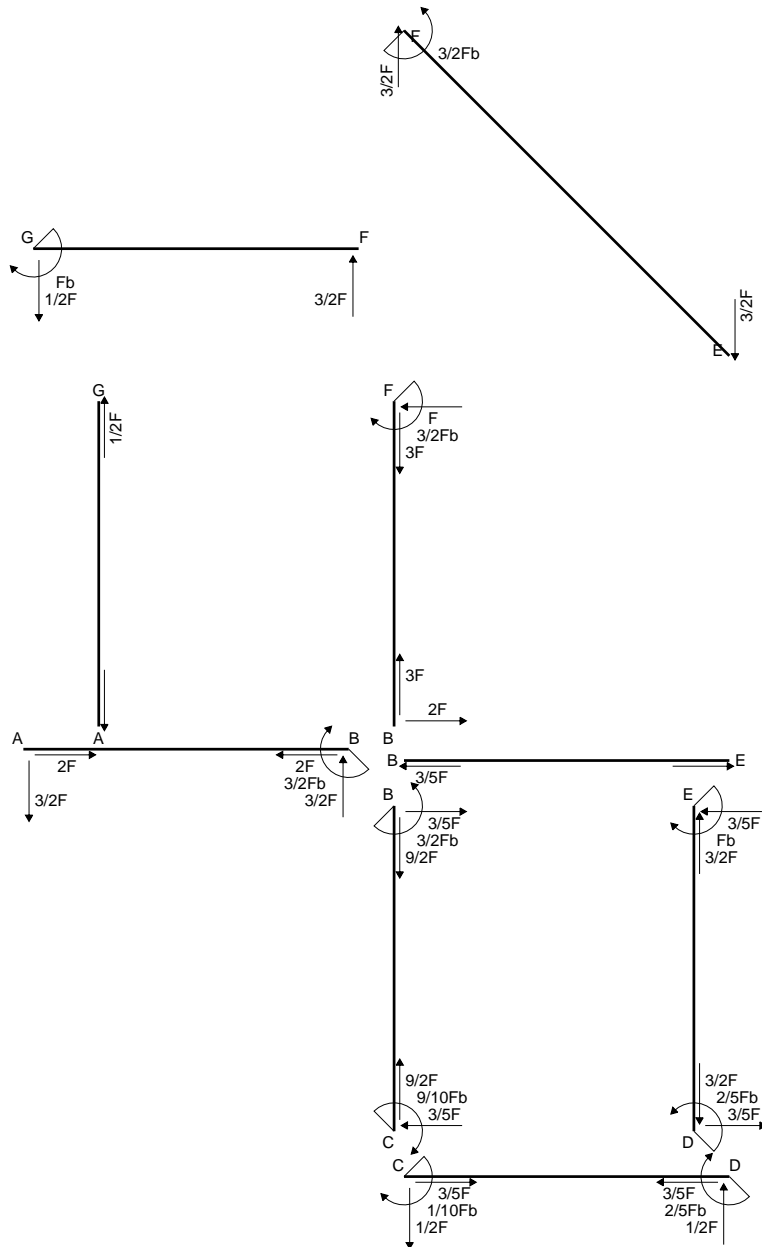
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

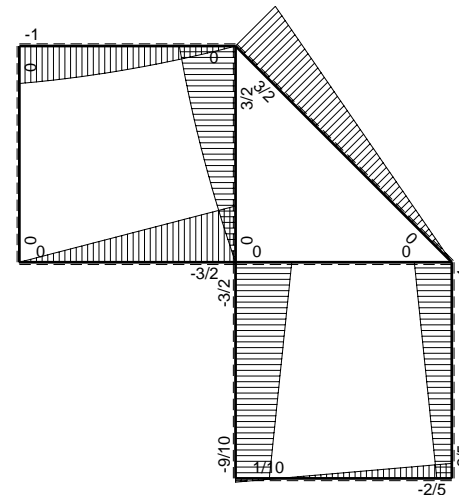
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

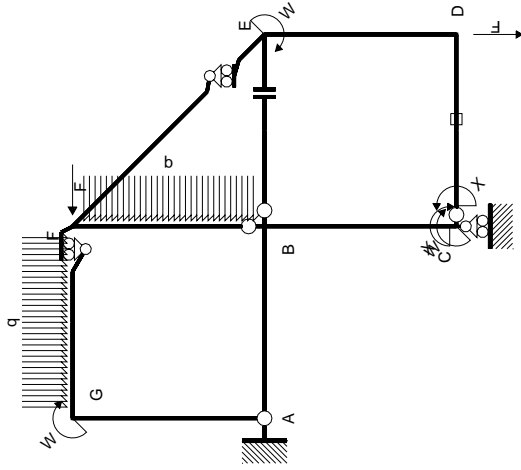


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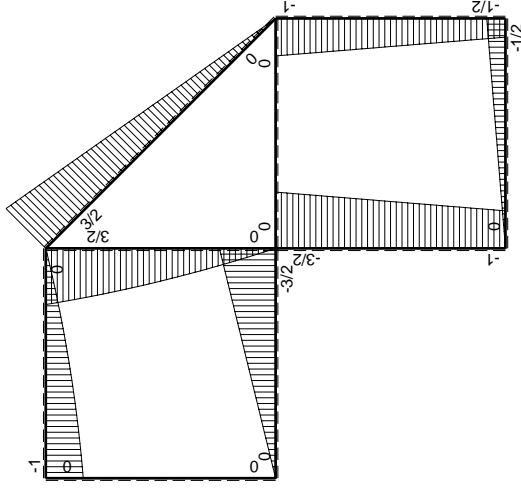
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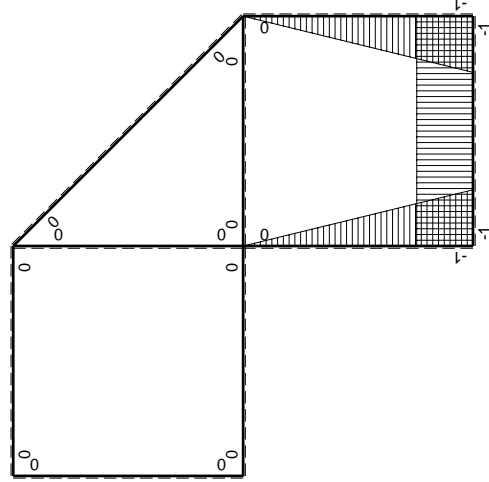
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

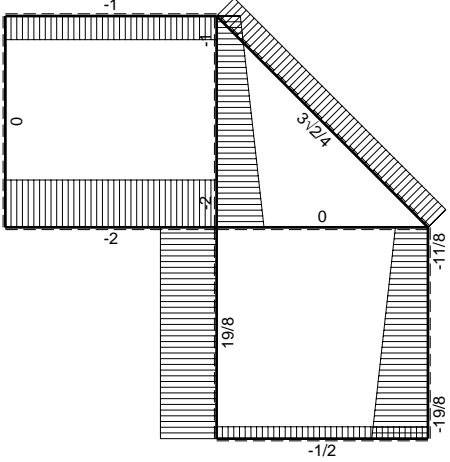
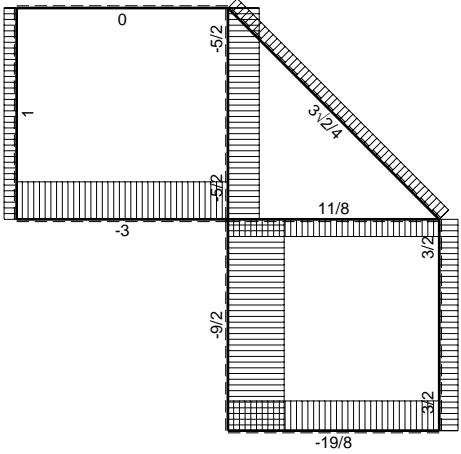
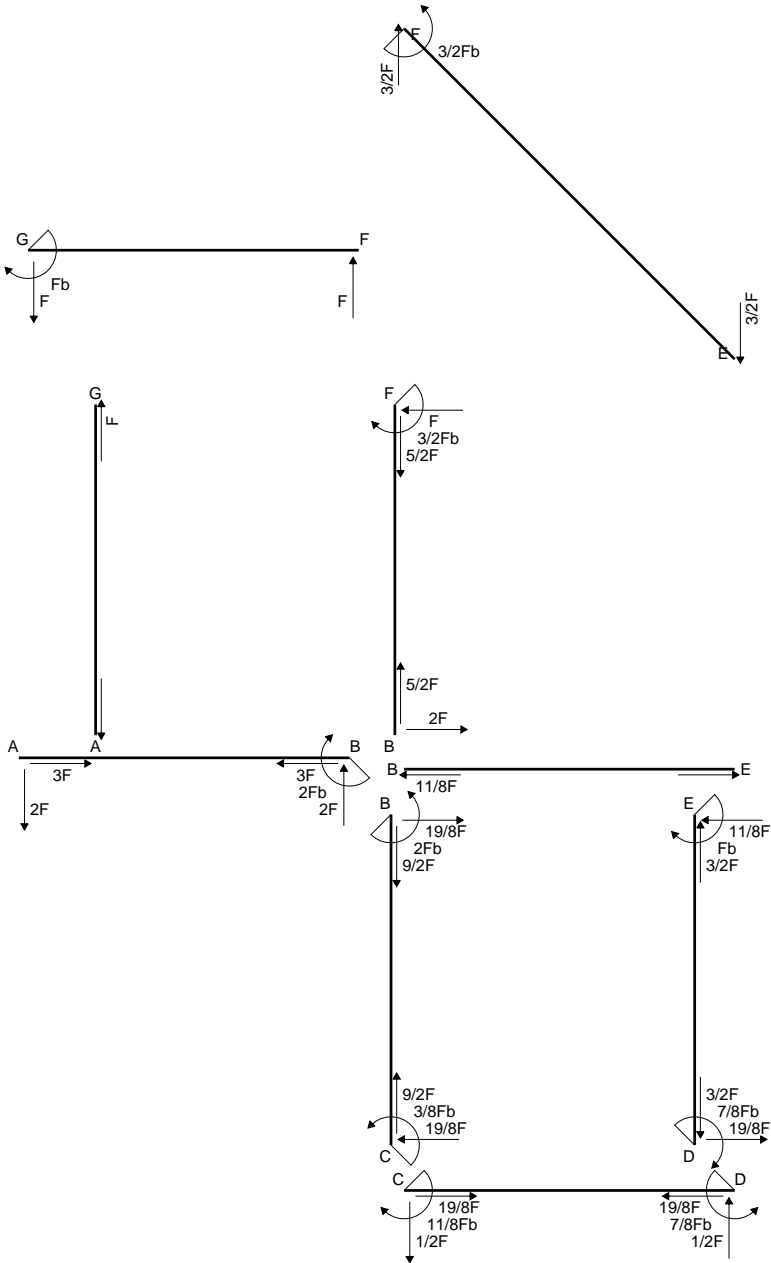
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

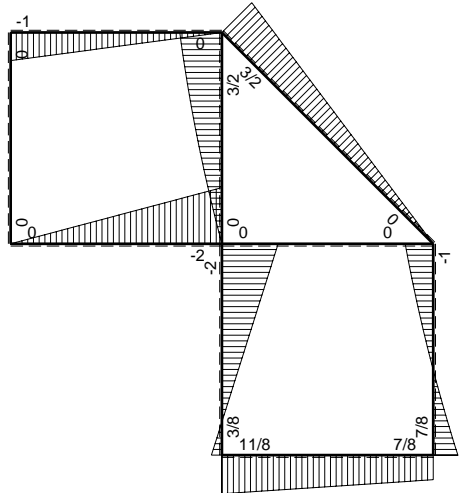
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

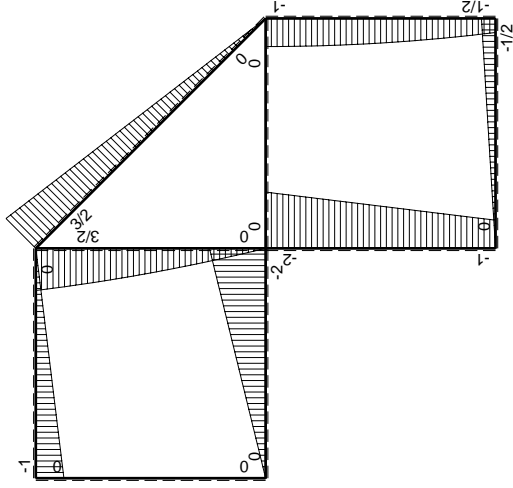
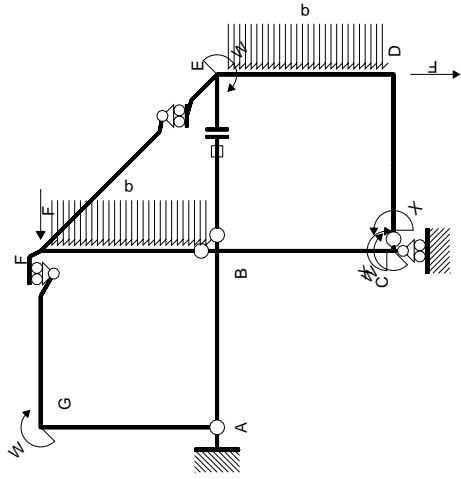


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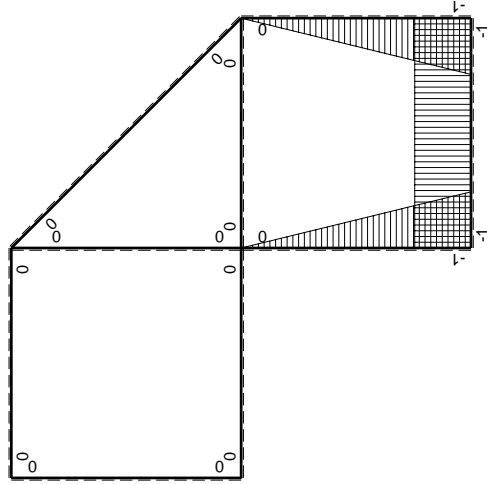


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$55/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-11/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

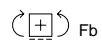
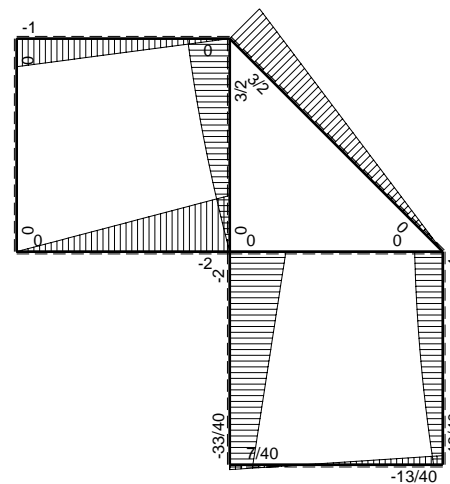
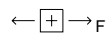
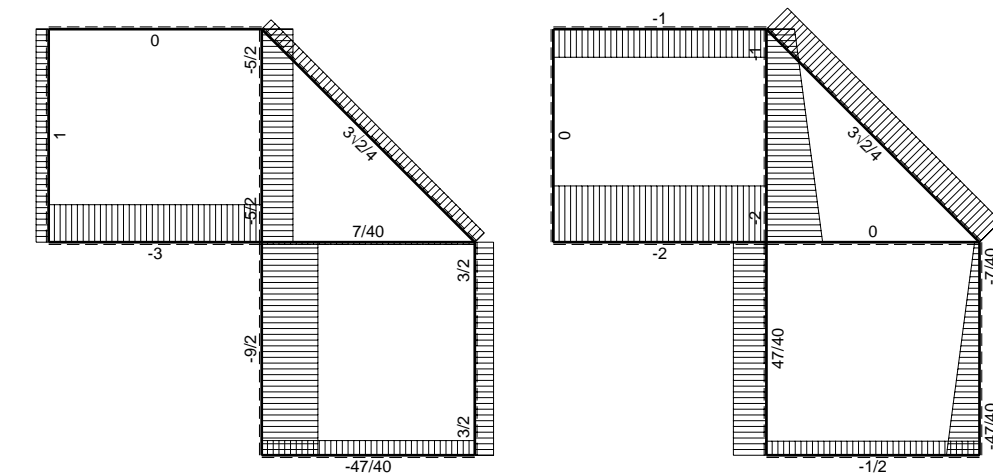
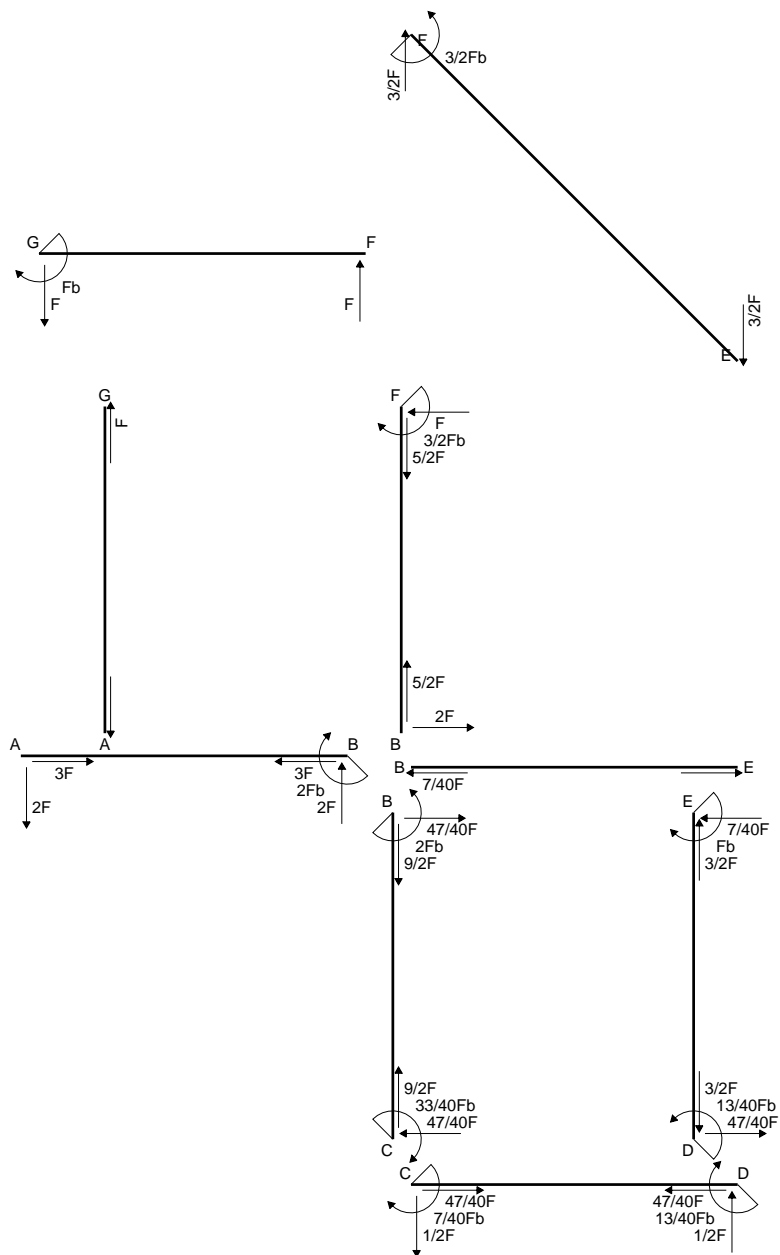
$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

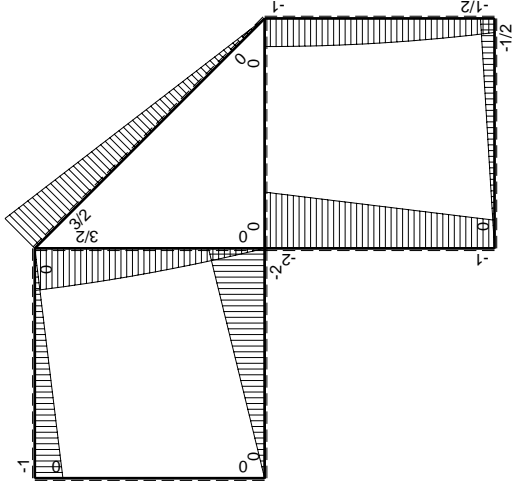
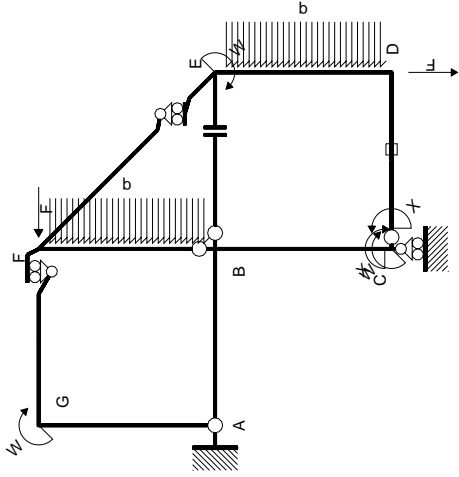
$$= [1/2 x + 1/4 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b + 1/4 b - 1/2 b + 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

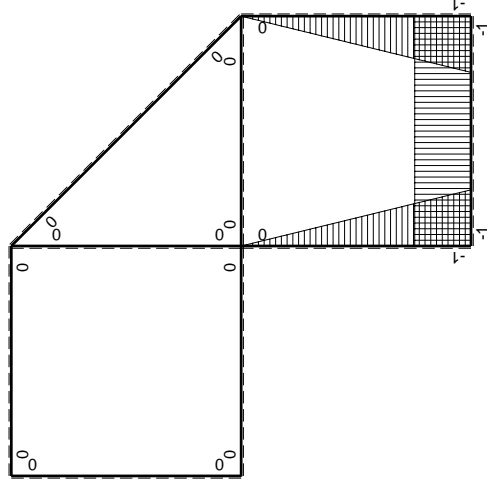
$$= (1/2 b - 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$7/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-7/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

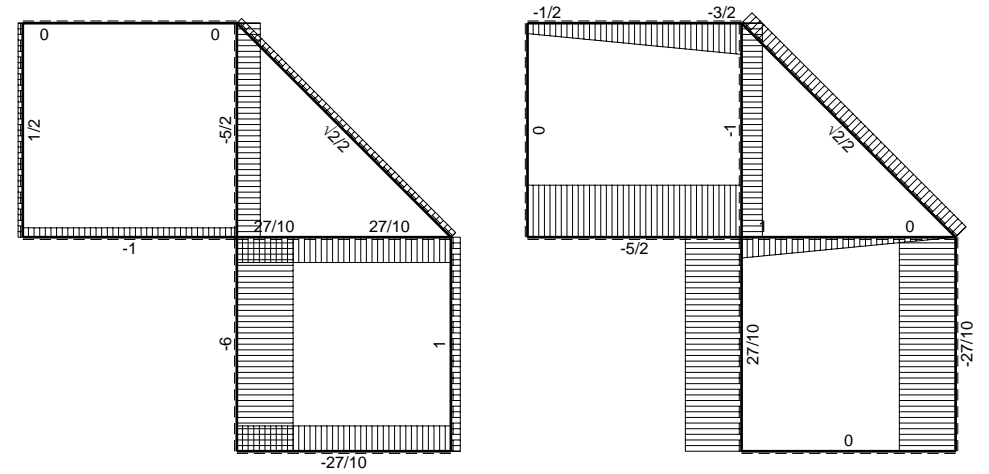
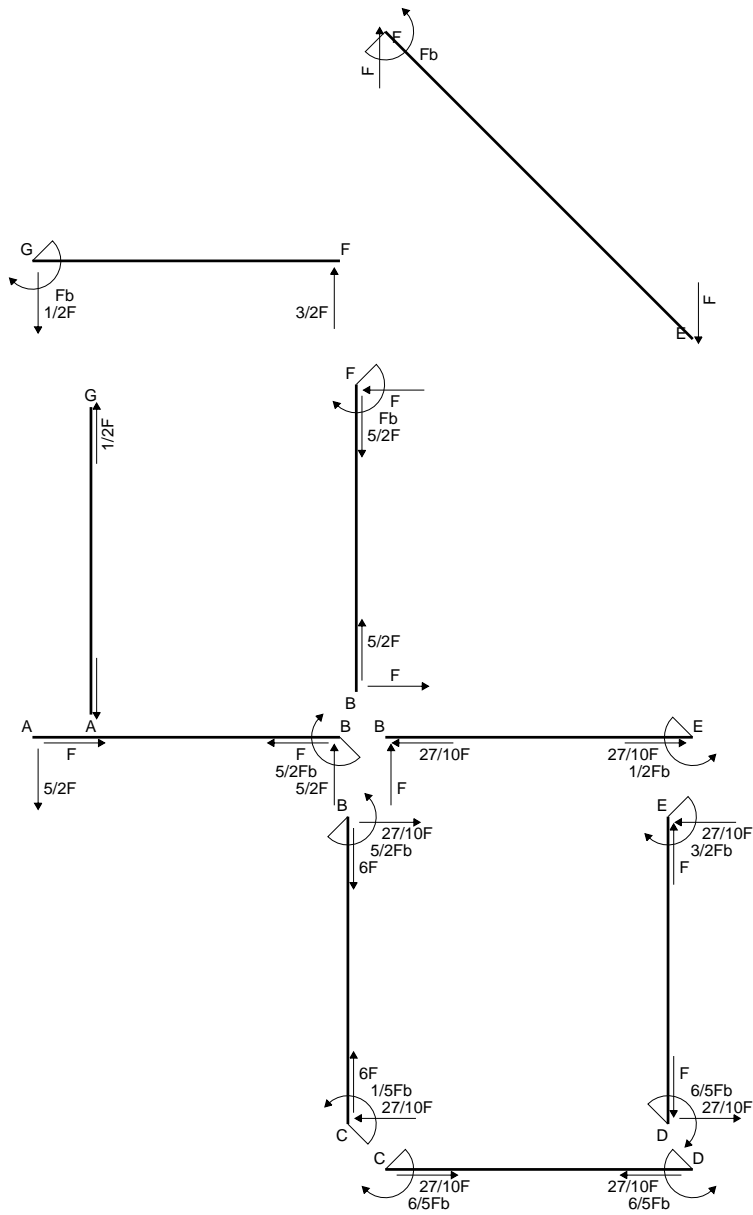
$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

$$= [1/2 x + 1/4 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b + 1/4 b - 1/2 b + 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 Fb^2/EJ$$

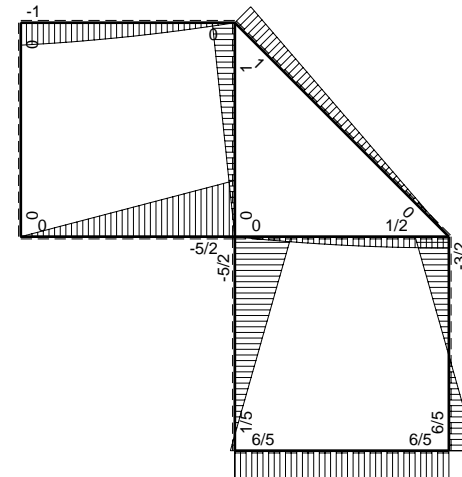
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 Fb^2/EJ$$

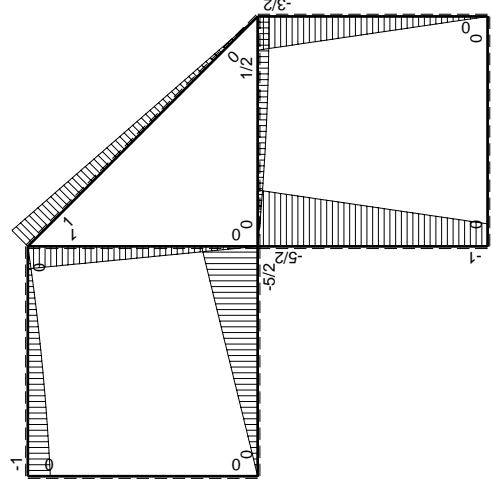
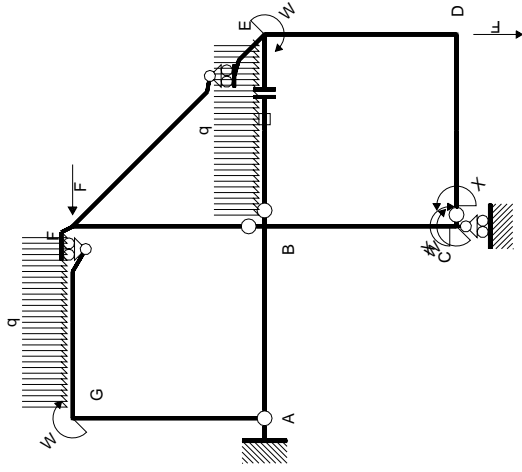


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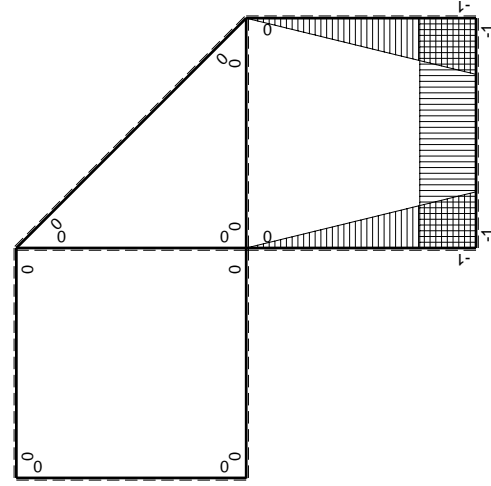


⊕ ⊖ F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-3/2Fx	3/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^{E-BE}$				Fb ² /EJ	
	totali				2Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

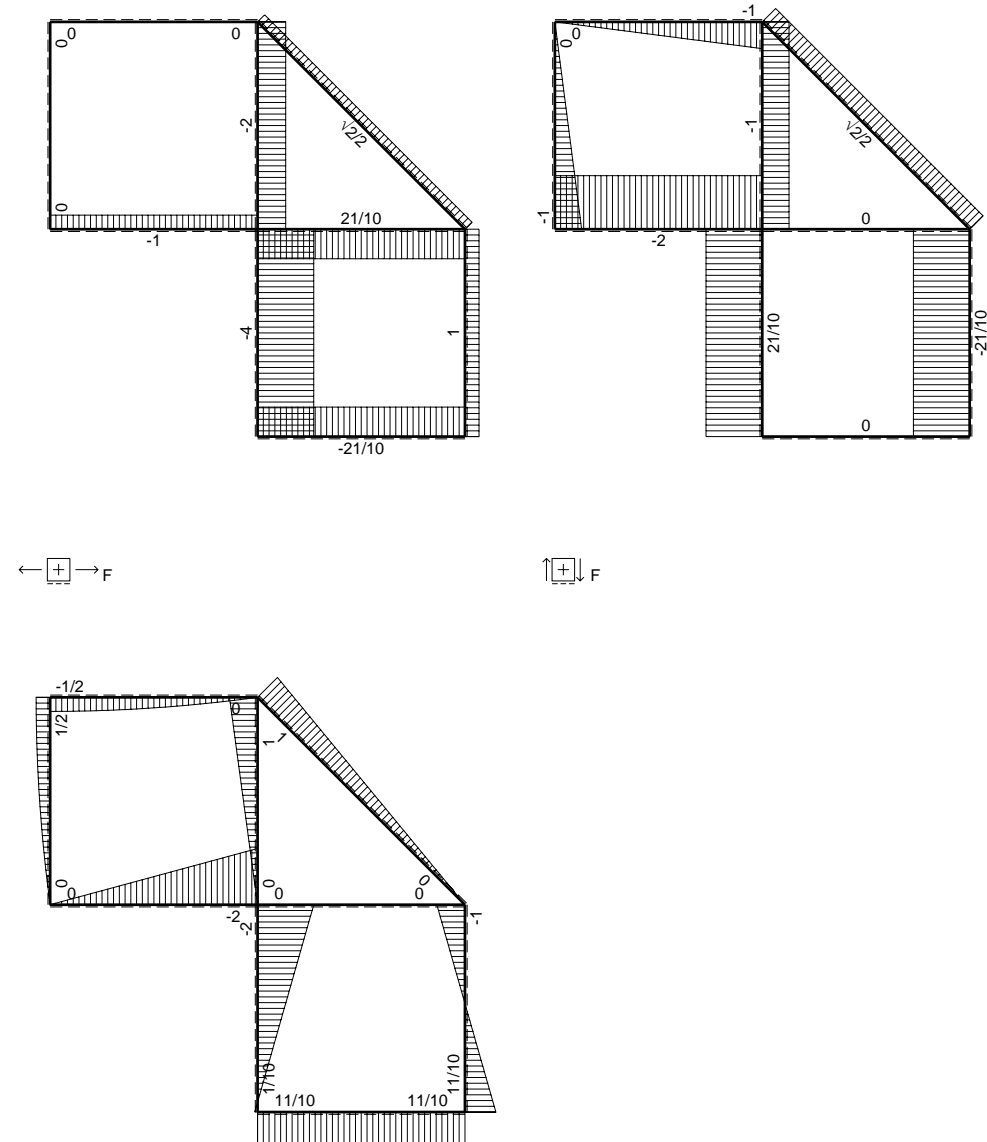
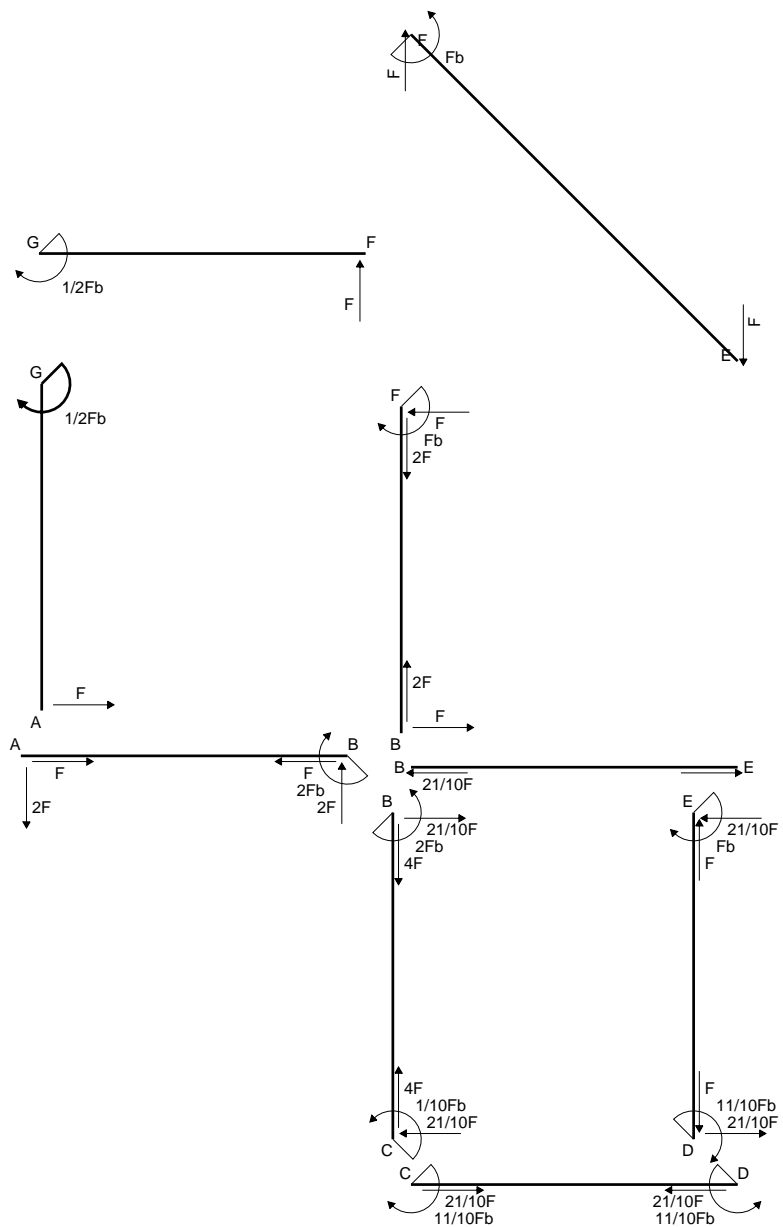
$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

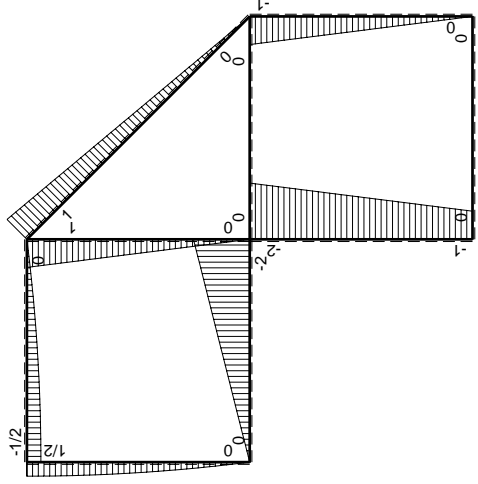
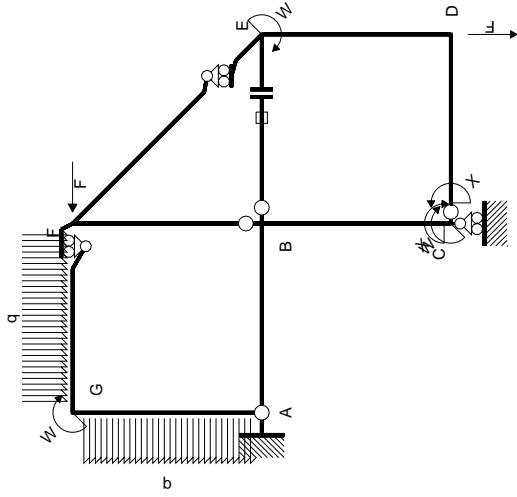
$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

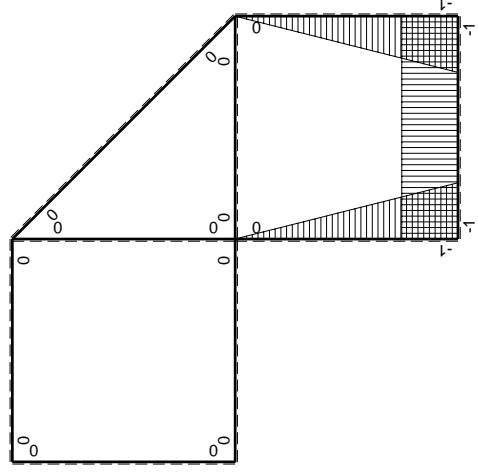


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx+1/2qx ²	0	0	0	0
GF b	0	1/2Fb-1/2qx ²	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

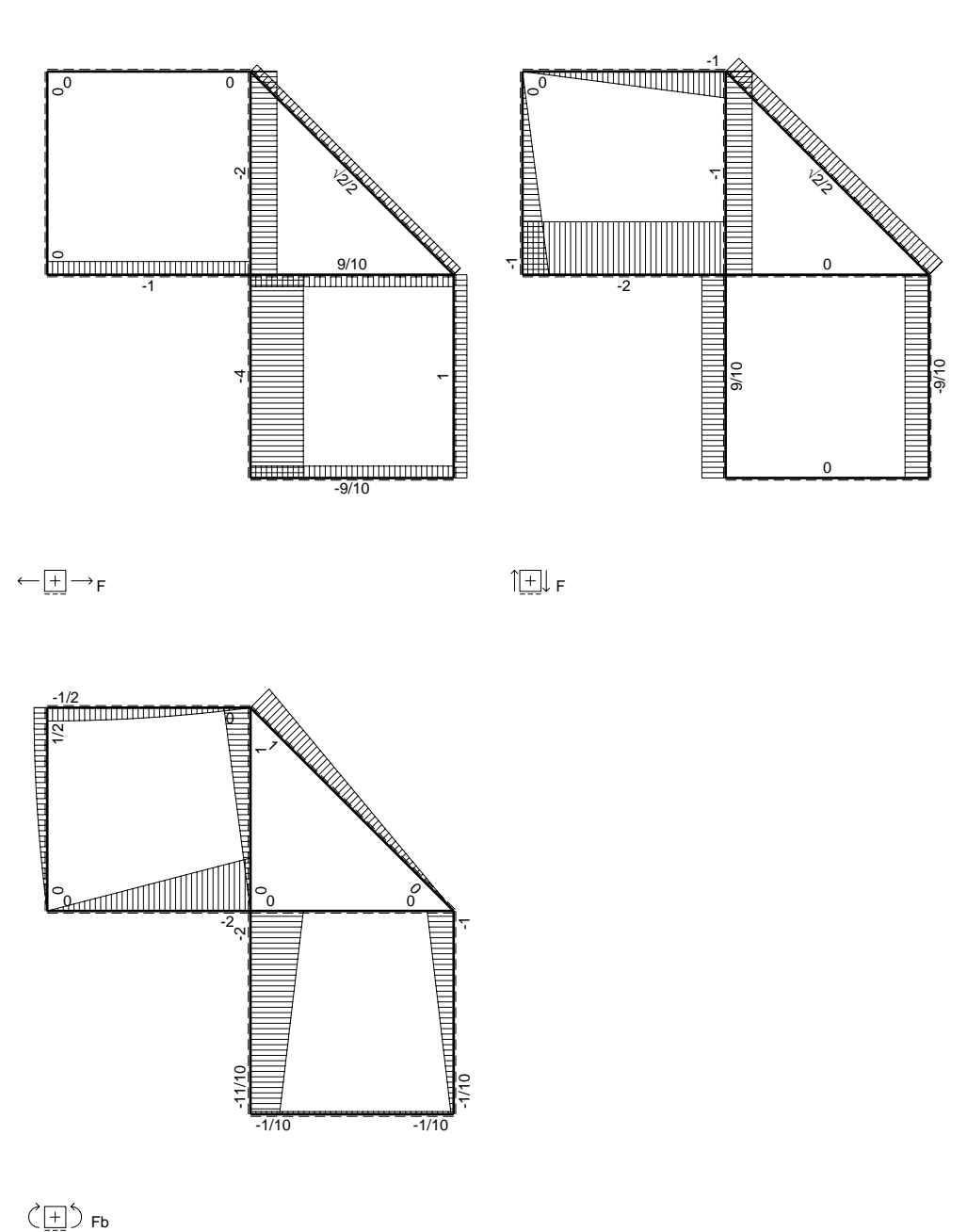
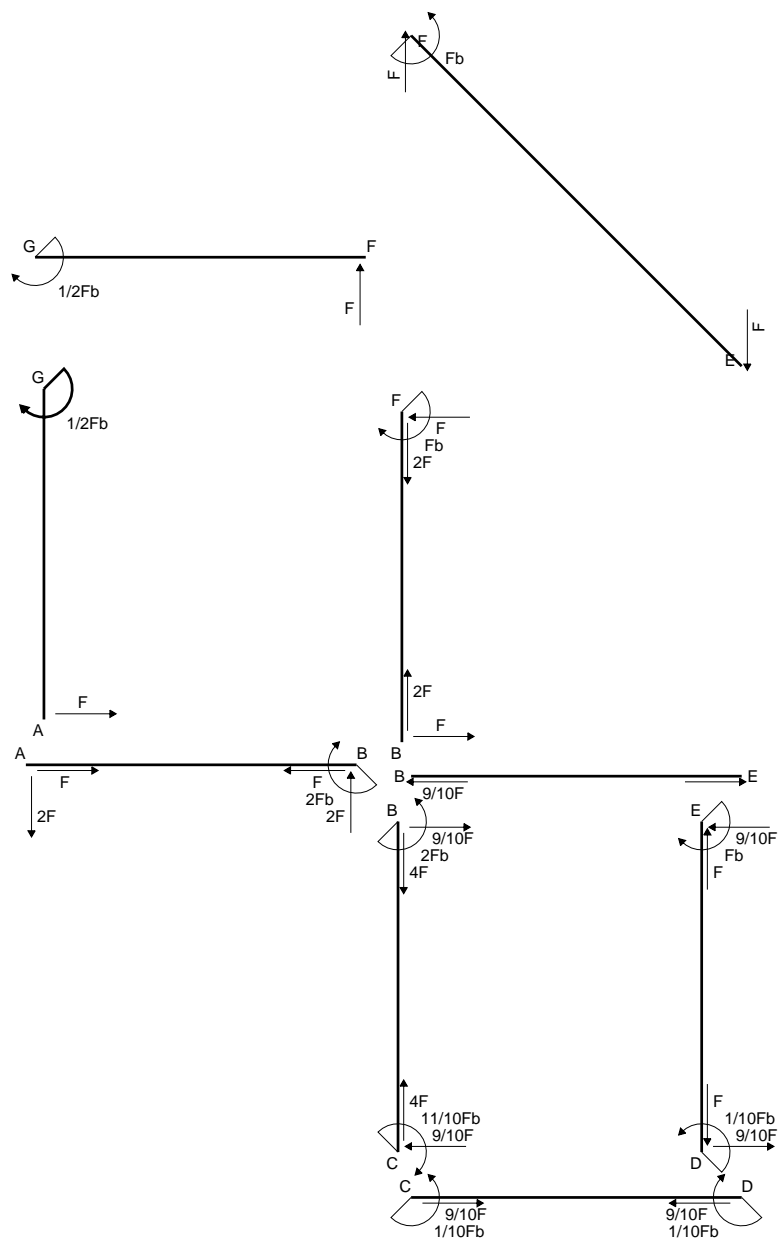
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

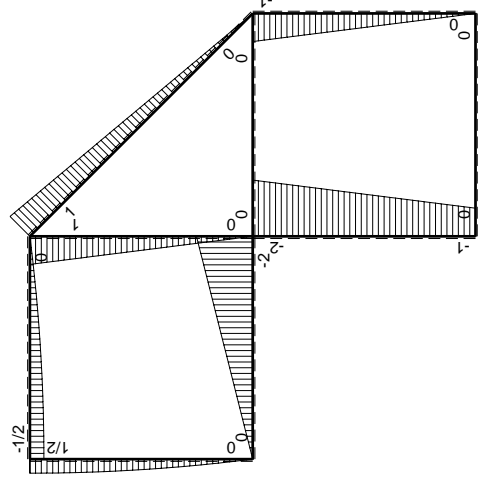
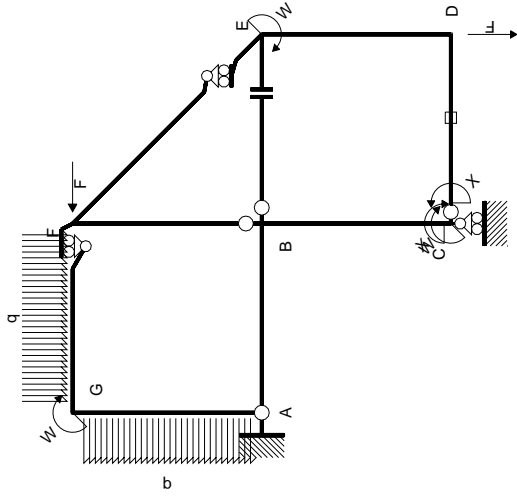
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

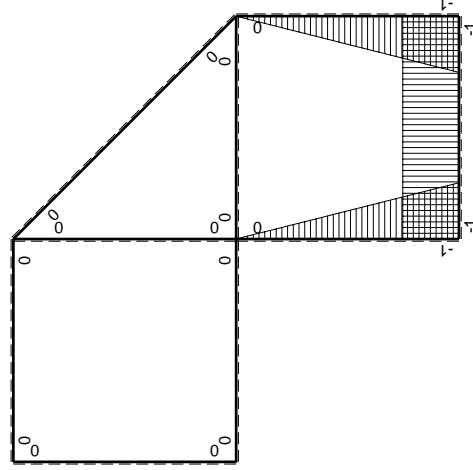
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{CD}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-Fx+1/2qx^2$	0	0	0	0
GF b	0	$1/2Fb-1/2qx^2$	0	0	0	0
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

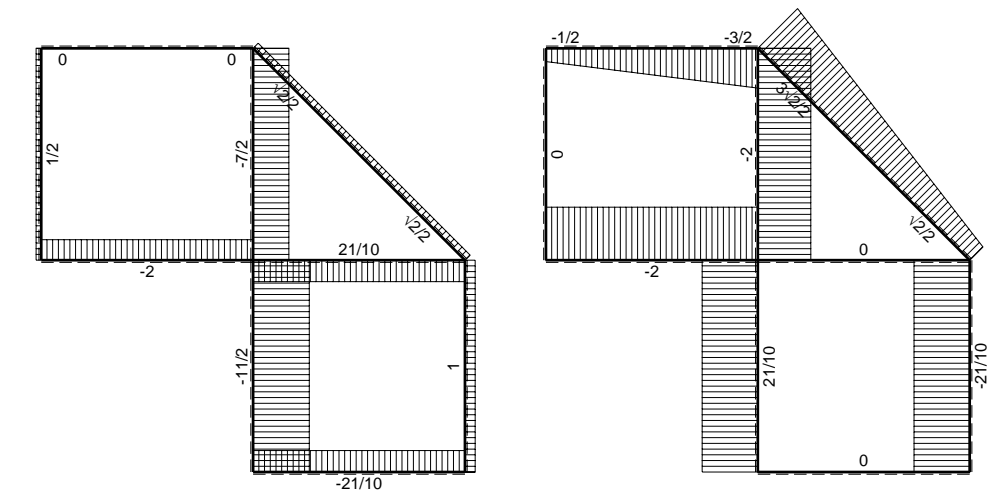
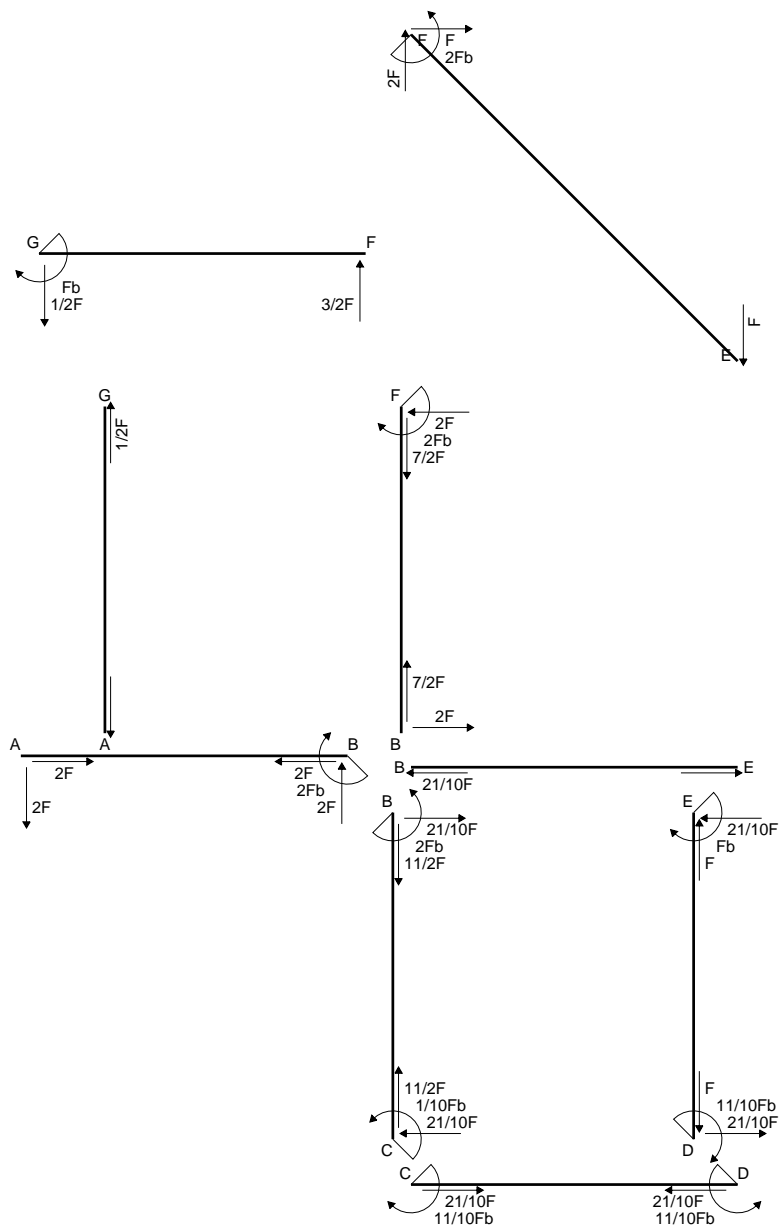
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

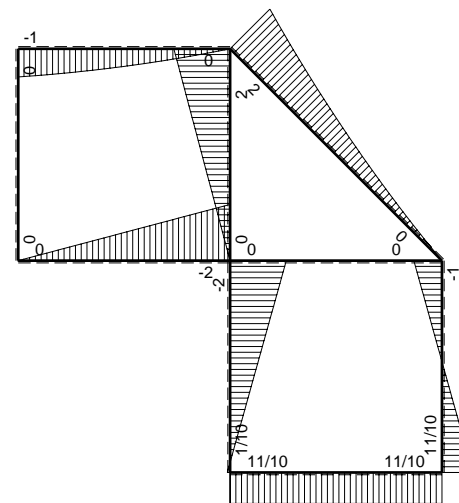
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

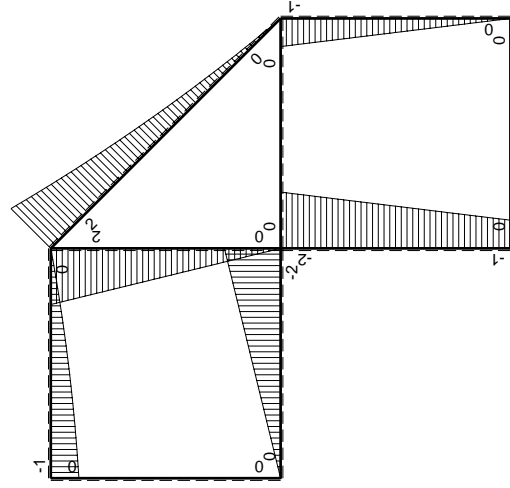
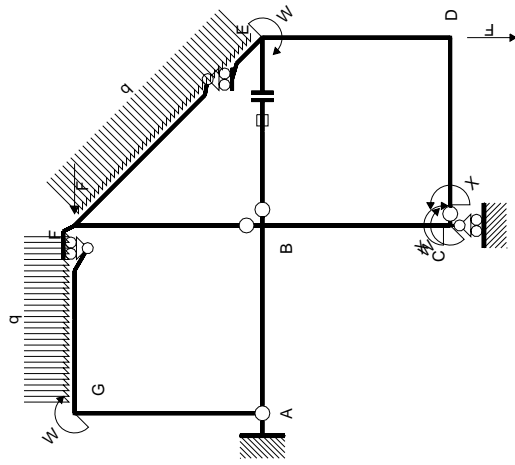


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Schema di calcolo iperstatico

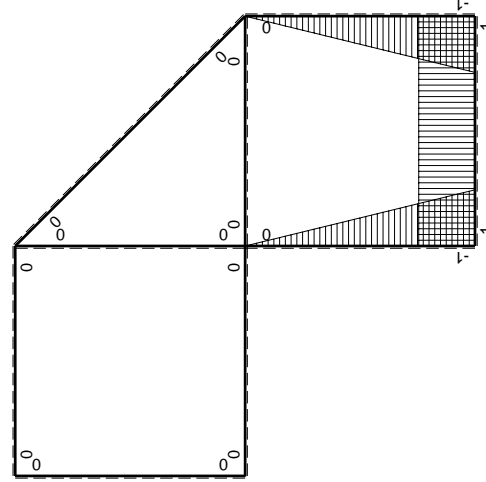
M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-11/10Fb	

Sviluppi di calcolo iperstatica



$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

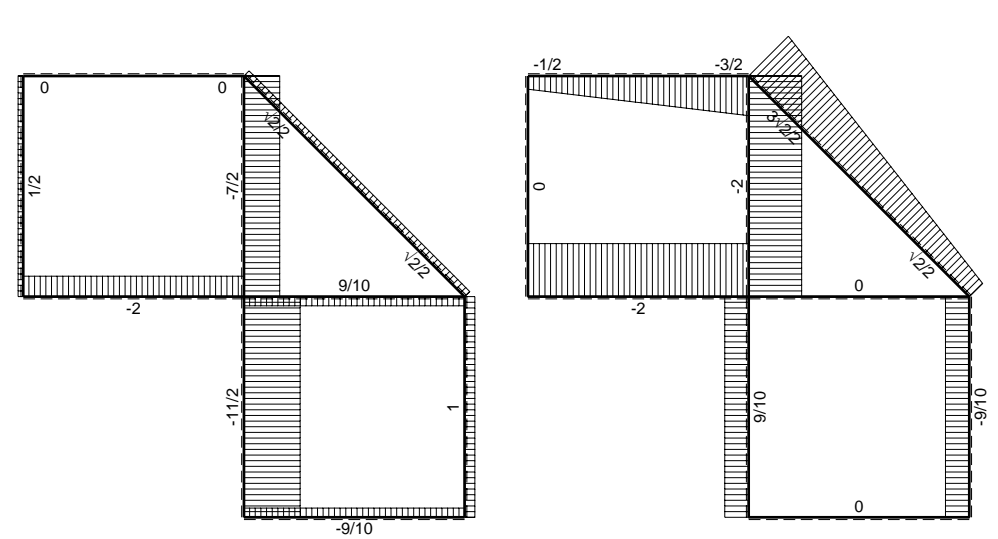
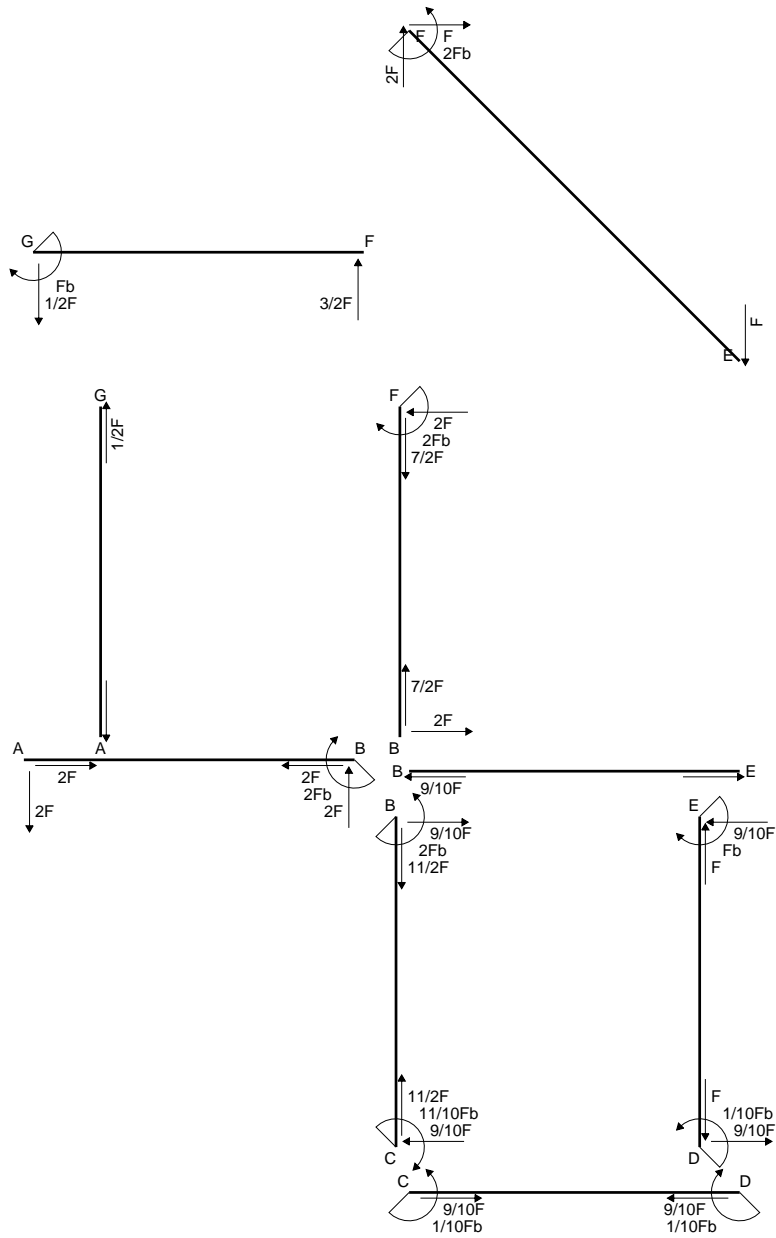
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

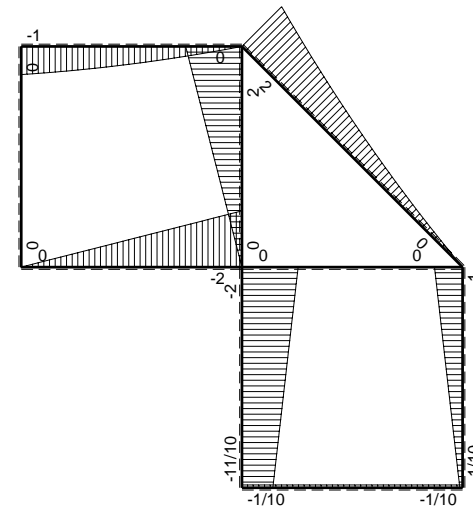
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

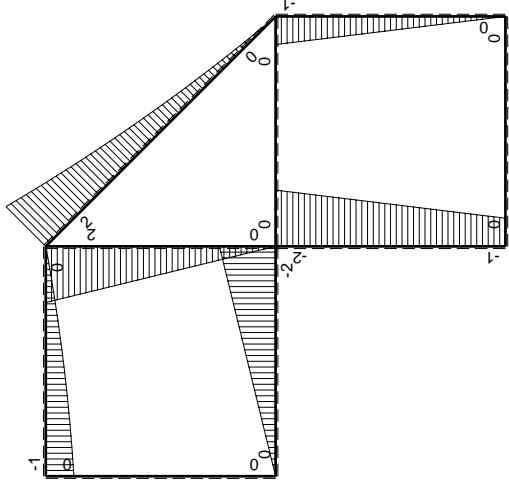
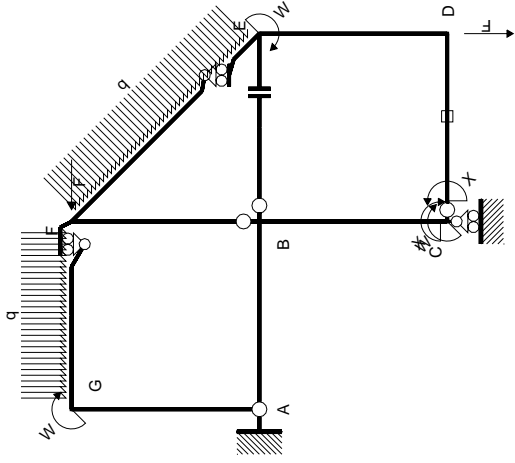


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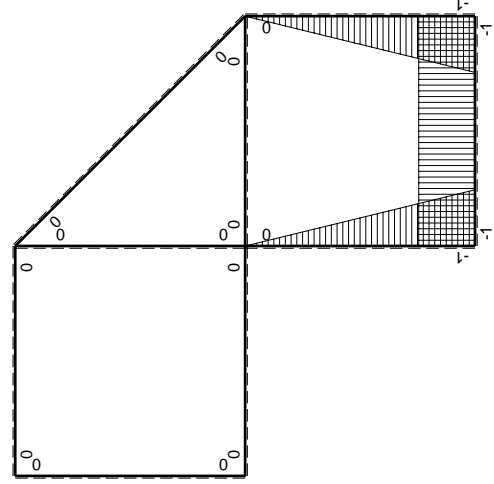


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

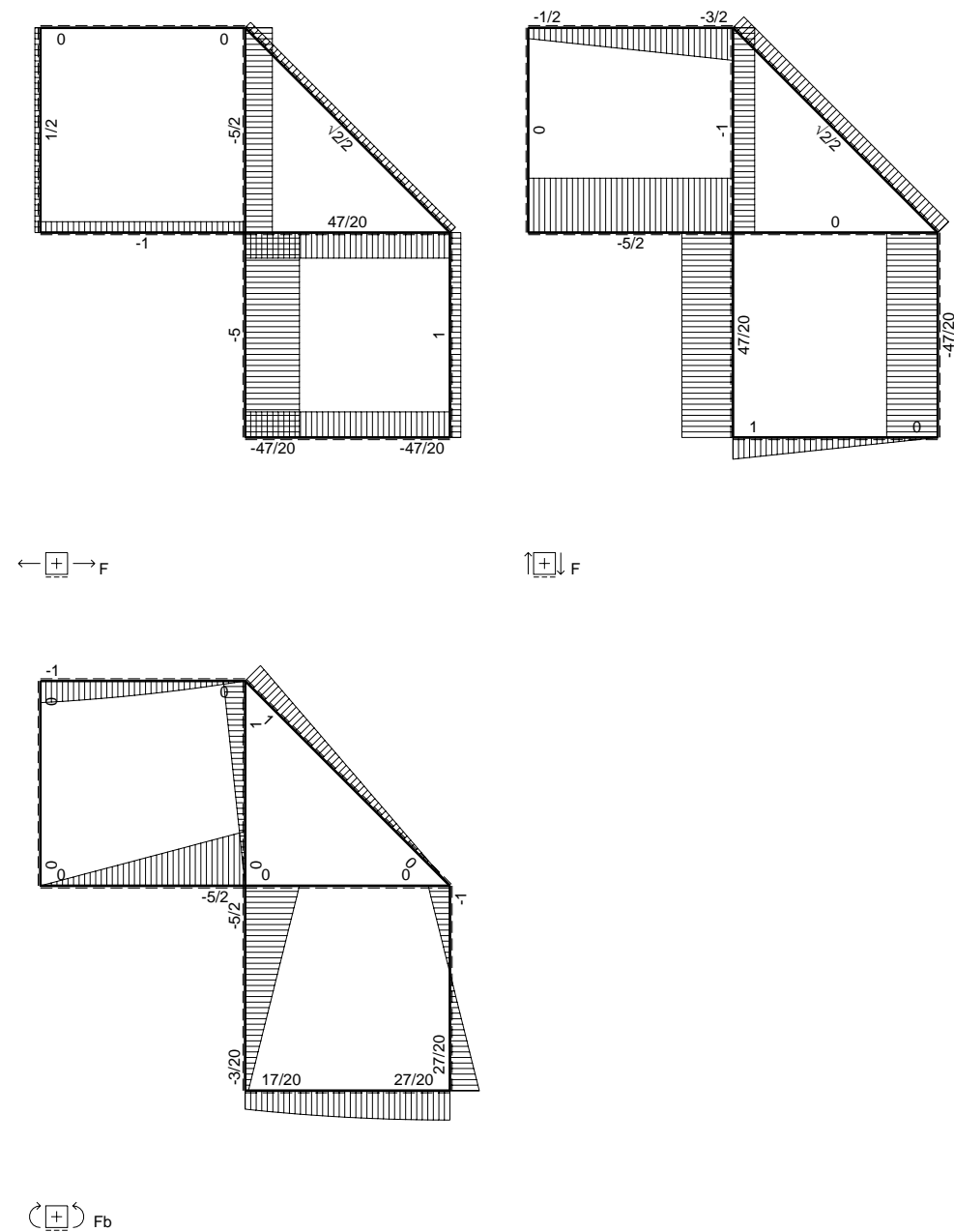
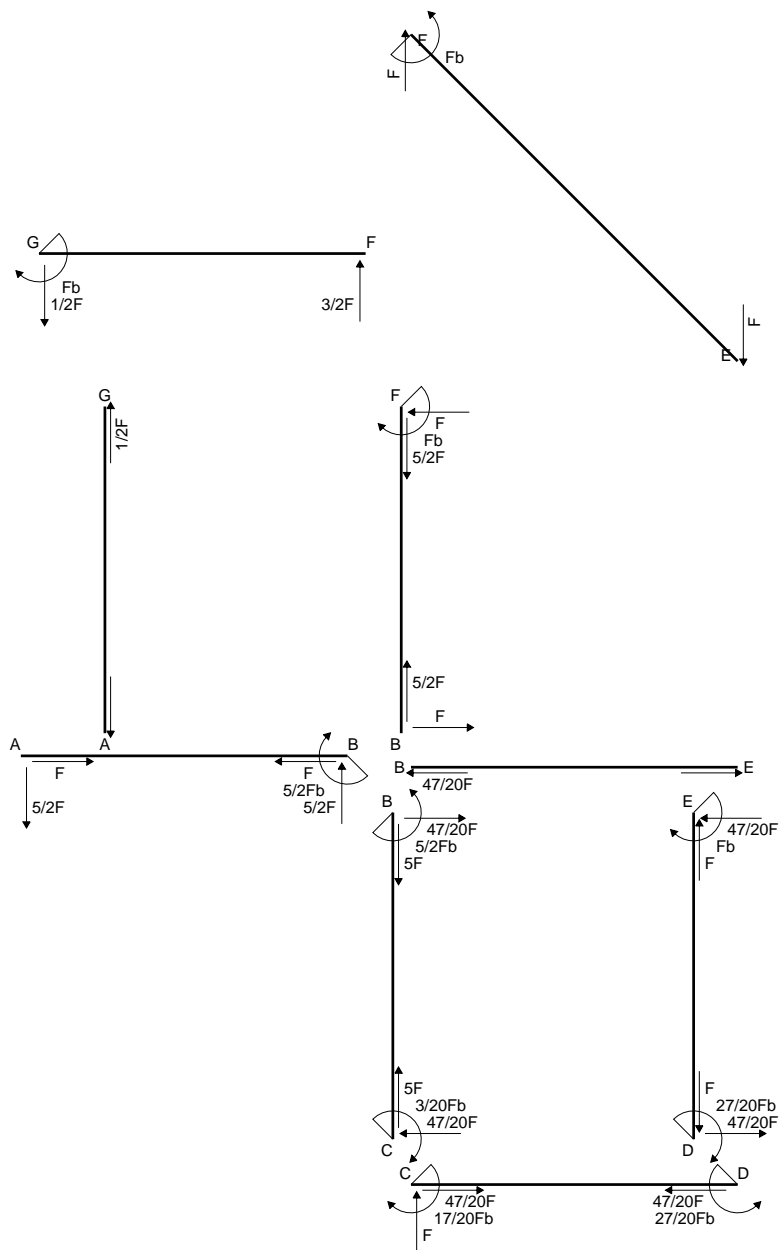
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

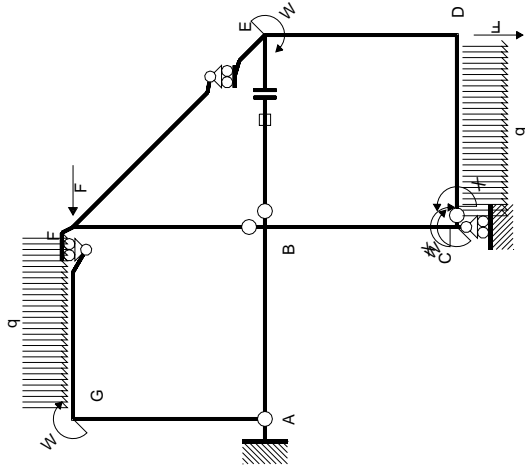
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

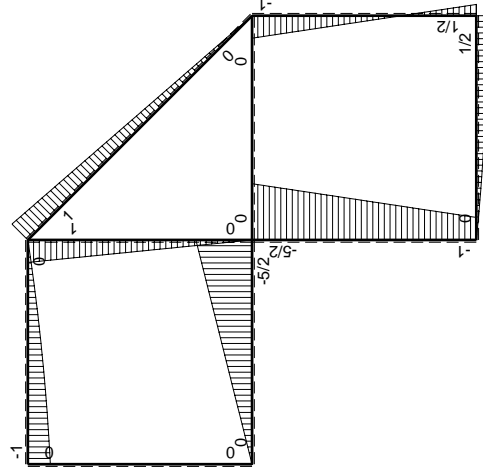
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

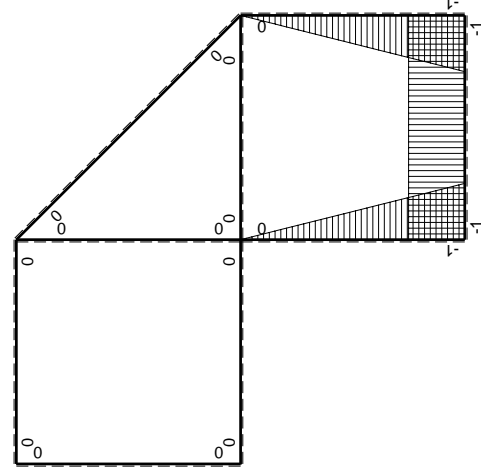




Schema di calcolo iperstatico



M₀ flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫M _x M _x /EJdx
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1		
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta N _{1, BE} ε _{BE} -l _{BE}				Fb ² /EJ	
	totali				17/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-17/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

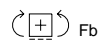
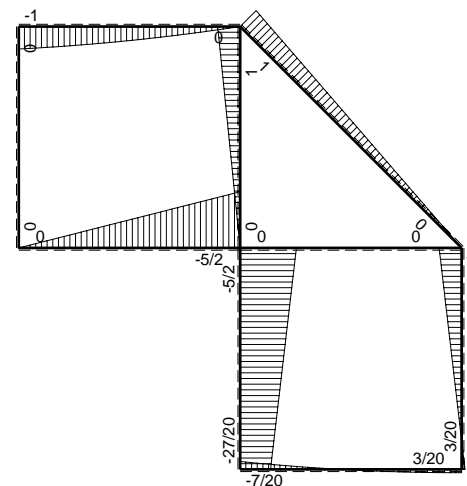
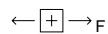
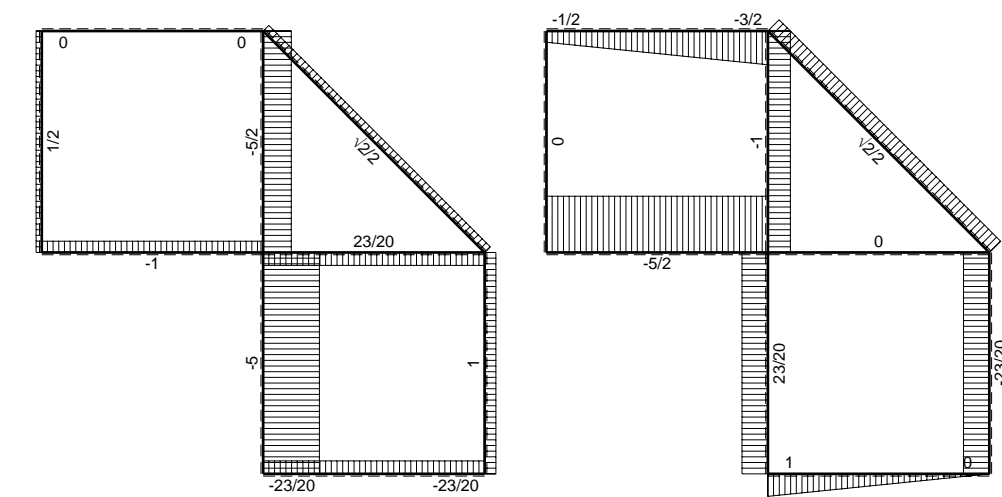
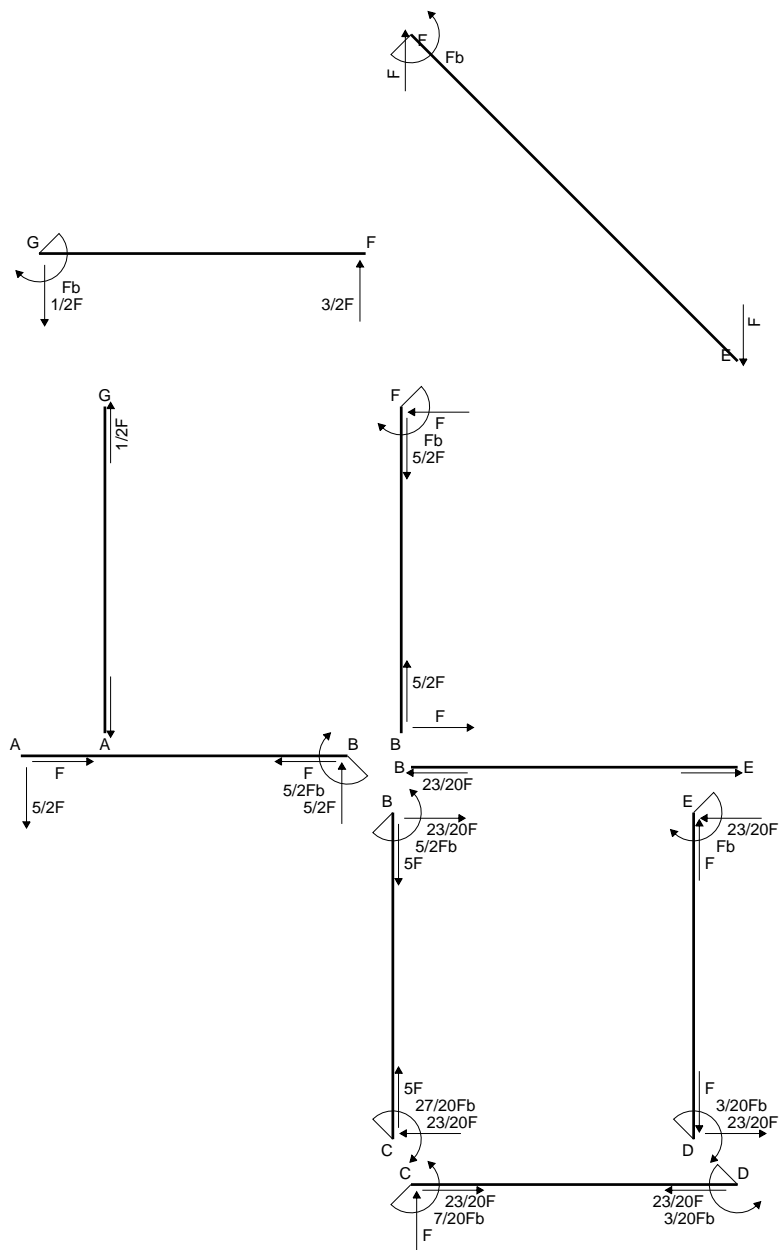
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

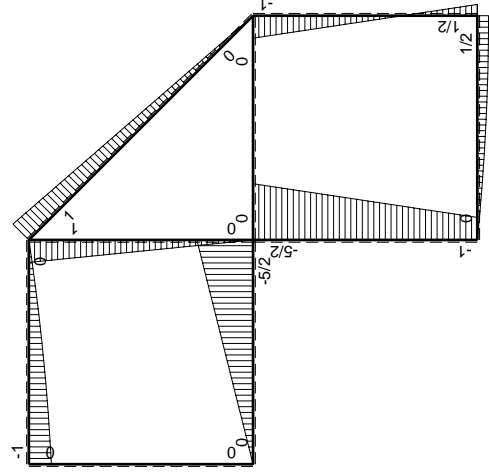
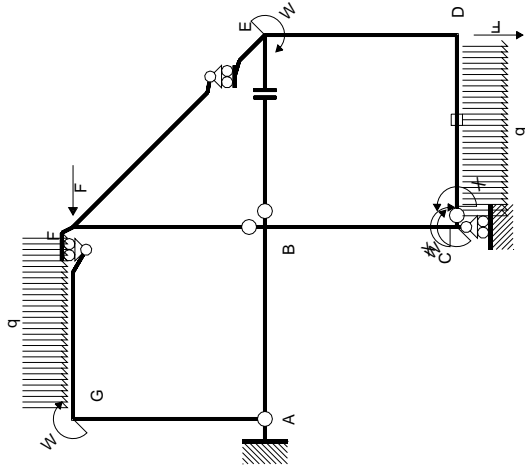
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

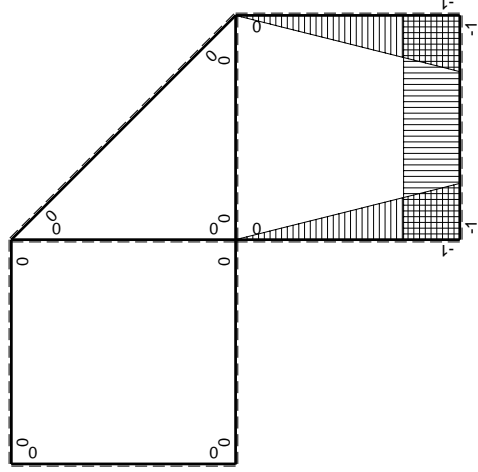
$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx ² /b	x ² /b ²	0	1/3Xb/EJ
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-7/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				7/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

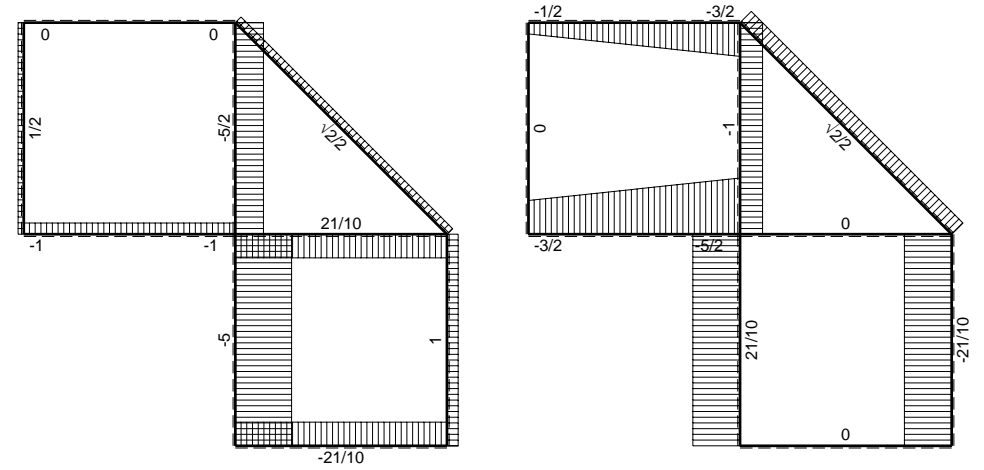
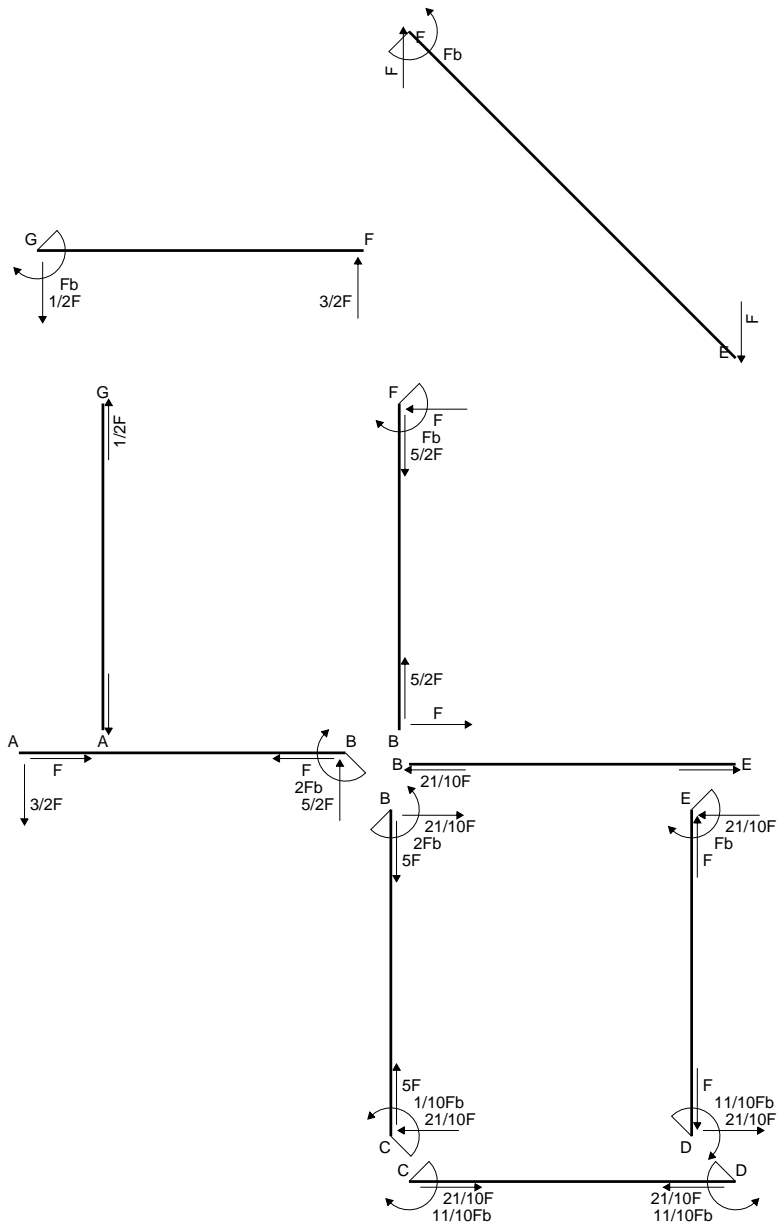
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

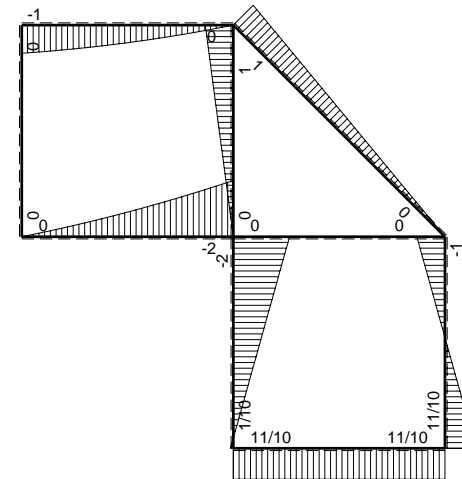
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$

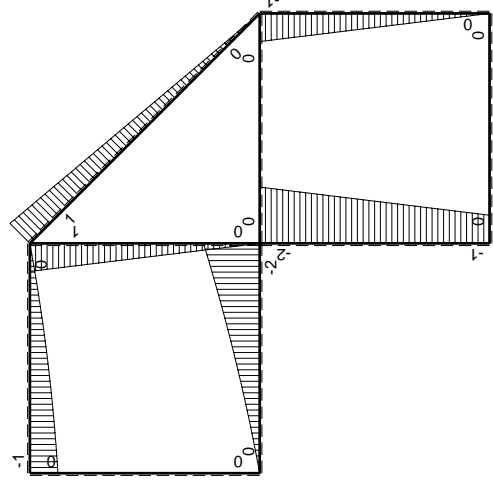
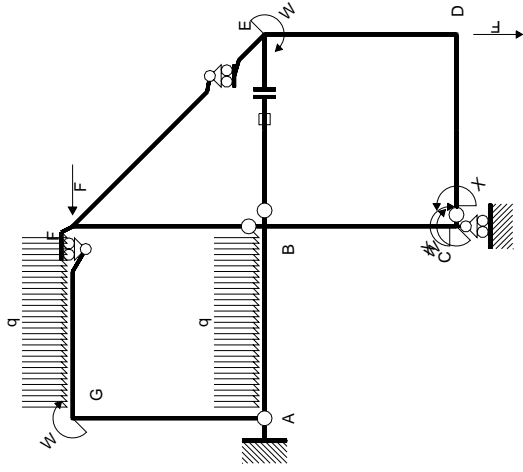


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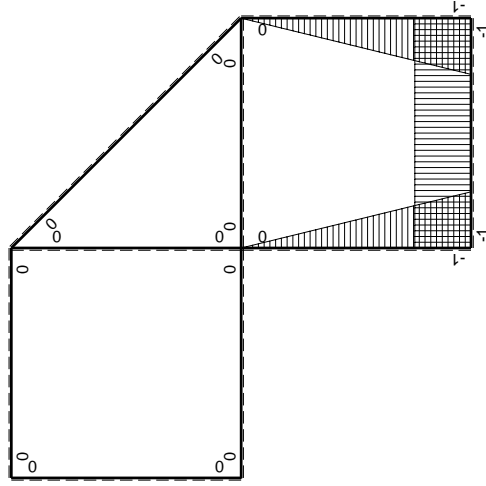


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$Fb - 1/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$					$-11/10Fb$

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

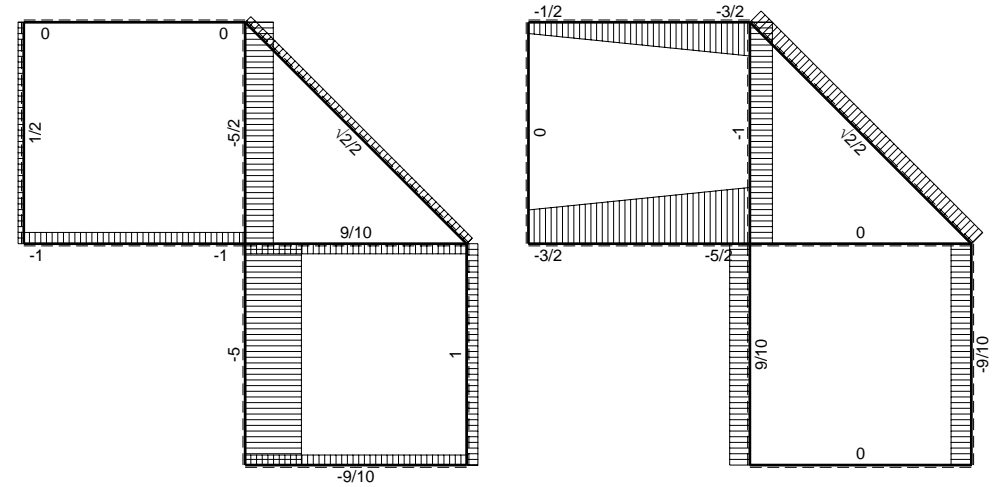
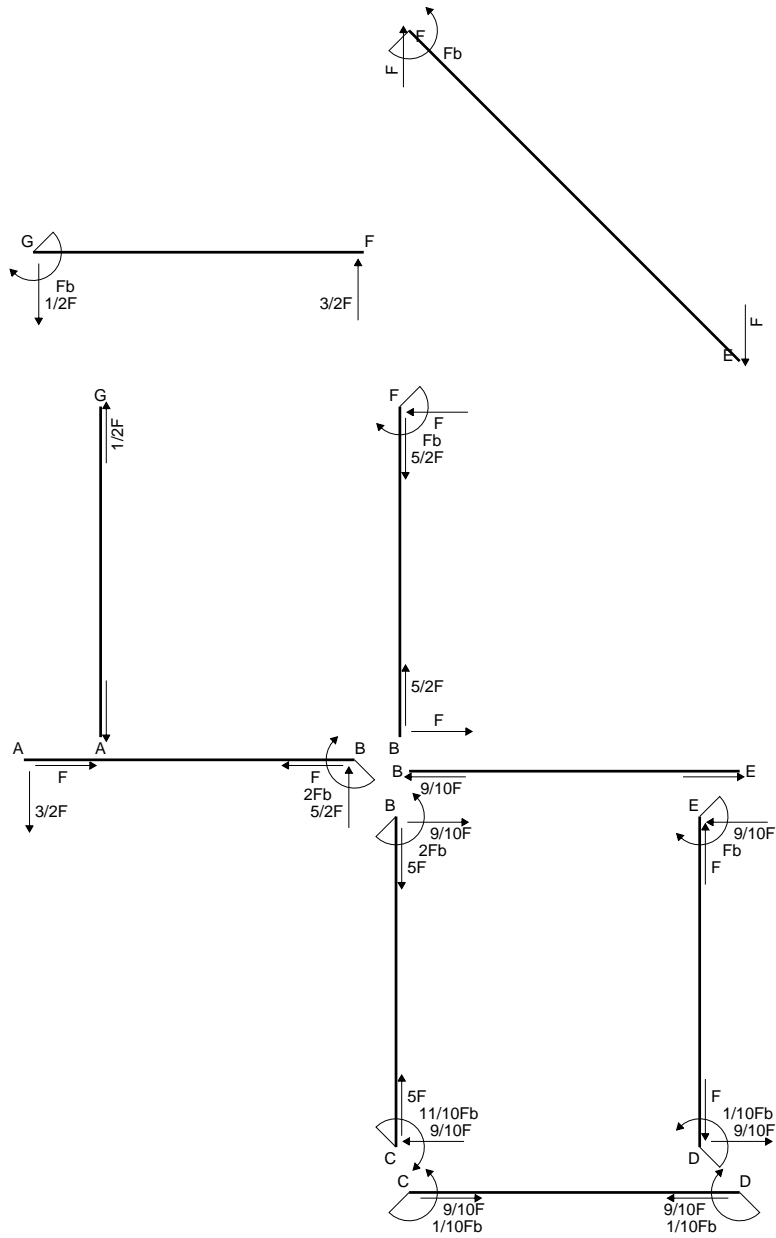
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

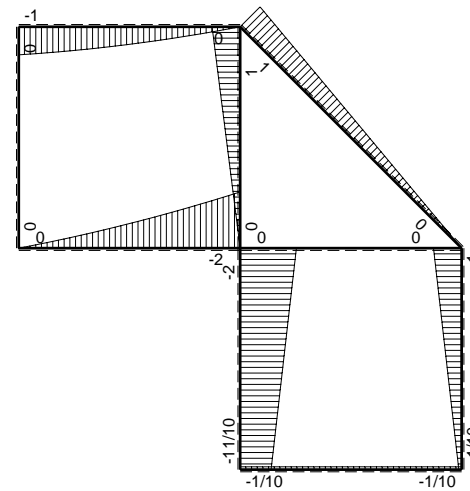
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

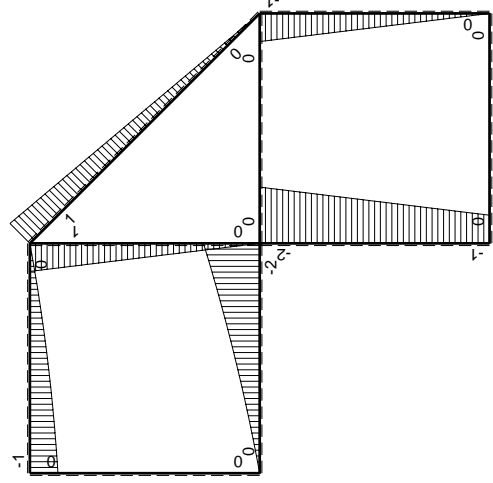
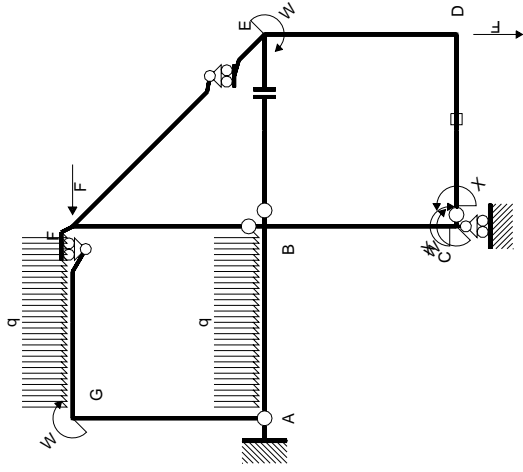


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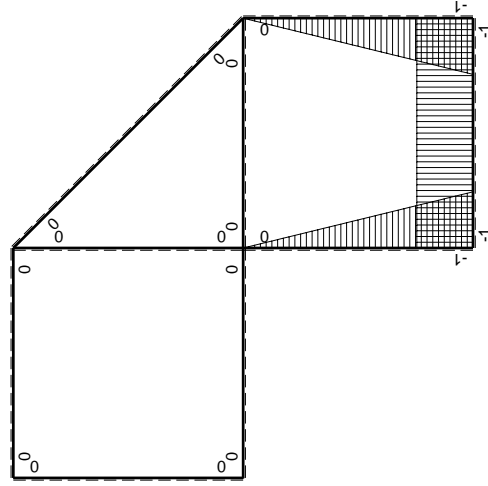


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-2Fb + Fx$	$2Fx - Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx$	$Fb - Fx^2/b$	$1 - 2x/b + x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	$-Fx$	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$Fb - 1/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

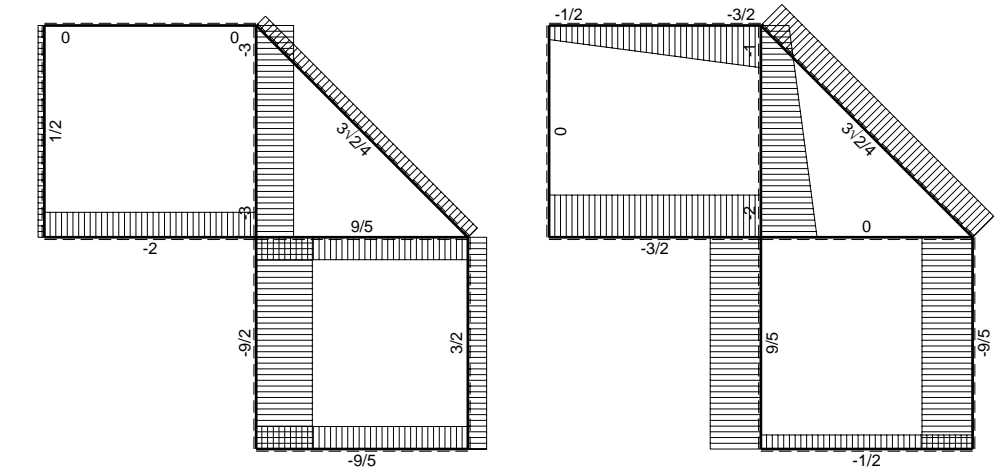
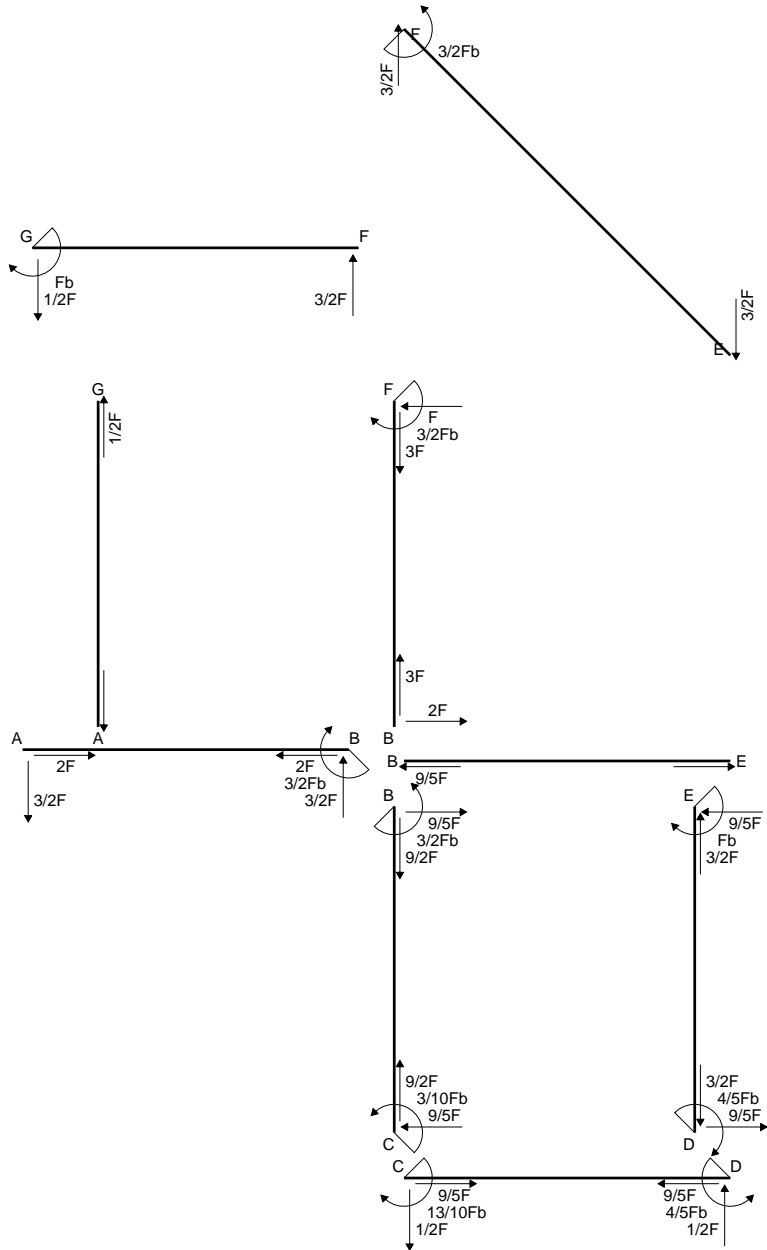
$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

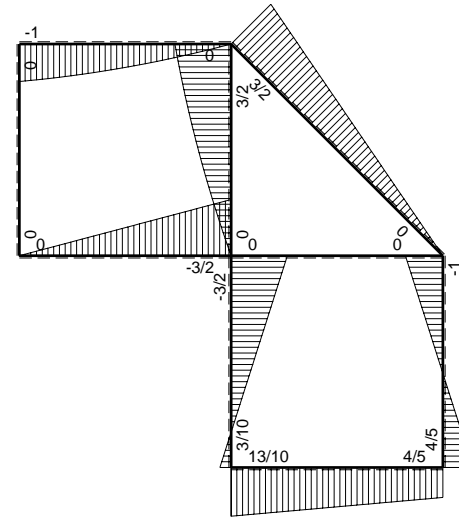
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

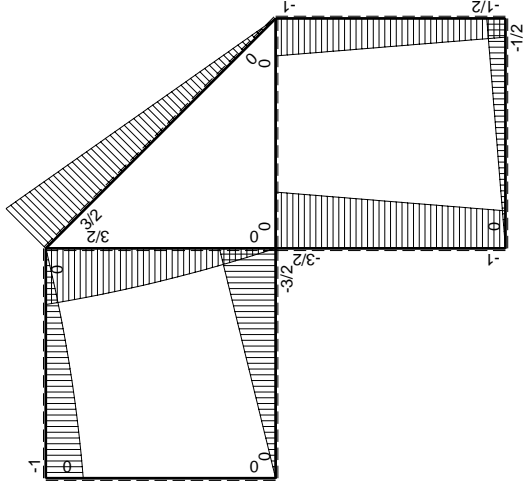
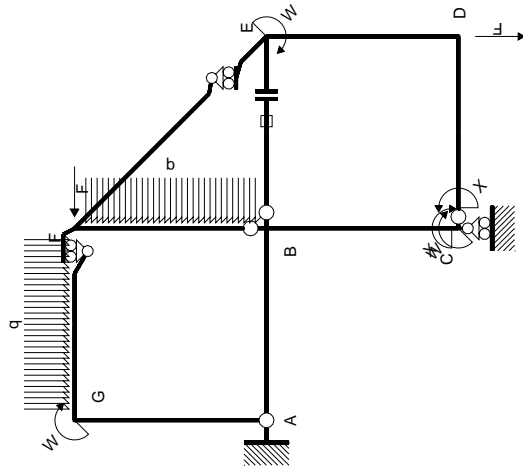


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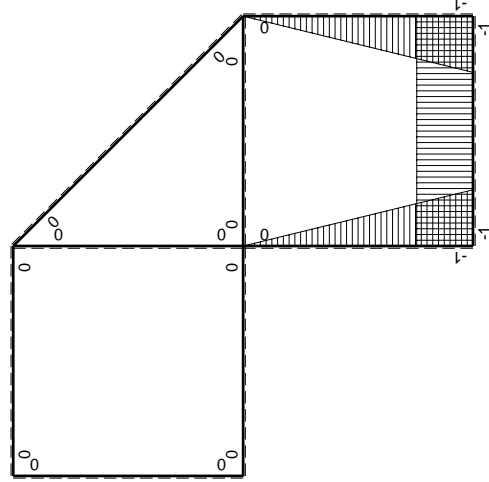


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/3Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^E$				Fb ² /EJ	
	totali				13/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-13/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x - \frac{1}{4} x^2/b \right]_0^b \cdot Fb \cdot 1/EJ$$

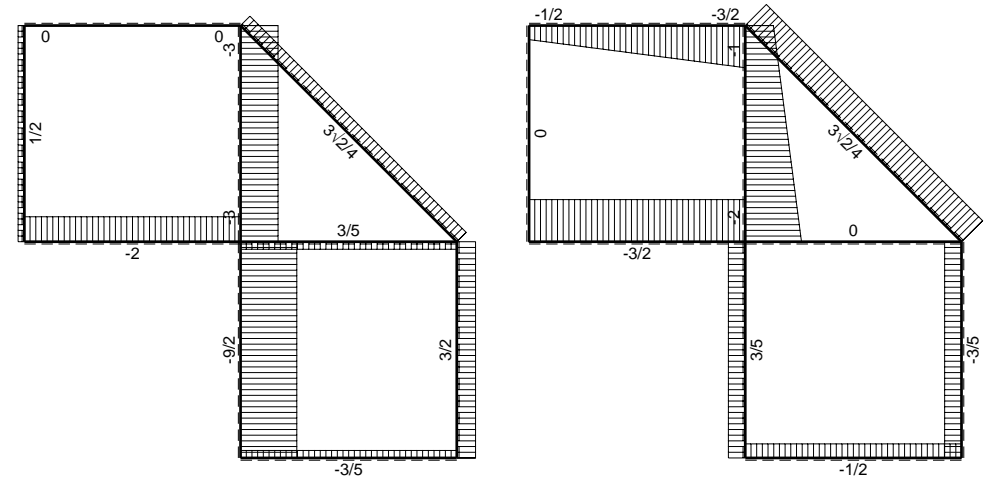
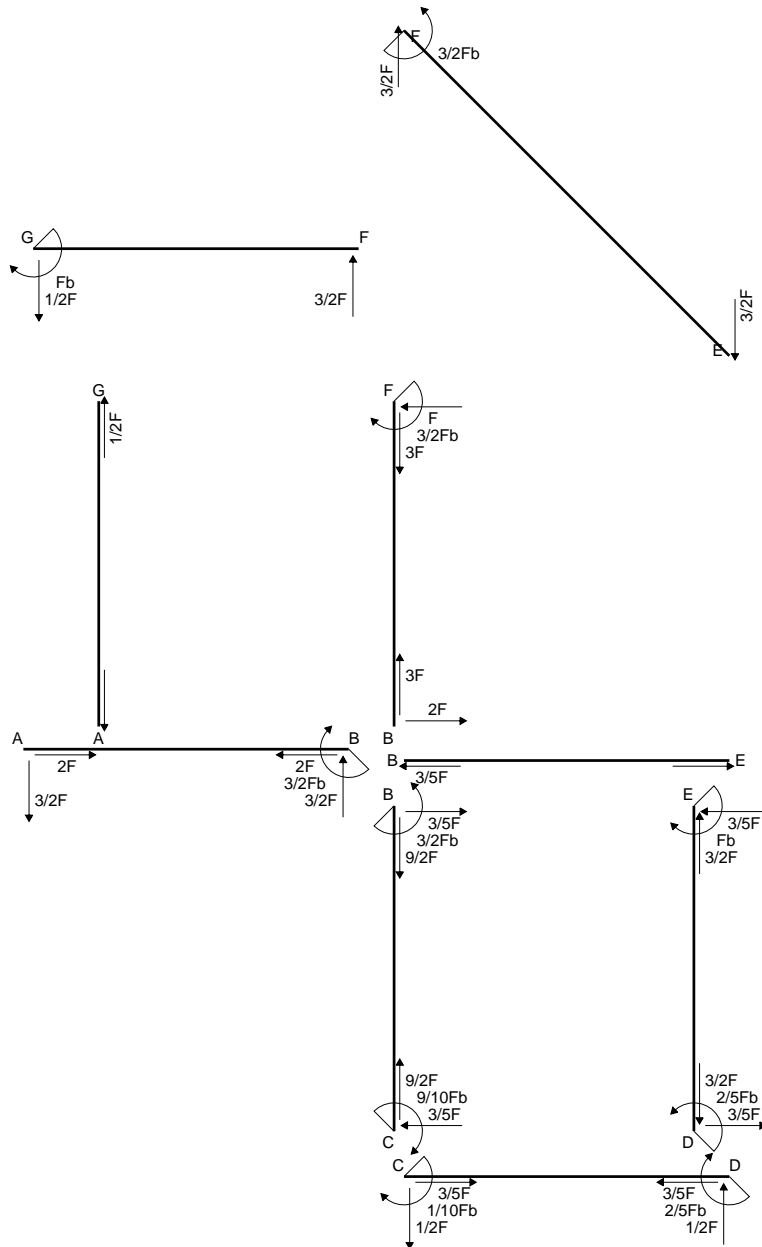
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

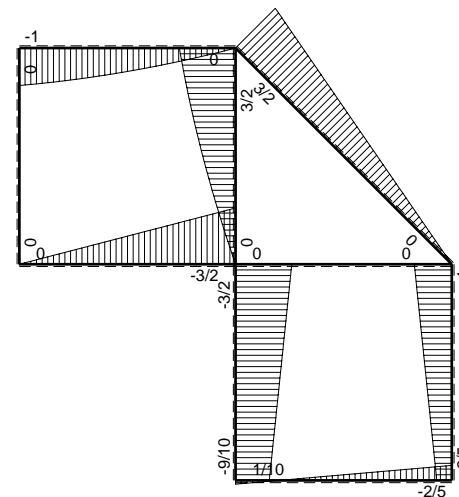
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

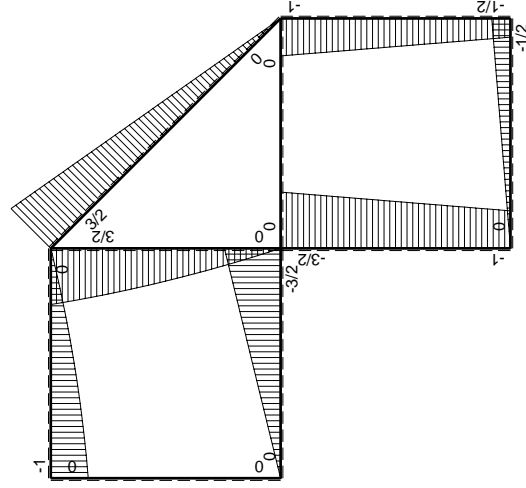
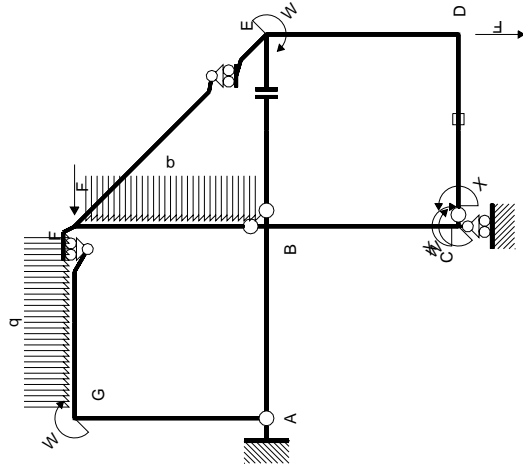


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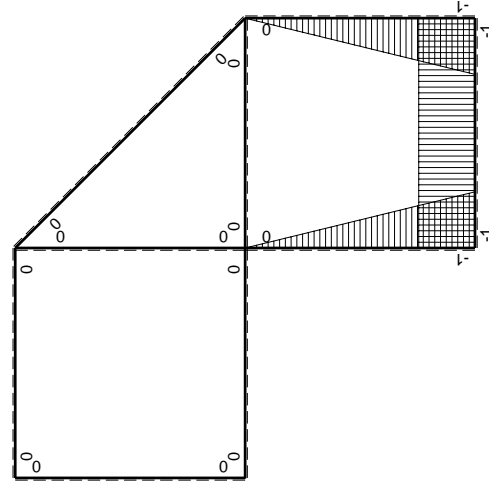


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/3Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

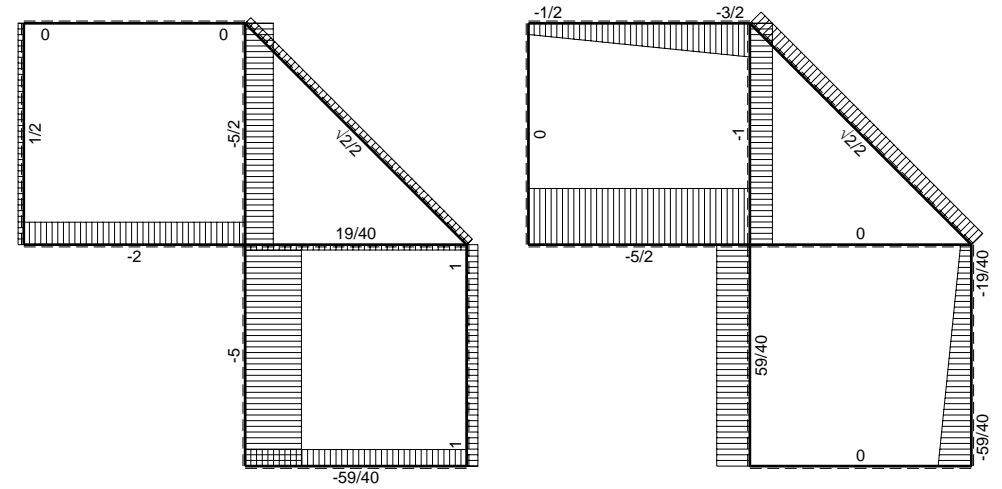
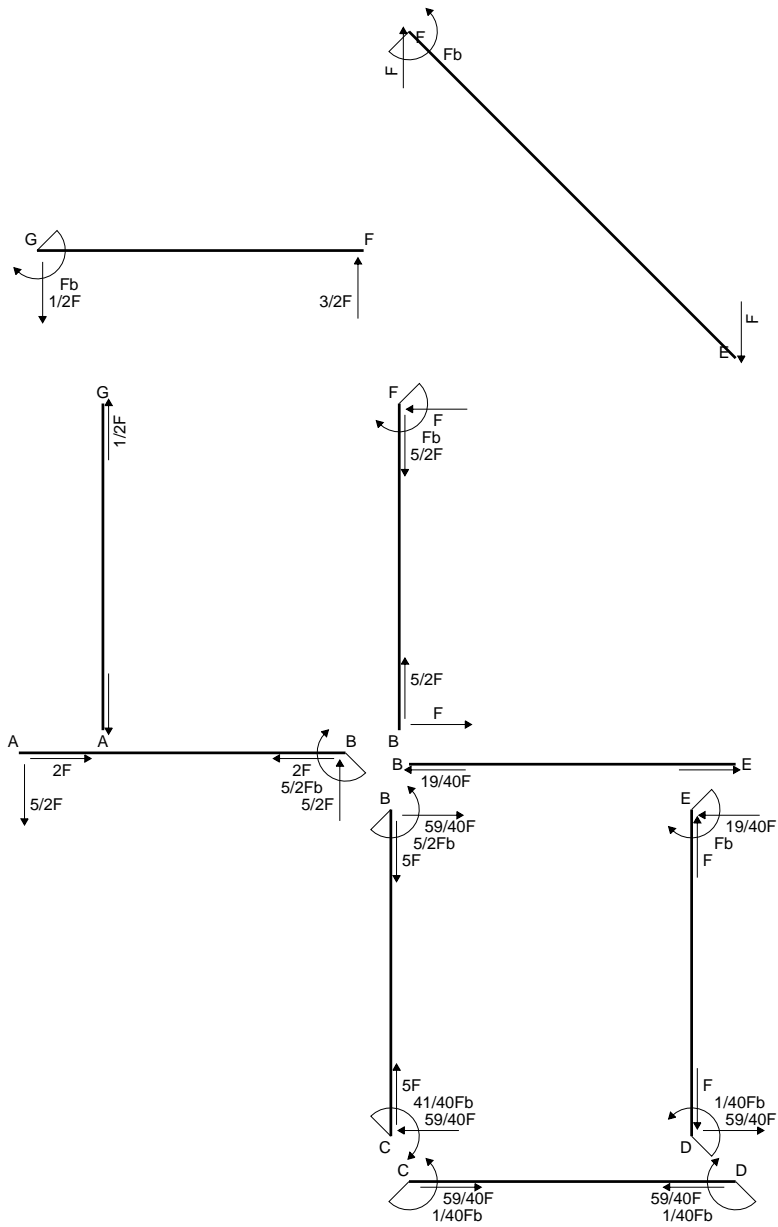
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

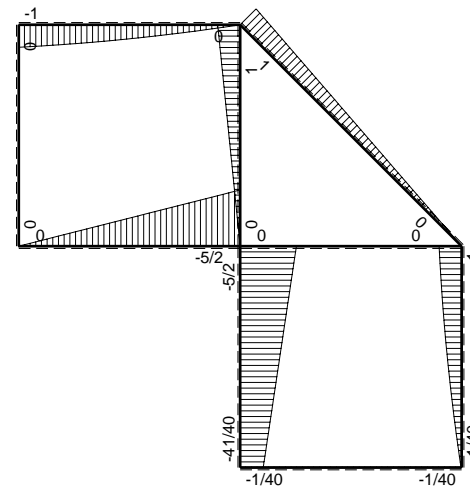
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/3 Fb^2/EJ$$

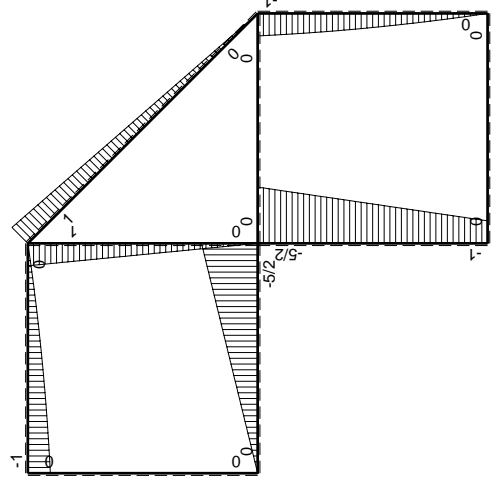
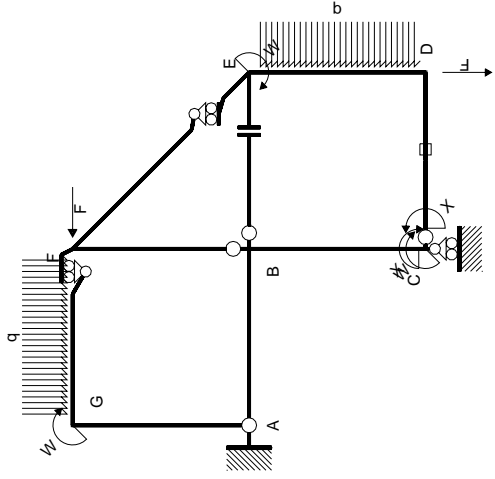


← (+) → F

↑ (+) ↓ F

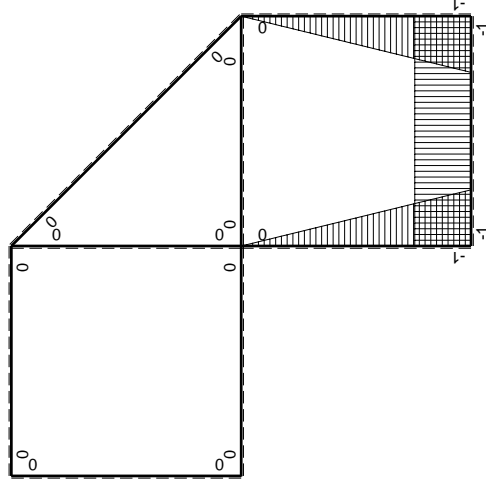


⊕ (+) ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	Xb/EJ
DE b	-1+x/b	-3/2Fx+1/2qx ²	3/2Fx-2Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	5/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx-1/2qx ²	Fx-1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/24Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				1/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \cdot b - 1/2 \cdot b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x + \frac{1}{4} x^2/b - \frac{1}{2} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

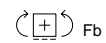
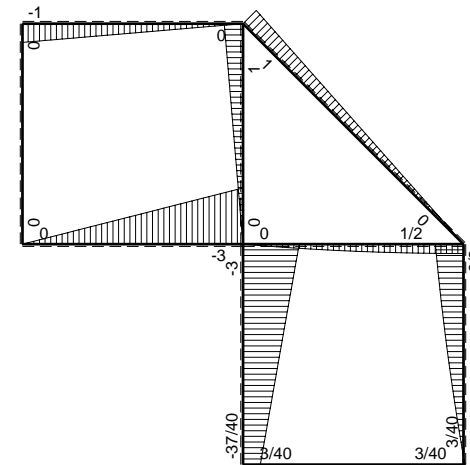
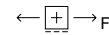
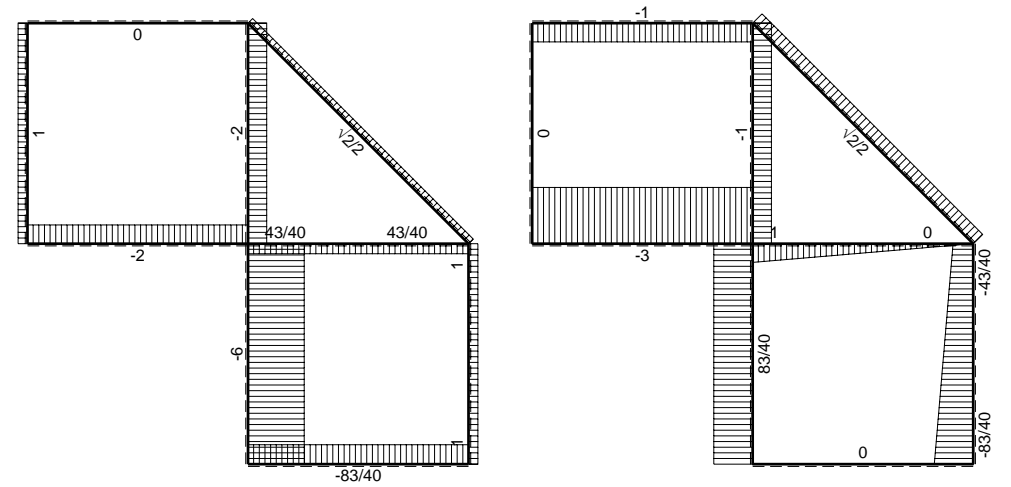
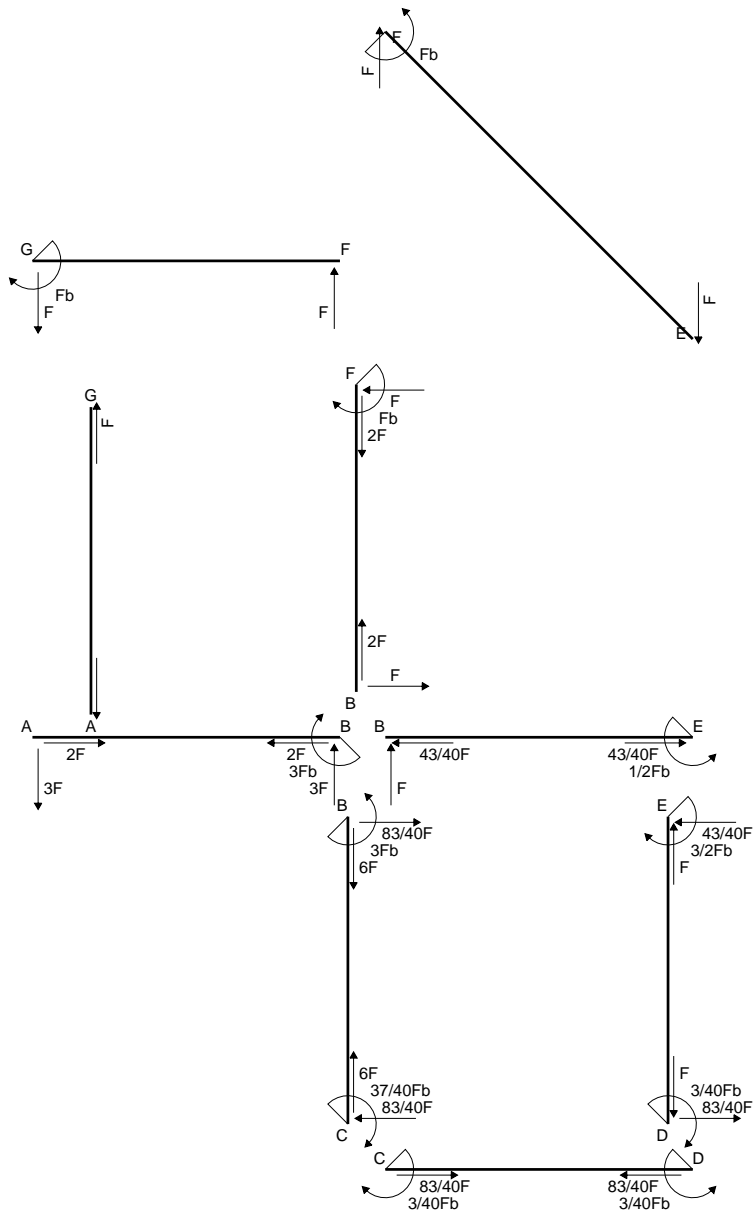
$$= (b + 1/4 \cdot b - 1/2 \cdot b) \cdot Fb \cdot 1/EJ = 3/4 \cdot Fb^2/EJ$$

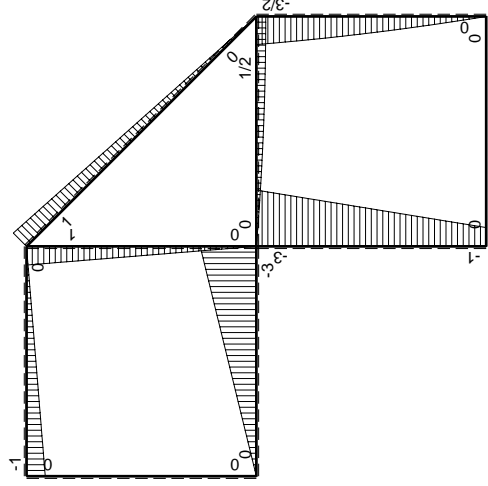
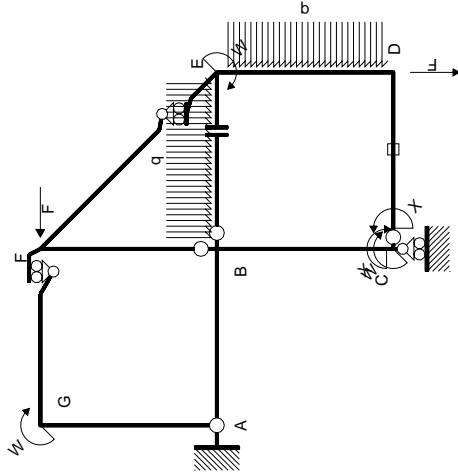
$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 2/3 \cdot b + 1/8 \cdot b) \cdot Fb \cdot 1/EJ = 5/24 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

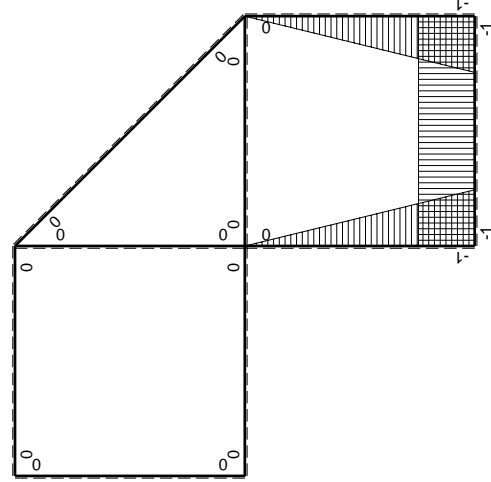
$$= (1/2 \cdot b - 1/6 \cdot b - 1/8 \cdot b) \cdot Fb \cdot 1/EJ = 5/24 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	3Fx-2Fx ² /b	x ² /b ²	5/6Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+2Fx	Fb+Fx-2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	Xb/EJ
DE b	-1+x/b	-2Fx+1/2qx ²	2Fx-5/2Fx ² /b+1/2qx ² /b	1-2x/b+x ² /b ²	7/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx-1/2qx ²	3/2Fx-Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				1/8Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-3/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) Fb 1/EJ dx = [3/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) Fb 1/EJ dx = [x + 1/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

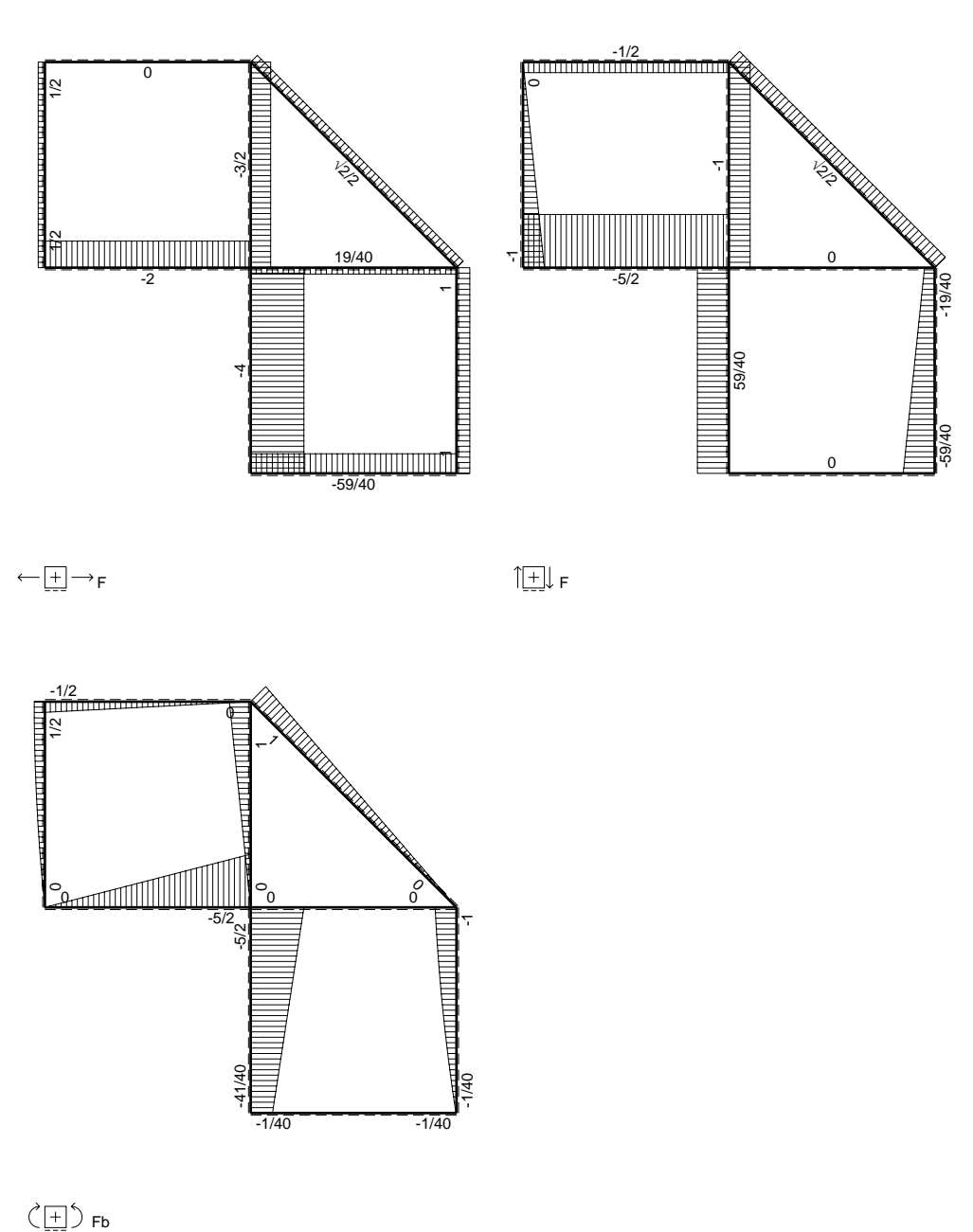
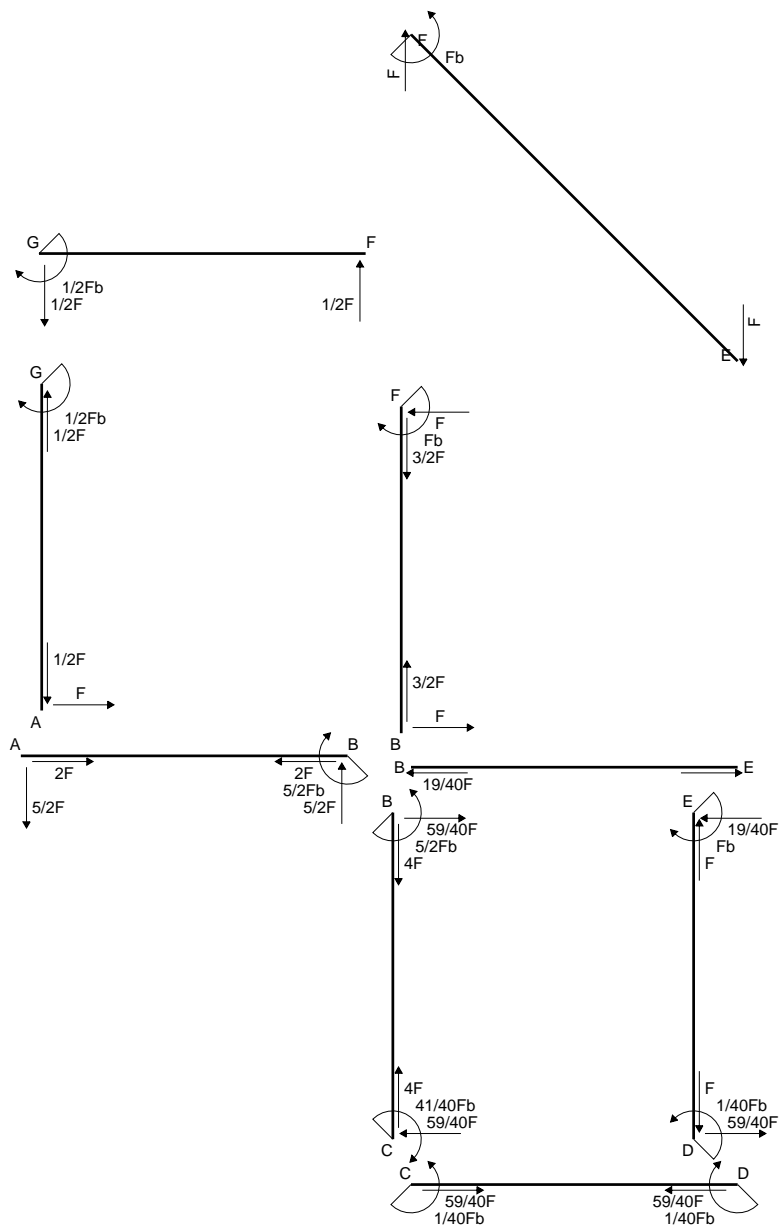
$$= (b + 1/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

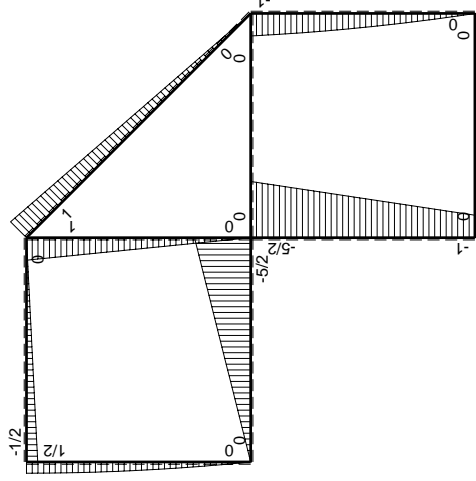
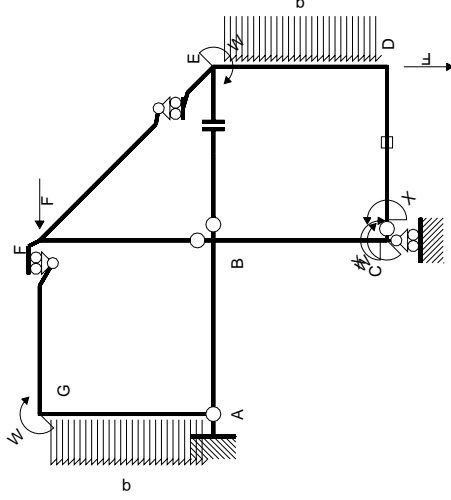
$$L_{DE}^{xo} = \int_0^b (2x/b - 5/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [x^2/b - 5/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 5/6 b + 1/8 b) Fb 1/EJ = 7/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (3/2 x/b - x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

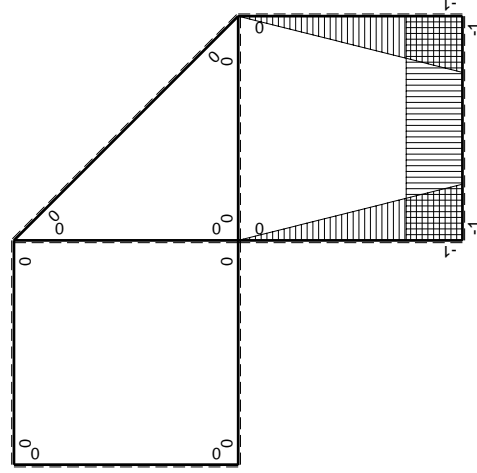
$$= (3/4 b - 1/3 b - 1/8 b) Fb 1/EJ = 7/24 Fb^2/EJ$$





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-5/2Fx$	0	0	0	0
BA b	0	$5/2Fb-5/2Fx$	0	0	0	0
BC b	$-x/b$	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-1/2Fx$	0	0	0	0
GF b	0	$1/2Fb-1/2Fx$	0	0	0	0
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$1/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

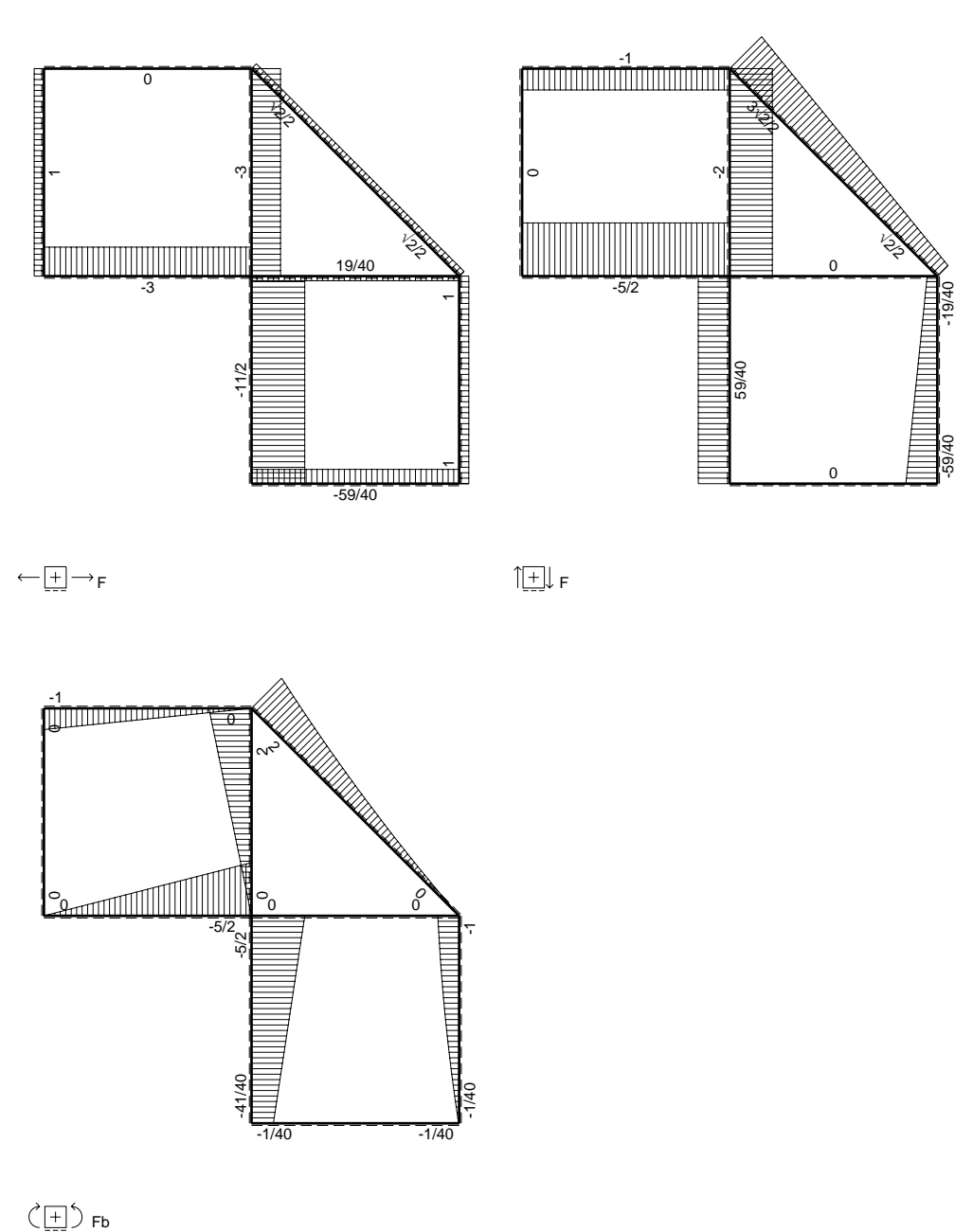
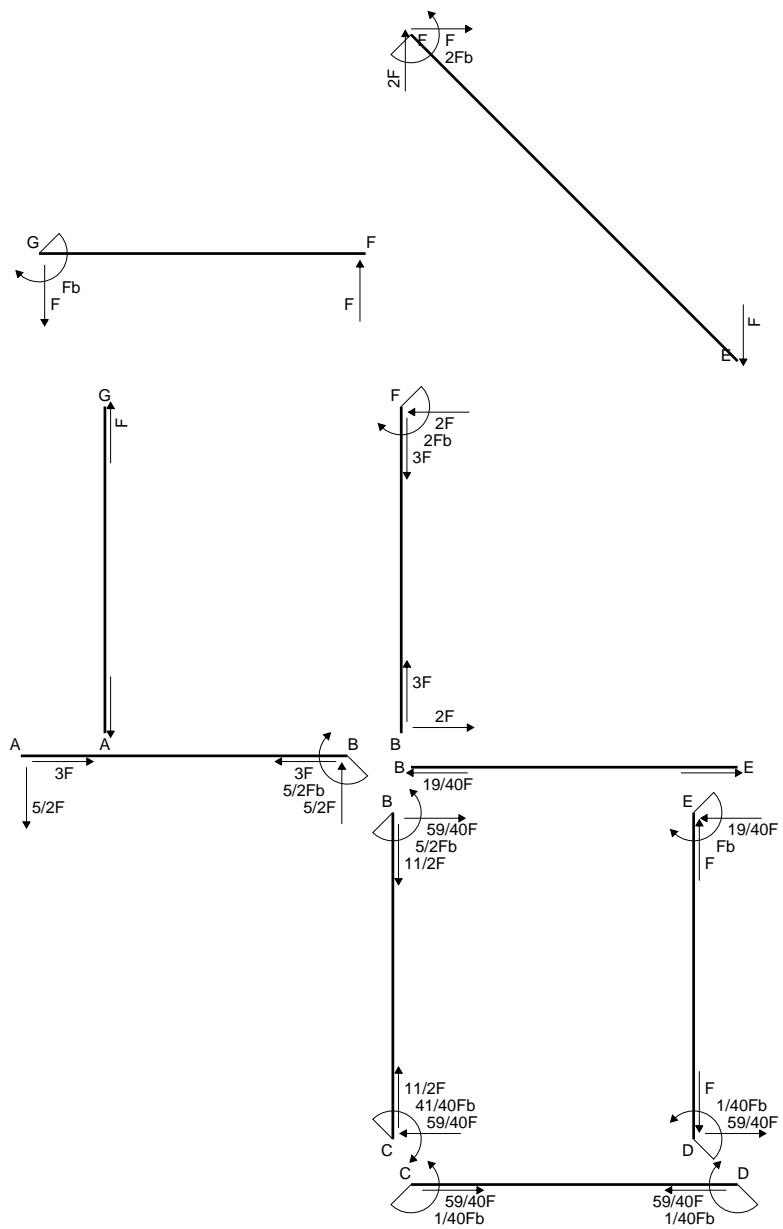
$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

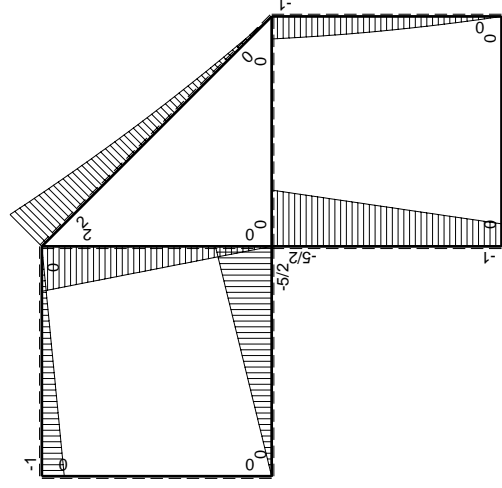
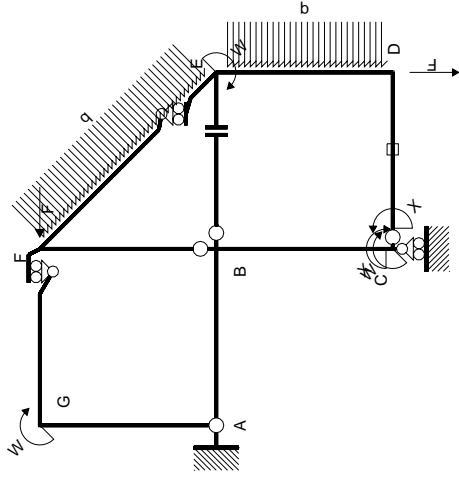
$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (3/4 b - 2/3 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

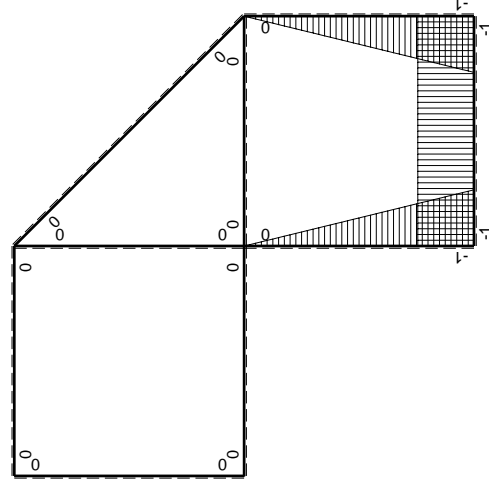
$$= (1/2 b - 1/6 b - 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-3/2Fx+1/2qx ²	3/2Fx-2Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	5/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx-1/2qx ²	Fb-1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/24Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

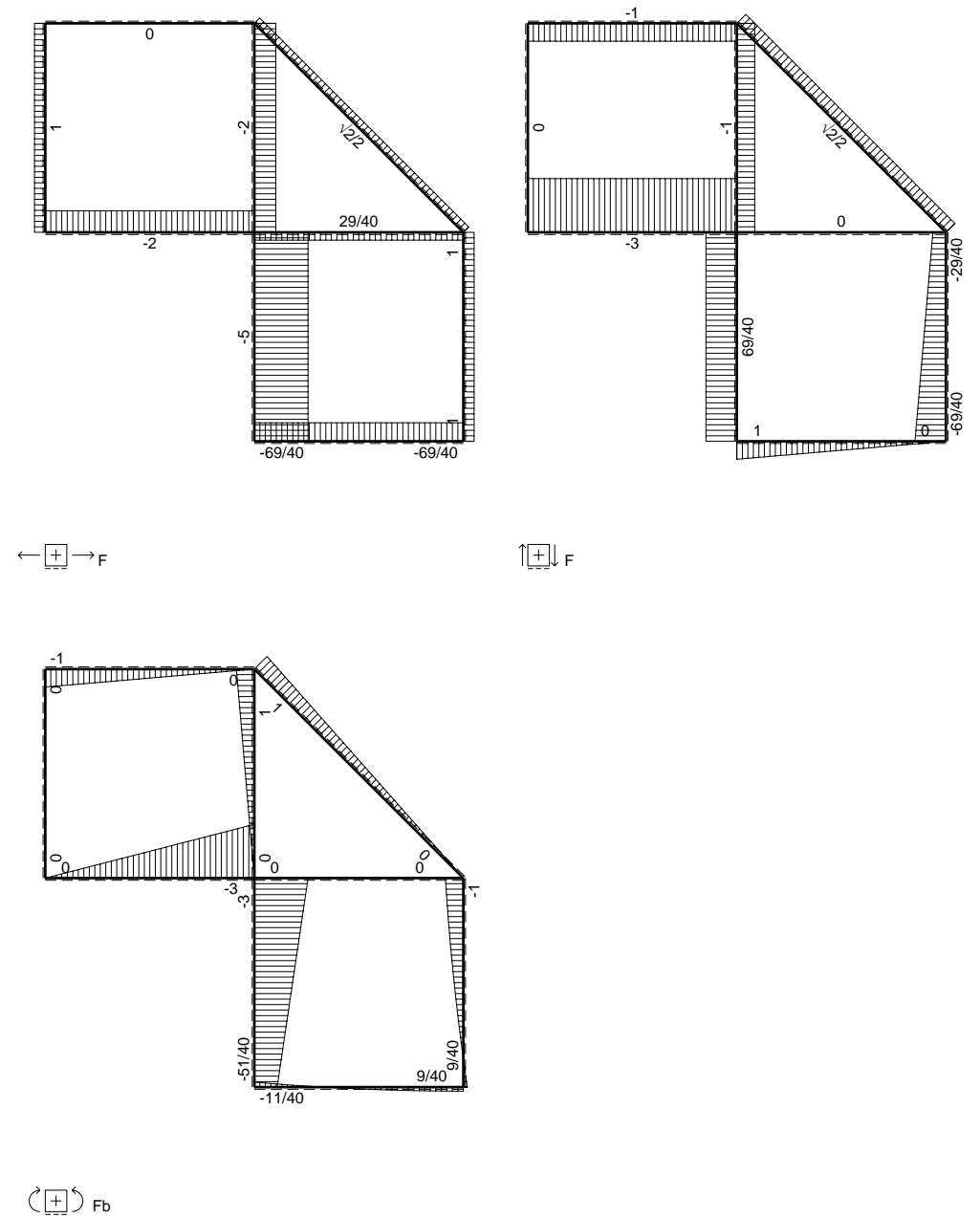
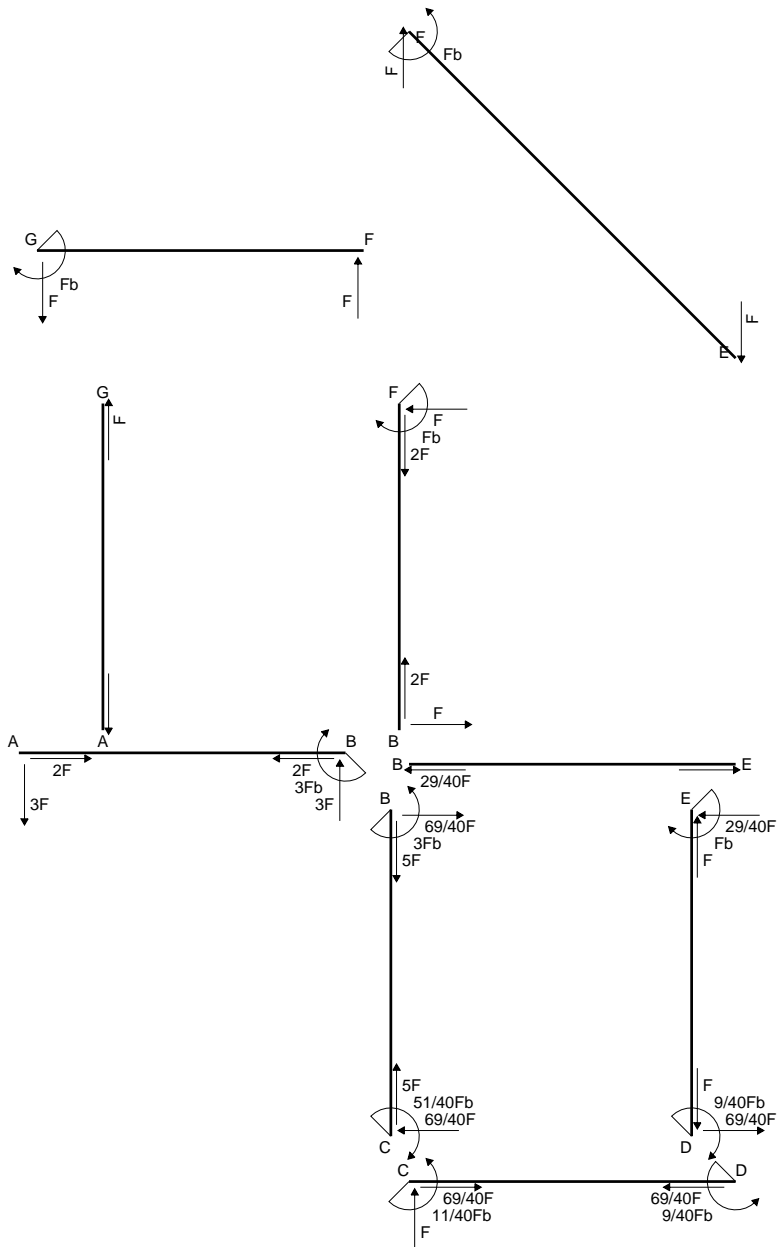
$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

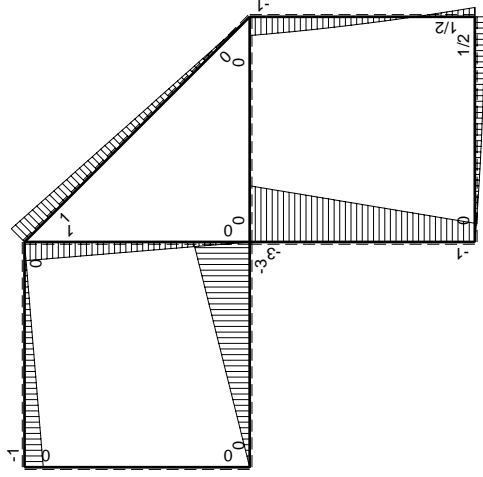
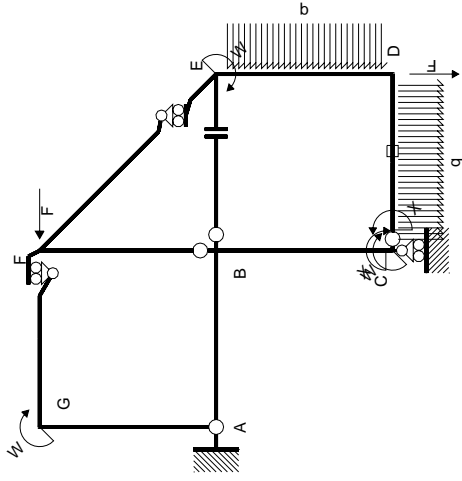
$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (3/4 b - 2/3 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

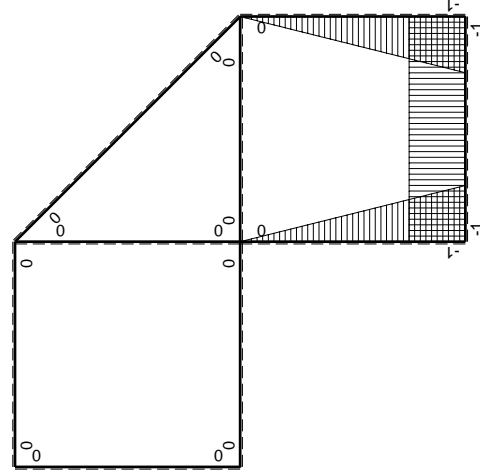
$$= (1/2 b - 1/6 b - 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_1 flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-2Fx+1/2qx^2$	$-1/2Fb+5/2Fx-5/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-Fx-1/2qx^2$	$Fx-Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-11/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$11/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 2x^2/b^2) Fb 1/EJ dx = [3/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + x/b - 2x^2/b^2) Fb 1/EJ dx = [x + 1/2 x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b + 1/2 b - 2/3 b) Fb 1/EJ = 5/6 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

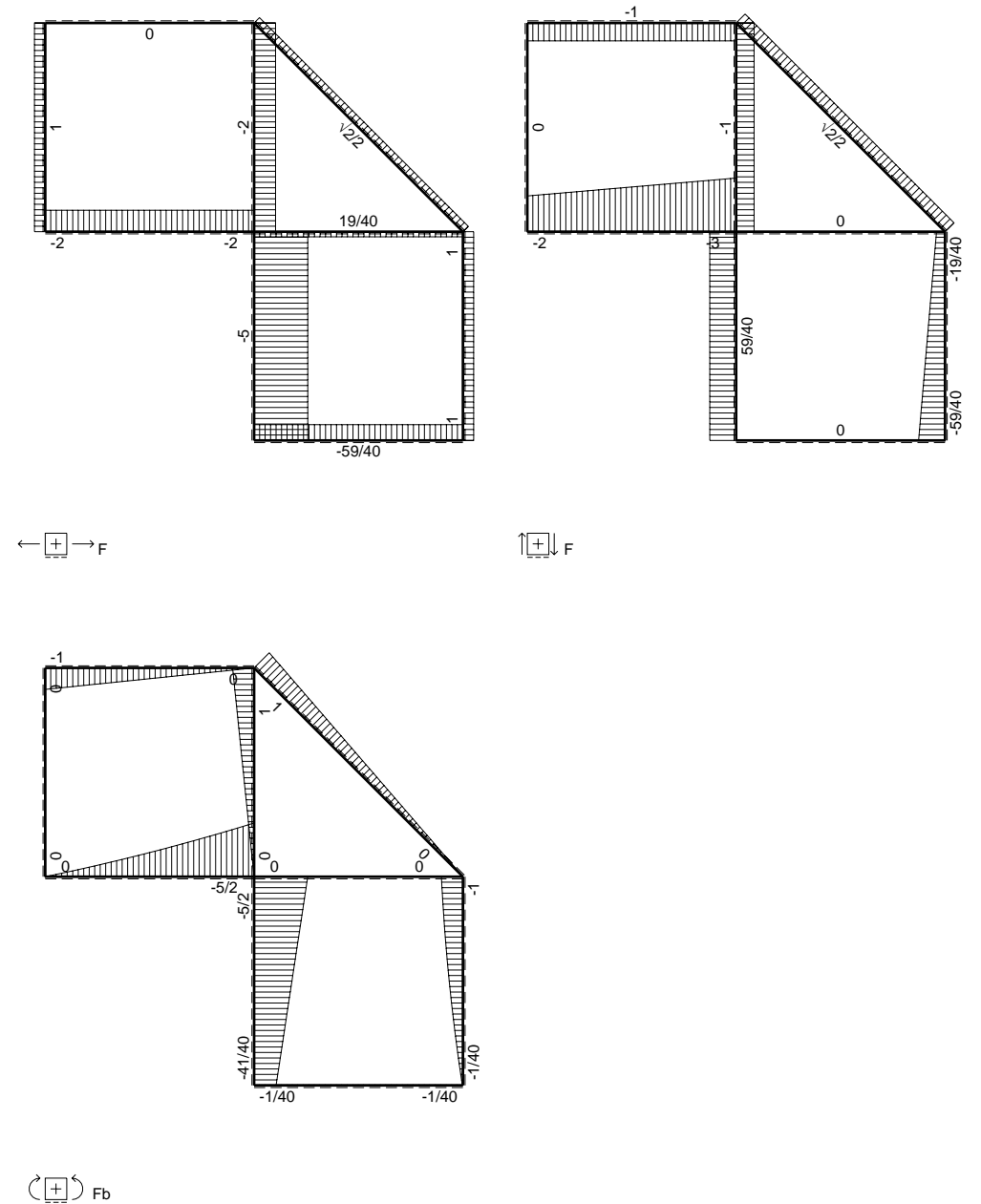
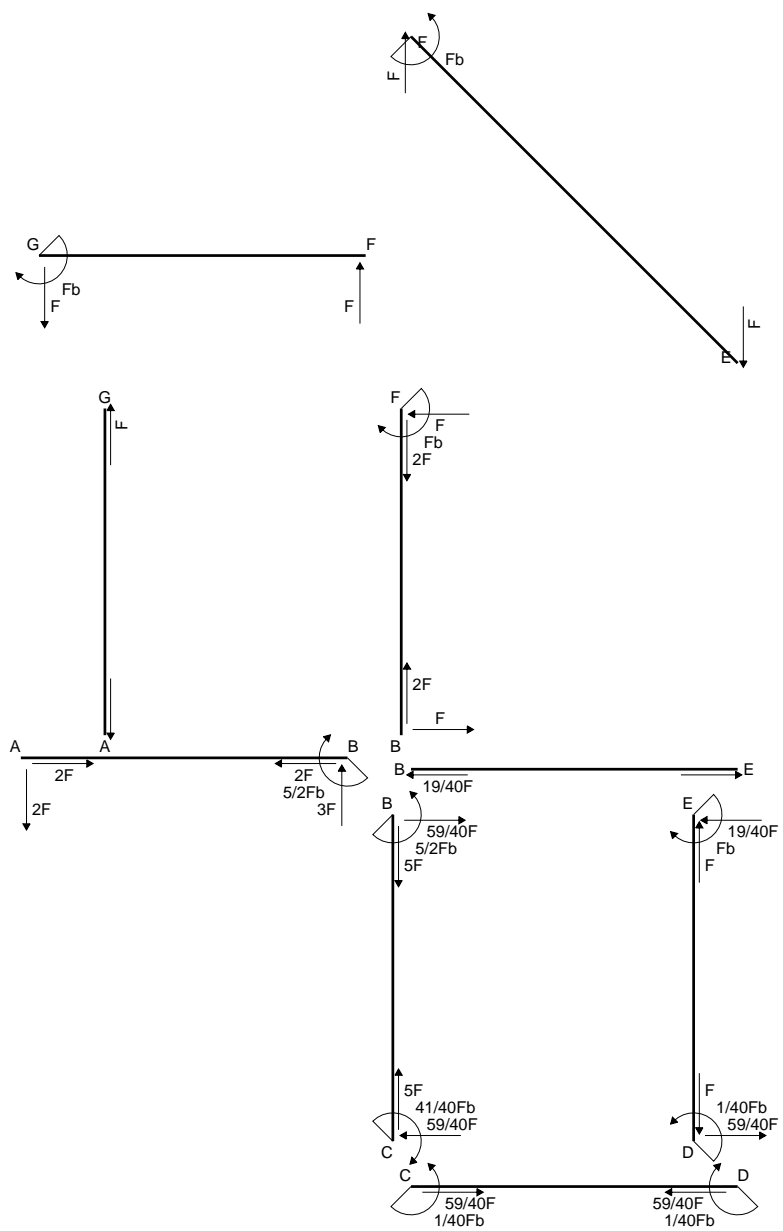
$$L_{DE}^{xo} = \int_0^b (-1/2 + 5/2 x/b - 5/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

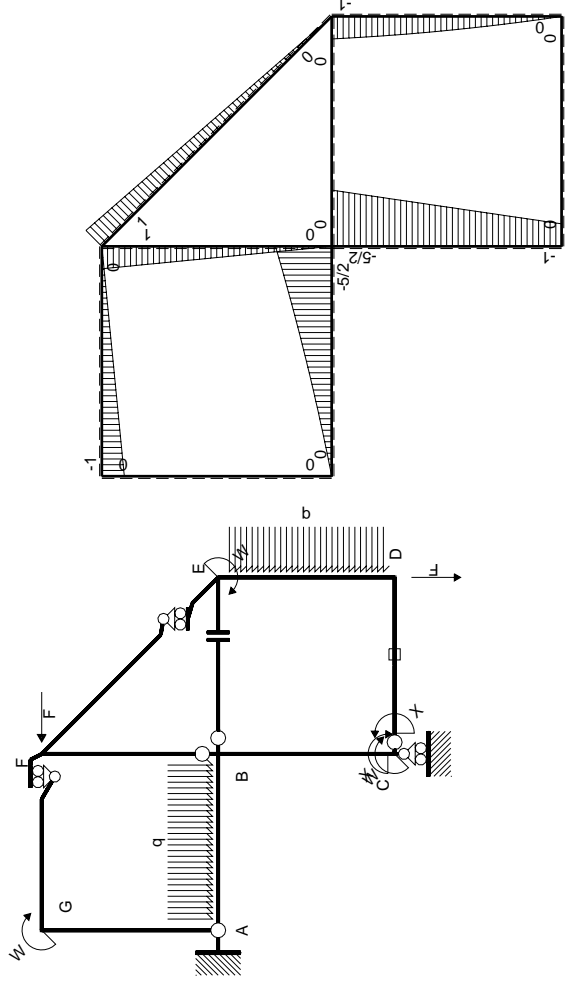
$$= [-1/2 x + 5/4 x^2/b - 5/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/2 b + 5/4 b - 5/6 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

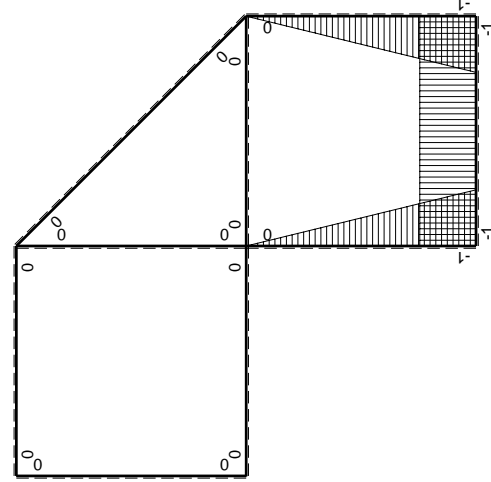
$$= (1/2 b - 1/3 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 3/2Fx$	$5/2Fx - 3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 3/2Fx$	$Fb + 1/2Fx - 3/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-3/2Fx + 1/2qx^2$	$3/2Fx - 2Fx^2/b + 1/2qx^3/b$	$1 - 2x/b + x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - 1/2Fx - 1/2qx^2$	$Fx - 1/2Fx^2/b - 1/2qx^3/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$1/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

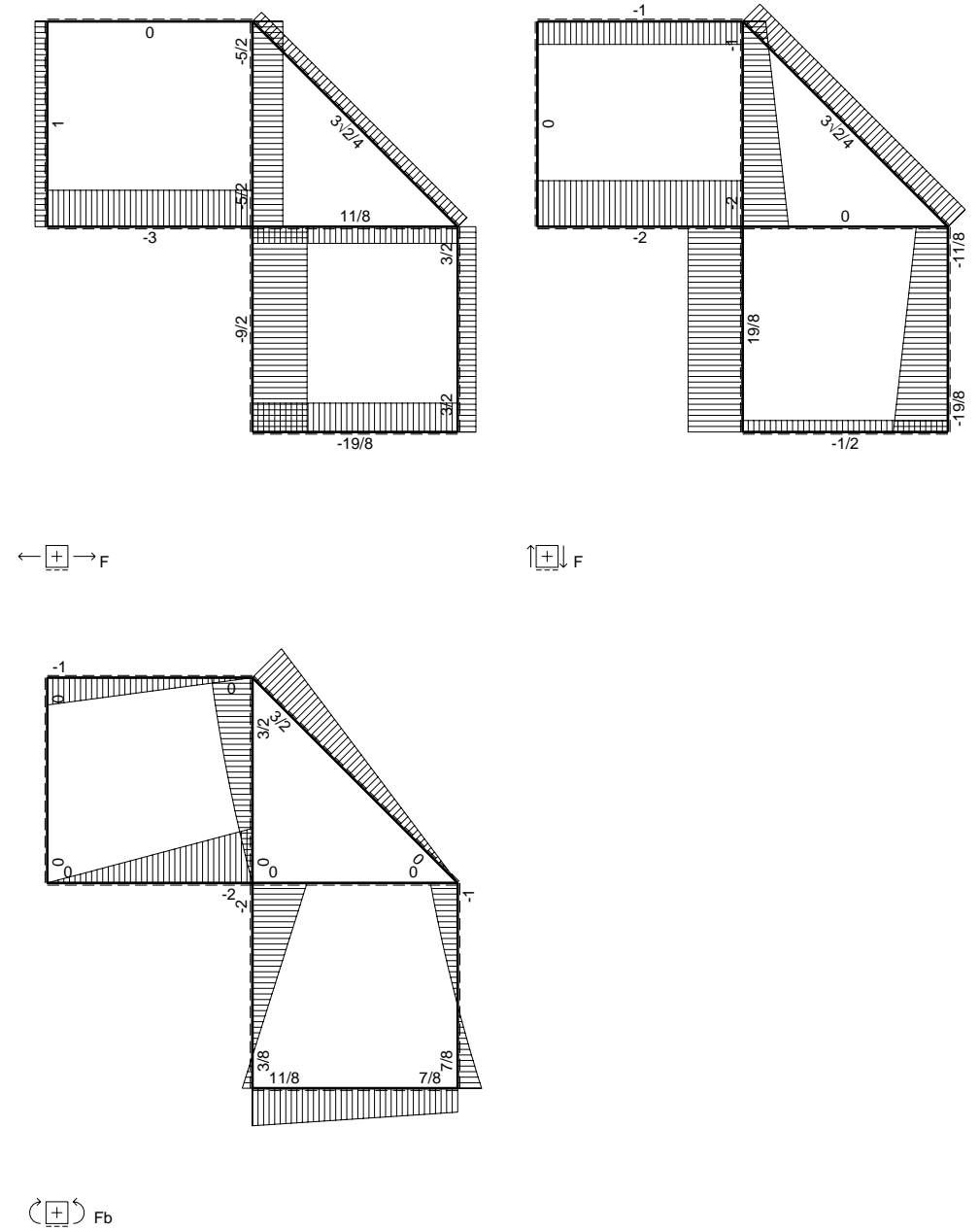
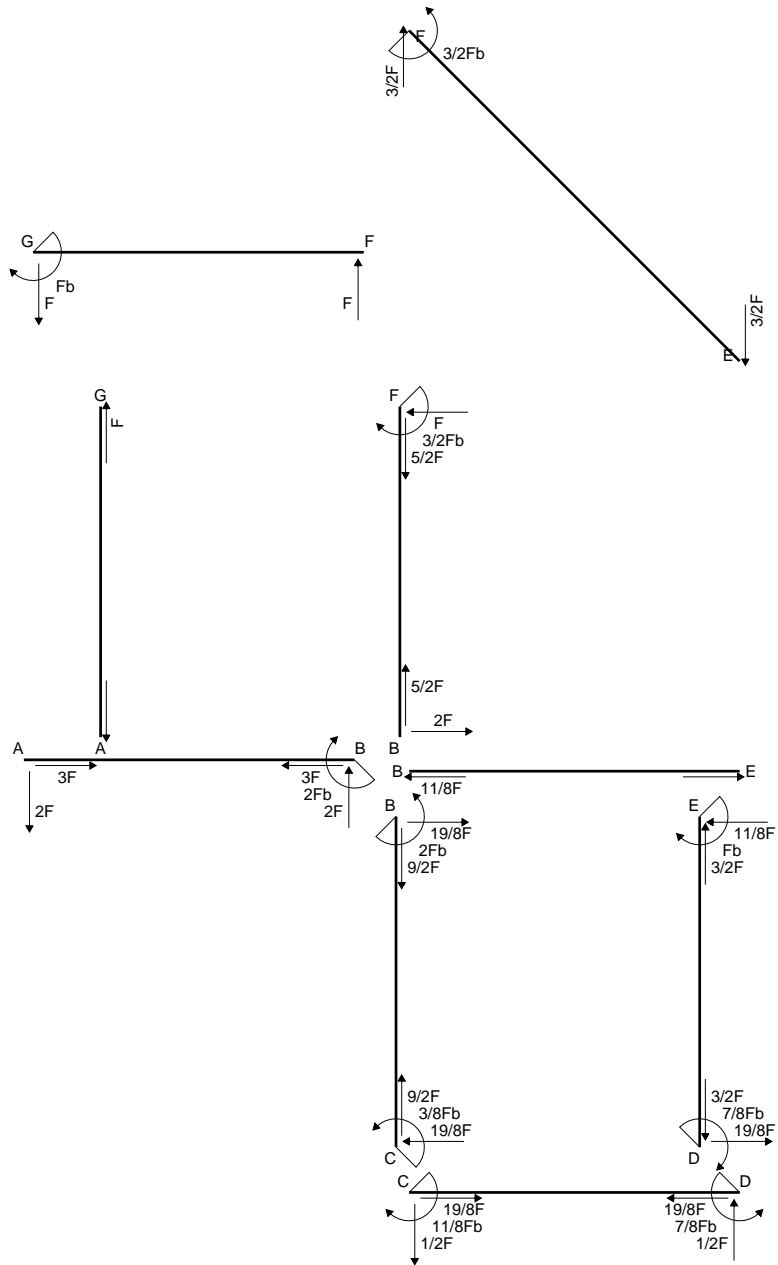
$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

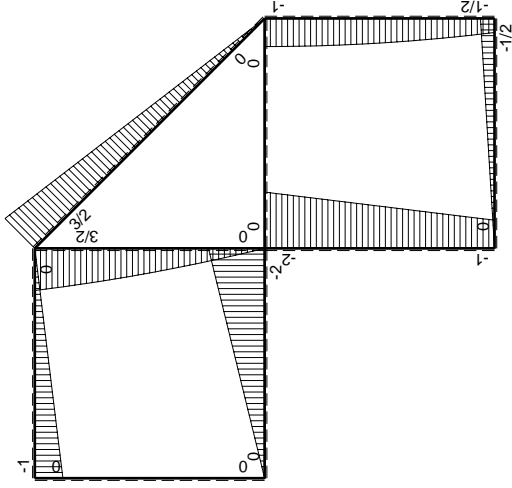
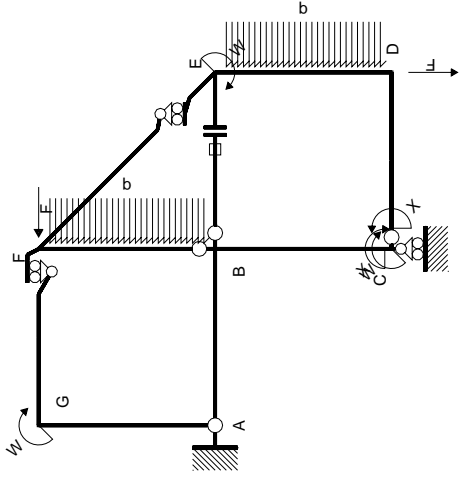
$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (3/4 b - 2/3 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

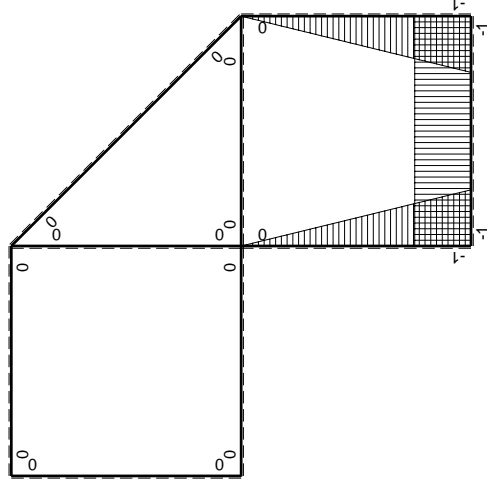
$$= (1/2 b - 1/6 b - 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$55/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-11/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

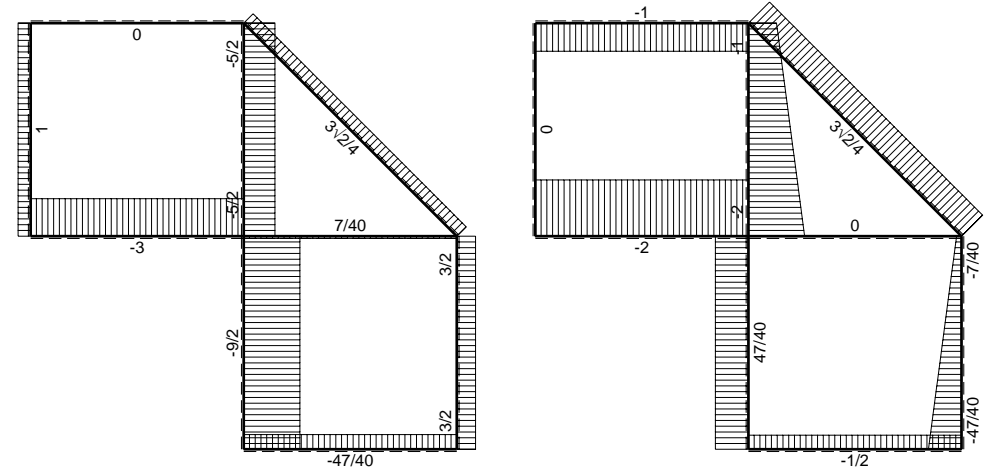
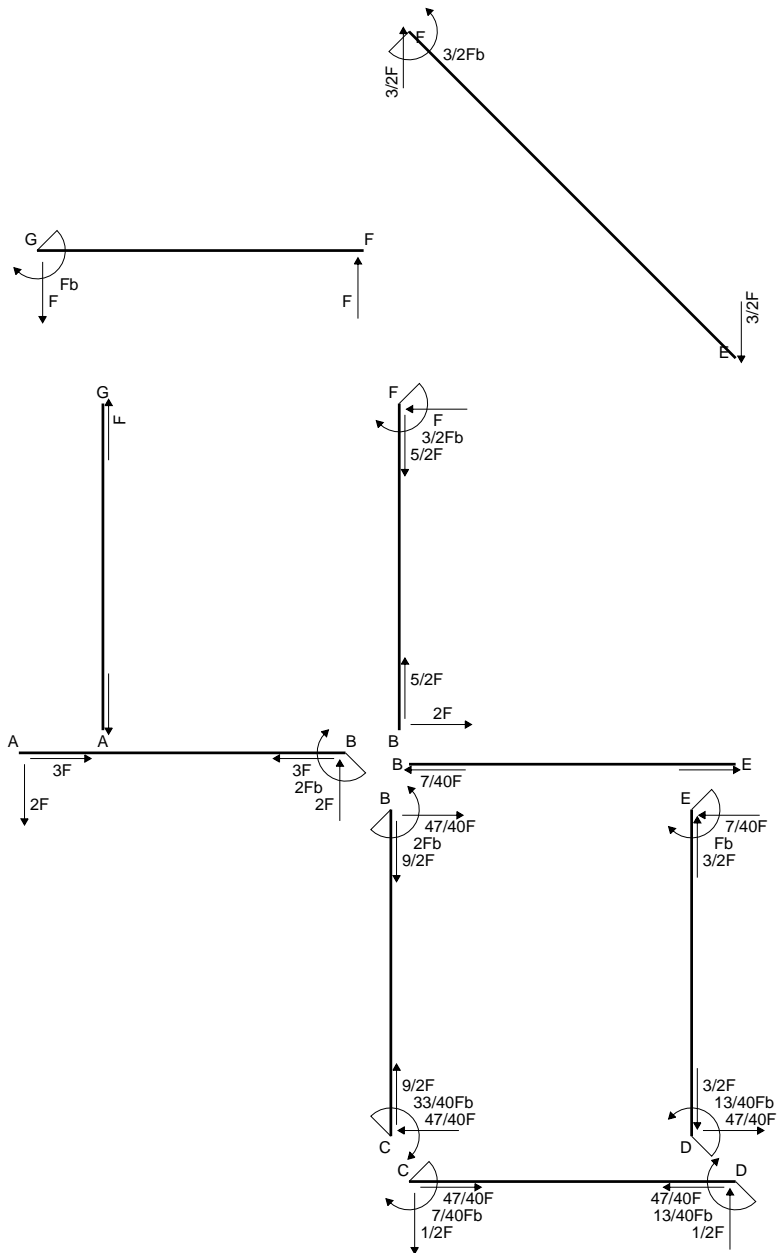
$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

$$= [1/2 x + 1/4 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b + 1/4 b - 1/2 b + 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 Fb^2/EJ$$

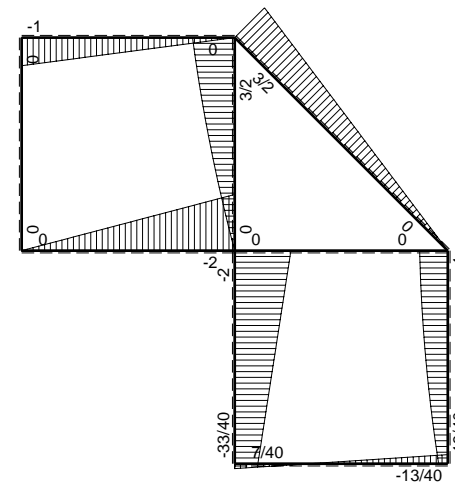
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 Fb^2/EJ$$

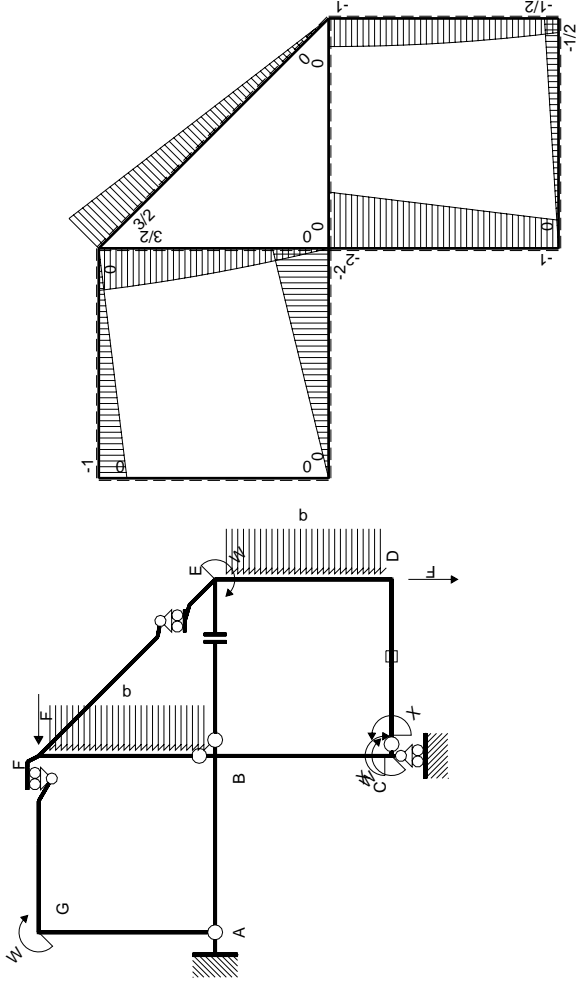


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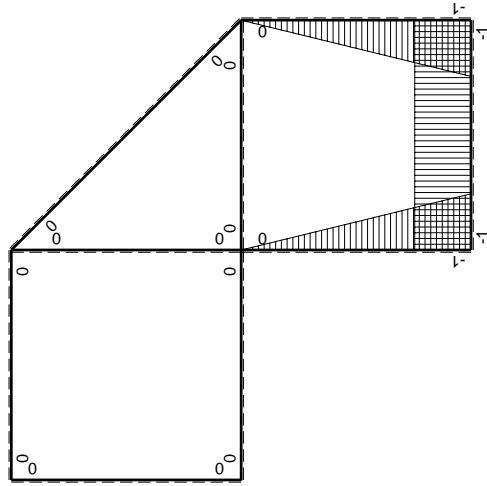


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$7/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-7/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/2 b - 1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

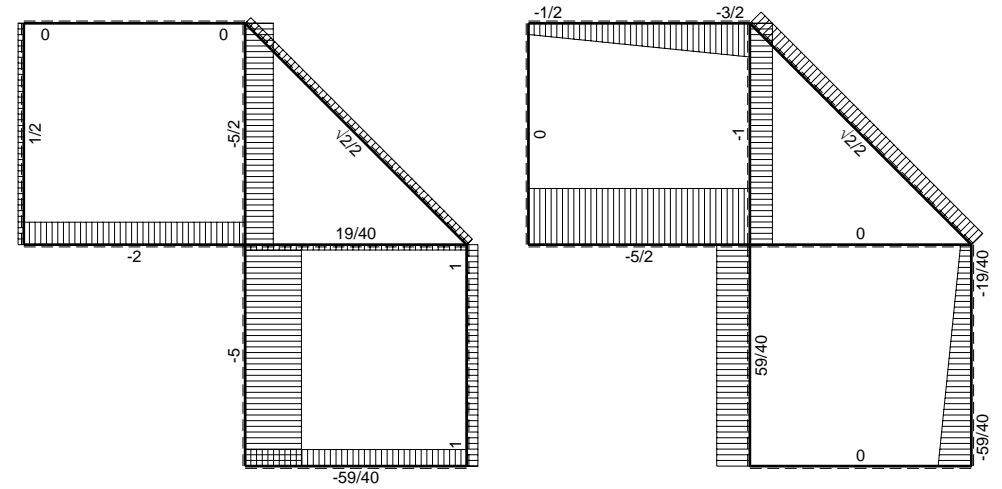
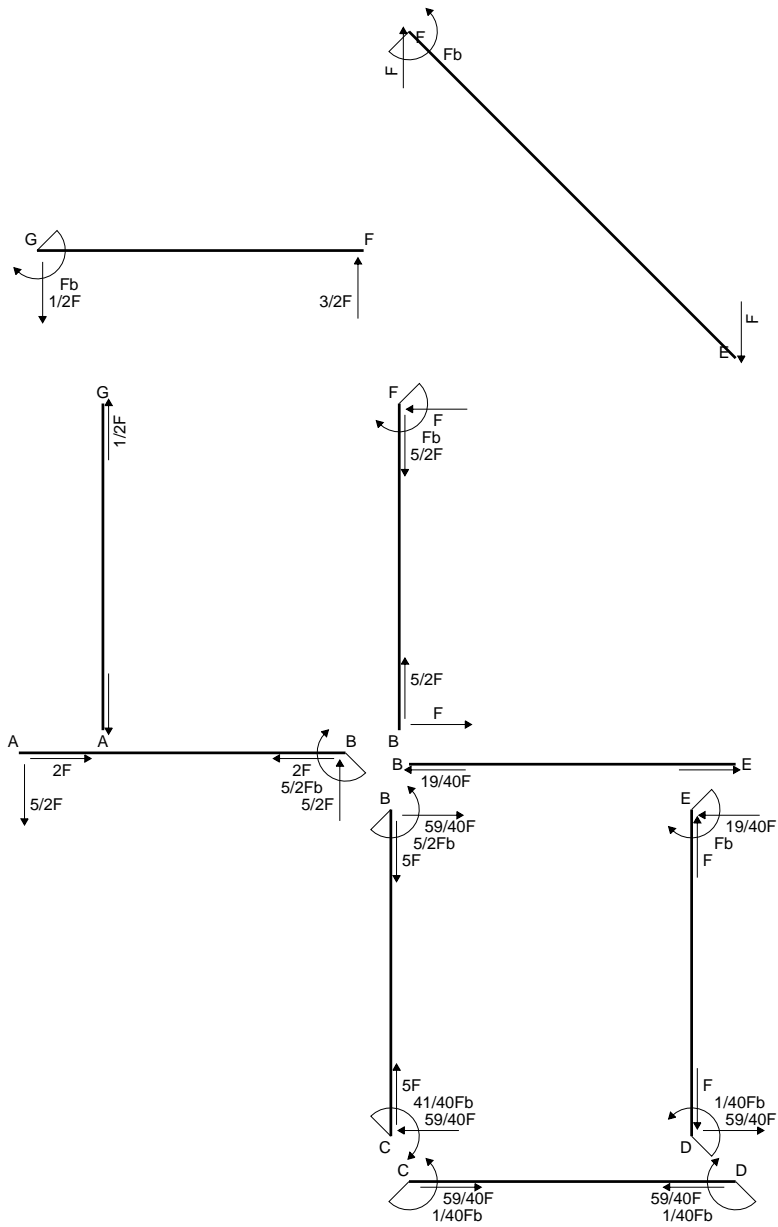
$$L_{DE}^{xo} = \int_0^b (1/2 + 1/2 x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

$$= [1/2 x + 1/4 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b + 1/4 b - 1/2 b + 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

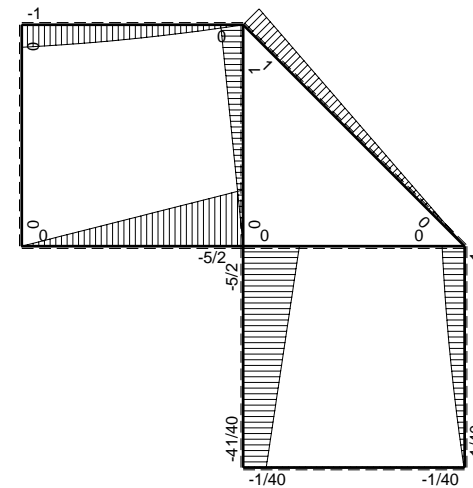
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

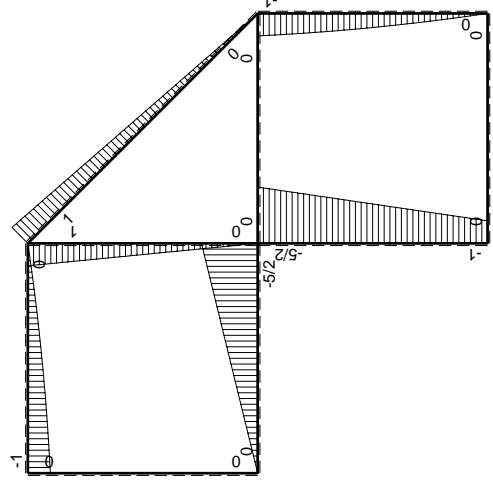
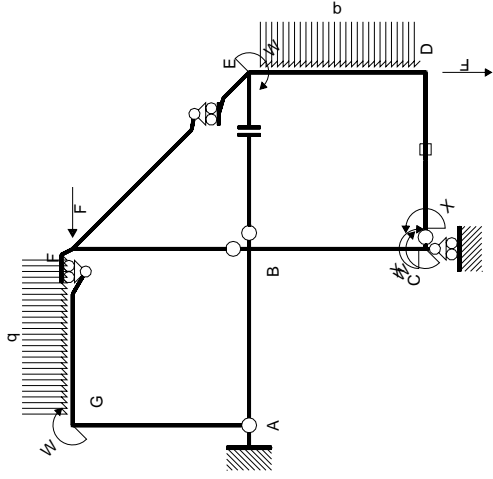


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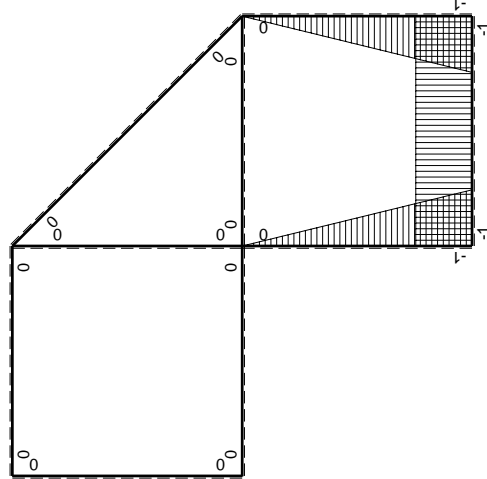


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx ² /b	x ² /b ²	3/4Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-3/2Fx+1/2qx ²	3/2Fx-2Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	5/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx-1/2qx ²	Fx-1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/24Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [5/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

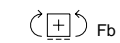
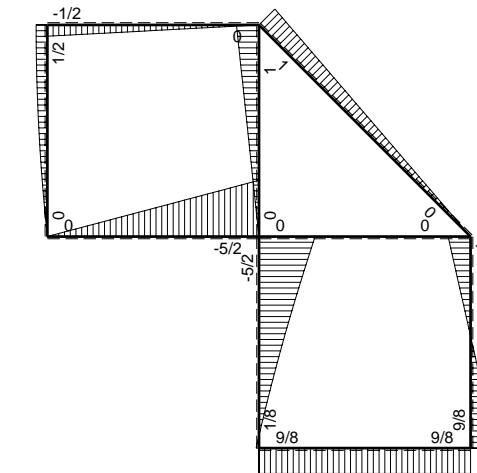
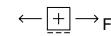
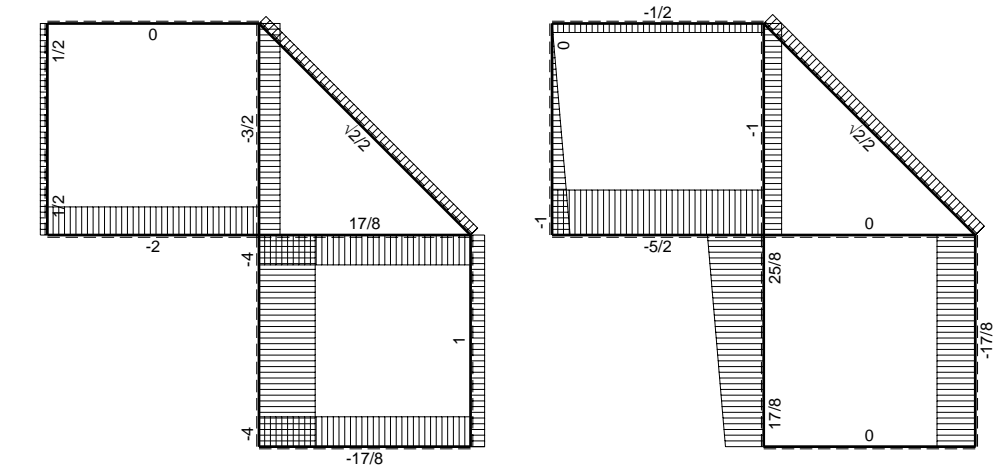
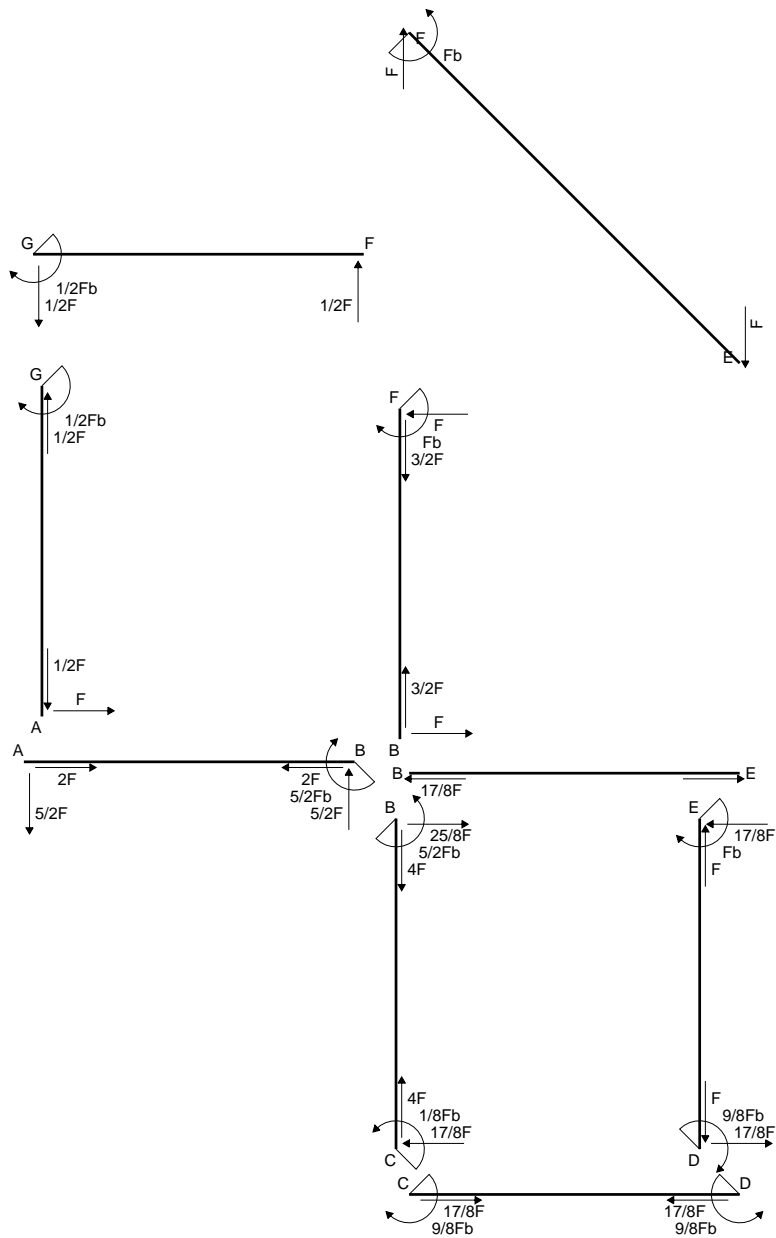
$$= (b + 1/4 b - 1/2 b) Fb 1/EJ = 3/4 Fb^2/EJ$$

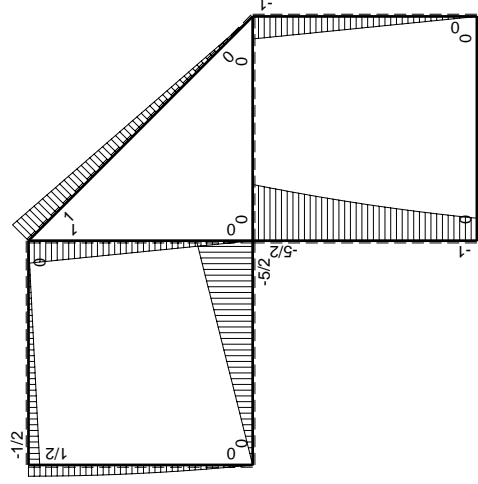
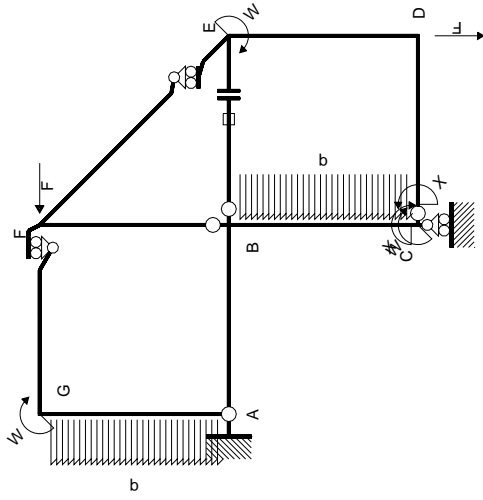
$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [3/4 x^2/b - 2/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (3/4 b - 2/3 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

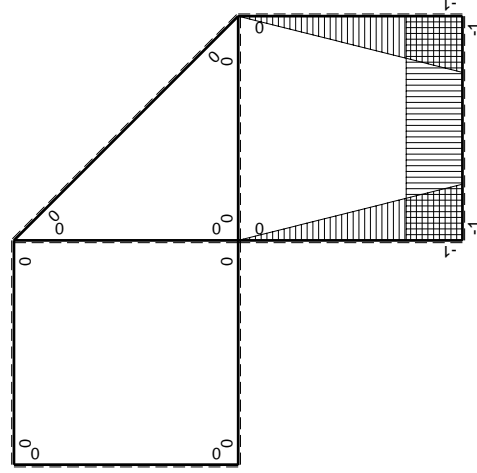
$$= (1/2 b - 1/6 b - 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+2Fx-1/2qx ²	5/2Fx-2Fx ² /b+1/2qx ³ /b	x ² /b ²	17/24Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx+1/2qx ²	Fb-1/2Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0	0	0
GA b	0	1/2Fb-1/2qx ²	0	0	0	0
AG b	0	-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				15/8Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-9/8Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 2x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 2/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

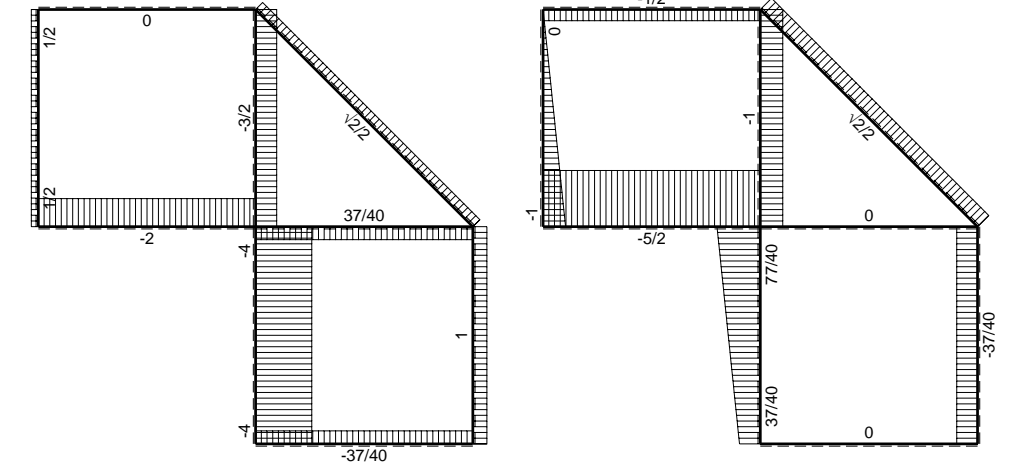
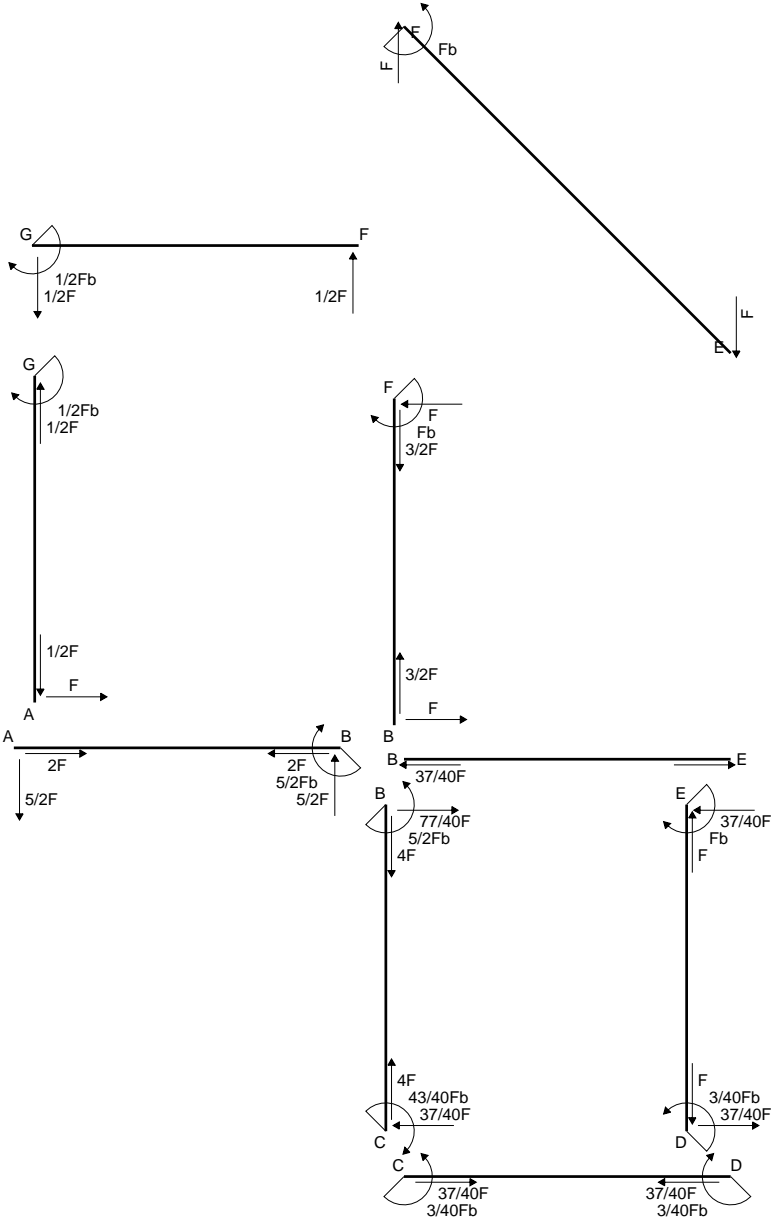
$$= (b - 1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

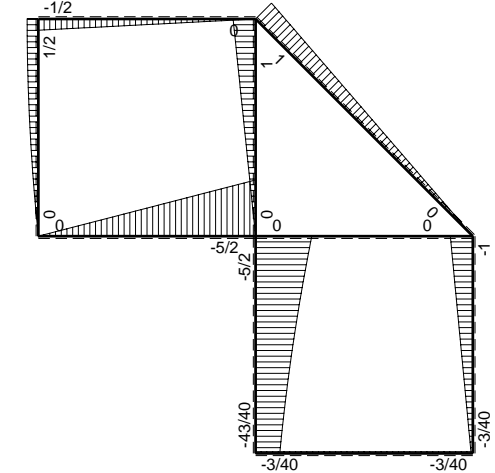
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

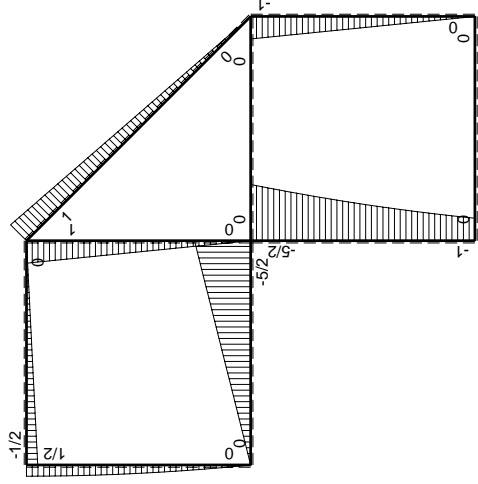
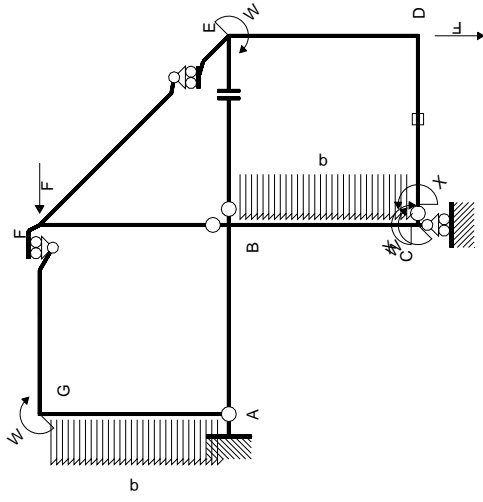


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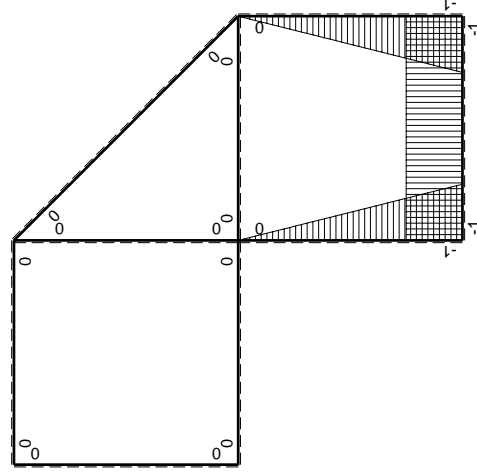


⊕ ↻ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-5/2Fx$	0	0	0	0
BA b	0	$5/2Fb-5/2Fx$	0	0	0	0
BC b	$-x/b$	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-1/2Fx$	0	0	0	0
GF b	0	$1/2Fb-1/2Fx$	0	0	0	0
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				$-Fb^2/EJ$	
	totali				$-1/8Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$3/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 2x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 2/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

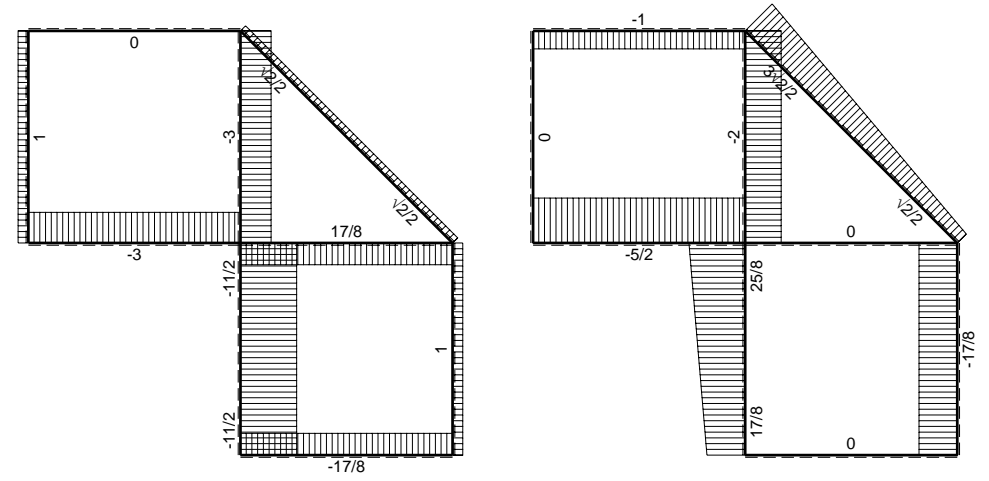
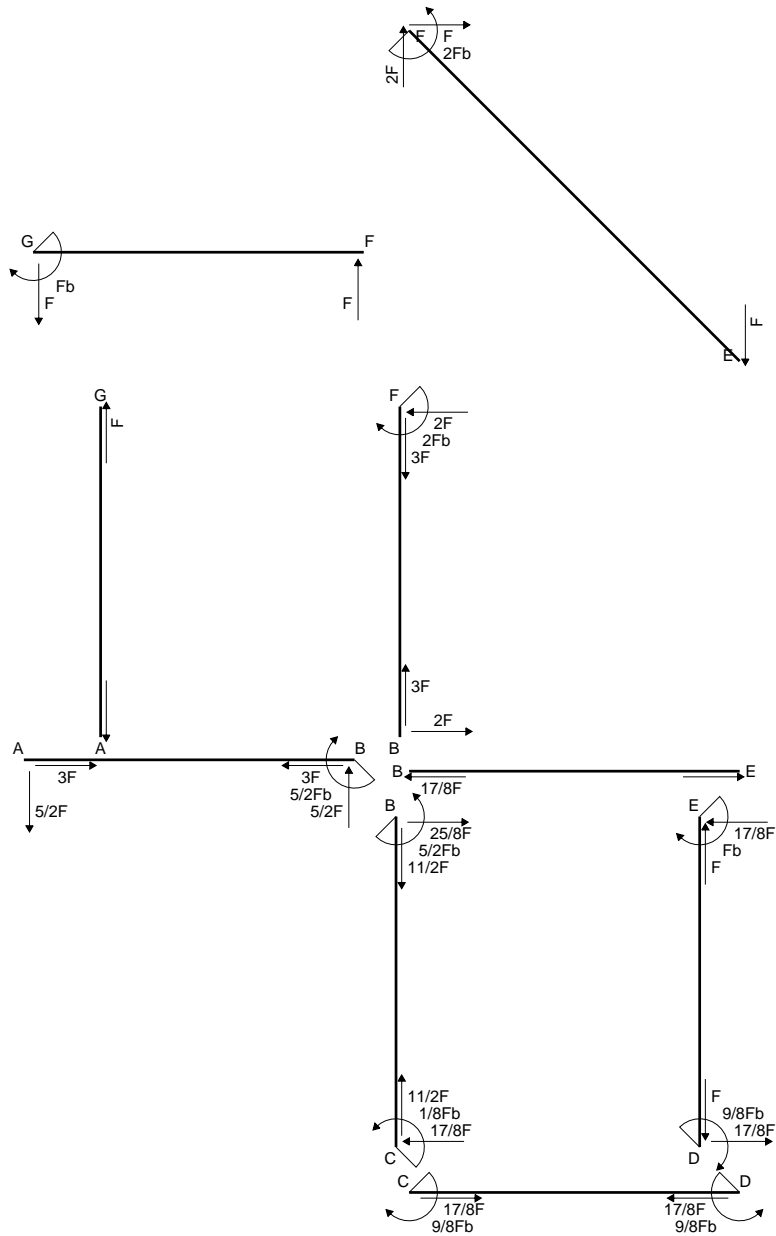
$$= (b - 1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

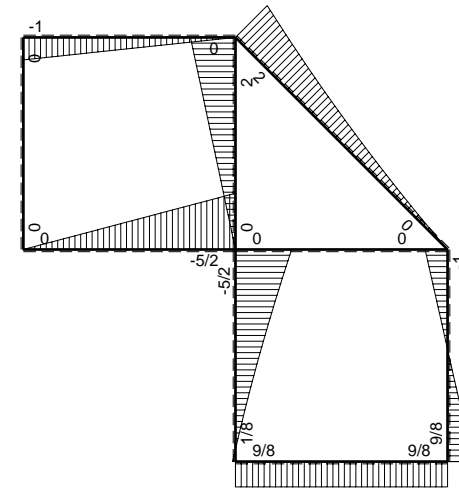
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

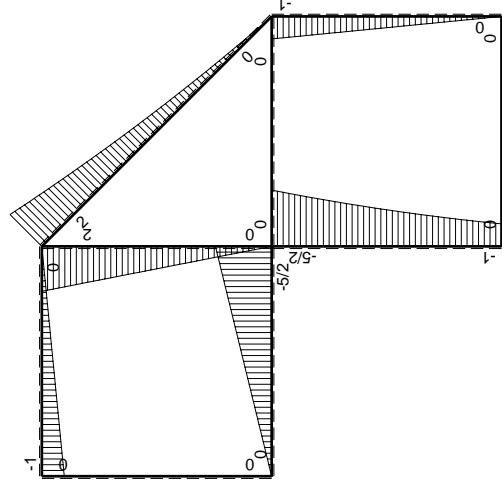
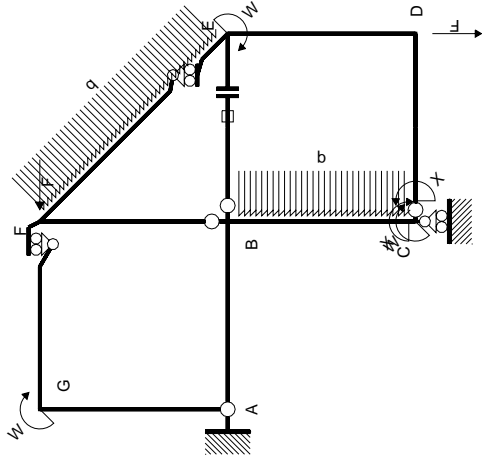


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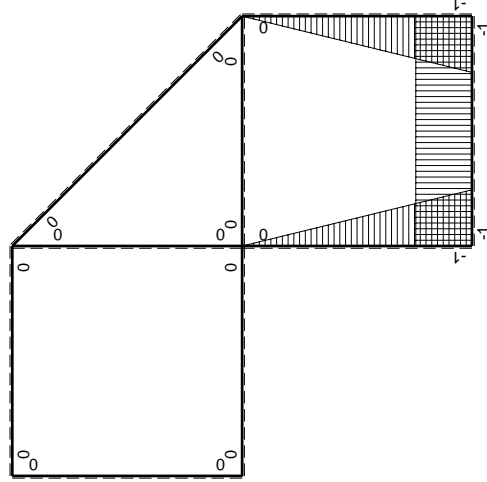


⊕ ⊖ Fb



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+2Fx-1/2qx ²	5/2Fx-2Fx ² /b+1/2qx ³ /b	x ² /b ²	17/24Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx+1/2qx ²	Fb-1/2Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				15/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-9/8Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 2x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 2/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

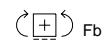
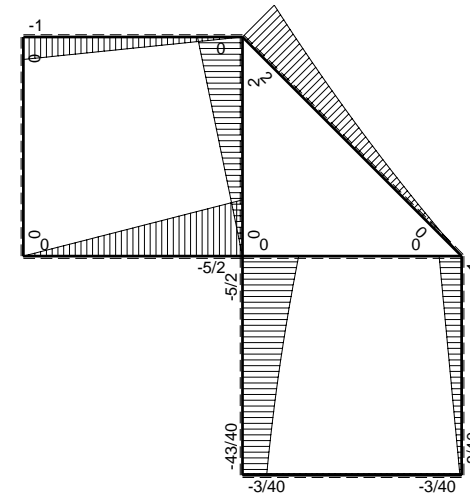
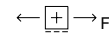
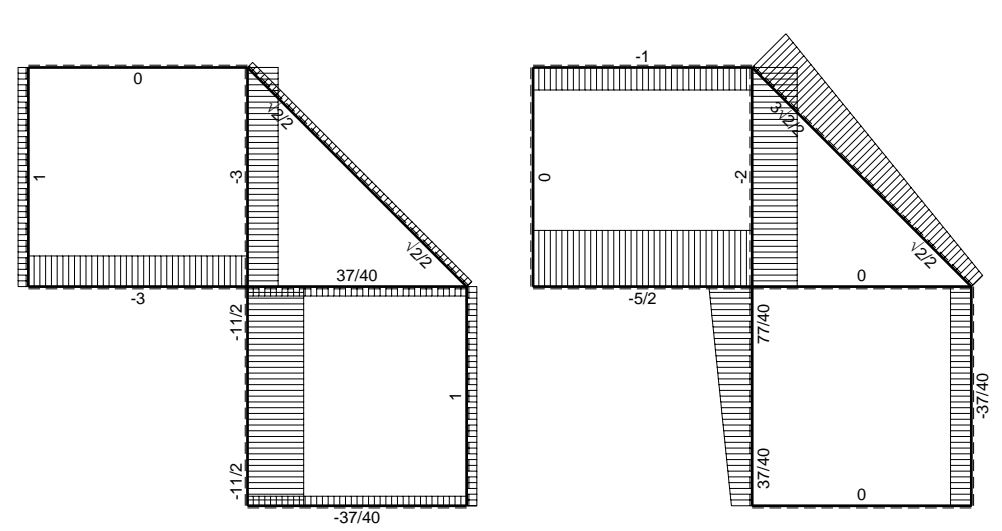
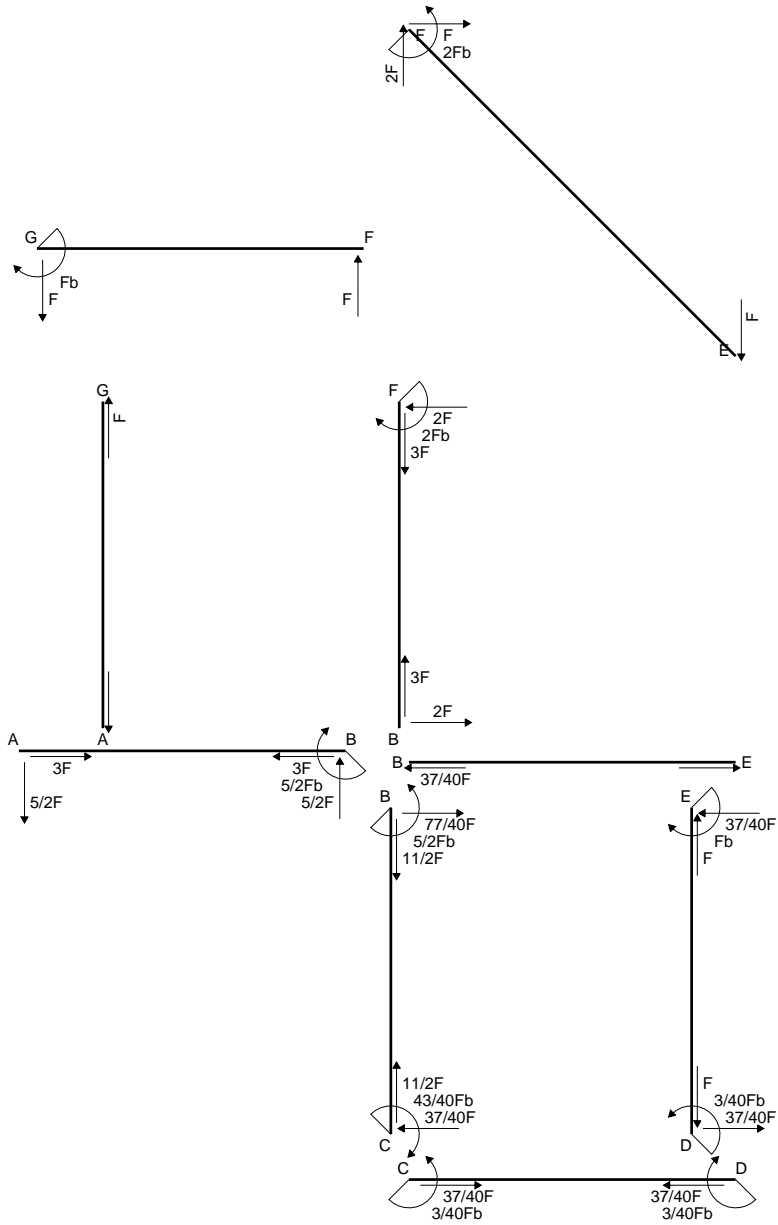
$$= (b - 1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

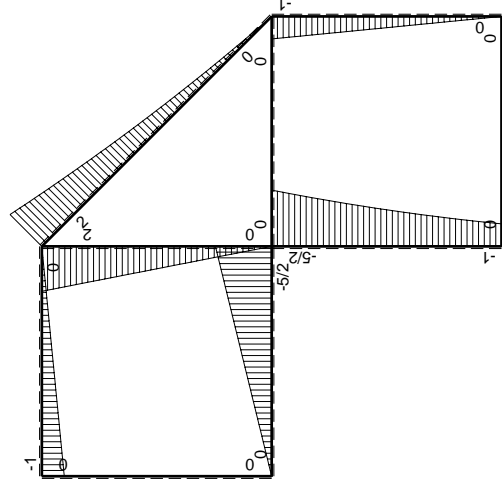
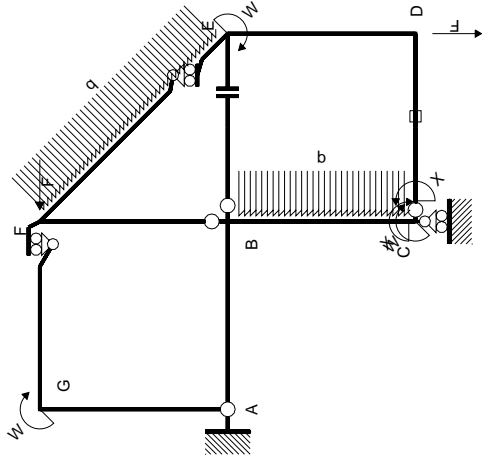
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

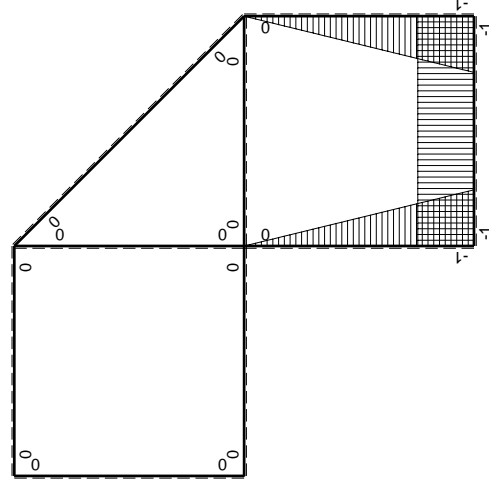
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+2Fx-1/2qx ²	5/2Fx-2Fx ² /b+1/2qx ³ /b	x ² /b ²	17/24Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx+1/2qx ²	Fb-1/2Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				3/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 2x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 2/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

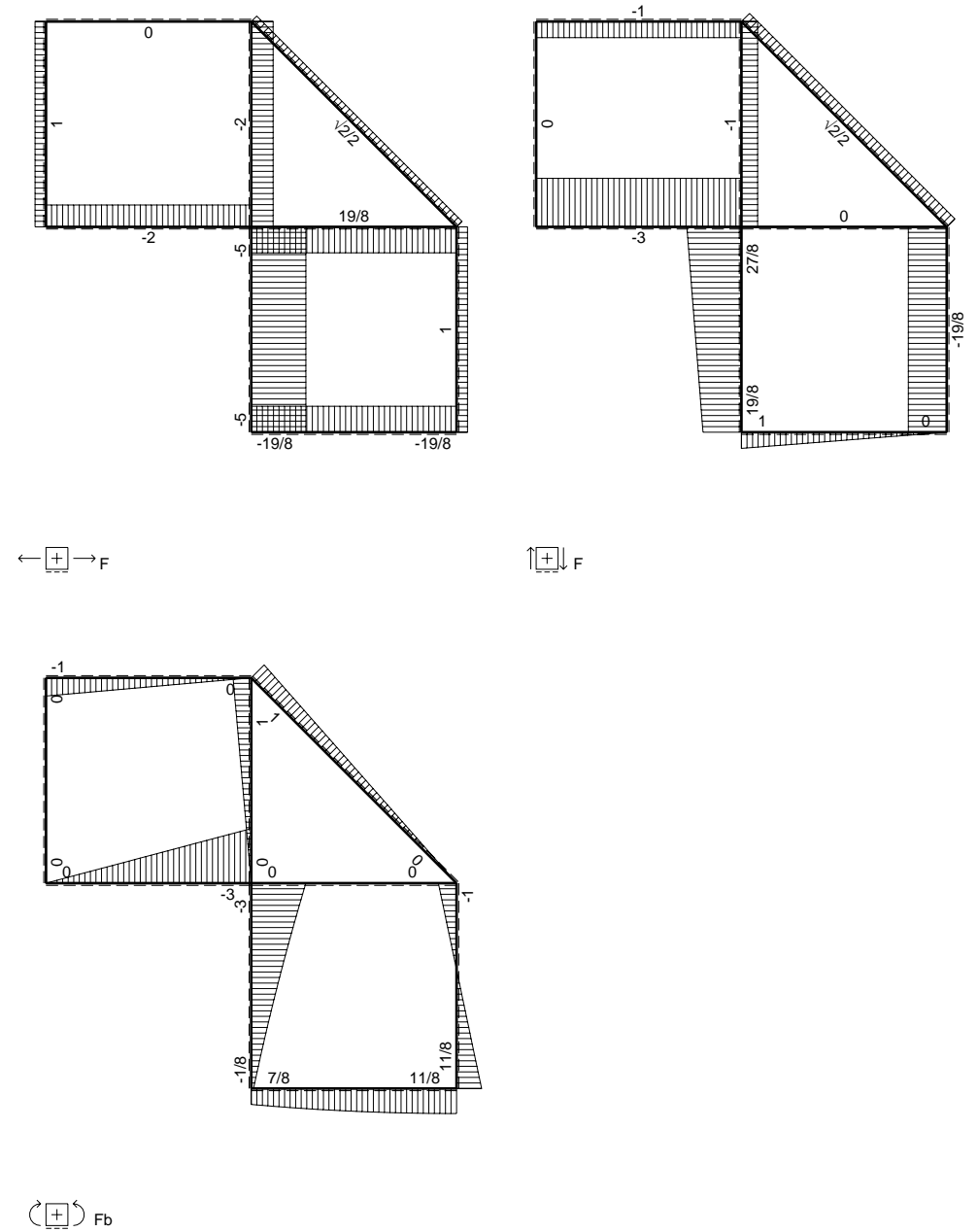
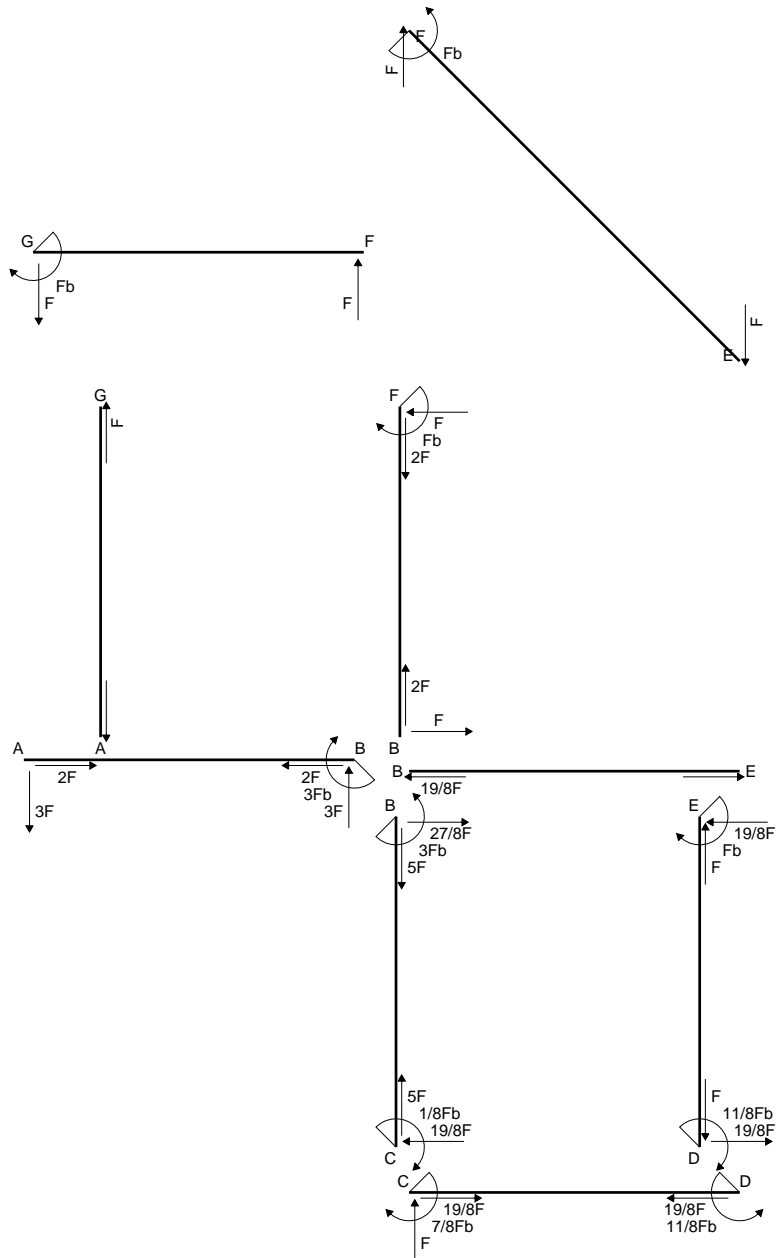
$$= (b - 1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

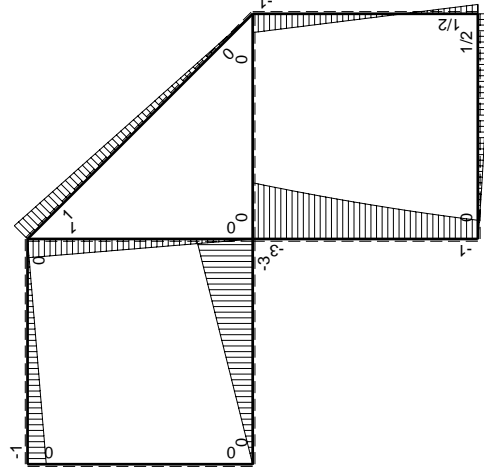
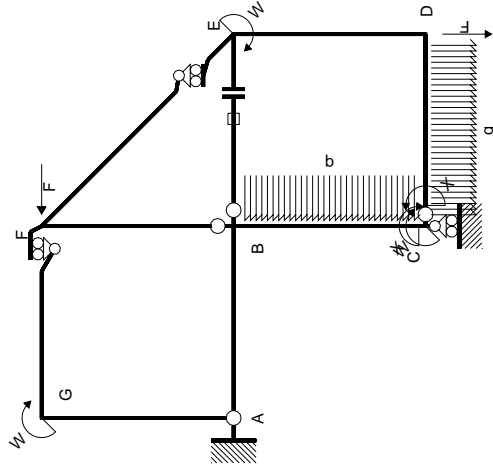
$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

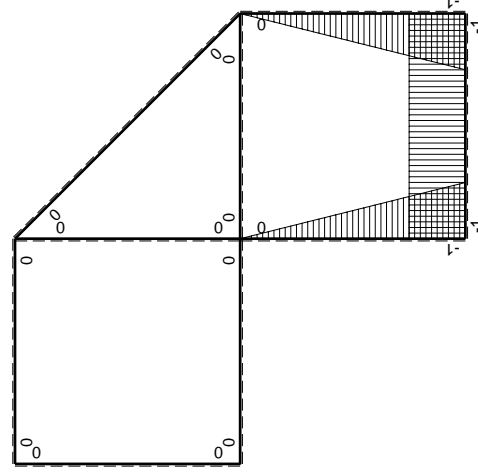
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	$-3Fb+5/2Fx-1/2qx^2$	$3Fx-5/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$19/24Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	$Fb+3/2Fx+1/2qx^2$	$Fb+1/2Fx-Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-3/2Fx$	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	$Fb-3/2Fx$	$Fx-3/2Fx^2/b$	x^2/b^2	0	
EF √2b	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$35/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$-7/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 5/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = [3/2 x^2/b - 5/6 x^3/b^2 + 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/2 b - 5/6 b + 1/8 b) \cdot Fb \cdot 1/EJ = 19/24 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = [x + 1/4 x^2/b - 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b + 1/4 b - 1/3 b - 1/8 b) \cdot Fb \cdot 1/EJ = 19/24 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

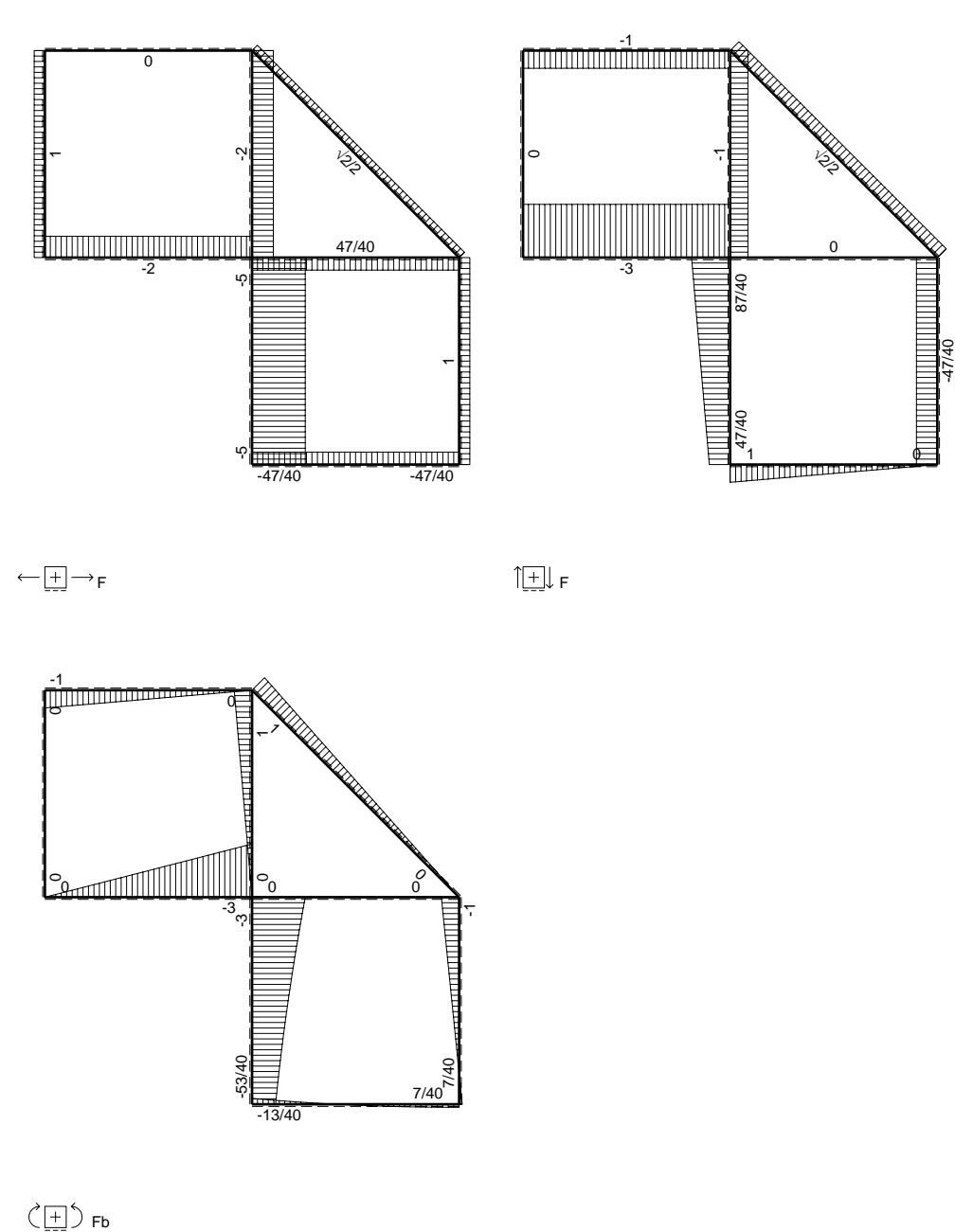
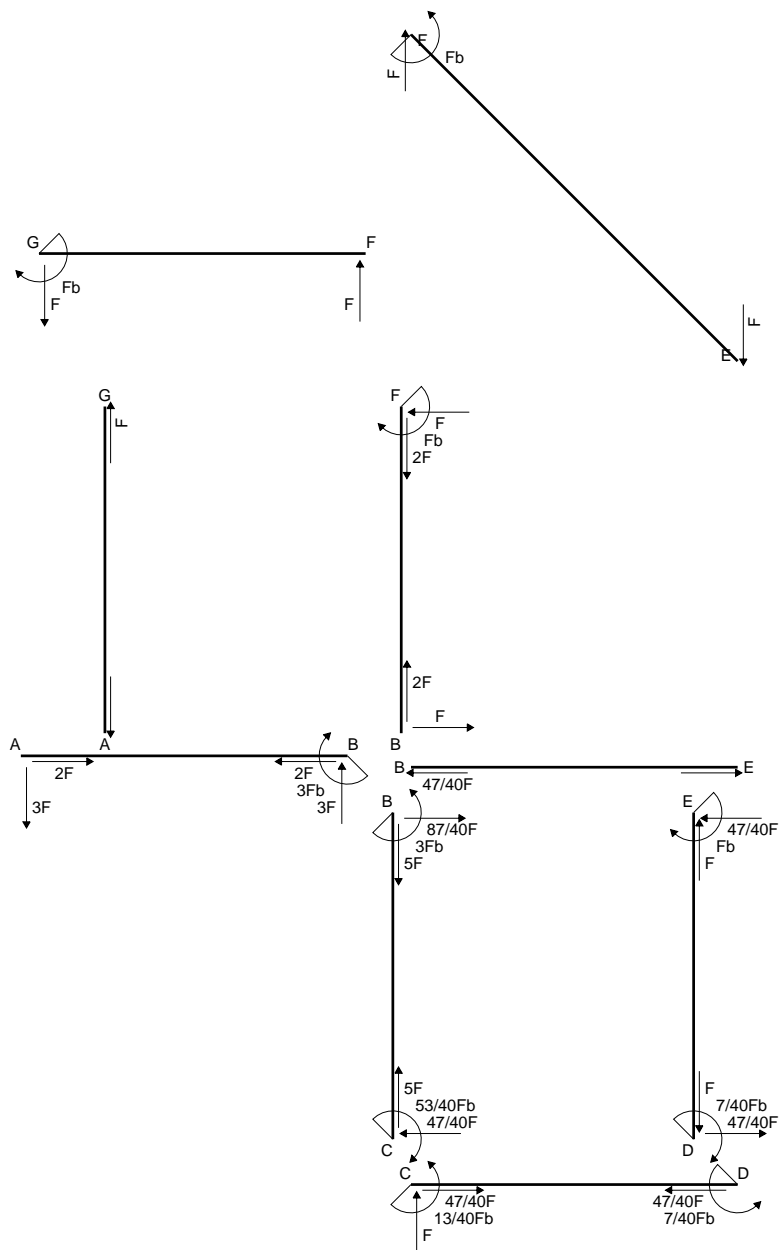
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

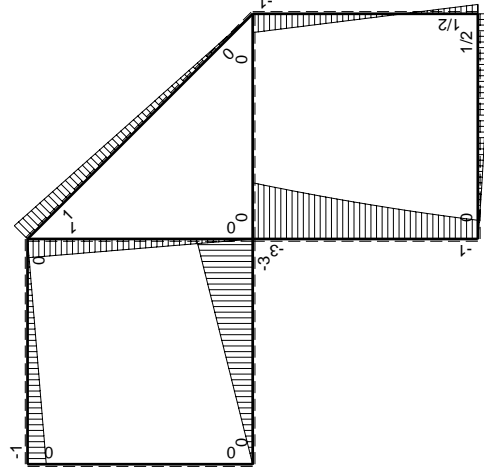
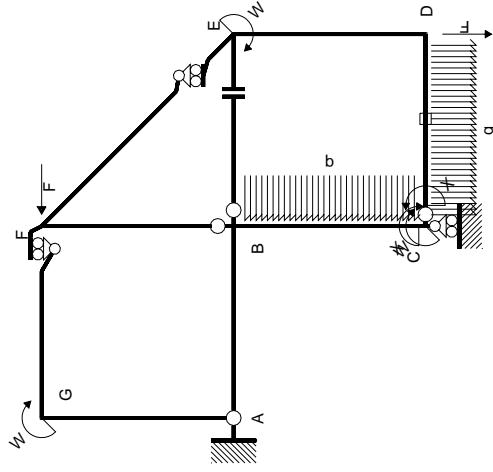
$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$

$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

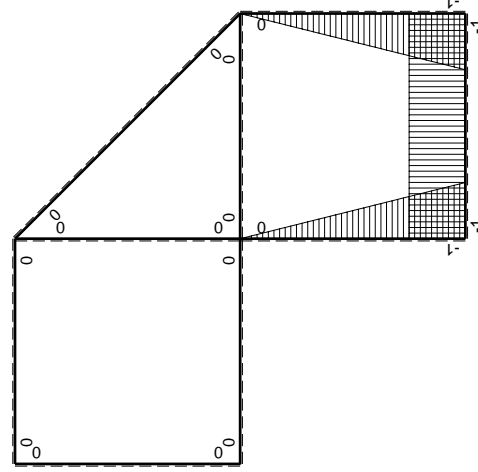
$$= (1/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = 0$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	$-3Fb+5/2Fx-1/2qx^2$	$3Fx-5/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$19/24Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	$Fb+3/2Fx+1/2qx^2$	$Fb+1/2Fx-Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-3/2Fx$	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	$Fb-3/2Fx$	$Fx-3/2Fx^2/b$	x^2/b^2	0	
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				$-Fb^2/EJ$	
	totali				$-13/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$13/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 5/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [3/2 x^2/b - 5/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (3/2 b - 5/6 b + 1/8 b) Fb 1/EJ = 19/24 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [x + 1/4 x^2/b - 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b + 1/4 b - 1/3 b - 1/8 b) Fb 1/EJ = 19/24 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

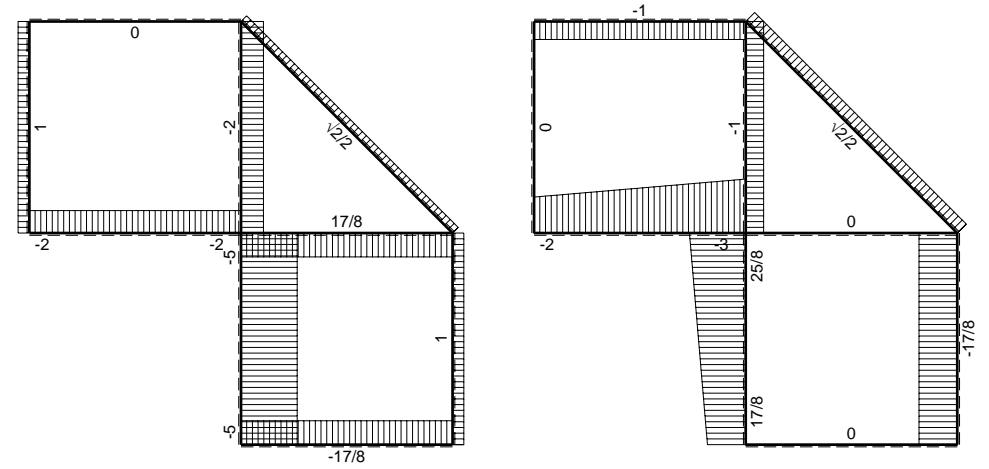
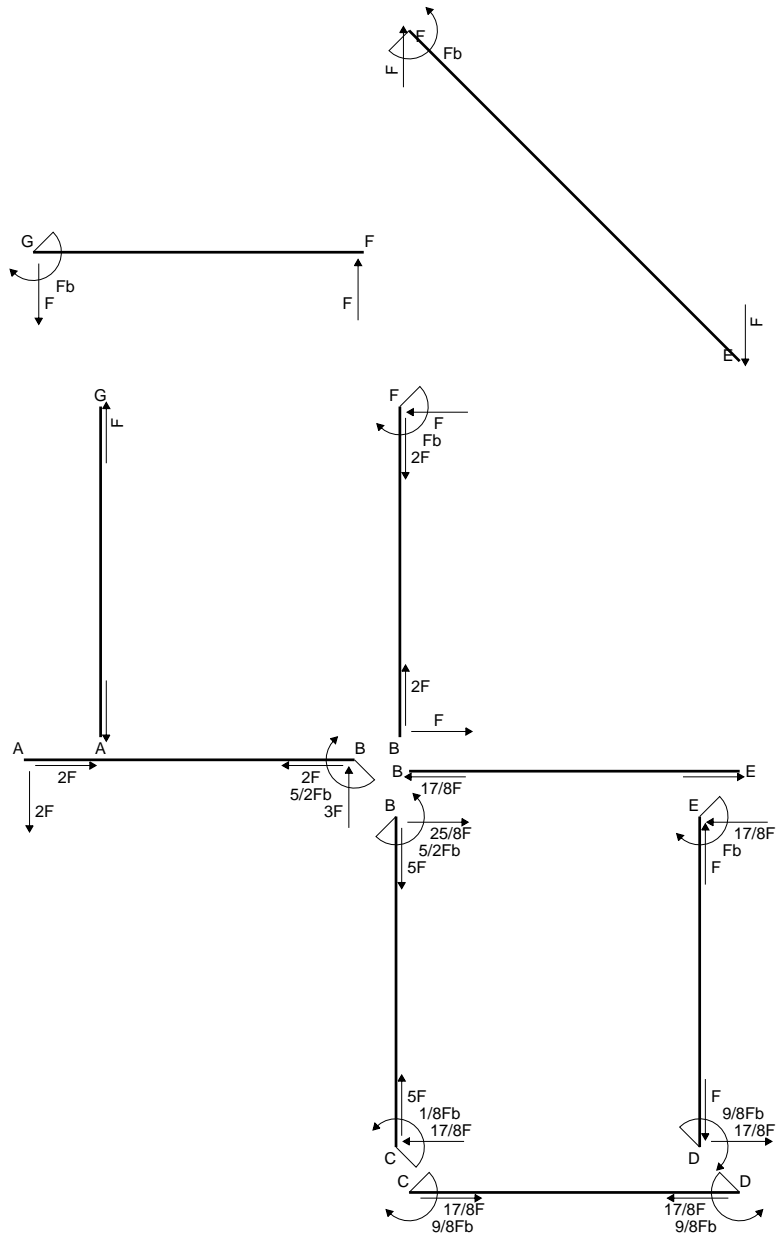
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 2x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + b - 1/2 b) Fb 1/EJ = 0$$

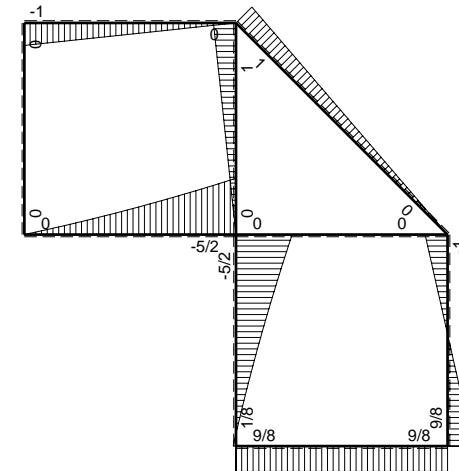
$$L_{ED}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b) Fb 1/EJ = 0$$

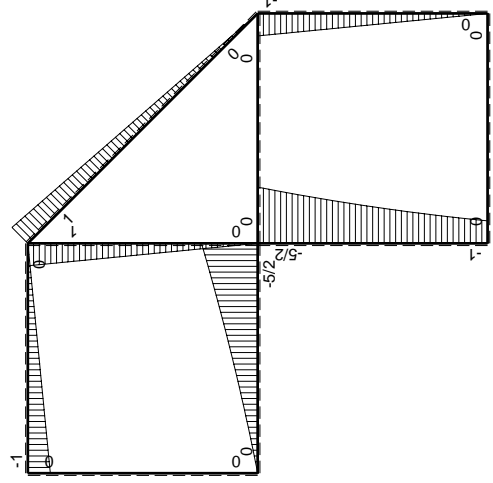
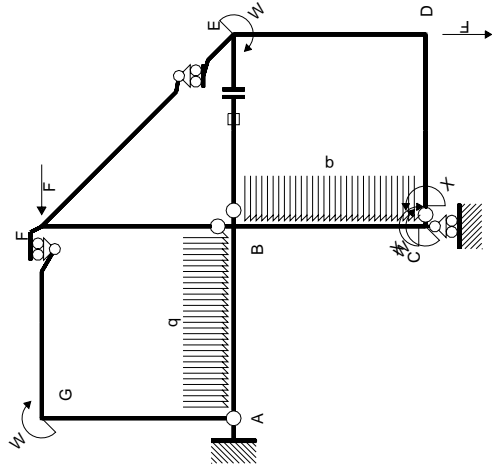


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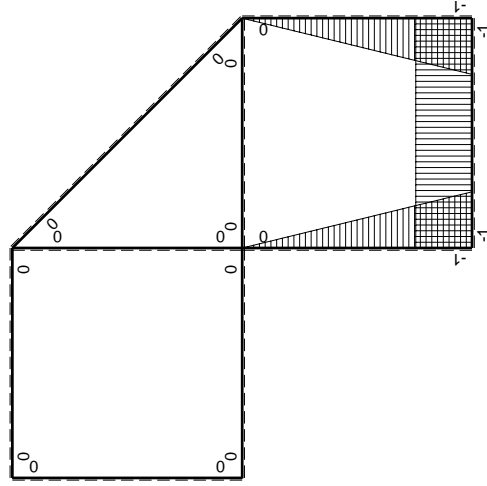


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 2Fx - 1/2qx^2$	$5/2Fx - 2Fx^2/b + 1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx + 1/2qx^2$	$Fb - 1/2Fx^2/b - 1/2qx^3/b$	$1 - 2x/b + x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	-Fx	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE}} L_{BE}$				Fb^2/EJ	
	totali				$15/8Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				-9/8Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 \, x/b - 2 \, x^2/b^2 + 1/2 \, x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \, b - 2/3 \, b + 1/8 \, b) \cdot Fb \cdot 1/EJ = 17/24 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 \, x^2/b^2 - 1/2 \, x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

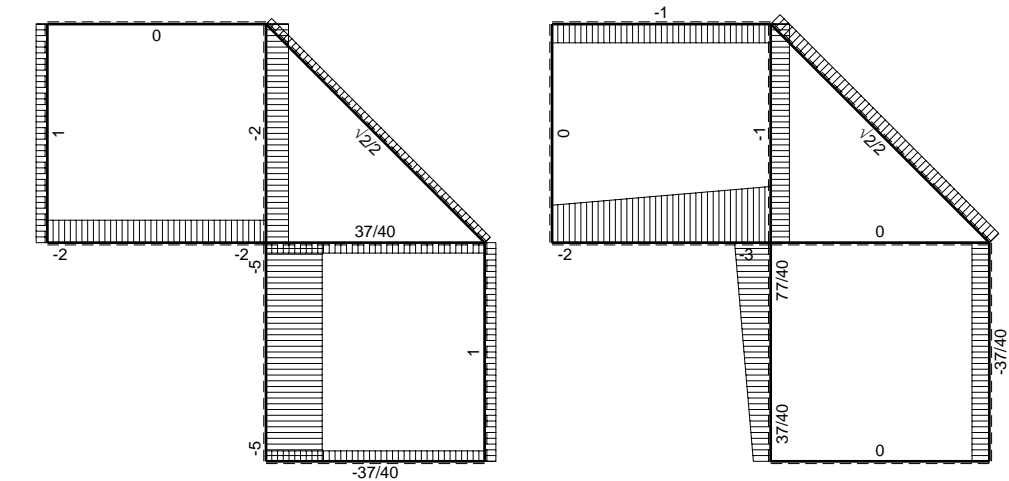
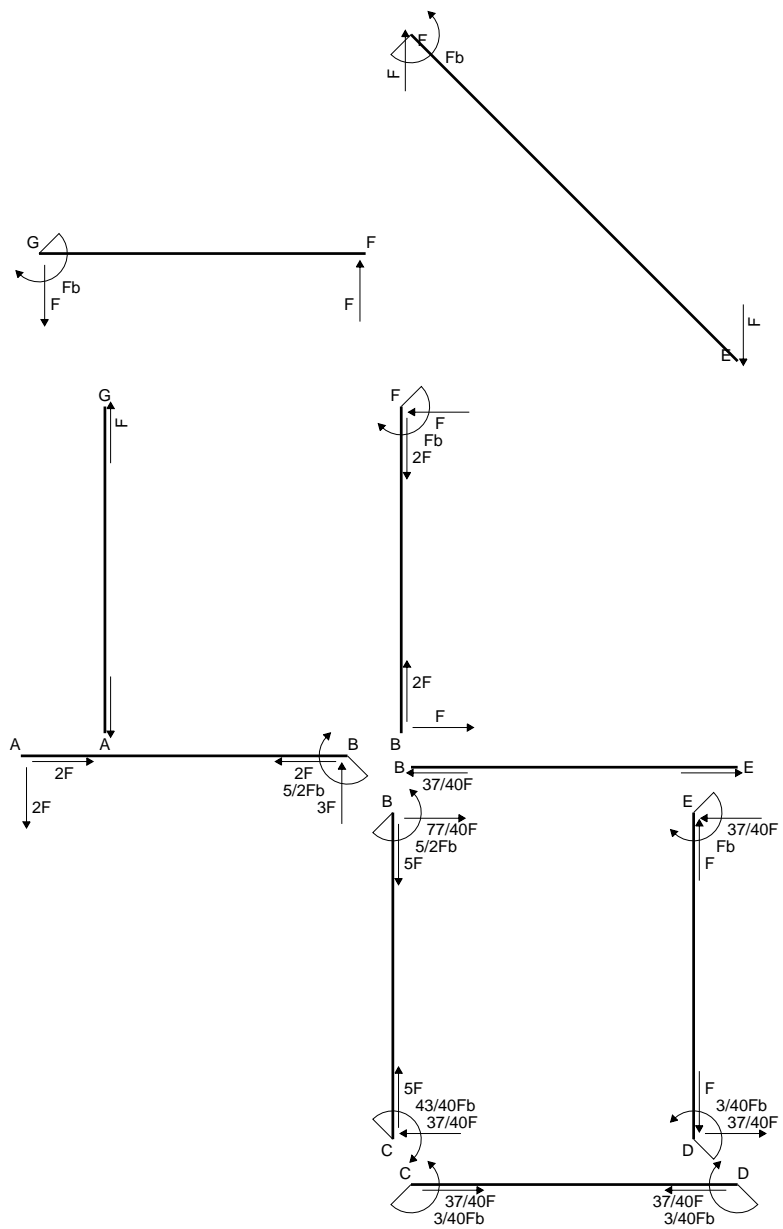
$$= (b - 1/6 \, b - 1/8 \, b) \cdot Fb \cdot 1/EJ = 17/24 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 \, b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 1/6 \, Fb^2/EJ$$

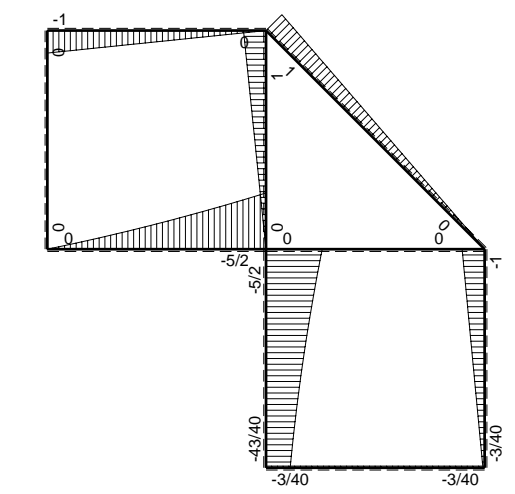
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 \, b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 1/6 \, Fb^2/EJ$$

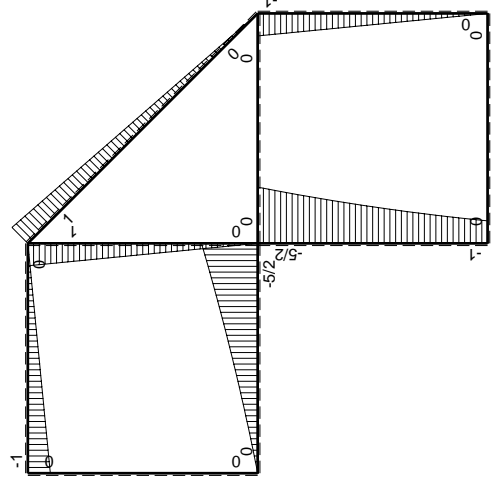
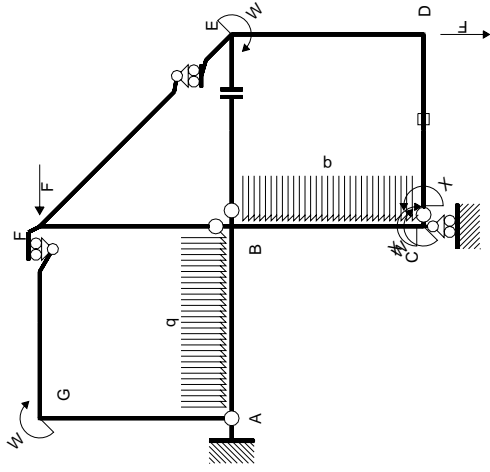


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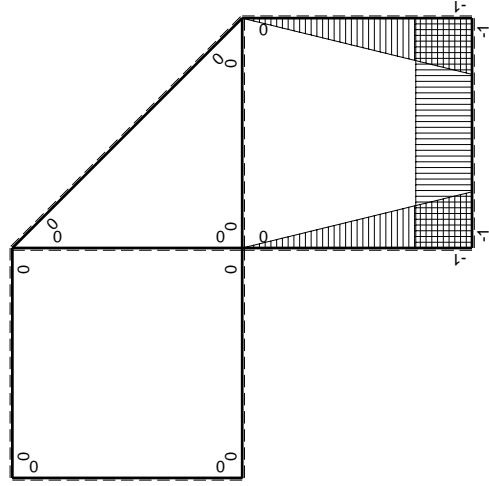


⊕ Fb



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-5/2Fb + 2Fx - 1/2qx^2$	$5/2Fx - 2Fx^2/b + 1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + Fx + 1/2qx^2$	$Fb - 1/2Fx^2/b - 1/2qx^3/b$	$1 - 2x/b + x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	-Fx	$Fx - Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb - Fx$	$Fx - Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	$Fb - Fx$	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/8Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$3/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 2x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 2/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

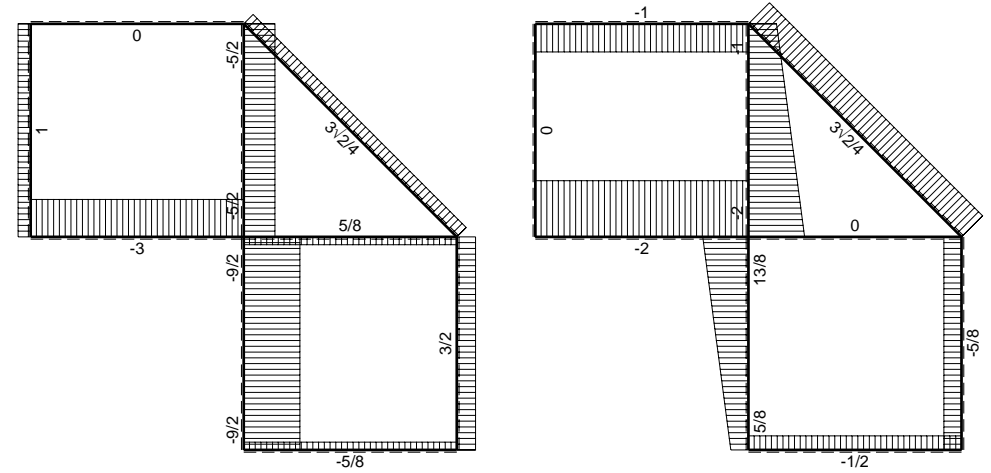
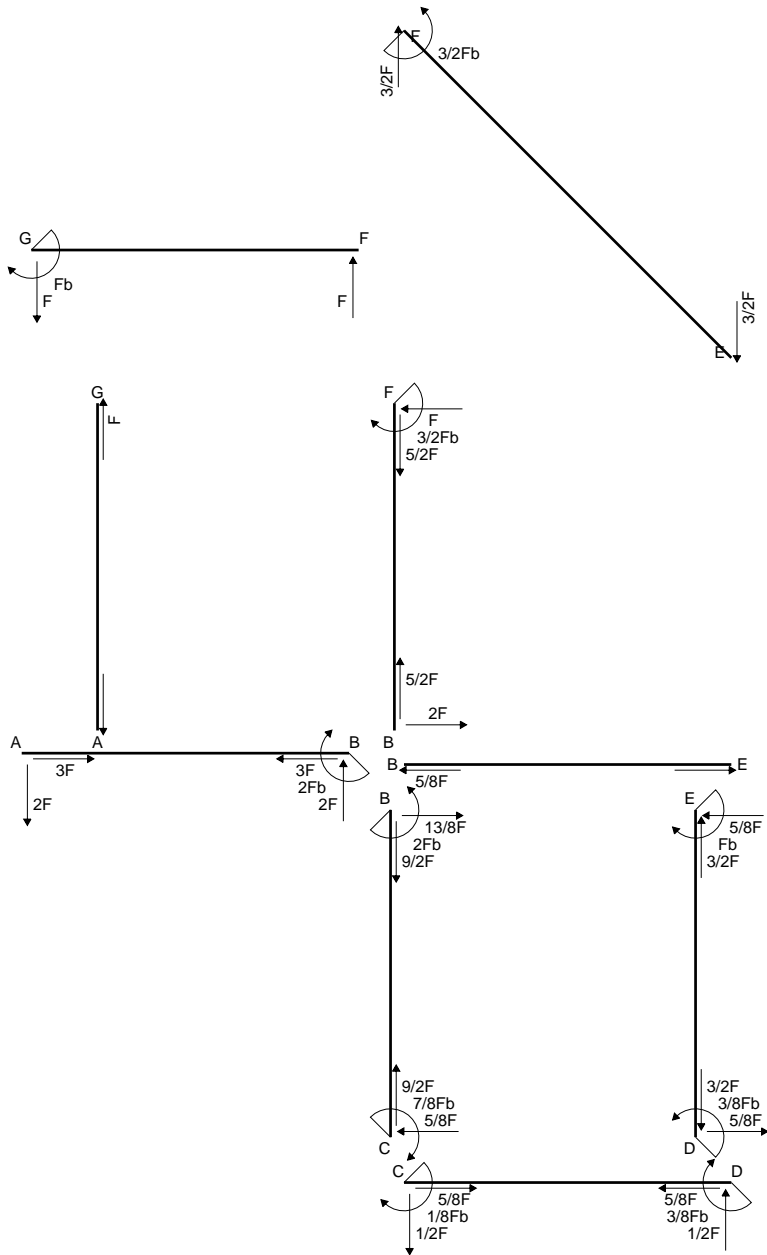
$$= (b - 1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

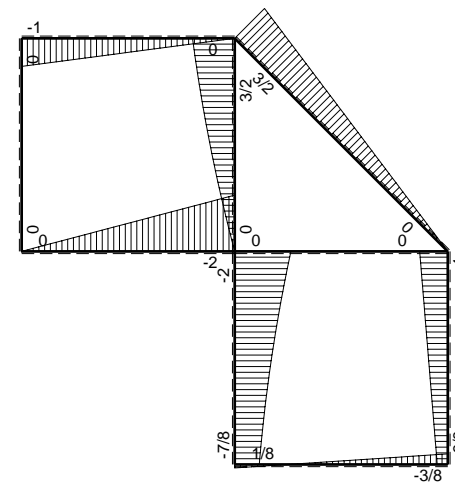
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

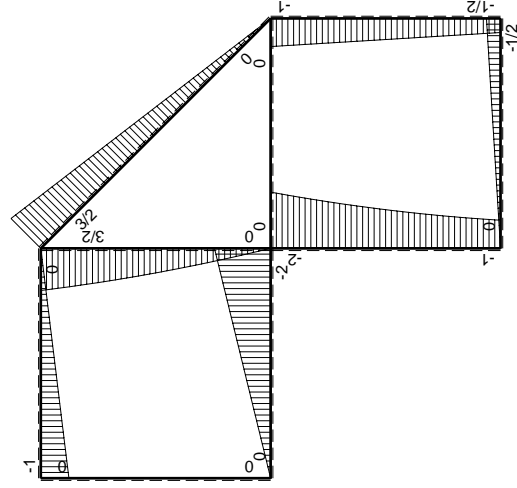
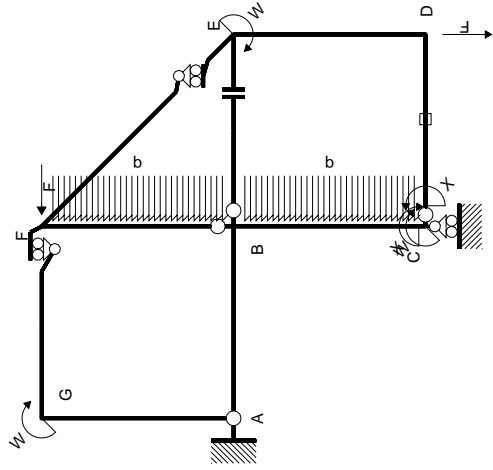


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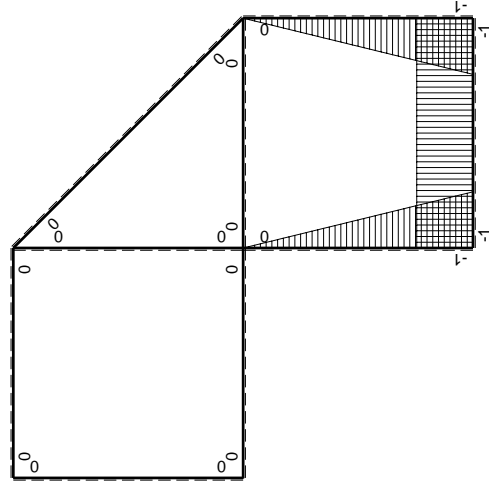


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+3/2Fx-1/2qx ²	2Fx-3/2Fx ² /b+1/2qx ³ /b	x ² /b ²	5/8Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx+1/2qx ²	Fb-1/2Fx-1/2qx ³ /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb-1/2Fx	1/2Fb-1/2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
EF $\sqrt{2}b$	0	3\sqrt{2}4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				5/24Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-1/8Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 1/2 b + 1/8 b) Fb 1/EJ = 5/8 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^3/b^3) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/8 b) Fb 1/EJ = 5/8 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

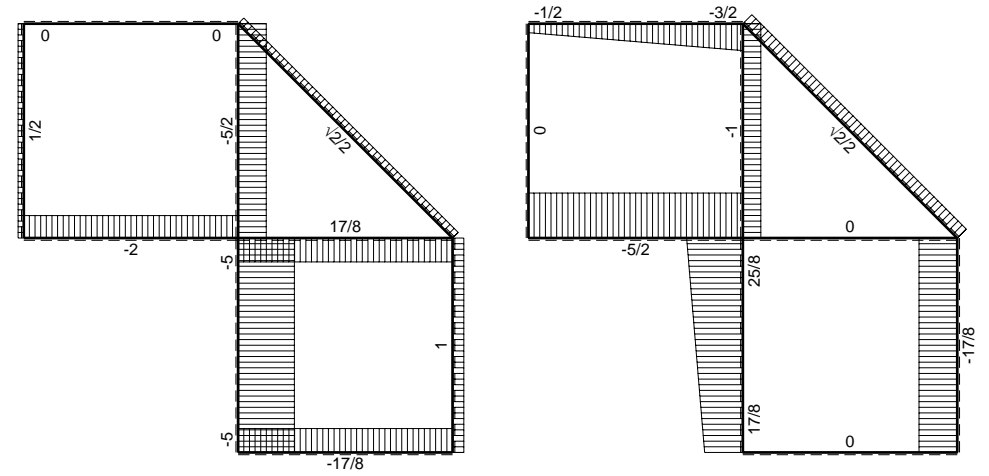
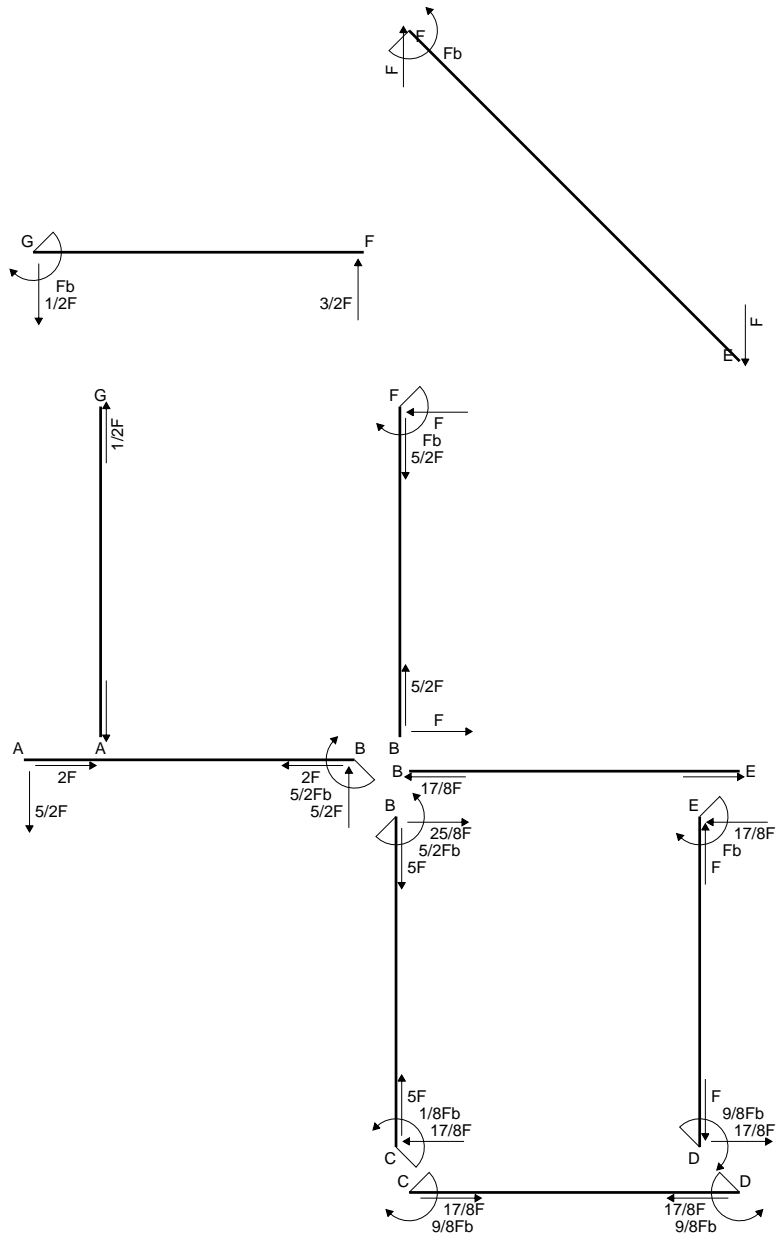
$$= (1/2 b - 1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

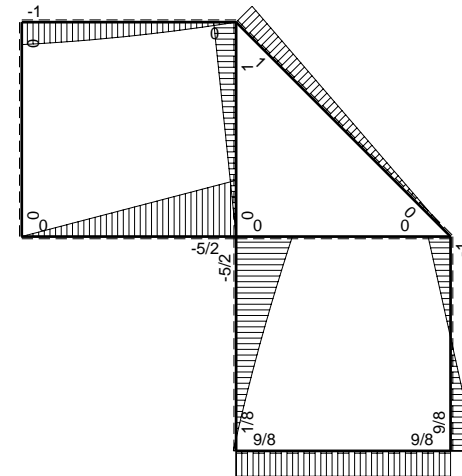
$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

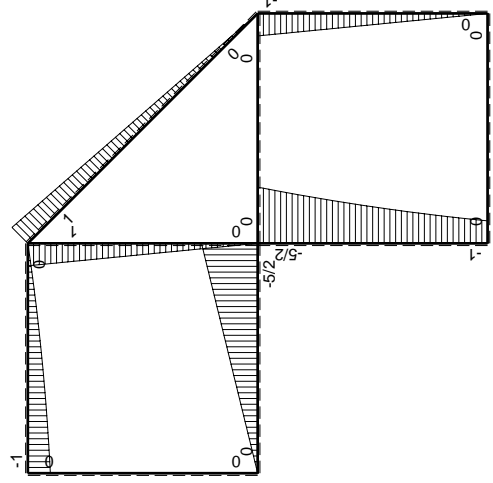
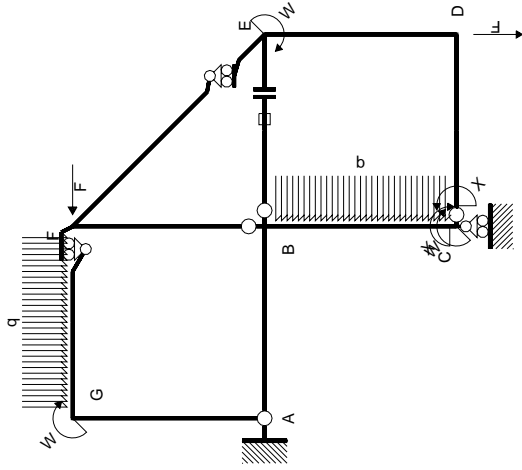


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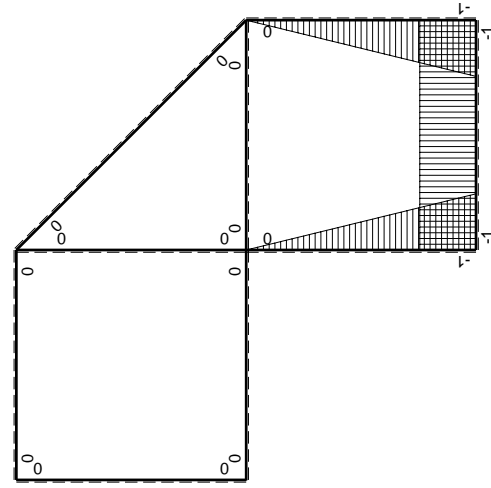


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+2Fx-1/2qx ²	5/2Fx-2Fx ² /b+1/2qx ³ /b	x ² /b ²	17/24Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx+1/2qx ²	Fb-1/2Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				15/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-9/8Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 \, x/b - 2 \, x^2/b^2 + 1/2 \, x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 \, b - 2/3 \, b + 1/8 \, b) \cdot Fb \cdot 1/EJ = 17/24 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 \, x^2/b^2 - 1/2 \, x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

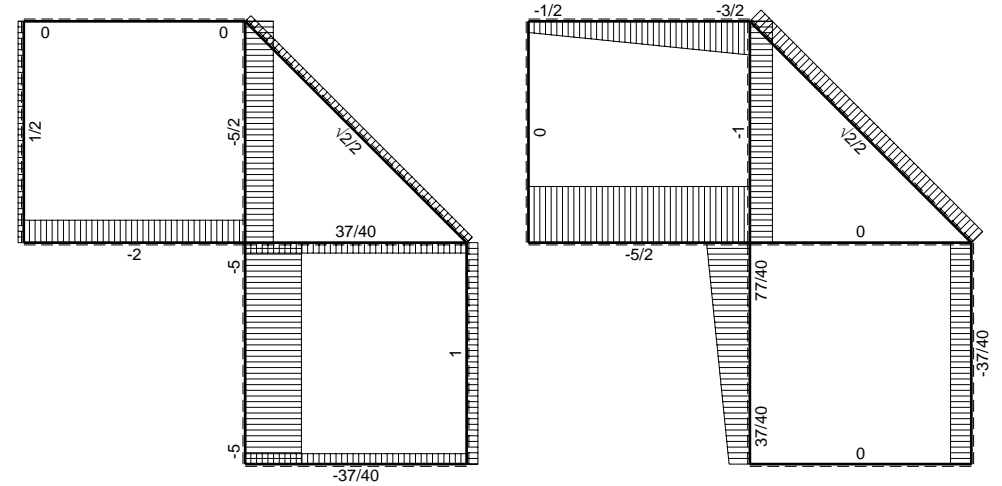
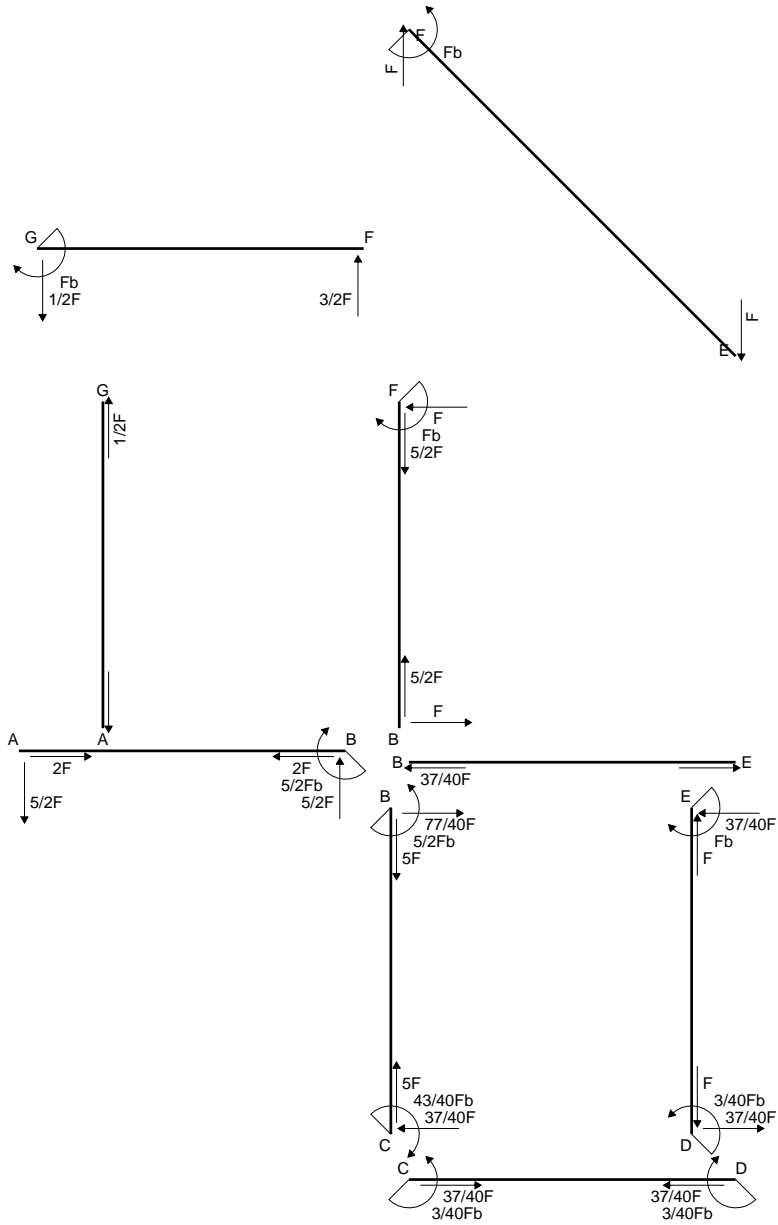
$$= (b - 1/6 \, b - 1/8 \, b) \cdot Fb \cdot 1/EJ = 17/24 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 \, b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 1/6 \, Fb^2/EJ$$

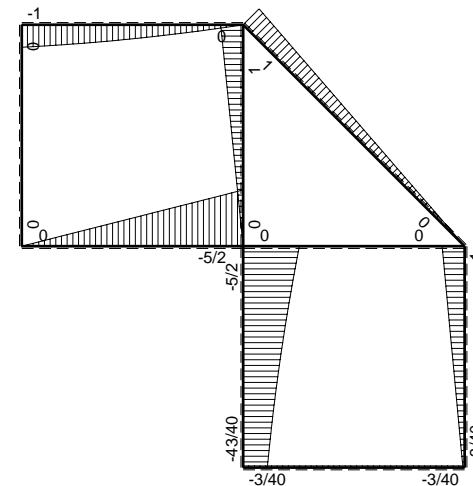
$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 \, b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 1/6 \, Fb^2/EJ$$

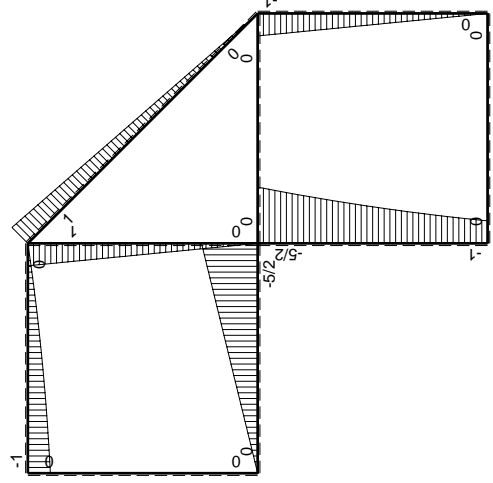
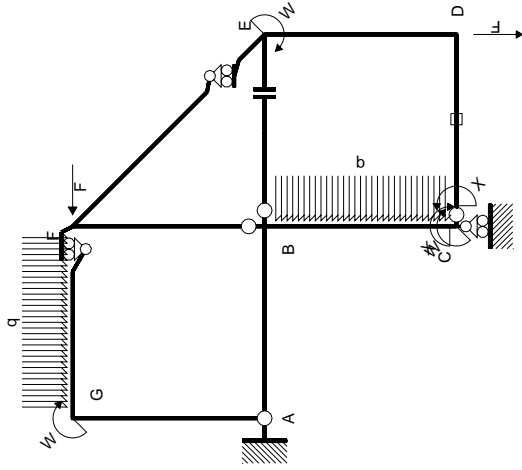


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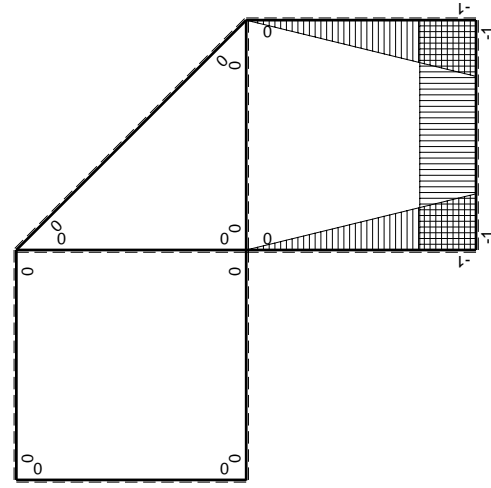


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0	0	0
BC b	-x/b	-5/2Fb+2Fx-1/2qx ²	5/2Fx-2Fx ² /b+1/2qx ³ /b	x ² /b ²	17/24Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx+1/2qx ²	Fb-1/2Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx ²	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx ²	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta N _{1,cd} ε _{cd} L _{cd}				-Fb ² /EJ	
	totali				-1/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				3/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/2 x/b - 2x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{5}{4} x^2/b - \frac{2}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (5/4 b - 2/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

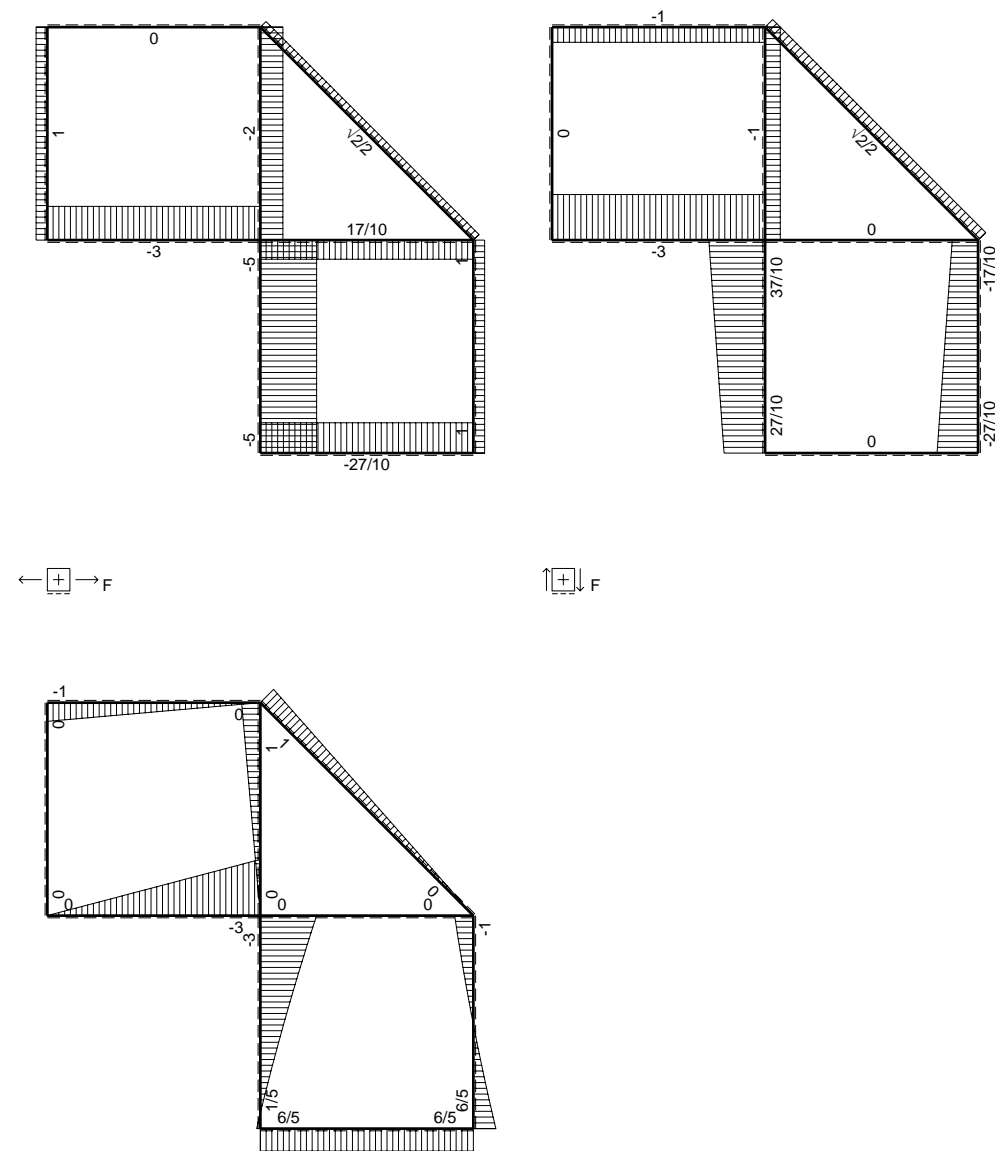
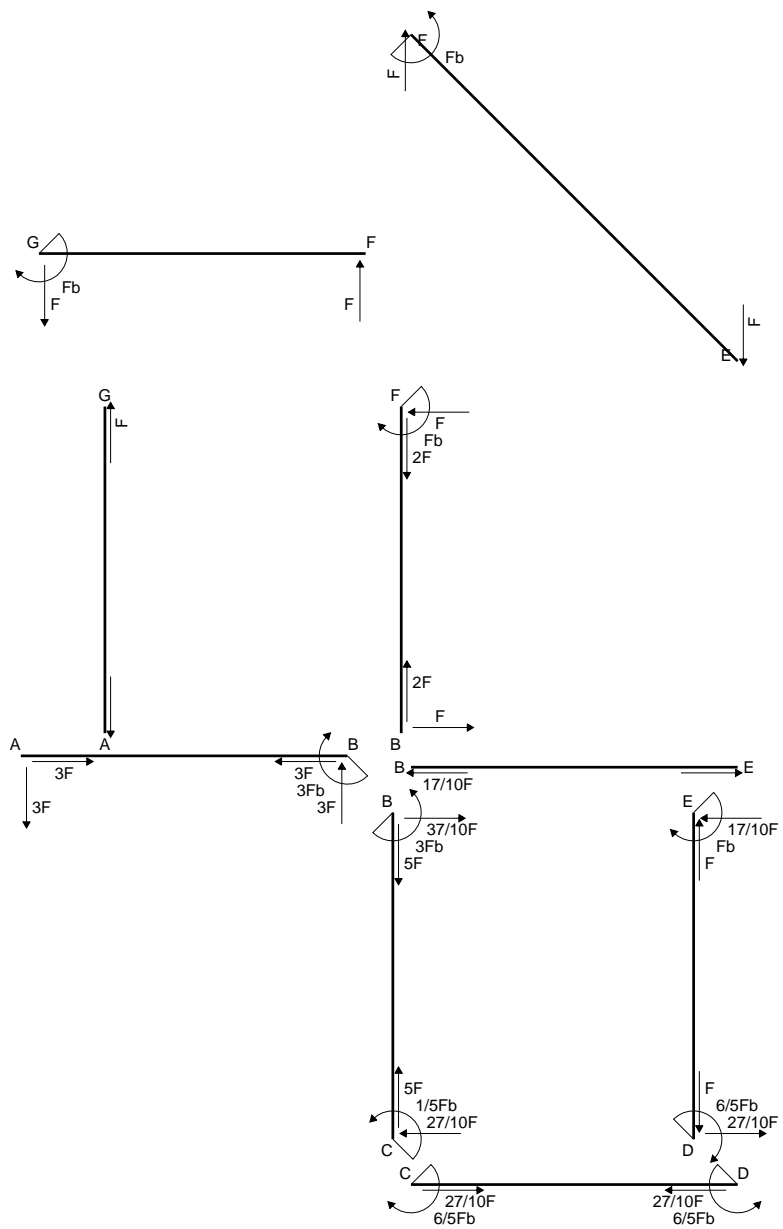
$$= (b - 1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 17/24 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

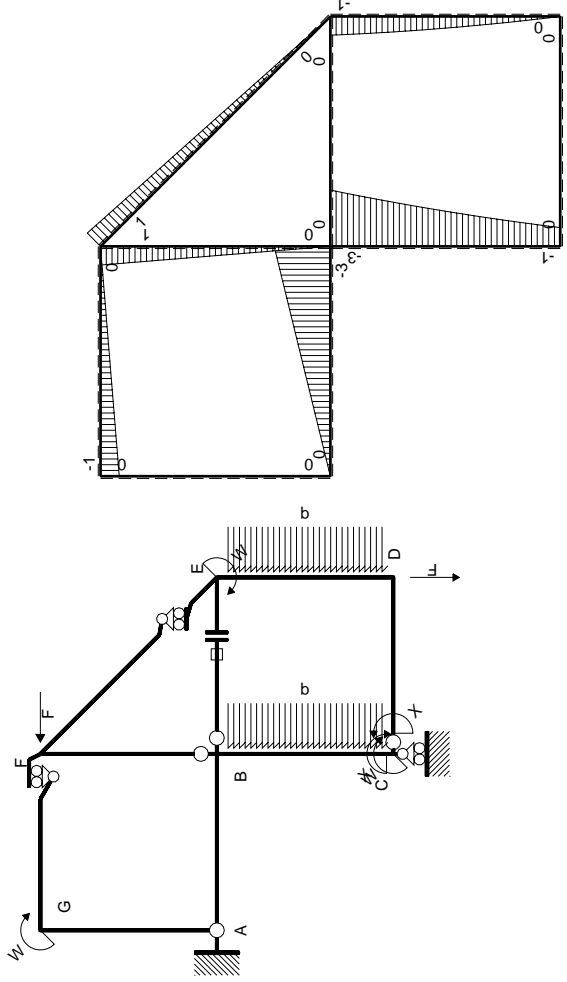
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

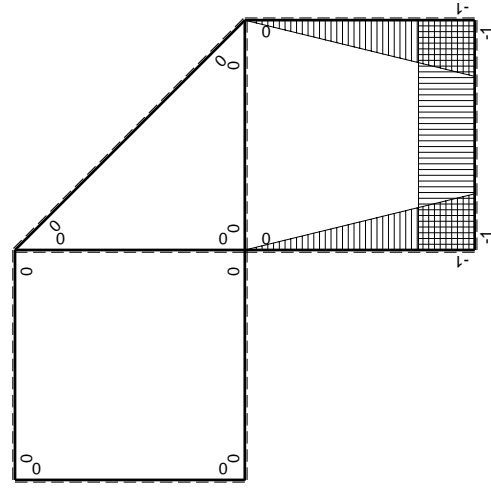


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0	0	0
BC b	-x/b	-3Fb+5/2Fx-1/2qx ²	3/2Fx-5/2Fx ² /b+1/2qx ³ /b	x ² /b ²	19/24Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx+1/2qx ²	Fb+1/2Fx-Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-3/2Fx+1/2qx ²	3/2Fx-2Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	5/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	Fb-1/2Fx-1/2qx ²	Fx-1/2Fx ² /b-1/2qx ³ /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0	0	0
GA b	0	0	0	0	0	0
AG b	0	0	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				2Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-6/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3x/b - 5/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{2} x^2/b - 5/6 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/2 \, b - 5/6 \, b + 1/8 \, b) \cdot Fb \cdot 1/EJ = 19/24 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 + 1/2 x/b - x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x + 1/4 x^2/b - 1/3 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

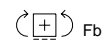
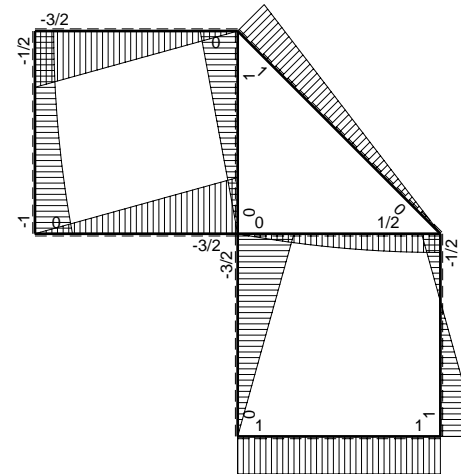
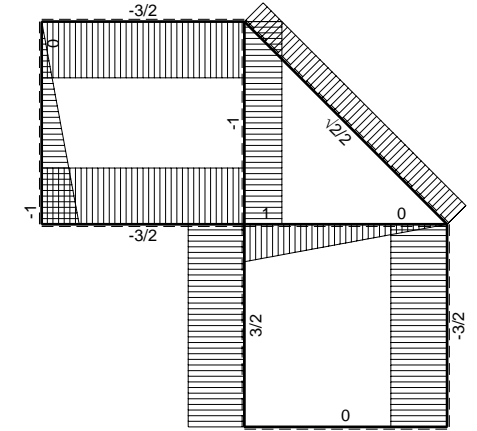
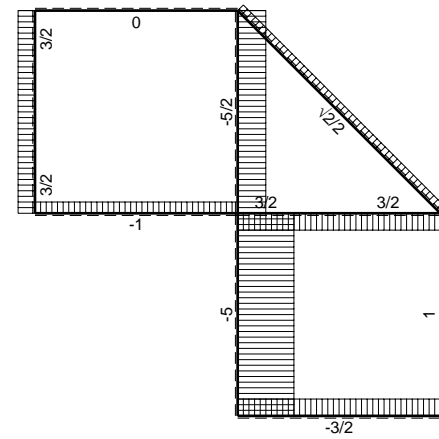
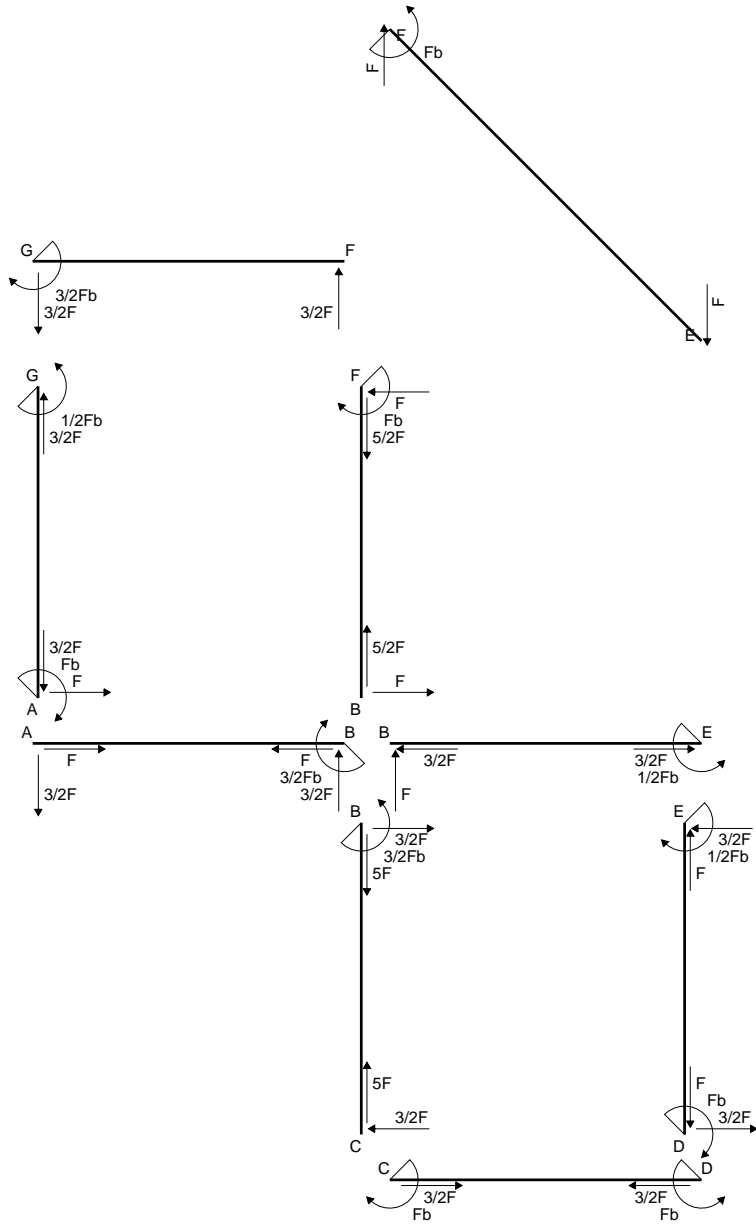
$$= (b + 1/4 \, b - 1/3 \, b - 1/8 \, b) \cdot Fb \cdot 1/EJ = 19/24 \, Fb^2/EJ$$

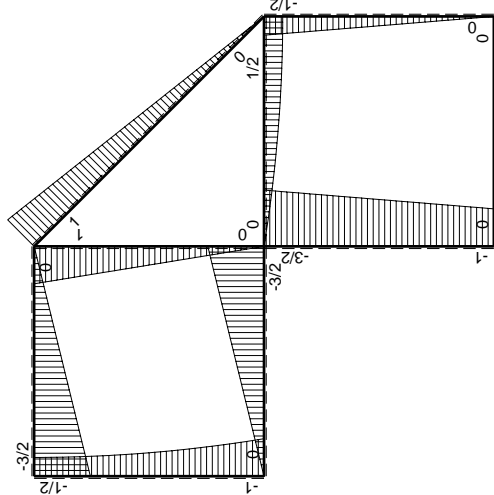
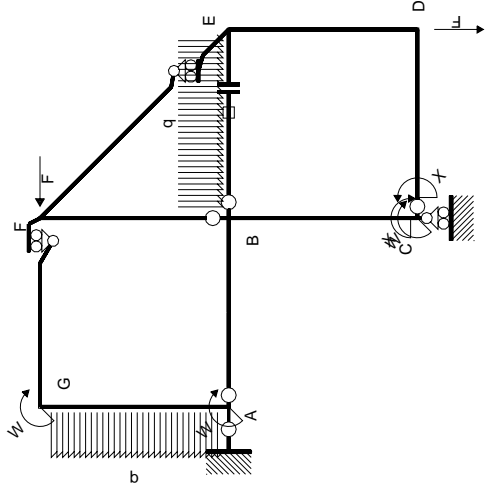
$$L_{DE}^{xo} = \int_0^b (3/2 x/b - 2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - 2/3 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 2/3 \, b + 1/8 \, b) \cdot Fb \cdot 1/EJ = 5/24 \, Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - 1/6 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

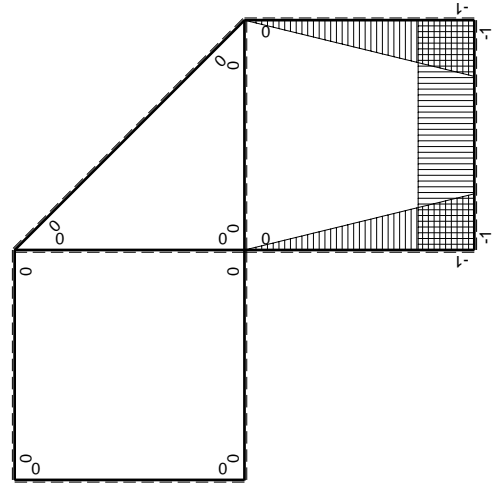
$$= (1/2 \, b - 1/6 \, b - 1/8 \, b) \cdot Fb \cdot 1/EJ = 5/24 \, Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	Xb/EJ
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				5/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 7/12 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 \, x^2/b - 1/6 \, x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

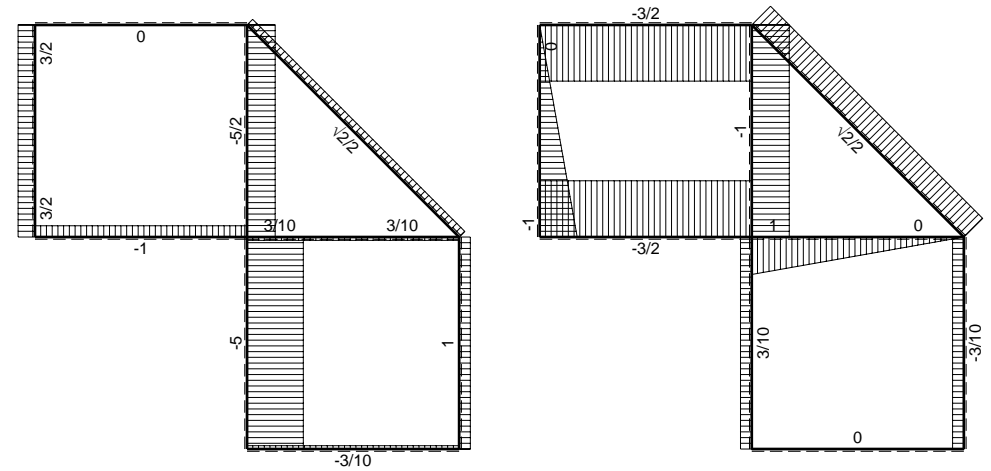
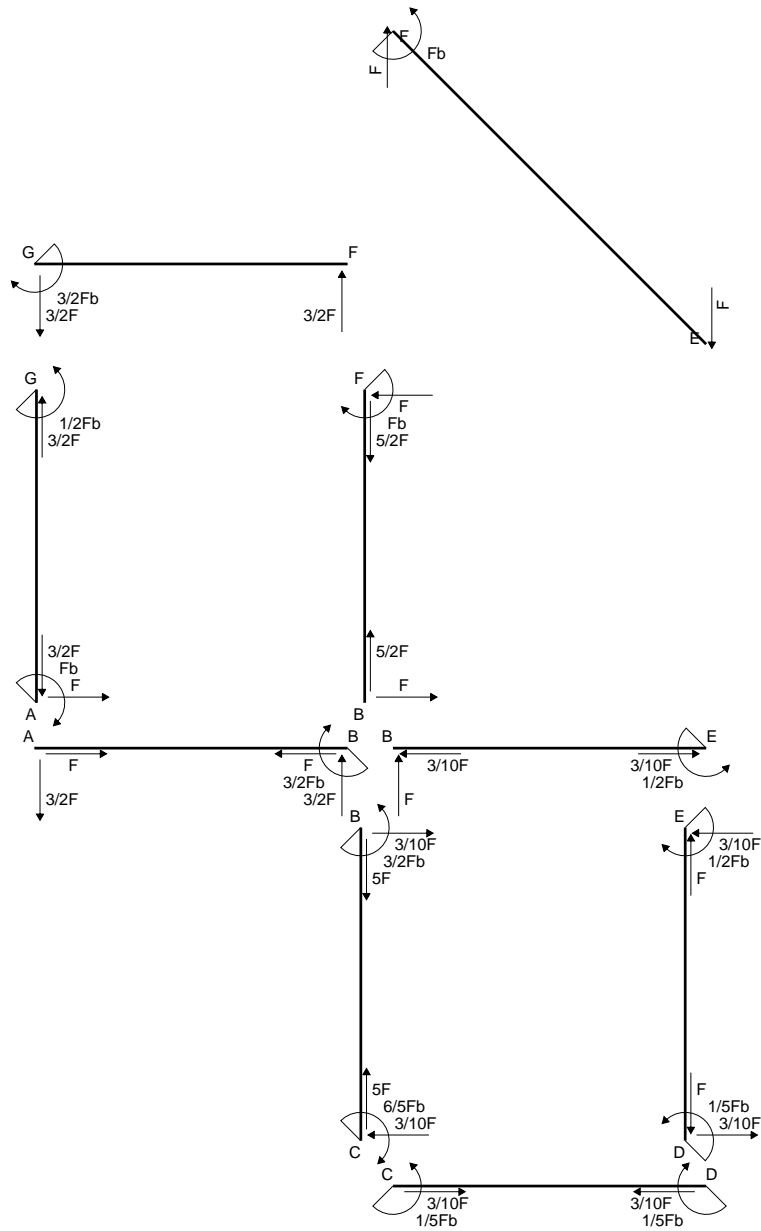
$$= (b - 1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 7/12 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 1/12 \, Fb^2/EJ$$

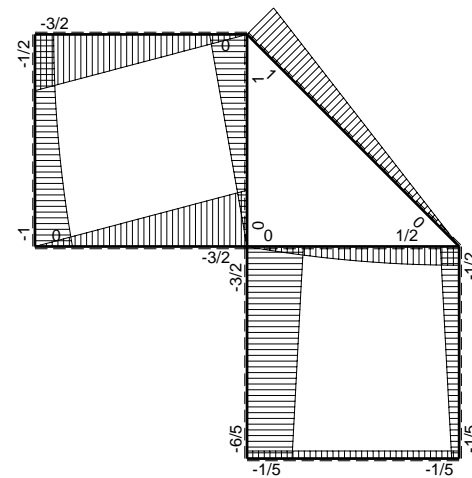
$$L_{ED}^{xo} = \int_0^b (1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 1/12 \, Fb^2/EJ$$

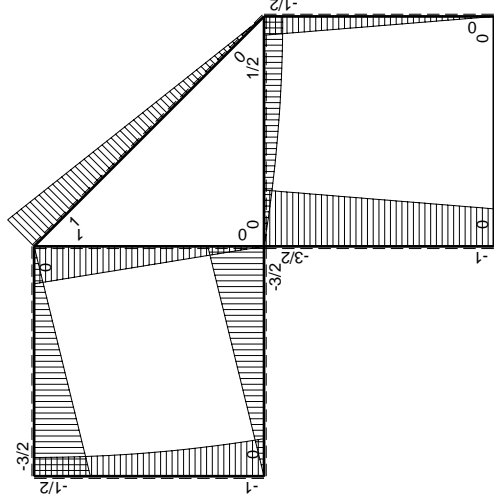
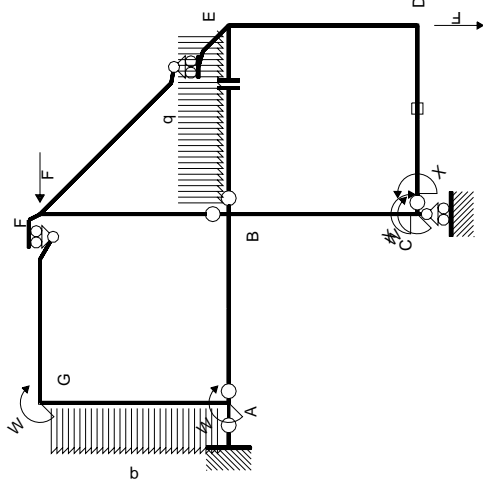


← ⊕ → F

↑ ⊕ ↓ F

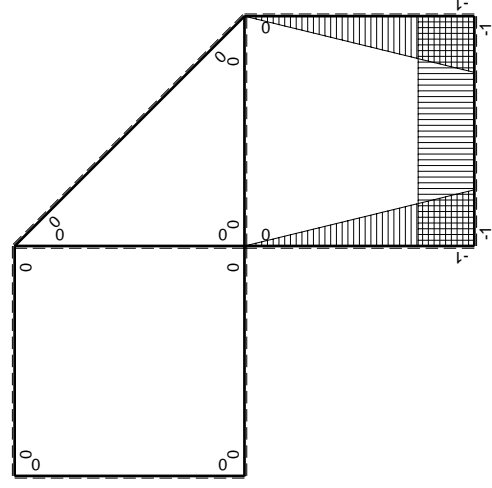


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	Xb/EJ
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	-Fb ² /EJ	
	totali				-1/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

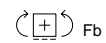
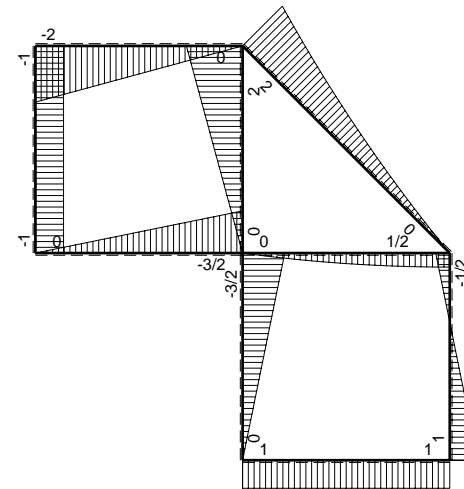
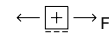
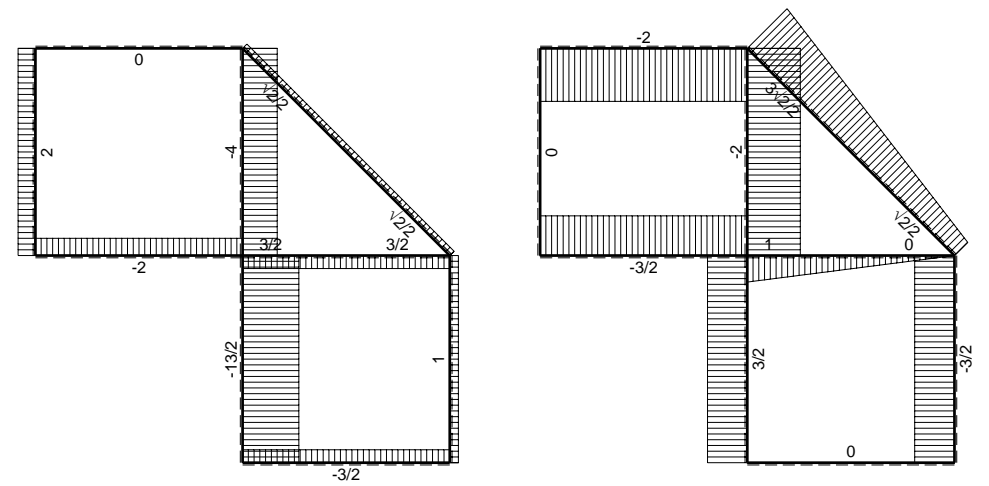
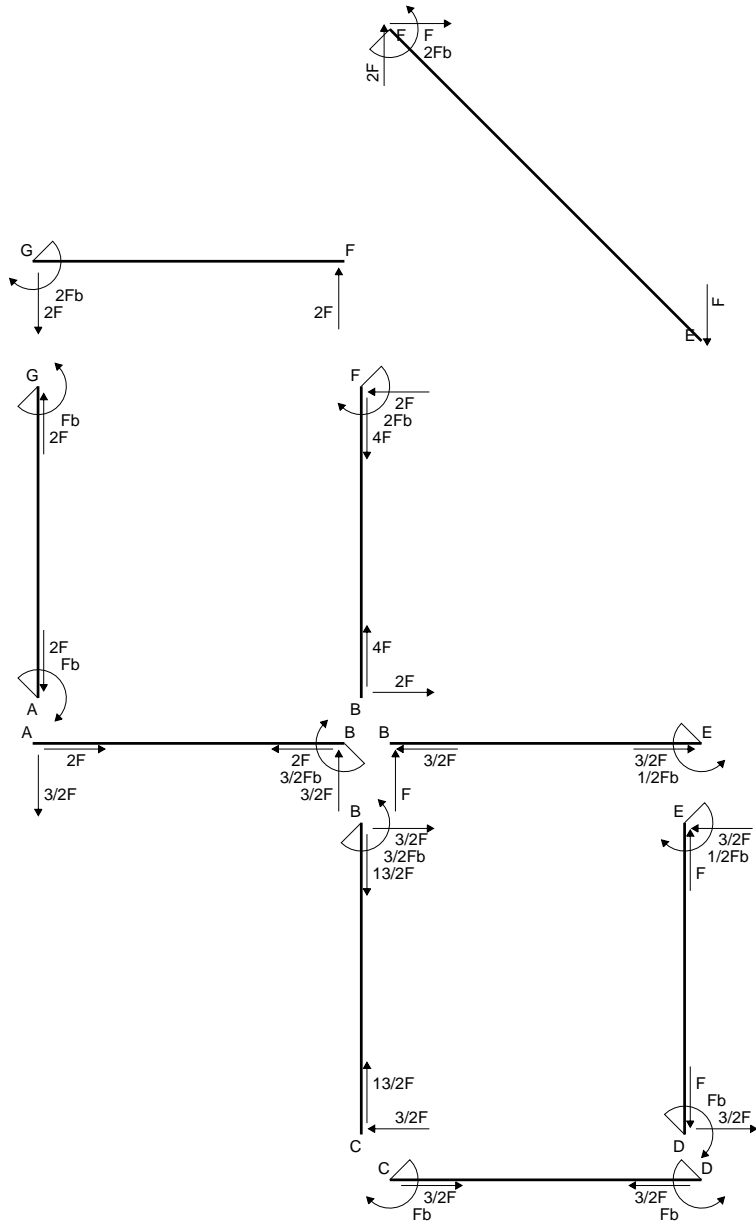
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

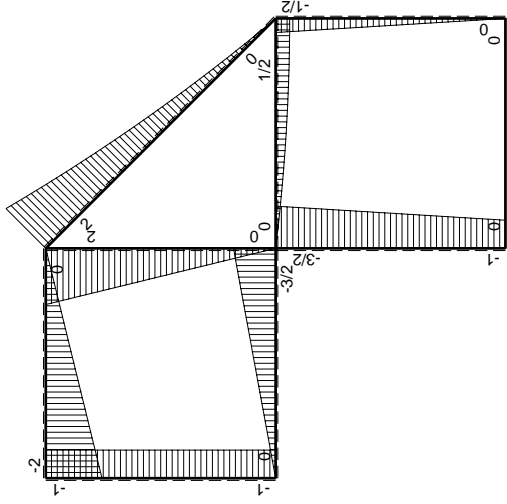
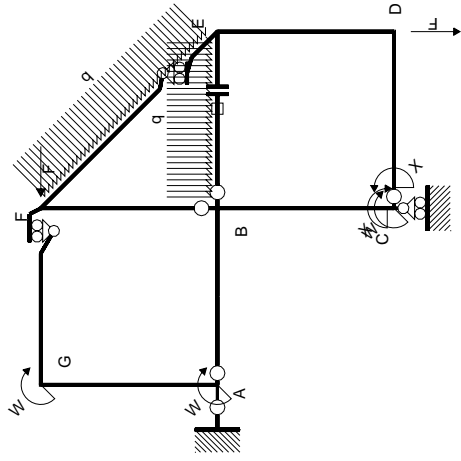
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

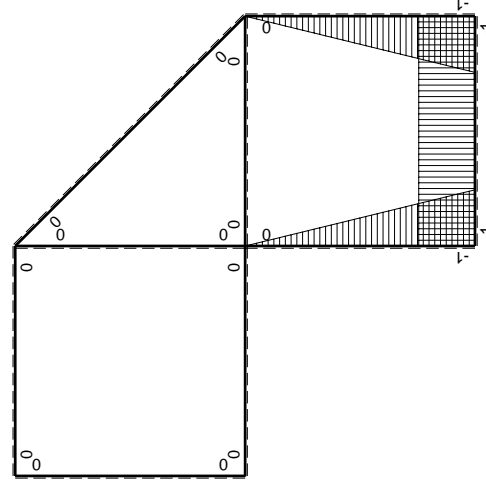
$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				5/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

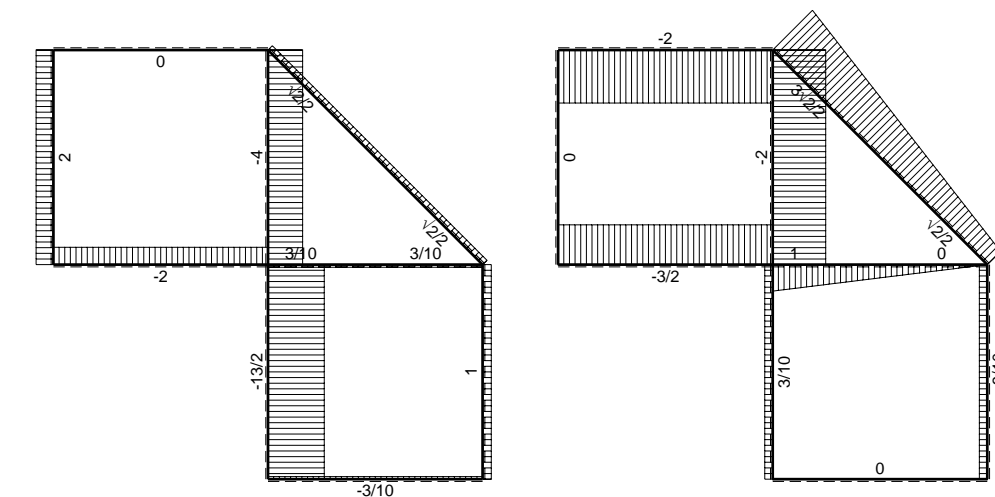
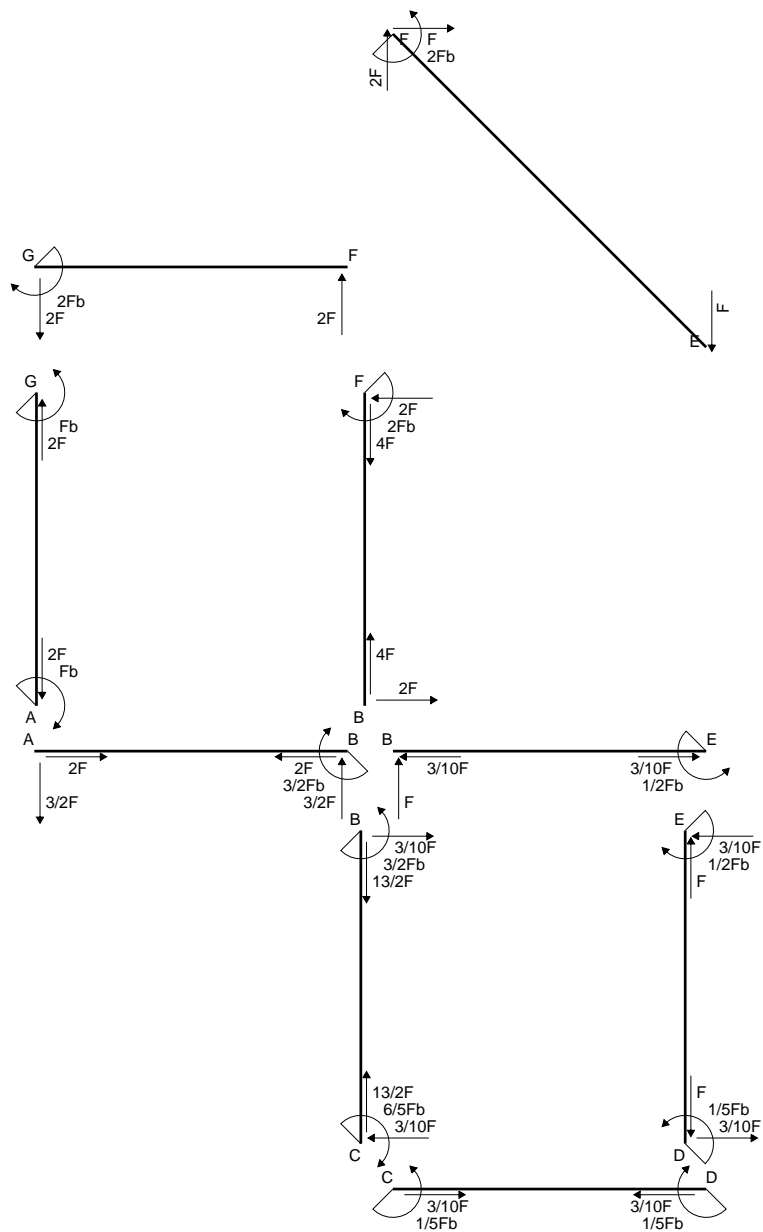
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

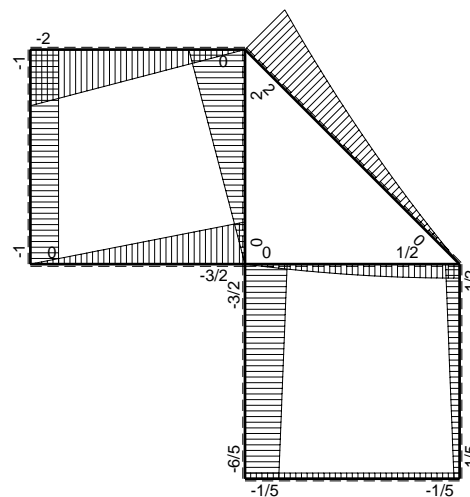
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

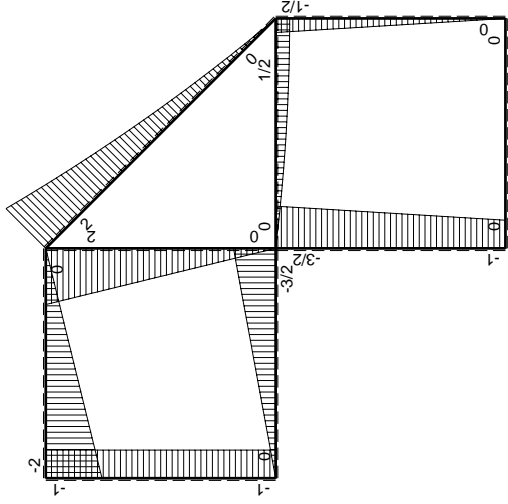
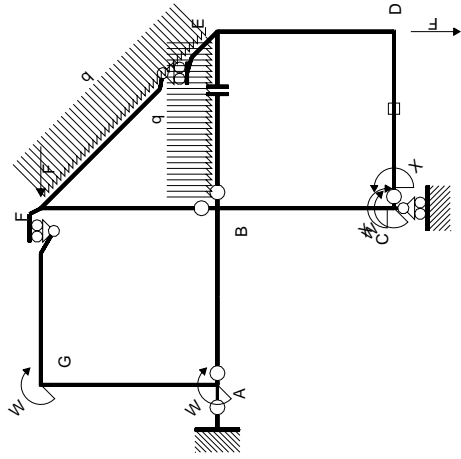


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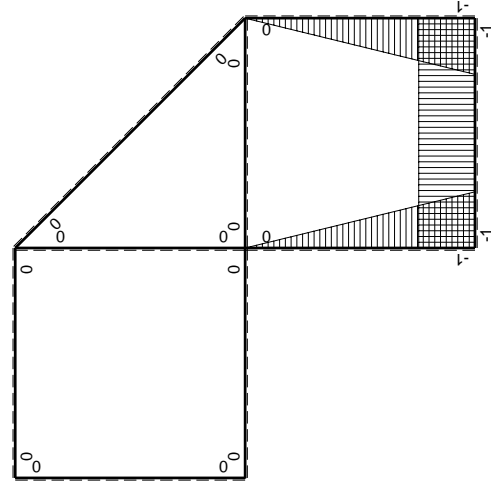


⊕ ⊖ F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	Xb/EJ
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/3Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				1/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

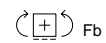
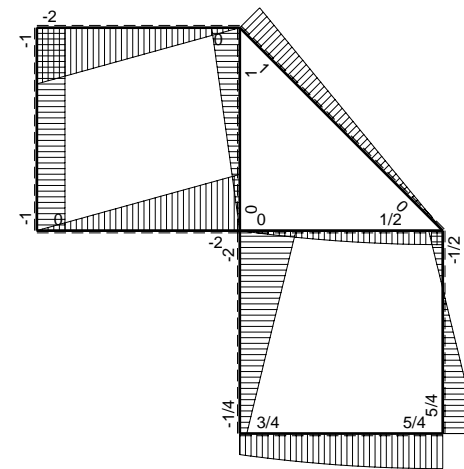
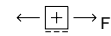
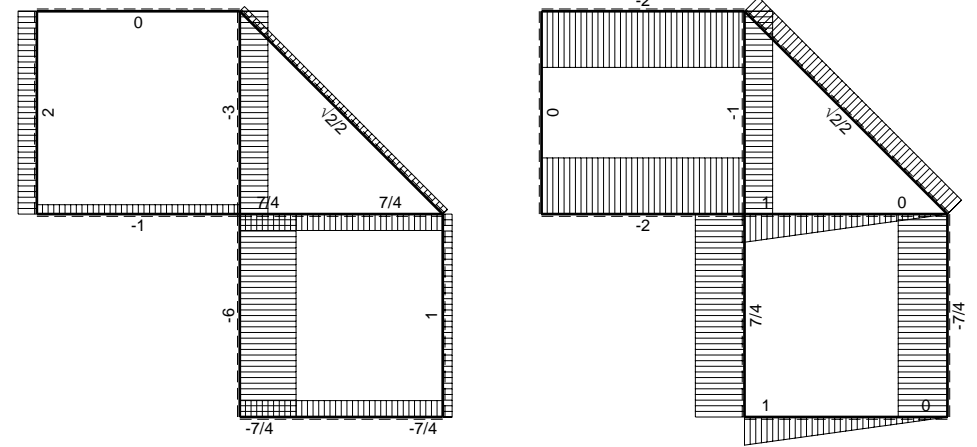
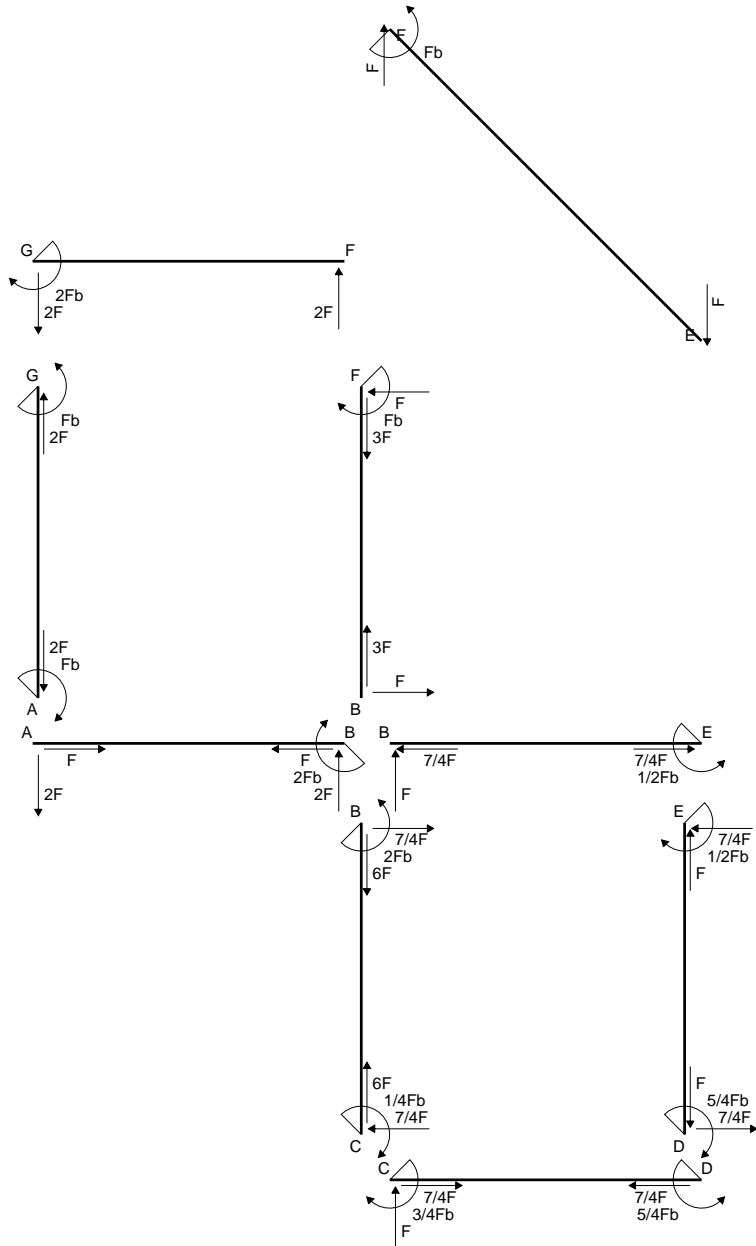
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

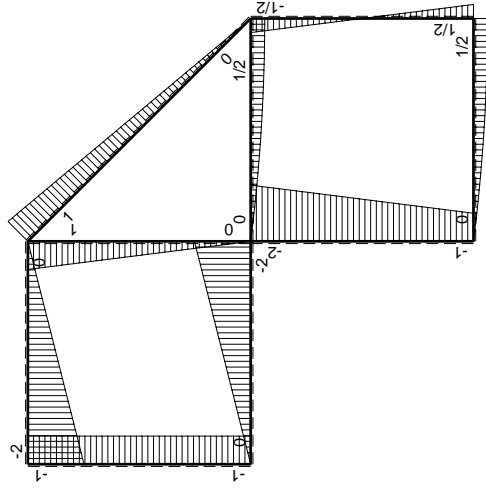
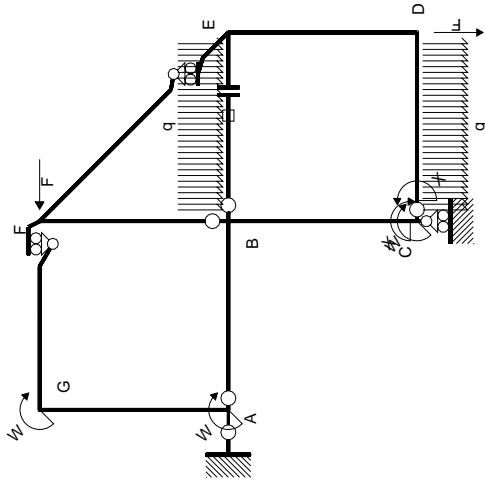
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

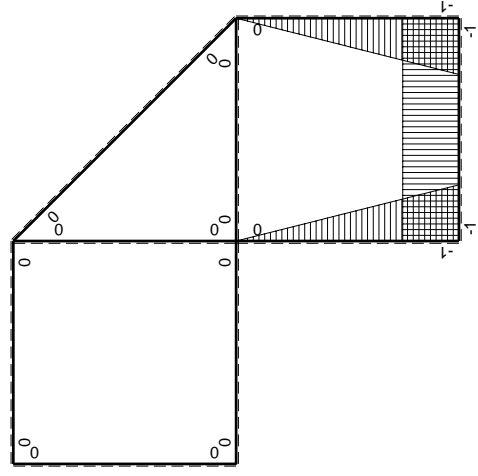
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$





(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	1/3Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/12Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	1/2Fb-Fx	-1/2Fb+3/2Fx-Fx ² /b	1-2x/b+x ² /b ²	0	0
ED b	x/b	1/2Fb-Fx	1/2Fx-Fx ² /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				5/4Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-3/4Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

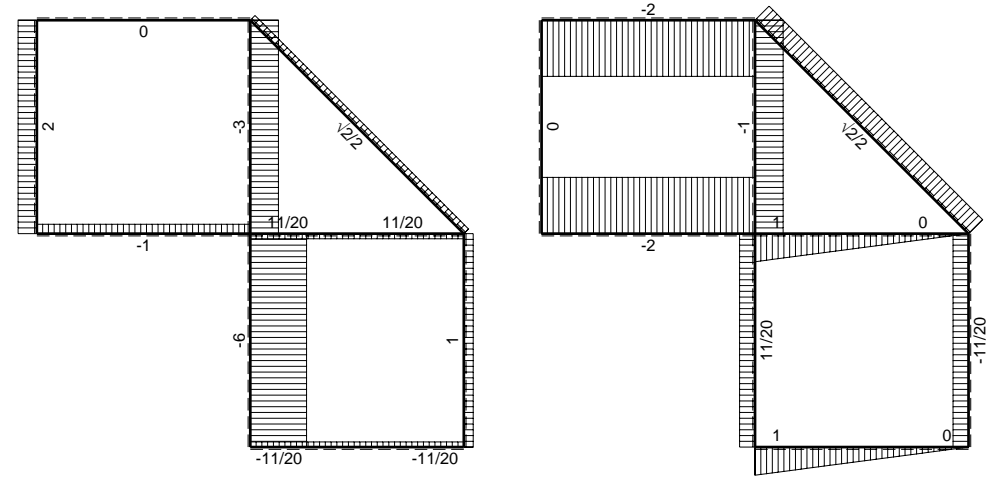
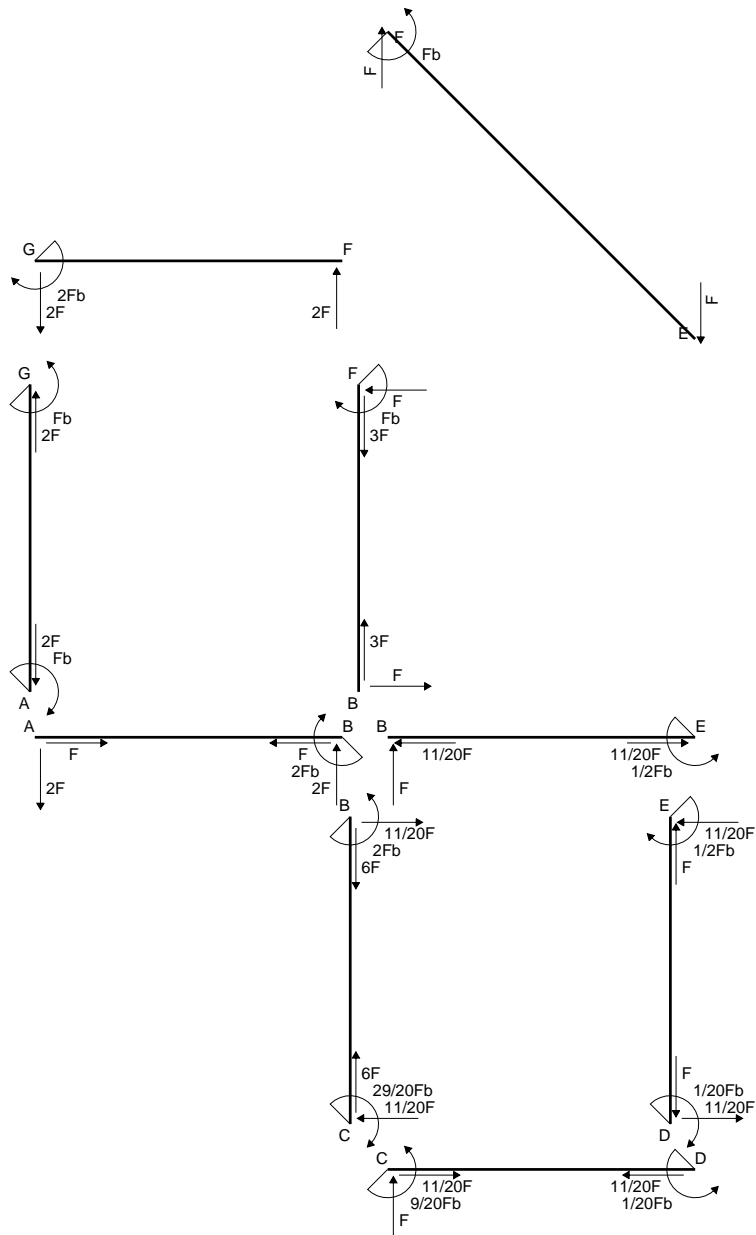
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 3/2 x/b - x^2/b^2) Fb 1/EJ dx = [-1/2 x + 3/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 3/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

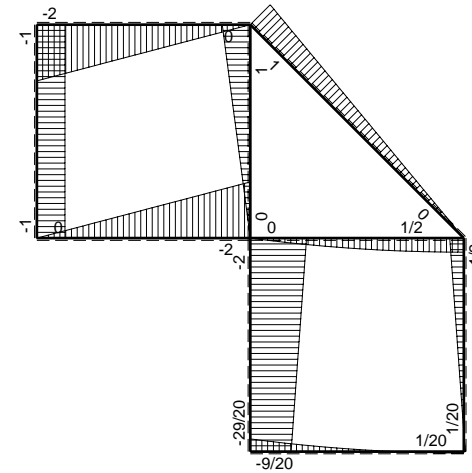
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

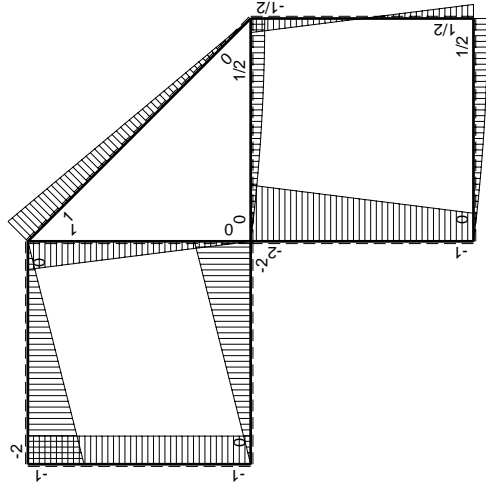
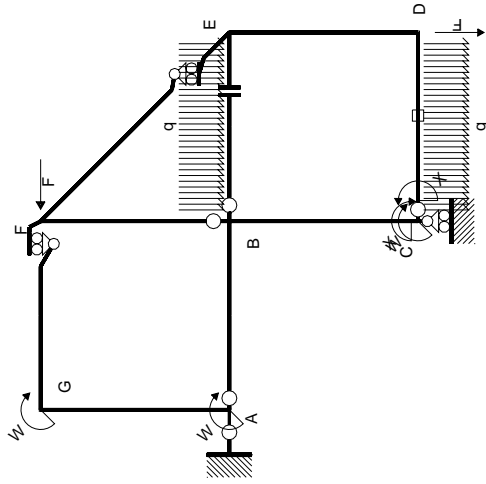


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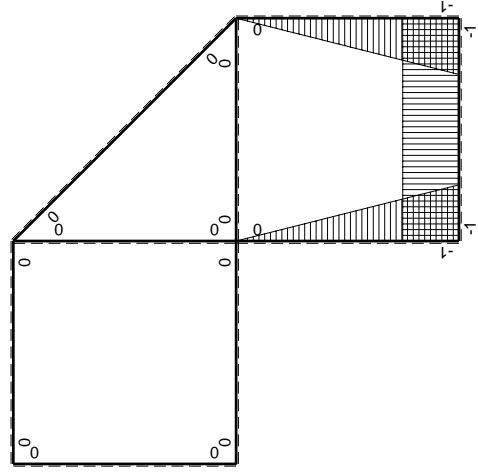
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(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	$1/3Xb/EJ$
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	$1/3Xb/EJ$
DE b	$-1+x/b$	$1/2Fb-Fx$	$-1/2Fb+3/2Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	0	0
ED b	x/b	$1/2Fb-Fx$	$1/2Fx-Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				$-Fb^2/EJ$	
	totali				$-3/4Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$9/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

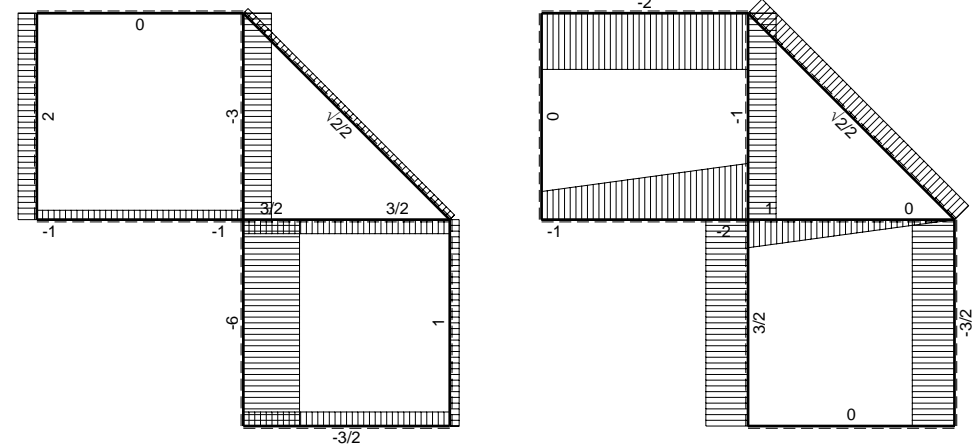
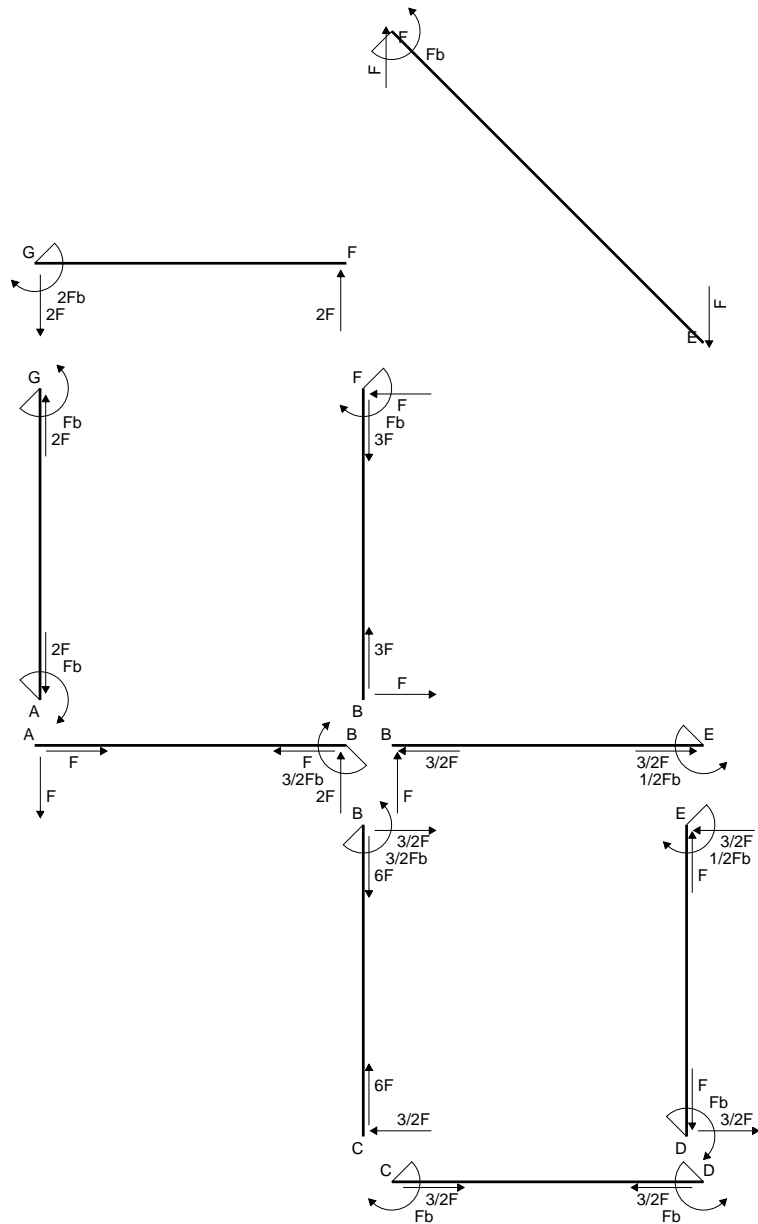
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 3/2 x/b - x^2/b^2) Fb 1/EJ dx = [-1/2 x + 3/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 3/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

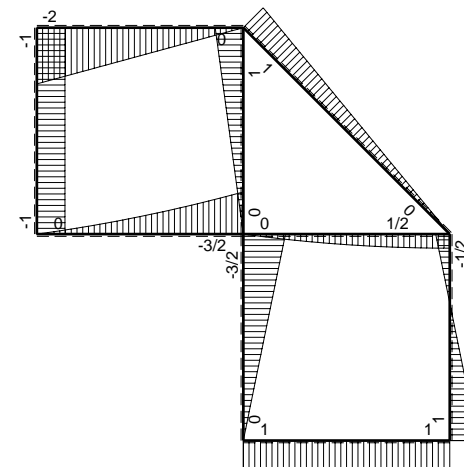
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

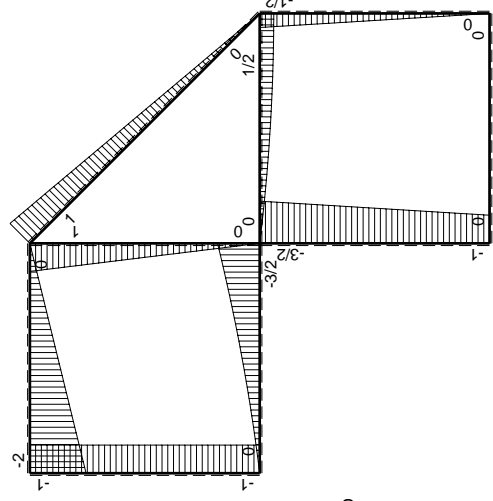
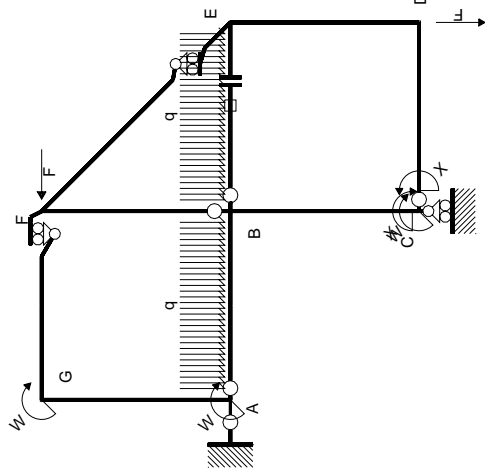


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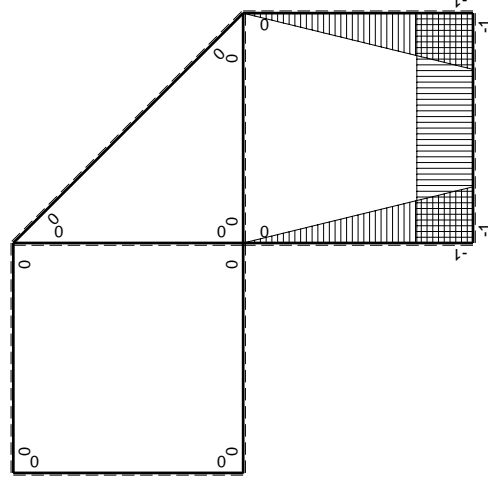


⊙ (+) ⊙ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	0
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	$Fx - 1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb + 1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^{L-BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

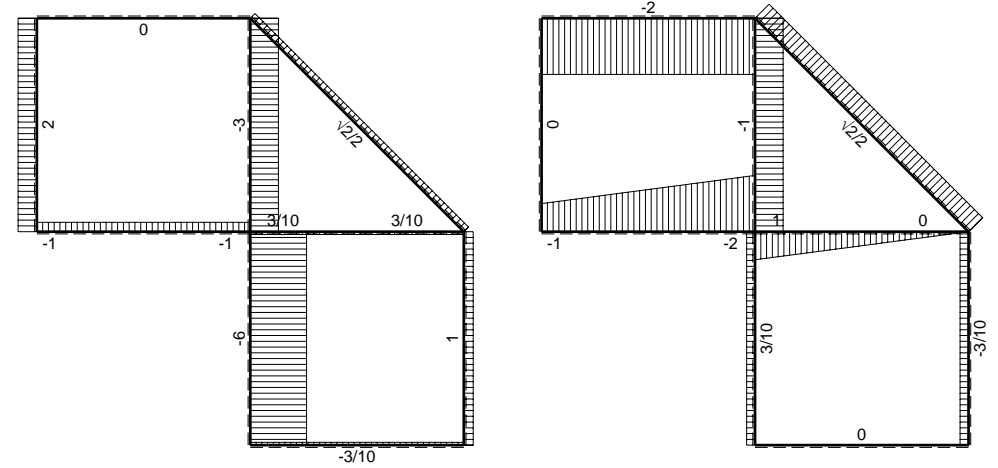
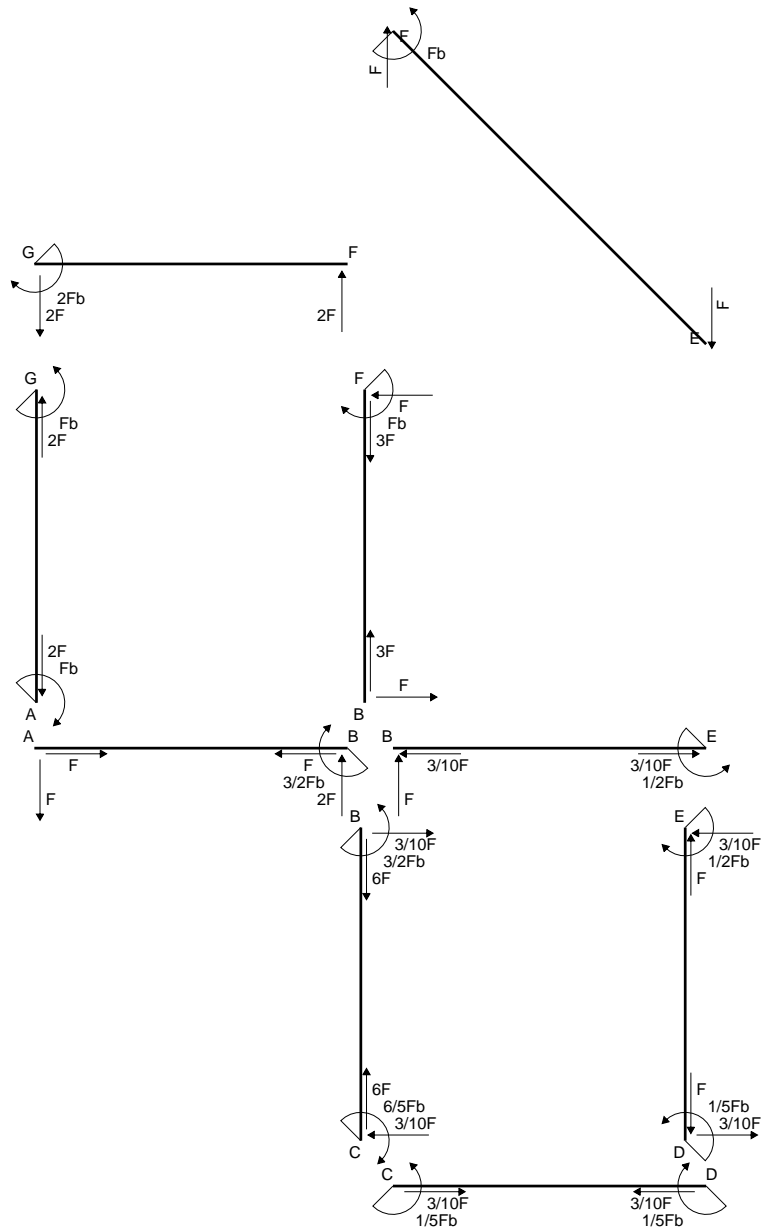
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

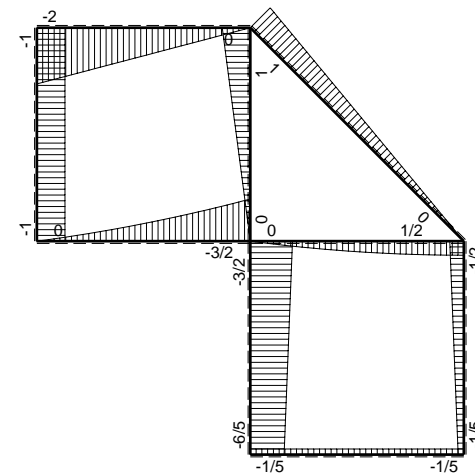
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

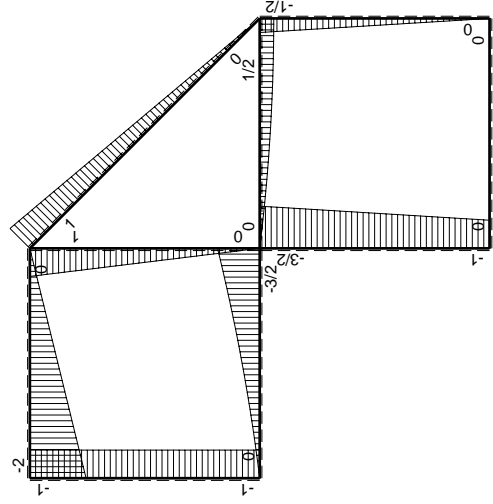
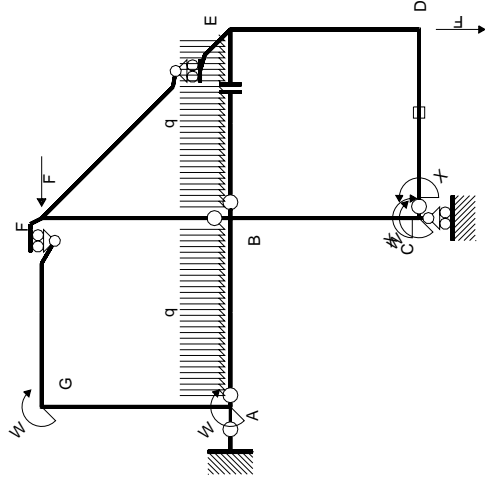


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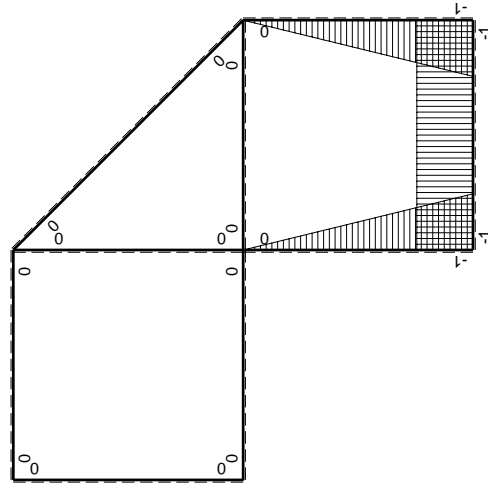


⊙ (+) ⊙ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	0
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	0	0
EF √2b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	$Fx - 1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb + 1/2qx^2$	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/3Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$1/5Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

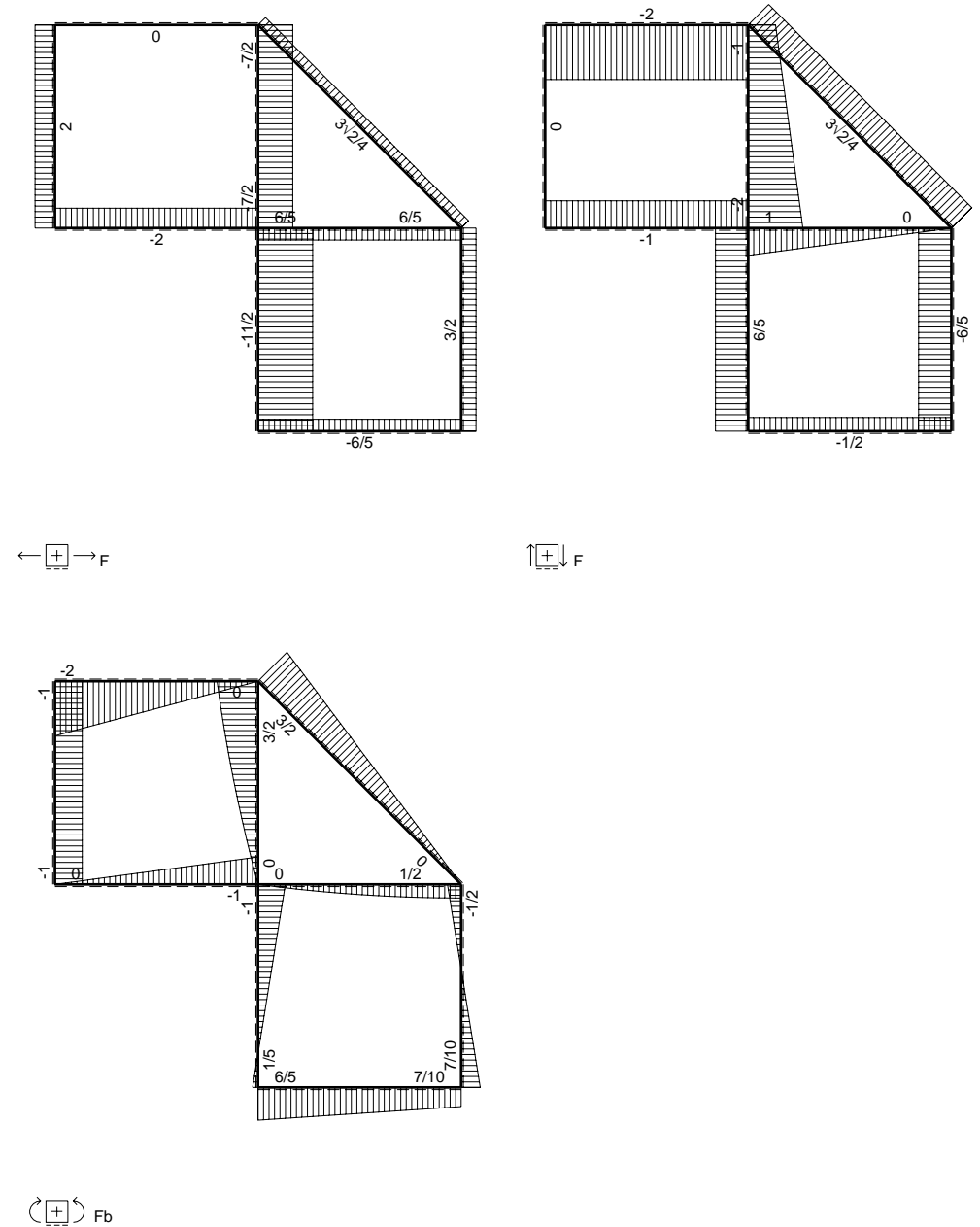
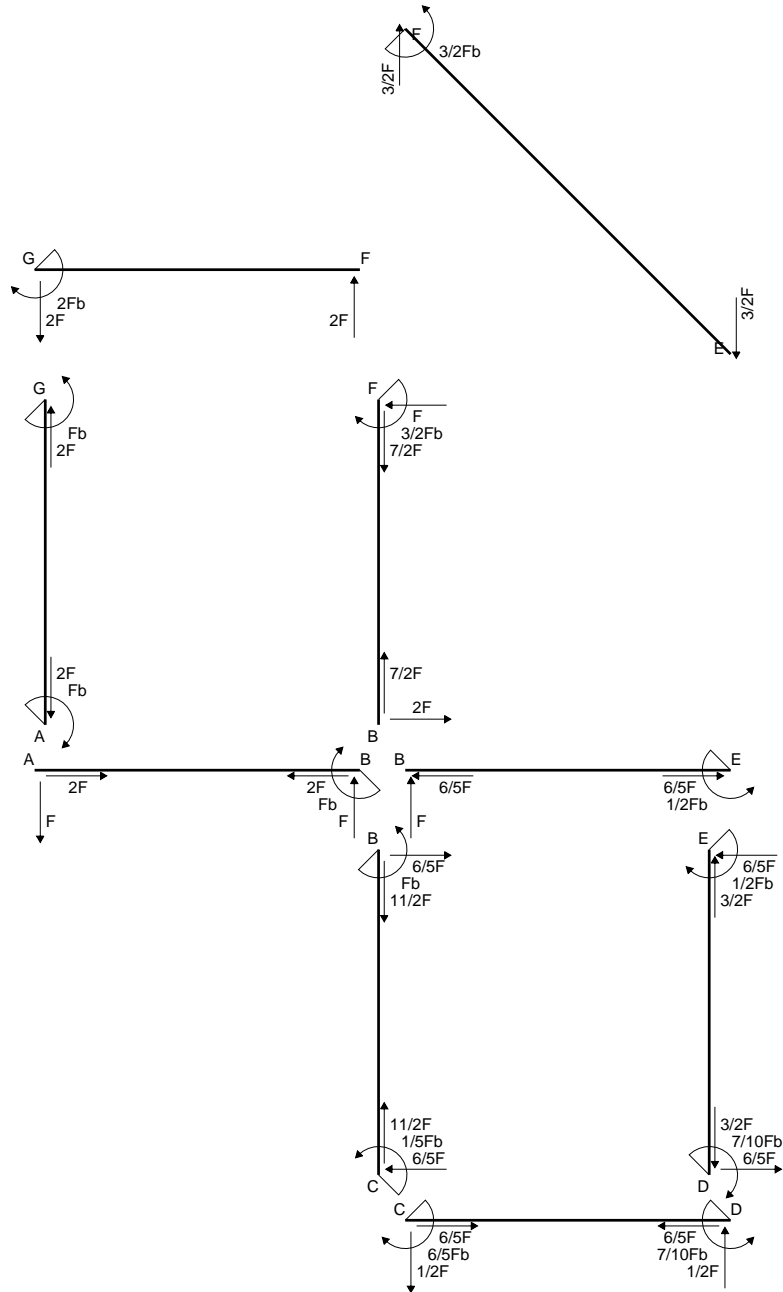
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

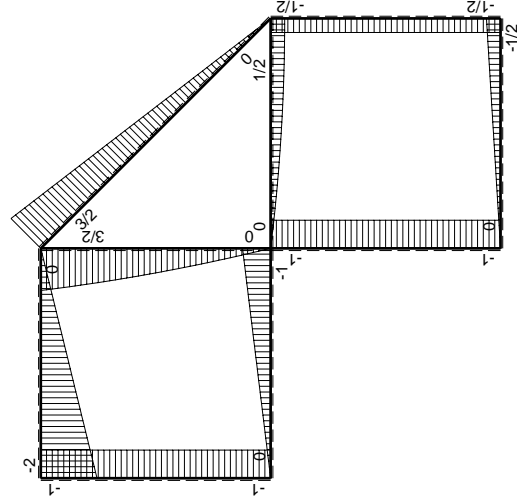
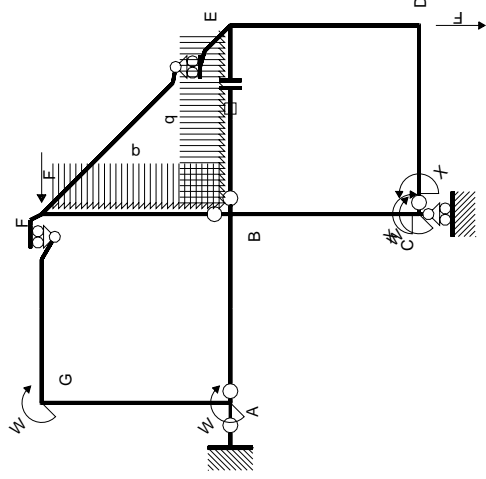
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

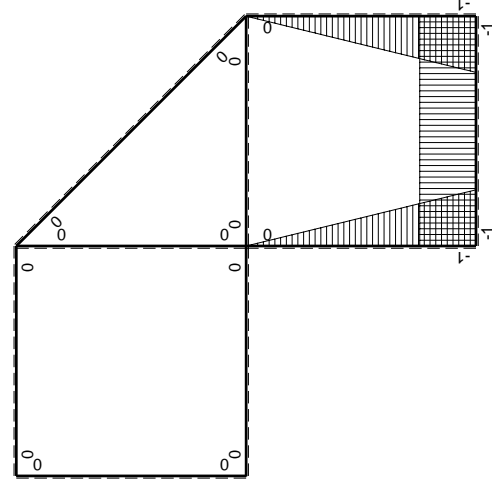
$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CD b	-1	-1/2Fx	1/2Fx	1	$1/4 Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	$1/4 Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	-1/2Fb	1/2Fb-1/2Fx	$1-2x/b+x^2/b^2$	$1/4 Fb^2/EJ$	$1/3 Xb/EJ$
ED b	x/b	1/2Fb	1/2Fx	x^2/b^2	$1/4 Fb^2/EJ$	$1/3 Xb/EJ$
EF √2b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE}} L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica X=W _{CD}				$-6/5 Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b) \cdot Fb \cdot 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) \cdot Fb \cdot 1/EJ \, dx = [x - 1/2 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

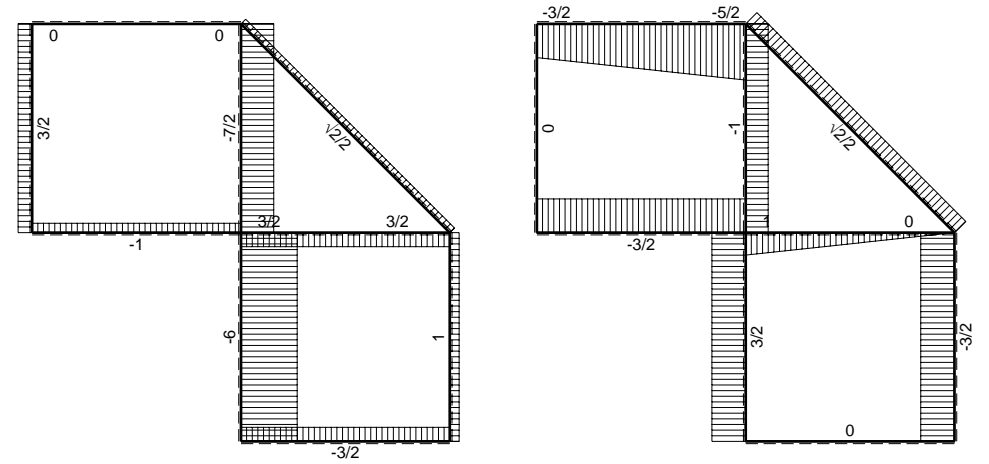
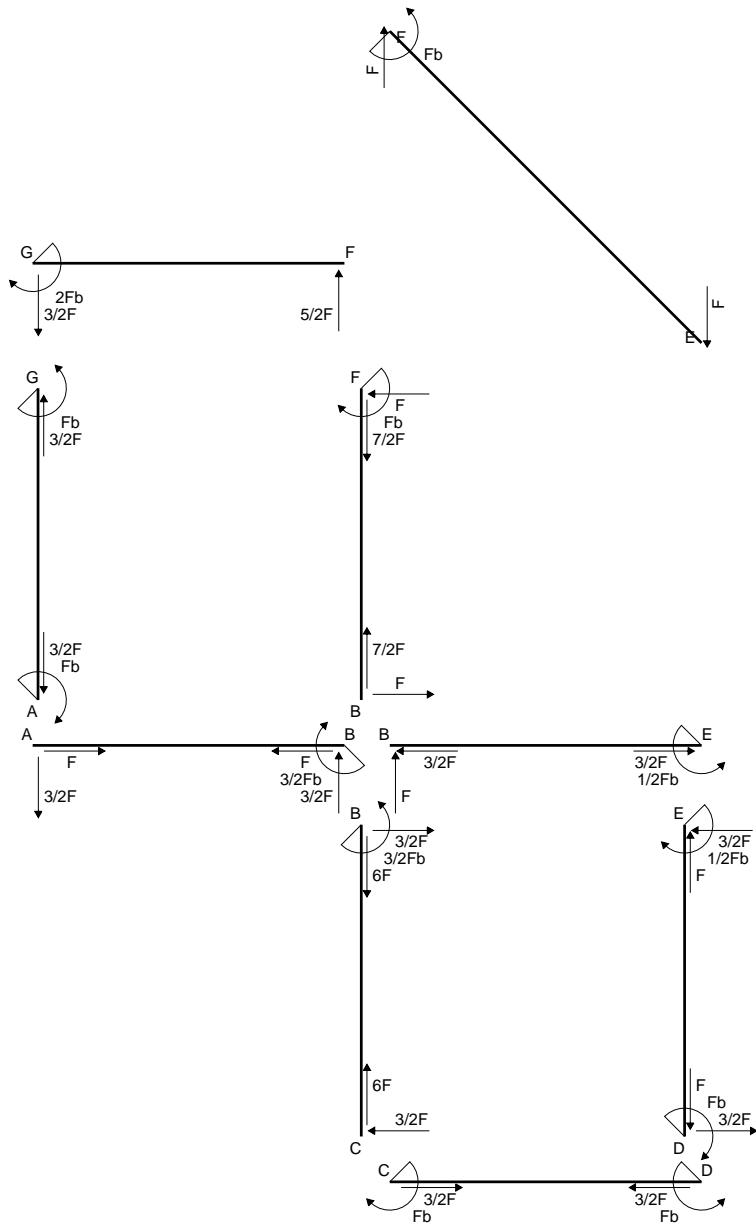
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

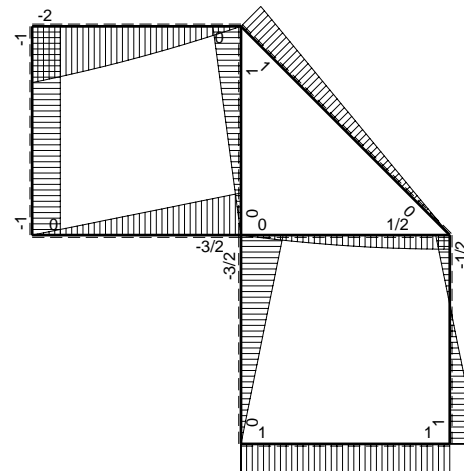
$$L_{ED}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

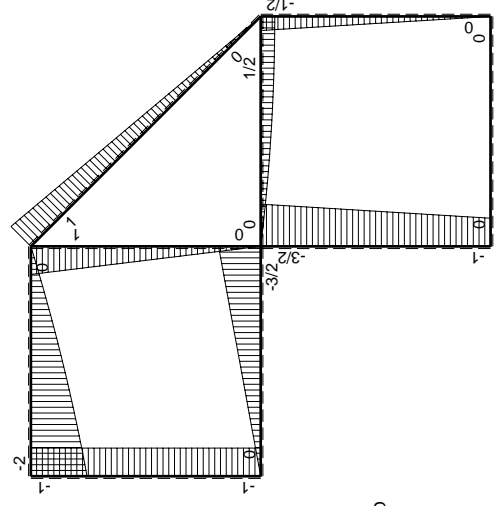
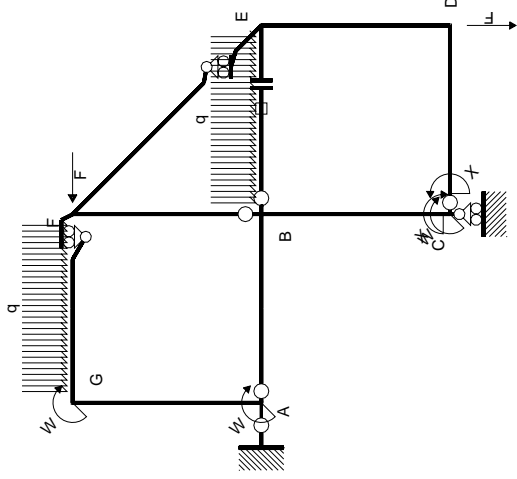


← (+) → F

↑ (+) ↓ F_b

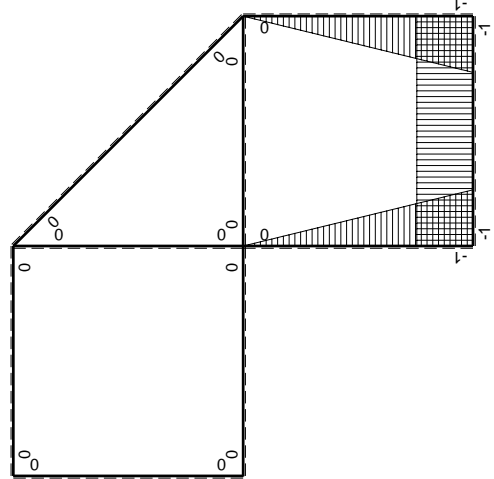


← (+) → F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1BE}^E - N_{BE}^E - N_{BE}^E$				Fb ² /EJ	
	totali				5/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

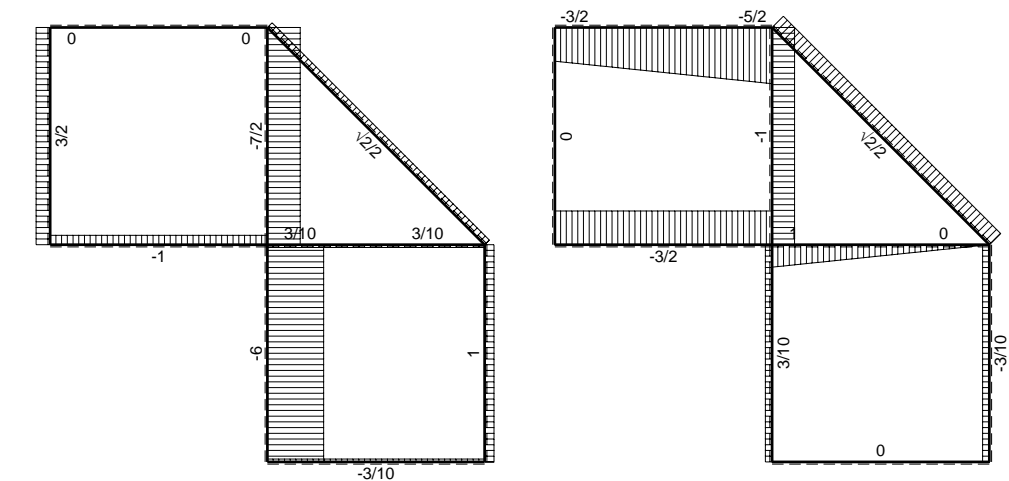
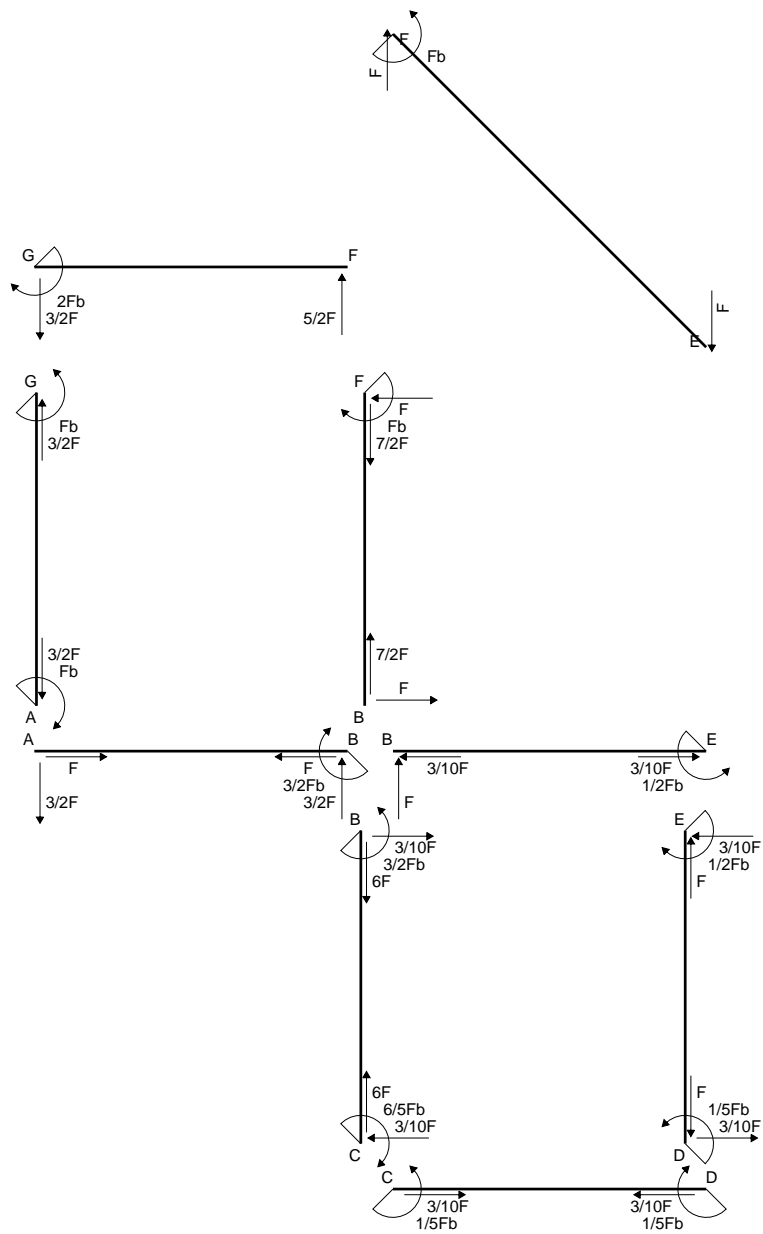
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

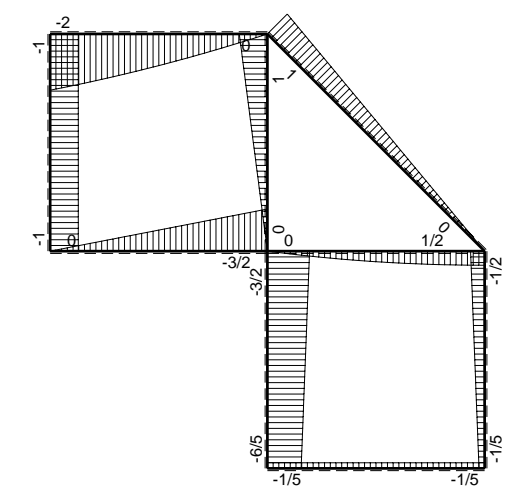
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

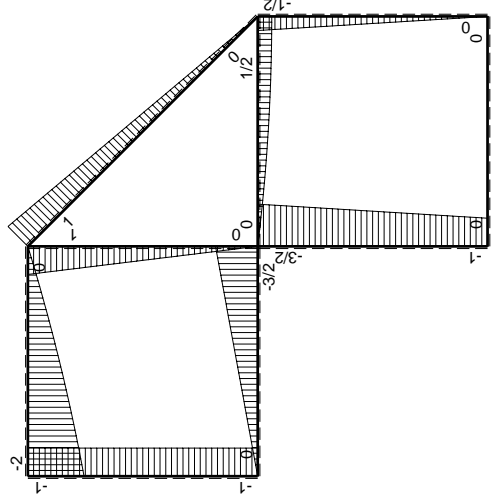
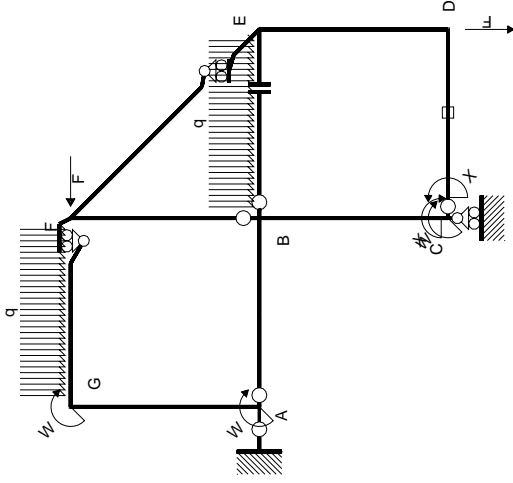


← (+) → F

↑ (+) ↓ F

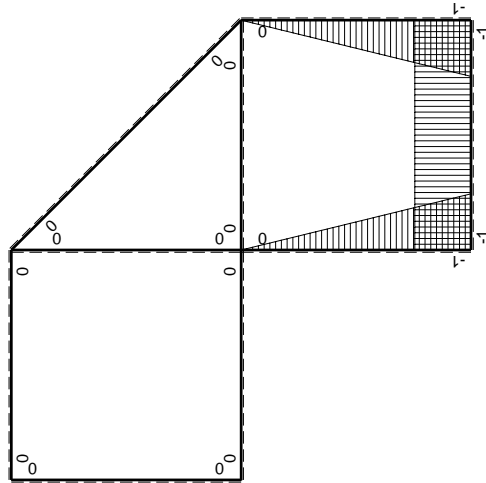


⊕ (+) ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$			0	-Fb ² /EJ	5/3Xb/EJ
	totali				-1/3Fb ² /EJ	1/5Fb
	iperstatica X=W _{CD}					

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 7/12 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 \, x^2/b - 1/6 \, x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

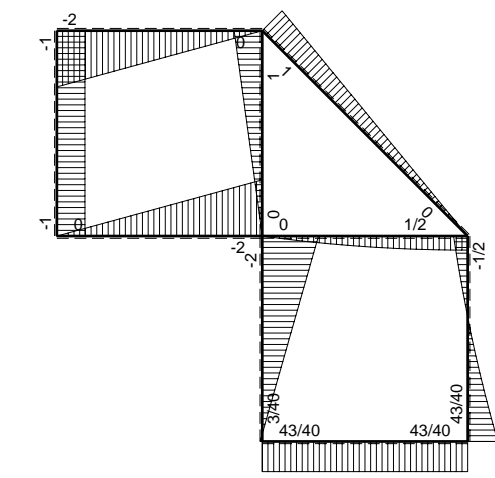
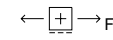
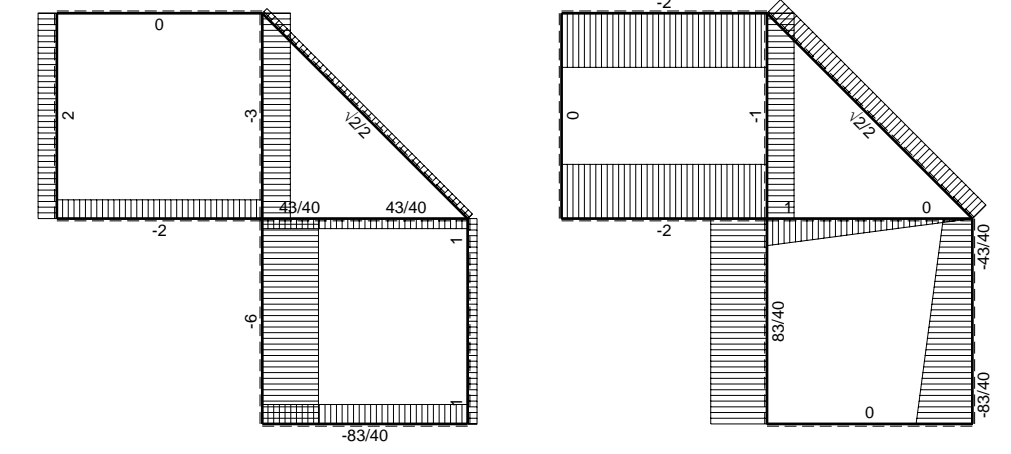
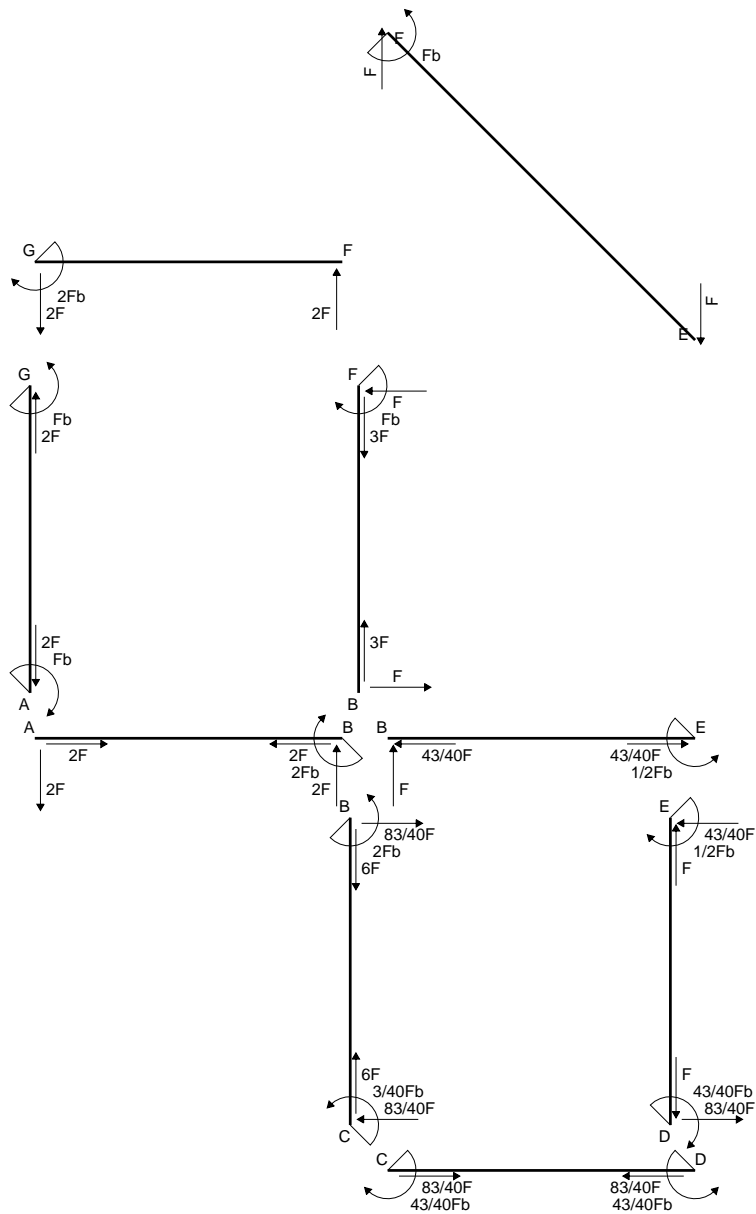
$$= (b - 1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 7/12 \, Fb^2/EJ$$

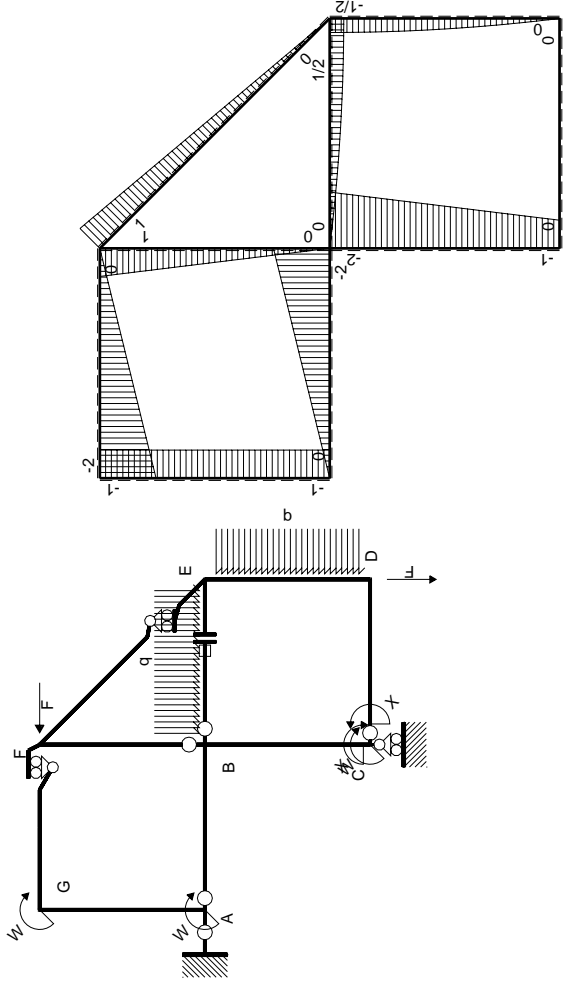
$$L_{DE}^{xo} = \int_0^b (1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 1/12 \, Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

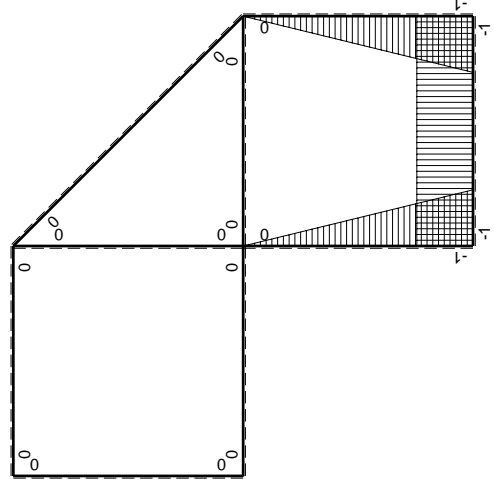
$$= (1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 1/12 \, Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-Fx+1/2qx ²	Fx-3/2Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2qx ²	1/2Fx-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta N _{1, BE} ε _{BE} L _{BE}				Fb ² /EJ	
	totali				43/24Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-43/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 2/3 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

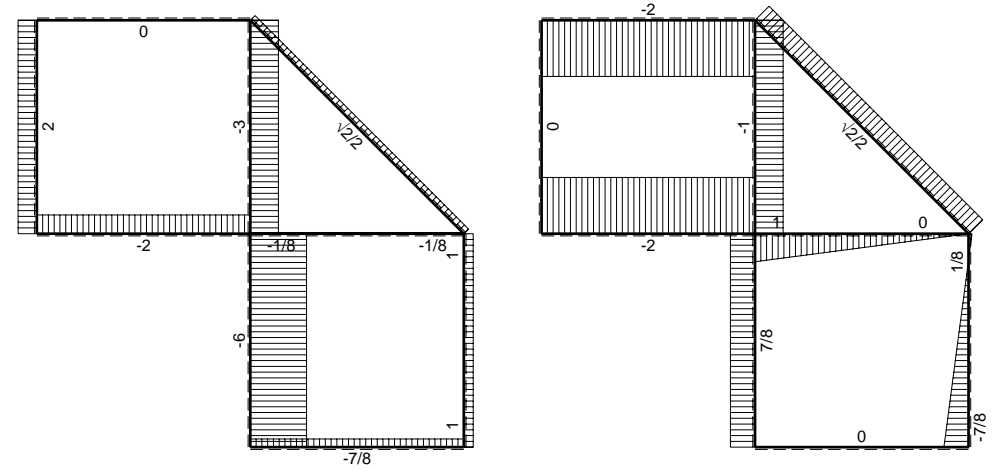
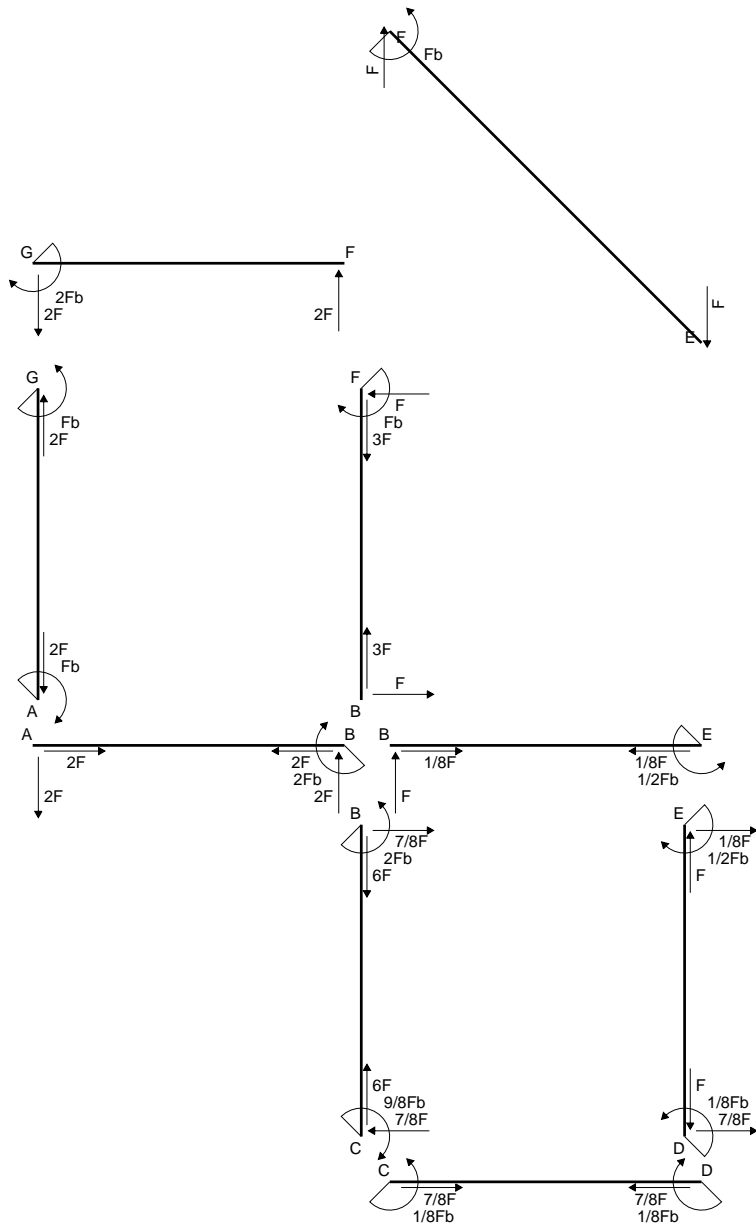
$$= (b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 2/3 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{2} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 \, b - 1/2 \, b + 1/8 \, b) \cdot Fb \cdot 1/EJ = 1/8 \, Fb^2/EJ$$

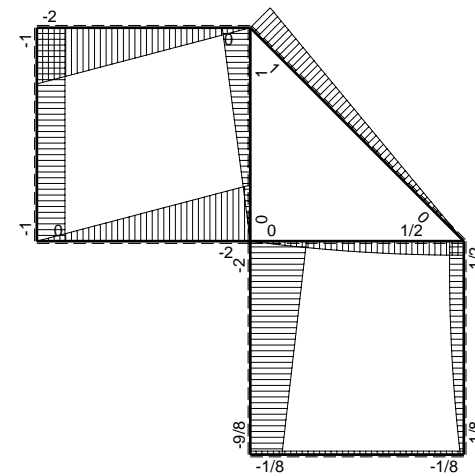
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \, b - 1/8 \, b) \cdot Fb \cdot 1/EJ = 1/8 \, Fb^2/EJ$$

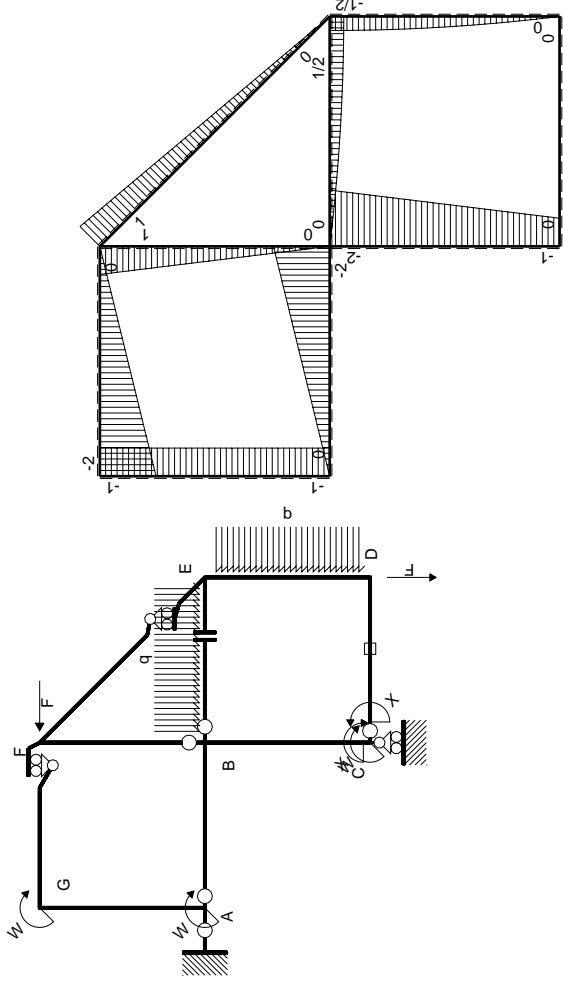


← (+) → F

↑ (+) ↓ F

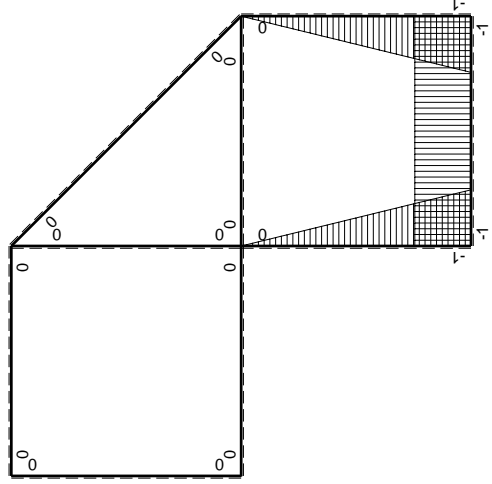


⊕ (+) ⊖ (-) Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	$-Fx+1/2qx^2$	$Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fb-1/2qx^2$	$1/2Fx-1/2qx^3/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-5/24Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/8Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x^2/b - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 2/3 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{3} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

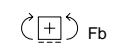
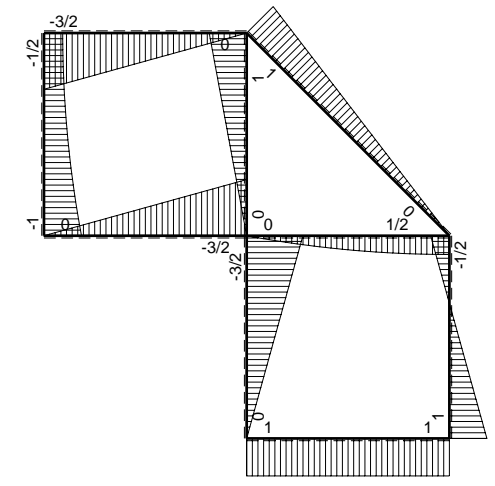
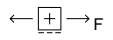
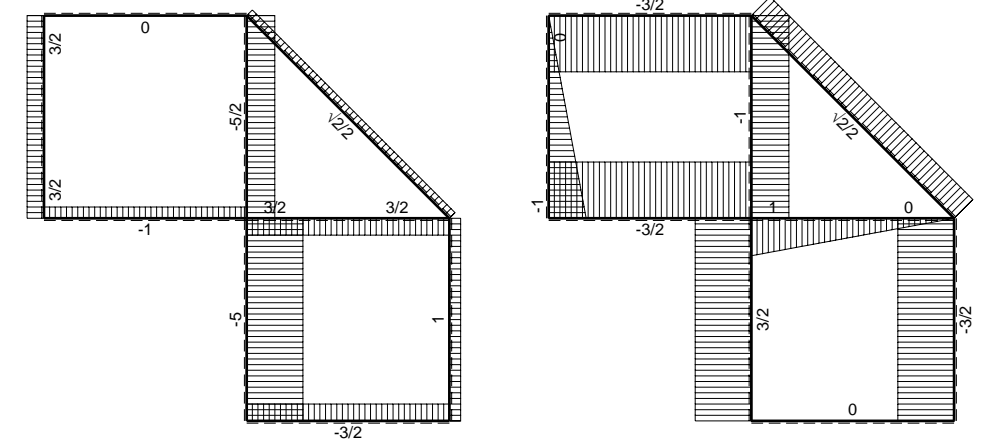
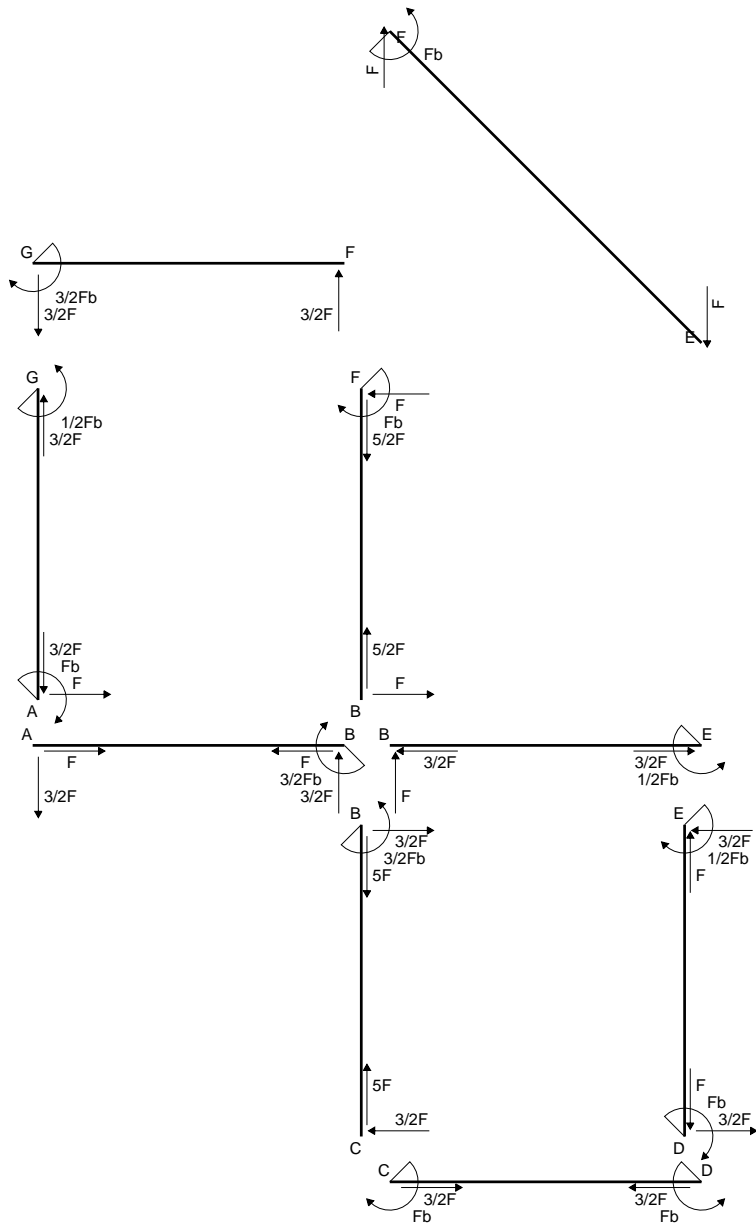
$$= (b - 1/3 \, b) \cdot Fb \cdot 1/EJ = 2/3 \, Fb^2/EJ$$

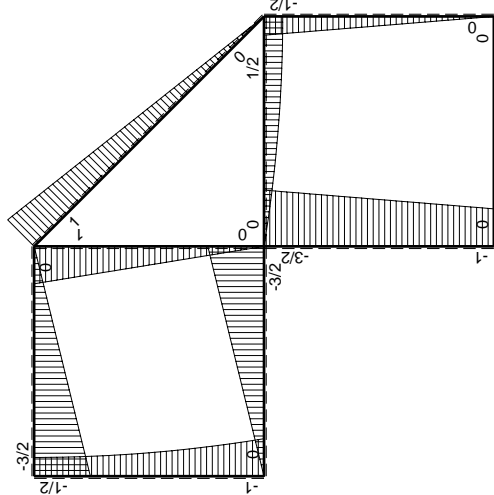
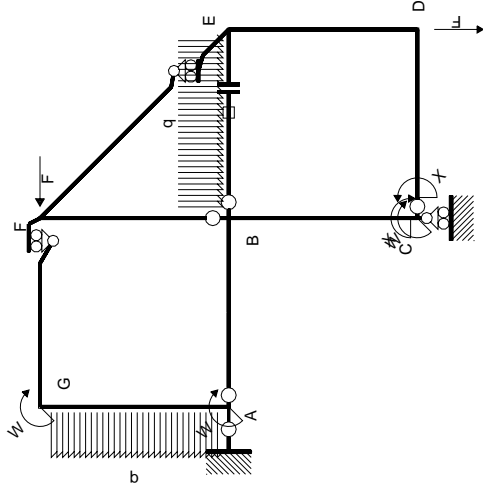
$$L_{DE}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b - \frac{1}{2} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 \, b - 1/2 \, b + 1/8 \, b) \cdot Fb \cdot 1/EJ = 1/8 \, Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

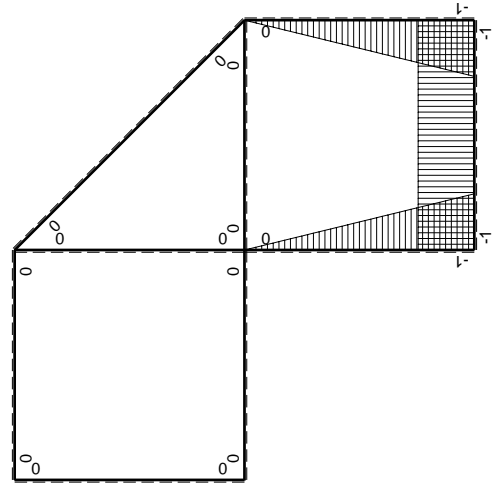
$$= (1/4 \, b - 1/8 \, b) \cdot Fb \cdot 1/EJ = 1/8 \, Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				5/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

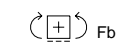
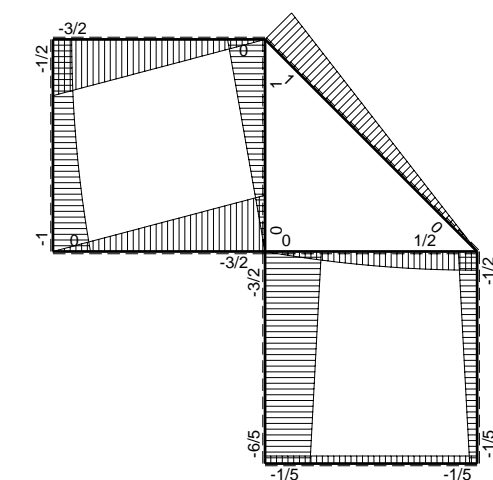
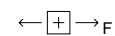
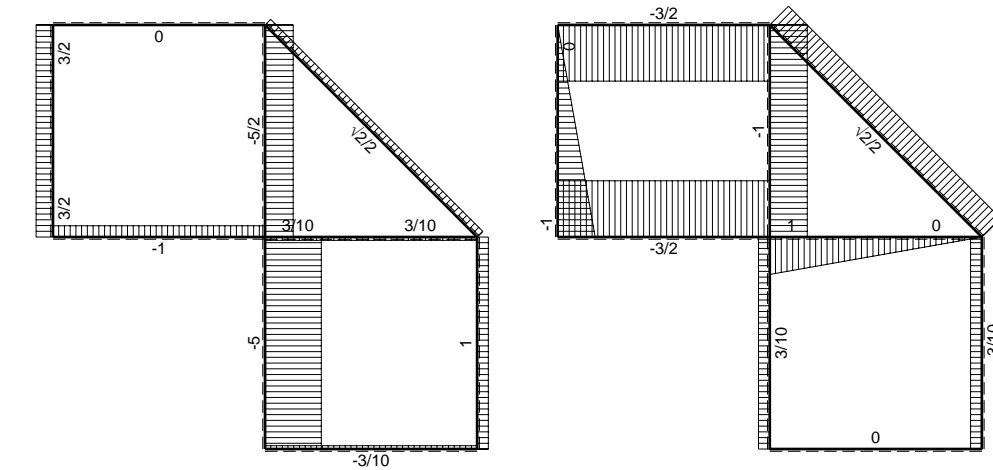
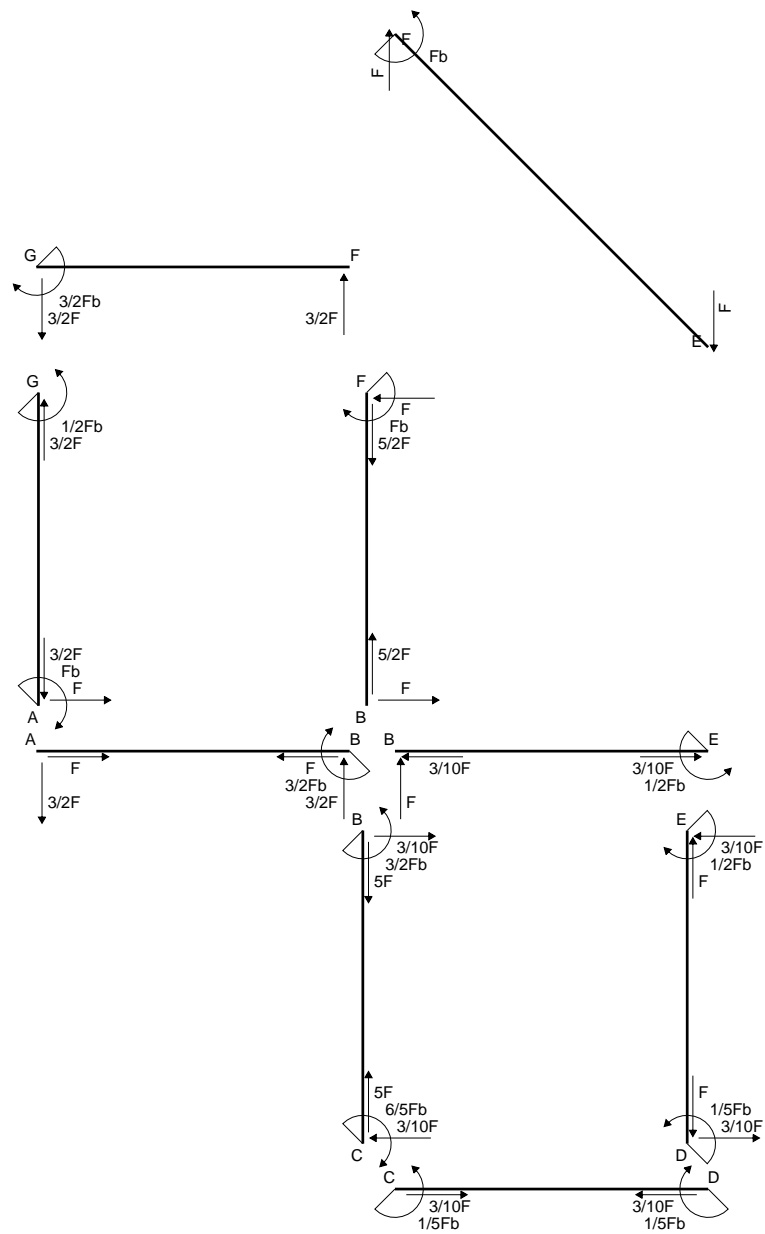
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

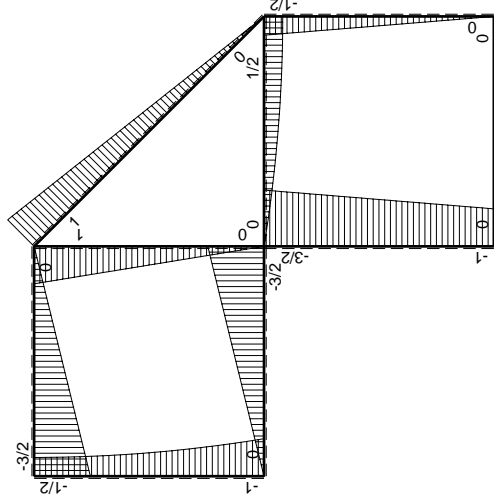
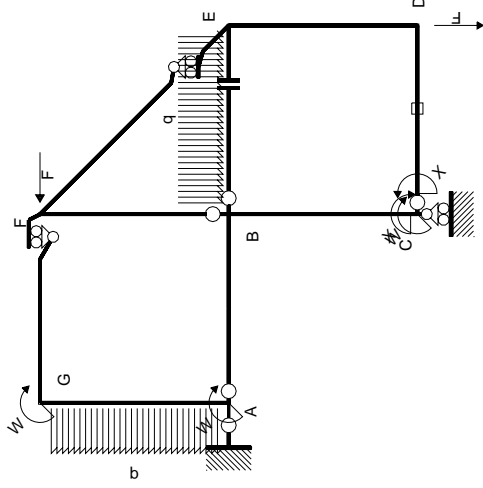
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

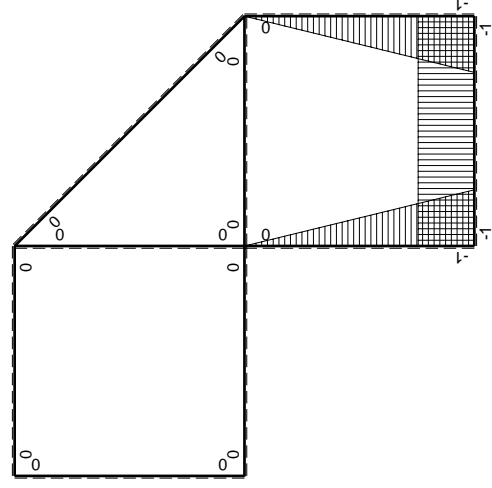
$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				-Fb ² /EJ	
	totali				-1/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

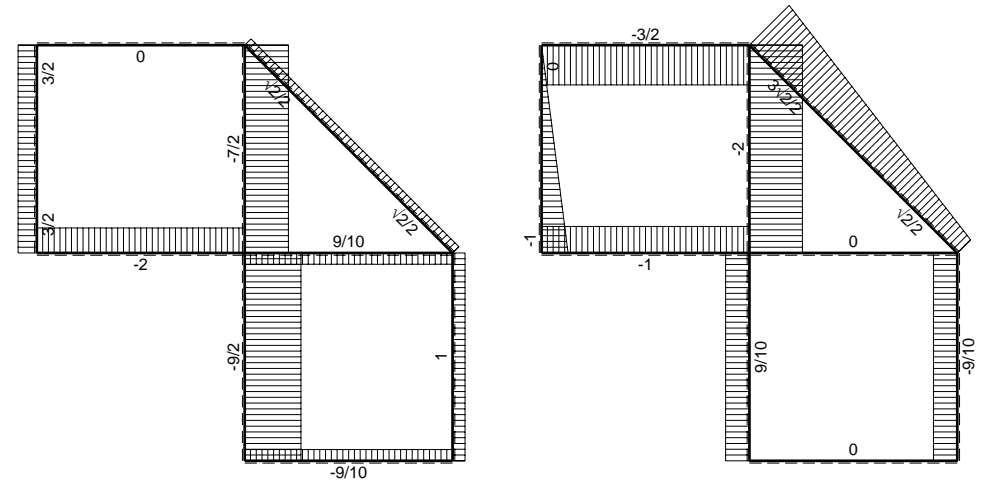
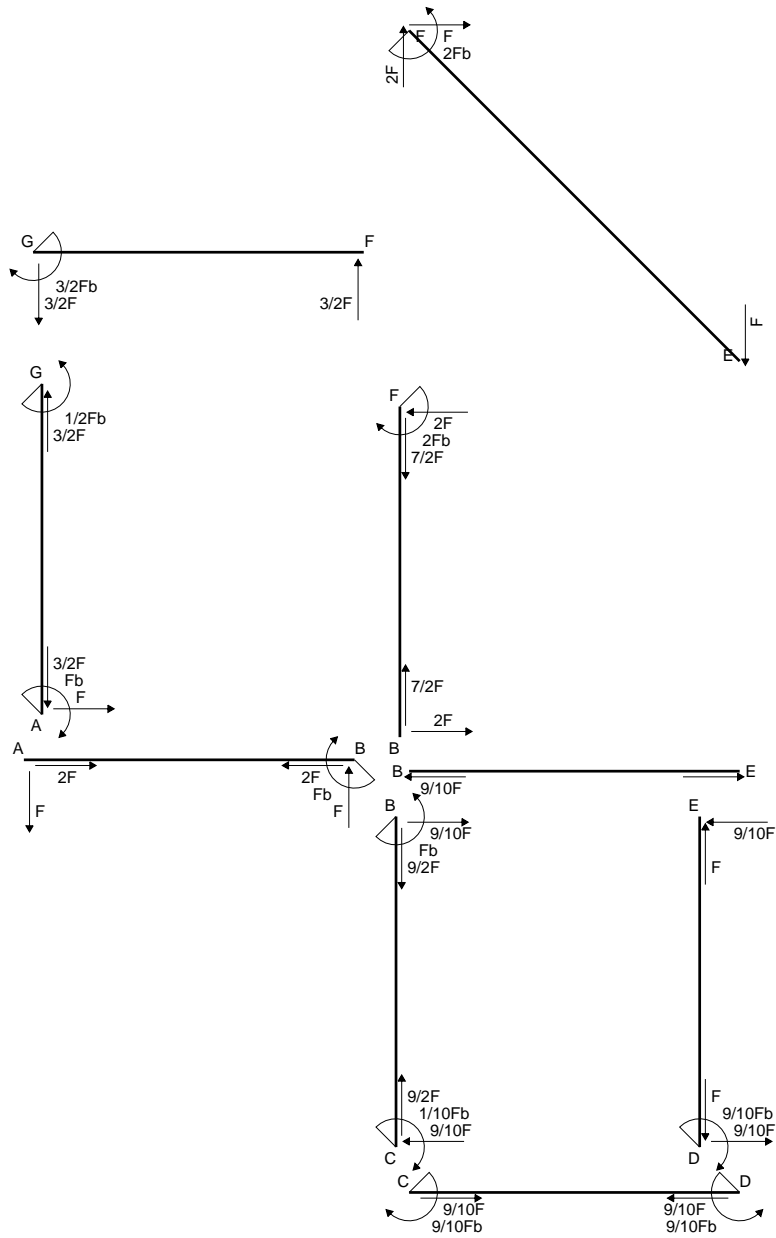
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

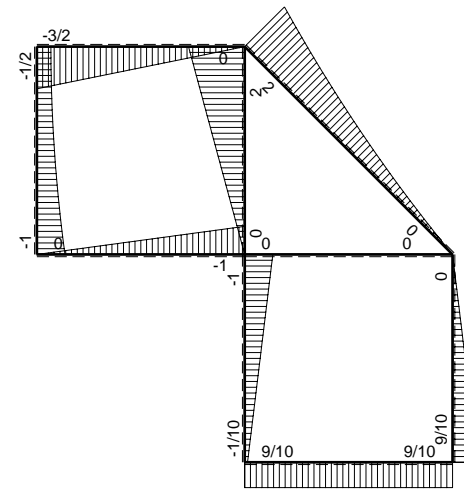
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

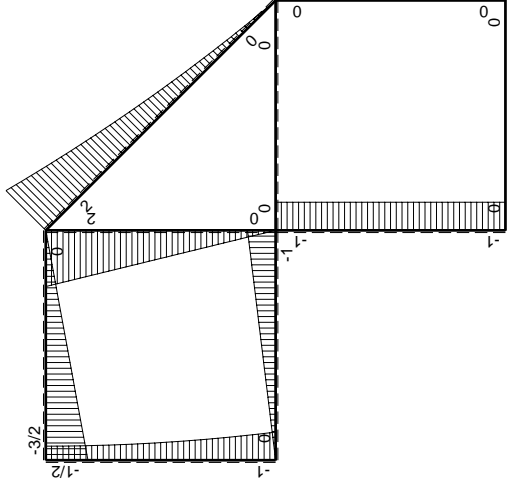
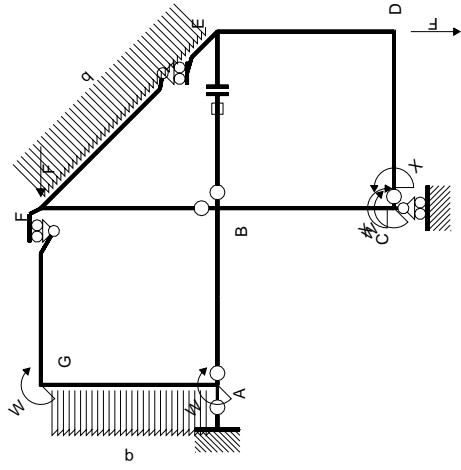


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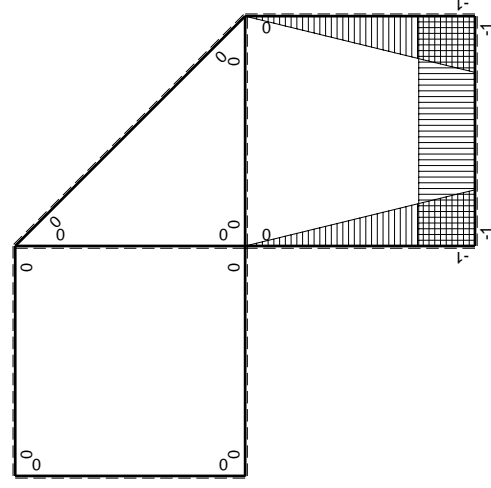


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb^2/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$	$1/2 Fb^2/EJ$	$1/3 Xb^2/EJ$
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	$1/3 Xb^2/EJ$
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb^2/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	-3/2 Fx	0	0	0	0
GF b	0	3/2 Fb - 3/2 Fx	0	0	0	0
GA b	0	$-1/2 Fb - 1/2 qx^2$	0	0	0	0
AG b	0	$Fb-Fx + 1/2 qx^2$	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2 Fb^2/EJ$	$5/3 Xb^2/EJ$
	iperstatica $X=W_{cd}$					$-9/10 Fb$

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

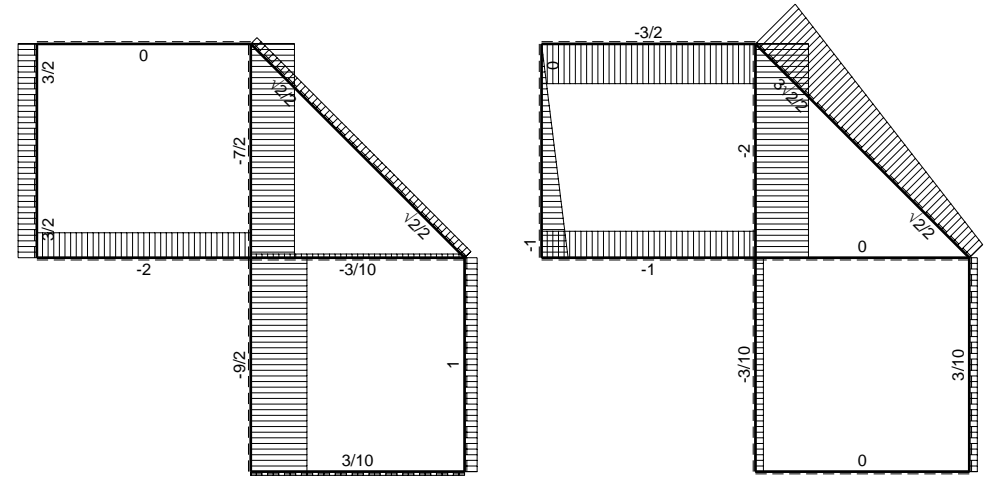
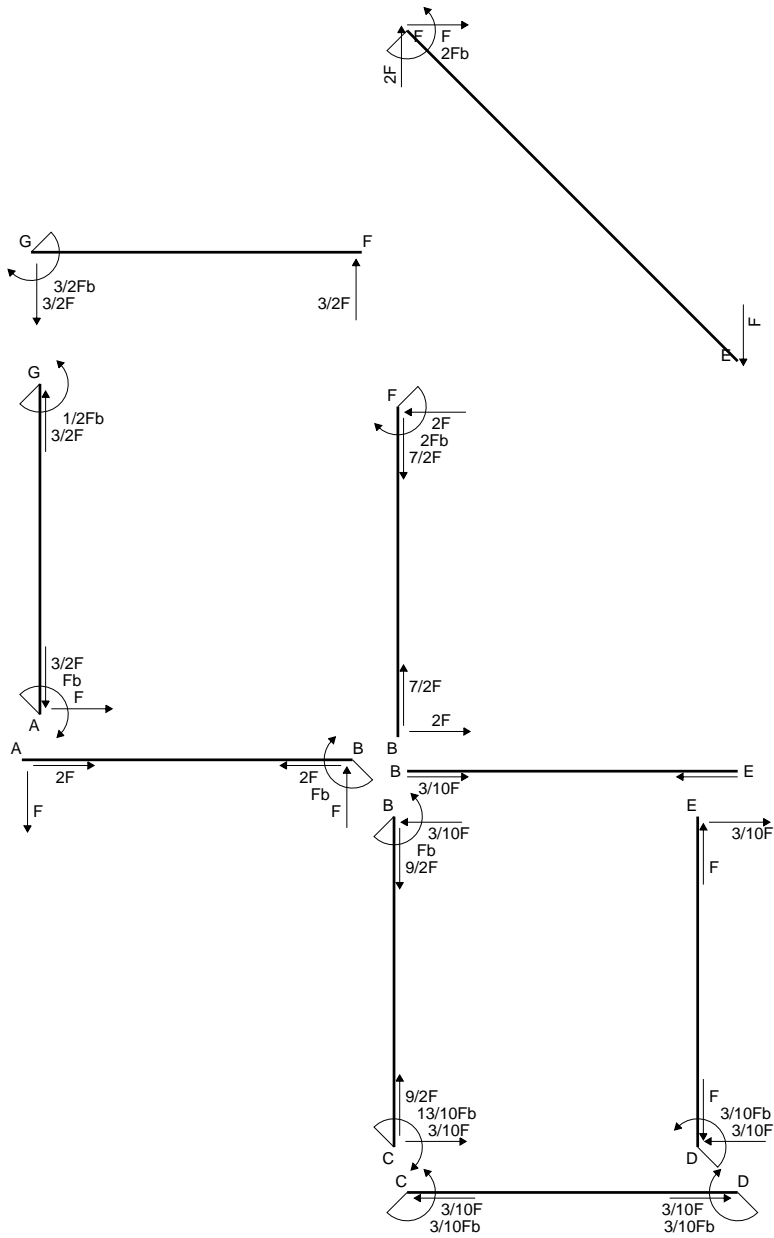
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

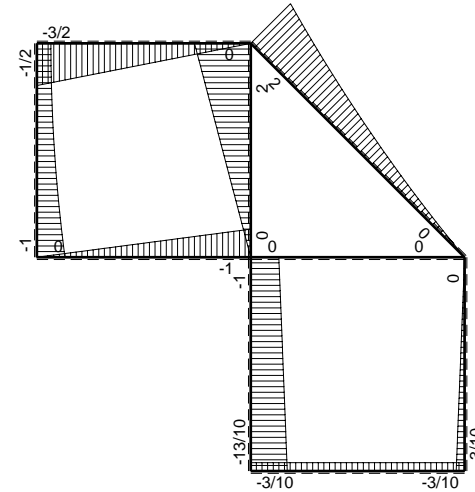
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

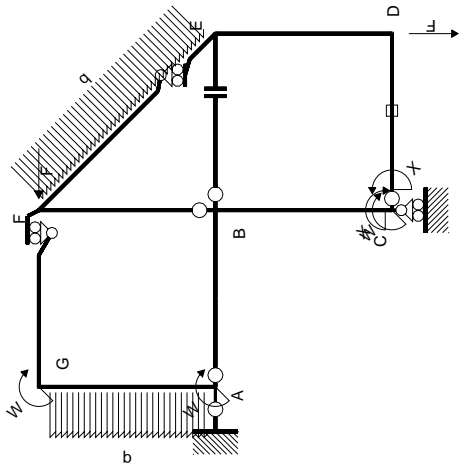


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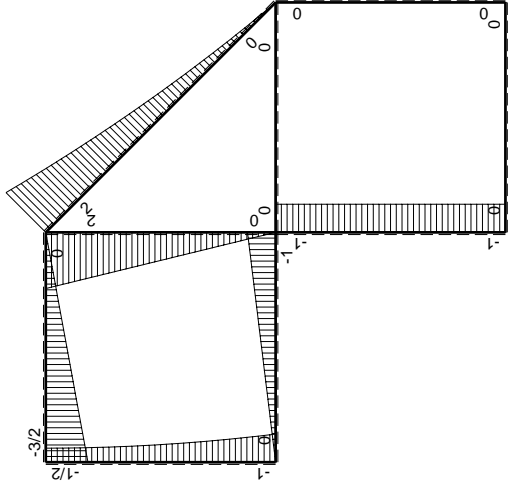
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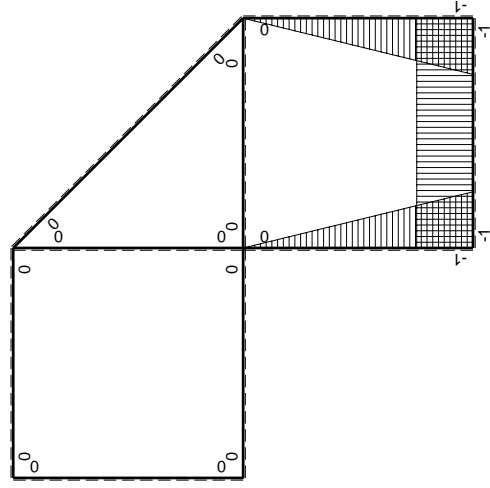
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{CD}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	$1/3 Xb/EJ$
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	-3/2 Fx	0	0	0	0
GF b	0	3/2 Fb - 3/2 Fx	0	0	0	0
GA b	0	$-1/2 Fb - 1/2 qx^2$	0	0	0	0
AG b	0	Fb-Fx + 1/2 qx^2	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2 Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica $X=W_{CD}$				$3/10 Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

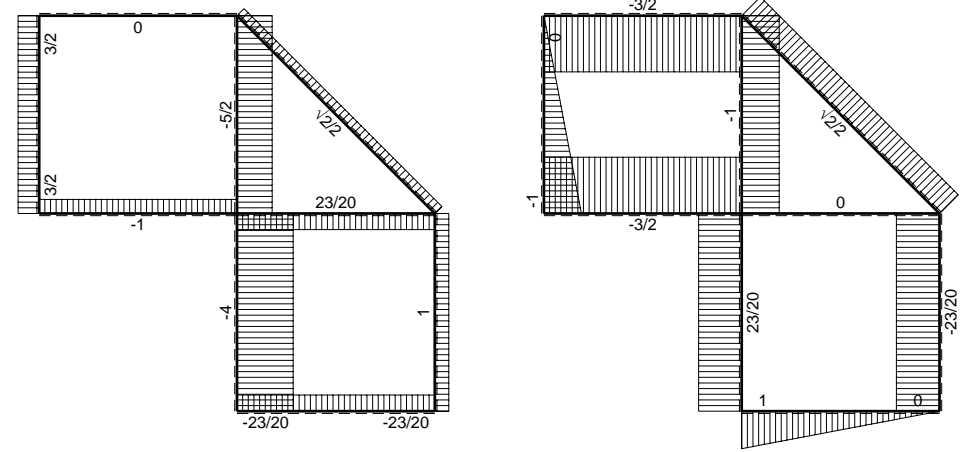
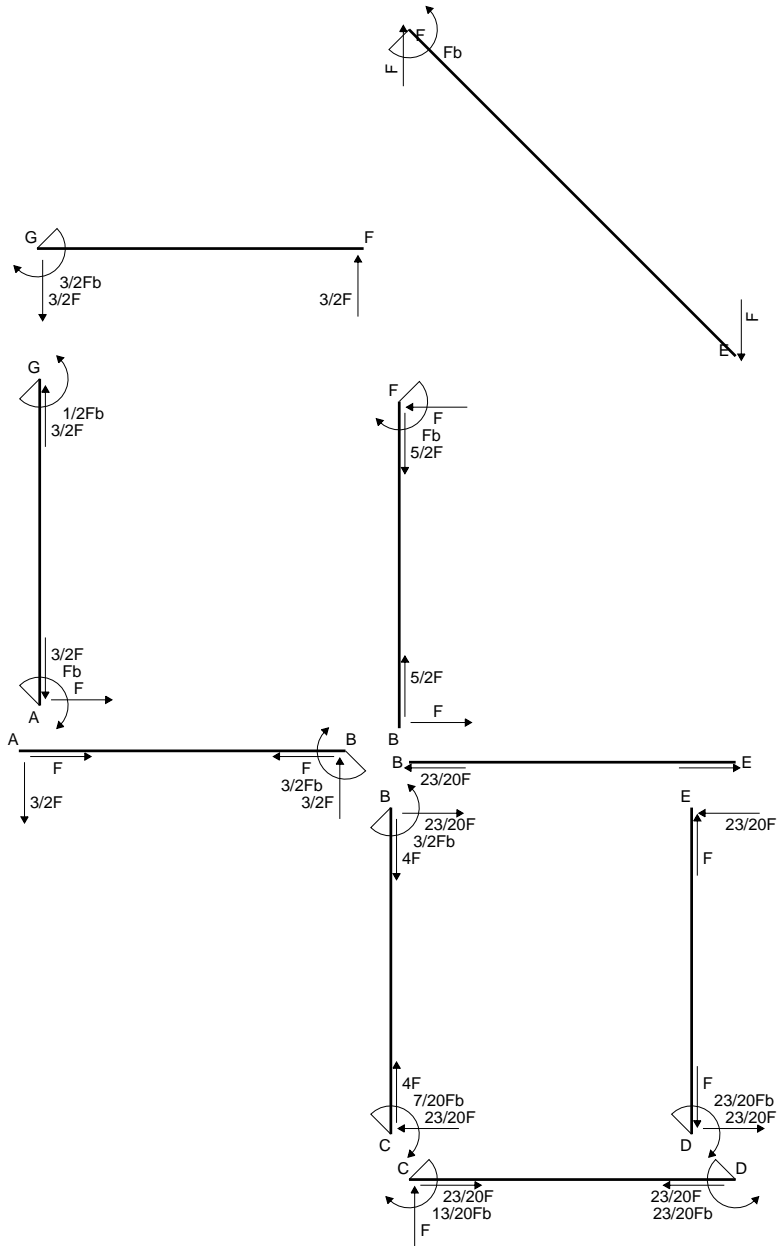
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

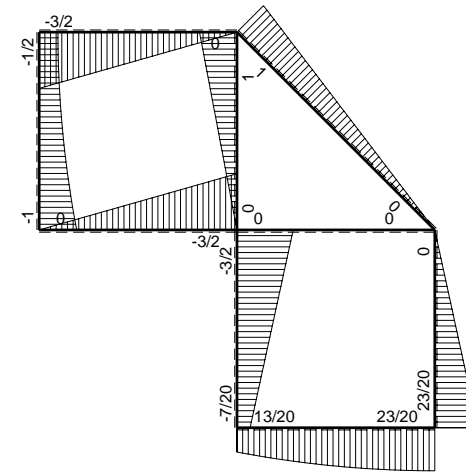
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

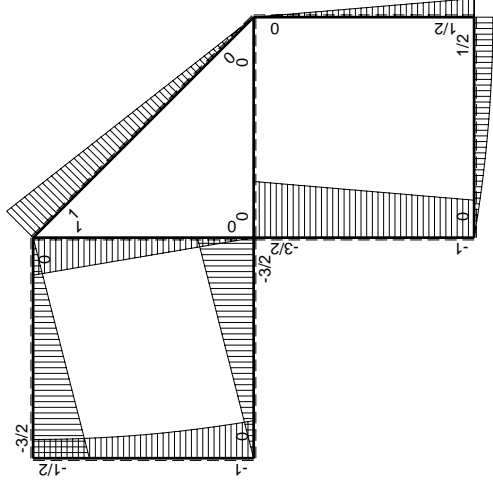
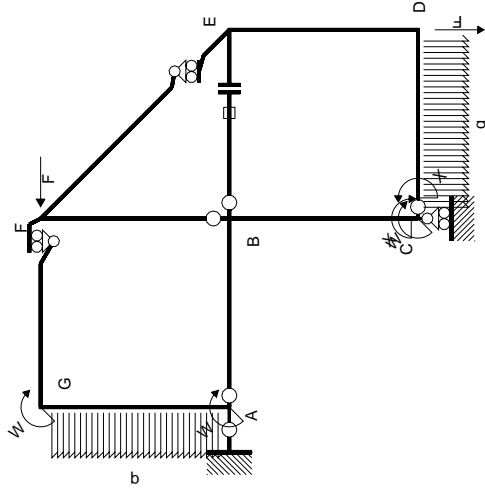


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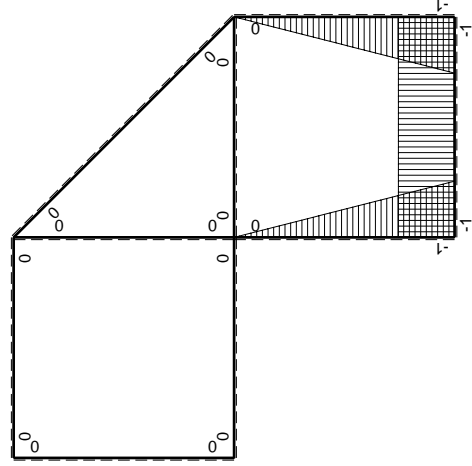
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⊕ ⊖ F_b



(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE-BE}}$				Fb ² /EJ	
	totali				13/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-13/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

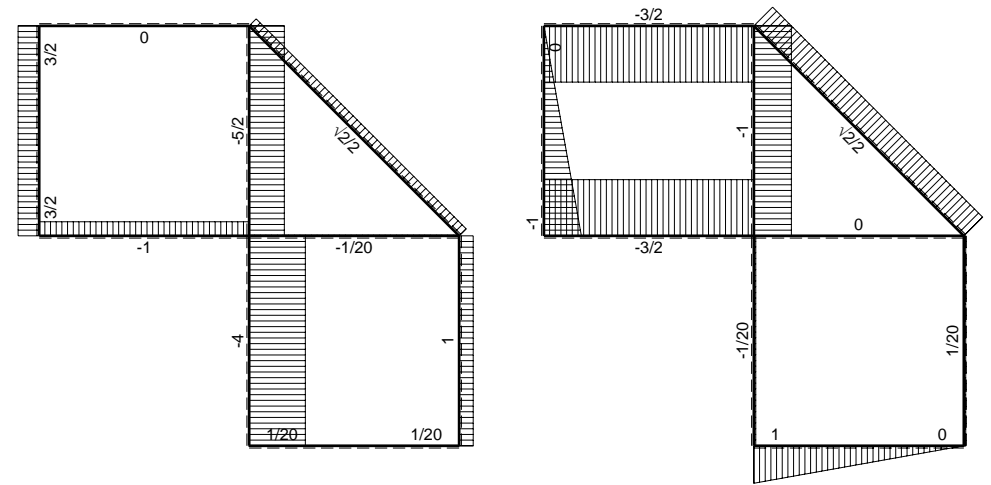
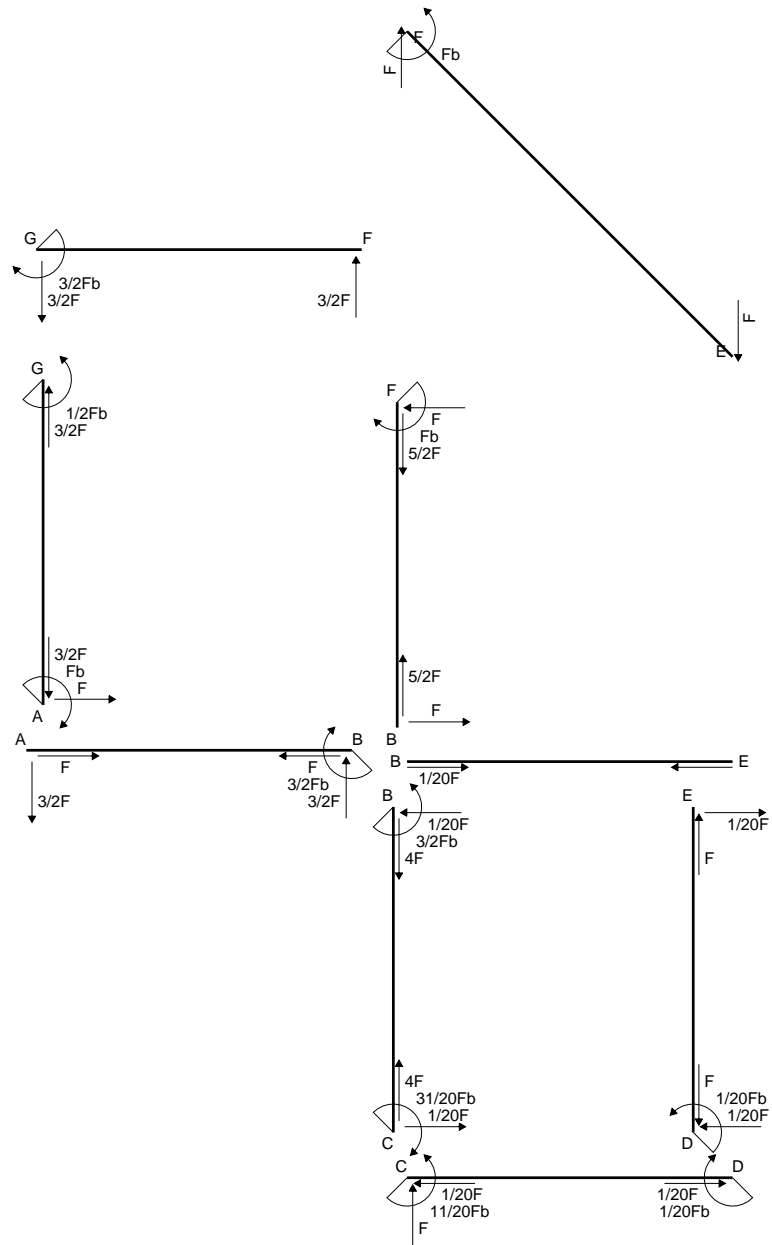
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

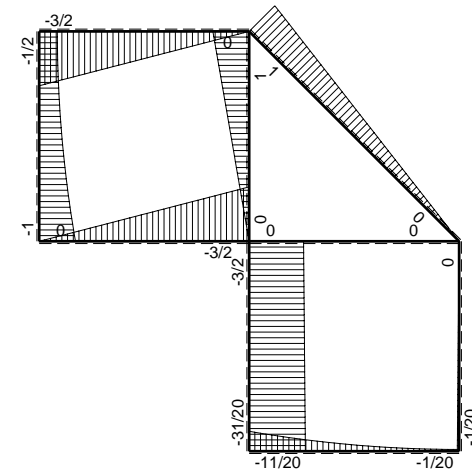
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

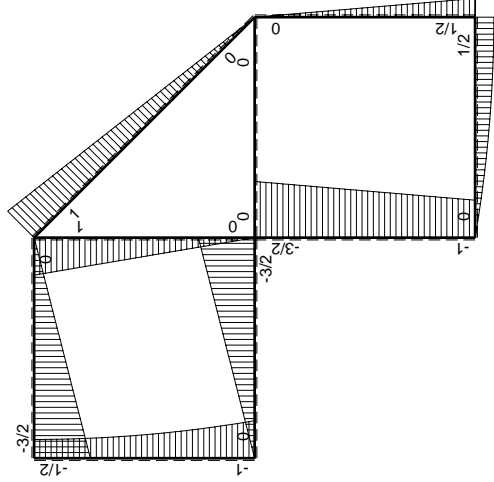
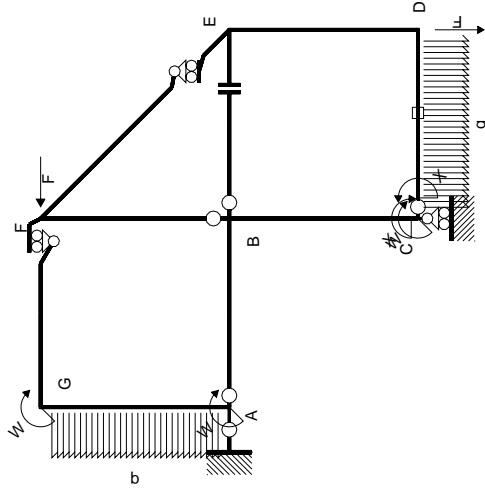


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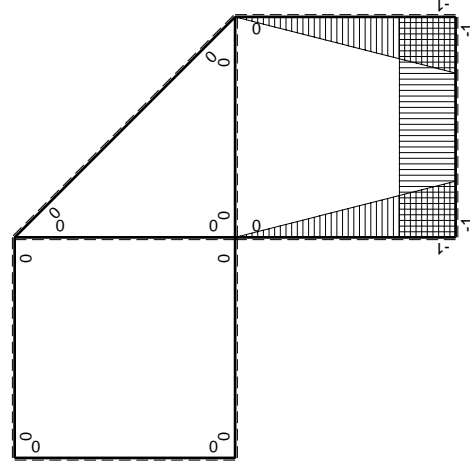
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⊕ ⊖ F_b



(\oplus) M_0 flessione da carichi assegnati



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

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-11/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				11/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

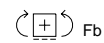
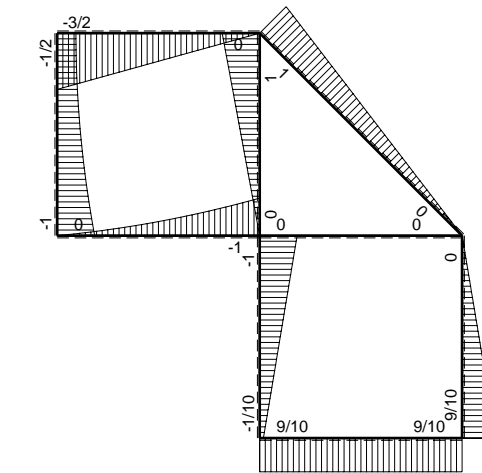
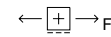
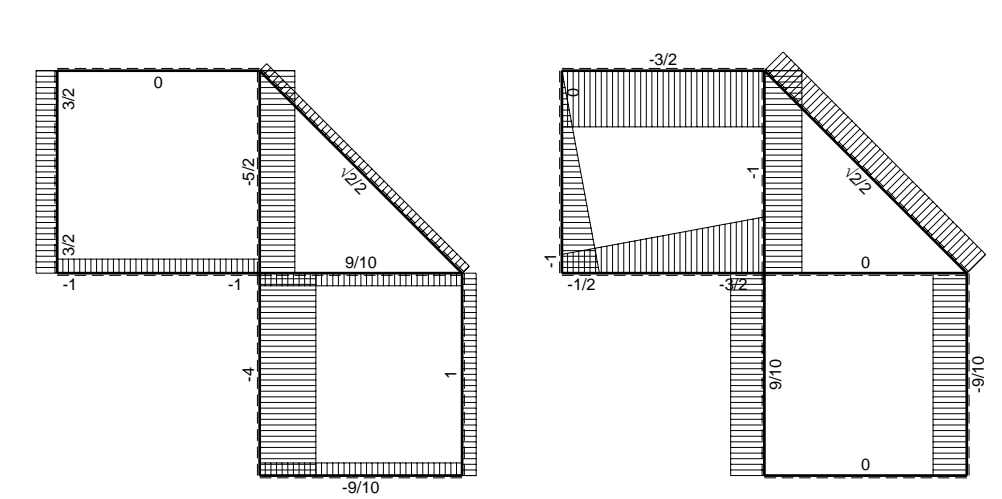
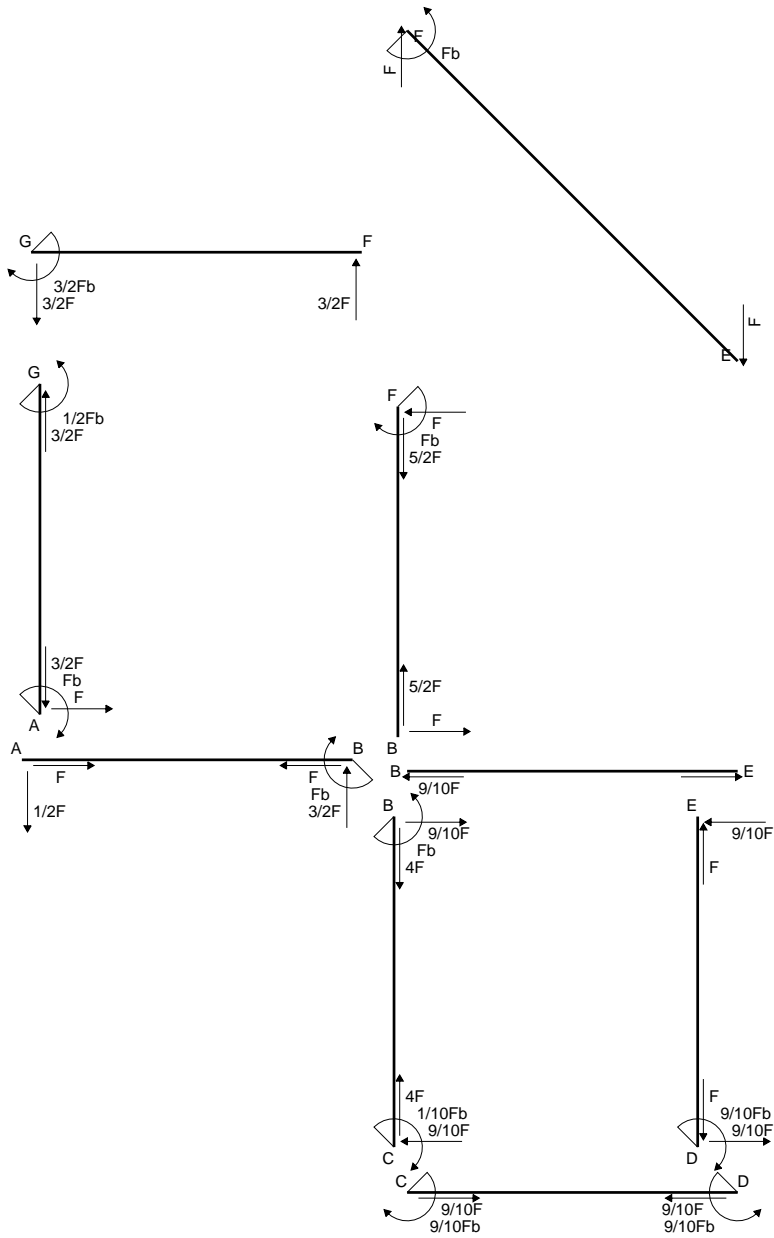
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

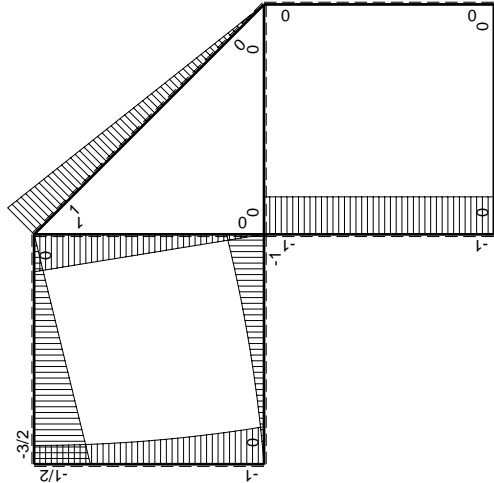
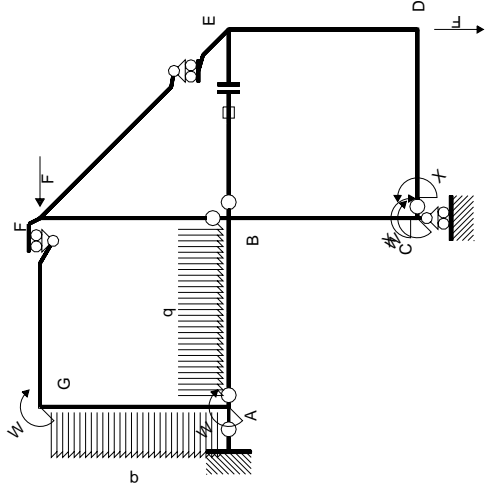
$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

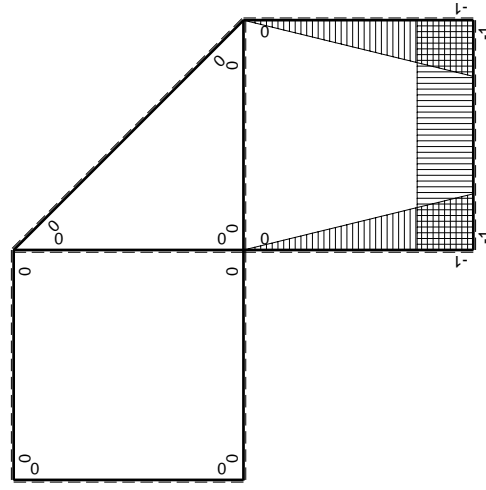
M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx$	0	0	0	0
GF b	0	$3/2Fb - 3/2Fx$	0	0	0	0
GA b	0	$-1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$Fb - Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$					$-9/10Fb$

Sviluppi di calcolo iperstatica



$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

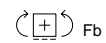
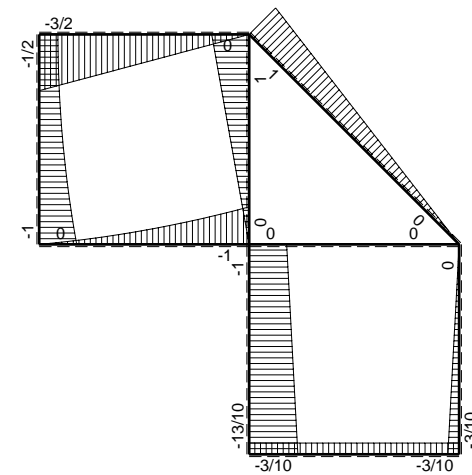
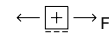
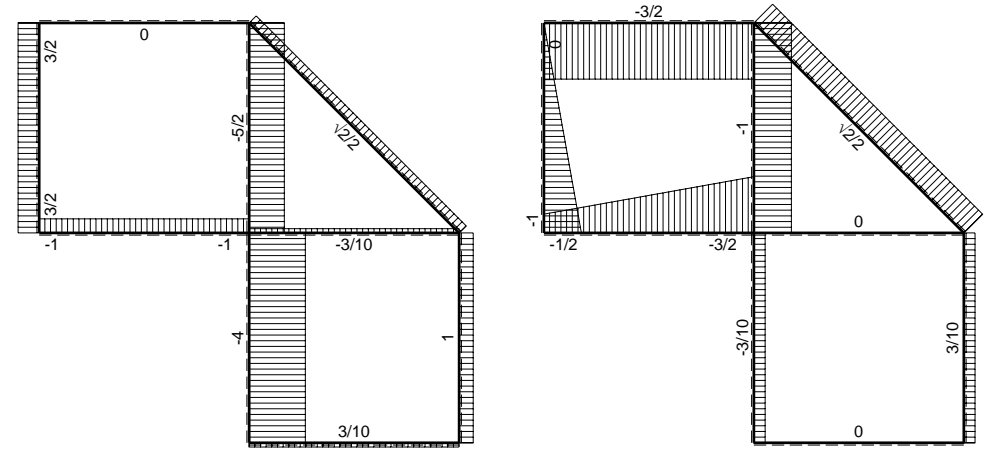
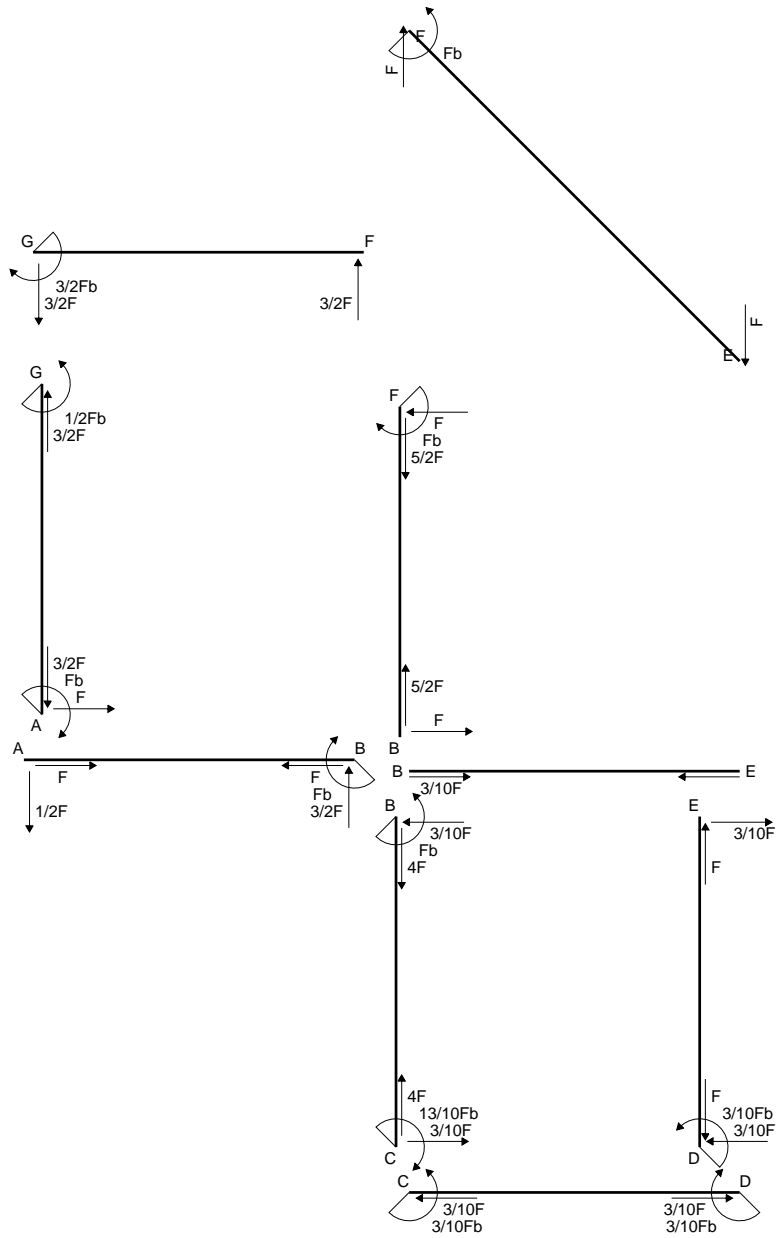
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

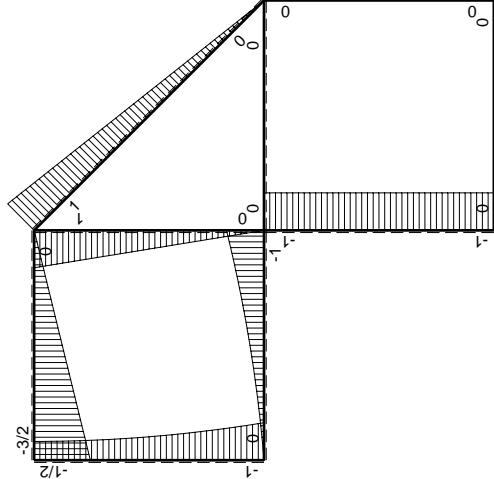
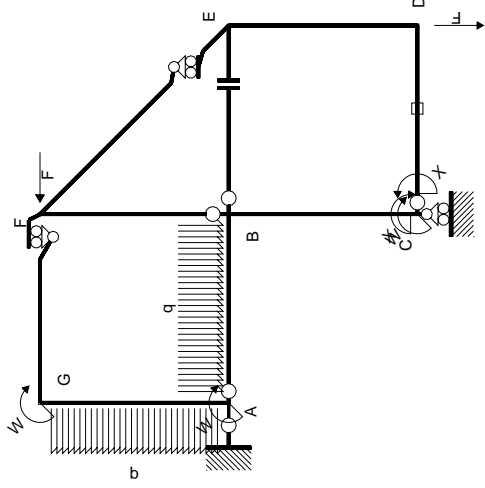
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





Schema di calcolo iperstatico

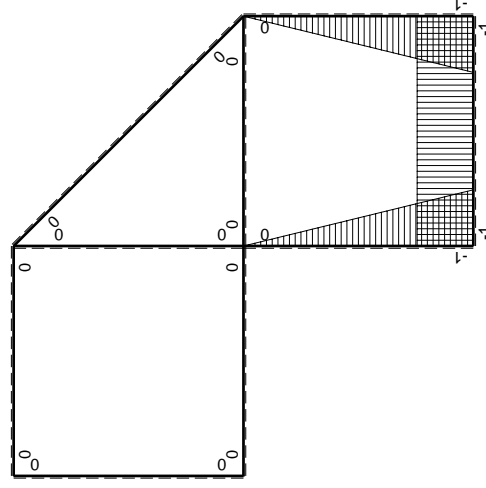
M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx$	0	0	0	0
GF b	0	$3/2Fb - 3/2Fx$	0	0	0	0
GA b	0	$-1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$3/10Fb$	

Sviluppi di calcolo iperstatica



$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

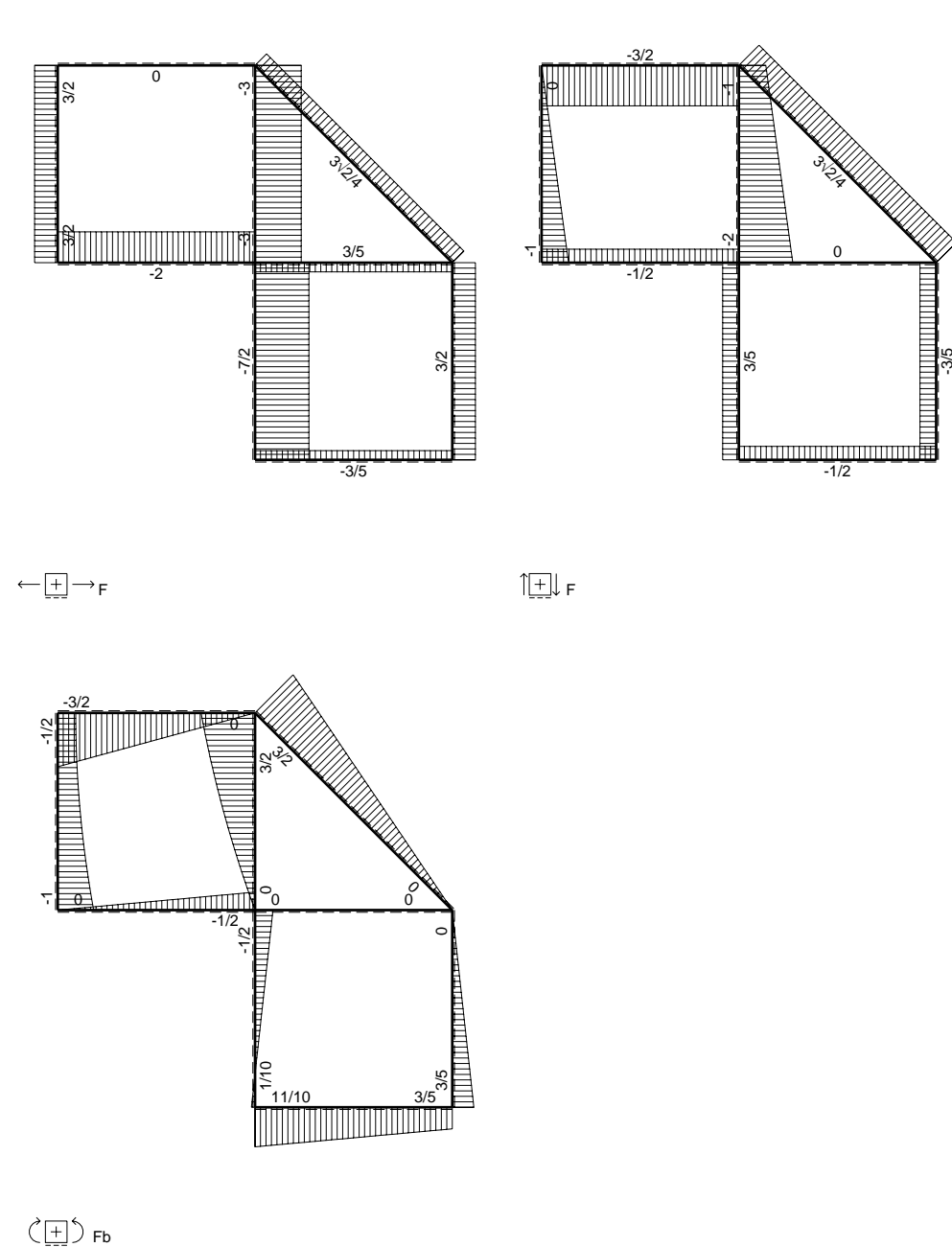
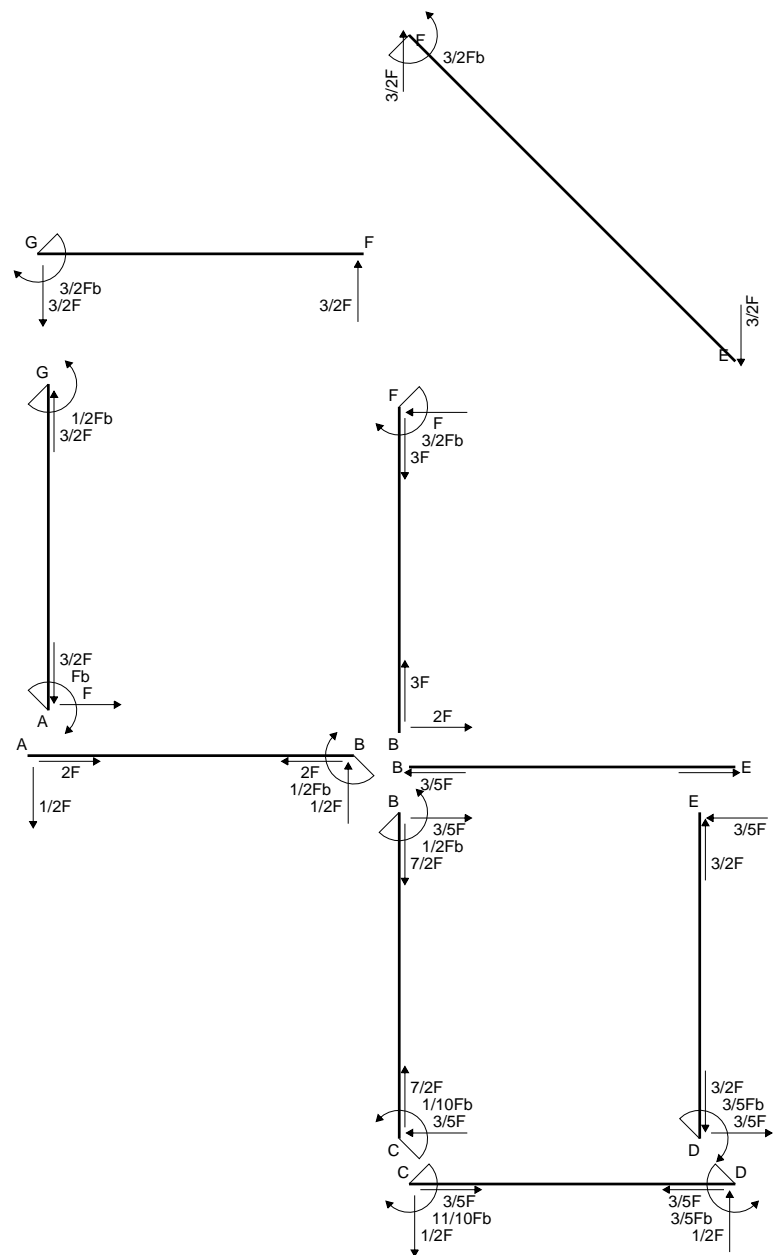
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

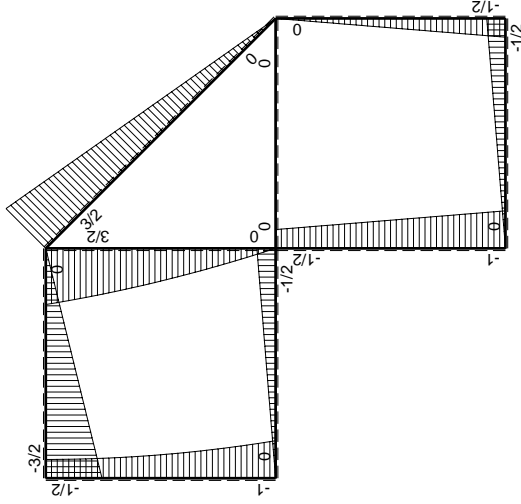
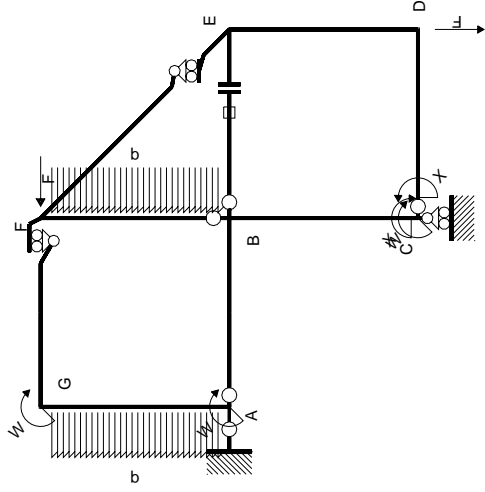
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

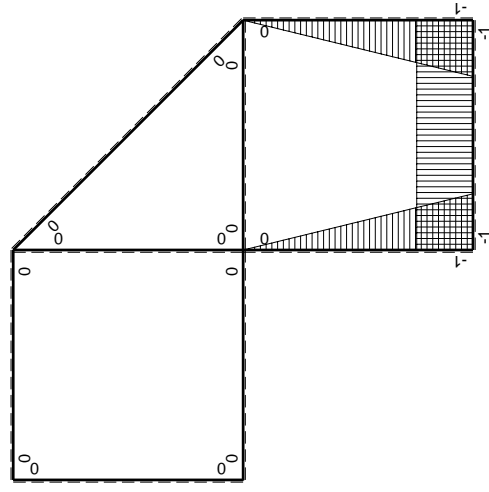
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/6Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	3 $\sqrt{2}$ /4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

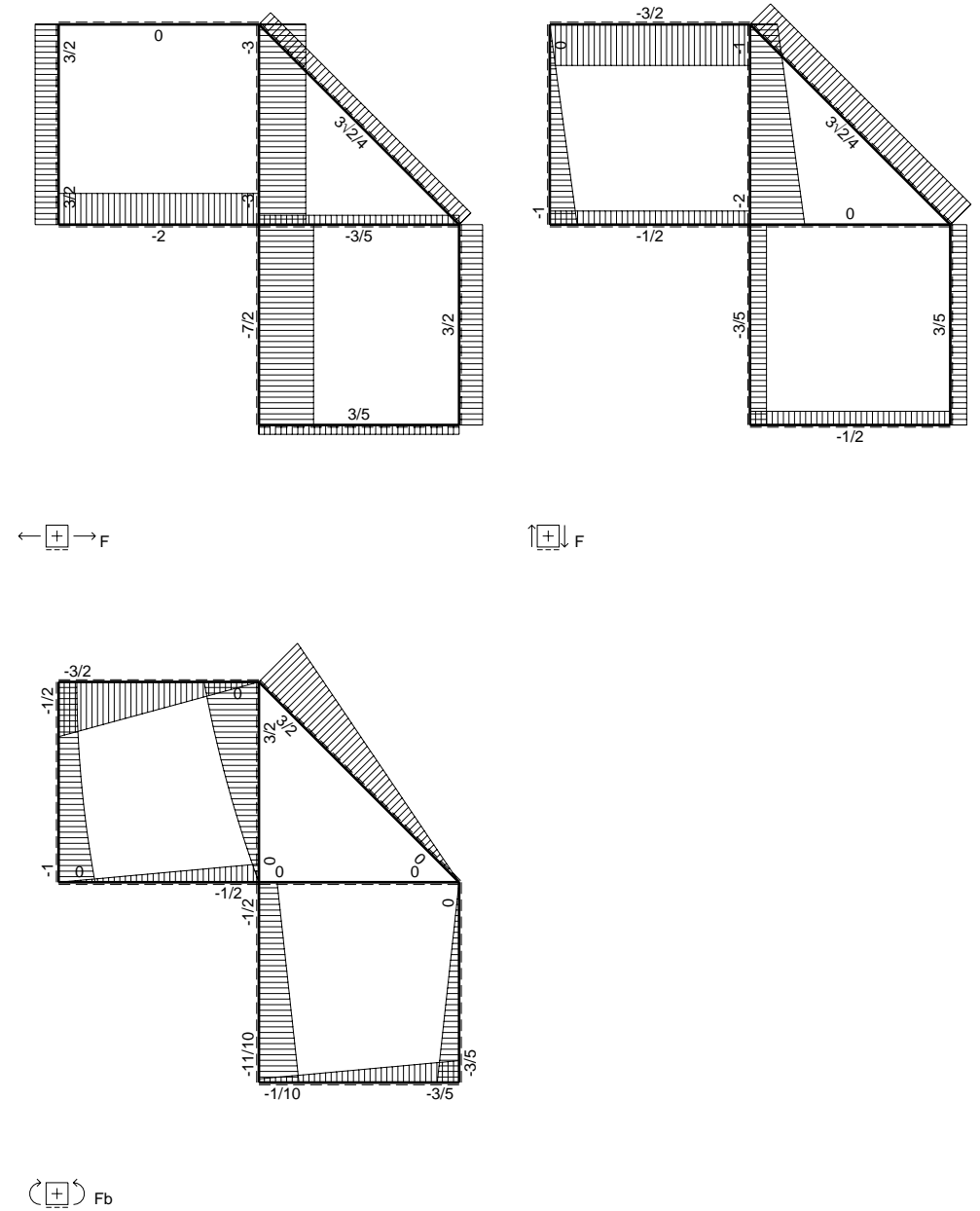
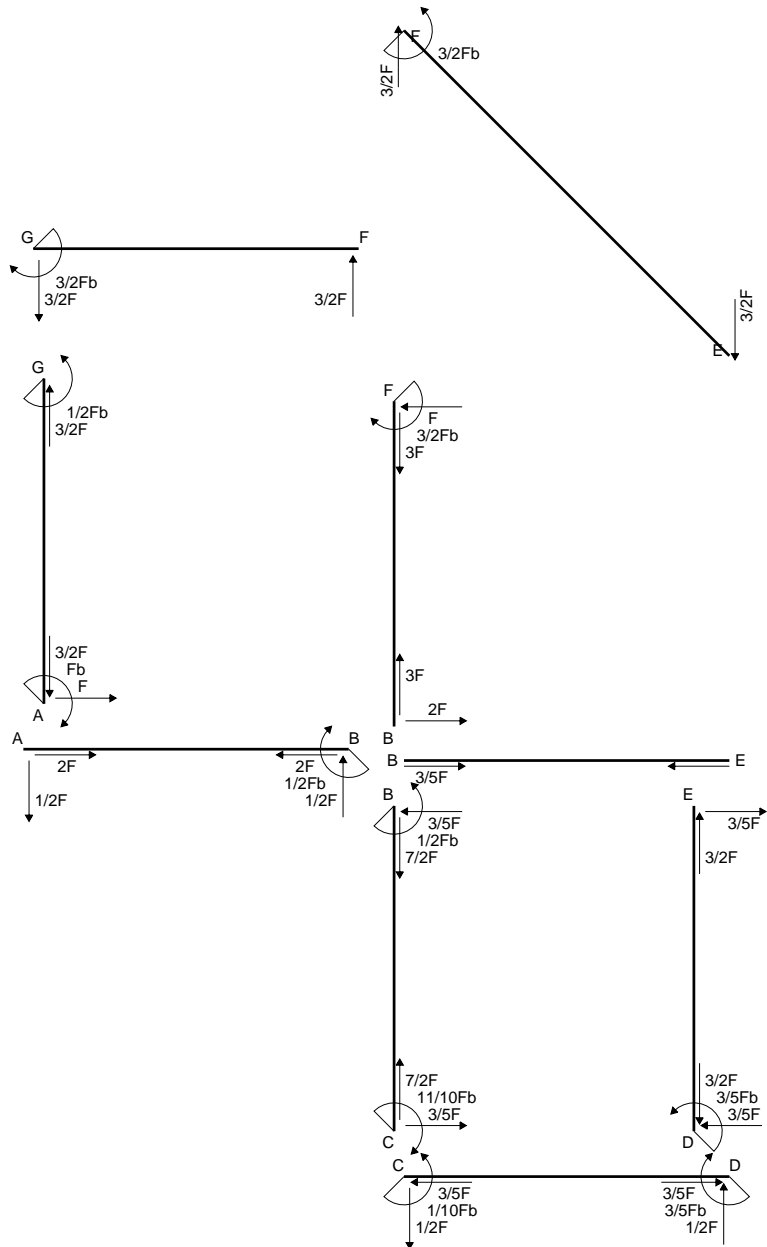
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

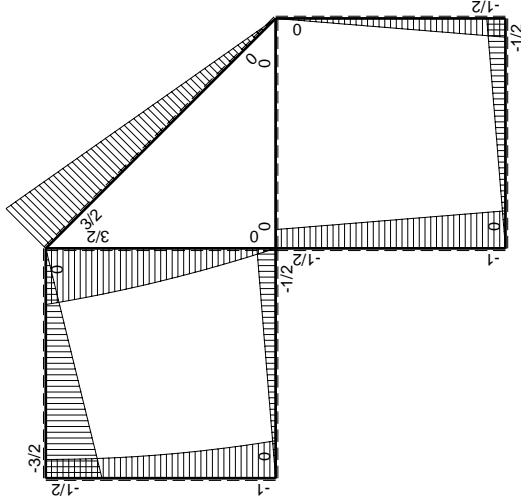
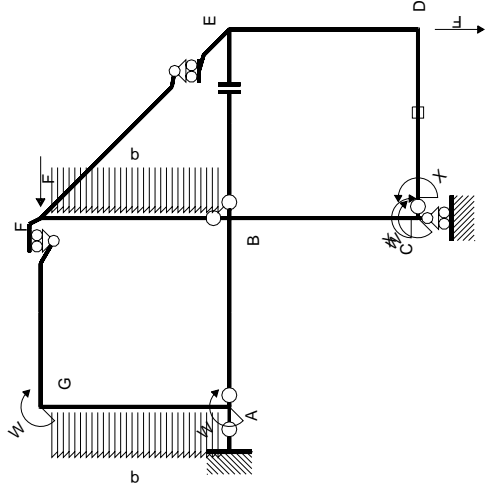
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

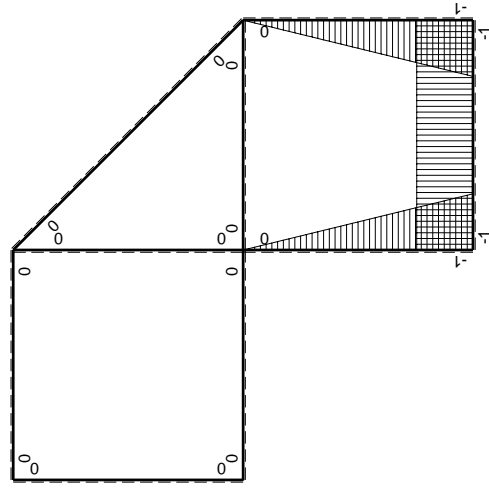
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/6Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

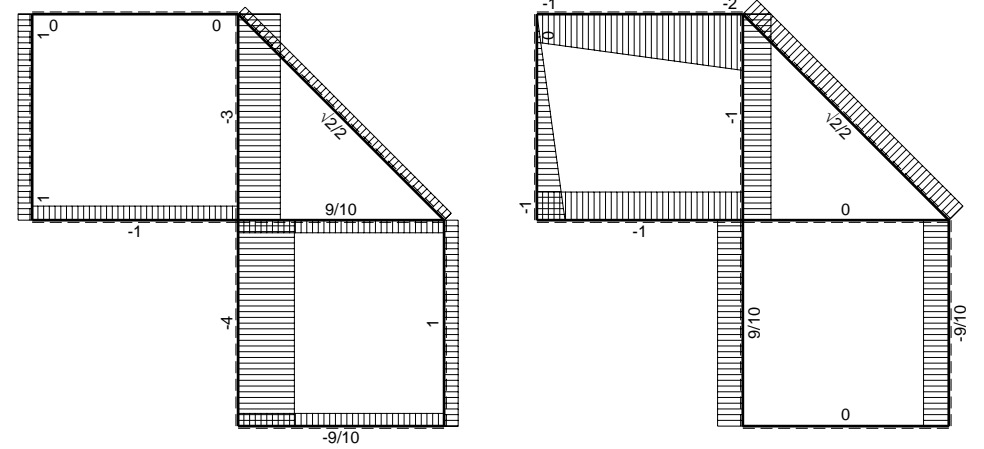
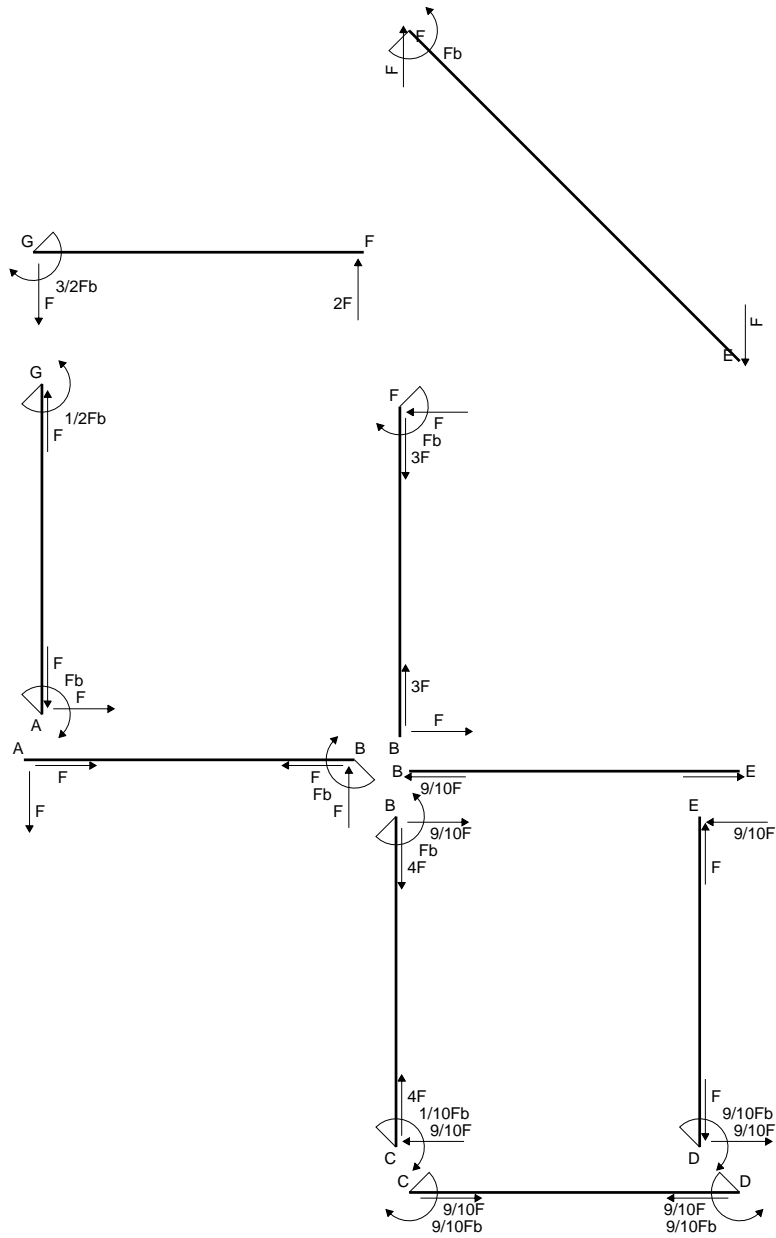
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

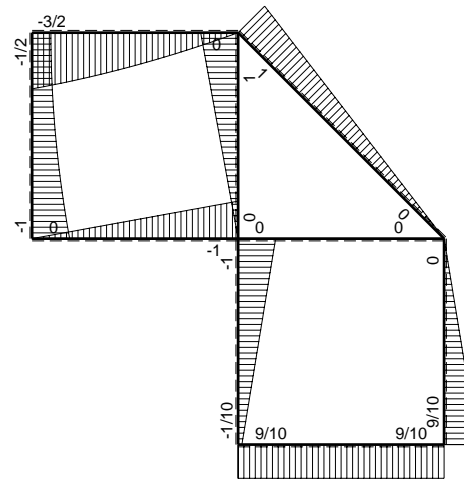
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

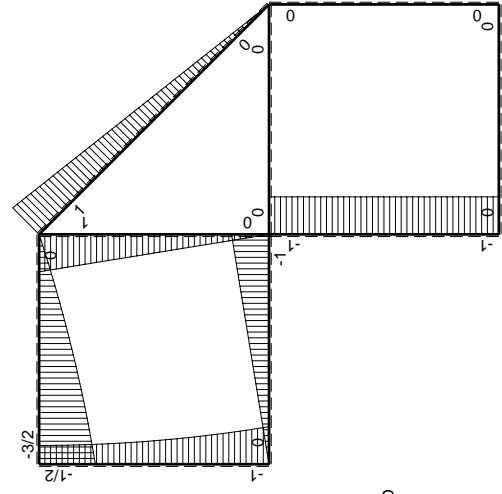
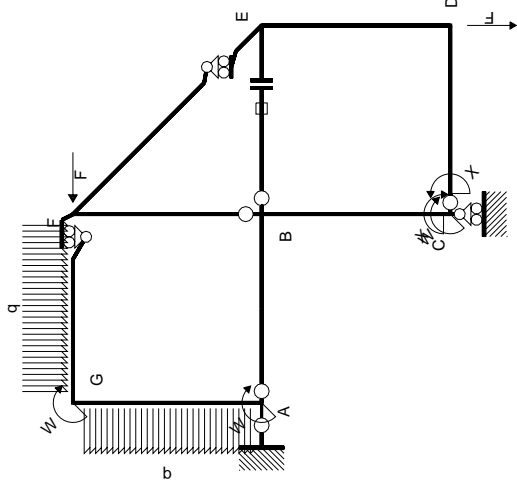


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↑ ⊕ ↓ F

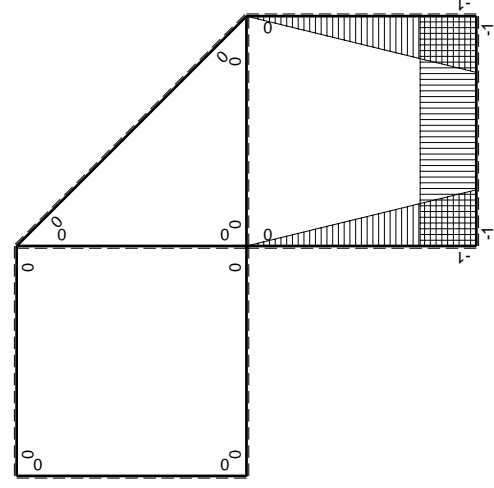


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx$	0	0	0	0
FG b	0	$-2Fx+1/2qx^2$	0	0	0	0
GF b	0	$3/2 Fb-Fx-1/2qx^2$	0	0	0	0
GA b	0	$-1/2 Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2 Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica X=W _{cd}				$-9/10 Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

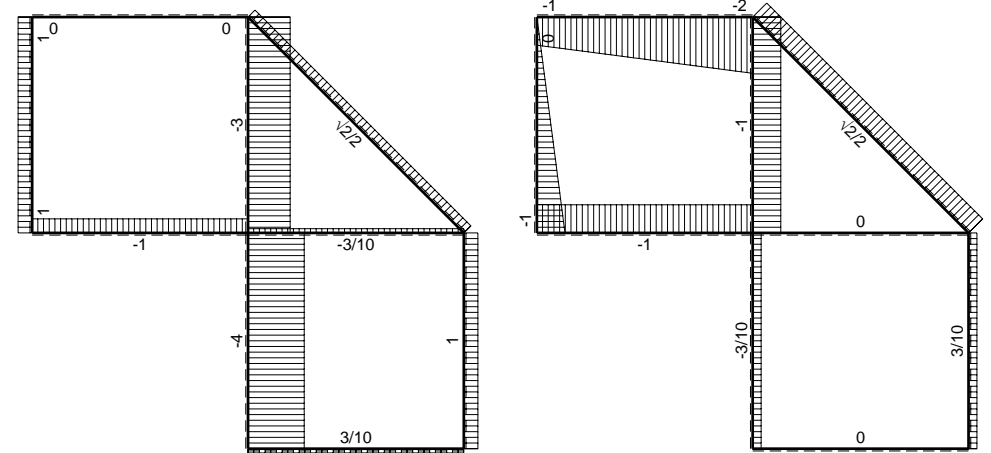
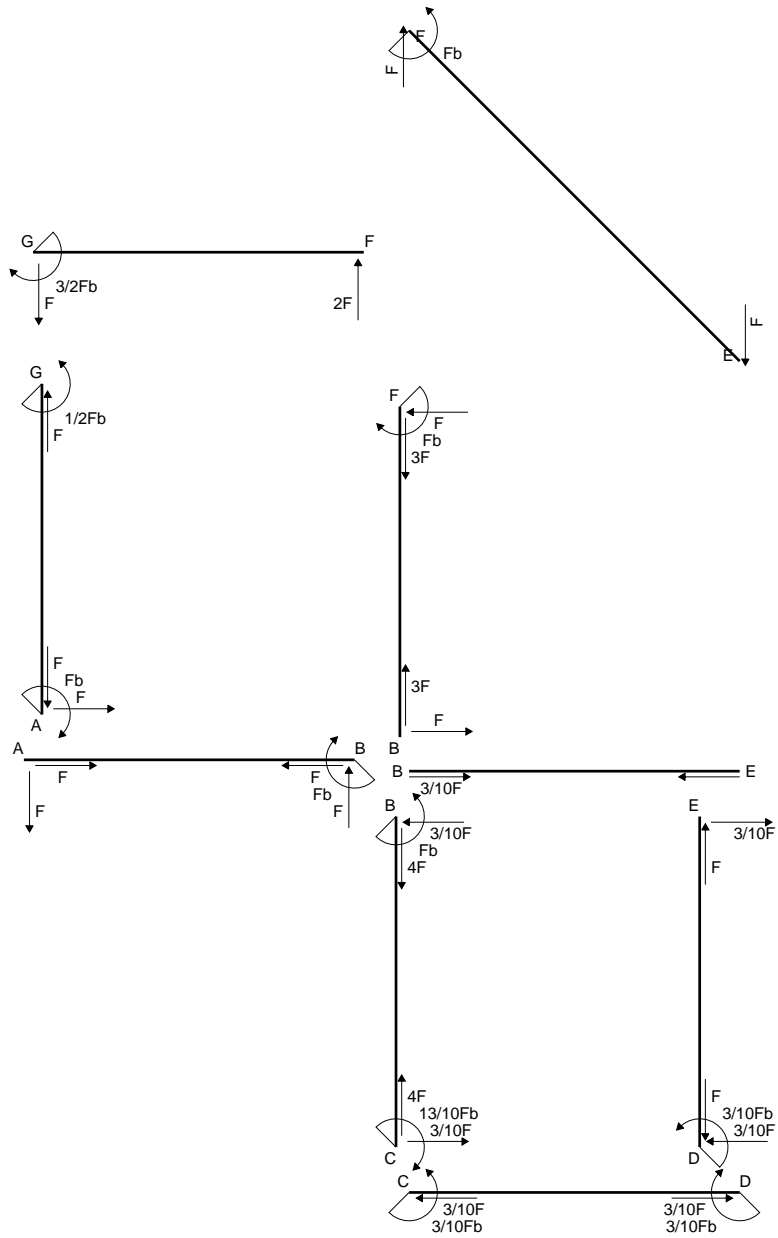
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

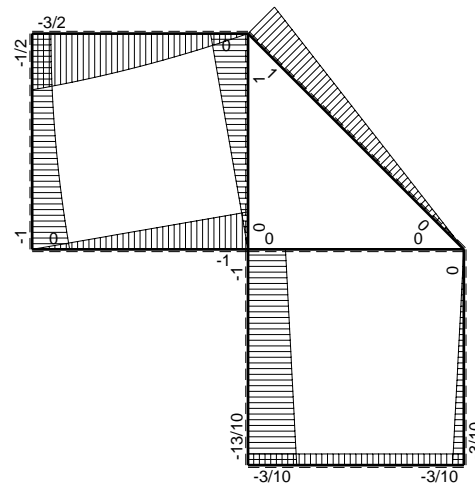
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

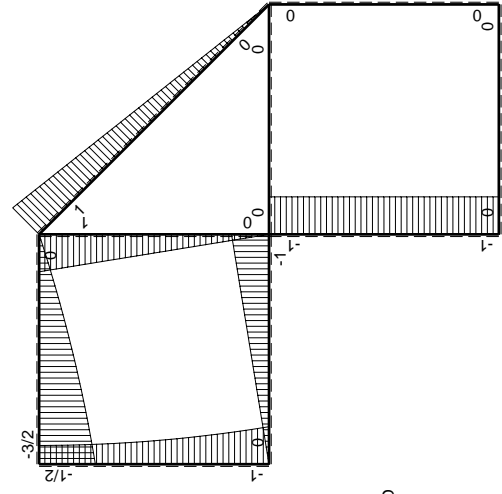
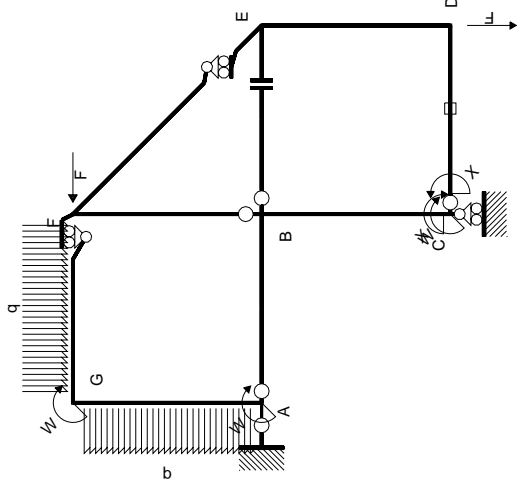


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⊕ ⊖ F_b



Schema di calcolo iperstatico

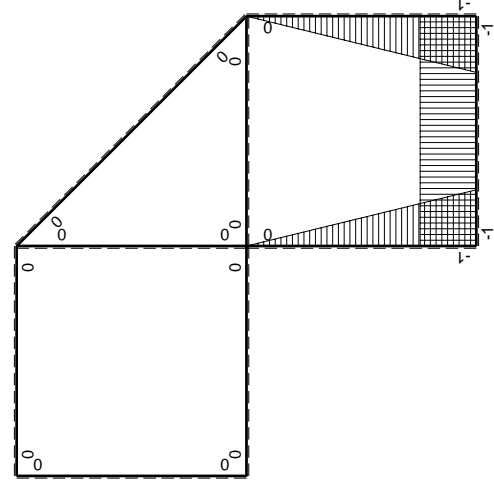
M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx$	0	0	0	0
FG b	0	$-2Fx+1/2qx^2$	0	0	0	0
GF b	0	$3/2 Fb-Fx-1/2qx^2$	0	0	0	0
GA b	0	$-1/2 Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/2 Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica $X=W_{cd}$				$3/10 Fb$	

Sviluppi di calcolo iperstatica



$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

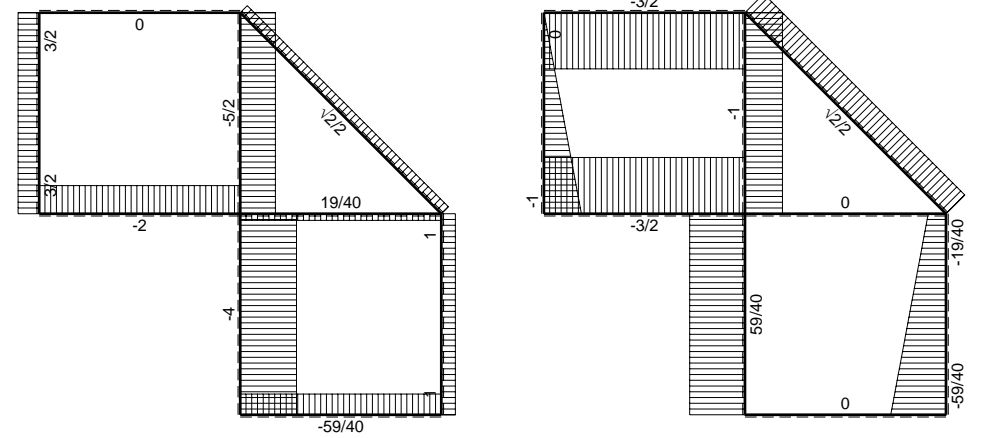
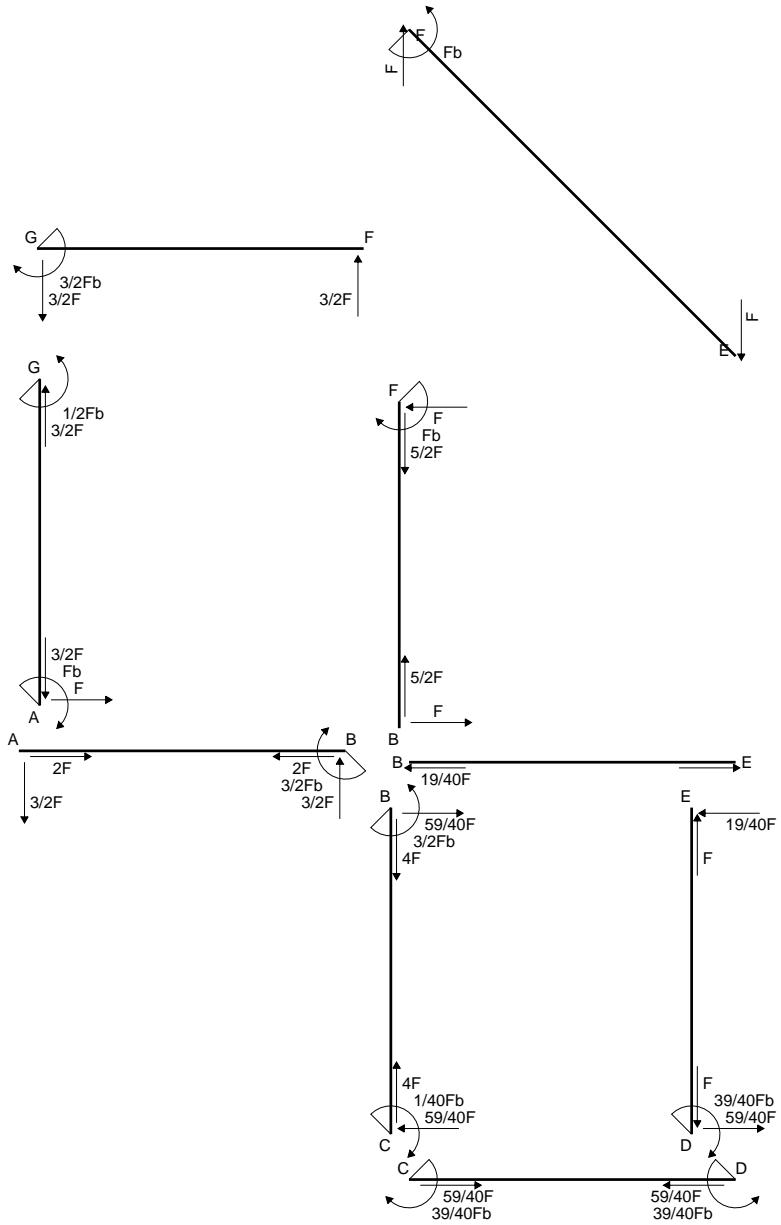
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

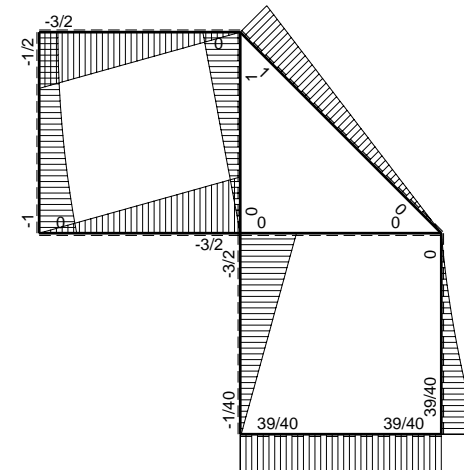
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

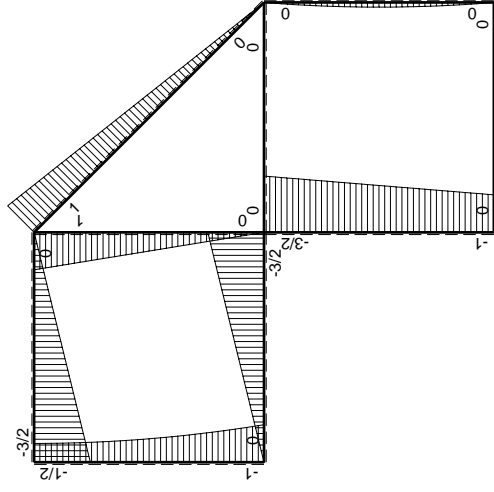
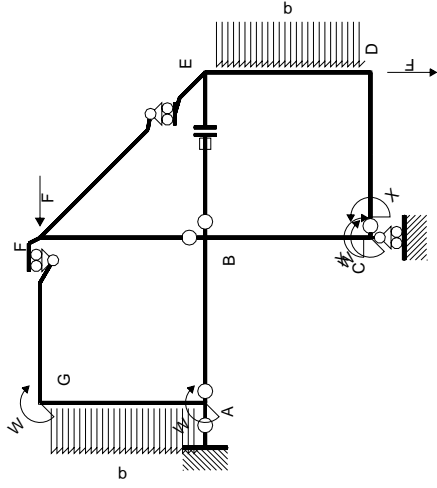


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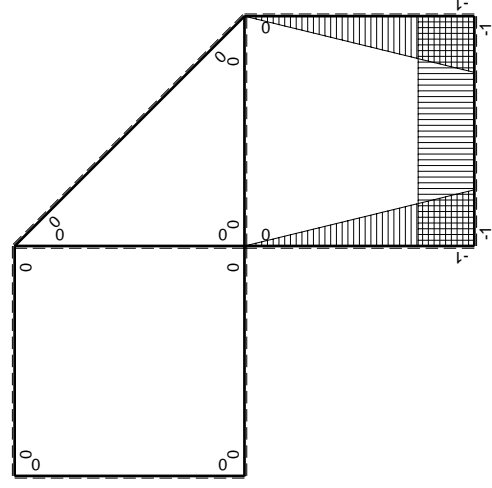


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx+1/2qx ²	1/2Fx-Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	1/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx-1/2qx ²	1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				13/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-39/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

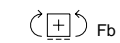
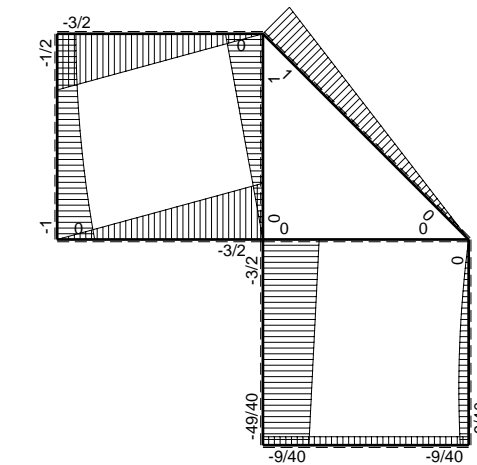
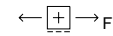
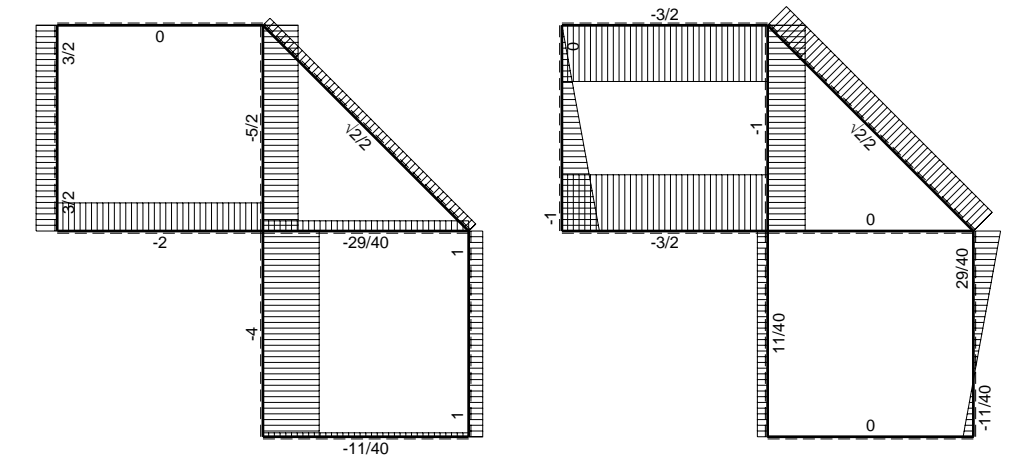
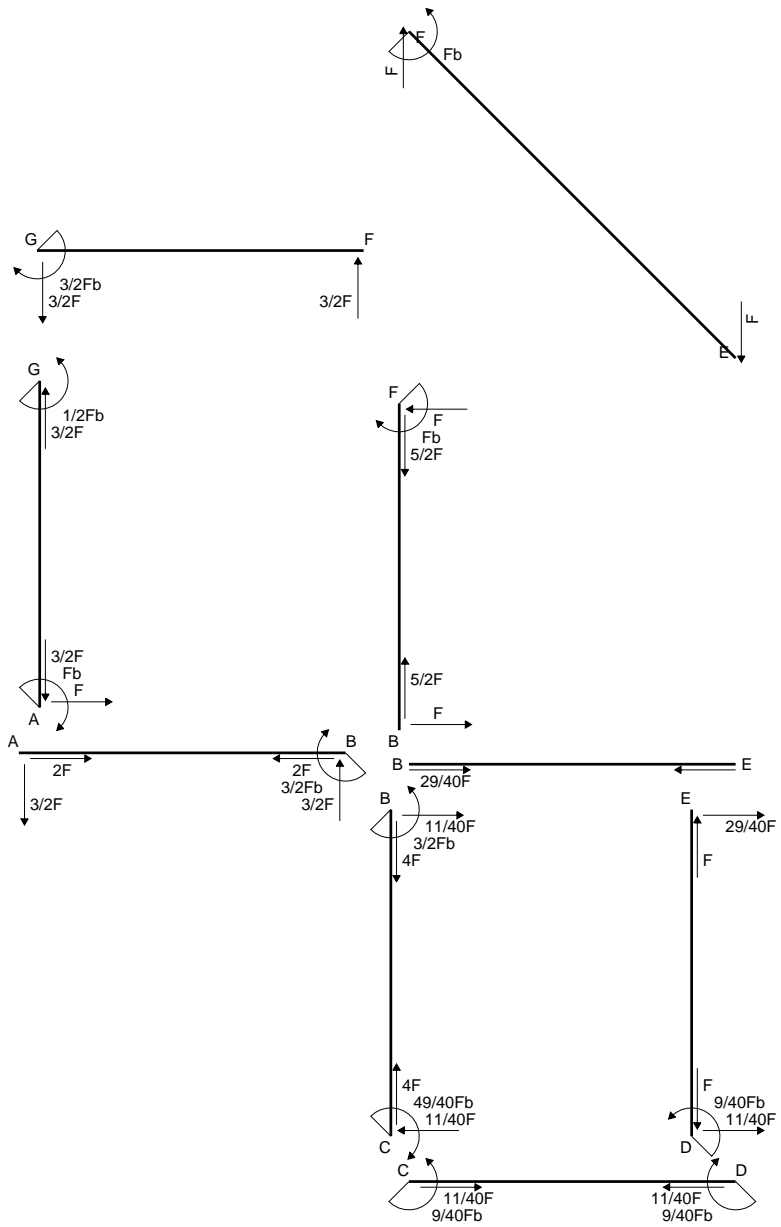
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

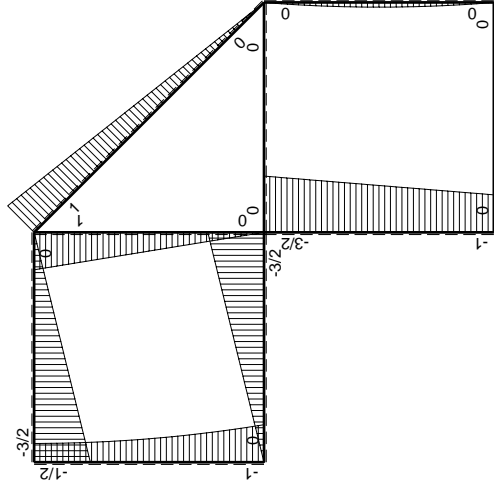
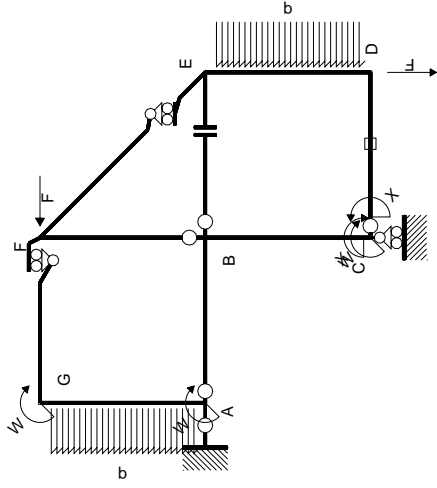
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/3 \cdot b + 1/8 \cdot b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

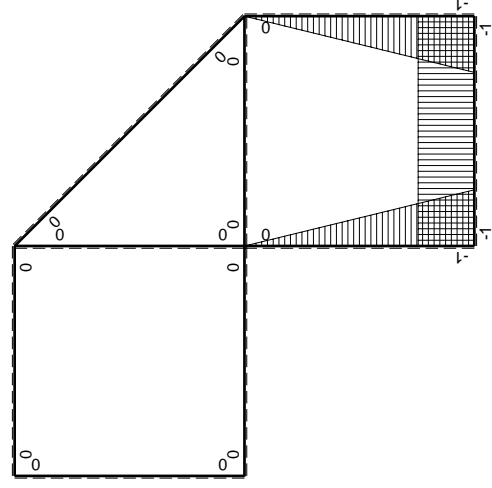
$$= (1/6 \cdot b - 1/8 \cdot b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx+1/2qx ²	1/2Fx-Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	1/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx-1/2qx ²	1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-3/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				9/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

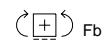
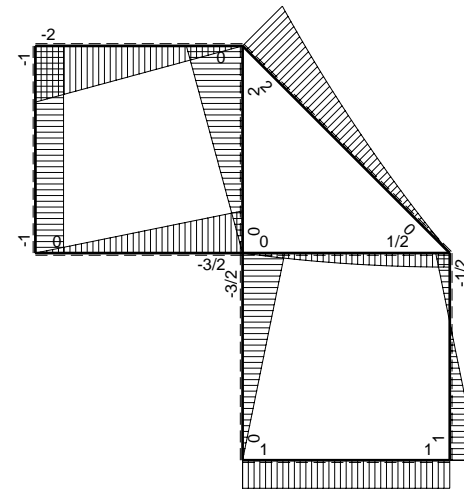
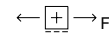
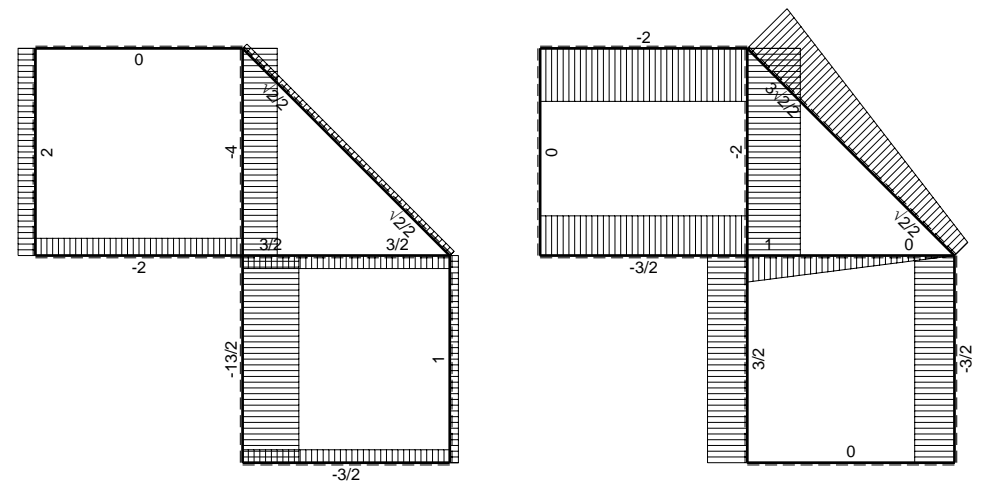
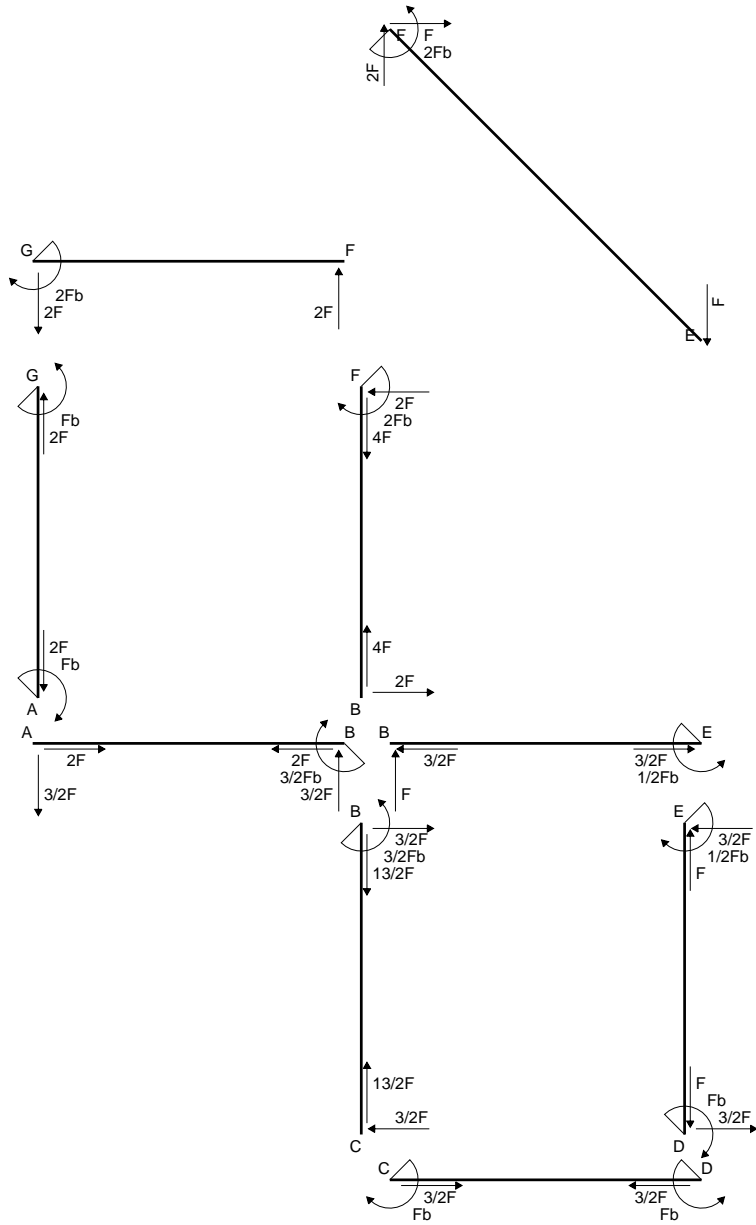
$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

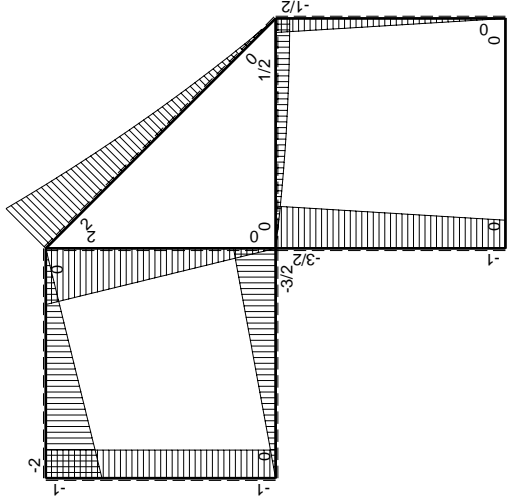
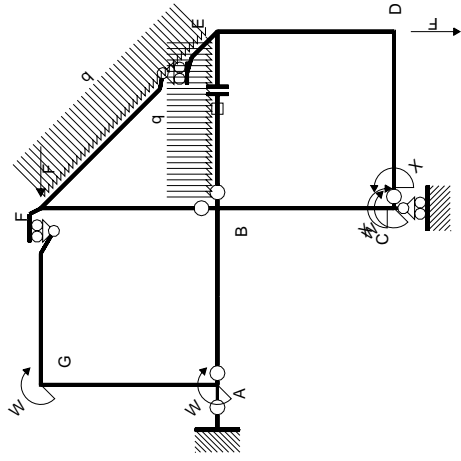
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

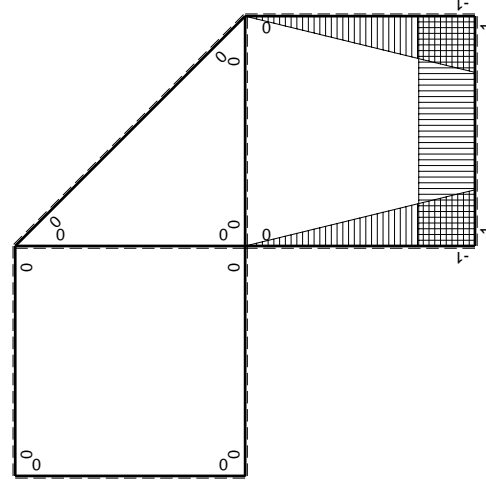
$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = l_{BE}$				Fb ² /EJ	
	totali				5/3Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

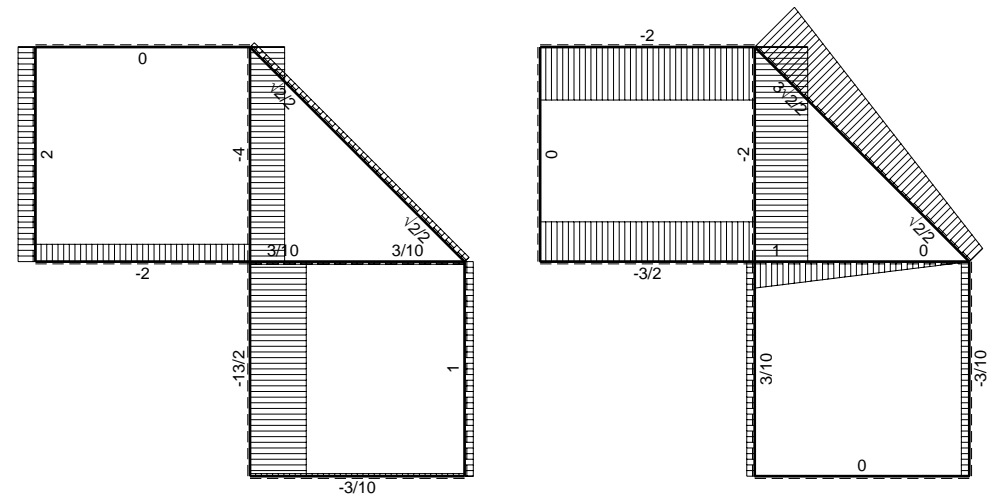
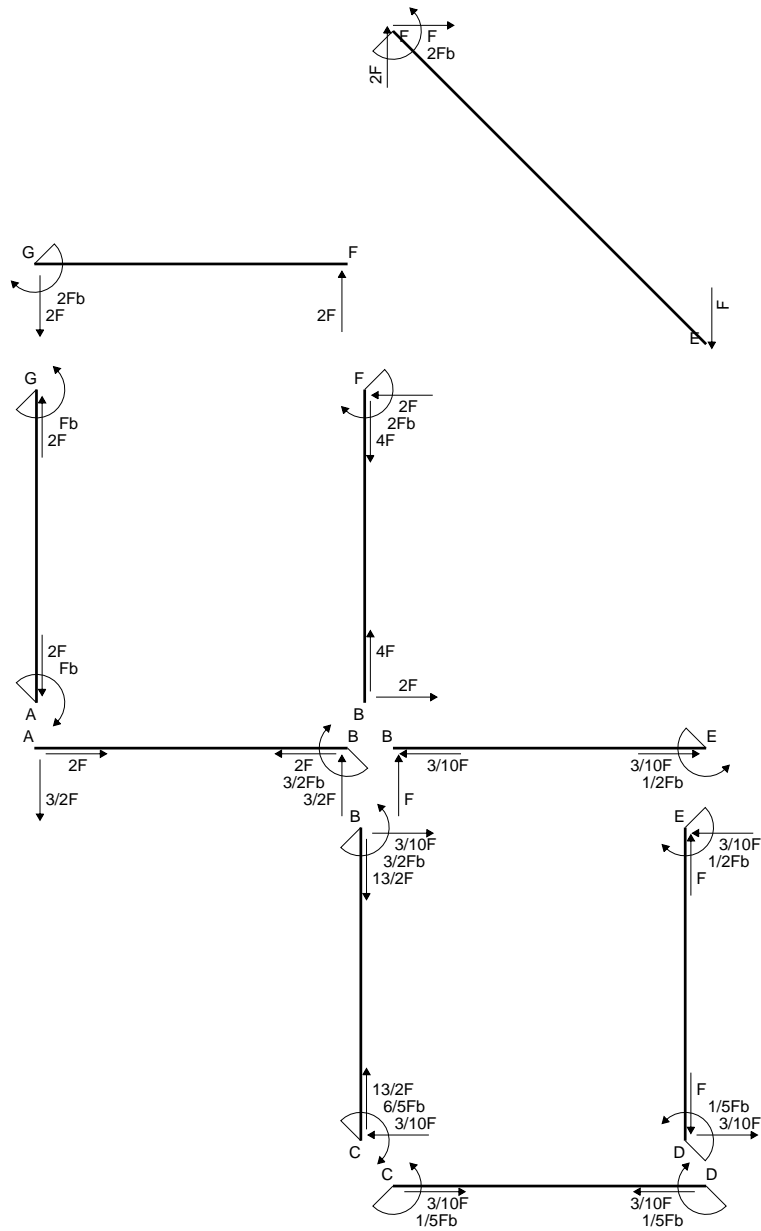
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

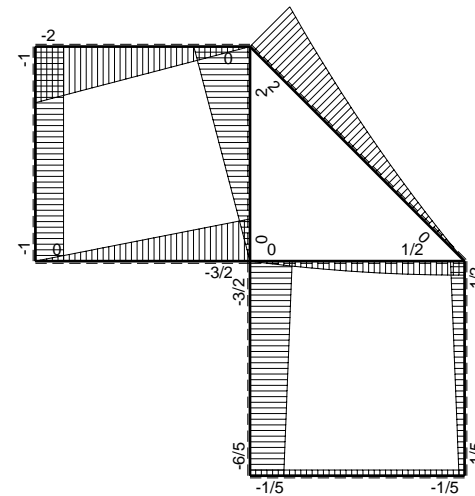
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

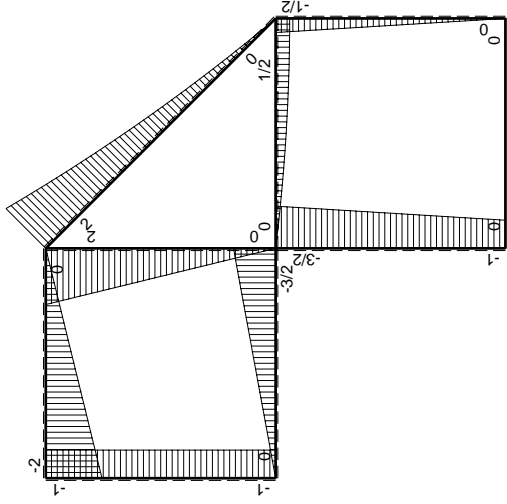
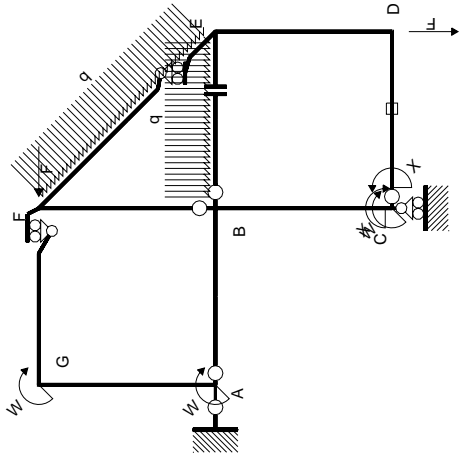


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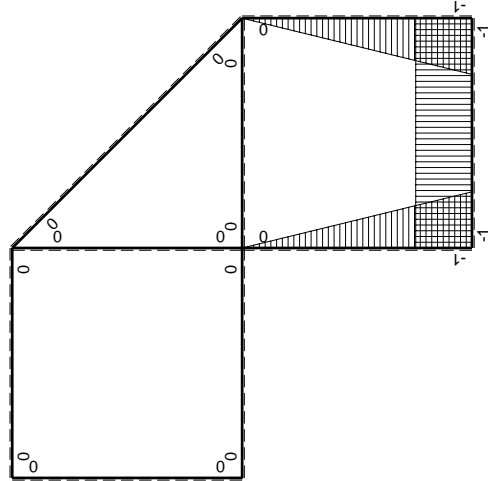


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta N _{1,cd} ε _{cd} L _{cd}				-Fb ² /EJ	
	totali				-1/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				1/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

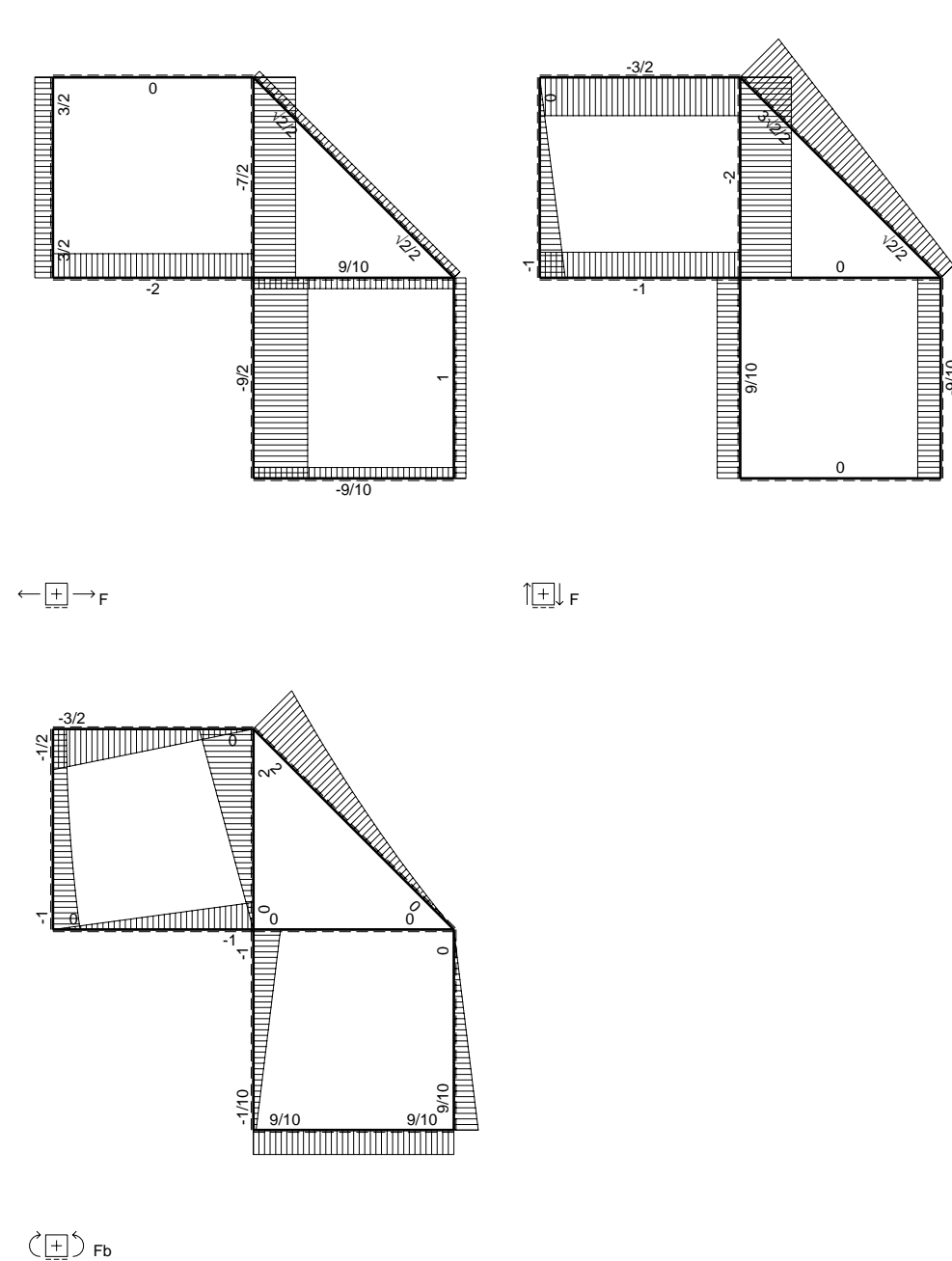
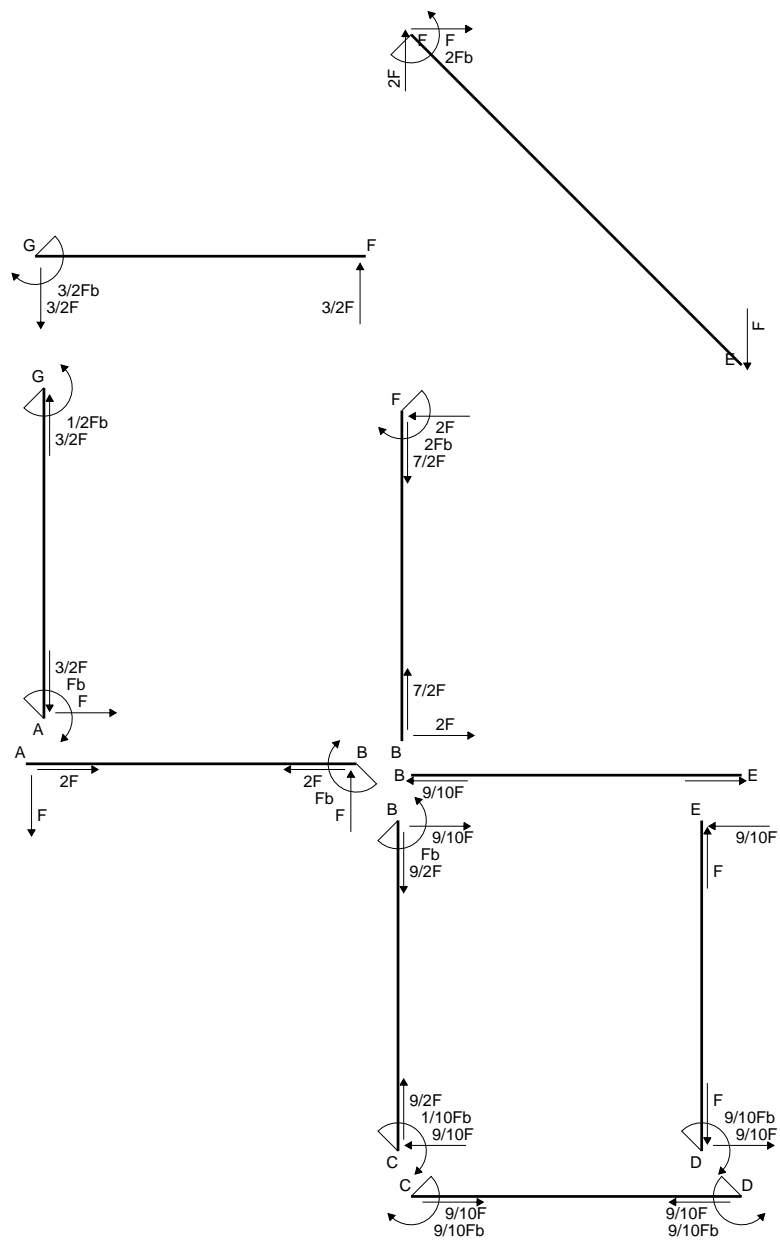
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

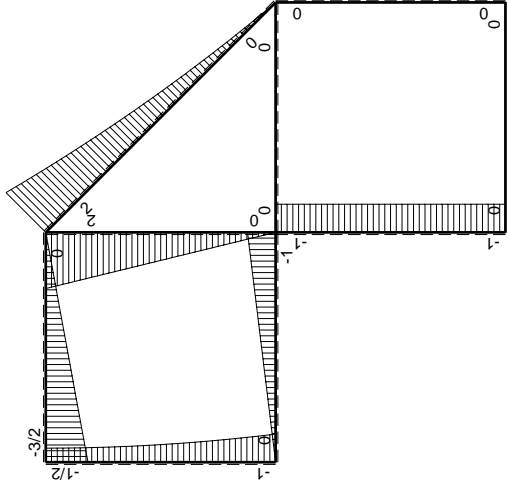
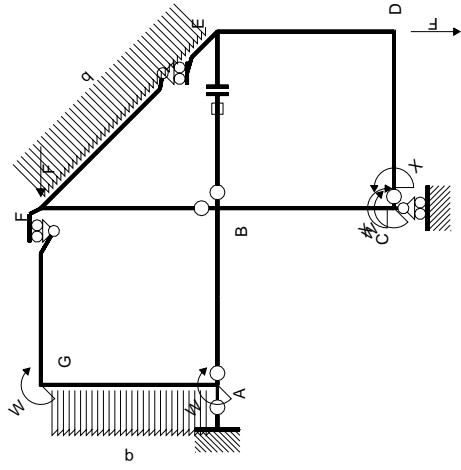
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

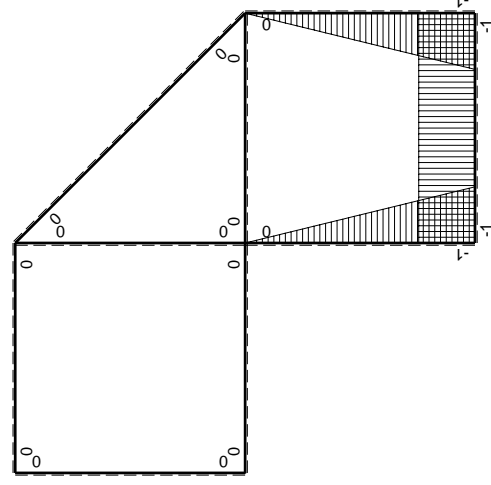
$$= (1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	-3/2 Fx	0	0	0	0
GF b	0	$3/2 Fb - 3/2 Fx$	0	0	0	0
GA b	0	$-1/2 Fb - 1/2 qx^2$	0	0	0	0
AG b	0	$Fb - Fx + 1/2 qx^2$	0	0	0	0
FB b	0	$2Fb - 2Fx$	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb^2/EJ	
	totali				$3/2 Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica $X=W_{cd}$				-9/10 Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

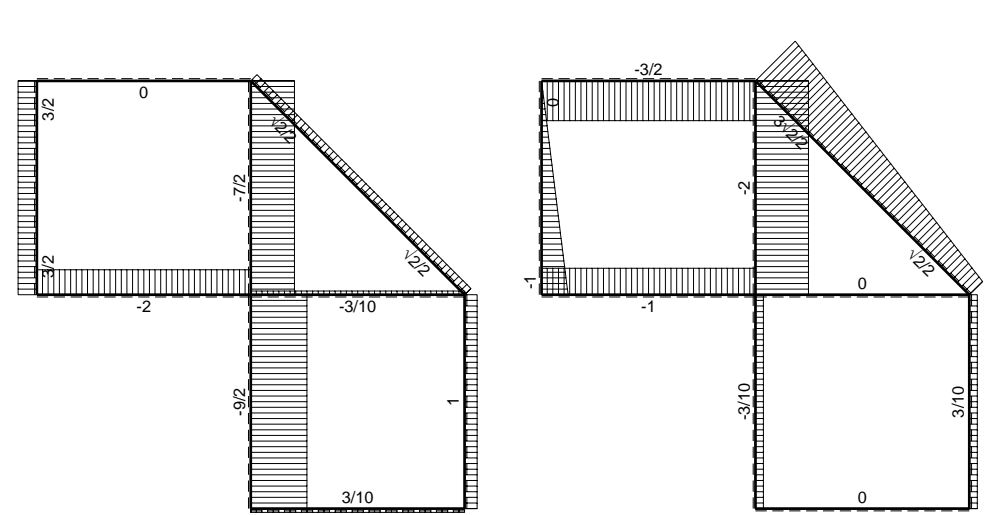
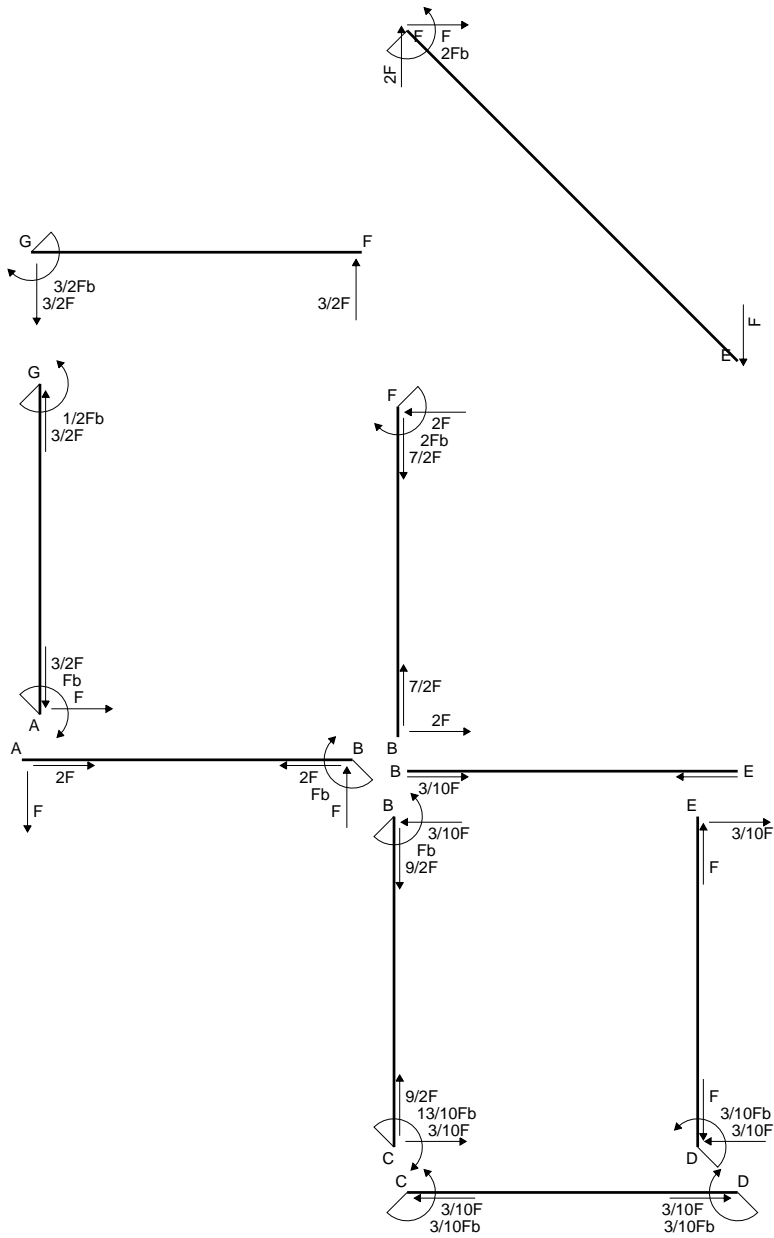
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

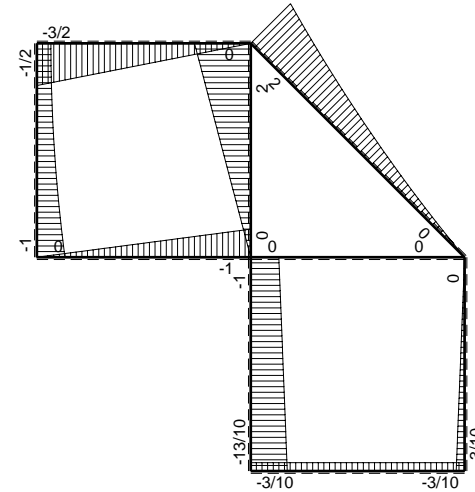
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

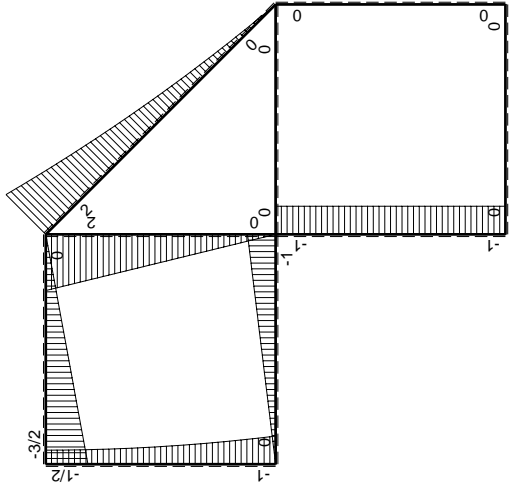
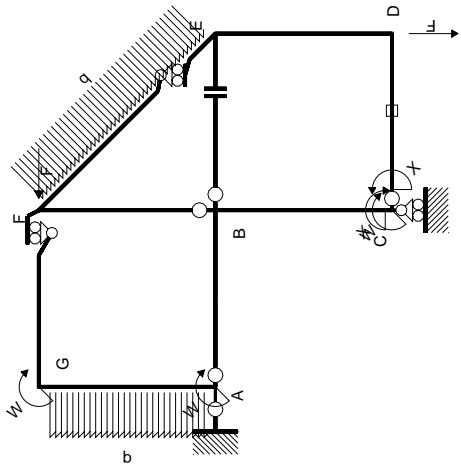


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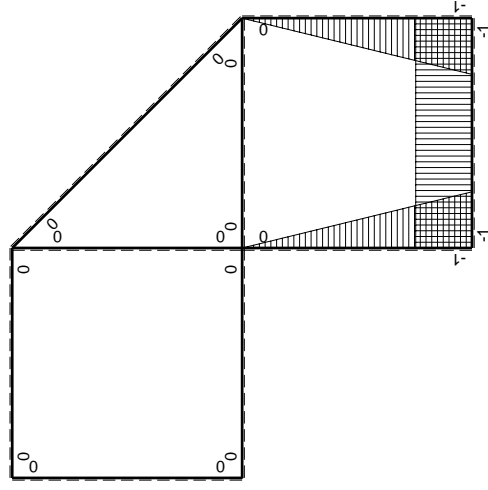


⊕ ⊖ F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



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

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	-3/2 Fx	0	0	0	0
GF b	0	3/2 Fb - 3/2 Fx	0	0	0	0
GA b	0	$-1/2 Fb - 1/2 qx^2$	0	0	0	0
AG b	0	Fb-Fx + 1/2 qx^2	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				-Fb ² /EJ	
	totali				-1/2 Fb ² /EJ	5/3 Xb/EJ
	iperstatica $X=W_{CD}$				3/10 Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

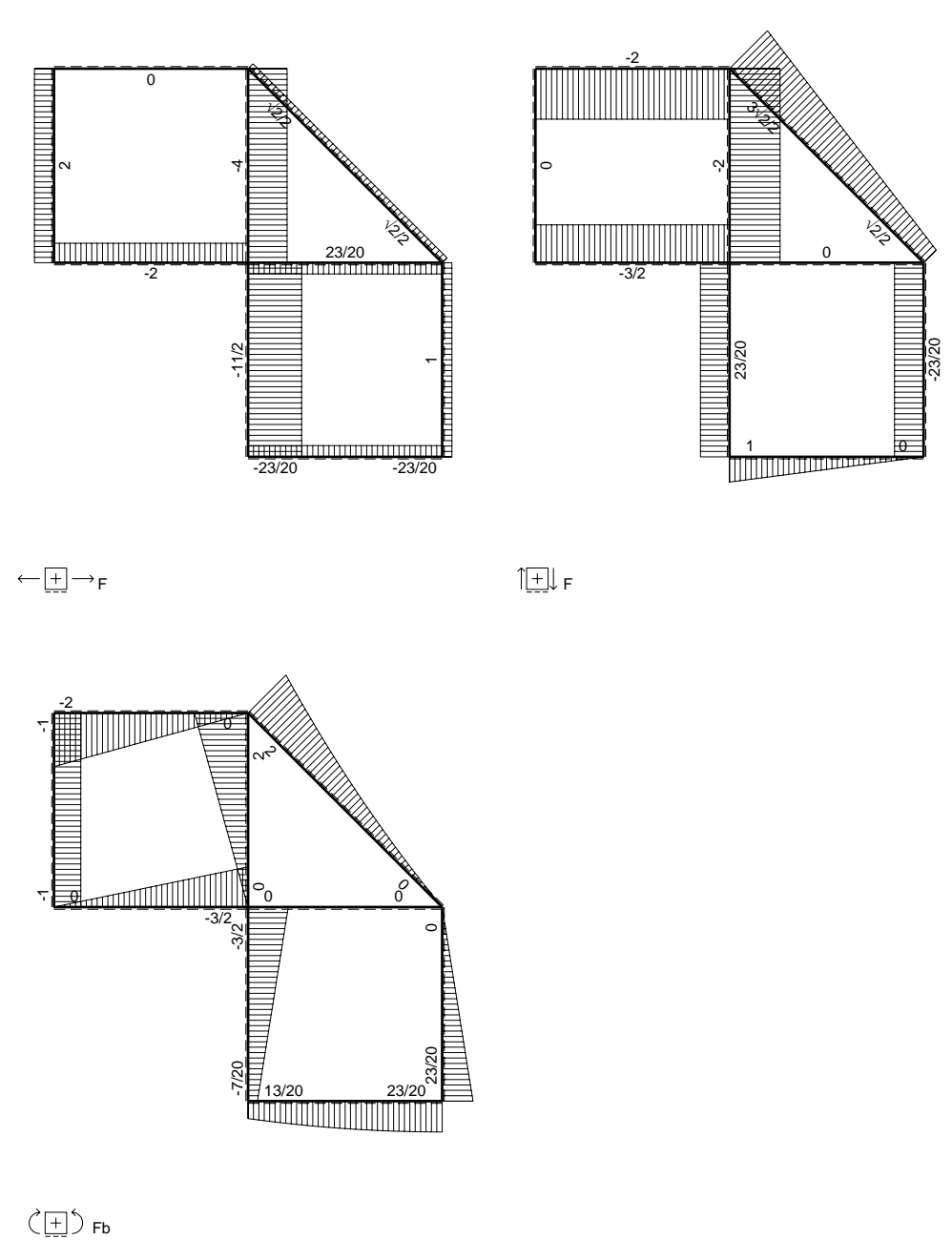
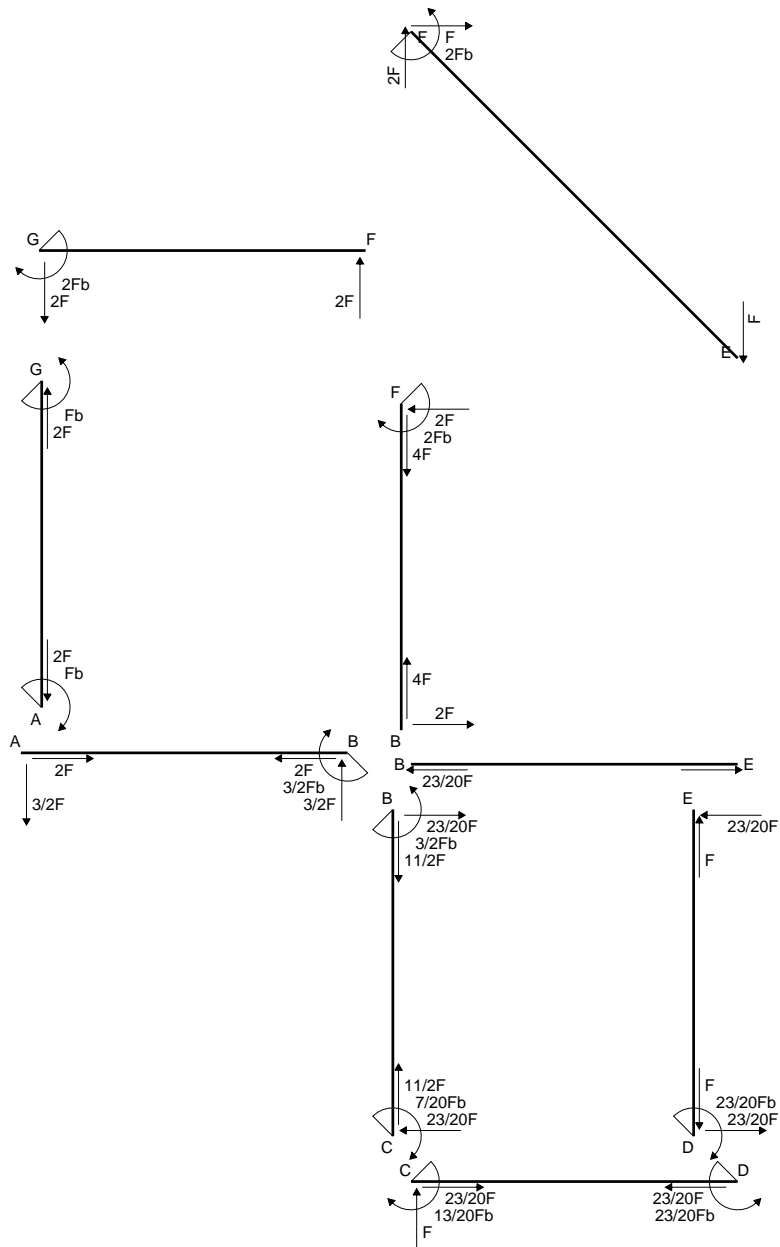
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

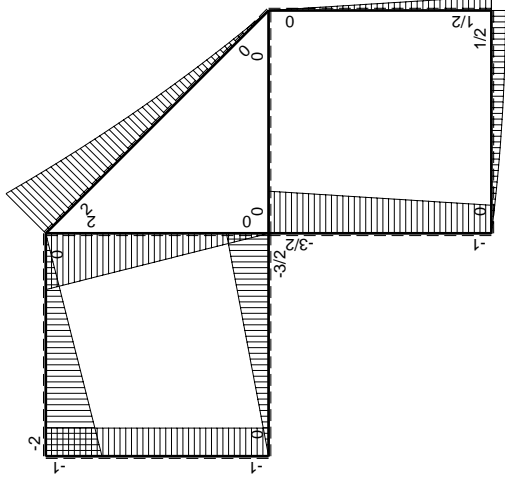
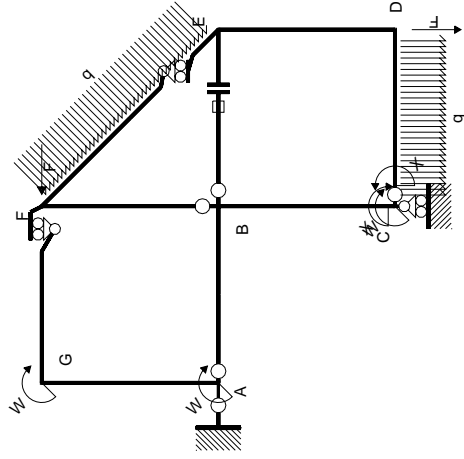
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

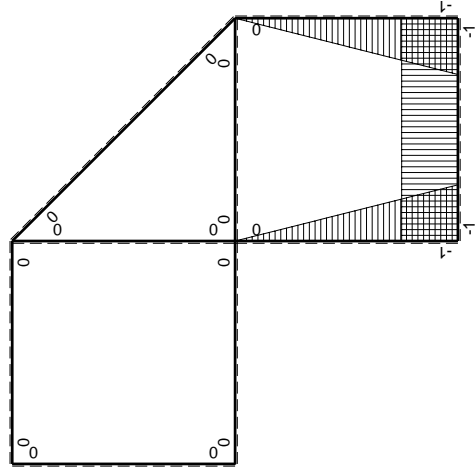
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/6Fb ² /EJ	1/3Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/6Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				13/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

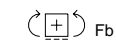
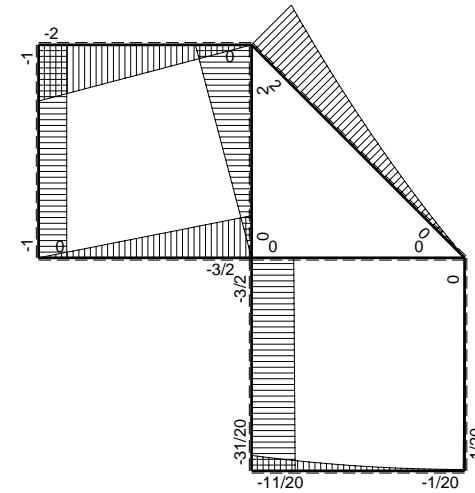
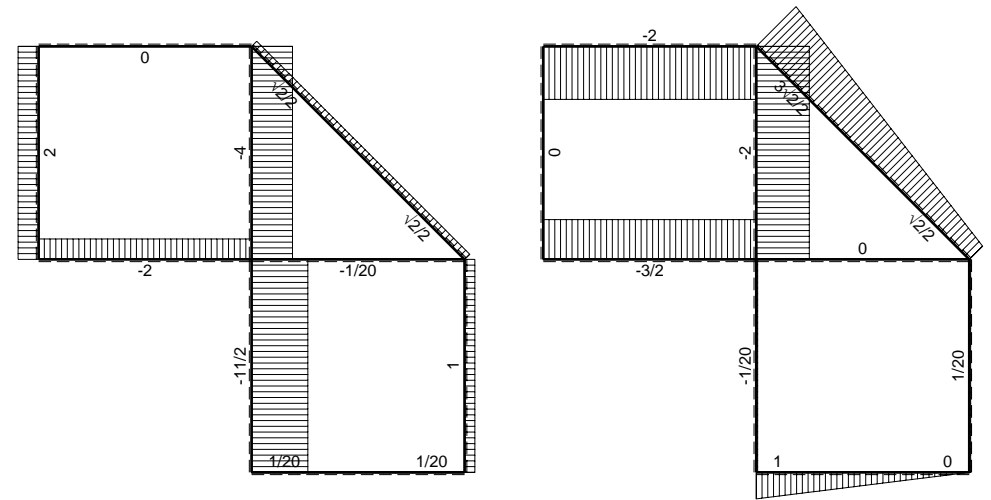
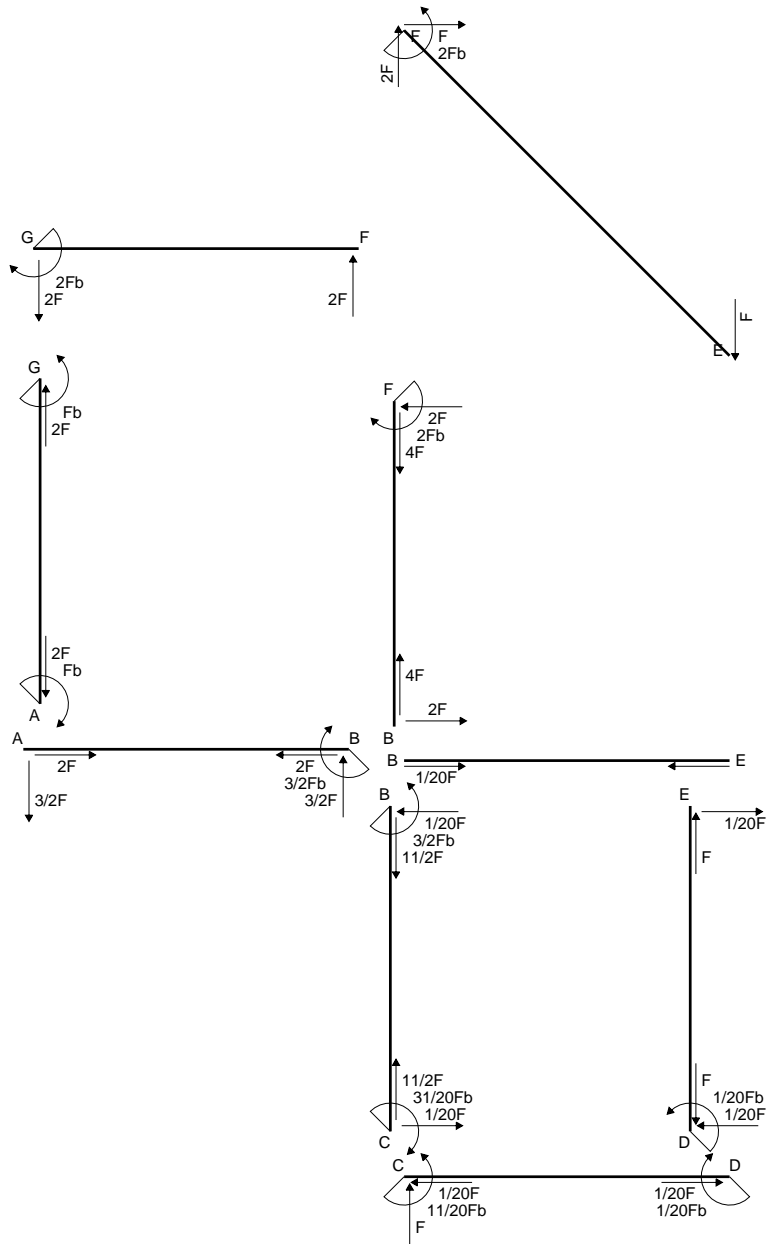
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

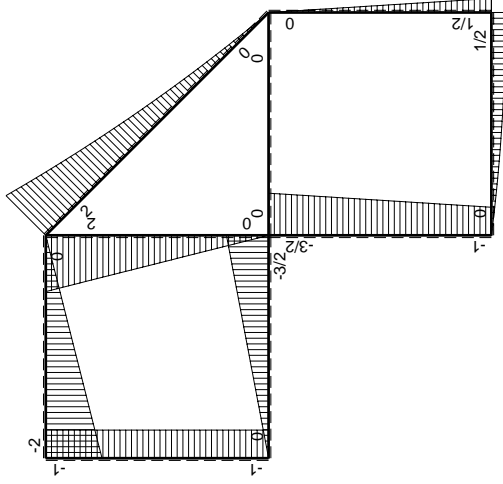
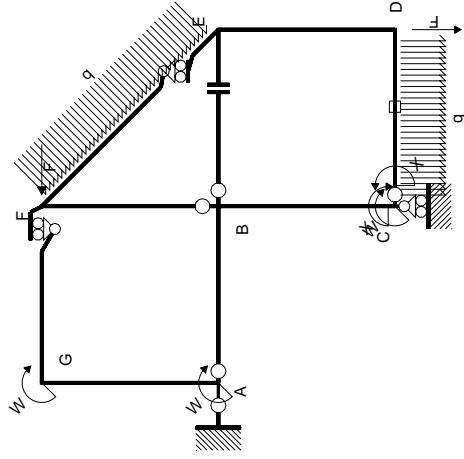
$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

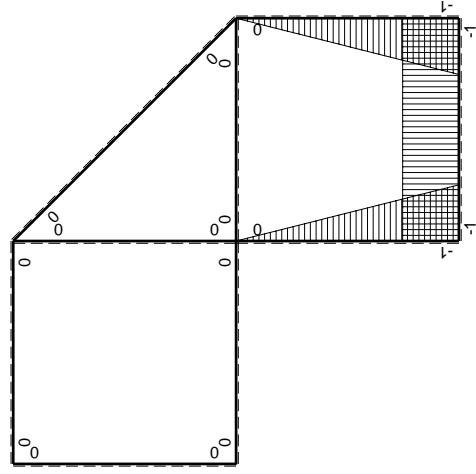
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$





(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-11/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				11/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

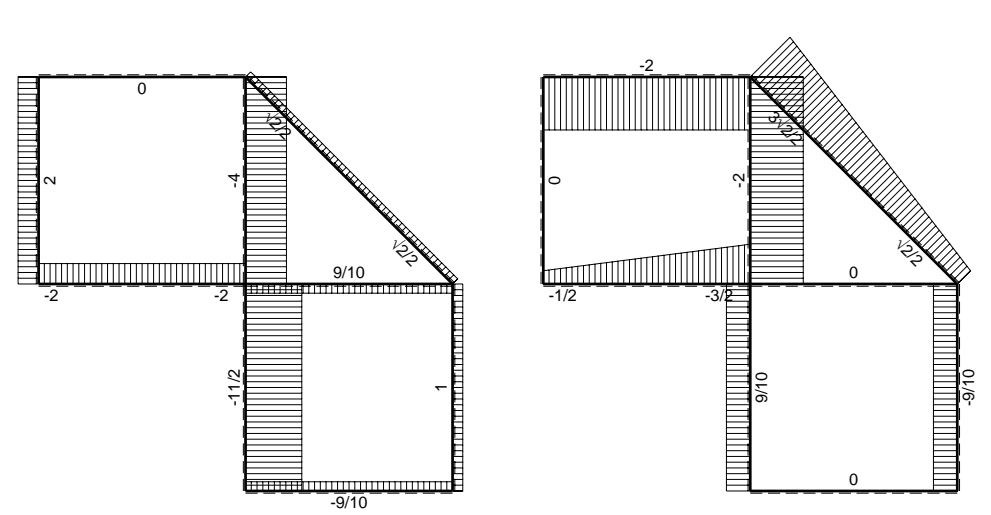
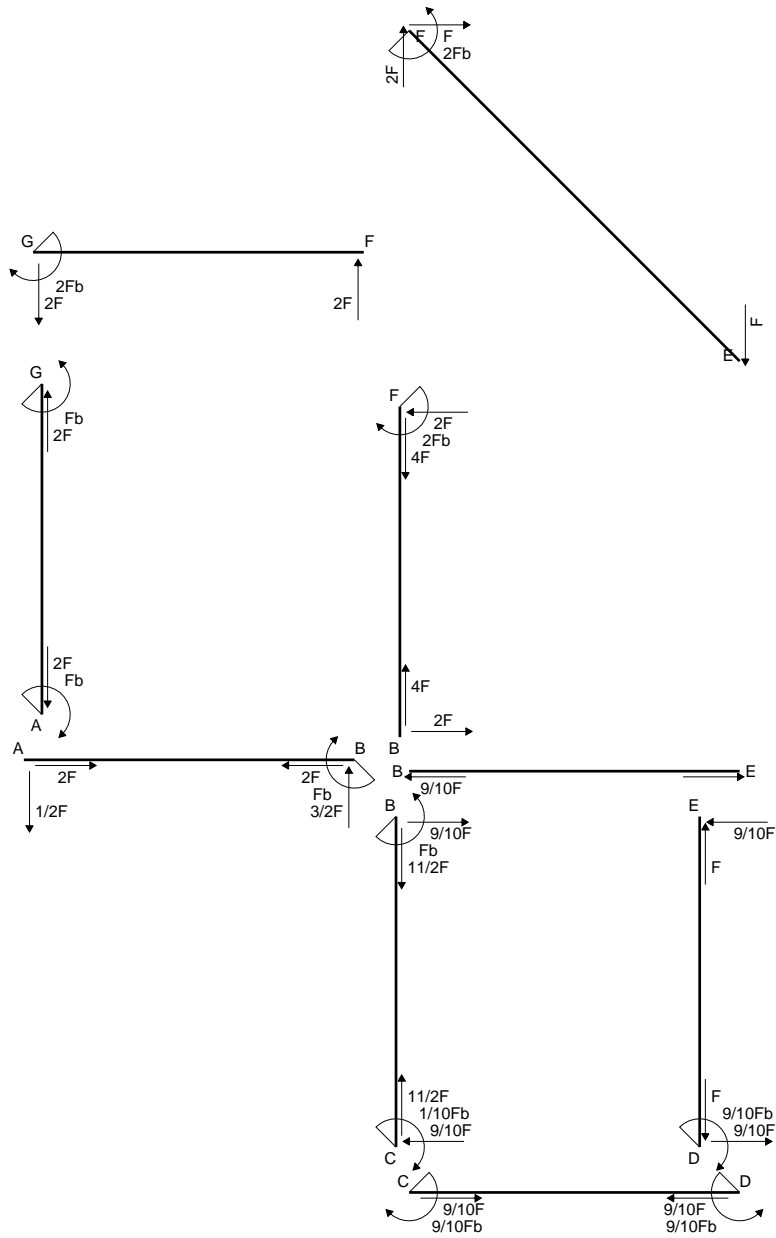
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

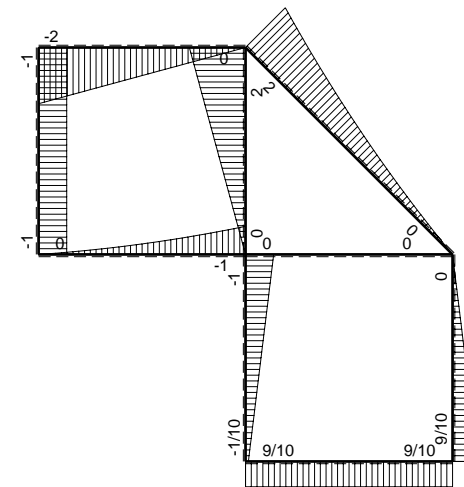
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

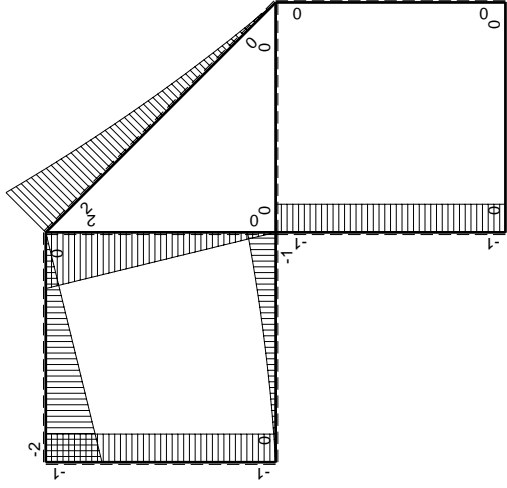
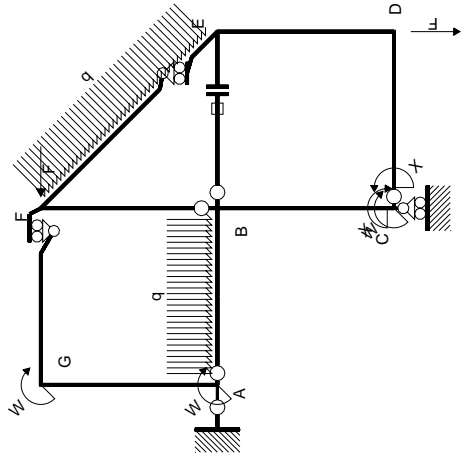


← (+) → F

↑ (+) ↓ F



⊕ (+) ⊖ Fb



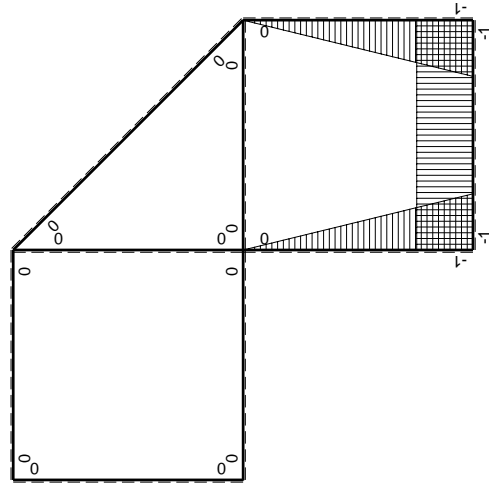
Schema di calcolo iperstatico

M_0 flessione da carichi assegnati

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$2Fb-2Fx$	0	0	0	0
BF b	0	$-2Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$-9/10Fb$	

Sviluppi di calcolo iperstatica



M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

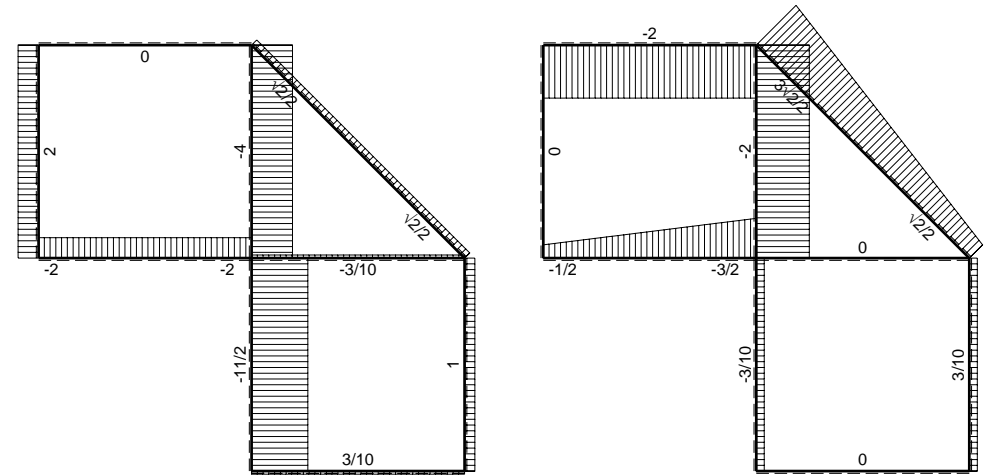
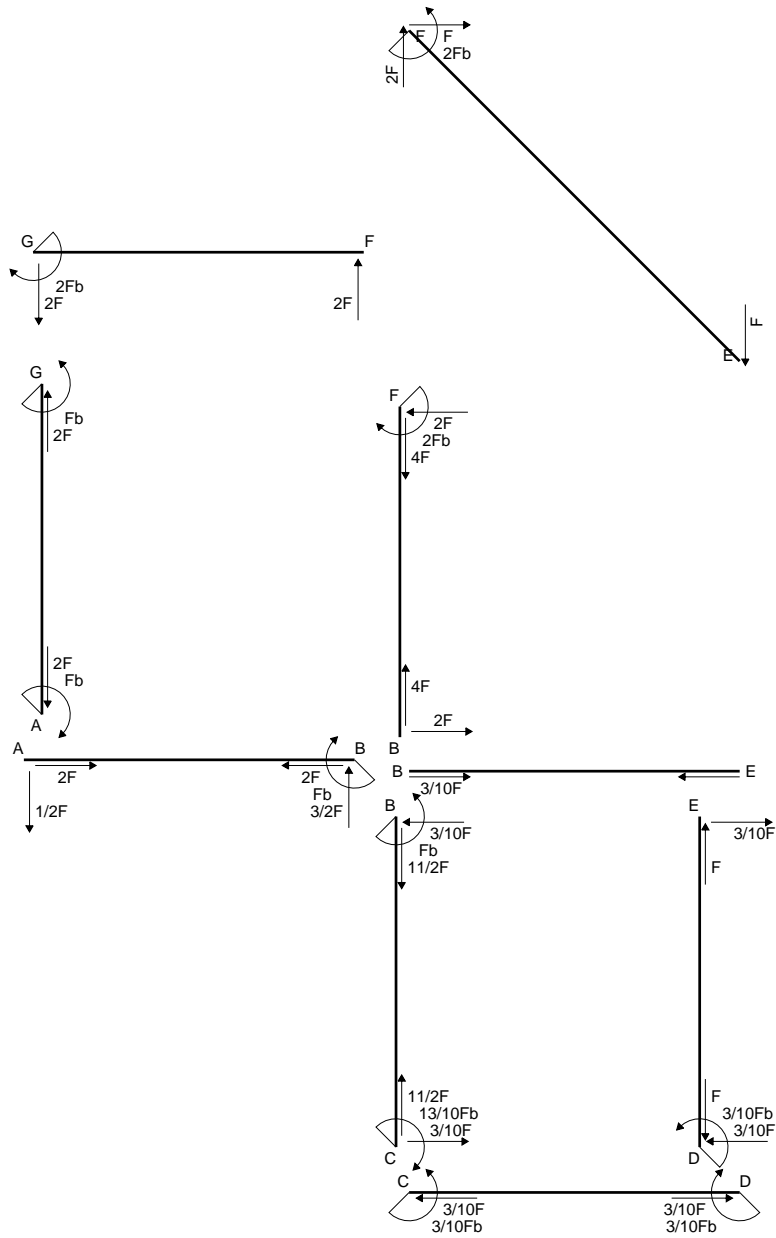
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

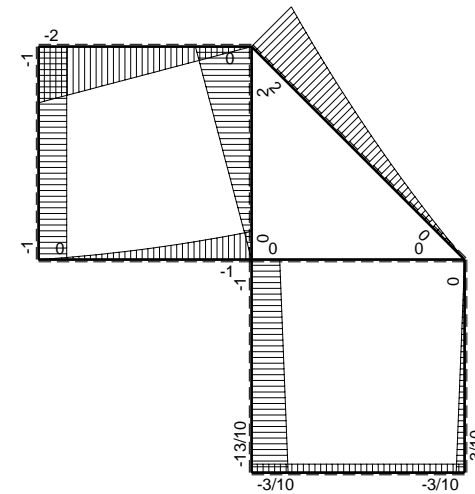
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

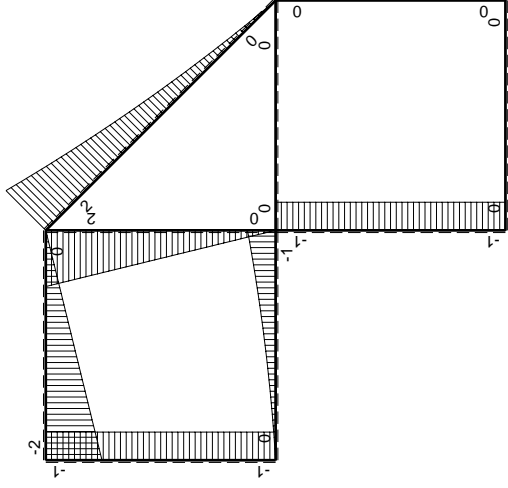
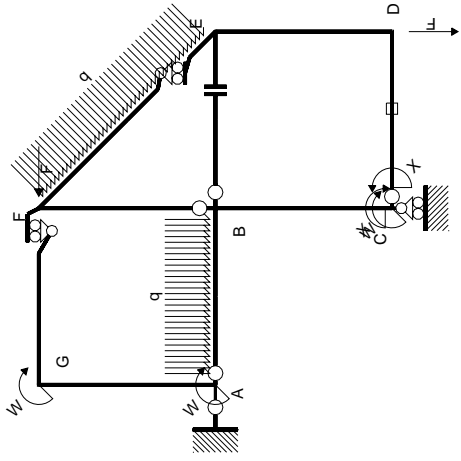


← (+) → F

↑ (+) ↓ F



⊙ (+) ⊙ F_b



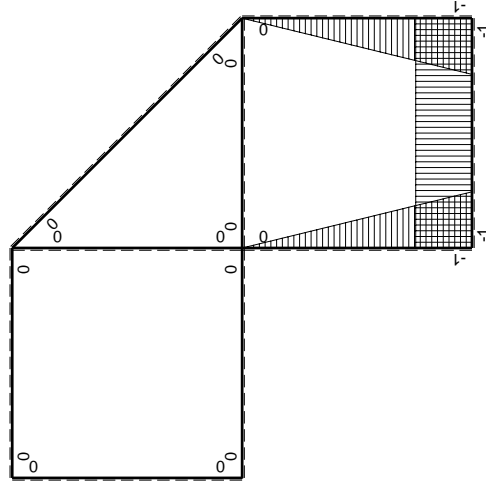
Schema di calcolo iperstatico

M_0 flessione da carichi assegnati

Quadro contributi PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$2Fb-2Fx$	0	0	0	0
BF b	0	$-2Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$3/10Fb$	

Sviluppi di calcolo iperstatica



M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

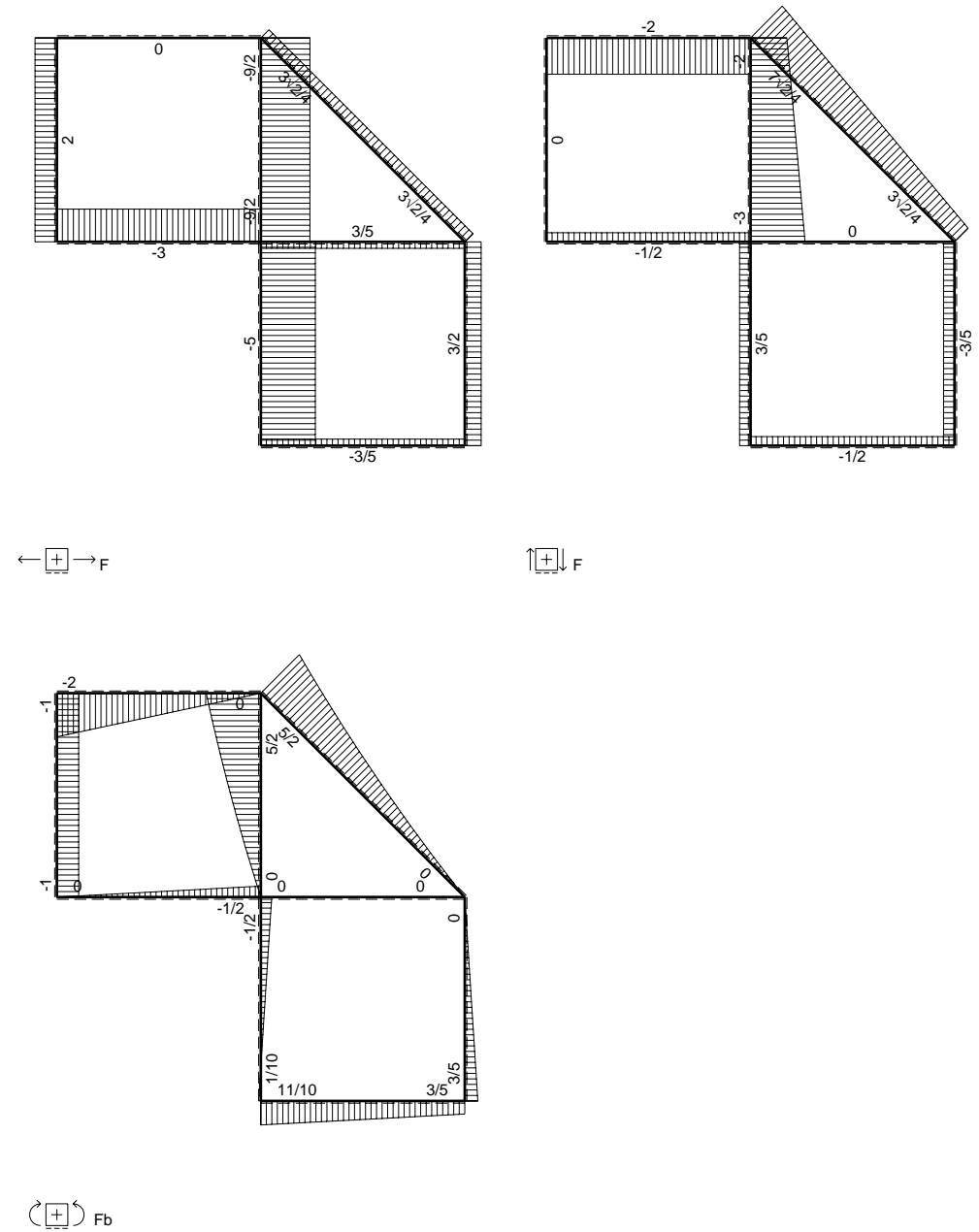
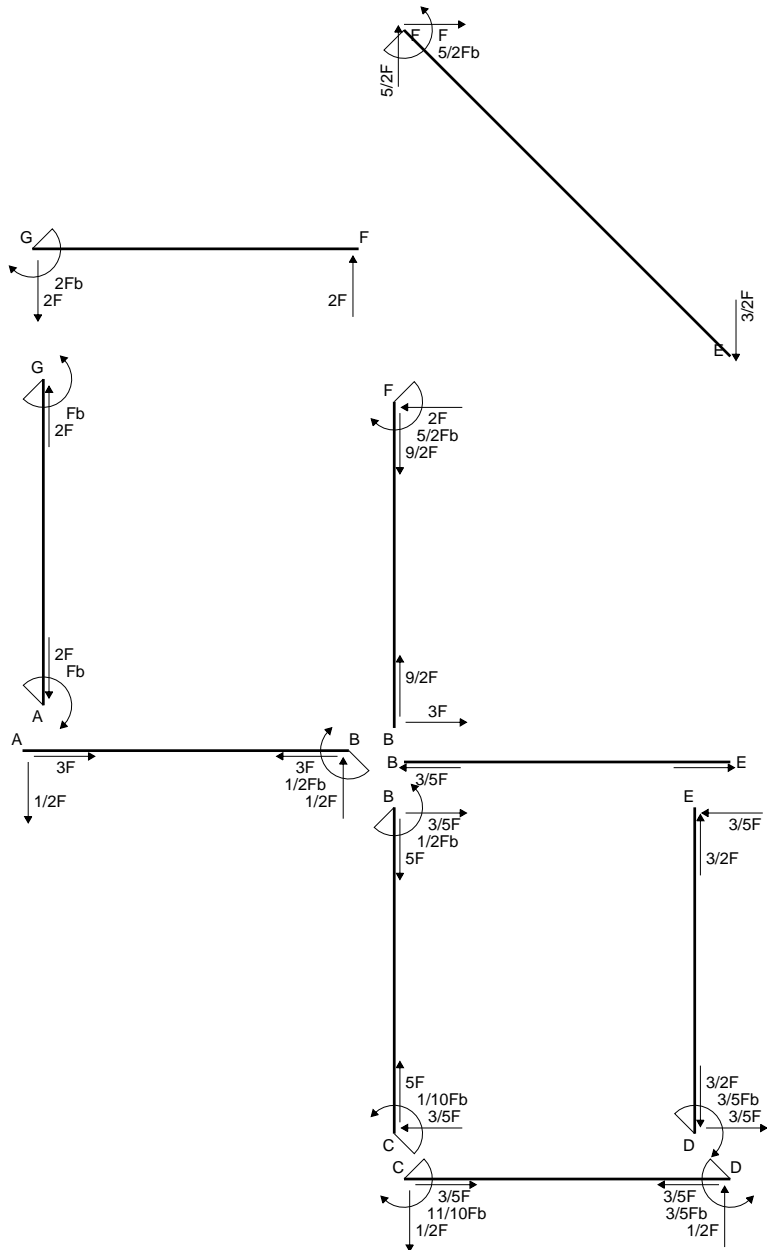
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

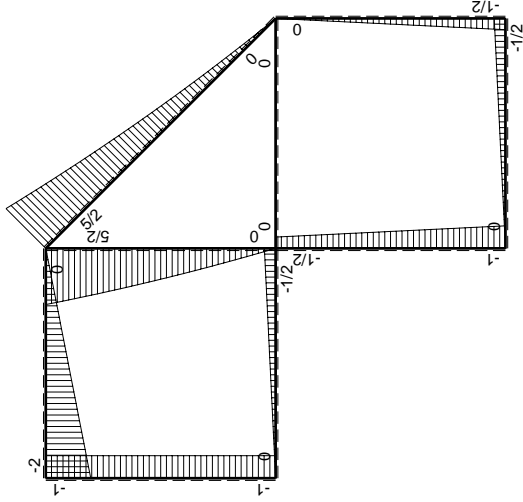
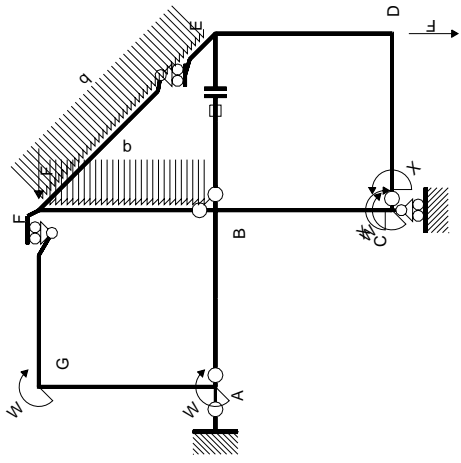
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

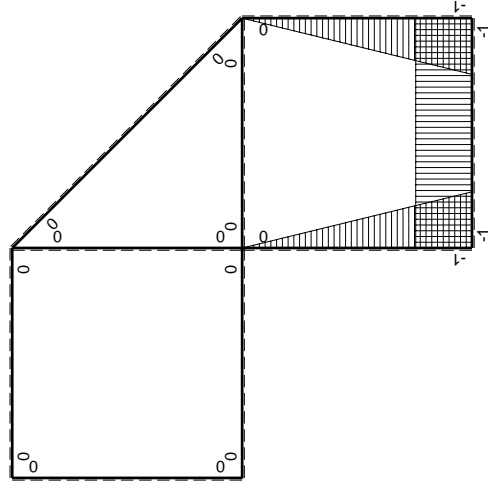
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^E$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

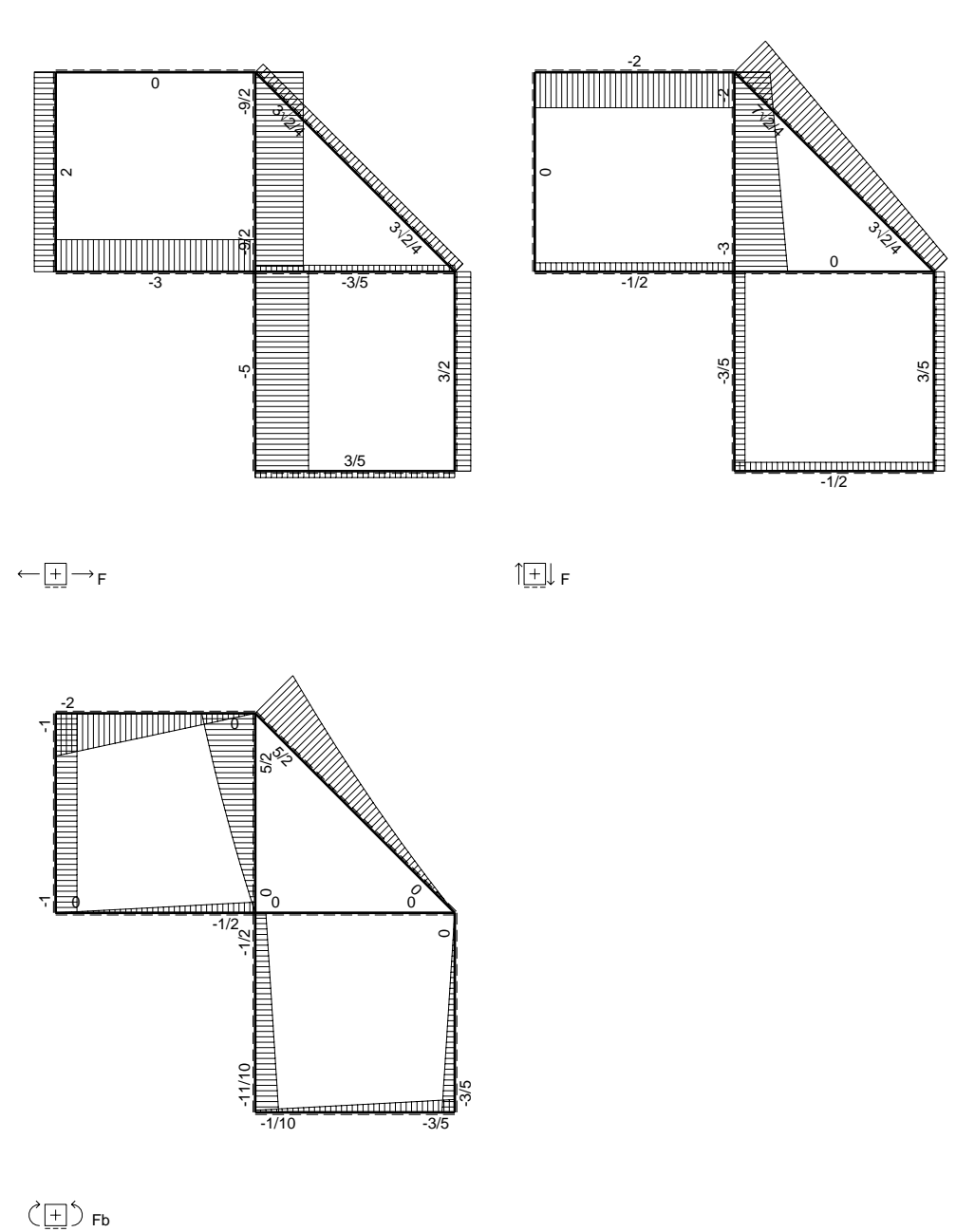
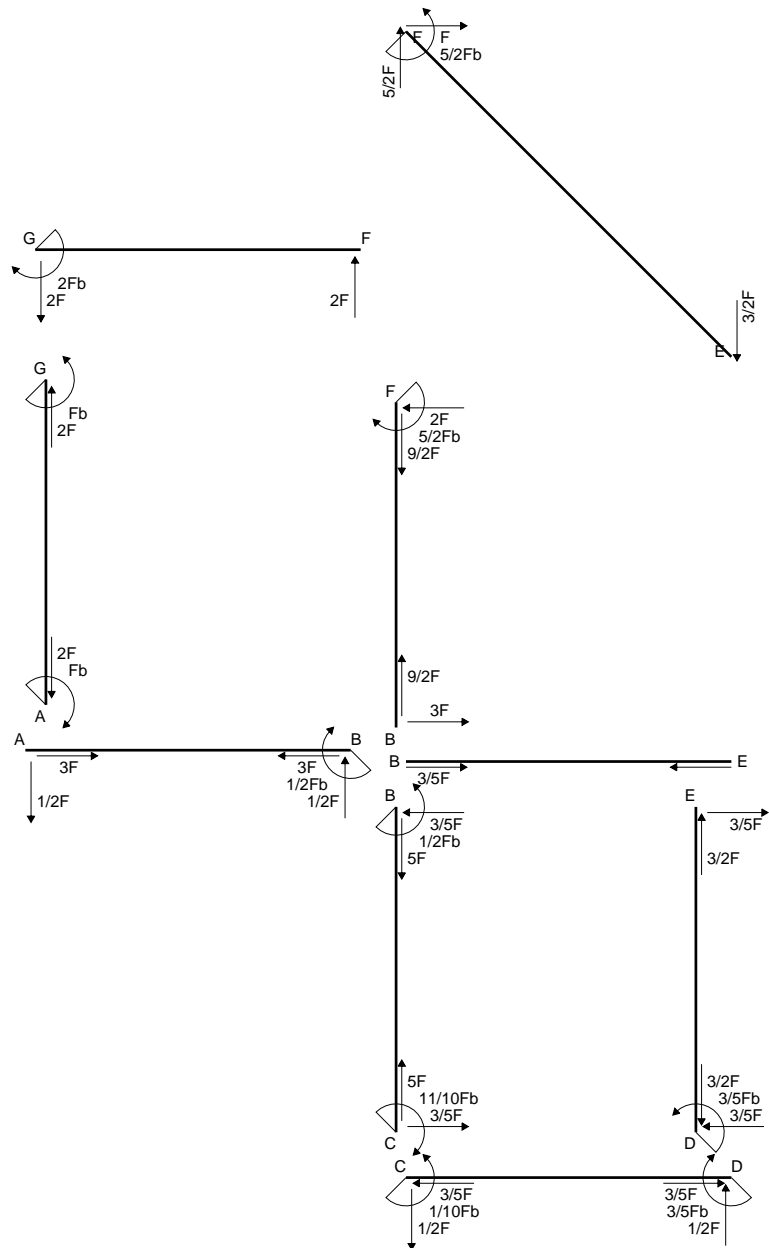
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

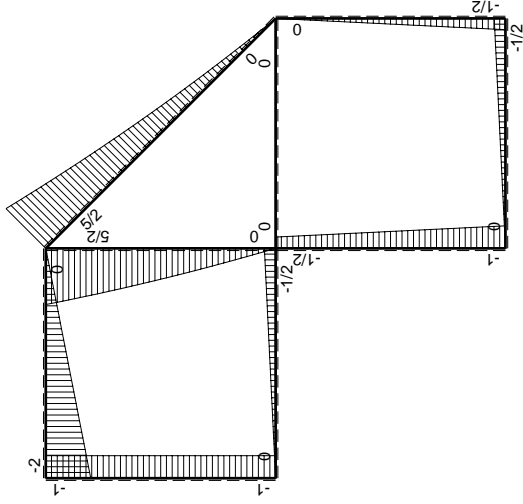
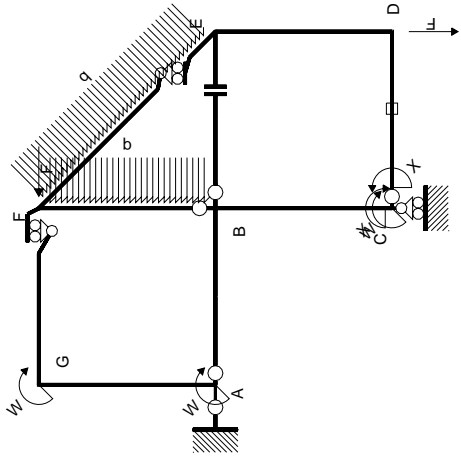
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

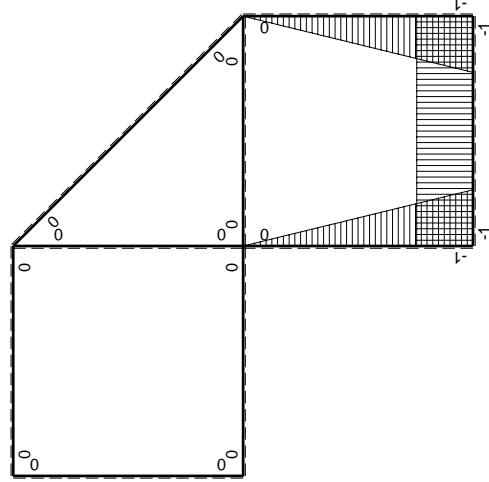
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

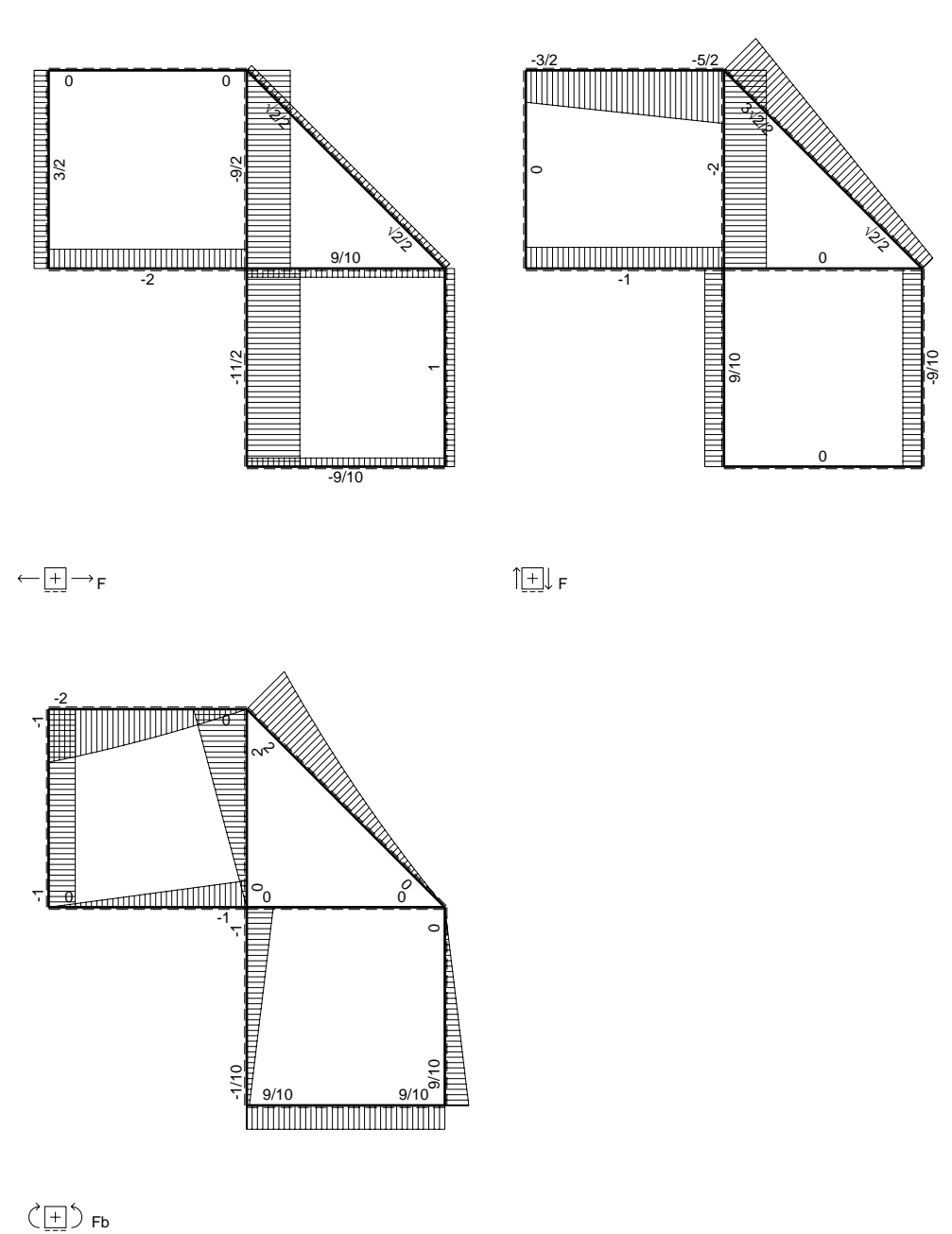
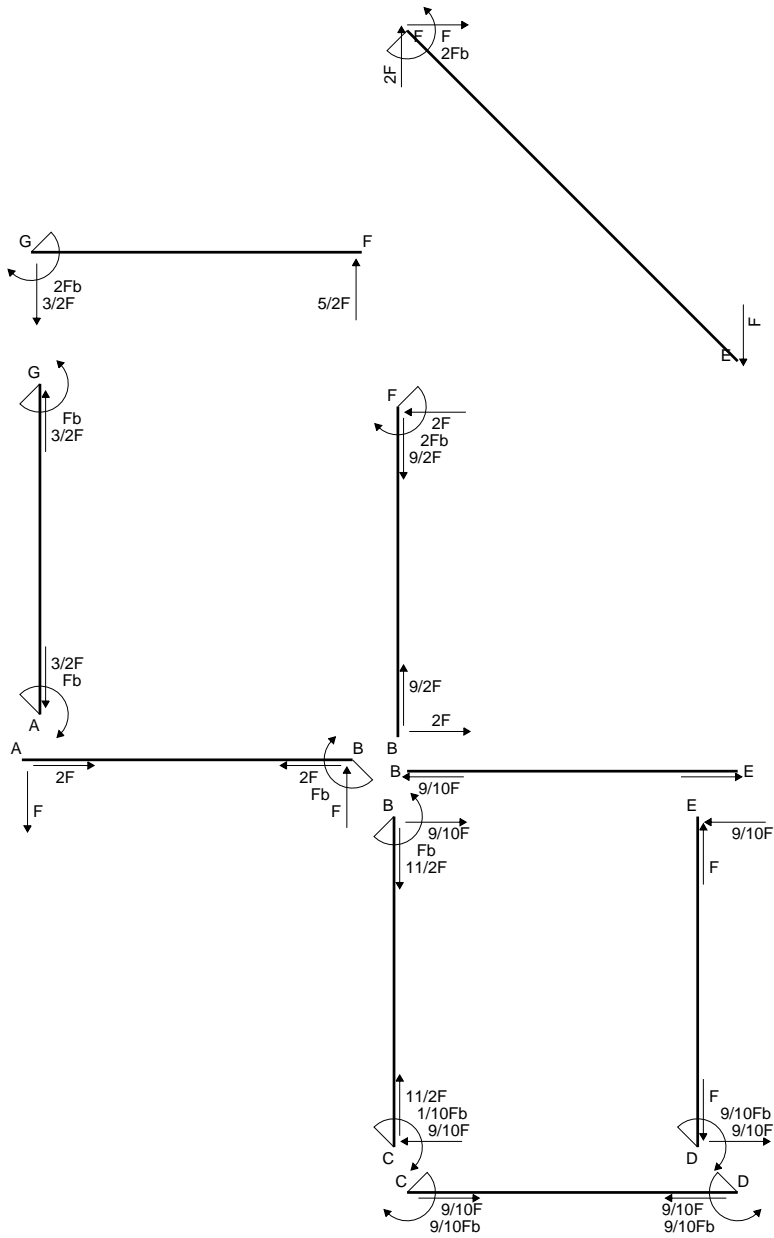
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

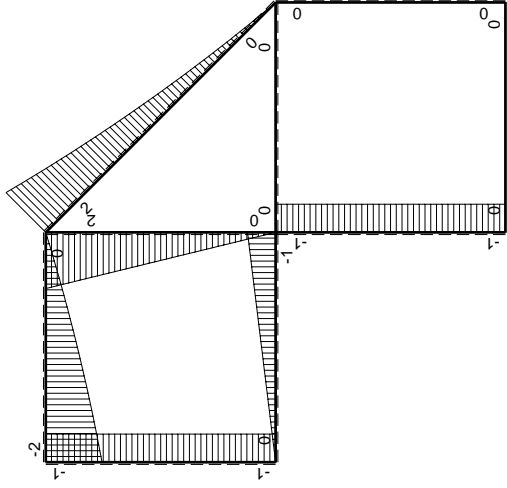
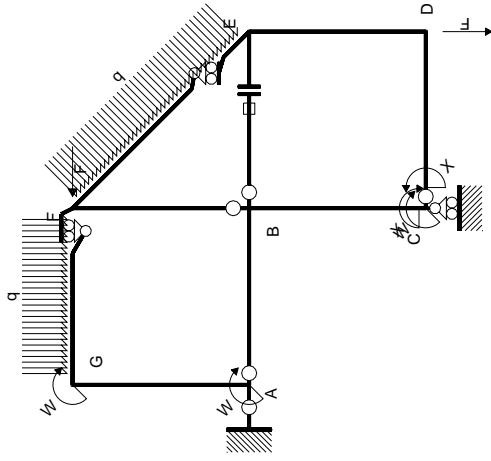
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

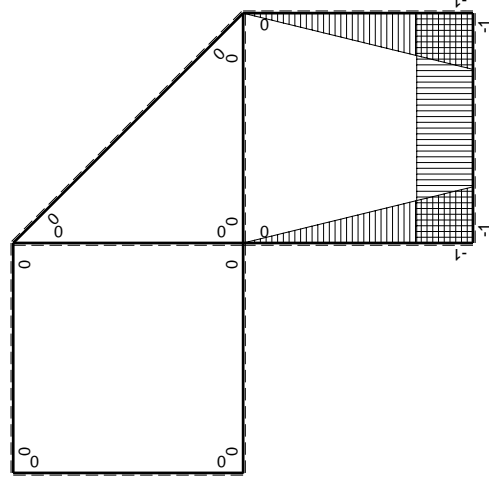
M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	$-5/2 Fx + 1/2 qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2 Fx - 1/2 qx^2$	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$2Fb - 2Fx$	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2 Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica $X=W_{cd}$				$-9/10 Fb$	

Sviluppi di calcolo iperstatica



$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

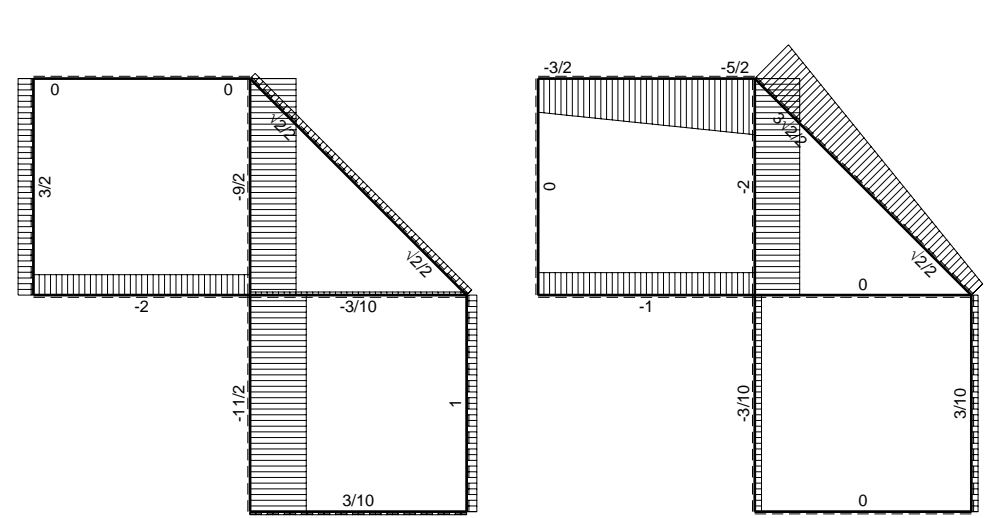
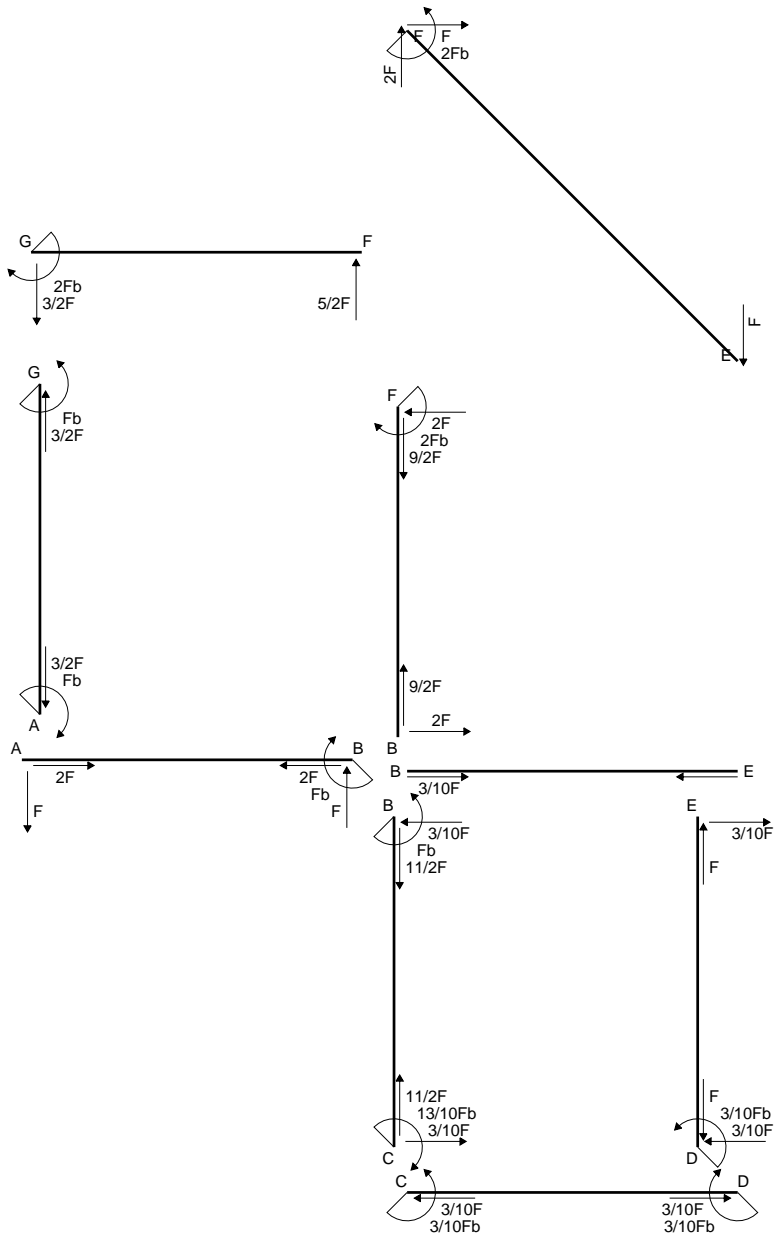
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

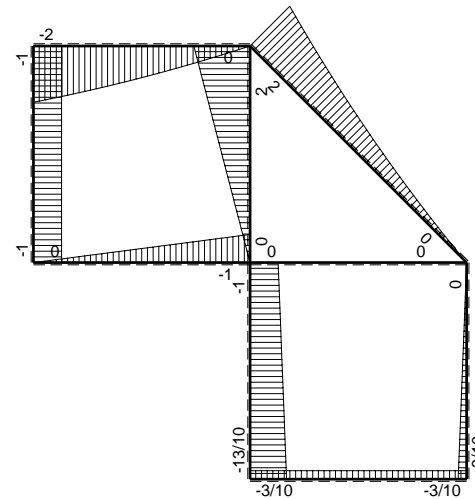
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

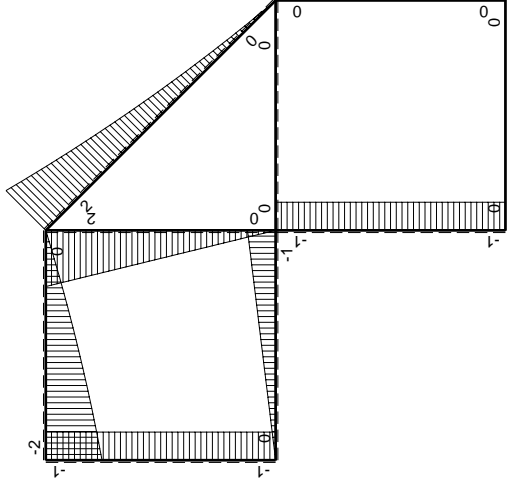
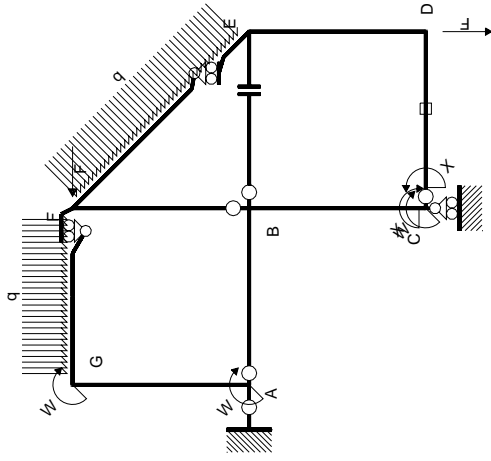


← ⊕ → F

↑ ⊕ ↓ F_b



⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	$-5/2 Fx + 1/2 qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2 Fx - 1/2 qx^2$	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$2Fb - 2Fx$	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/2 Fb ² /EJ	5/3 Xb/EJ
	iperstatica $X=W_{cd}$				3/10 Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

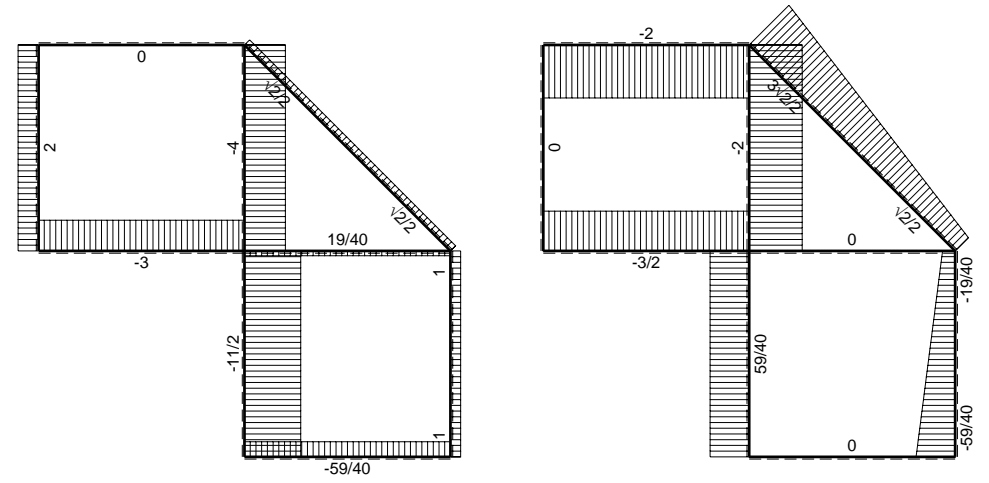
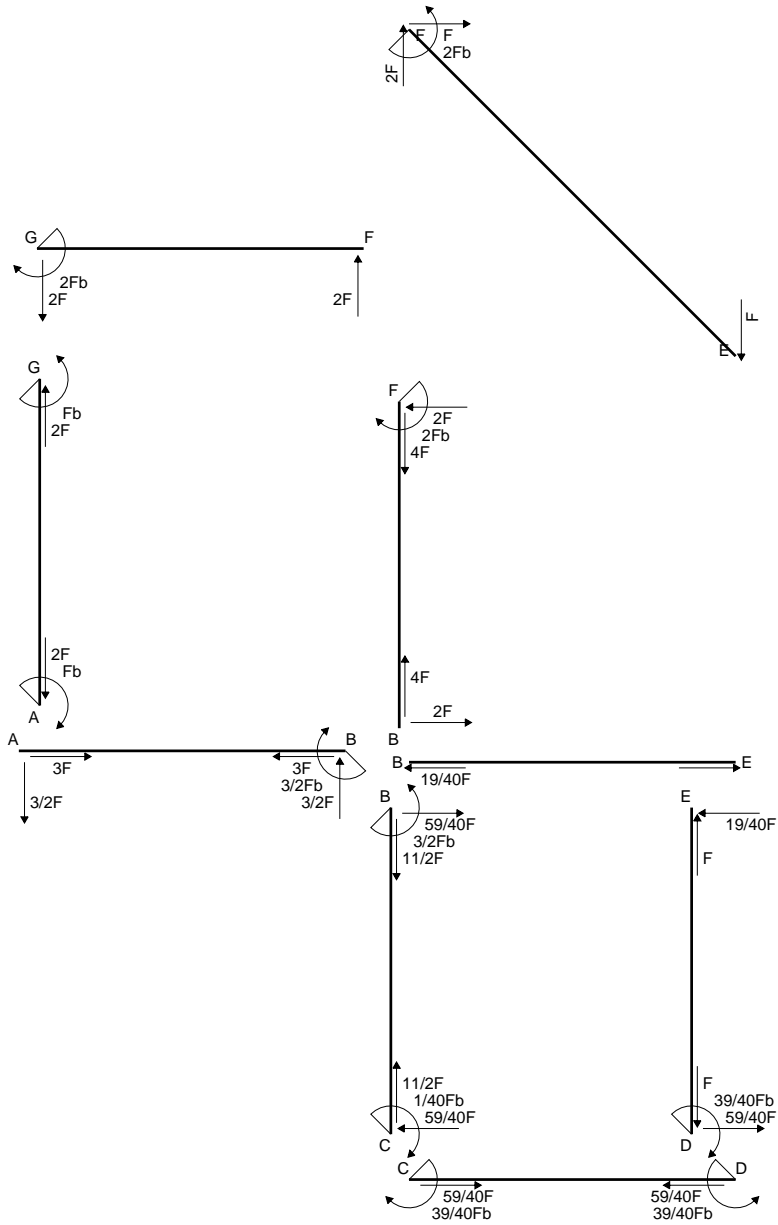
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

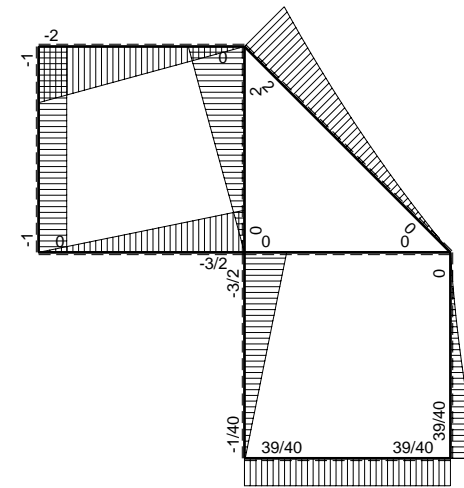
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

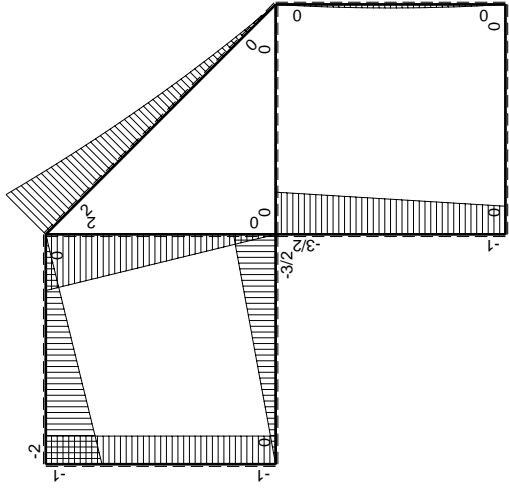
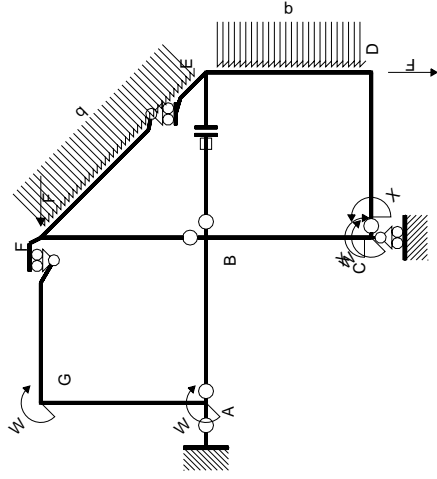


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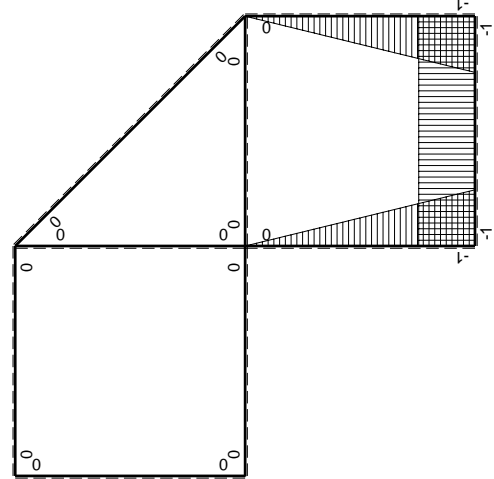


⊙ (+) ⊙ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx+1/2qx ²	1/2Fx-Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	1/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx-1/2qx ²	1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				13/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-39/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

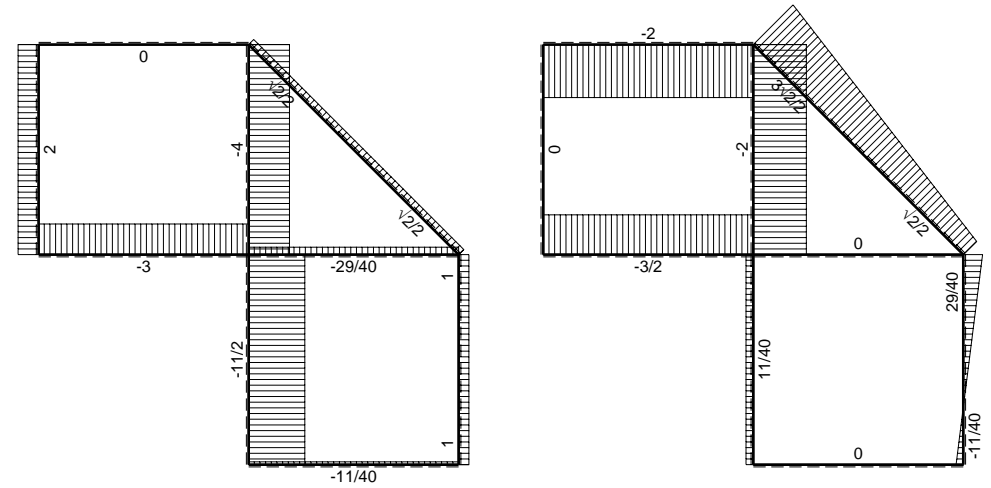
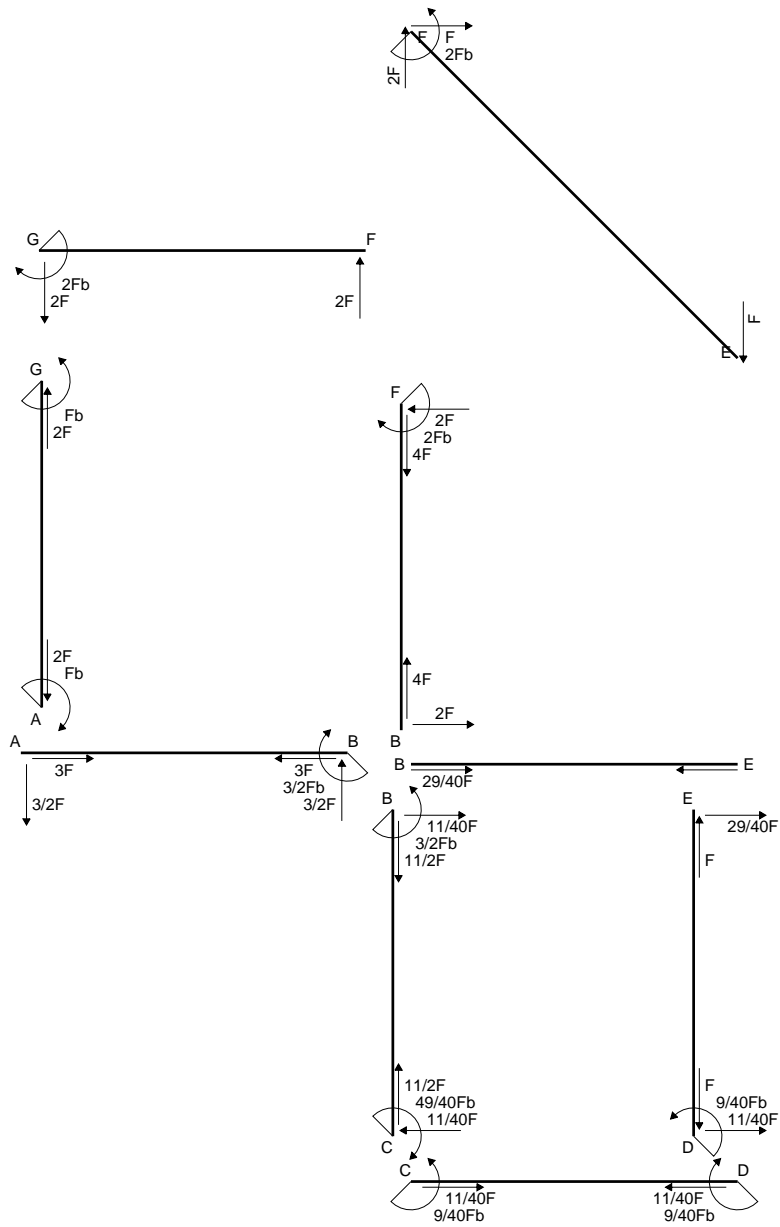
$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

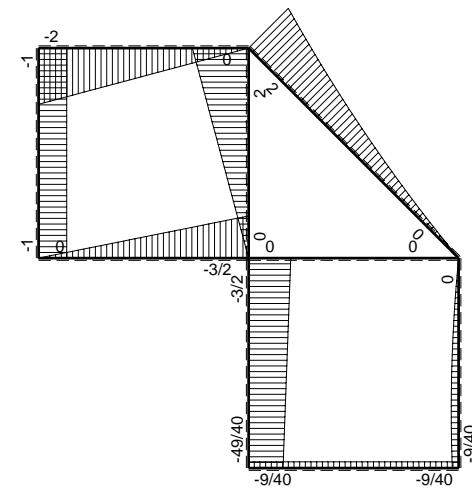
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

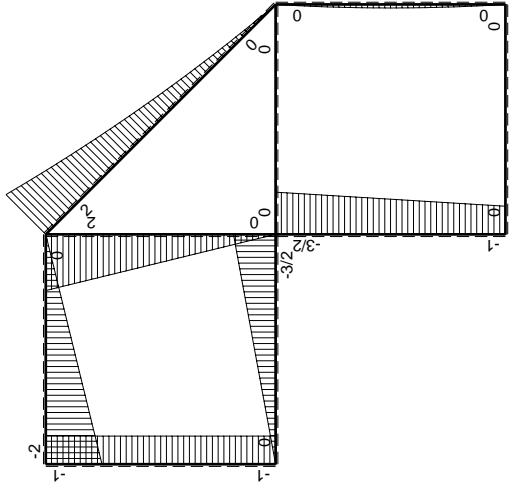
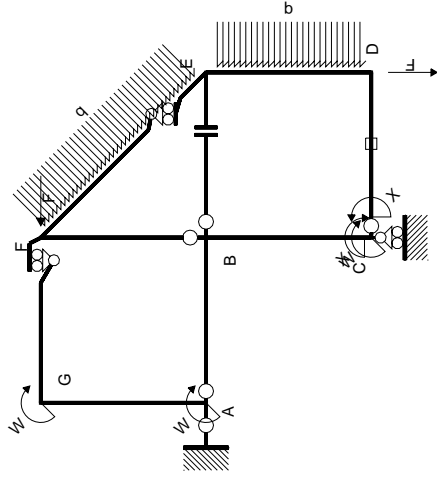


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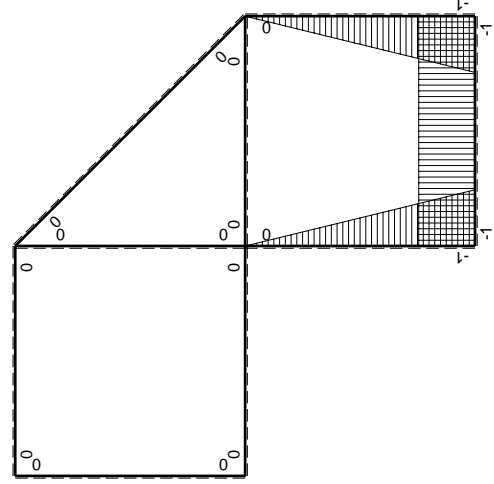


⊕ (+) ⊖ (-) F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx+1/2qx ²	1/2Fx-Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	1/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx-1/2qx ²	1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-3/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				9/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \cdot b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

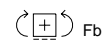
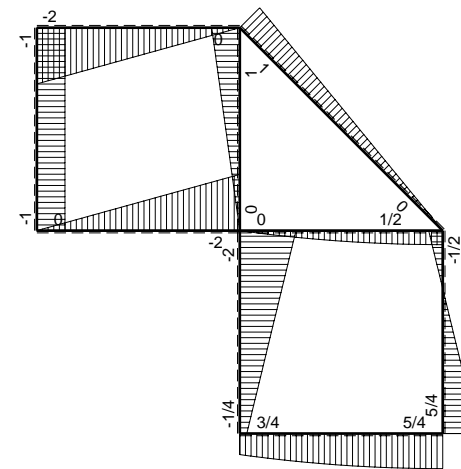
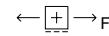
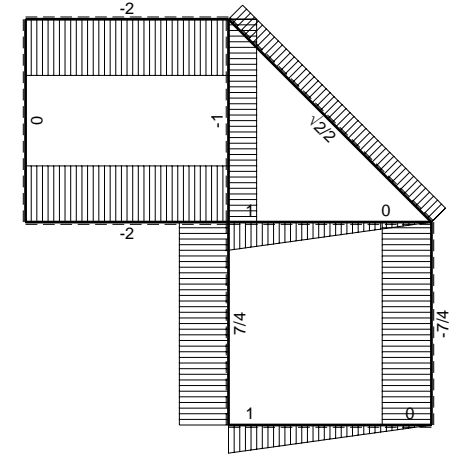
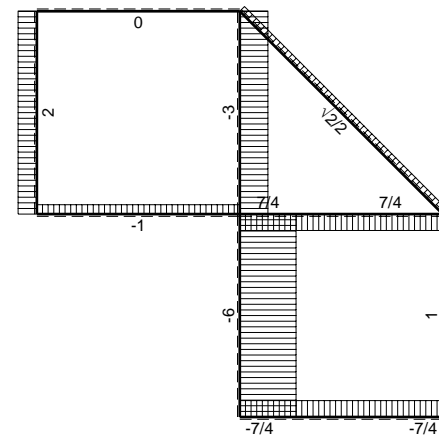
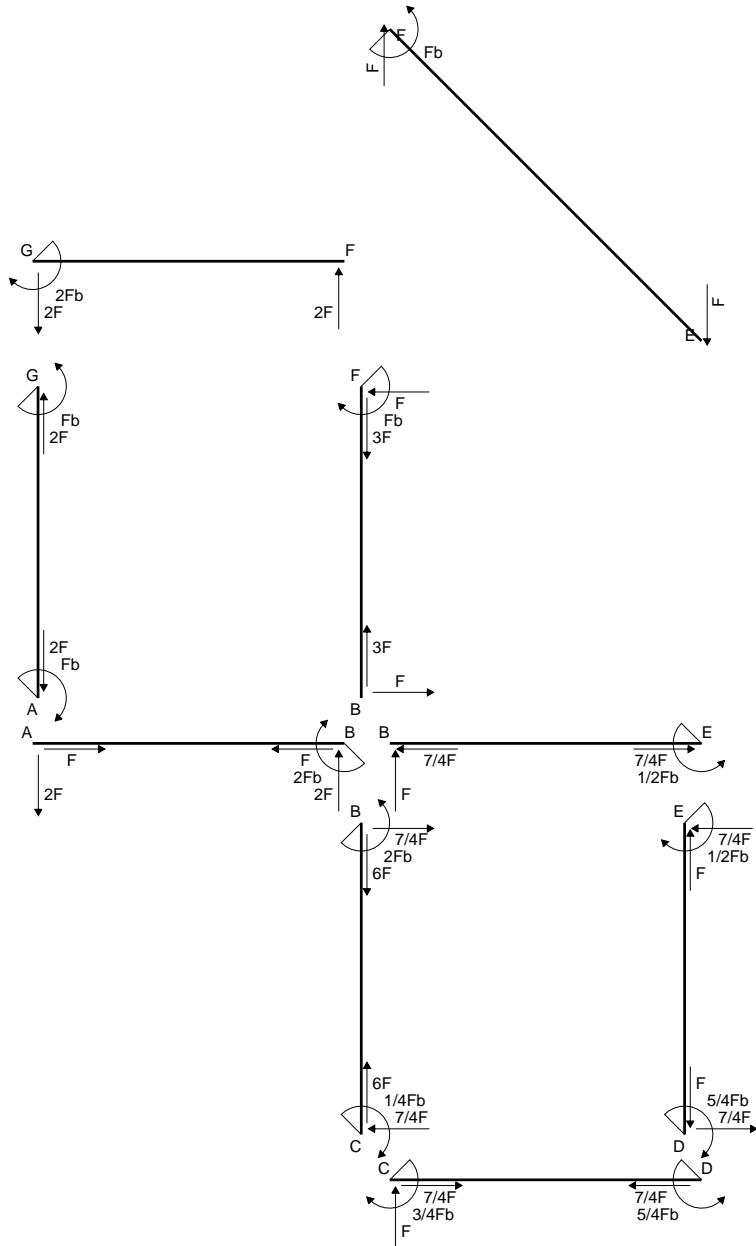
$$= (b - 1/4 \cdot b - 1/6 \cdot b) \cdot Fb \cdot 1/EJ = 7/12 \cdot Fb^2/EJ$$

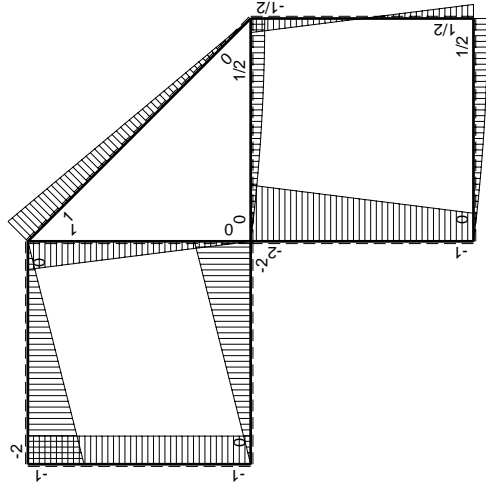
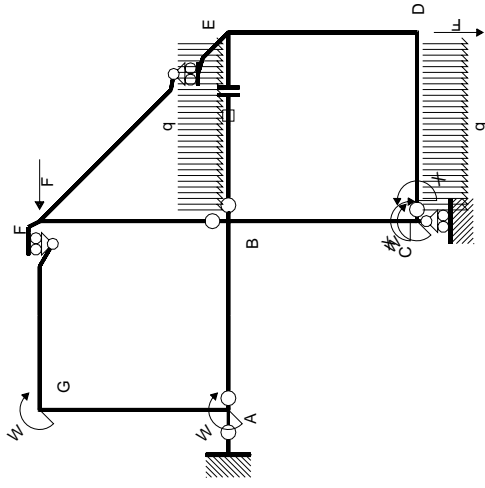
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{3} x^3/b^2 + \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 \cdot b - 1/3 \cdot b + 1/8 \cdot b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

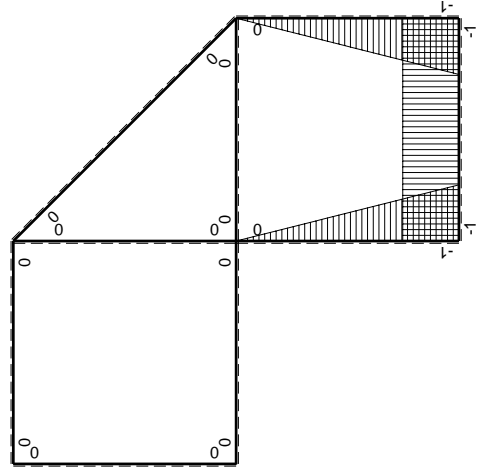
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{6} x^3/b^2 - \frac{1}{8} x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 \cdot b - 1/8 \cdot b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/12Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	1/2Fb-Fx	-1/2Fb+3/2Fx-Fx ² /b	1-2x/b+x ² /b ²	-1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-Fx	1/2Fx-Fx ² /b	x ² /b ²	-1/12Fb ² /EJ	1/3Xb/EJ
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1BE} \epsilon_{BE} = L_{BE}$				Fb ² /EJ	
	totali				5/4Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-3/4Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

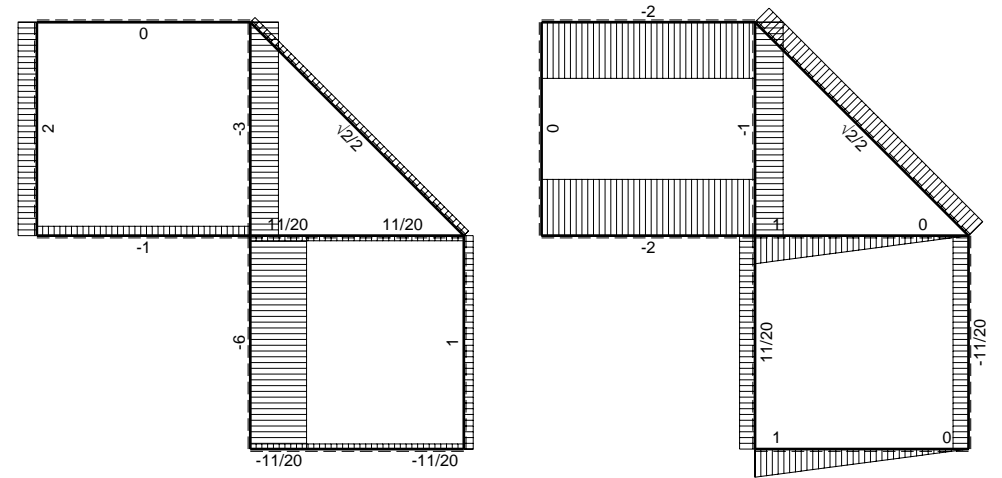
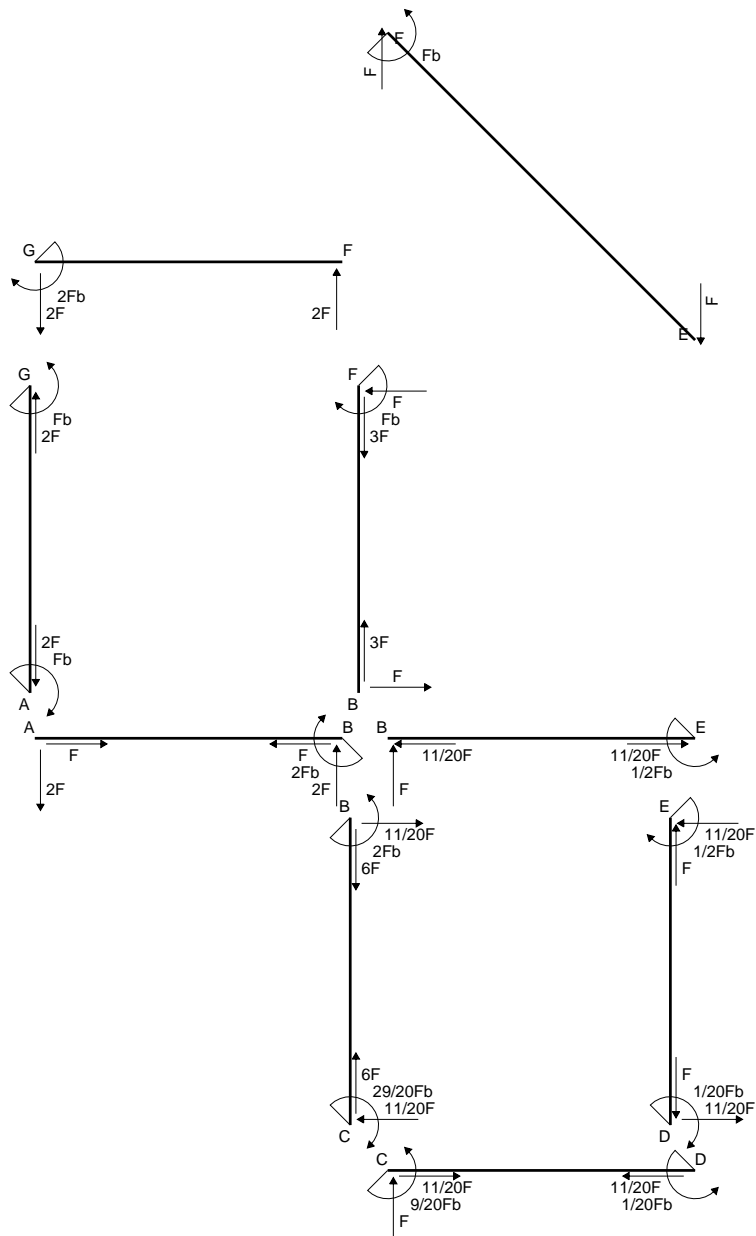
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 3/2 x/b - x^2/b^2) Fb 1/EJ dx = [-1/2 x + 3/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 3/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

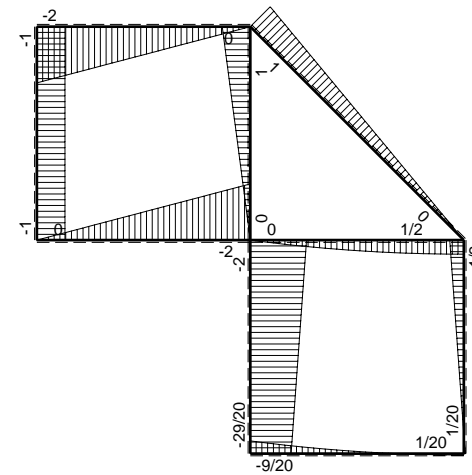
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

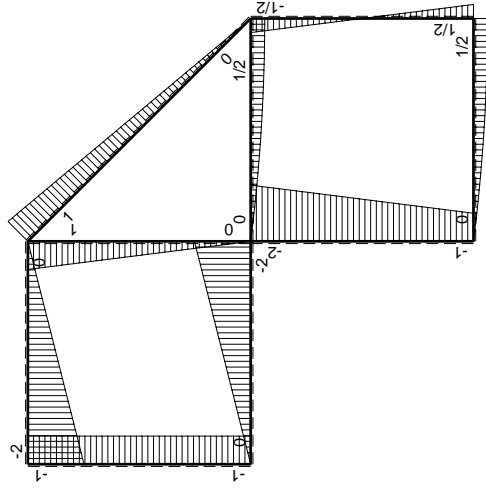
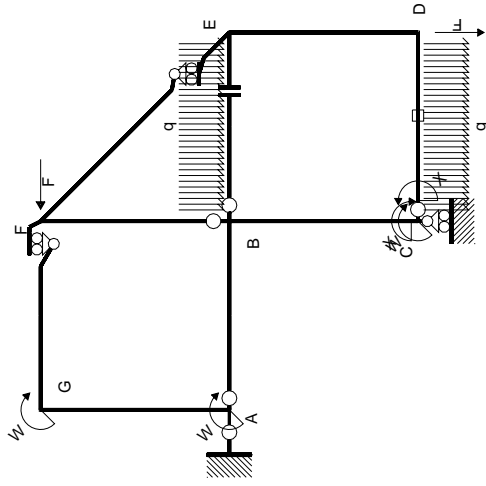


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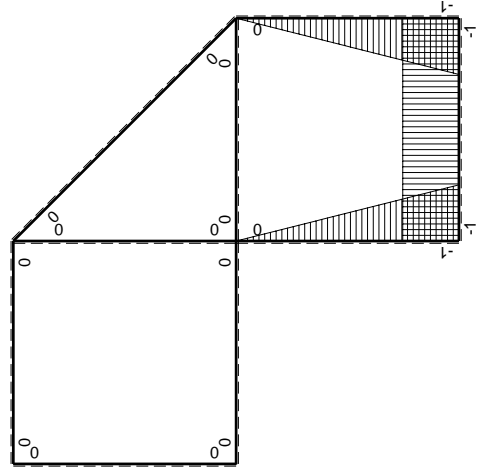
↑ ⊕ ↓ F



⊕ ⊖ Fb



(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	2Fx-Fx ² /b	x ² /b ²	2/3Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/12Fb ² /EJ	1/3Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	-1/12Fb ² /EJ	1/3Xb/EJ
DE b	-1+x/b	1/2Fb-Fx	-1/2Fb+3/2Fx-Fx ² /b	1-2x/b+x ² /b ²	-1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-Fx	1/2Fx-Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} l_{cd}$				-Fb ² /EJ	
	totali				-3/4Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				9/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

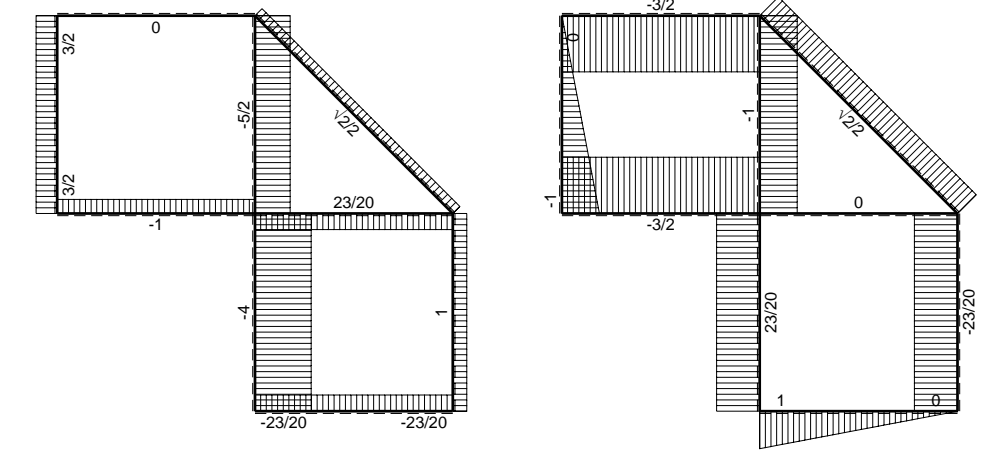
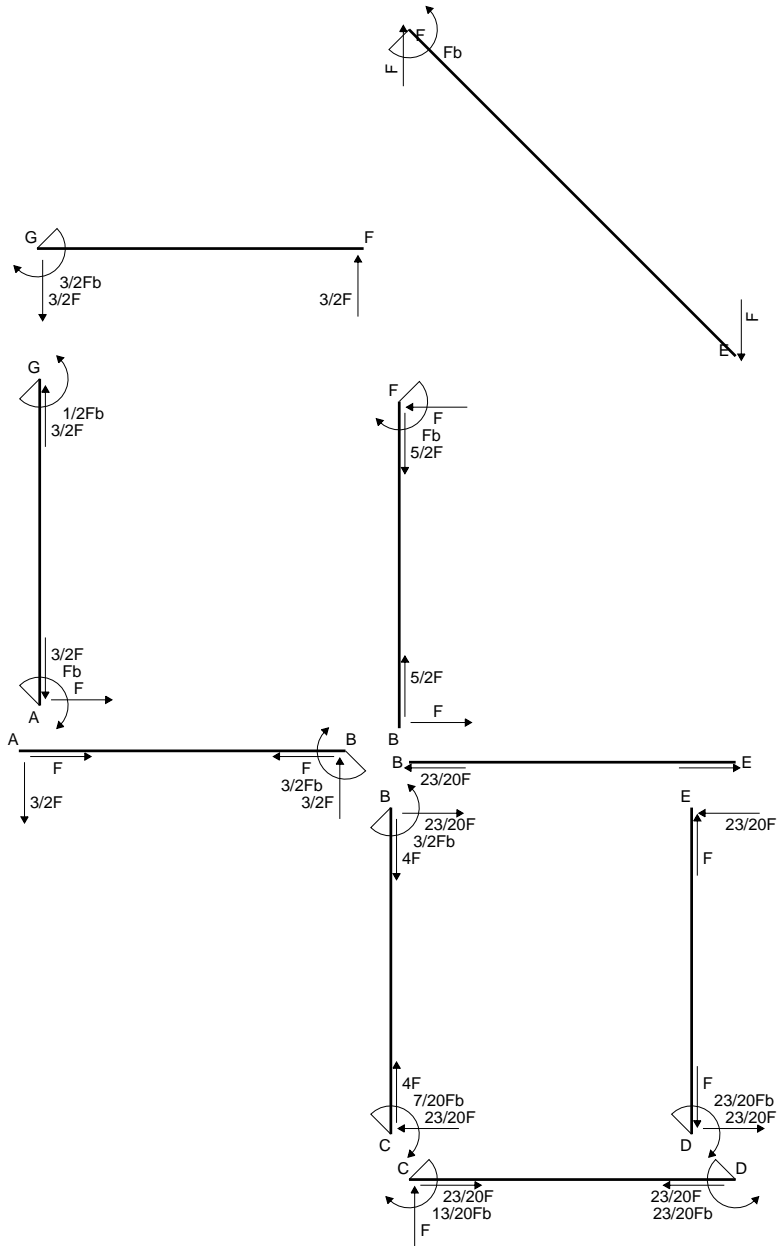
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + 3/2 x/b - x^2/b^2) Fb 1/EJ dx = [-1/2 x + 3/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 3/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

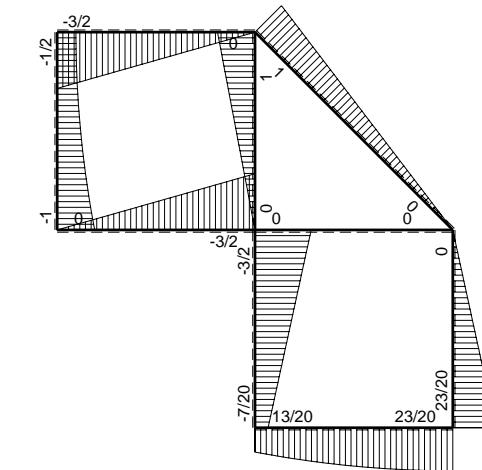
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

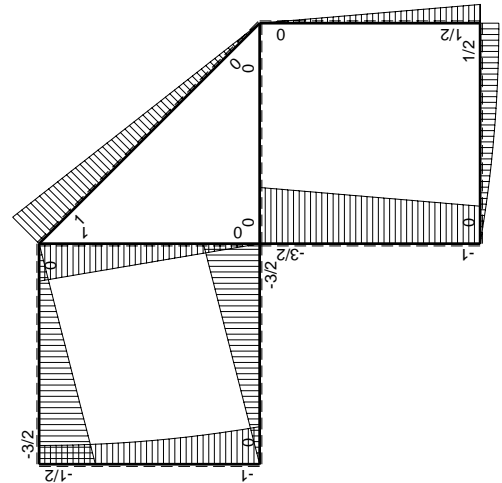
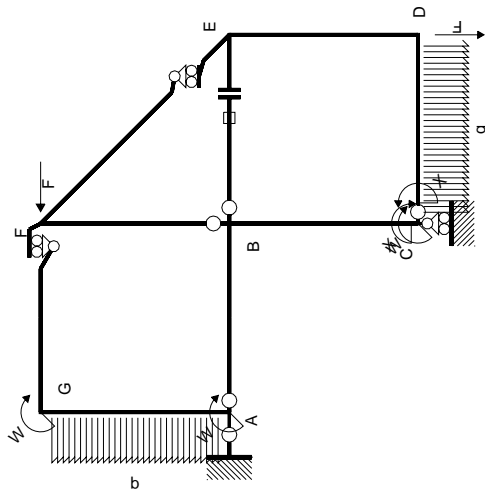


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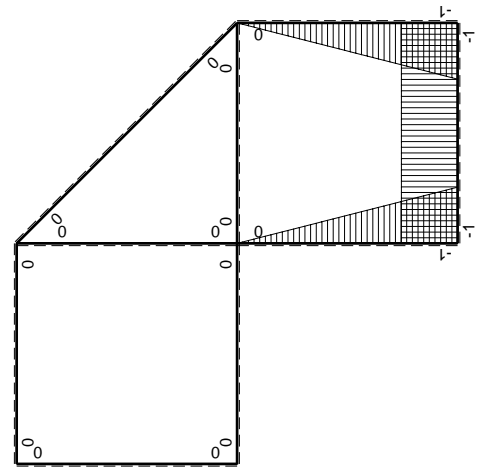
↑ ⊕ ↓ F



⊕ ⊖ F_b



(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1		
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE}} L_{BE}$				Fb ² /EJ	
	totali				13/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

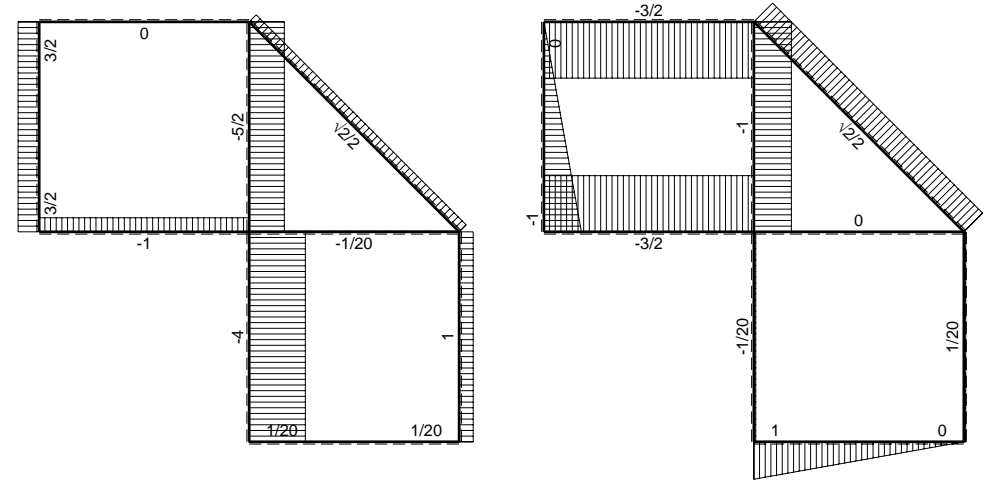
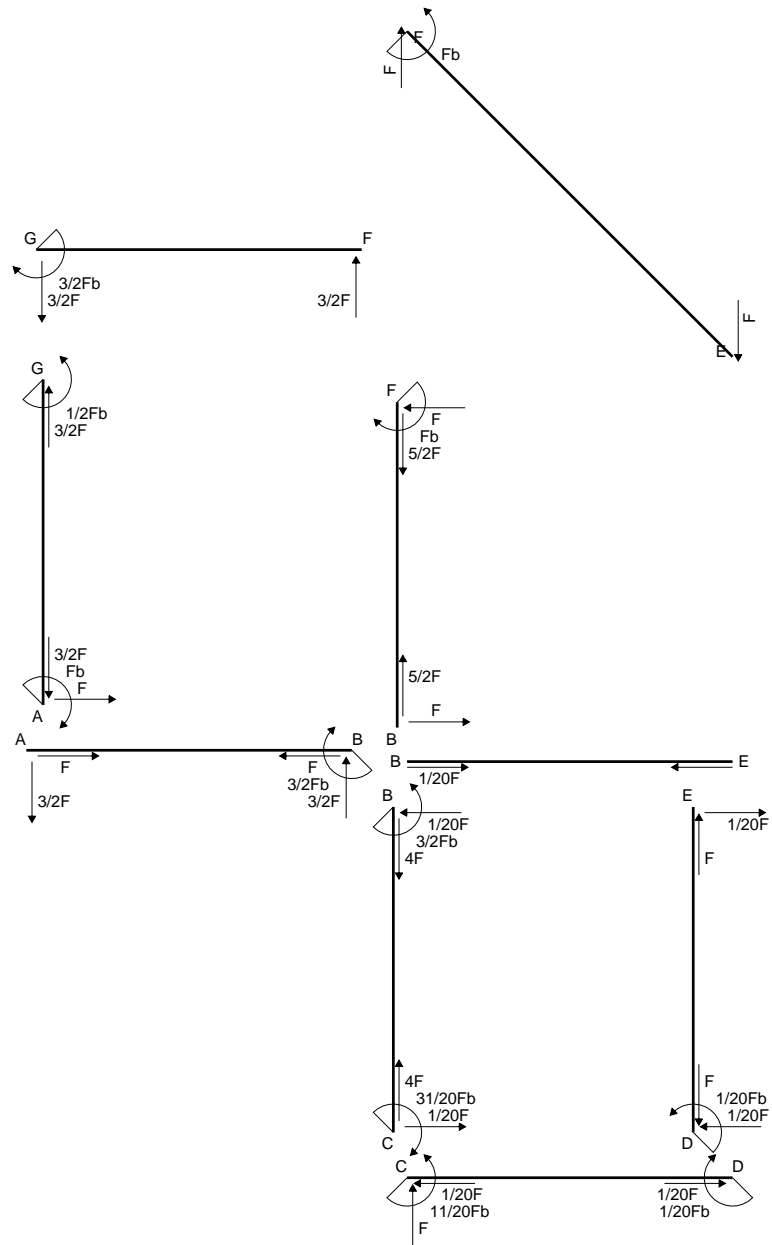
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

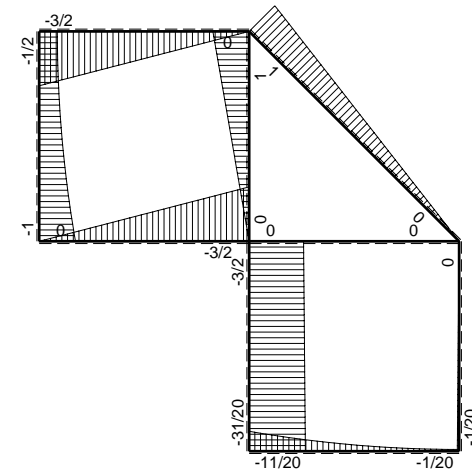
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

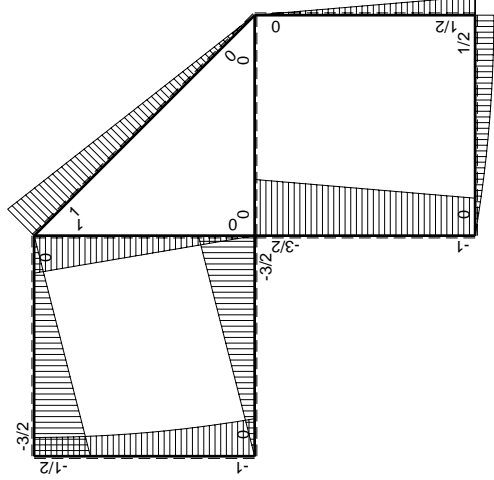
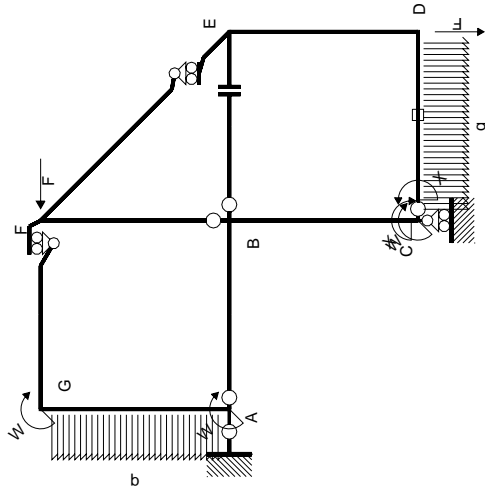


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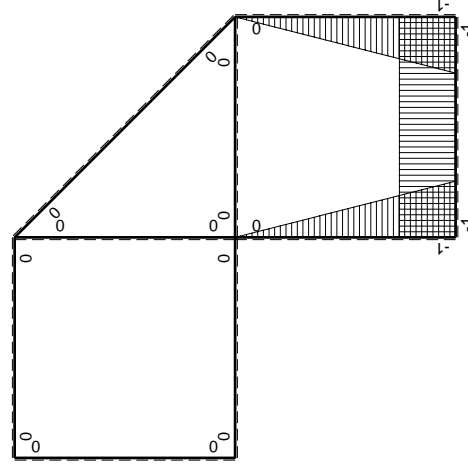
↑ ⊕ ↓ F



⊕ ⊖ F_b



(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1		
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				-Fb ² /EJ	
	totali				-11/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				11/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

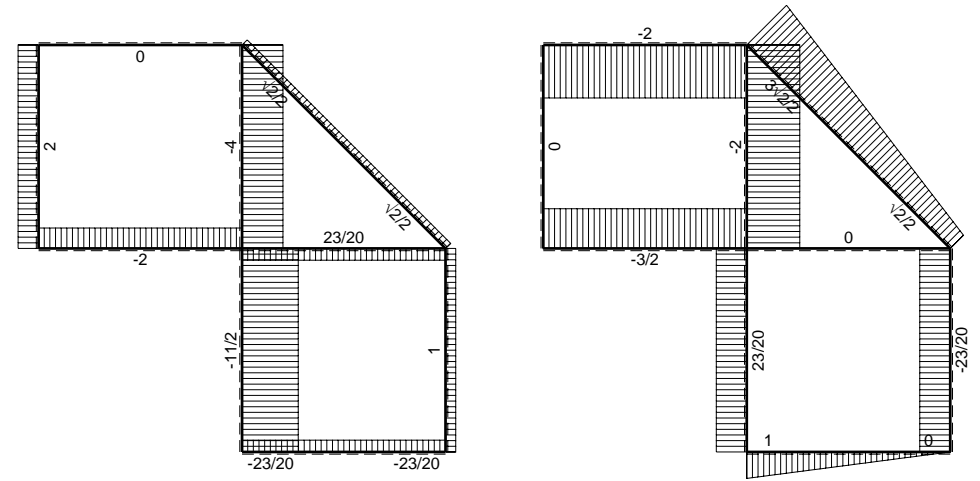
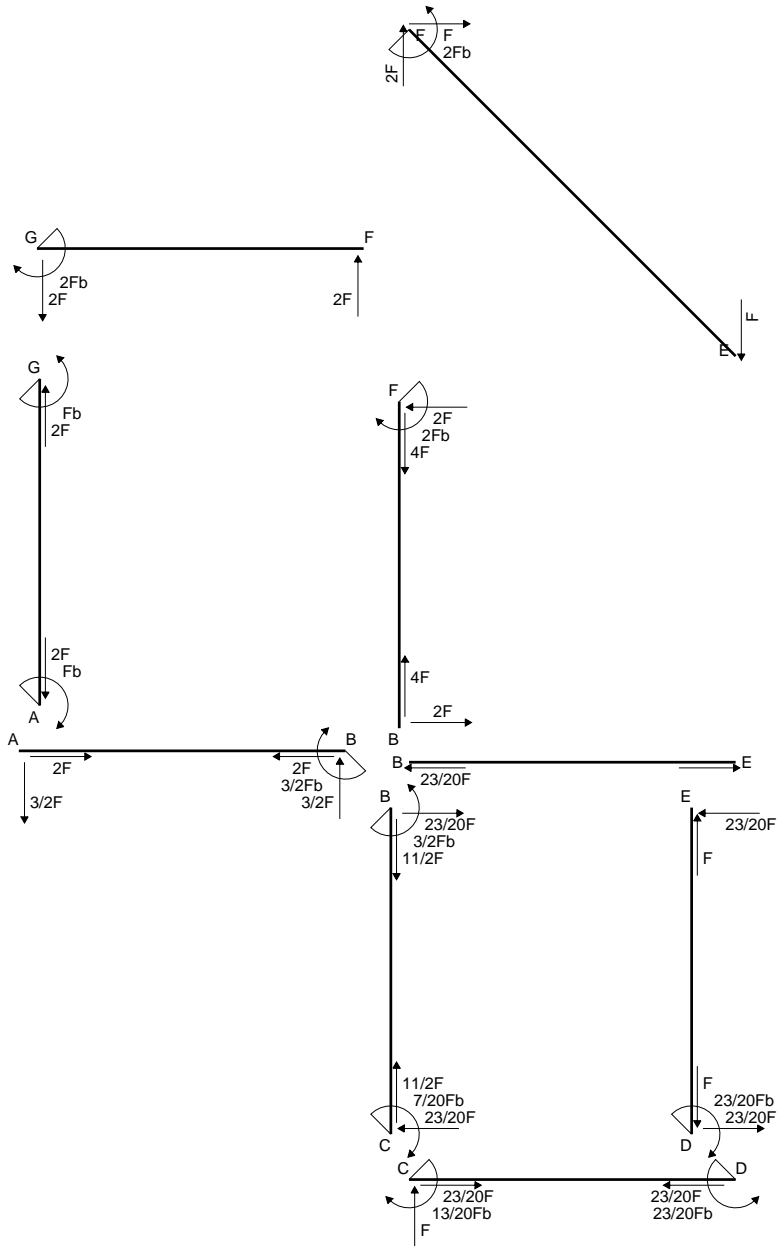
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

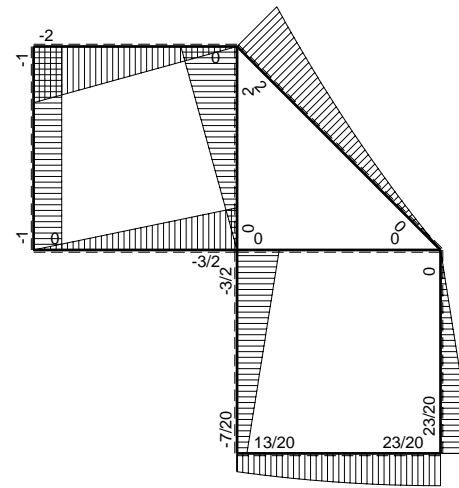
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

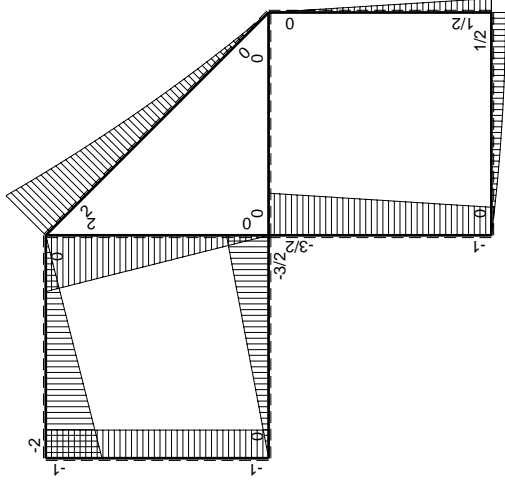
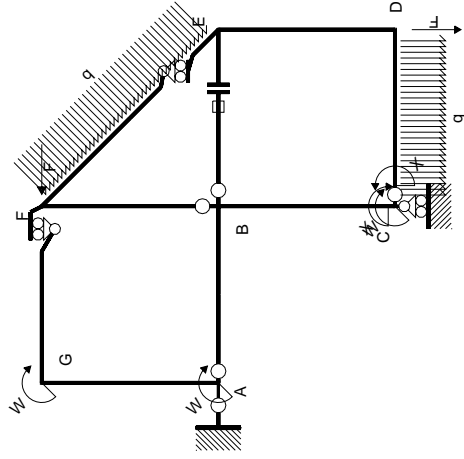


← $\boxed{+}$ → F

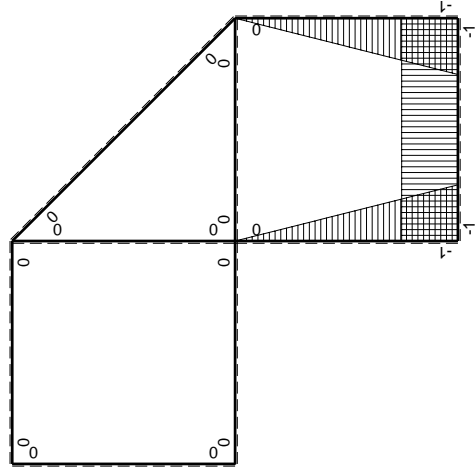
↑ $\boxed{+}$ ↓ F



↺ $\boxed{+}$ ↻ F_b



(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/6Fb ² /EJ	1/3Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	0	0
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				13/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

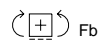
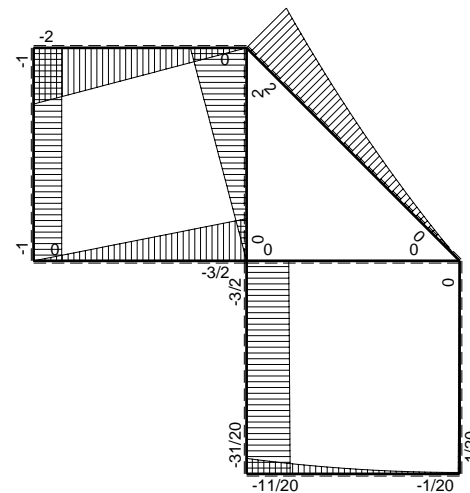
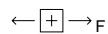
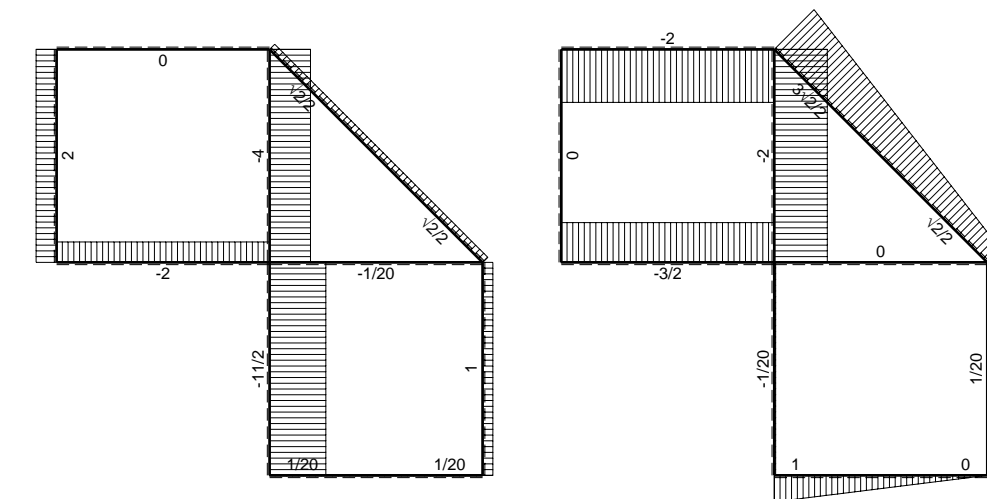
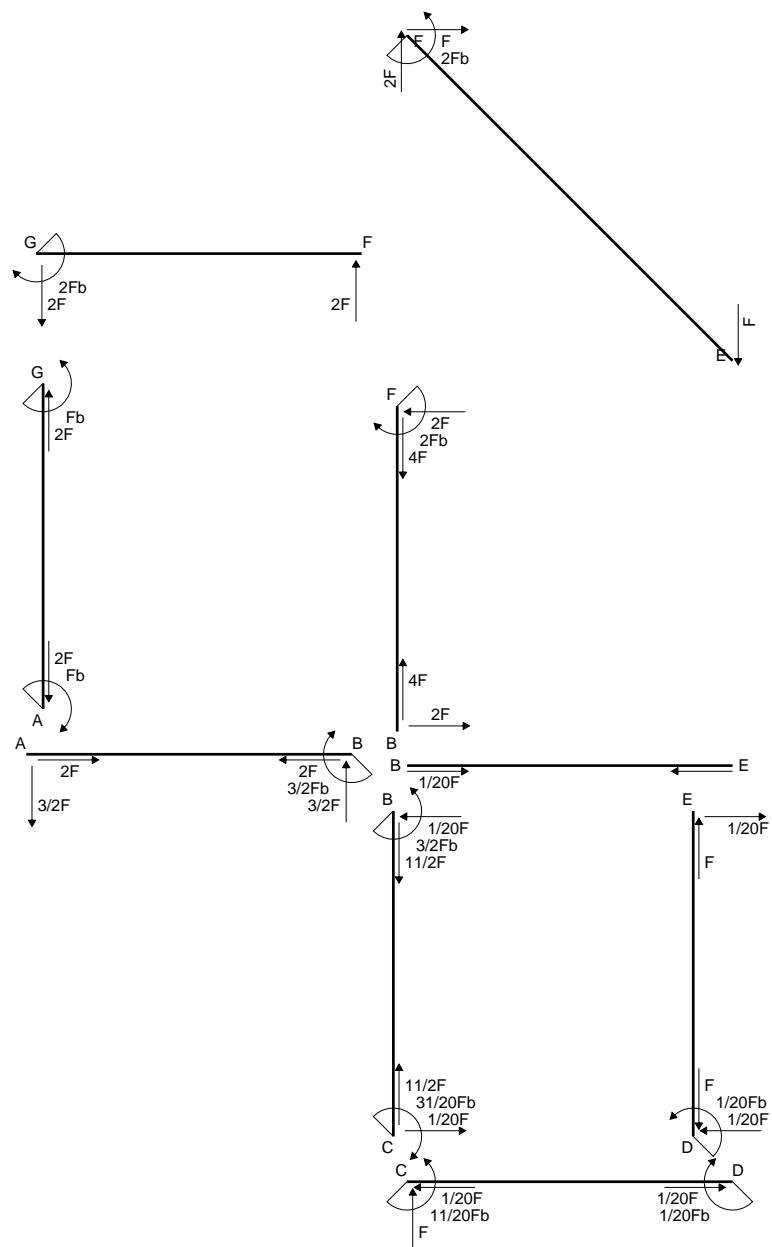
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

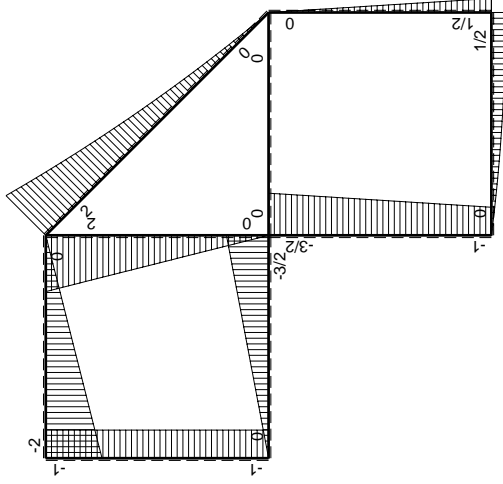
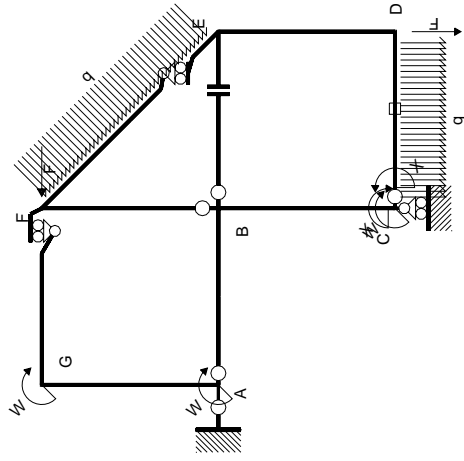
$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

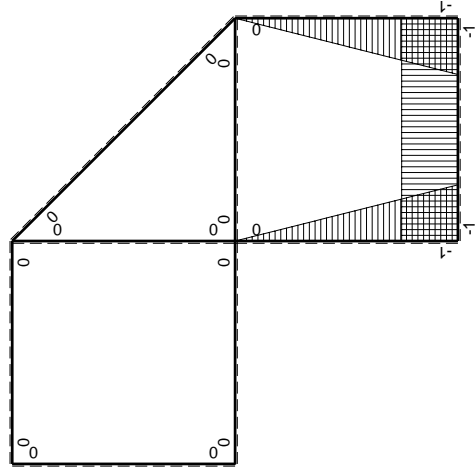
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$





(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	Xb/EJ
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/6Fb ² /EJ	1/3Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1	0	0
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-11/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				11/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

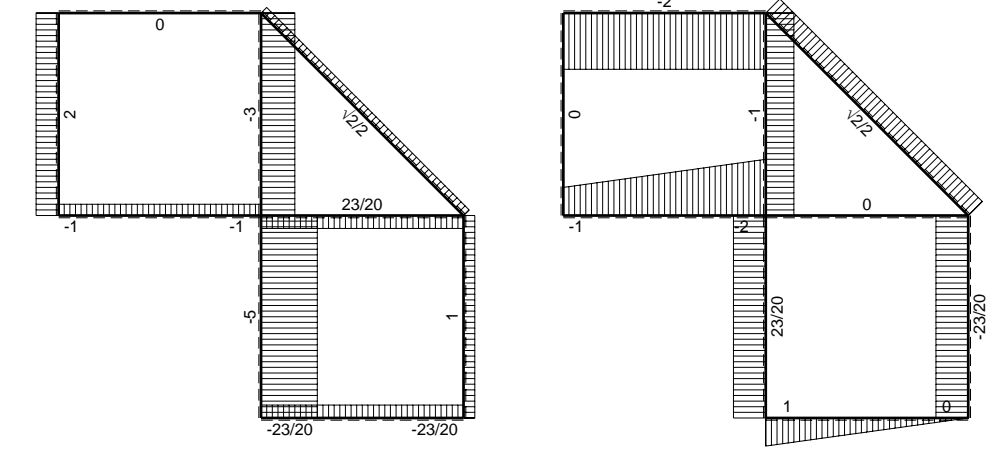
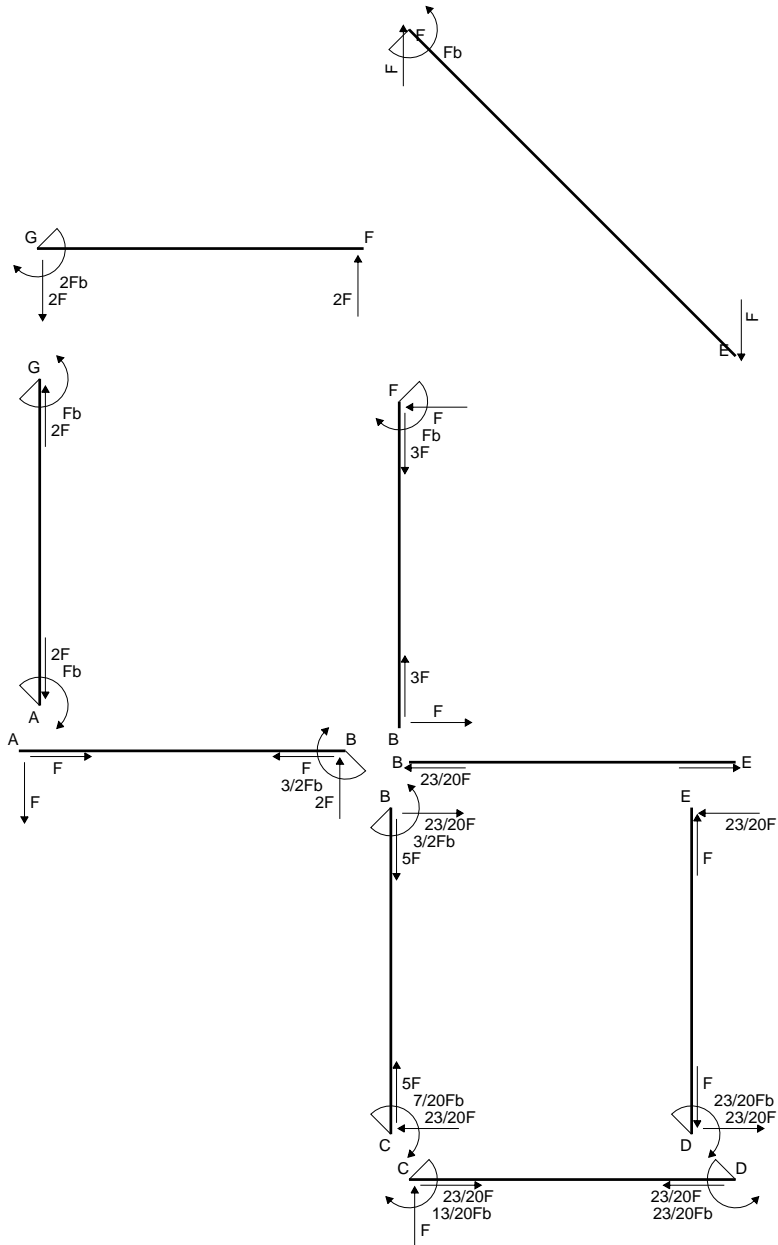
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

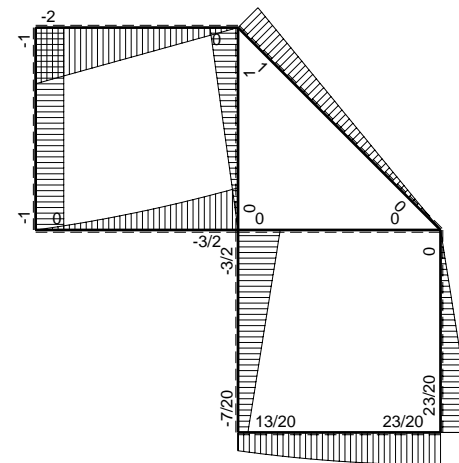
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

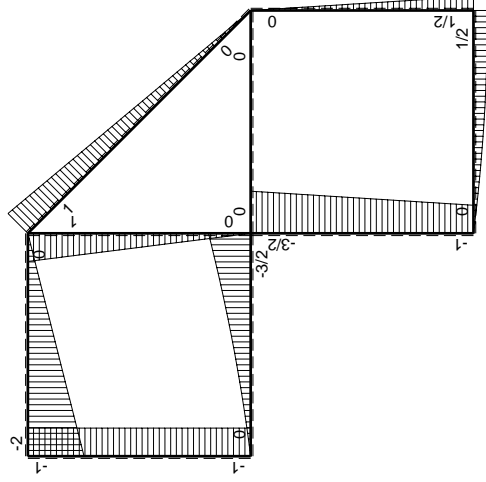
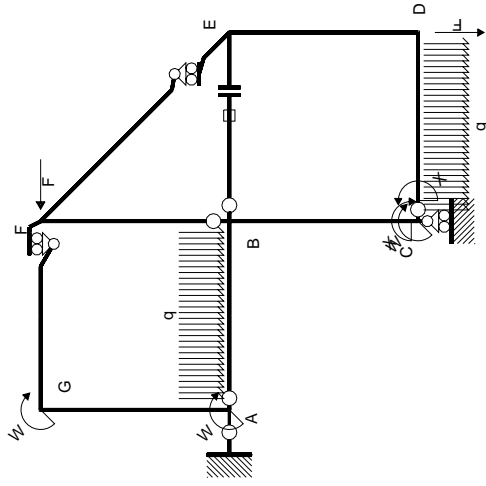


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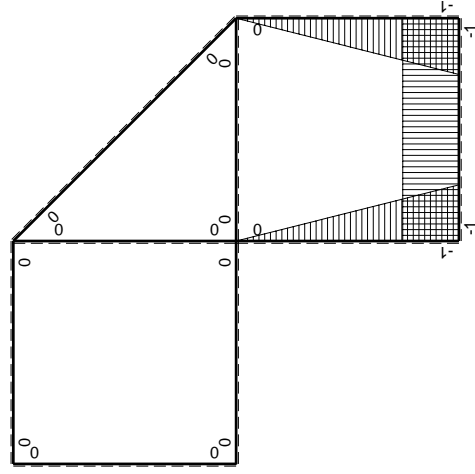
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⊕ F_b



(\oplus) M_0 flessione da carichi assegnati



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

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DE b	$-1 + x/b$	$1/2Fb - 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon} L_{BE}^{\epsilon}$				Fb^2/EJ	
	totali				$13/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$-13/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

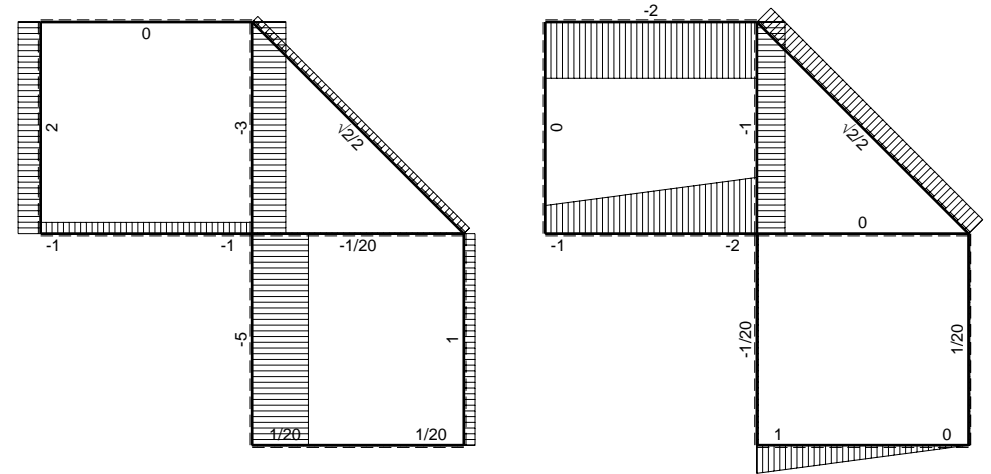
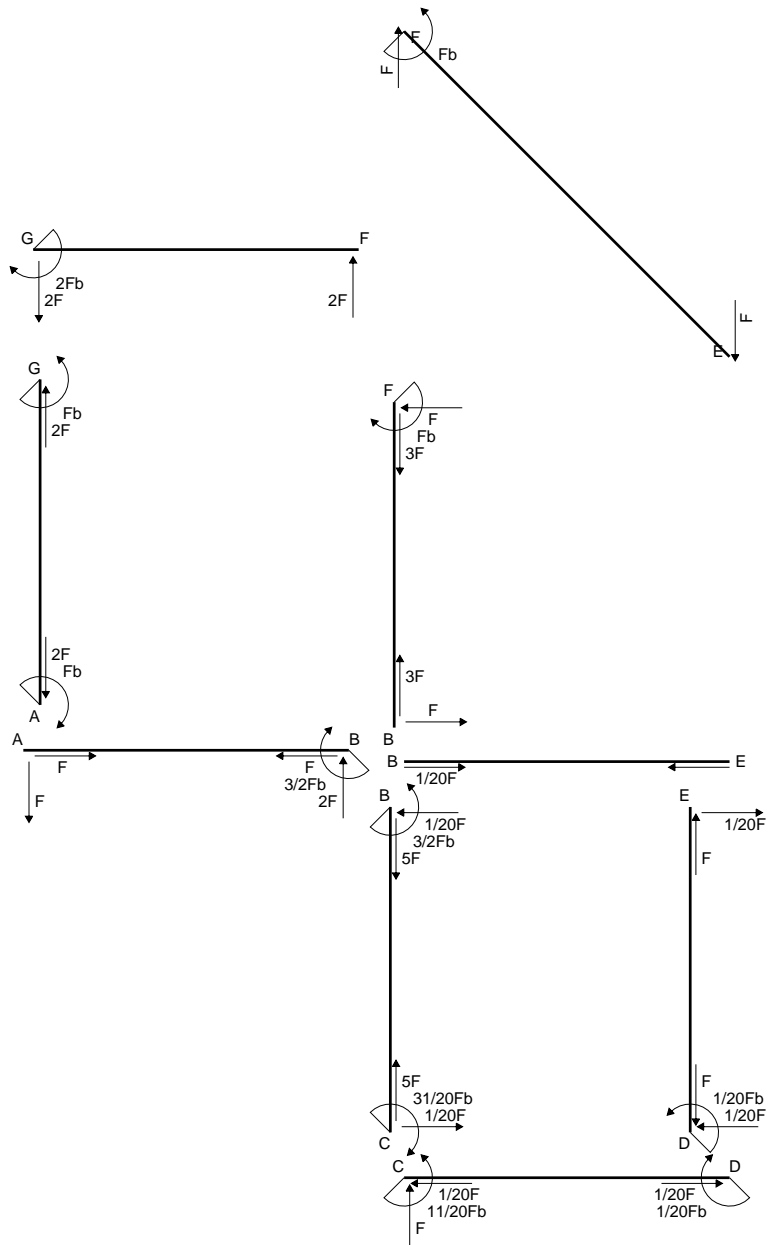
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

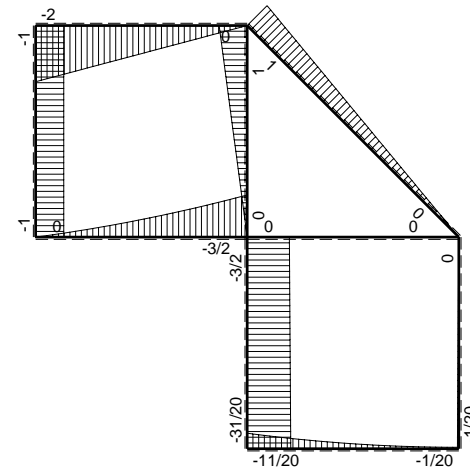
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

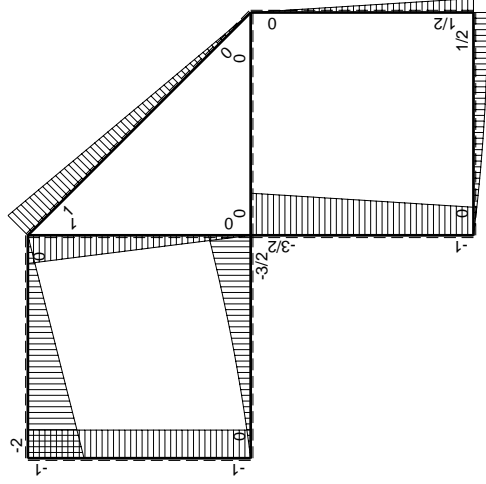
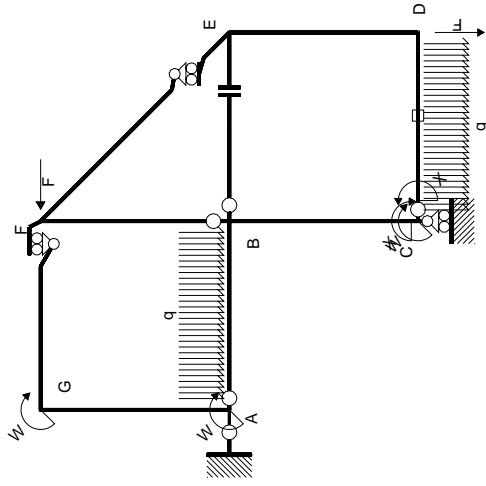


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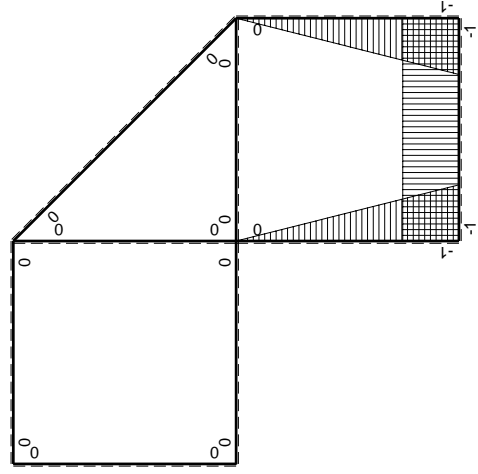
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⊕ ⊖ F_b



(\oplus) M_0 flessione da carichi assegnati



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

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$1/2Fb - 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-11/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$11/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

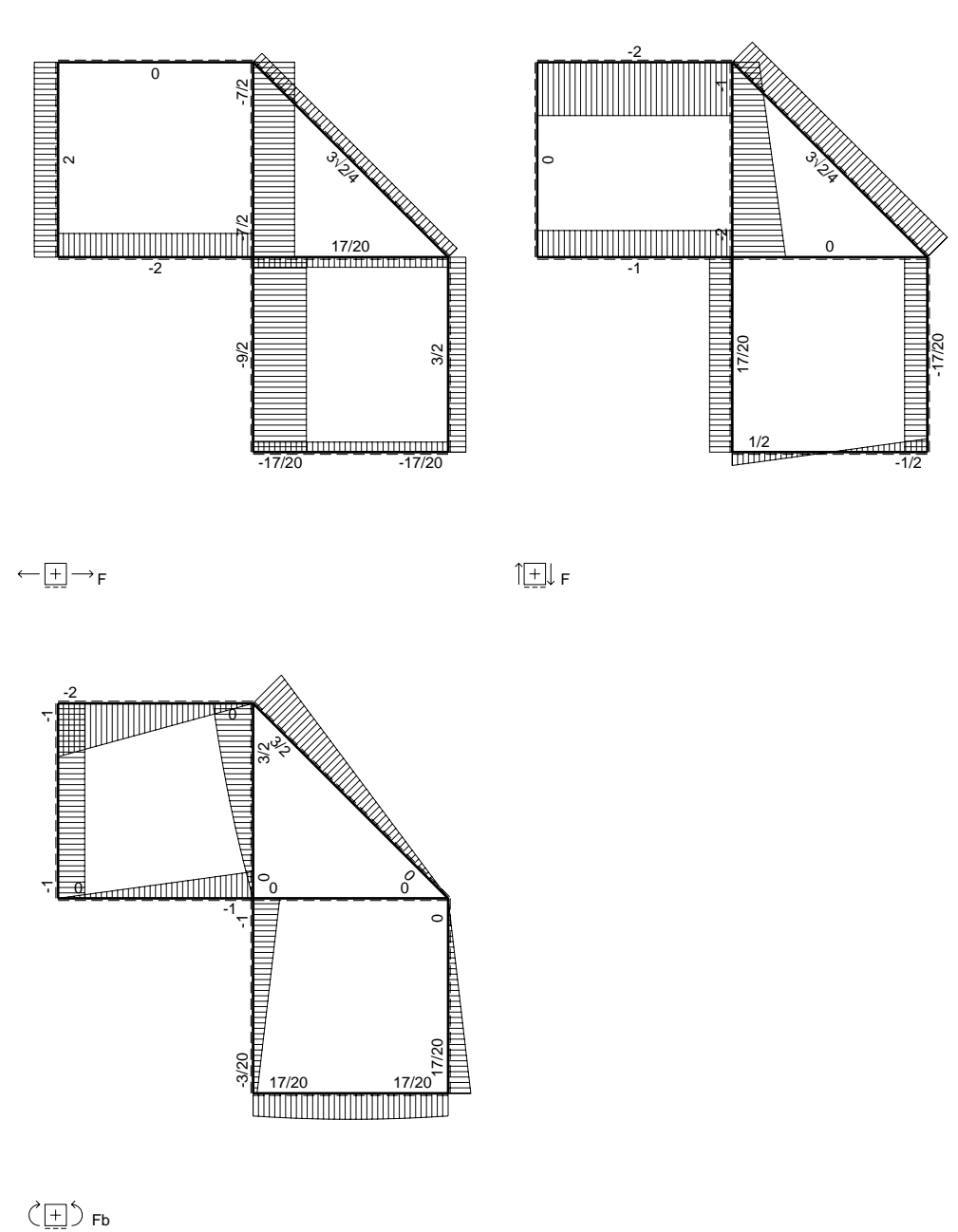
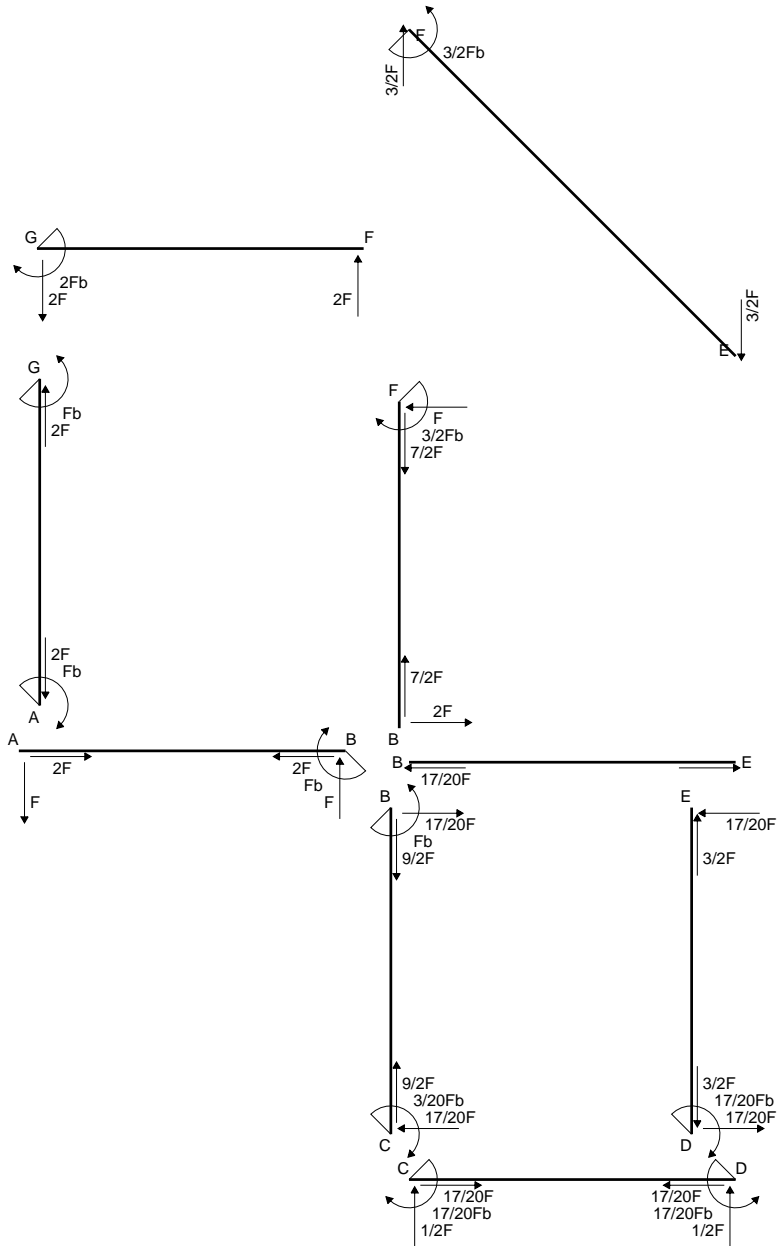
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

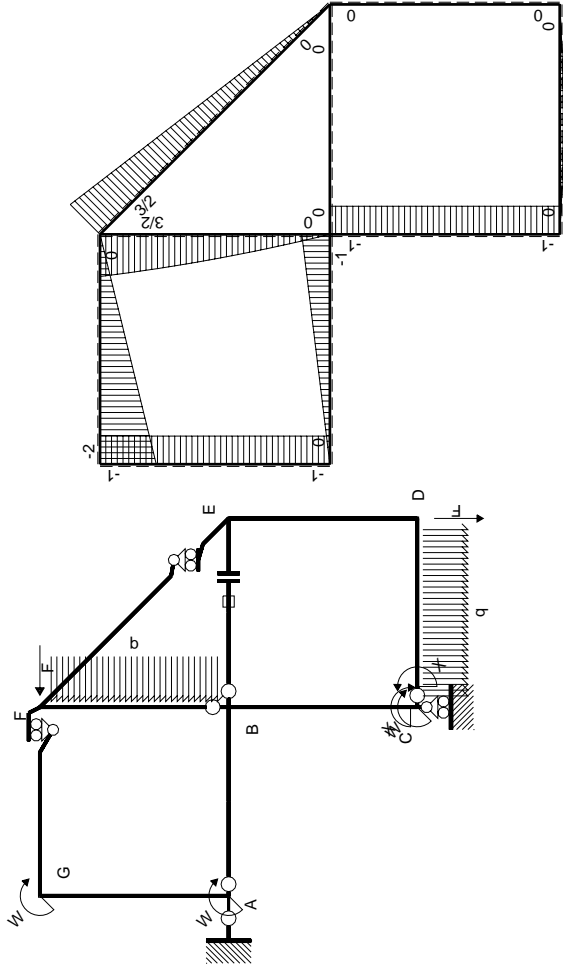
$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

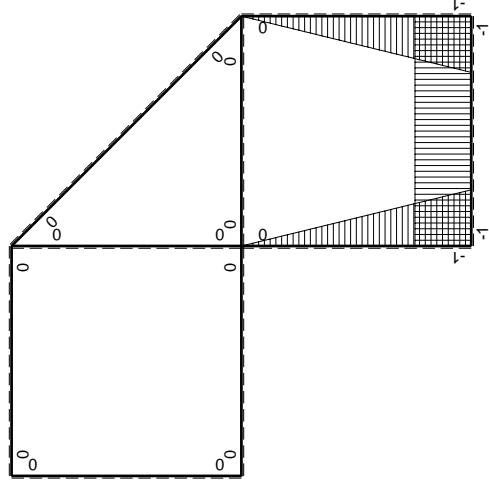


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
EF √2b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE}} L_{BE}$			0	Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-17/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

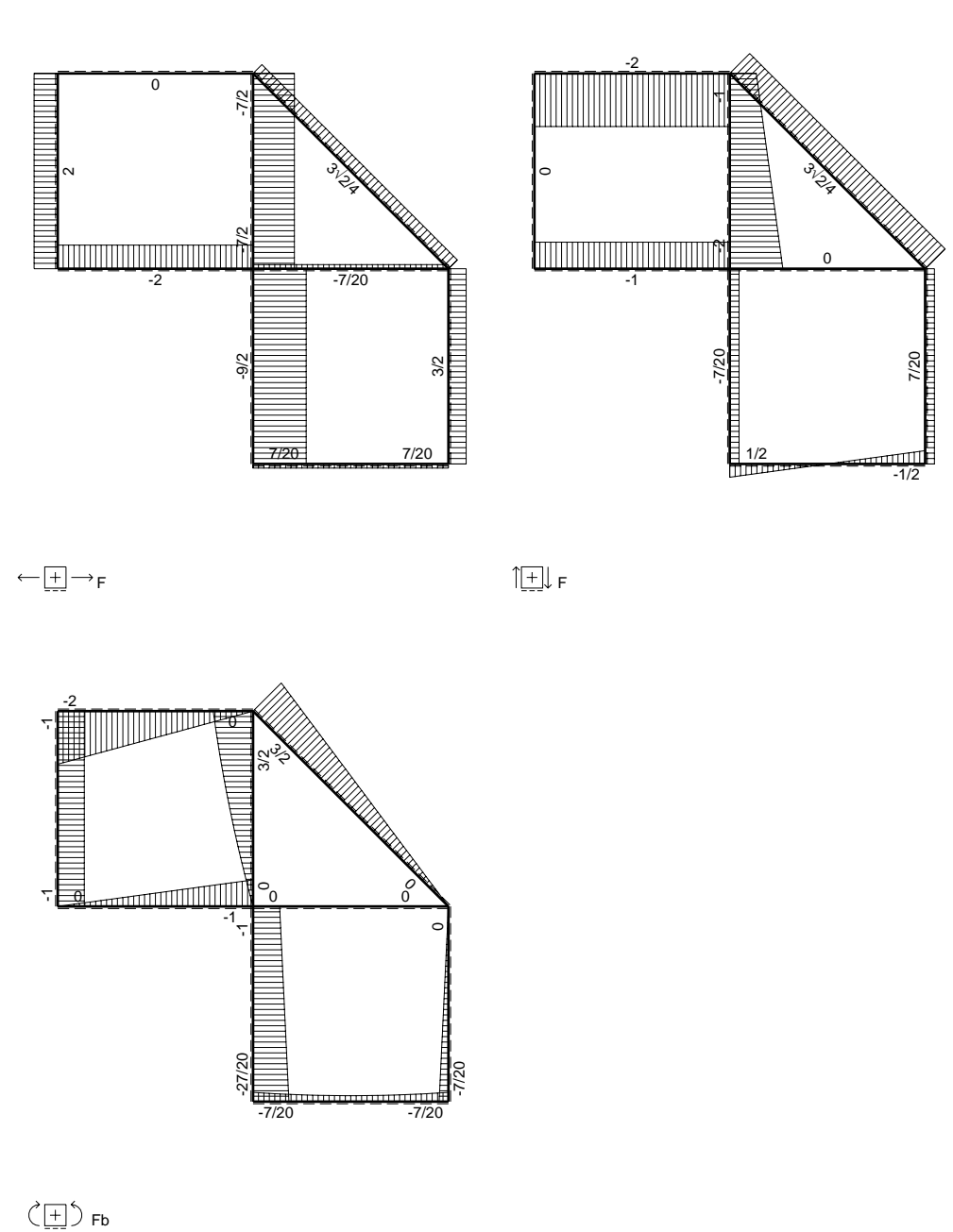
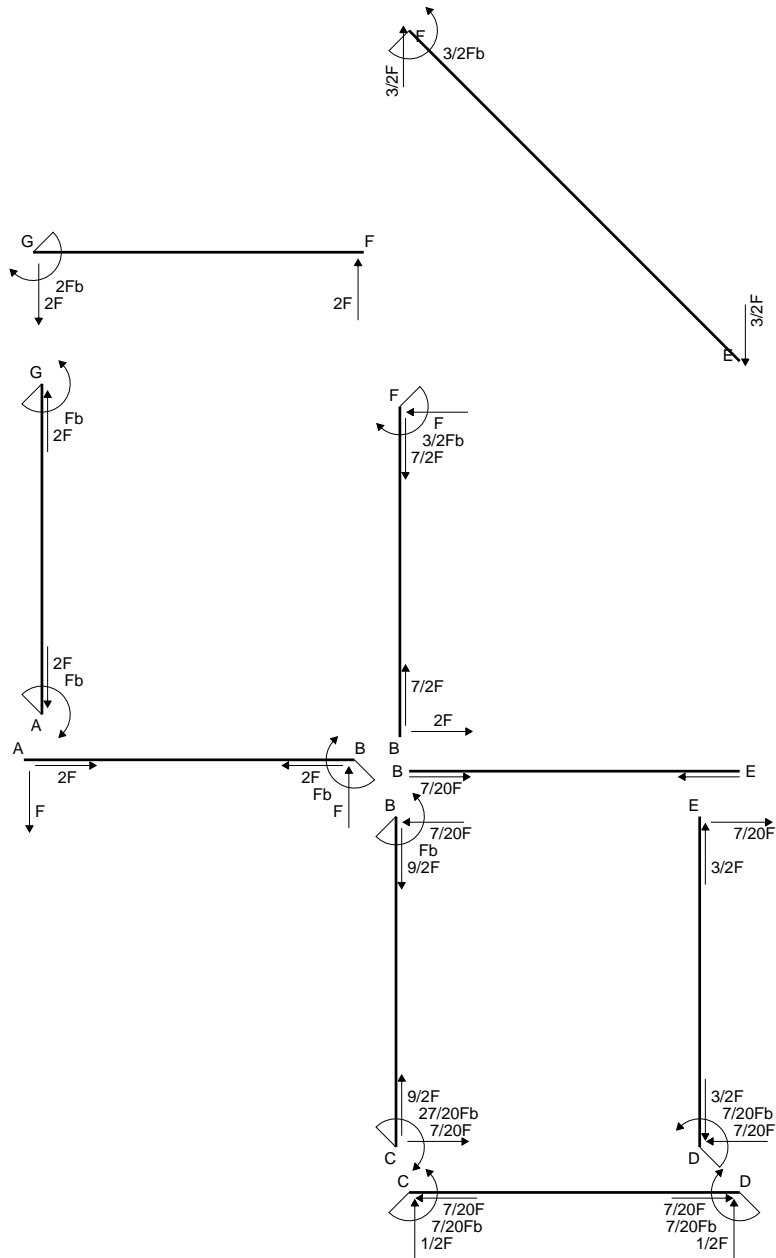
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

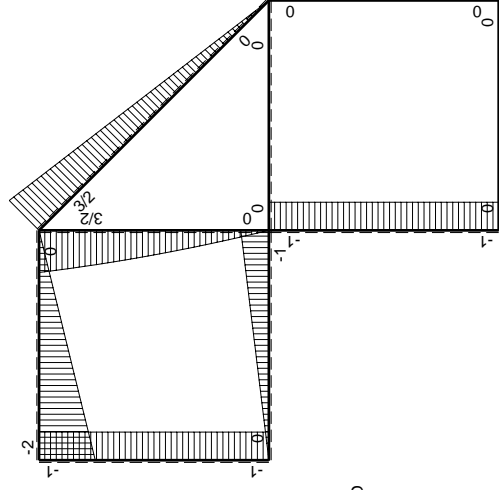
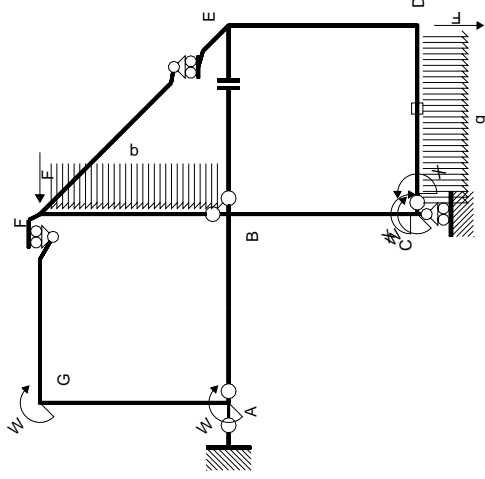
$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/6 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

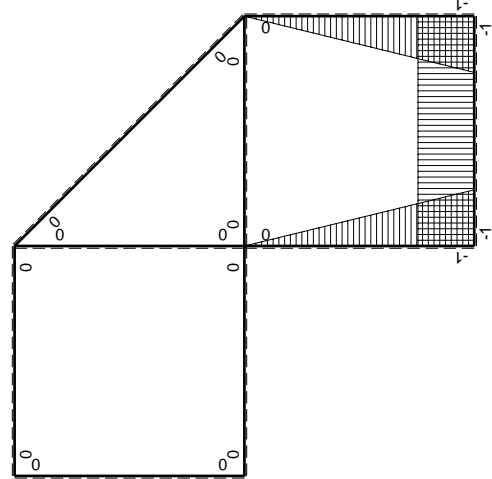
$$= (-1/4 b + 1/6 b) Fb 1/EJ = -1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF √2b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$7/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{2} x^2/b \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b) \cdot Fb \cdot 1/EJ = 1/2 \cdot Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{2} x^2/b \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/2 \cdot Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

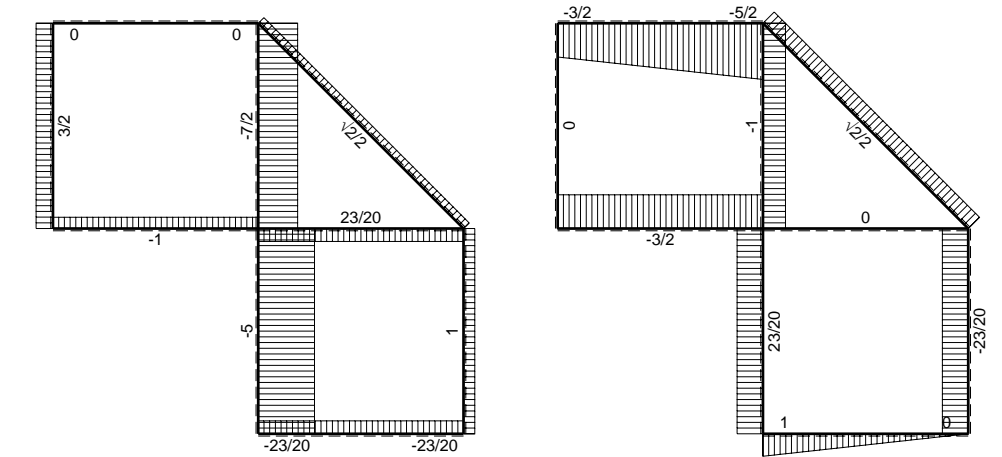
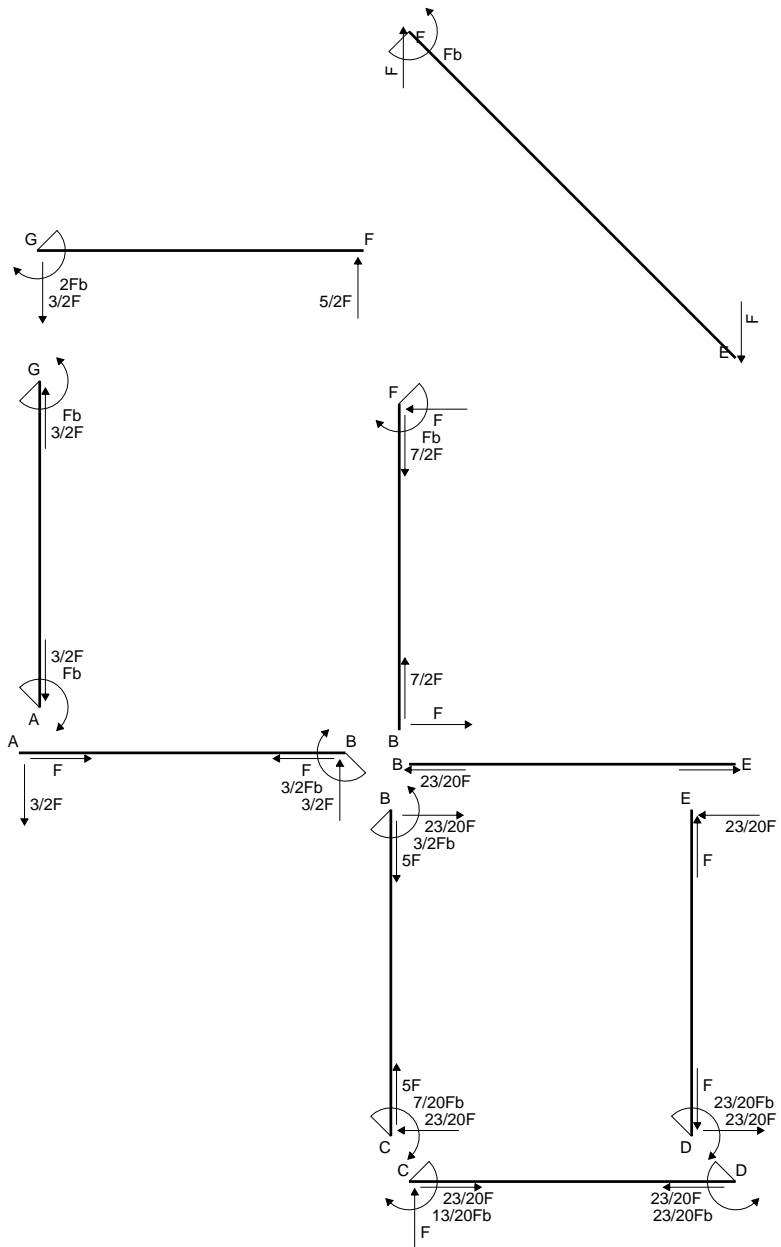
$$= \left[-1/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (-1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -13/12 \cdot Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

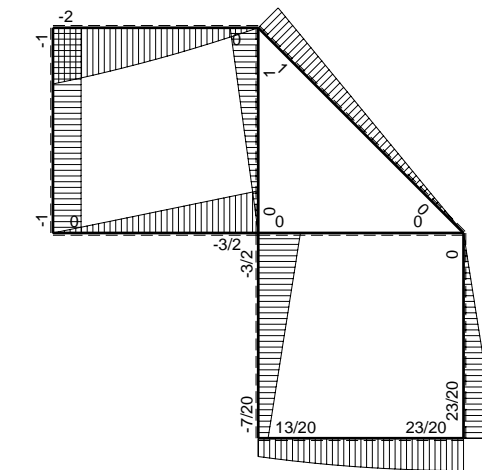
$$= \left[-1/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (-1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -13/12 \cdot Fb^2/EJ$$

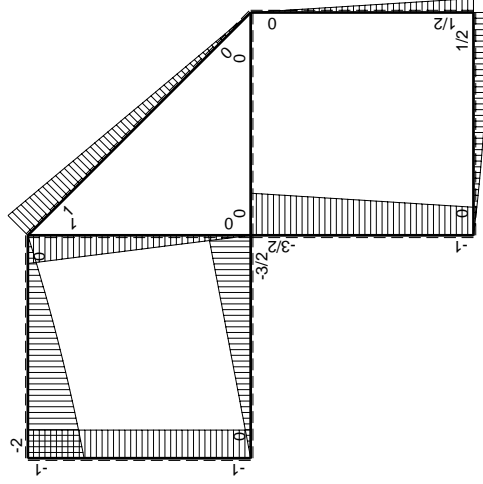
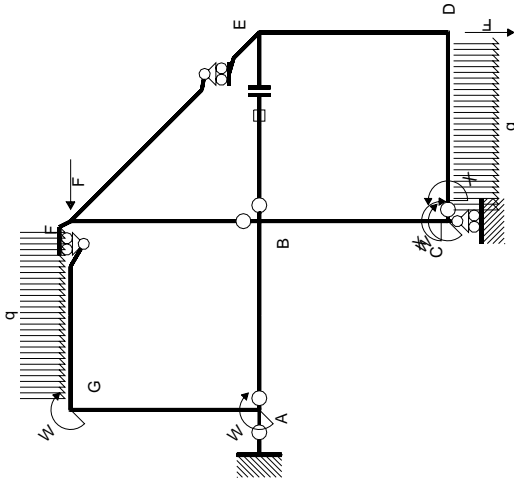


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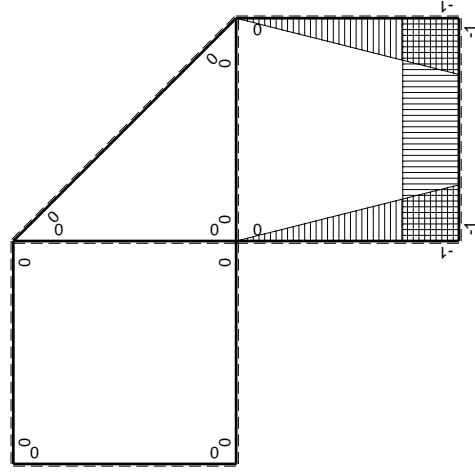
↑ ⊕ ↓ F



⊕ ⊖ F_b



M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1		
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - N_{BE}^E - N_{BE}^E$				Fb ² /EJ	
	totali				13/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

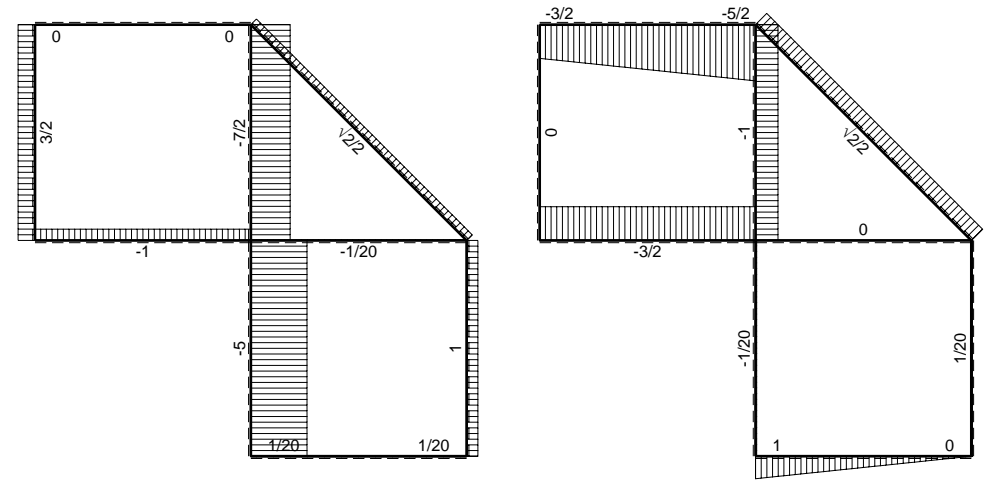
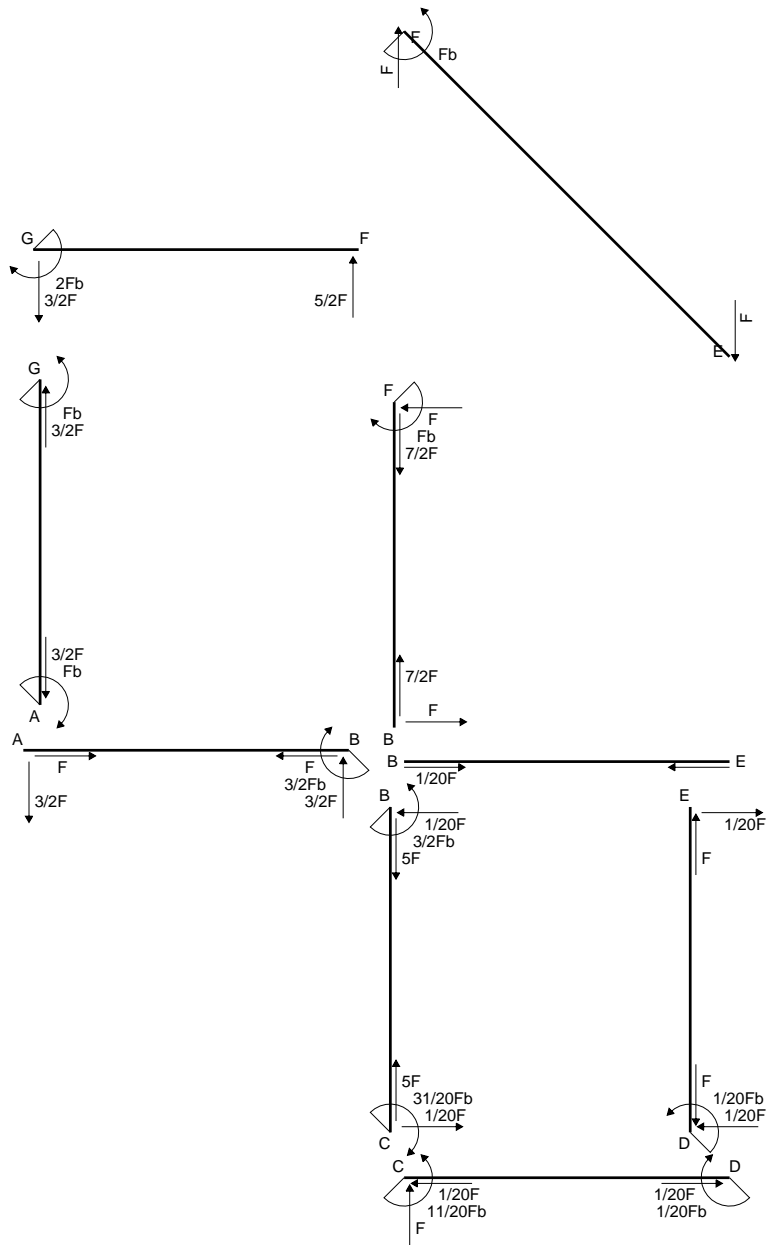
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

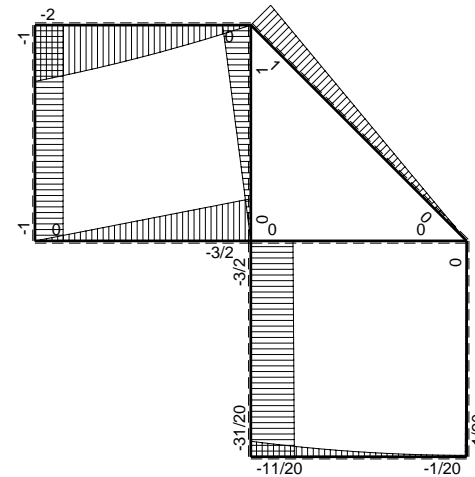
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

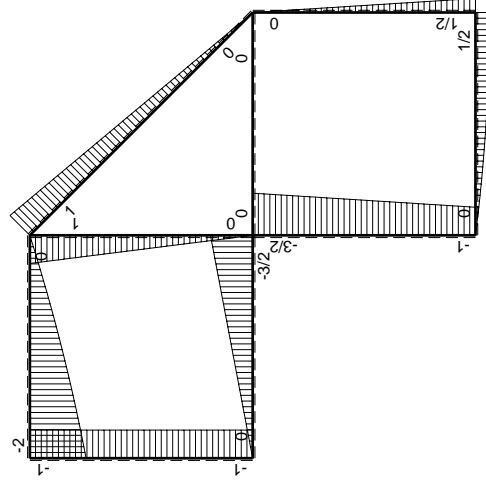
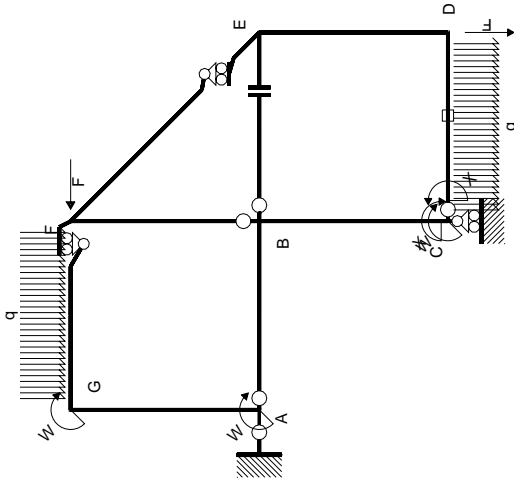


← ⊕ → F

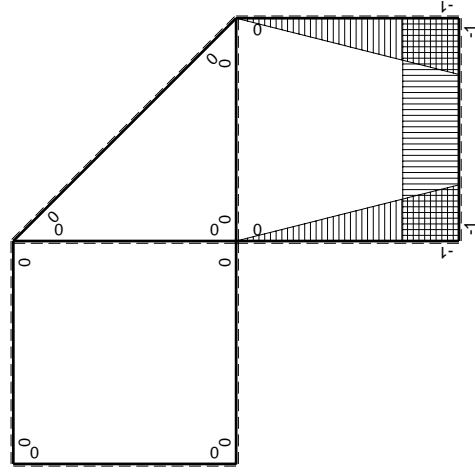
↑ ⊕ ↓ F



⊕ ⊖ F_b



(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fx$	0	0	0	0
BA b	0	$3/2Fb-3/2Fx$	0	0	0	0
BC b	$-x/b$	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
DE b	$-1+x/b$	$1/2Fb-1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-11/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$11/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

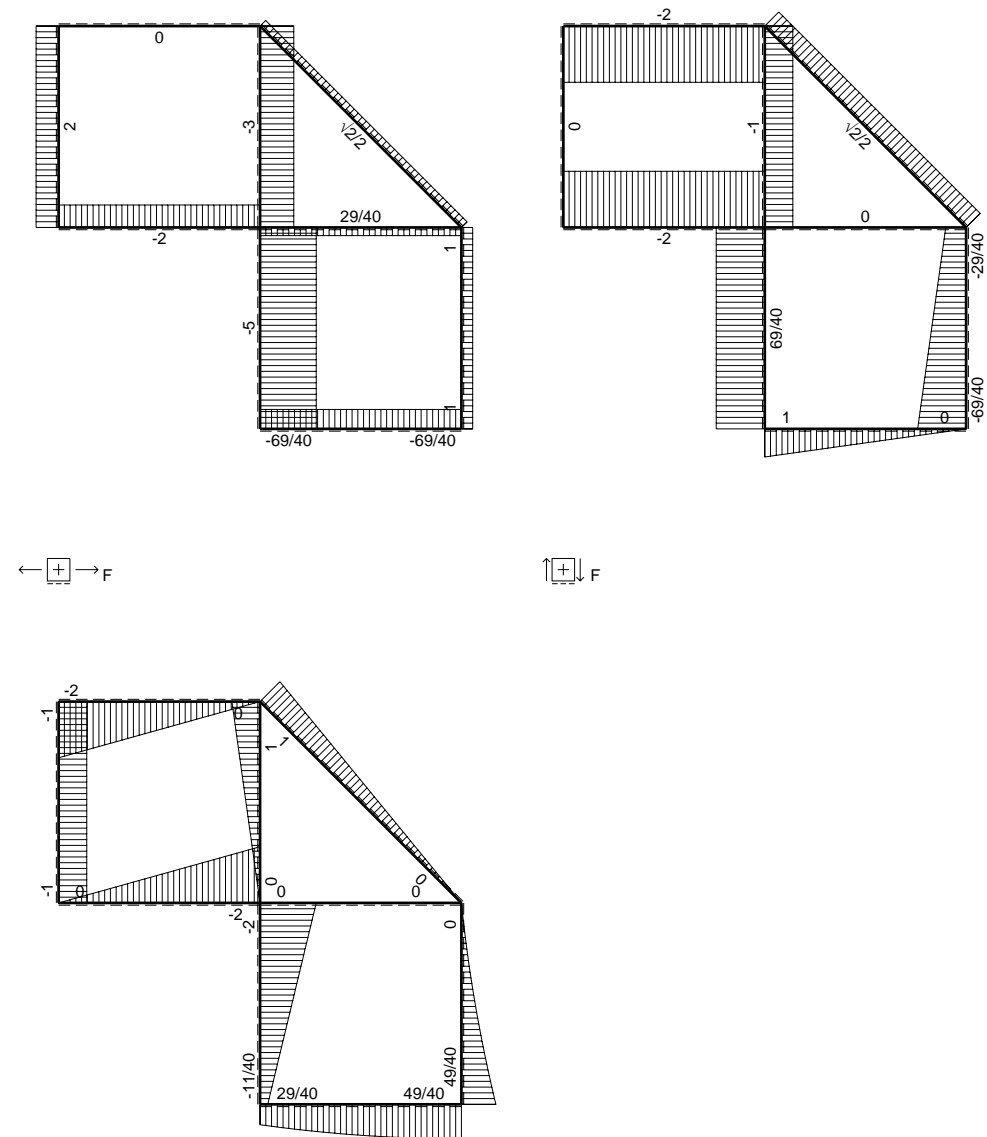
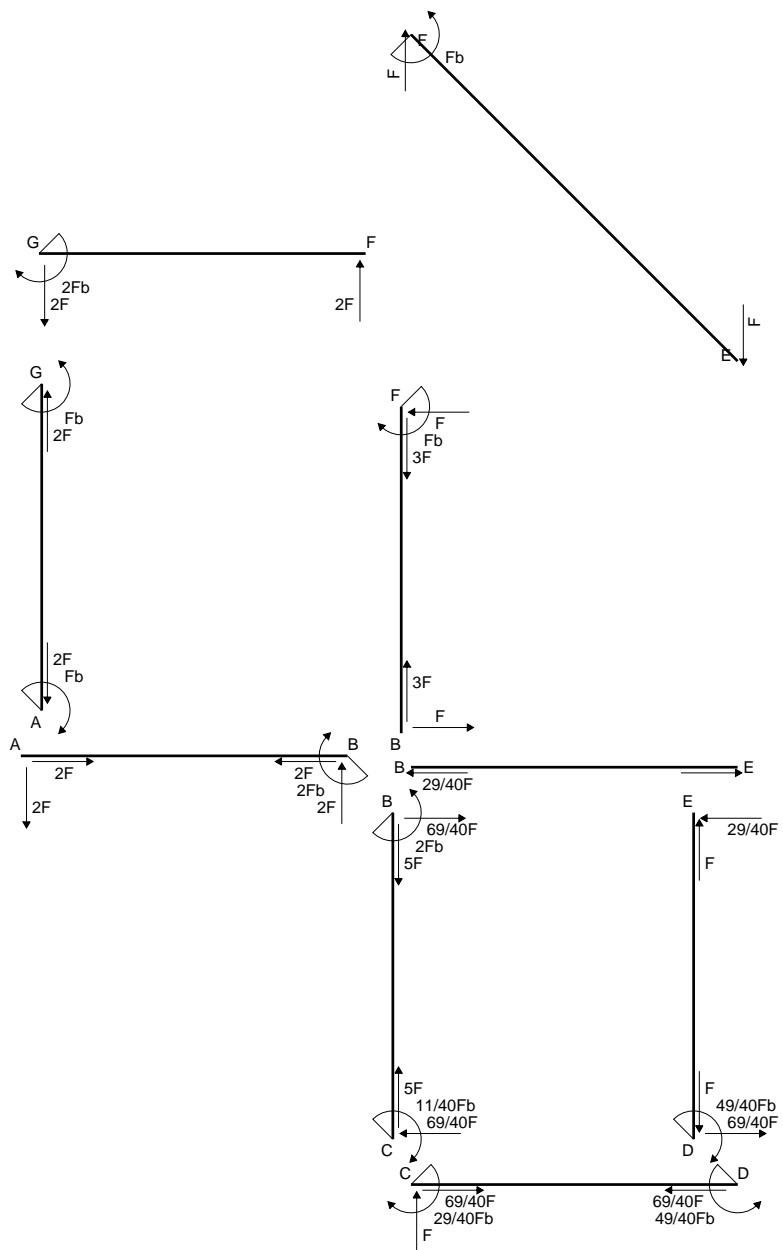
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

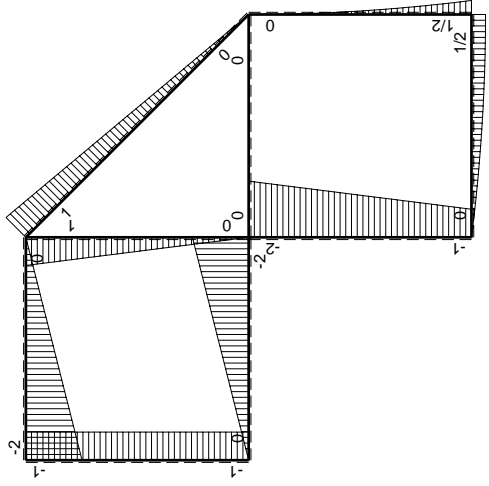
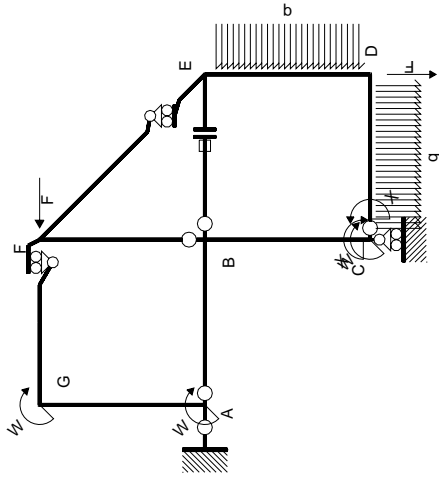
$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

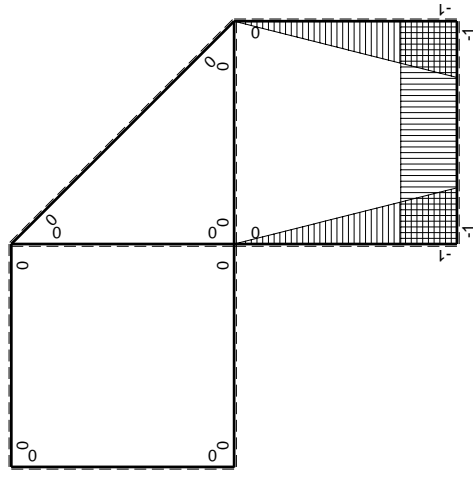
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$





M_0 flessione da carichi assegnati



M_1 flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	$1/2Fb-Fx+1/2qx^2$	$-1/2Fb+3/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$-1/2qx^2$	$-1/2qx^3/b$	x^2/b^2	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$29/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-29/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x^2/b - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/3 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/3 b) \cdot Fb \cdot 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

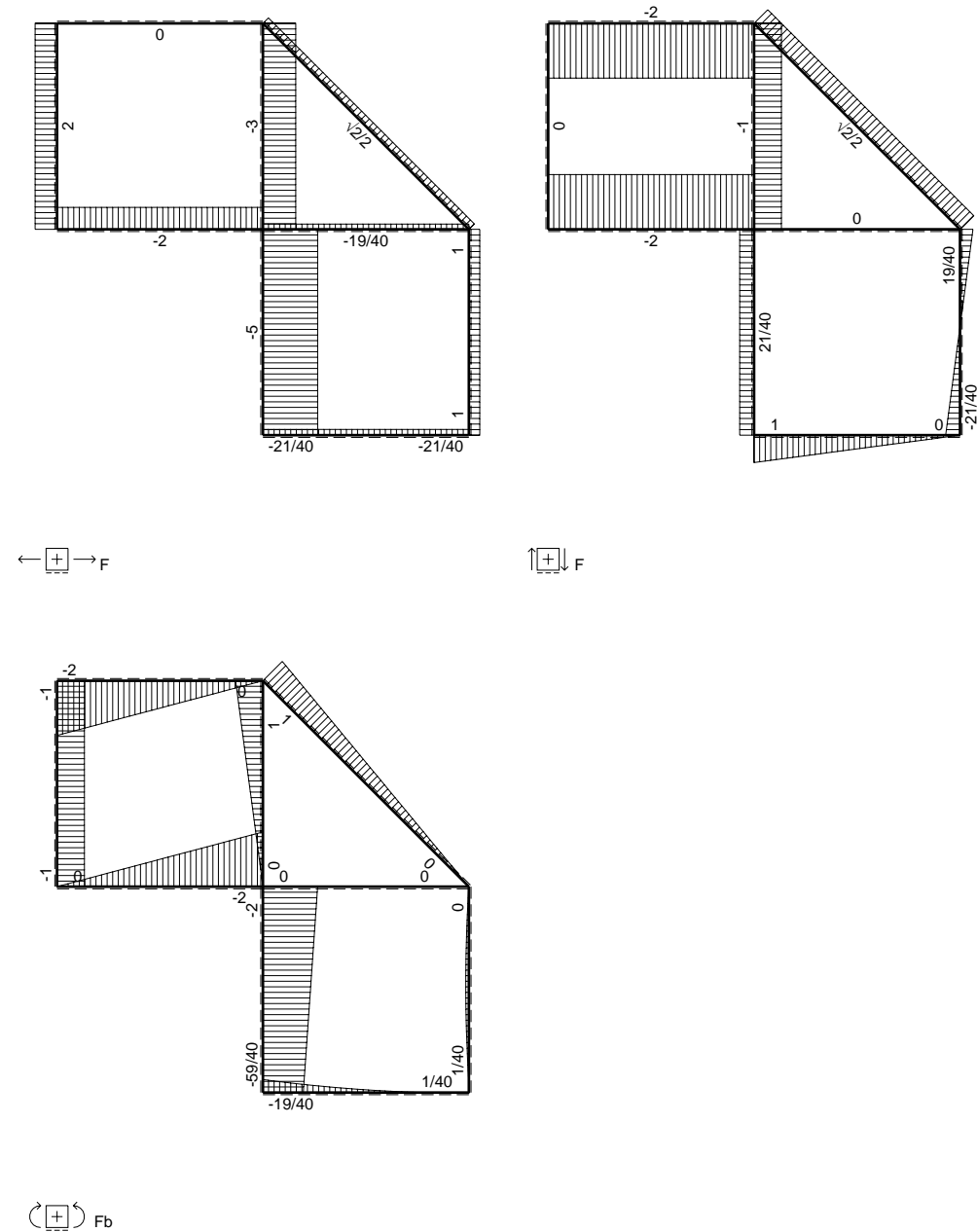
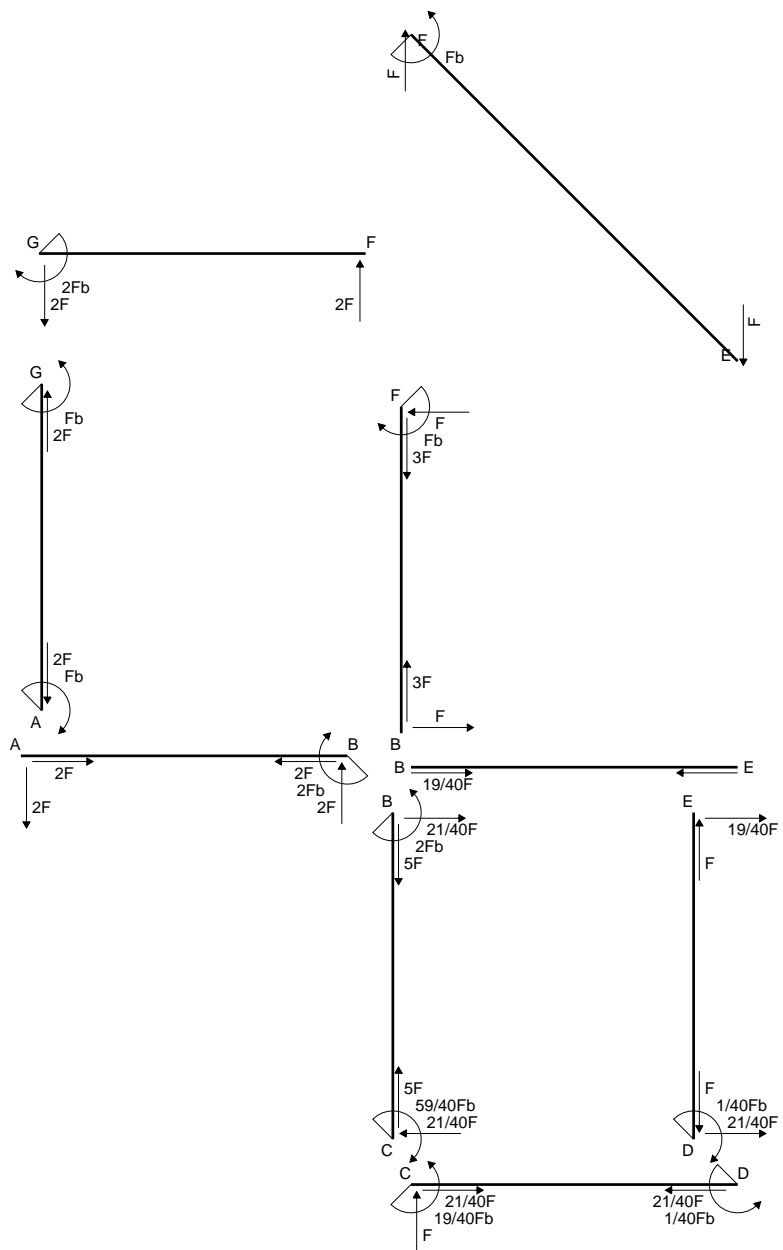
$$L_{DE}^{xo} = \int_0^b (-1/2 + 3/2 x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

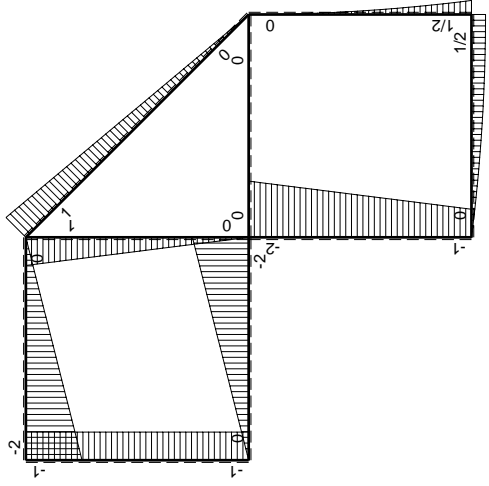
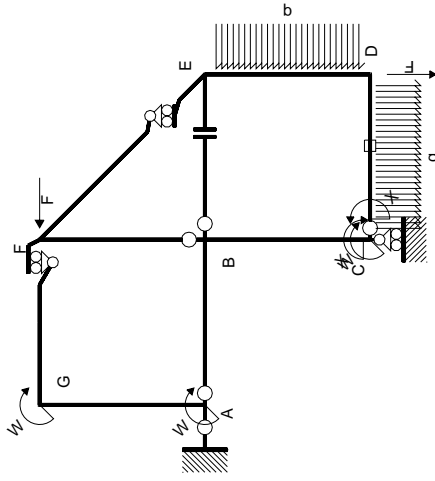
$$= [-1/2 x + 3/4 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 3/4 b - 1/2 b + 1/8 b) \cdot Fb \cdot 1/EJ = -1/8 Fb^2/EJ$$

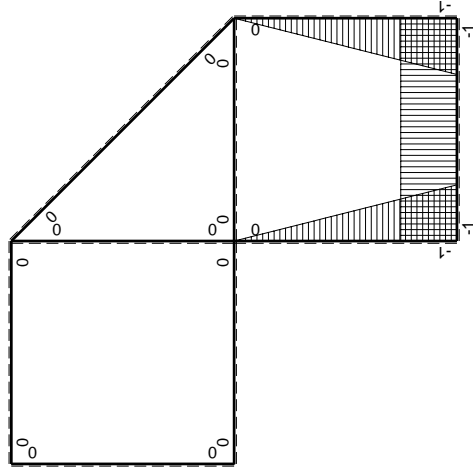
$$L_{ED}^{xo} = \int_0^b (-1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = [-1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/8 b) \cdot Fb \cdot 1/EJ = -1/8 Fb^2/EJ$$





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0	0	0
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	$1/2Fb-Fx+1/2qx^2$	$-1/2Fb+3/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$-1/2qx^2$	$-1/2qx^3/b$	x^2/b^2	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-19/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$19/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (2x/b - x^2/b^2) Fb 1/EJ dx = [x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x^2/b^2) Fb 1/EJ dx = [x - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/3 b) Fb 1/EJ = 2/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

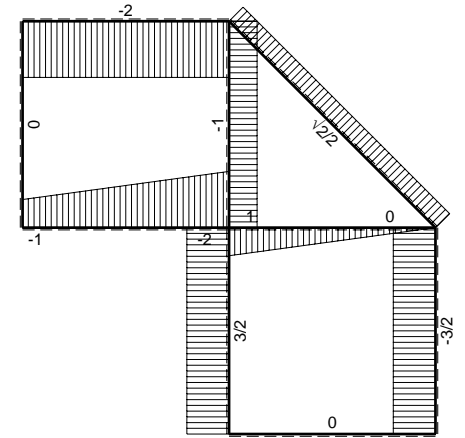
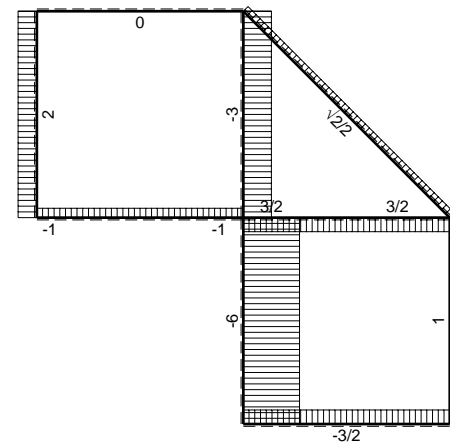
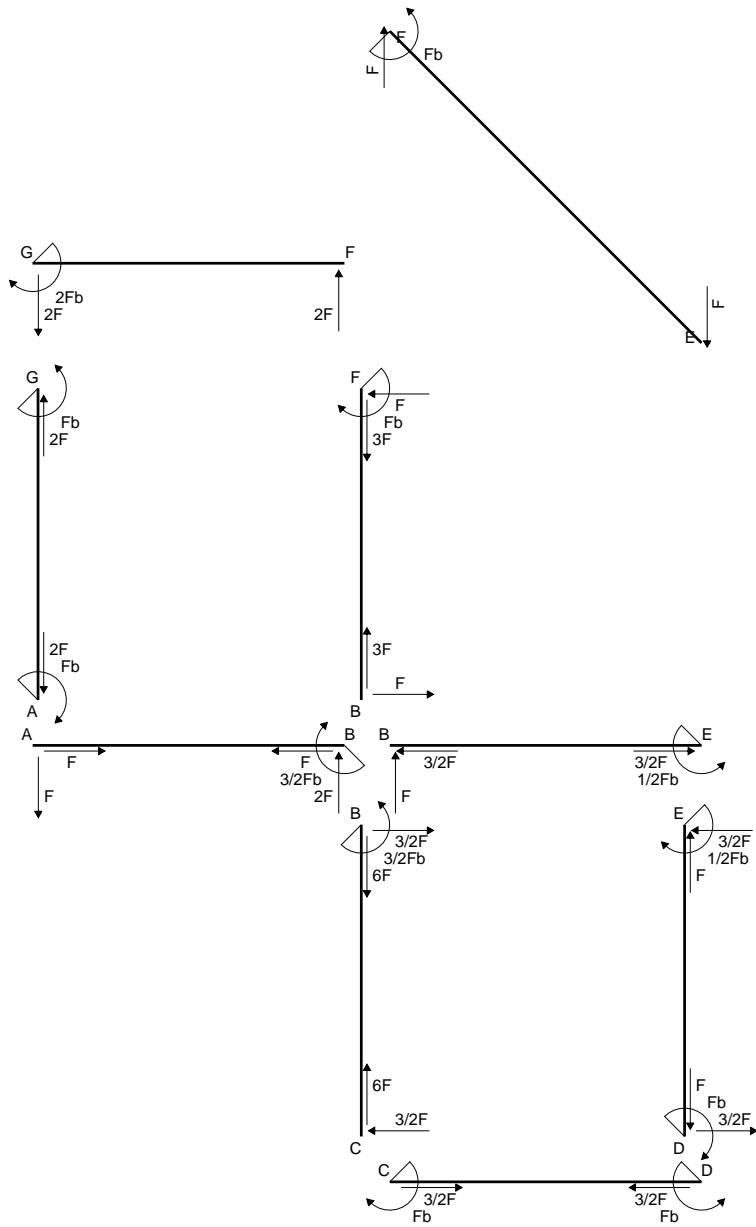
$$L_{DE}^{xo} = \int_0^b (-1/2 + 3/2 x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

$$= [-1/2 x + 3/4 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/2 b + 3/4 b - 1/2 b + 1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

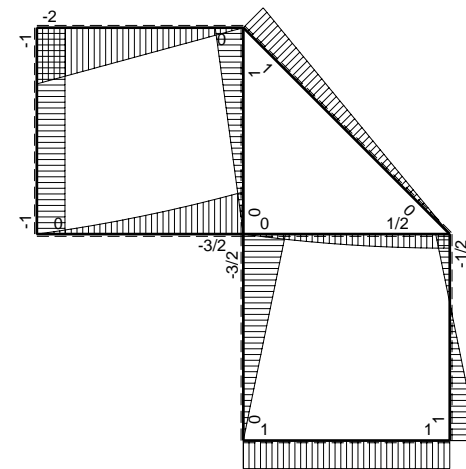
$$L_{ED}^{xo} = \int_0^b (-1/2 x^3/b^3) Fb 1/EJ dx = [-1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

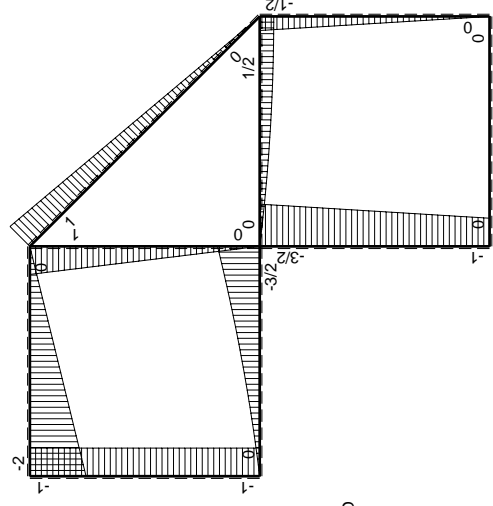
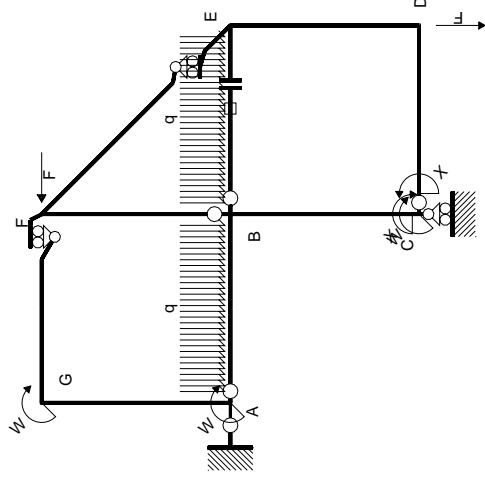


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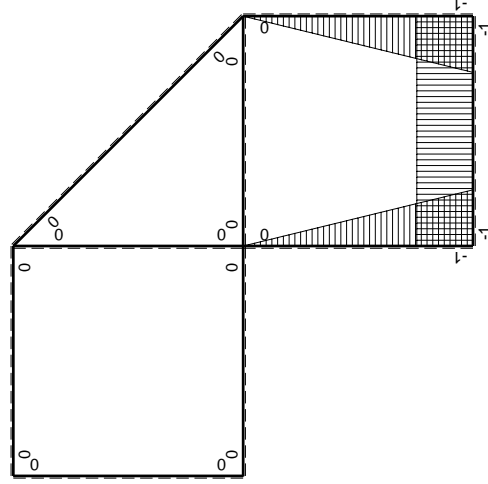


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	0
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	$Fx - 1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb + 1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - L_{BE}^{L-BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

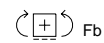
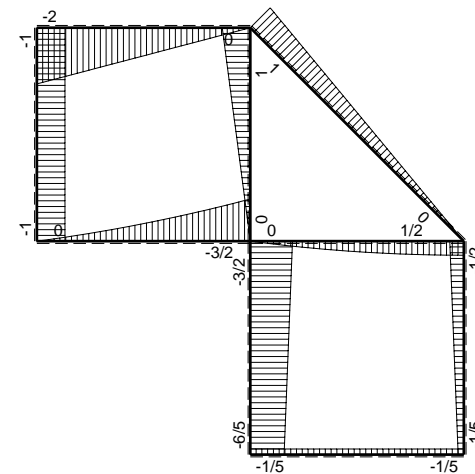
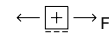
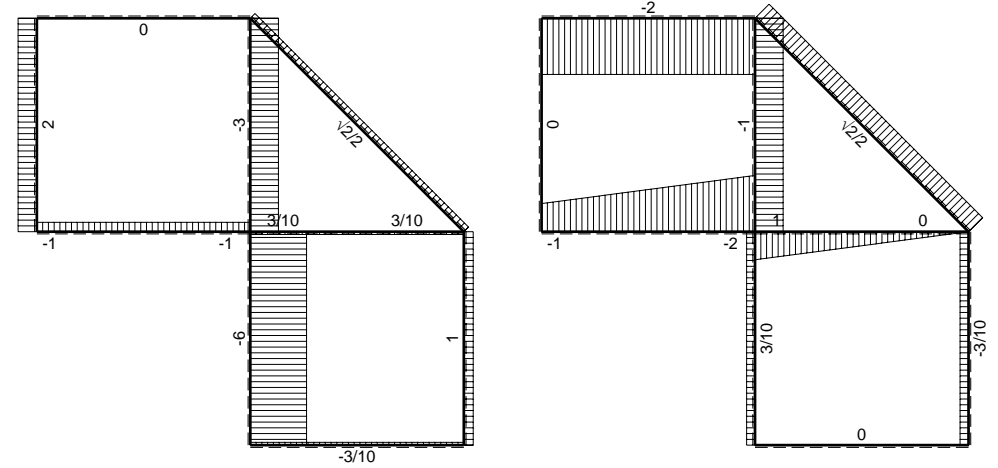
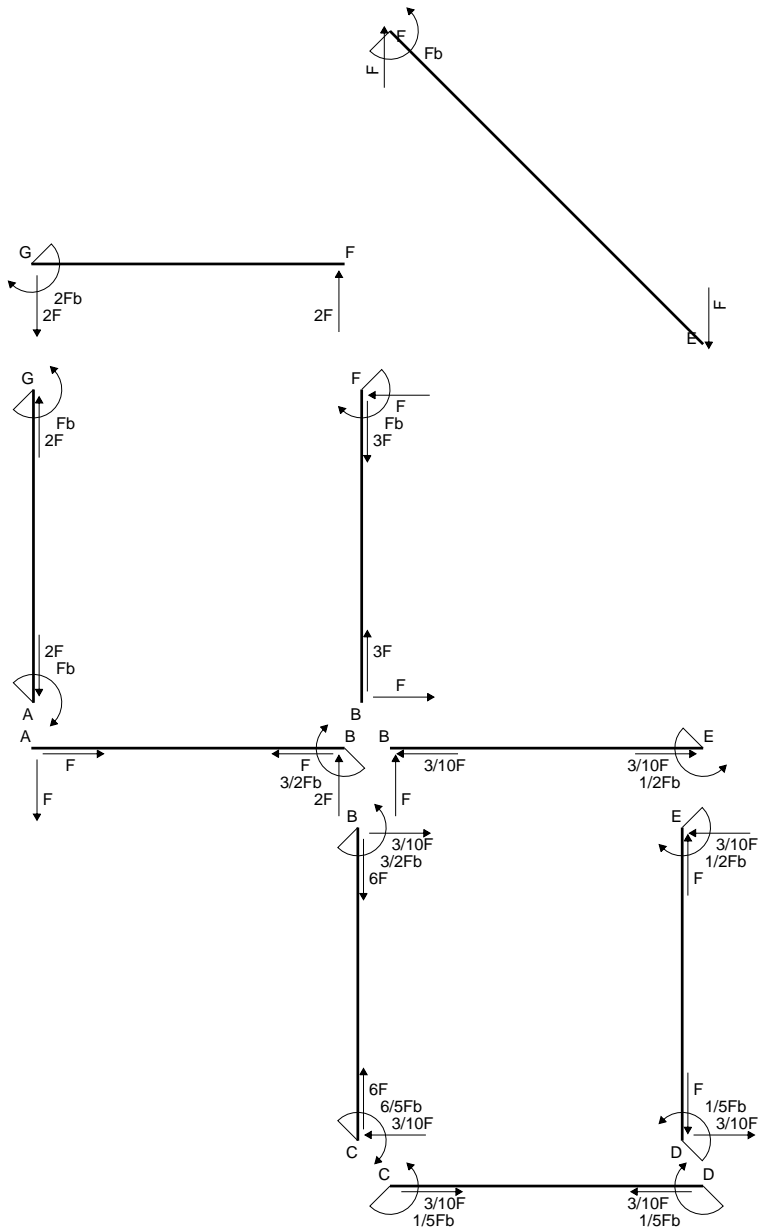
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

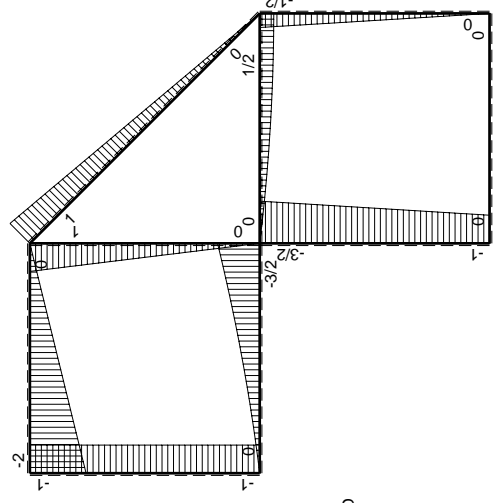
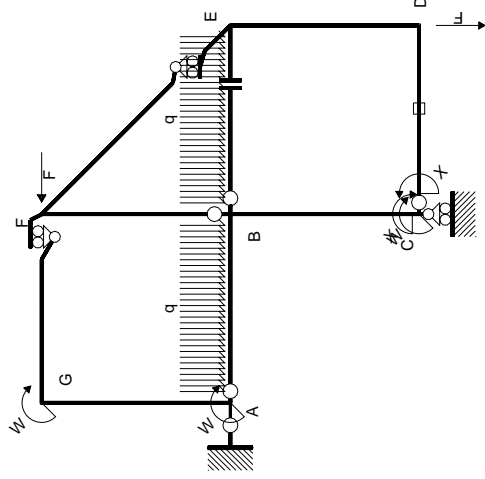
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

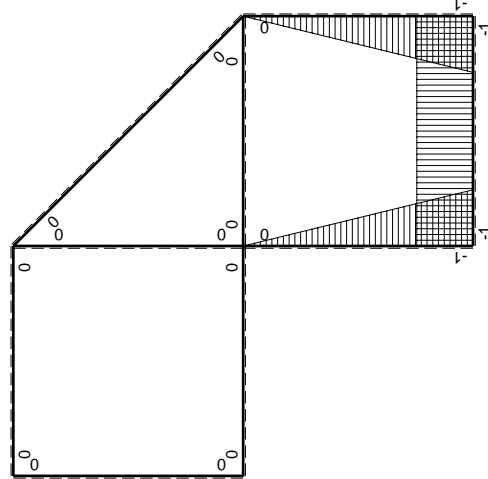
$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	0	0
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	$Fx - 1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb + 1/2qx^2$	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/3Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$1/5Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - \frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

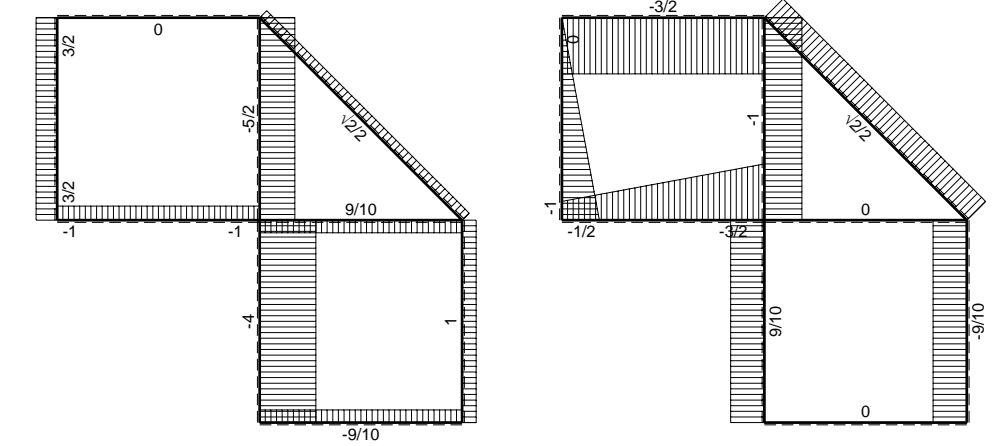
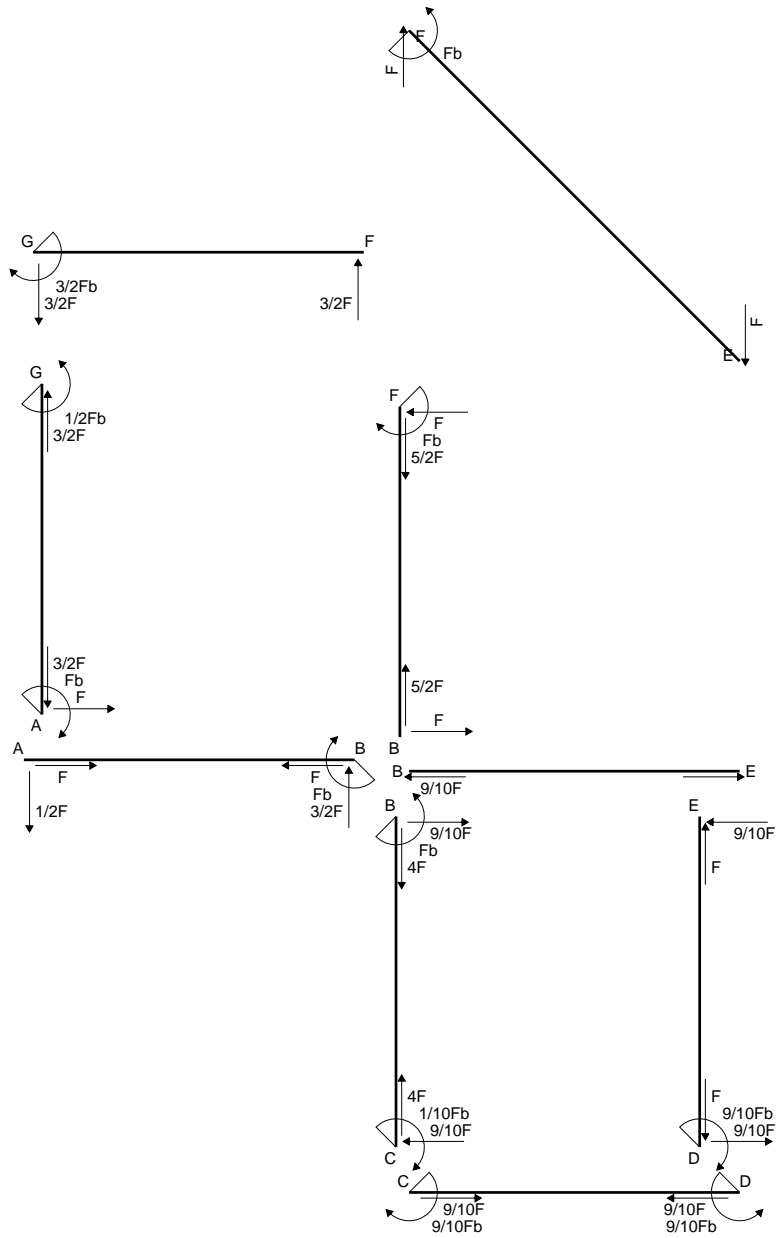
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

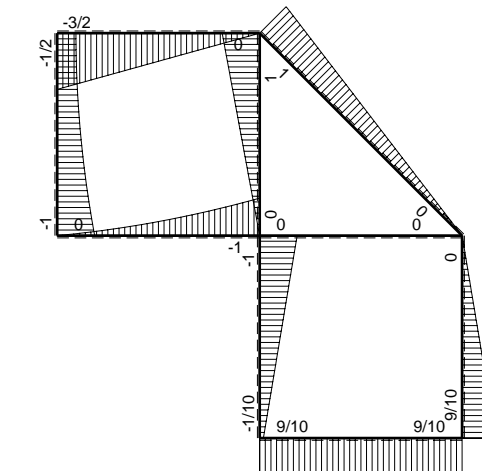
$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

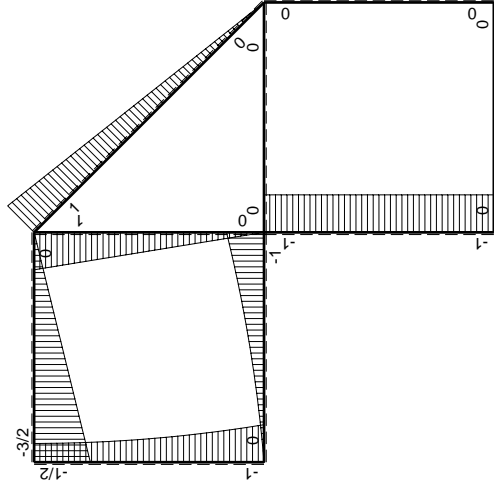
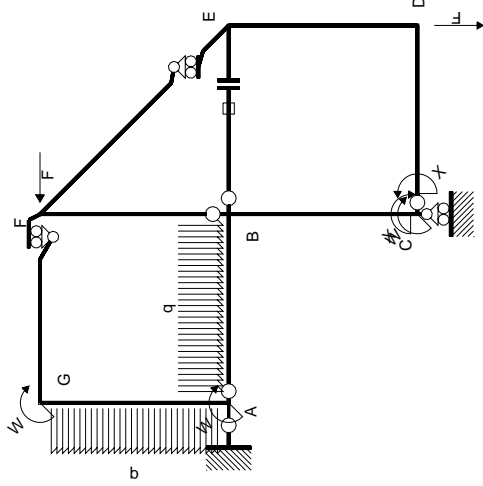


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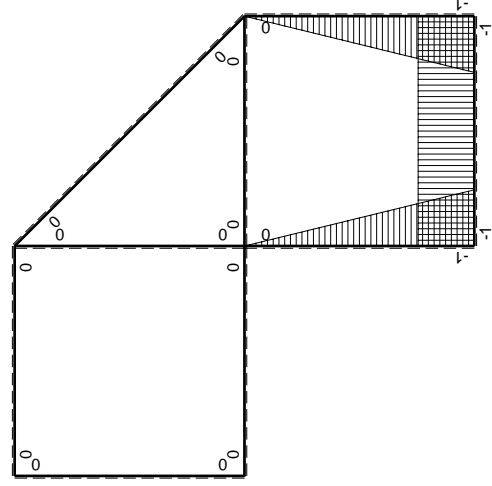


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx$	0	0	0	0
GF b	0	$3/2Fb - 3/2Fx$	0	0	0	0
GA b	0	$-1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$Fb - Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-9/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

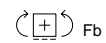
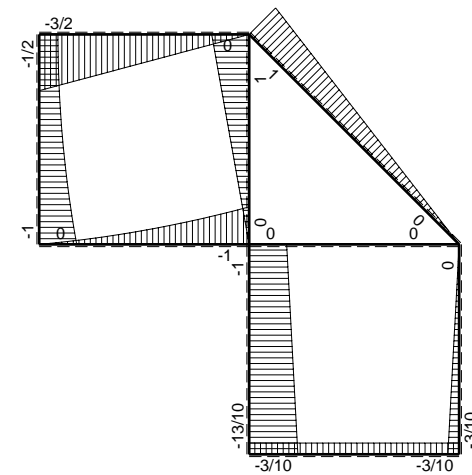
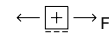
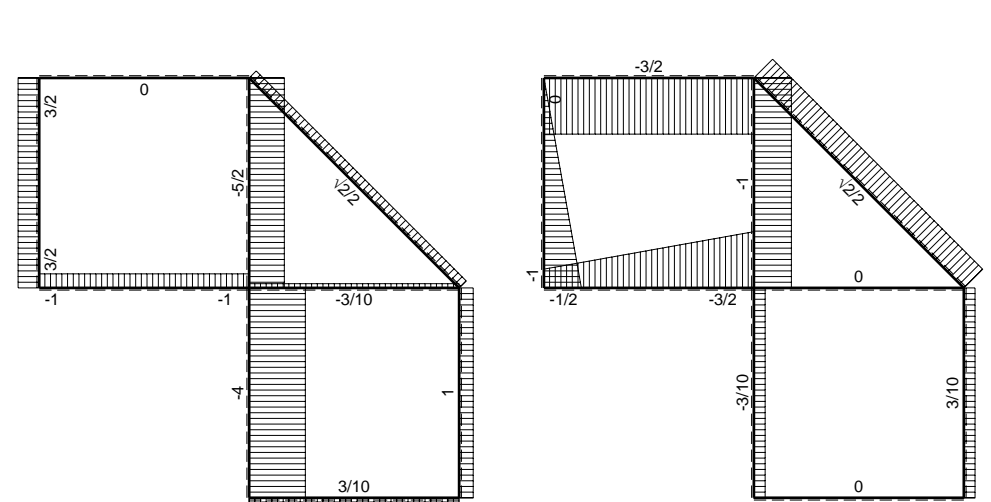
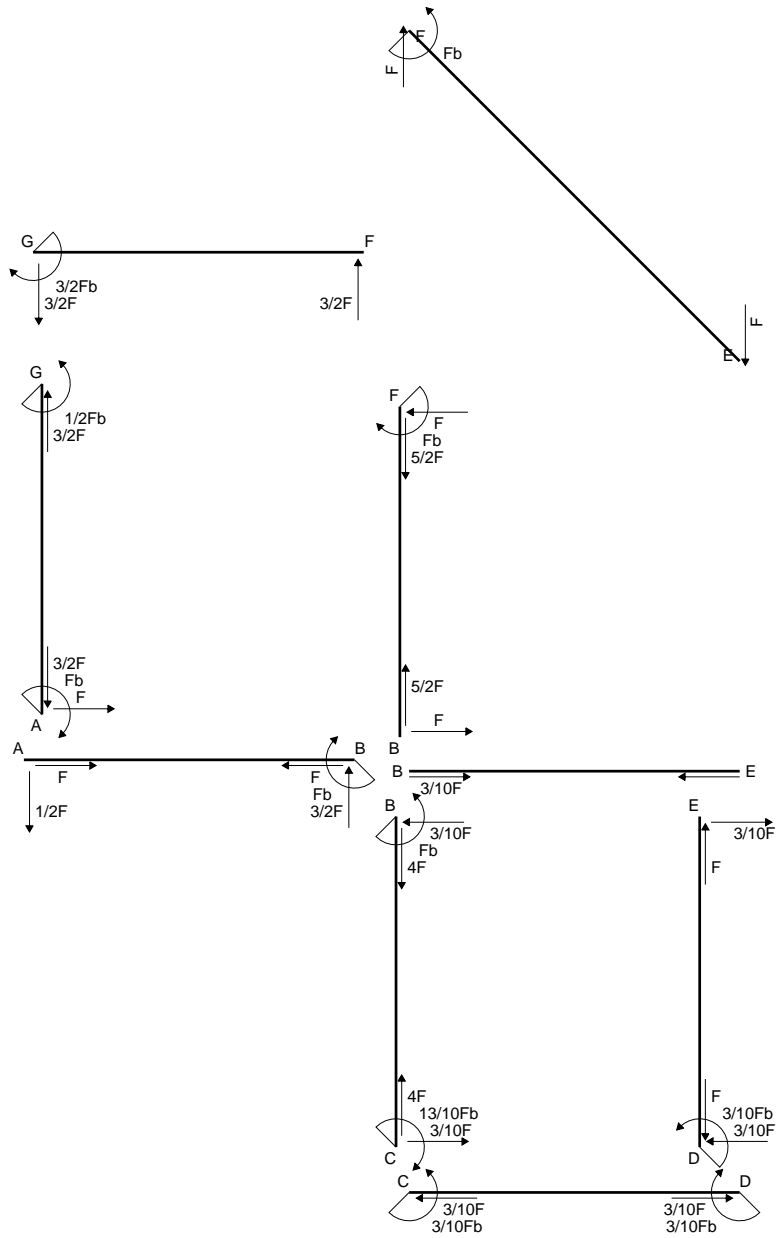
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

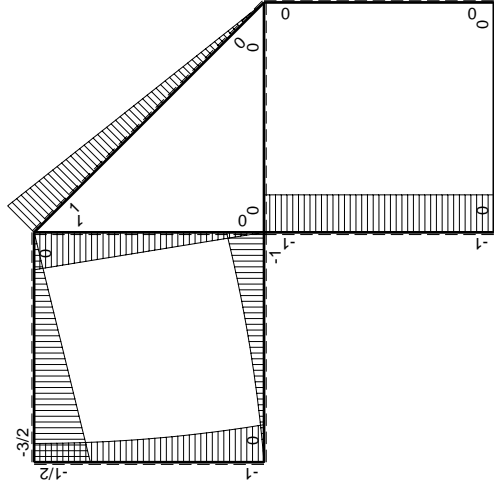
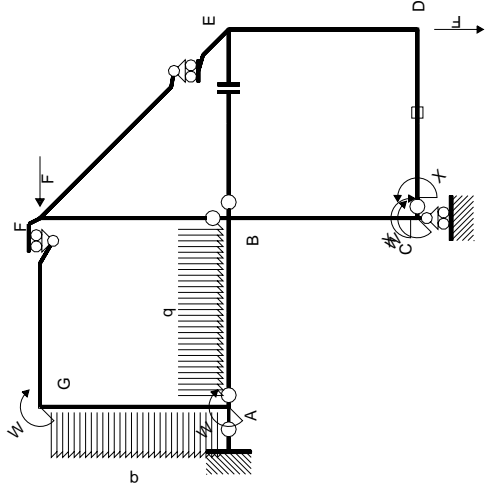
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

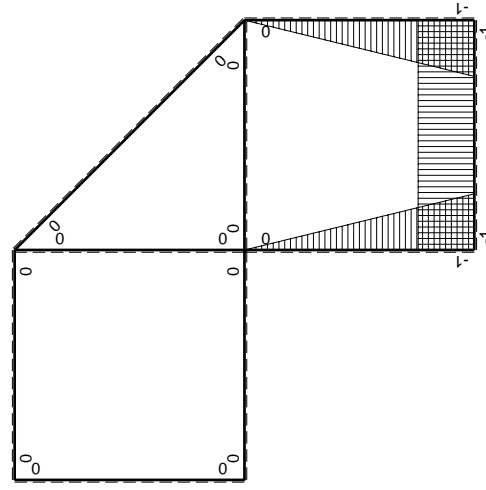
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx$	0	0	0	0
GF b	0	$3/2Fb - 3/2Fx$	0	0	0	0
GA b	0	$-1/2Fb - 1/2qx^2$	0	0	0	0
AG b	0	$Fb - Fx + 1/2qx^2$	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$3/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

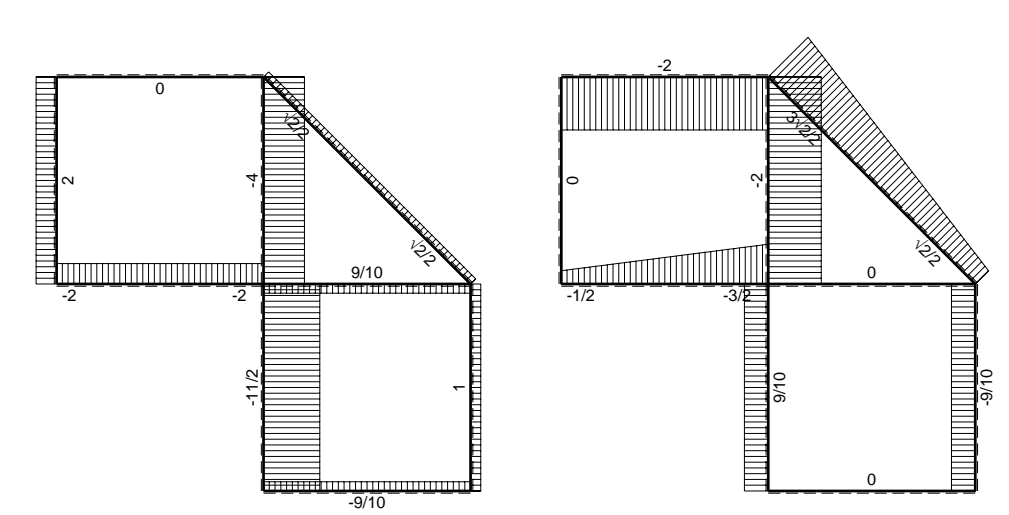
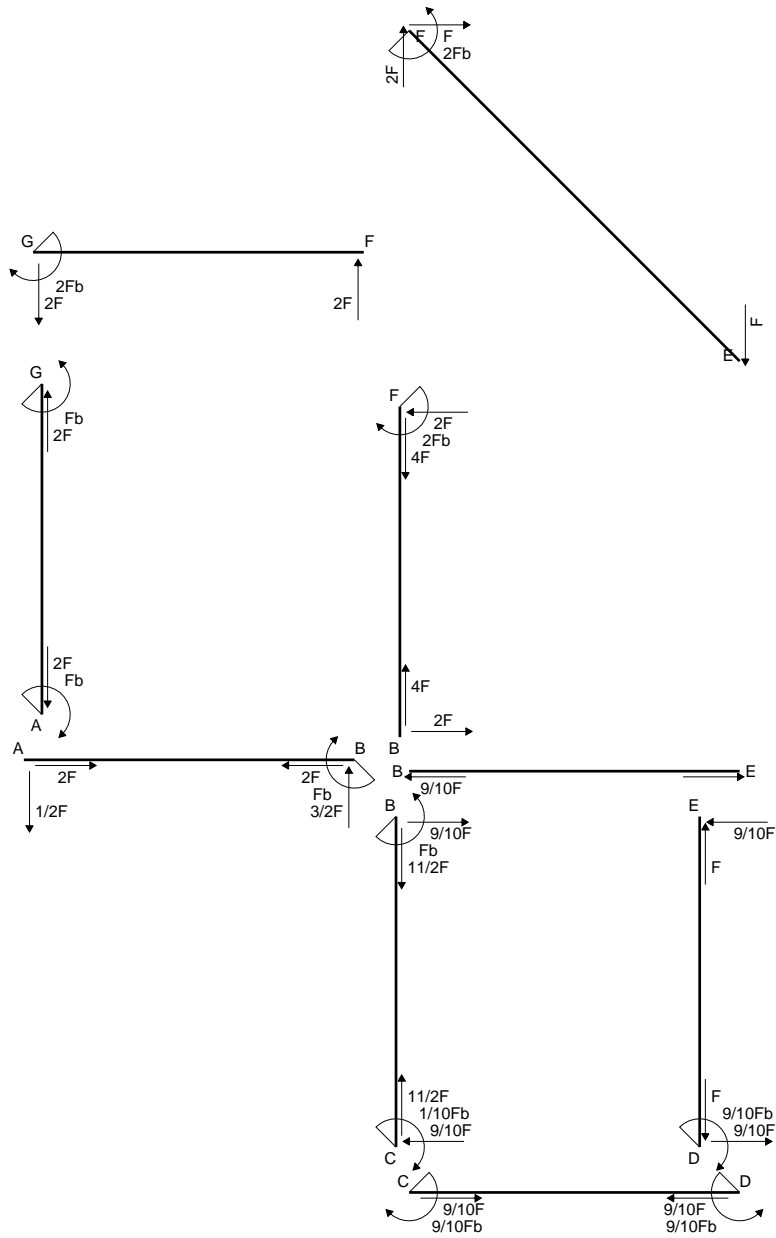
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

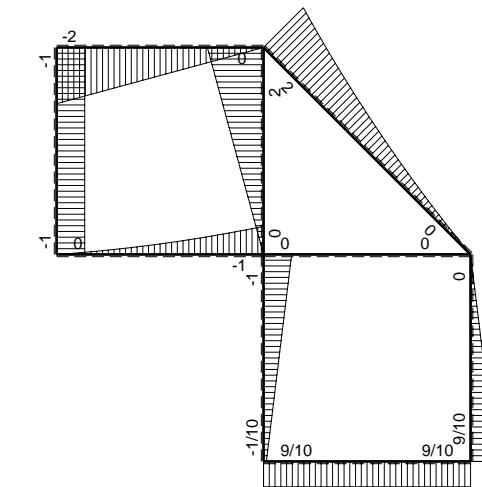
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

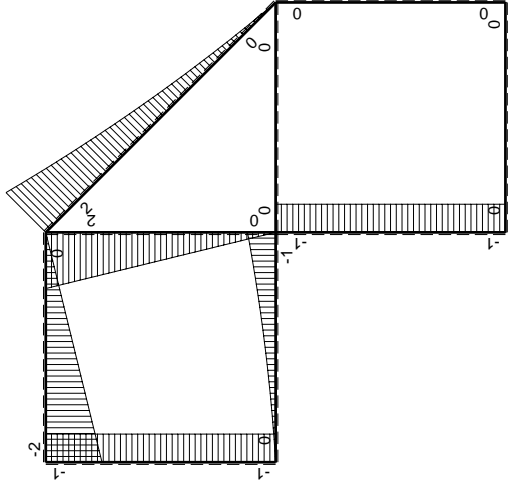
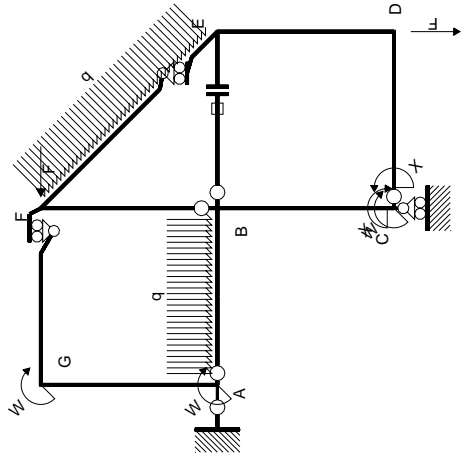


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⊕ ⊖ Fb



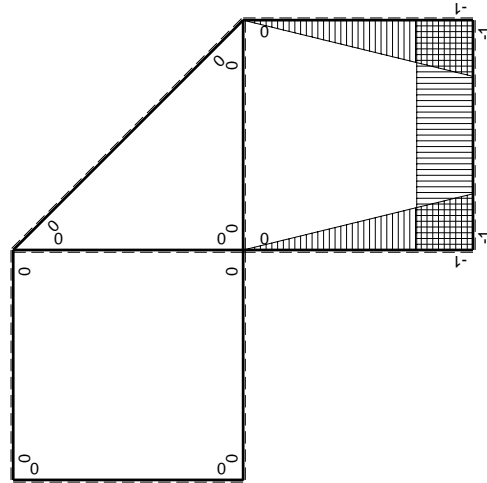
Schema di calcolo iperstatico

M_0 flessione da carichi assegnati

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$2Fb-2Fx$	0	0	0	0
BF b	0	$-2Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$-9/10Fb$	

Sviluppi di calcolo iperstatica



M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

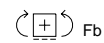
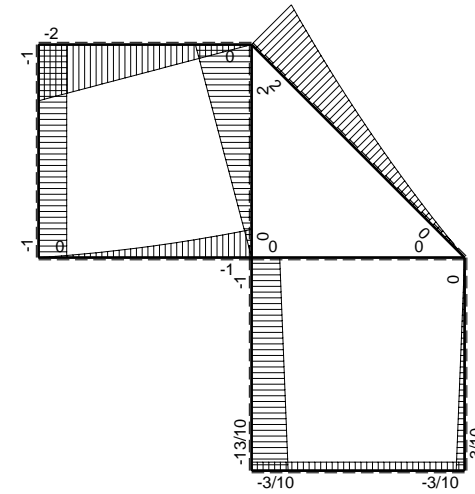
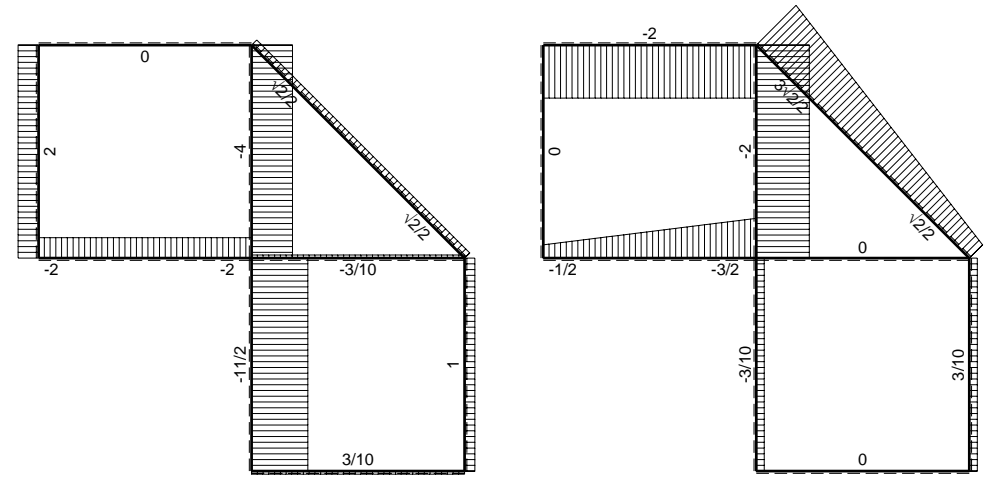
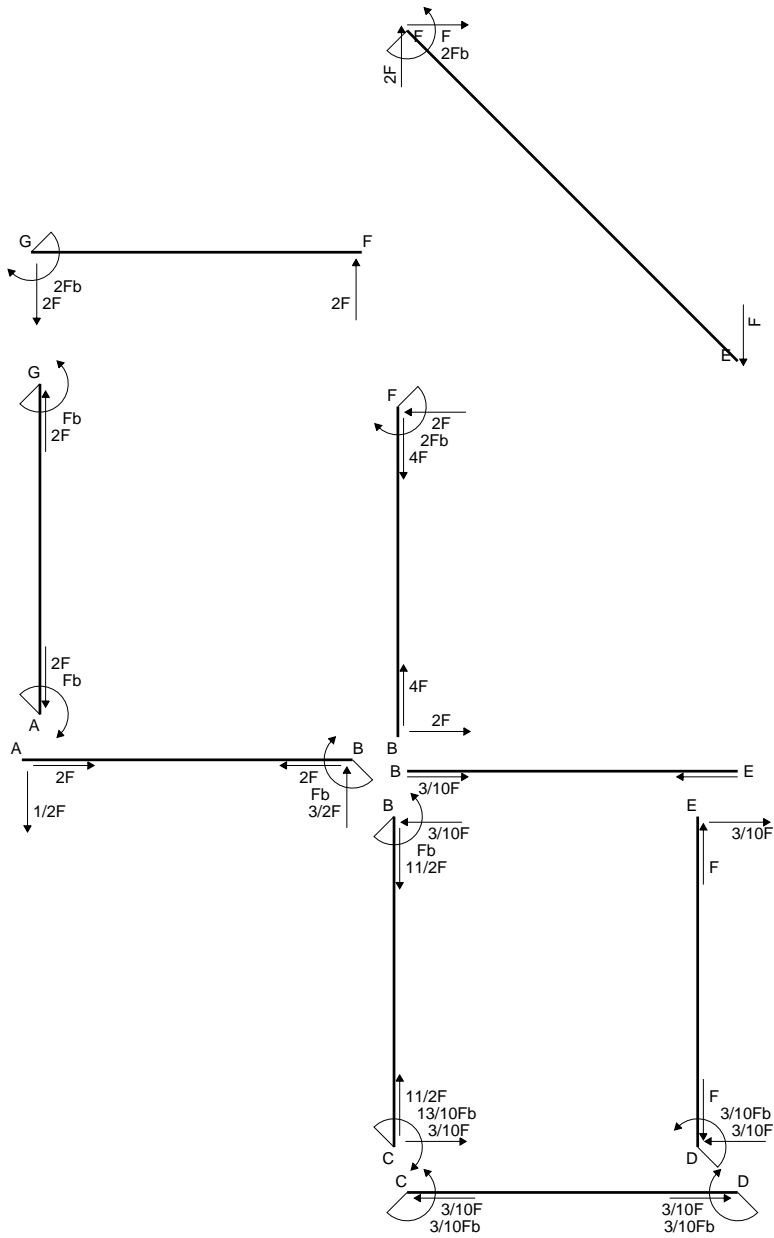
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

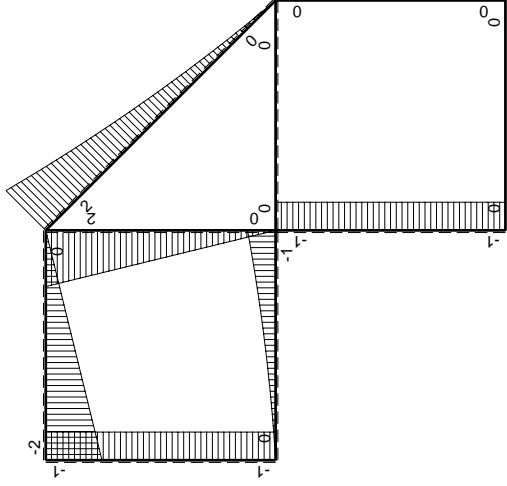
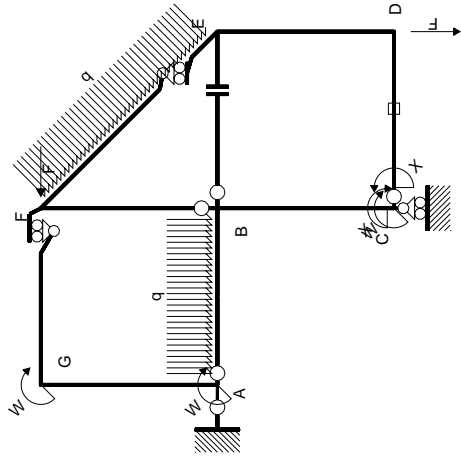
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





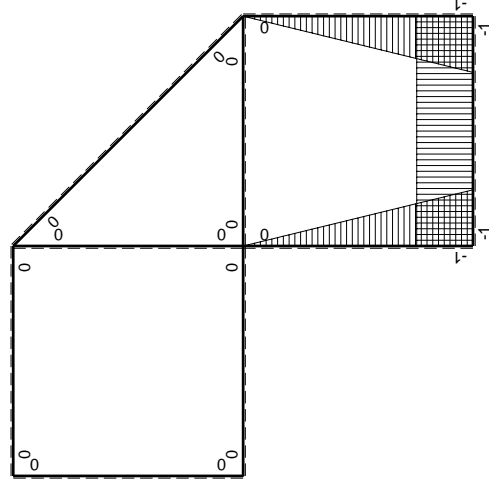
Schema di calcolo iperstatico

M_0 flessione da carichi assegnati

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx + 1/2qx^2$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$2Fb-2Fx$	0	0	0	0
BF b	0	$-2Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$3/10Fb$	

Sviluppi di calcolo iperstatica



M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

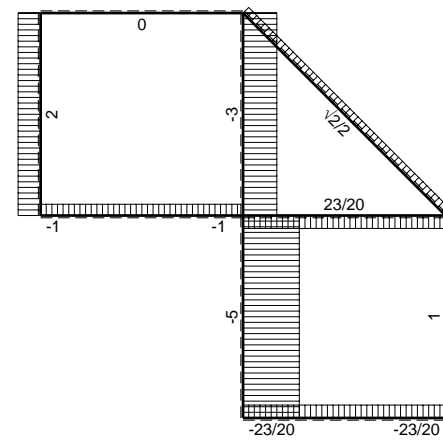
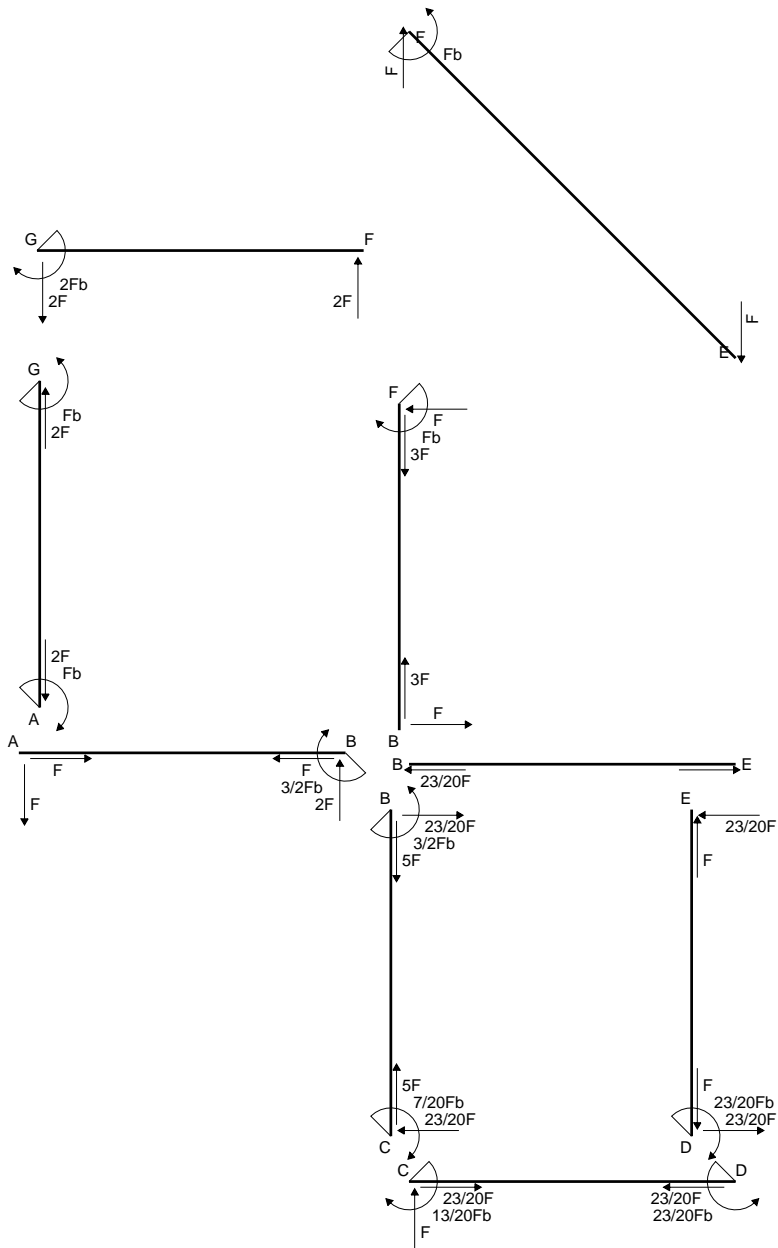
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

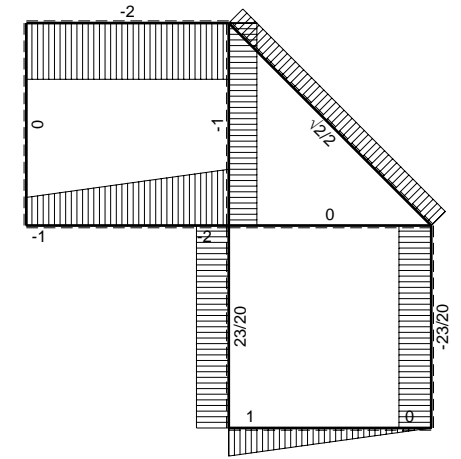
$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

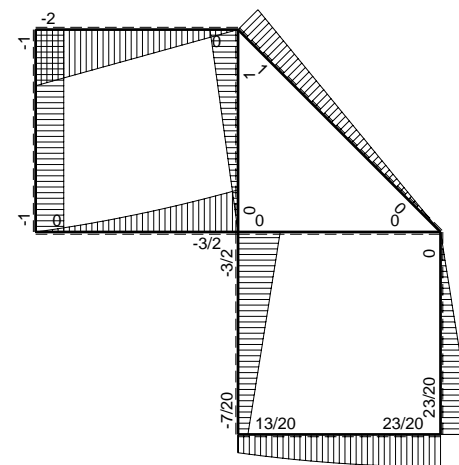
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$



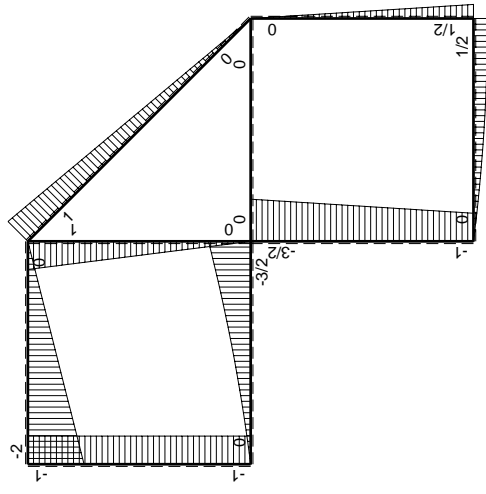
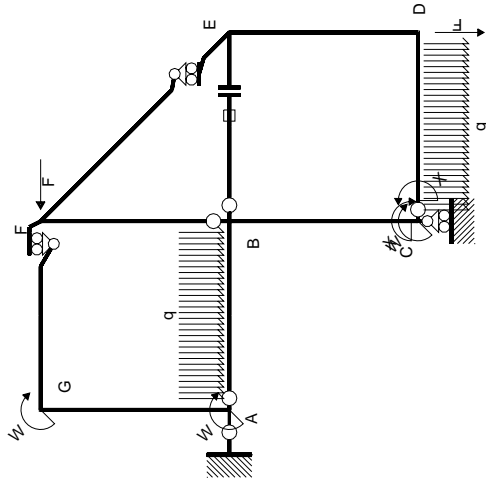
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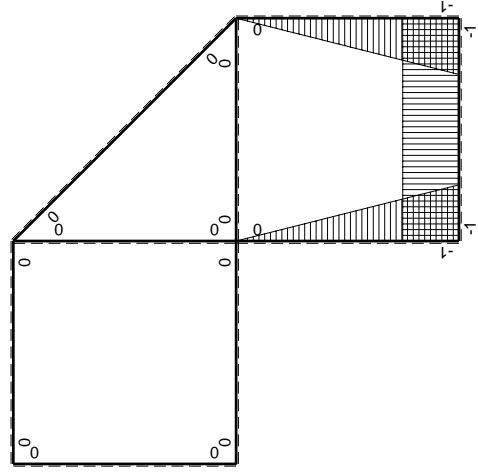
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M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$1/2Fb - 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon} L_{BE}^{\epsilon}$				Fb^2/EJ	
	totali				$13/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$-13/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

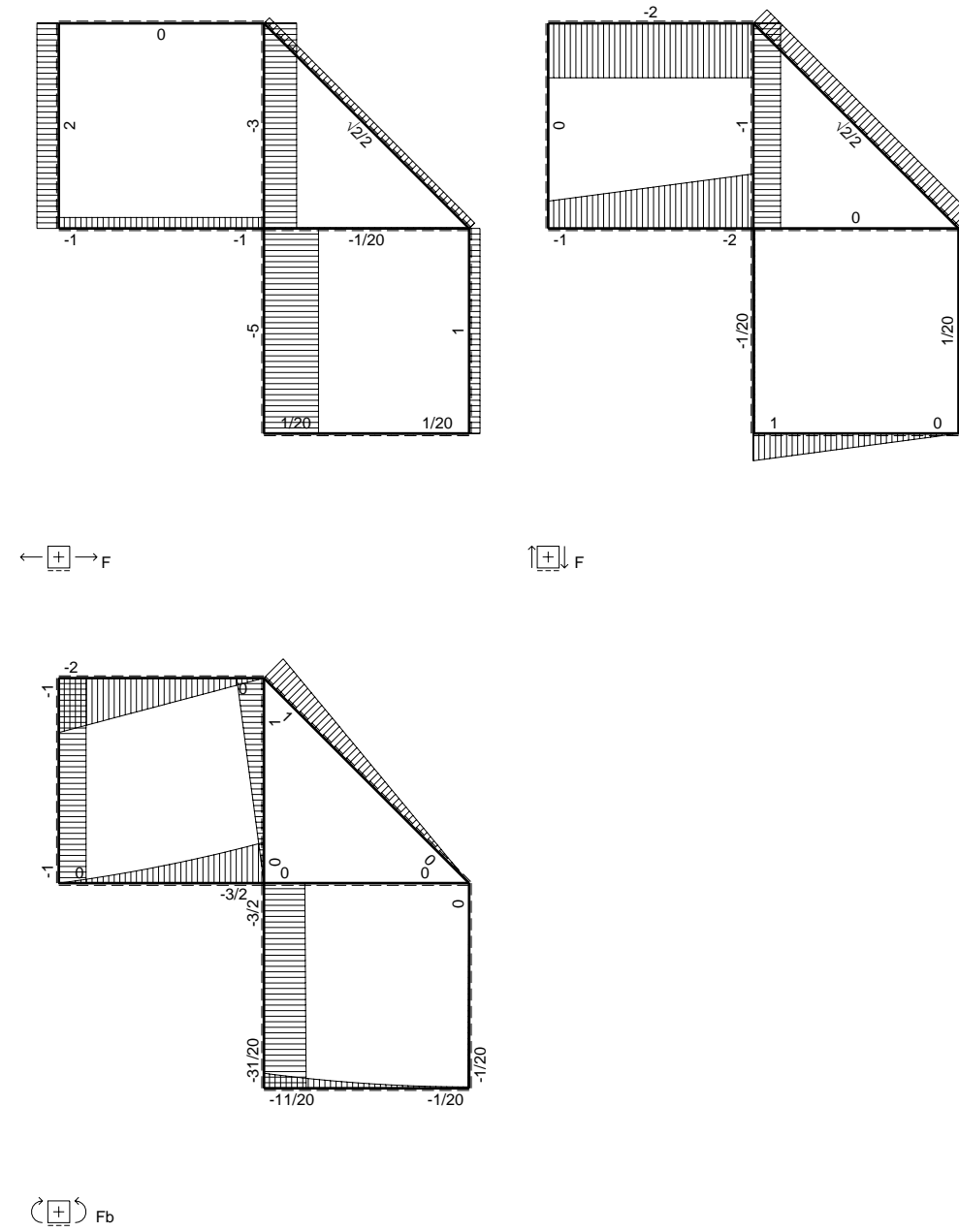
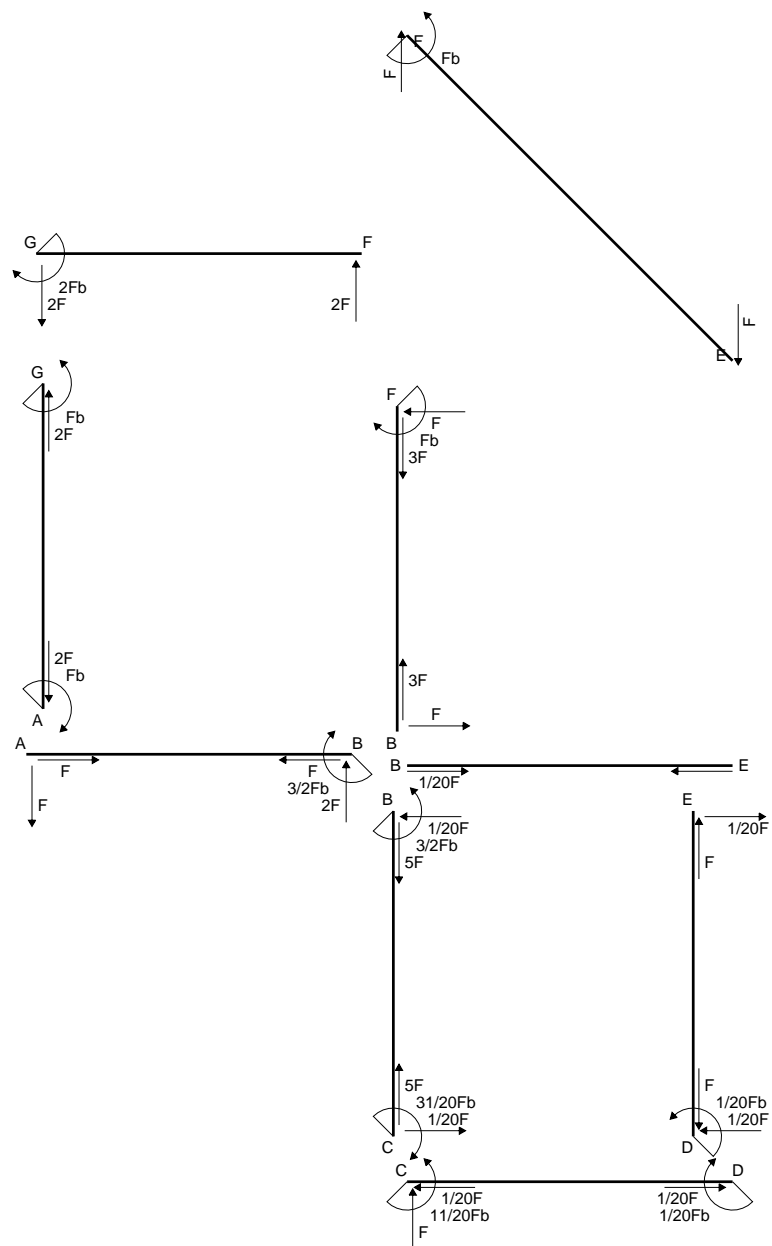
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

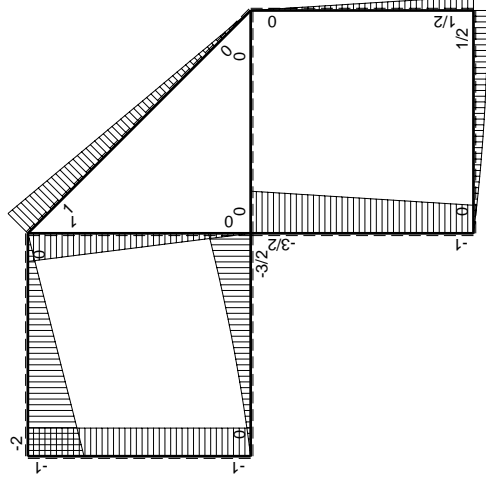
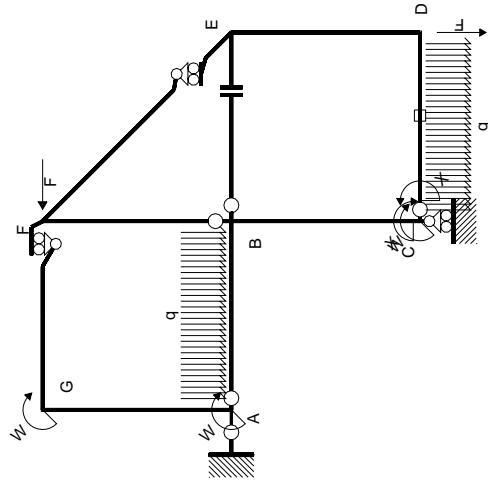
$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

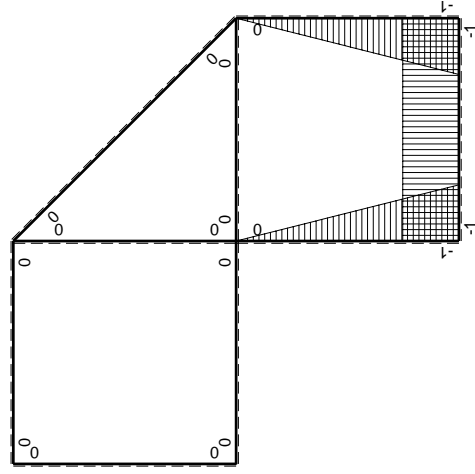
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	Xb/EJ
CD b	-1	$Fx - 1/2qx^2$	$-Fx + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb + 1/2qx^2$	$-1/2Fb + 1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$1/2Fb - 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-11/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$11/20Fb$	

Sviluppi di calcolo iperstatica

M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

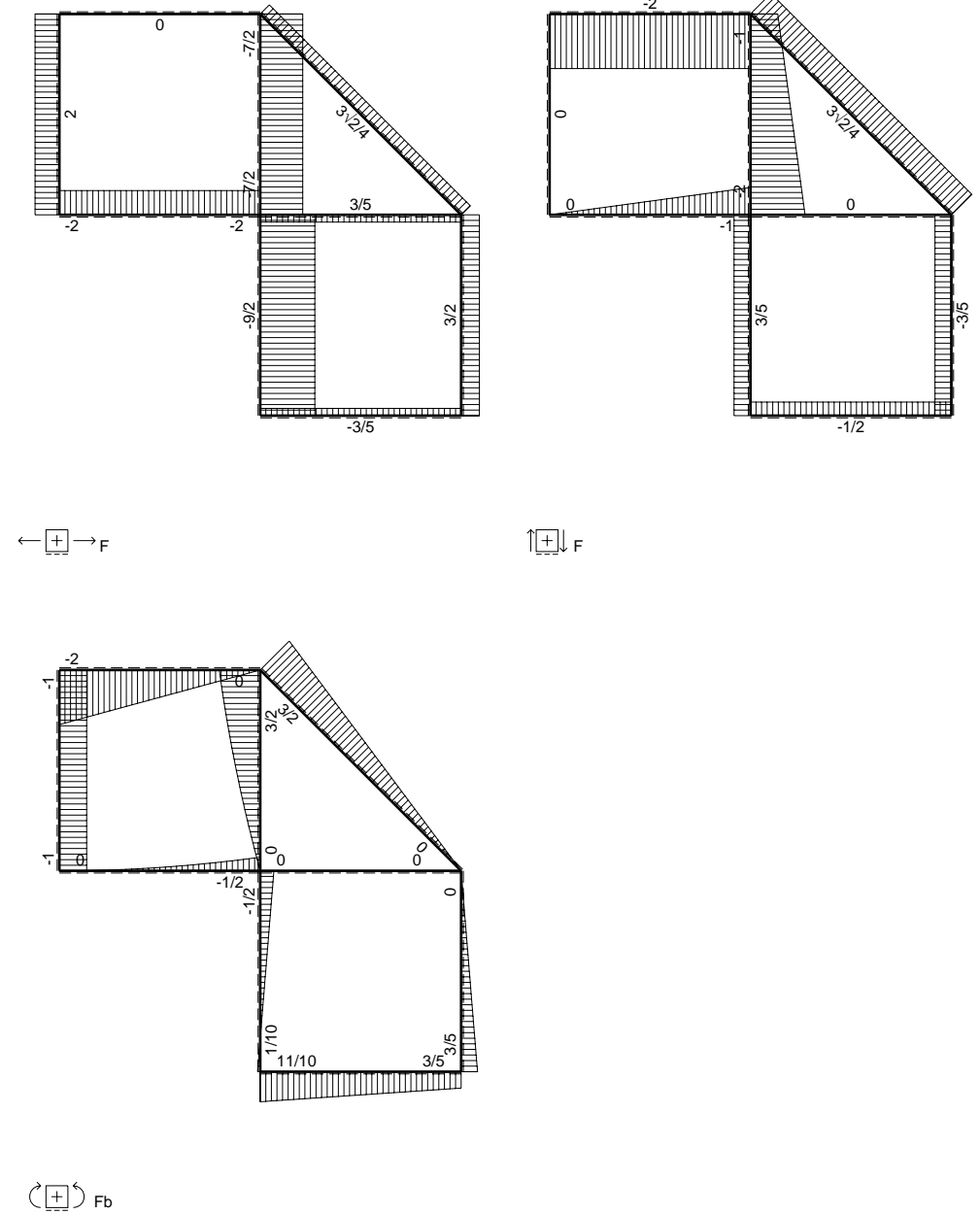
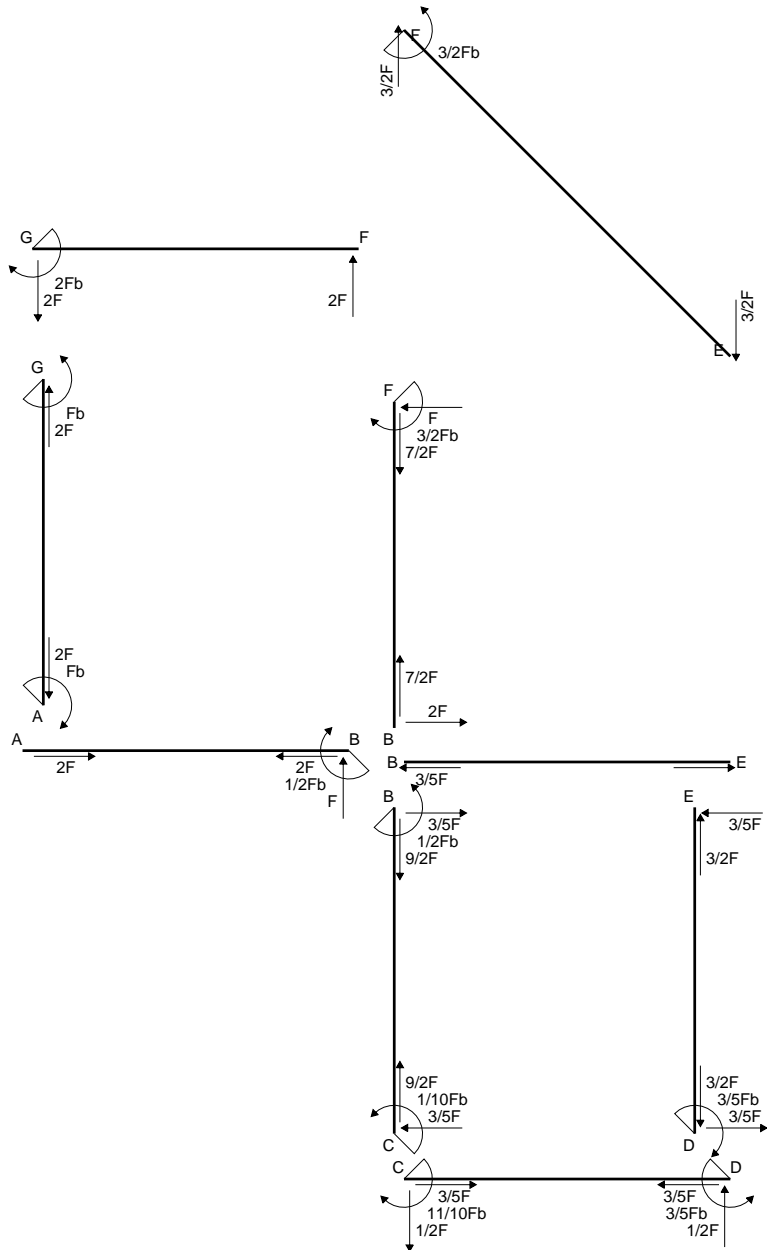
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

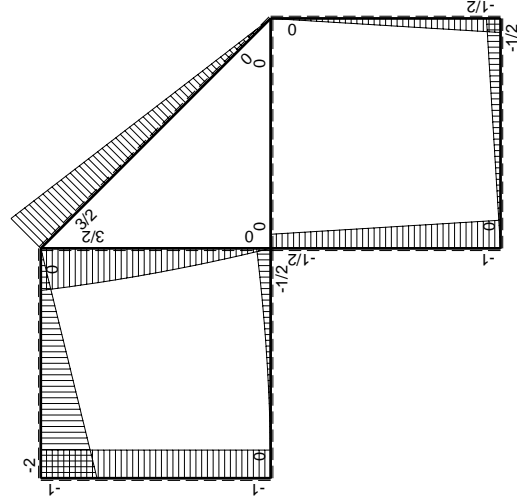
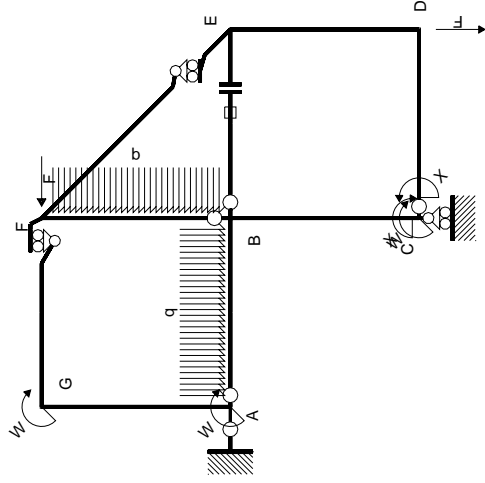
$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

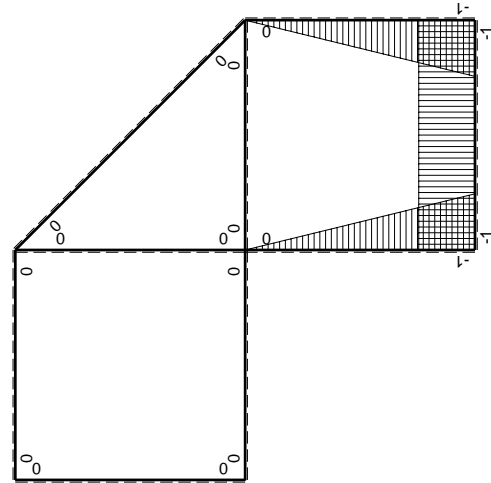
$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-1/2Fb-1/2Fx$	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb-1/2Fx$	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	Xb/EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/6Fb^2/EJ$	$1/3Xb/EJ$
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$-1/2Fb+1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fx$	$1/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE}} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-11/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

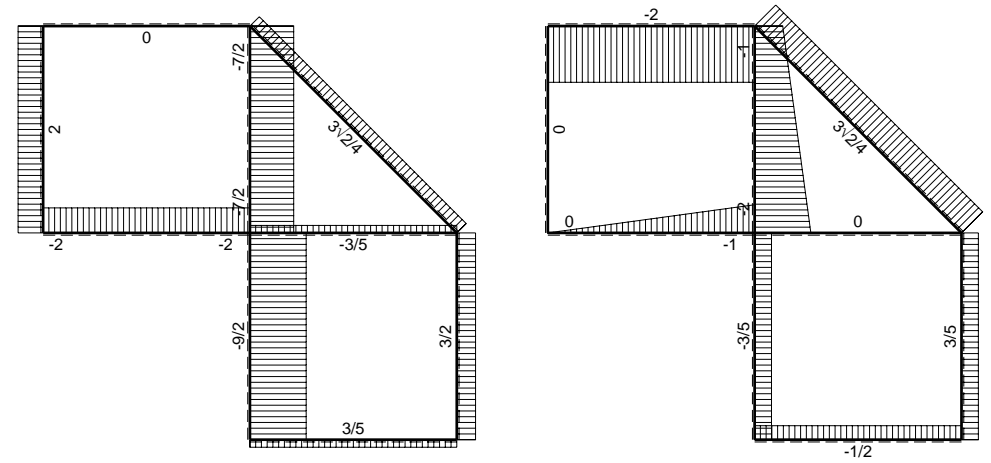
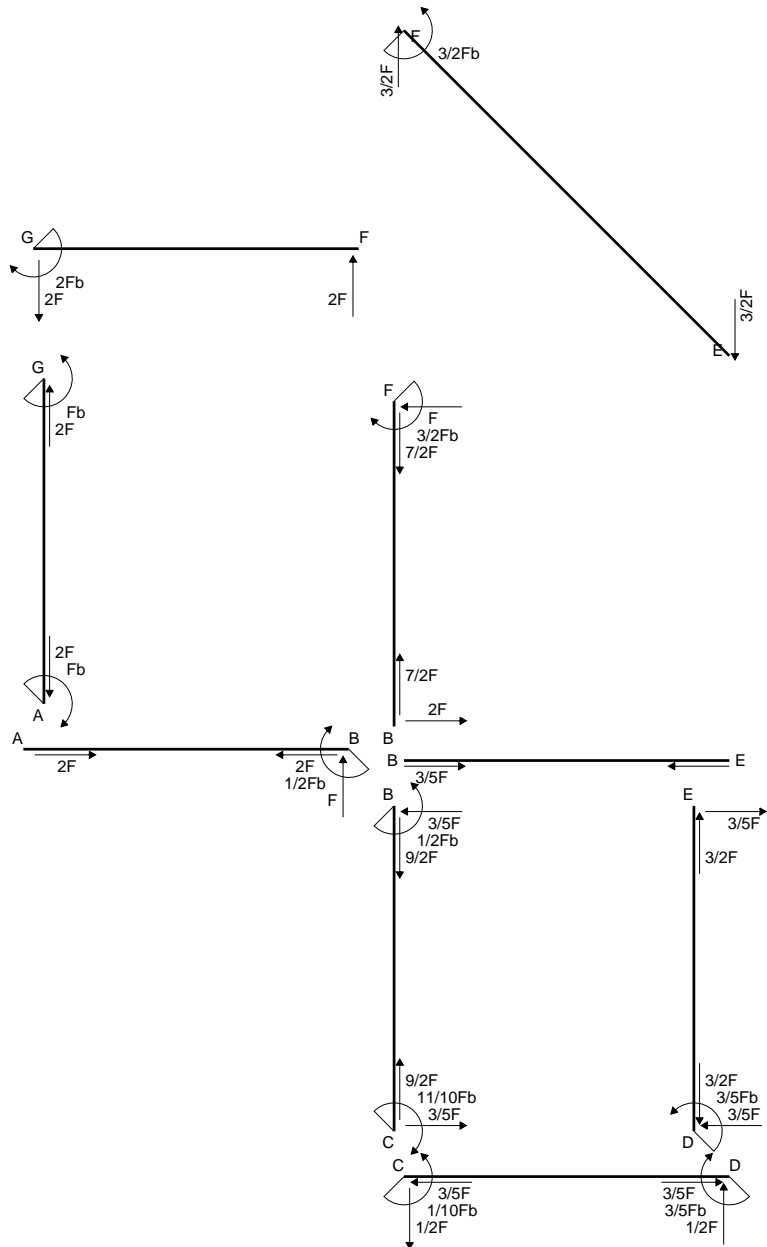
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

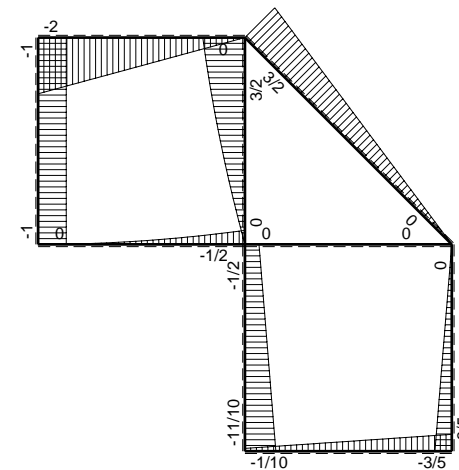
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

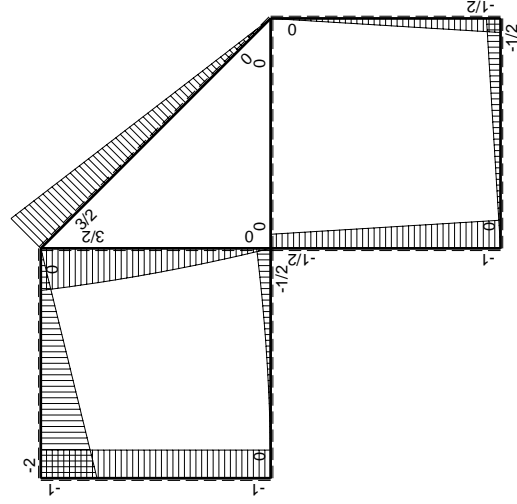
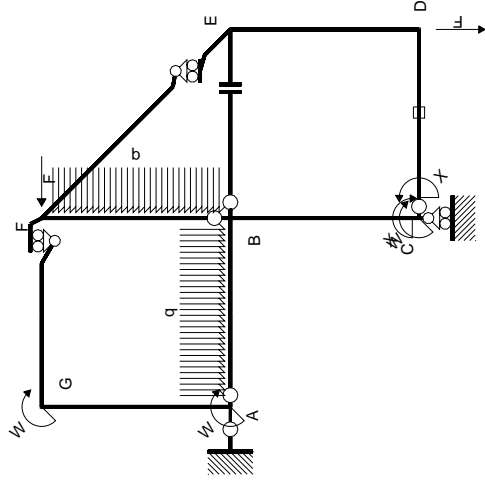


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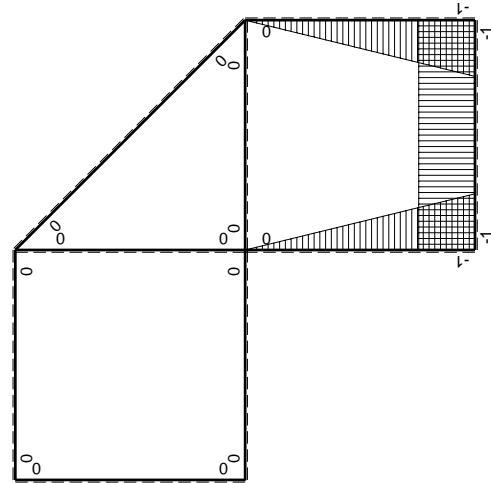


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-1/2Fb-1/2Fx$	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb-1/2Fx$	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	Xb/EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$-1/2Fb+1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$			0	$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

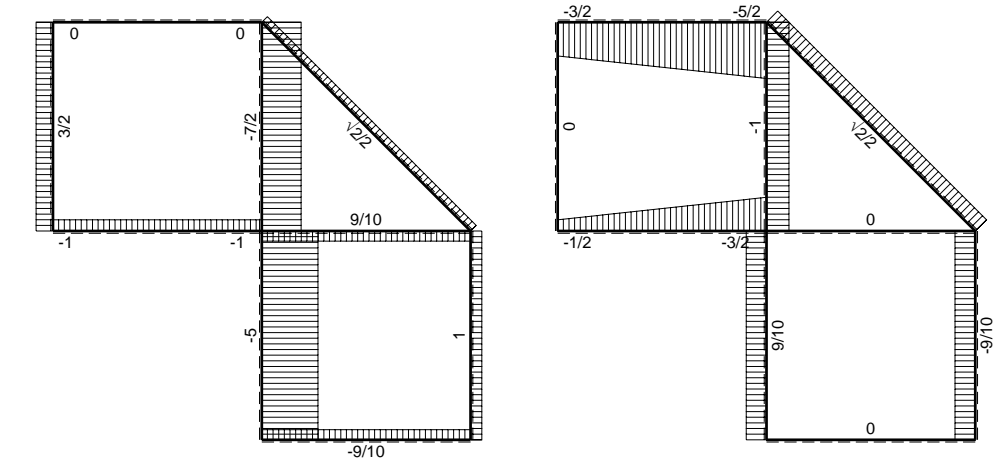
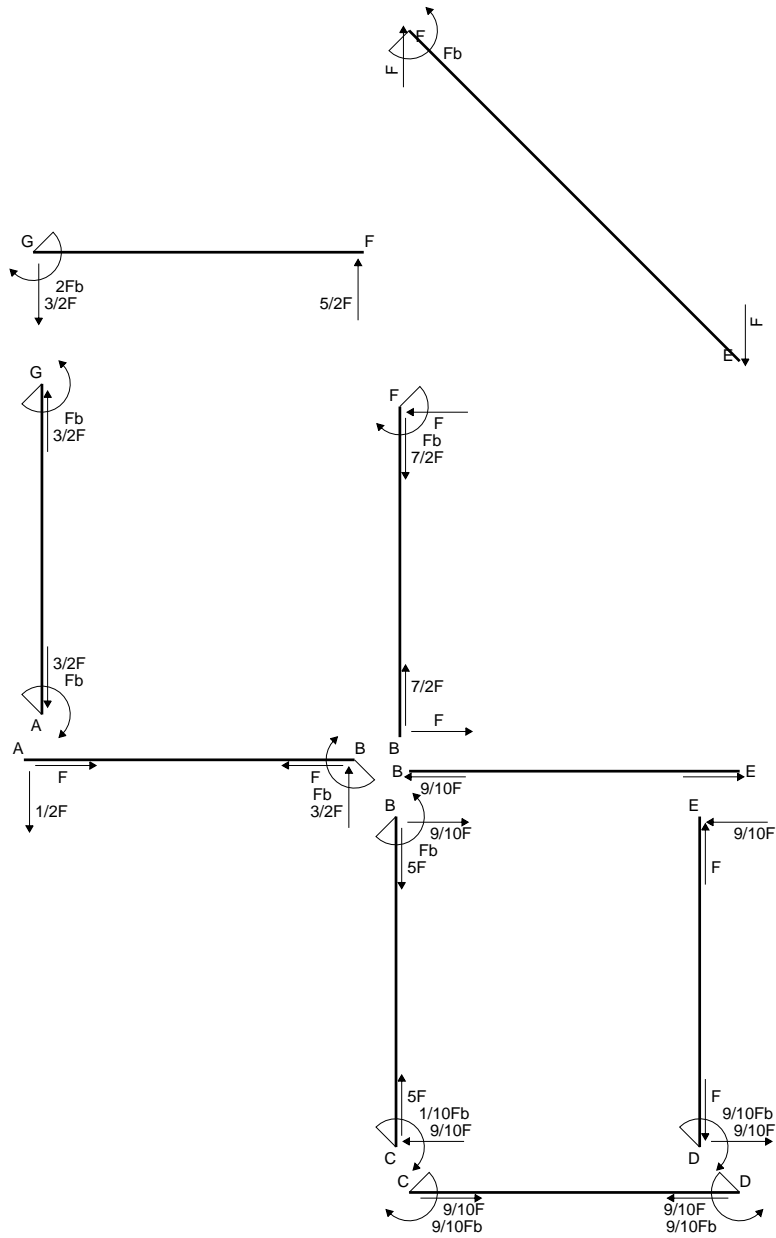
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

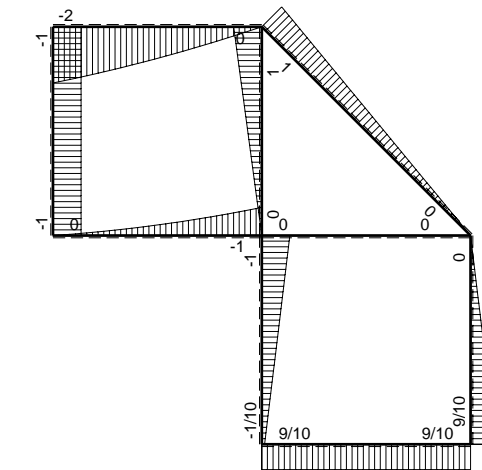
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

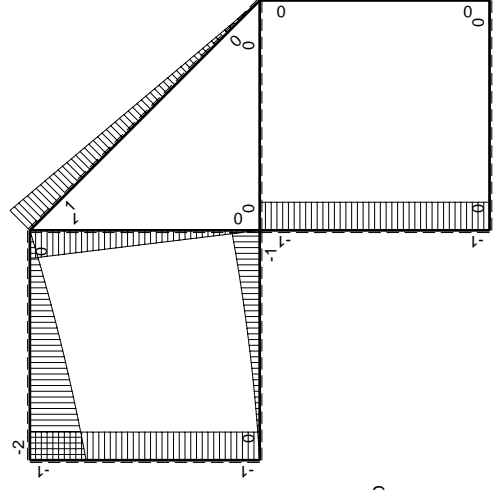
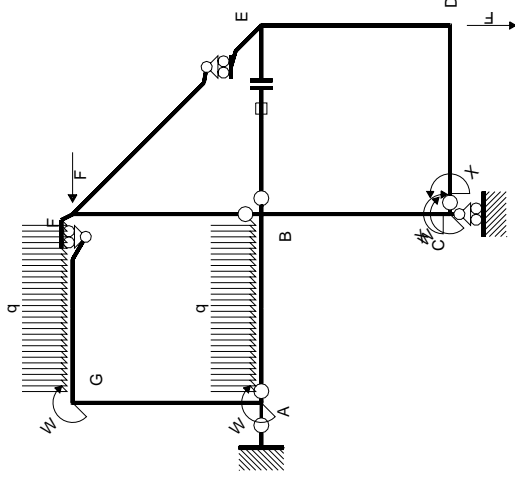


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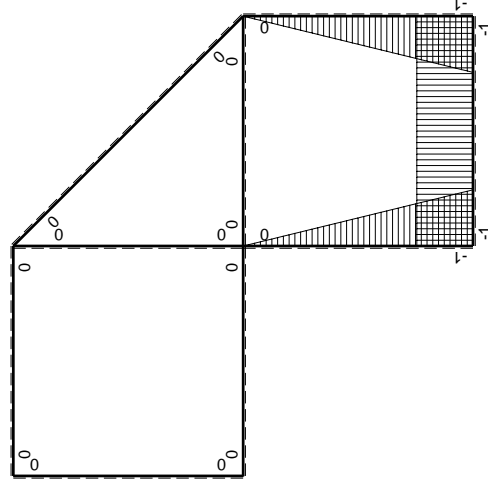


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$-9/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

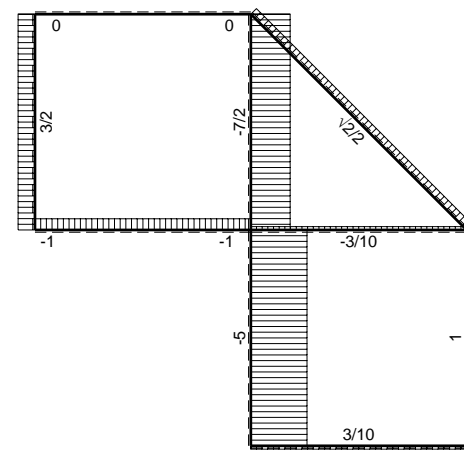
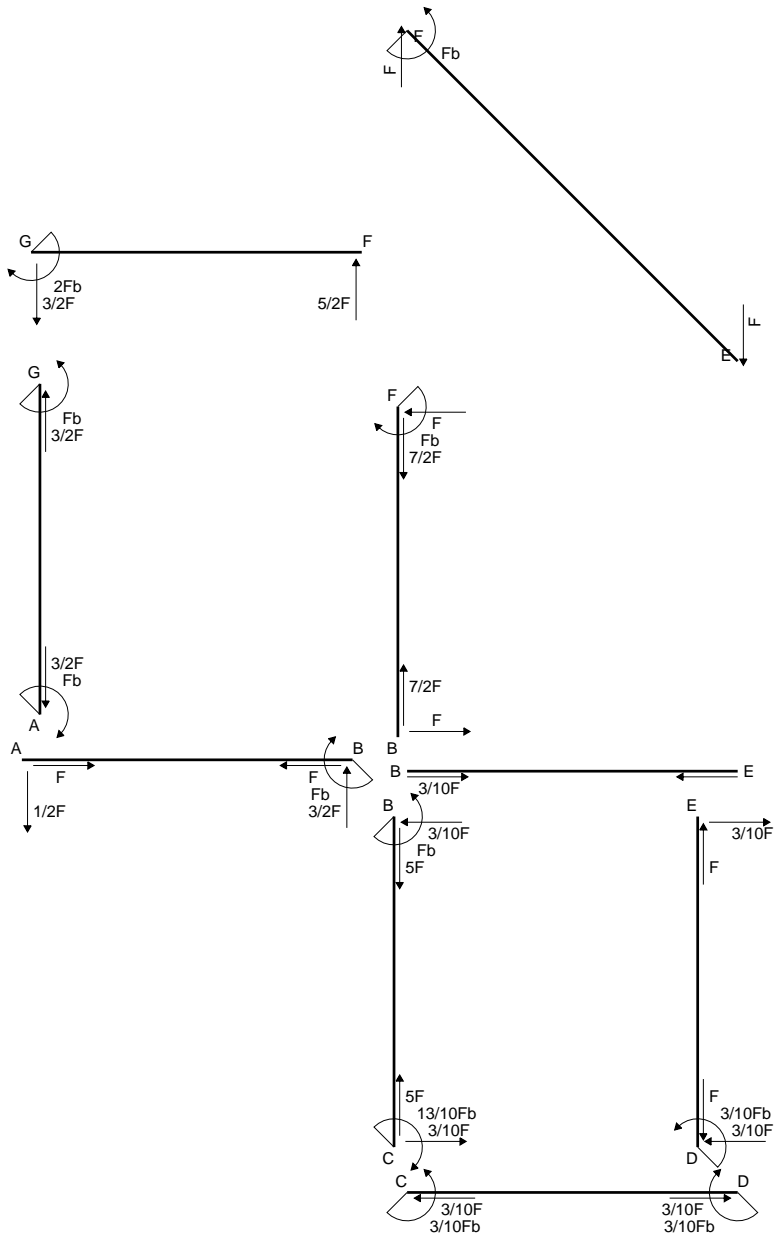
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

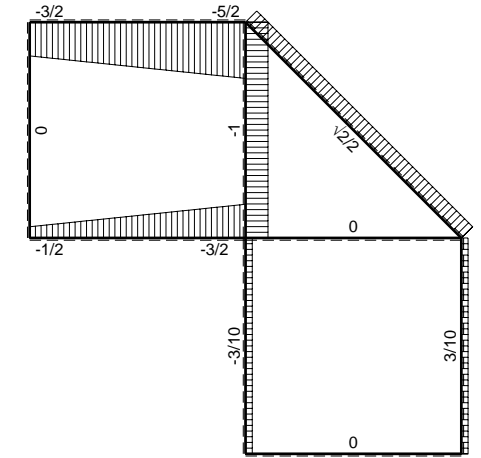
$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

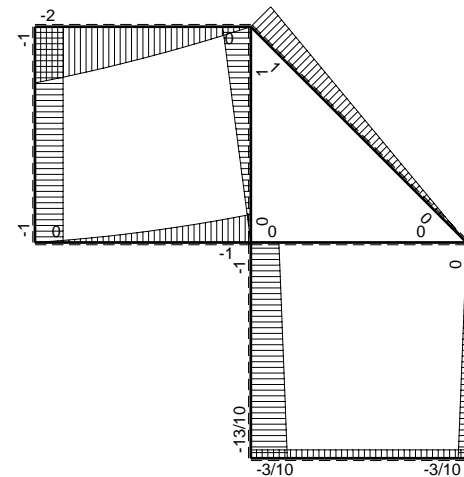
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$



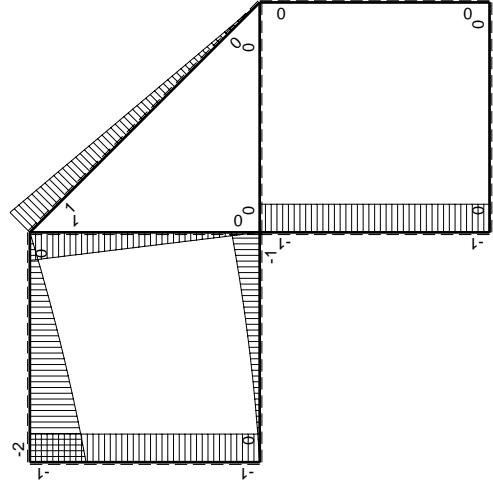
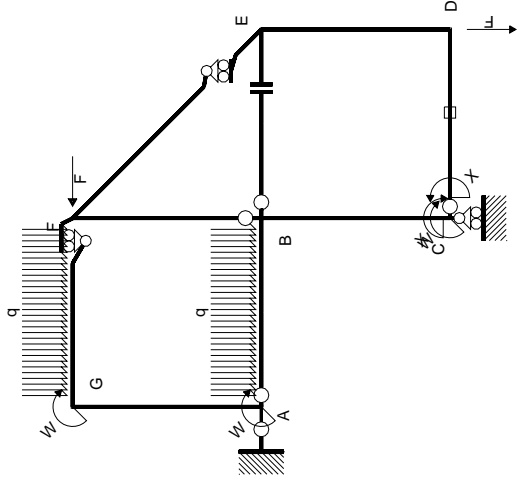
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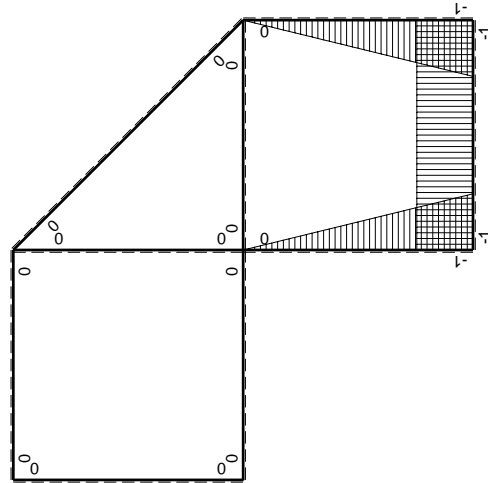


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$3/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

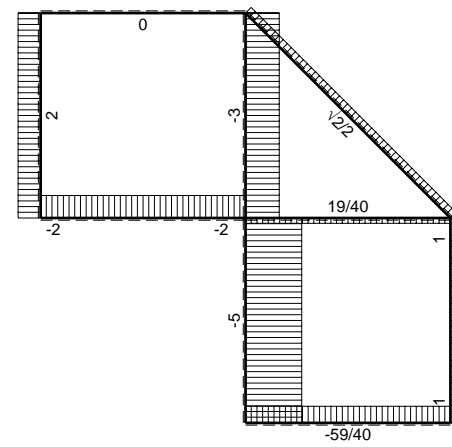
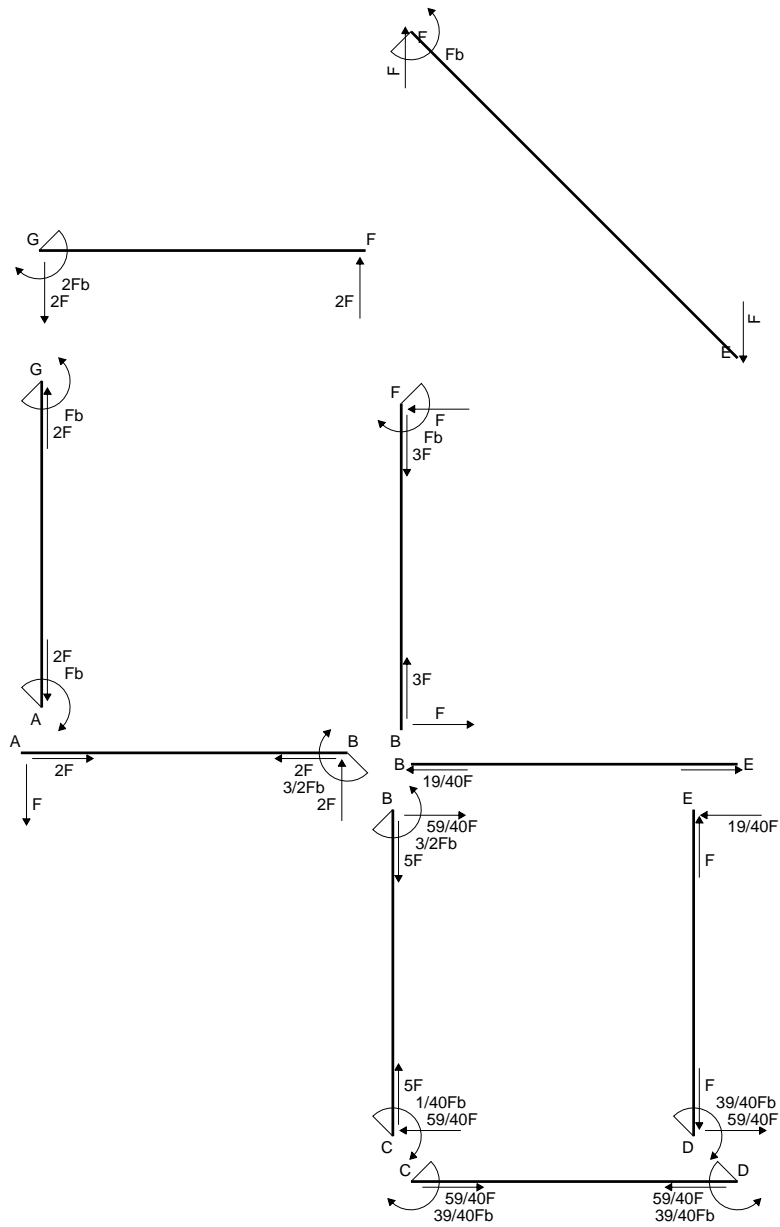
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

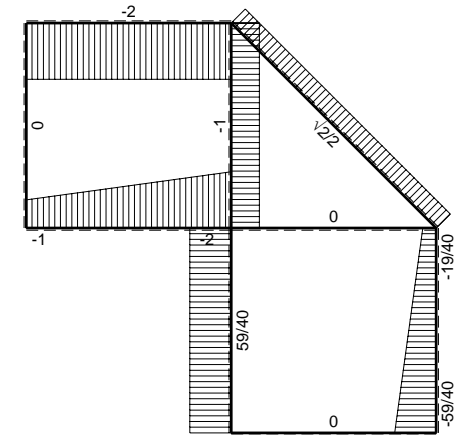
$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

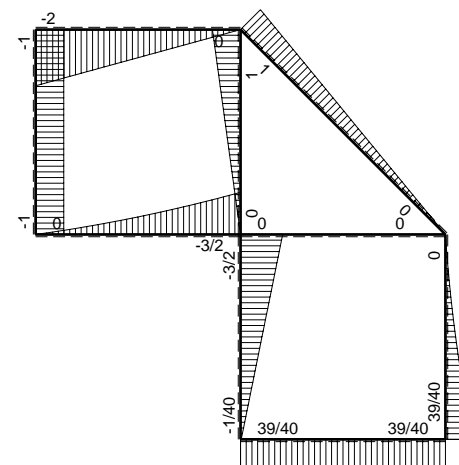
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$



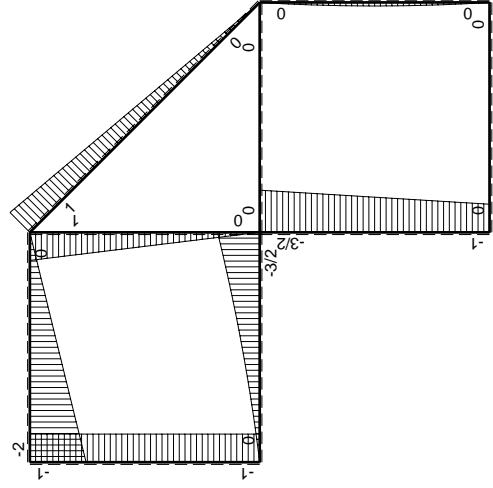
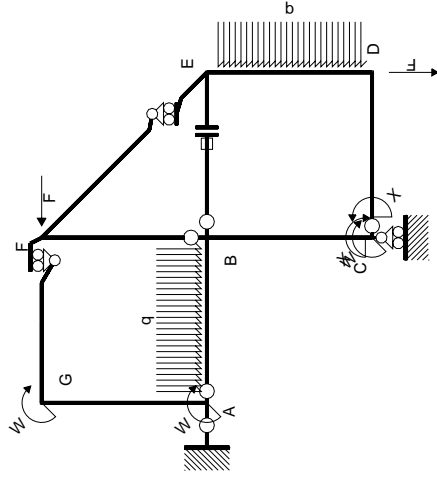
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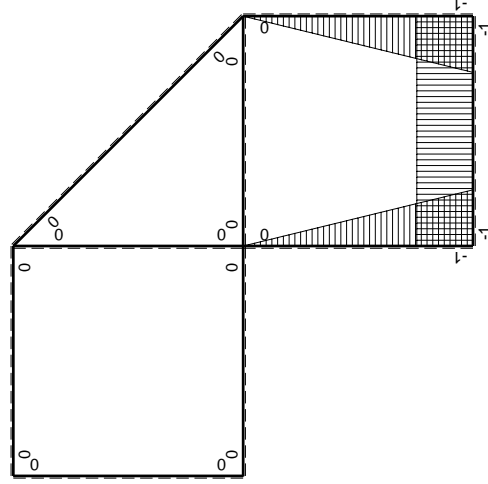


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fx - 1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb - 2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-3/2Fb + 1/2Fx$	$3/2Fx - 1/2Fx^2 / b$	x^2 / b^2	$7/12Fb^2 / EJ$	$1/3Xb / EJ$
CB b	$1-x/b$	$Fb + 1/2Fx$	$Fb - 1/2Fx - 1/2Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	0	Xb / EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	$-1+x/b$	$-1/2Fx + 1/2qx^2$	$1/2Fx - Fx^2 / b + 1/2qx^3 / b$	$1 - 2x/b + x^2 / b^2$	$1/24Fb^2 / EJ$	$1/3Xb / EJ$
ED b	x/b	$1/2Fx - 1/2qx^2$	$1/2Fx^2 / b - 1/2qx^3 / b$	x^2 / b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb - 2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb - Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2 / EJ	
	totali				$13/8Fb^2 / EJ$	$5/3Xb / EJ$
	iperstatica X=W _{cd}				$-39/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

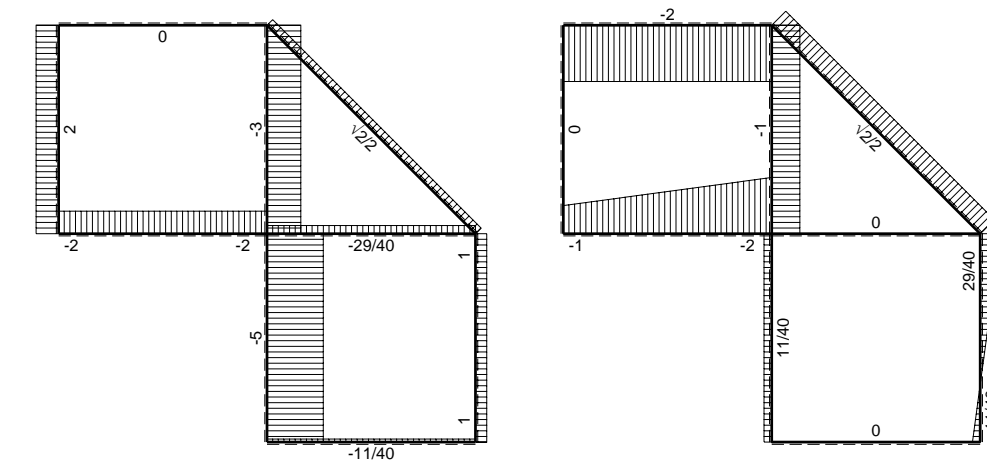
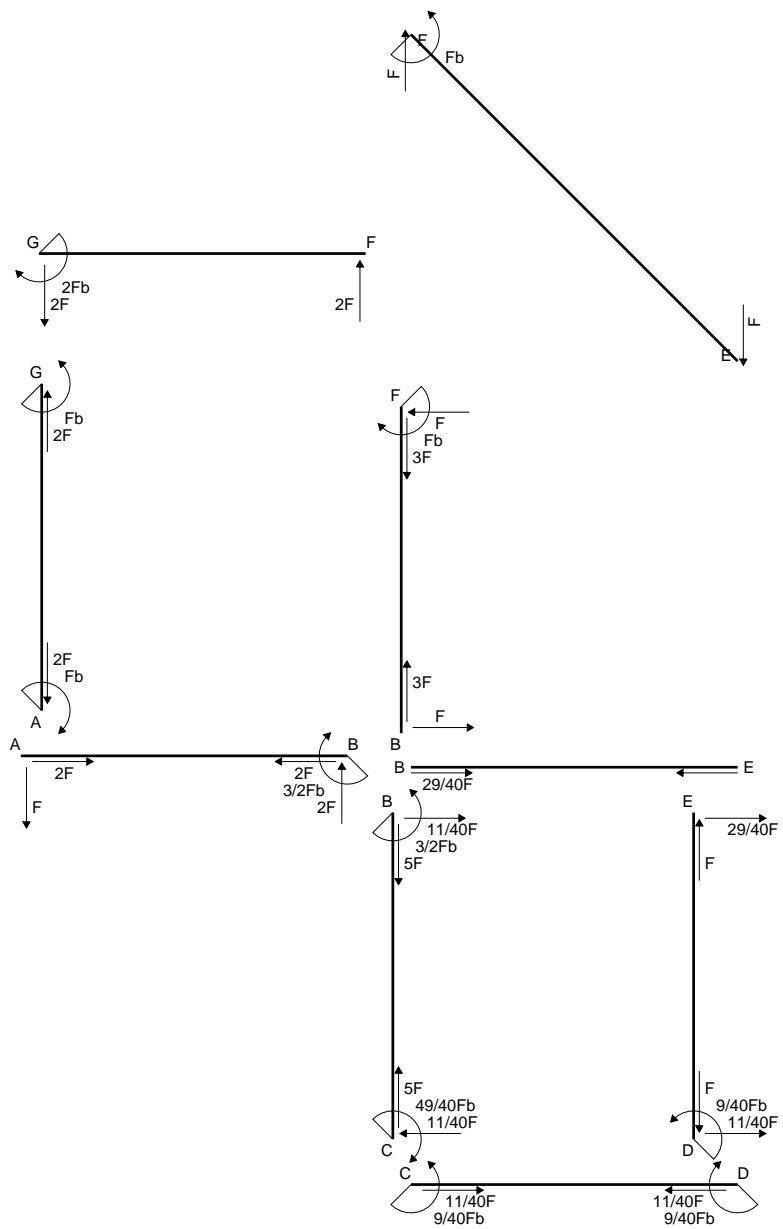
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 Fb^2/EJ$$

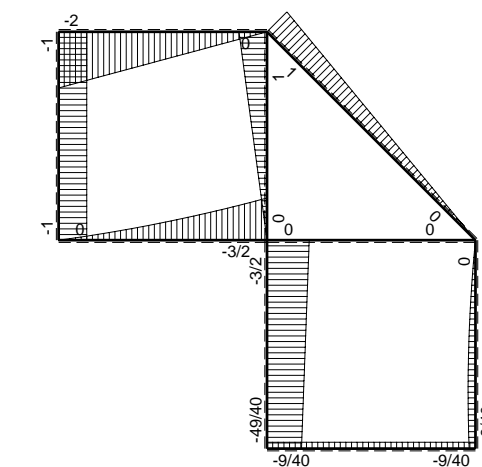
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{6} x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 Fb^2/EJ$$

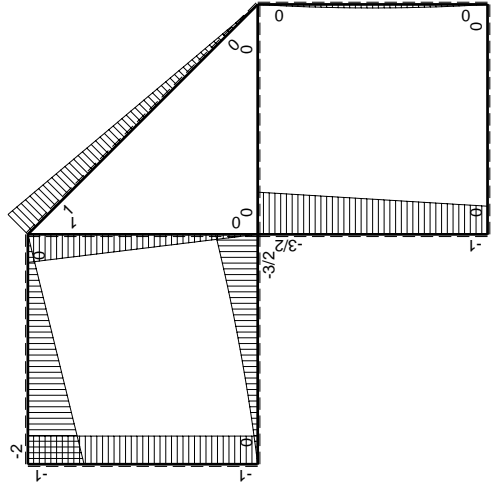
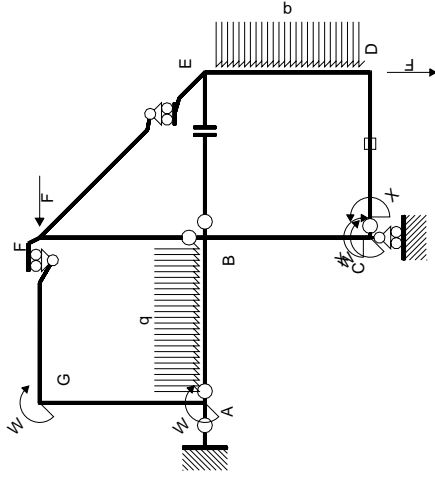


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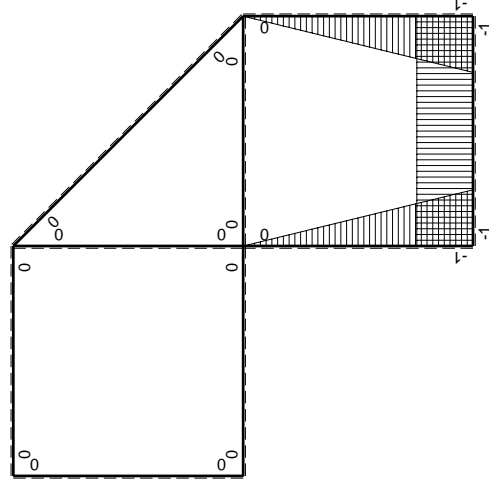


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫M _x M _x /EJdx
AB b	0	-Fx-1/2qx ²	0	0	0	0
BA b	0	3/2Fb-2Fx+1/2qx ²	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx+1/2qx ²	1/2Fx-Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	1/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx-1/2qx ²	1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta N _{1,cd} ε _{cd} L _{cd}				-Fb ² /EJ	
	totali				-3/8Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				9/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

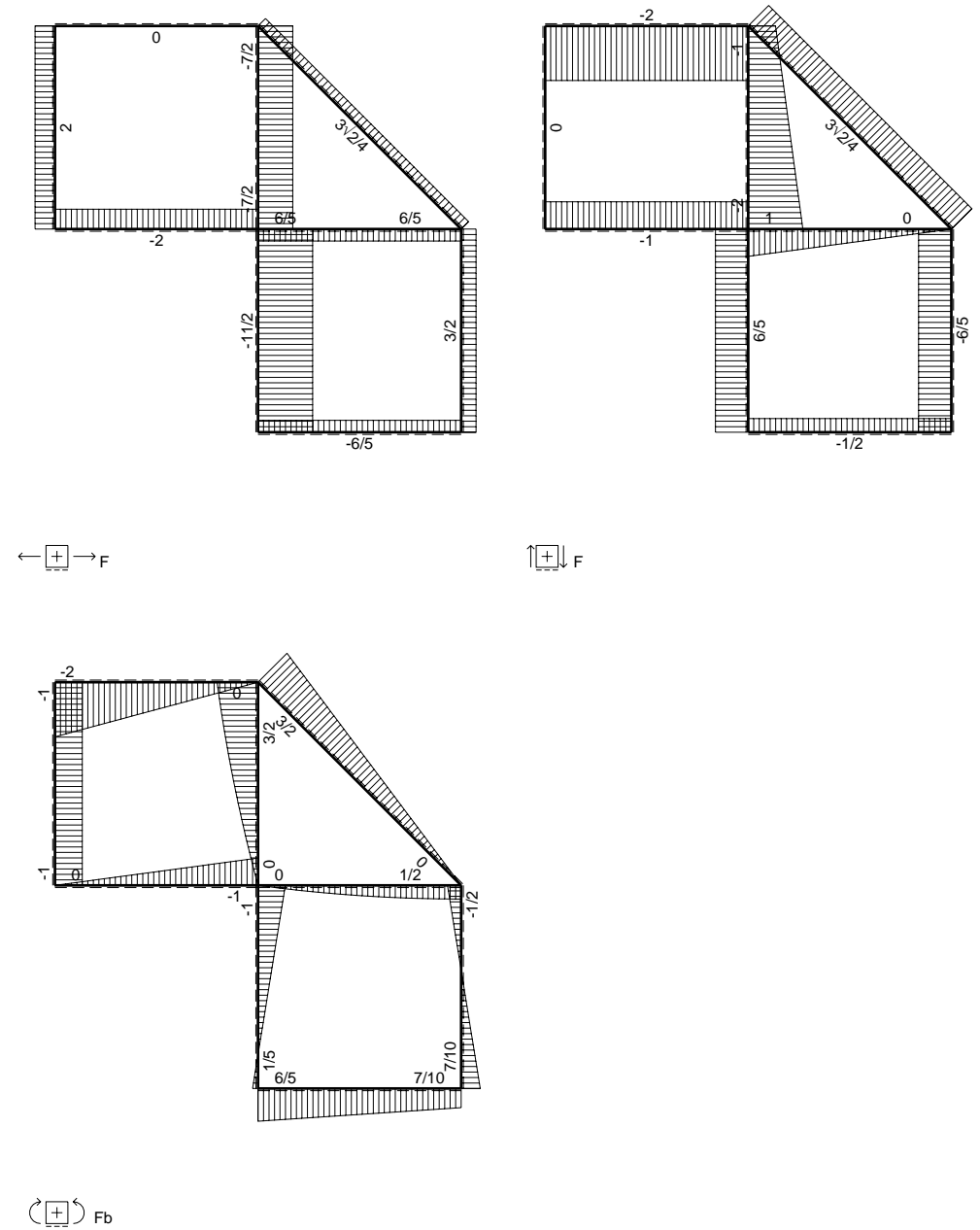
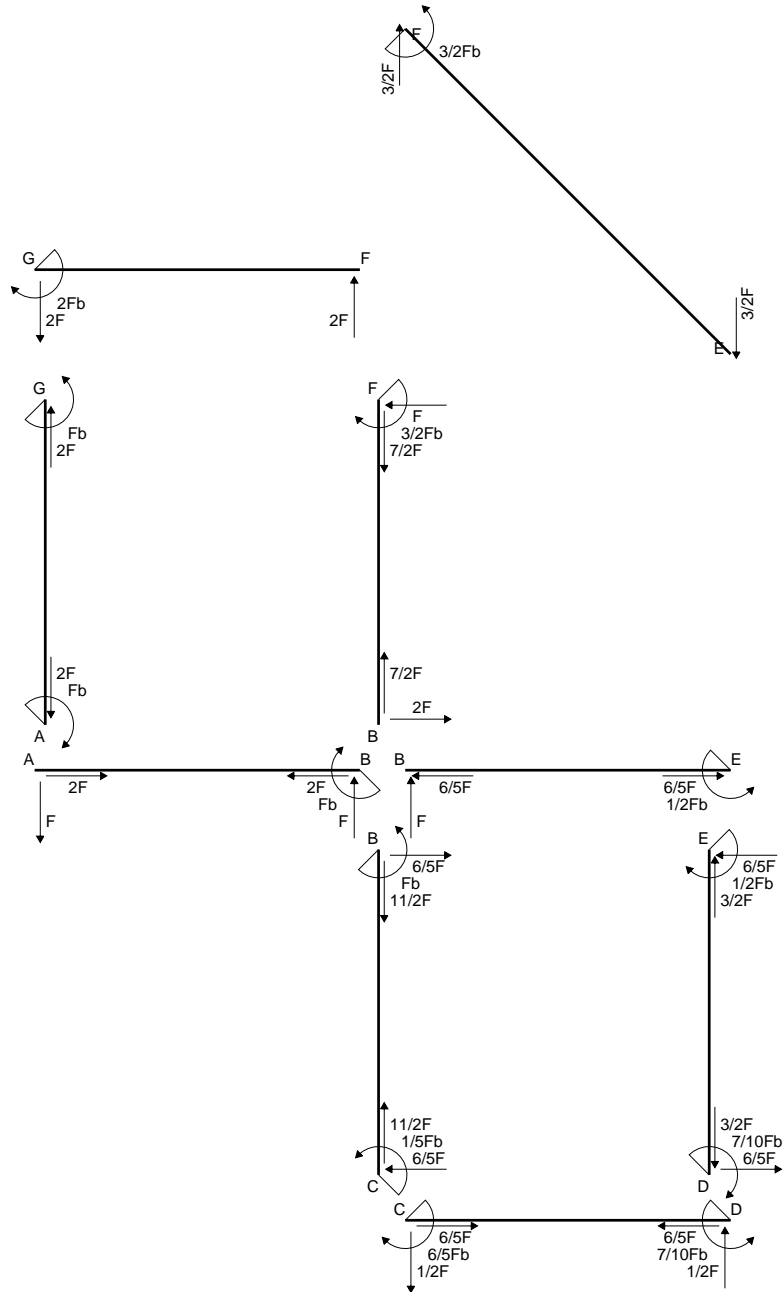
$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

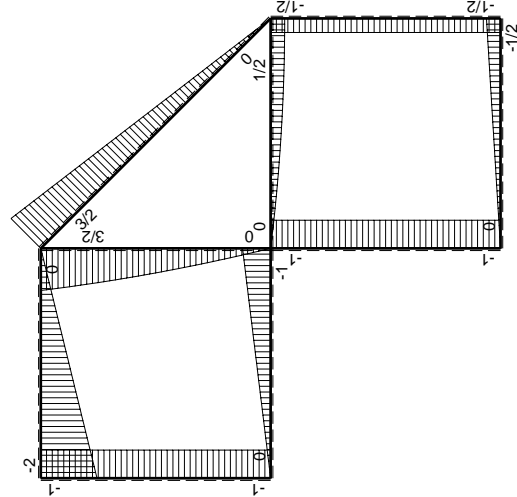
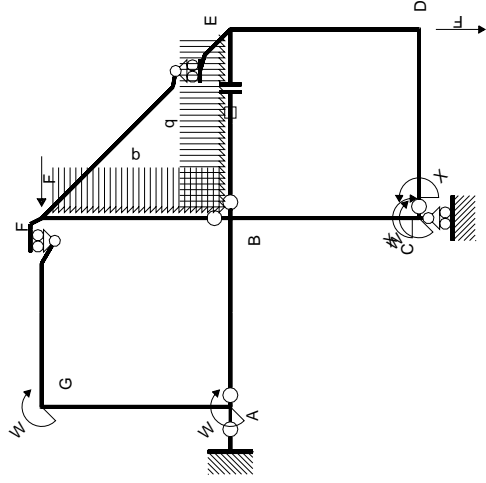
$$L_{DE}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

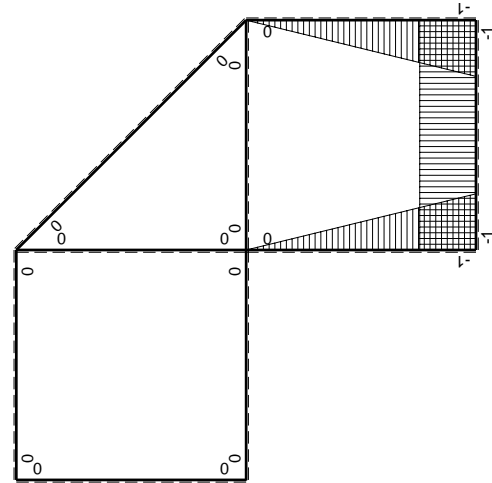
$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CD b	-1	-1/2Fx	1/2Fx	1	$1/4 Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	$1/4 Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	-1/2Fb	1/2Fb-1/2Fx	$1-2x/b+x^2/b^2$	$1/4 Fb^2/EJ$	$1/3 Xb/EJ$
ED b	x/b	1/2Fb	1/2Fx	x^2/b^2	$1/4 Fb^2/EJ$	$1/3 Xb/EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE}} L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica $X=W_{cd}$				$-6/5 Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b) \cdot Fb \cdot 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) \cdot Fb \cdot 1/EJ \, dx = [x - 1/2 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

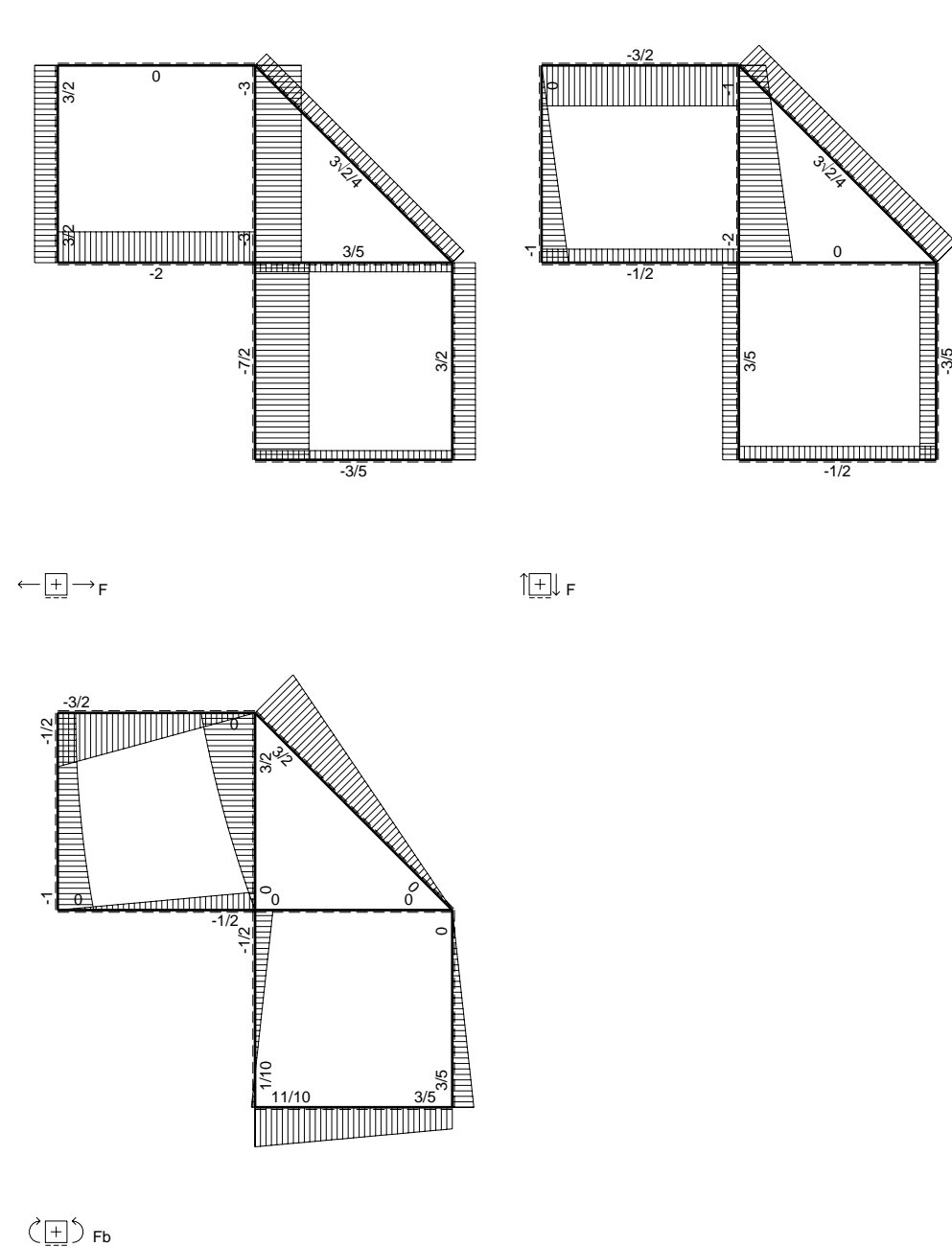
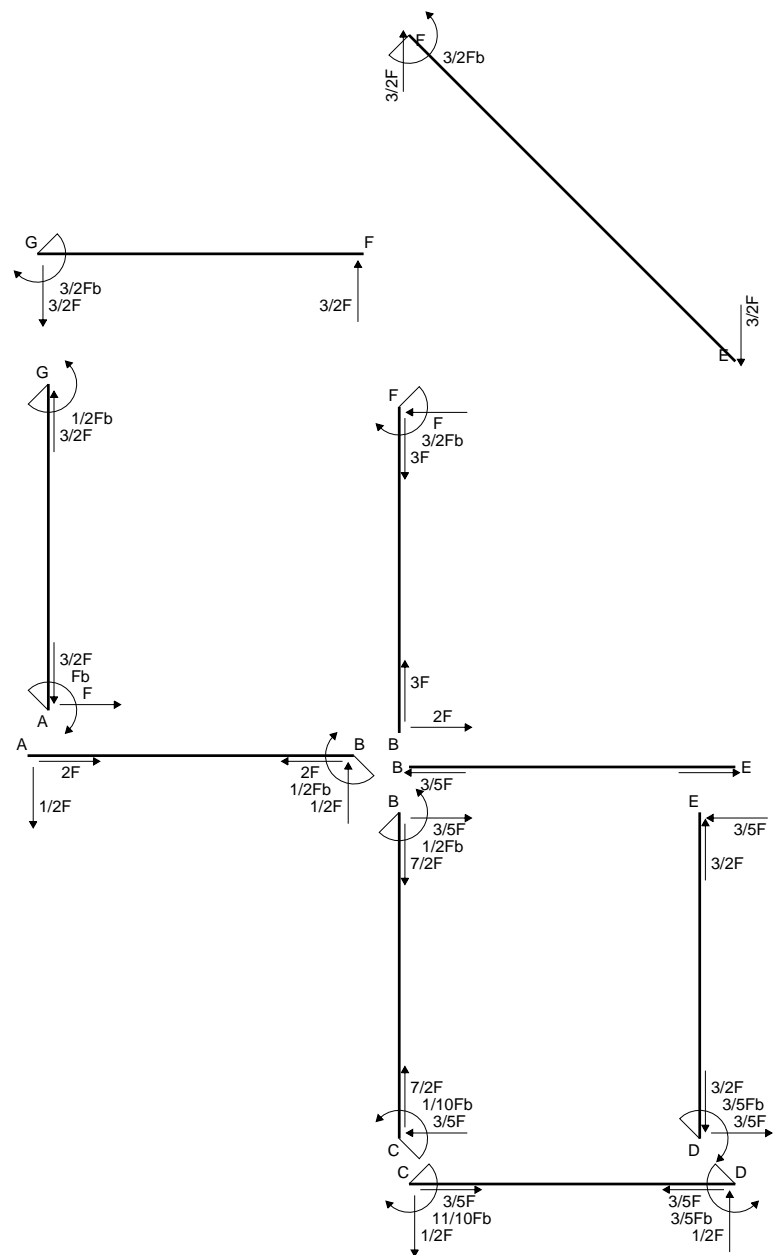
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

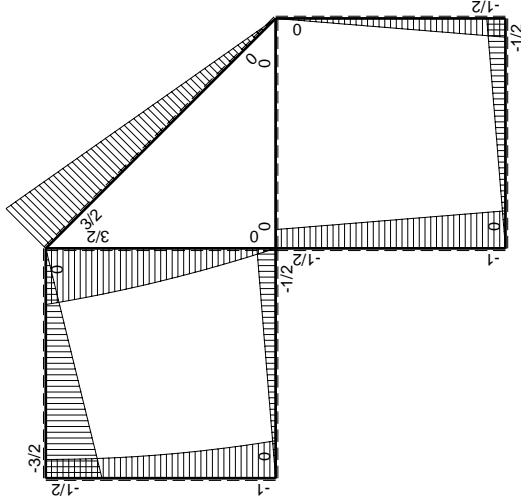
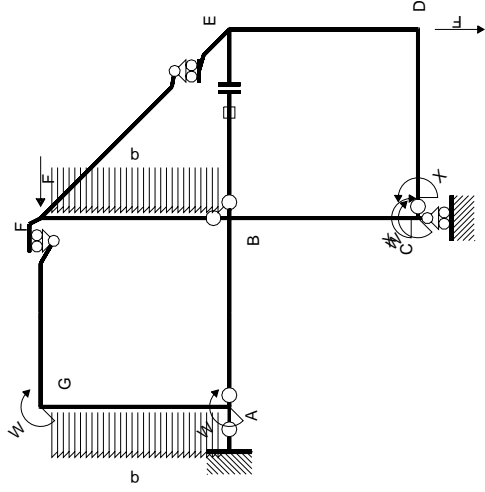
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

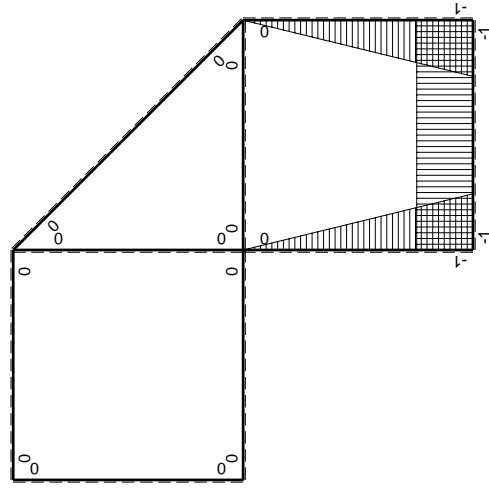
$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - N_{BE}^E$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

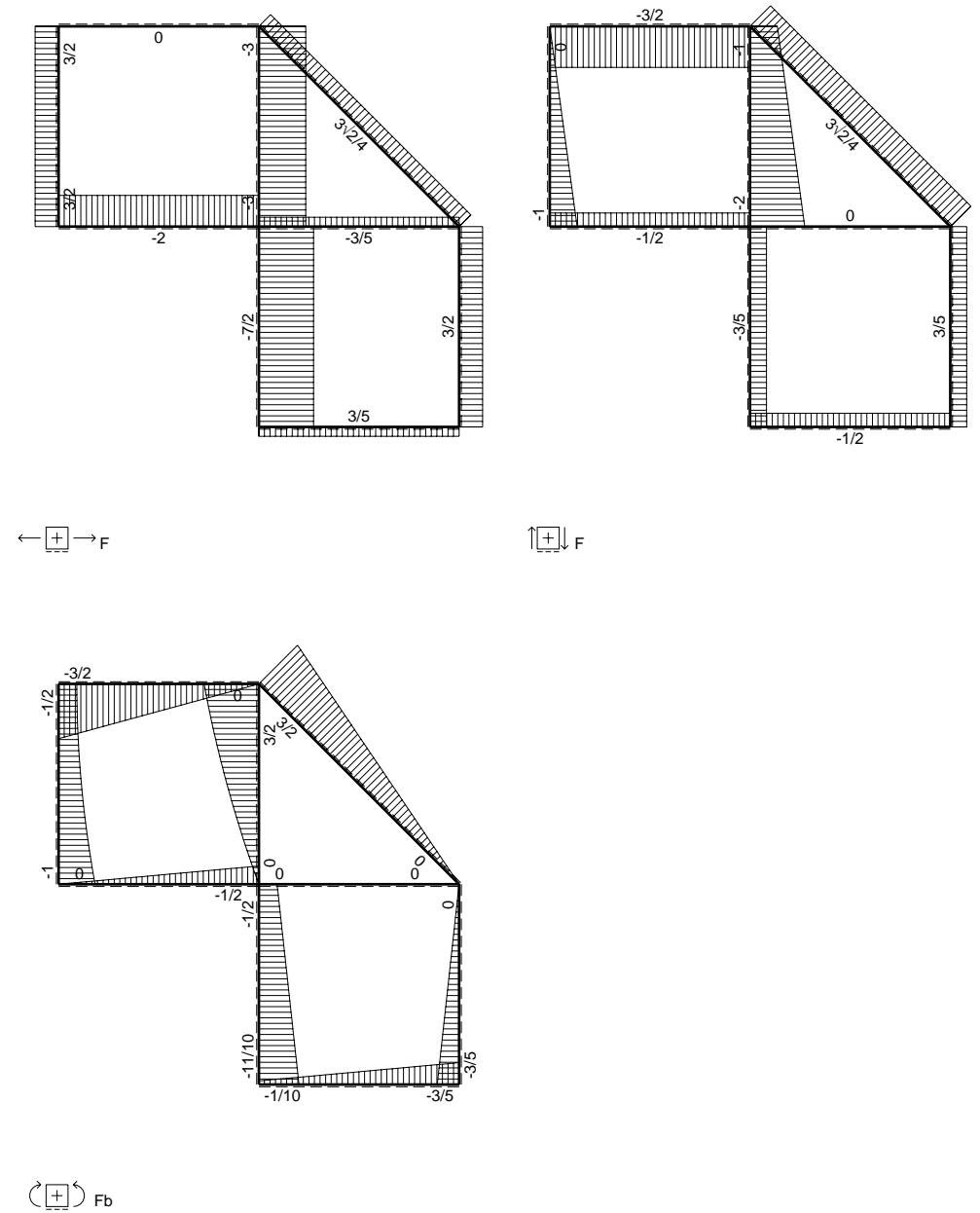
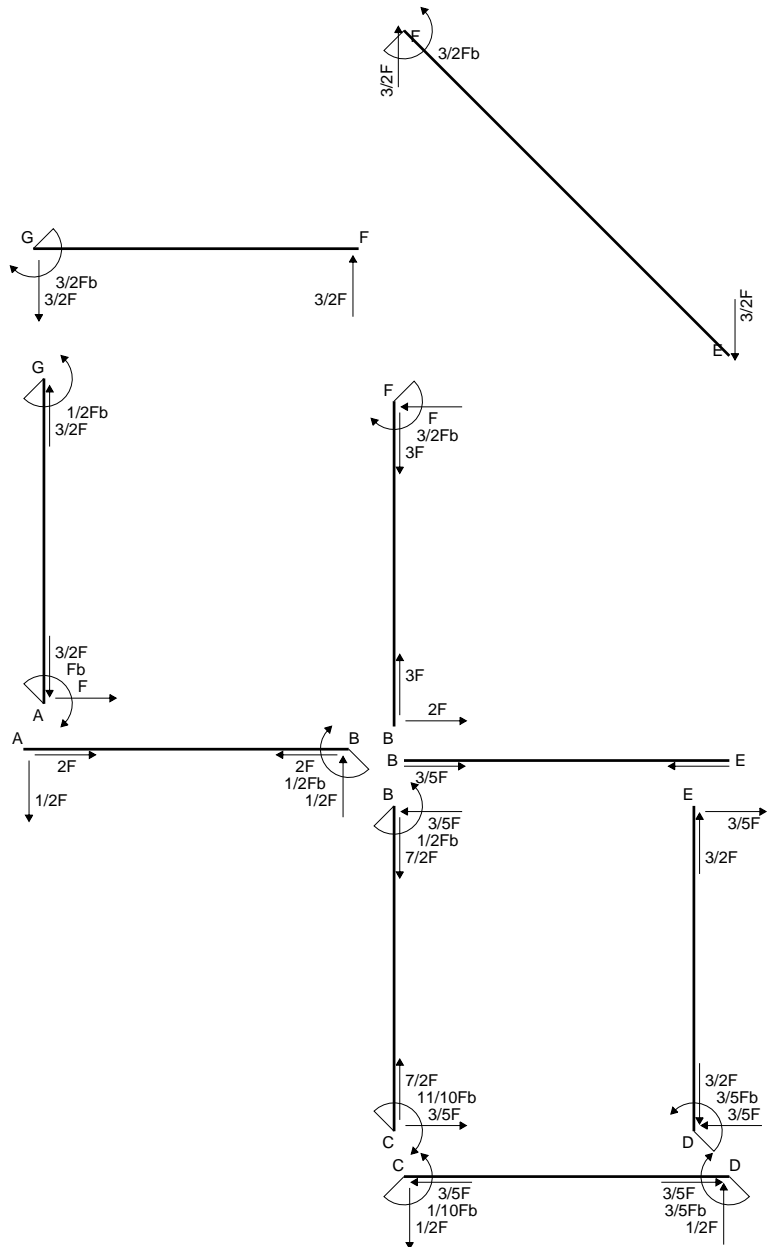
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

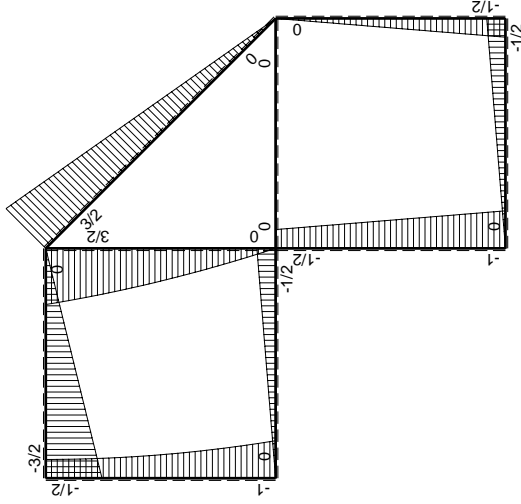
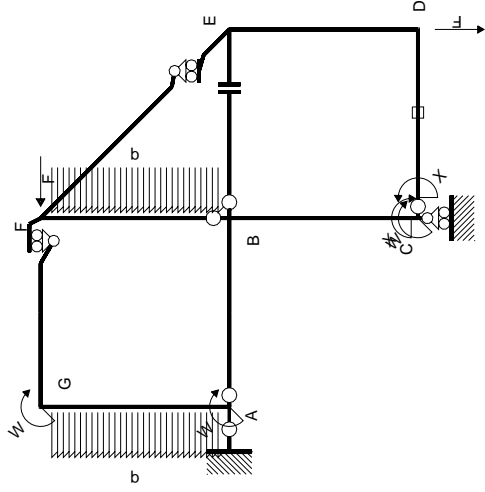
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

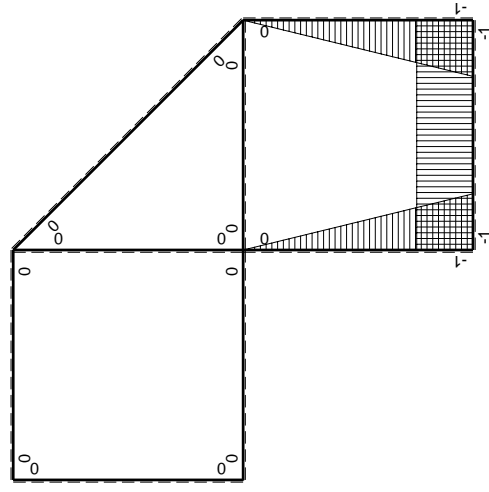
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0	0	0
GA b	0	-1/2Fb-1/2qx ²	0	0	0	0
AG b	0	Fb-Fx+1/2qx ²	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3xb/EJ
	iperstatica $X=W_{cd}$				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

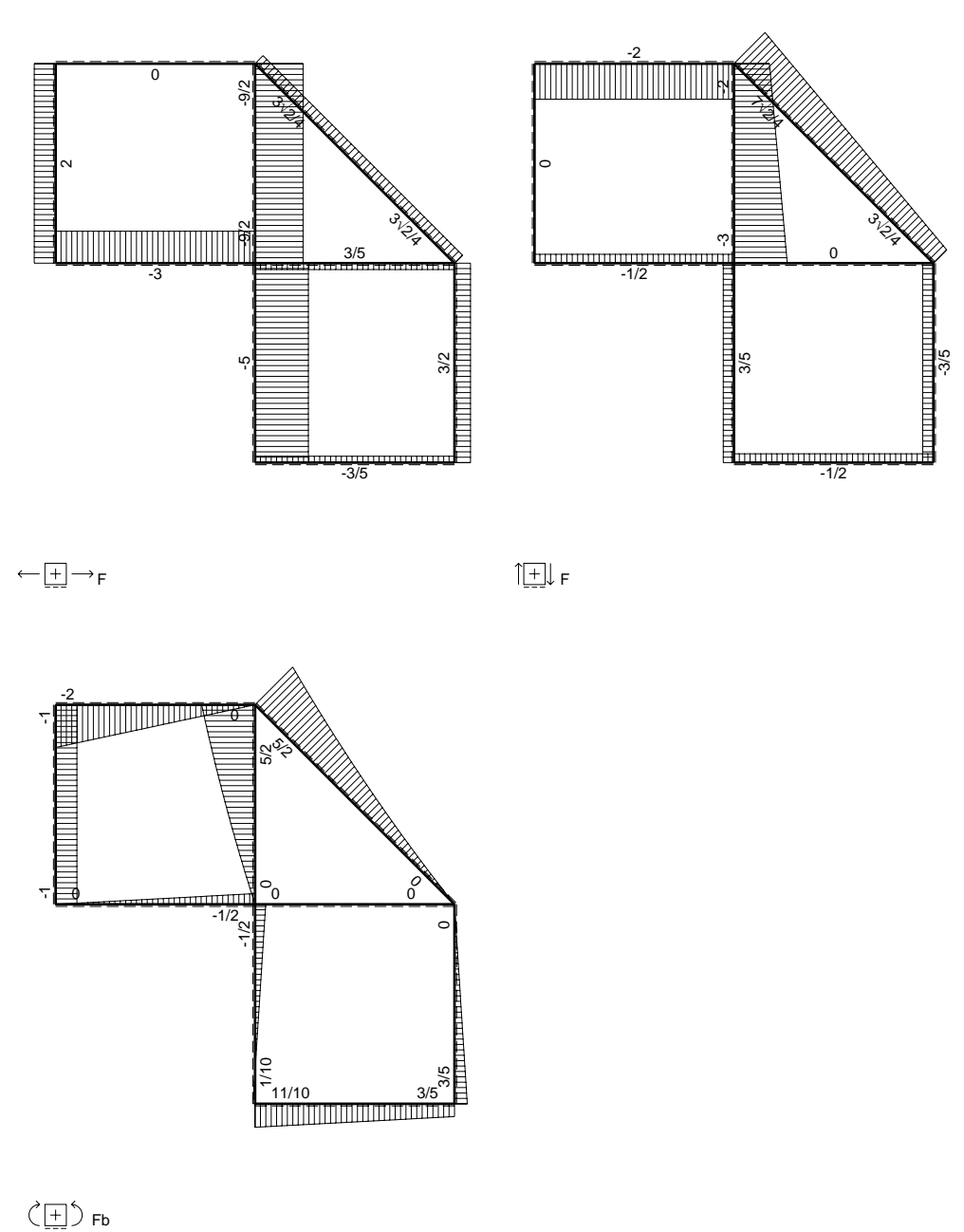
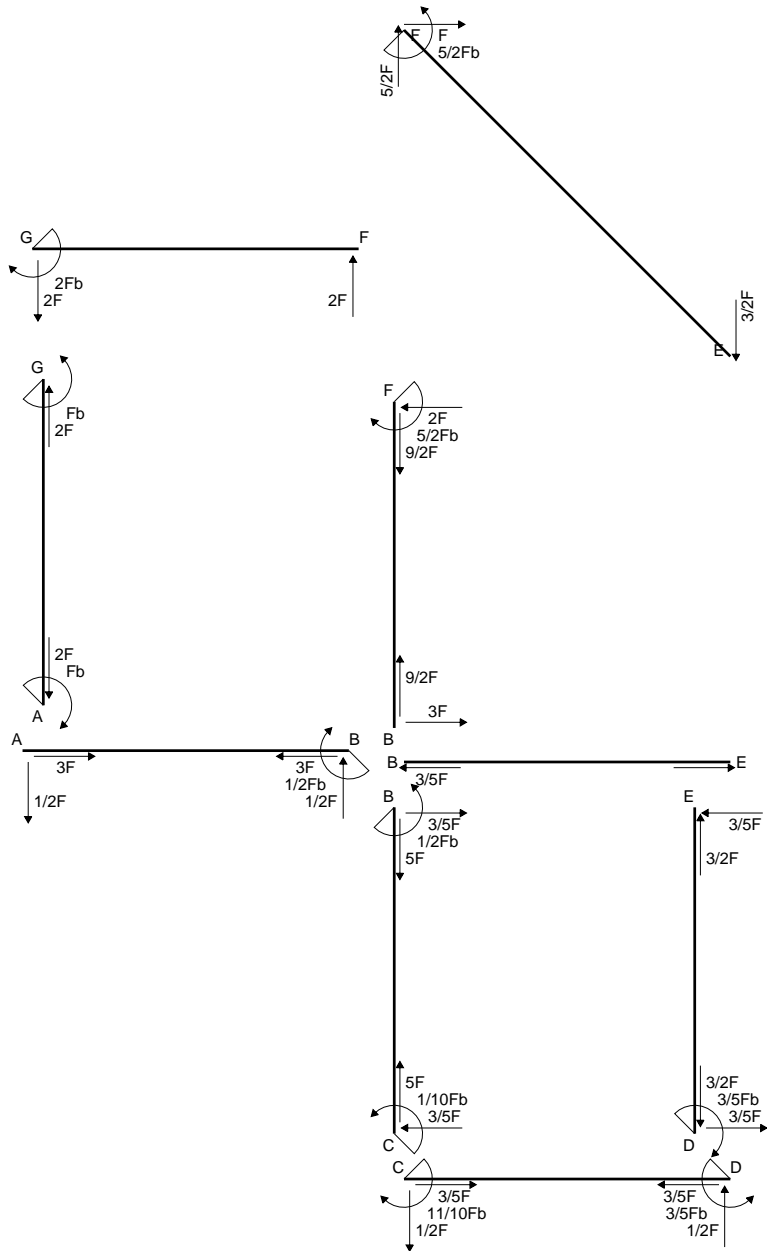
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

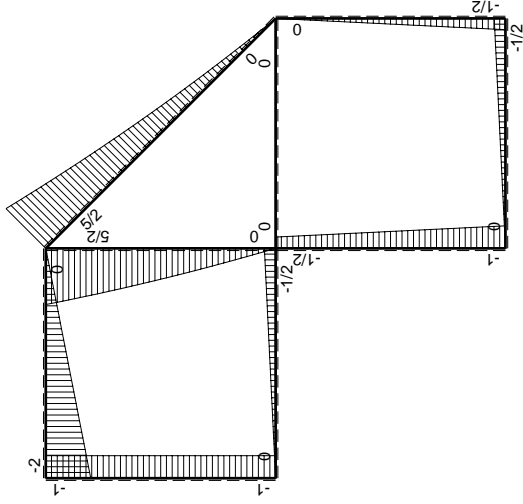
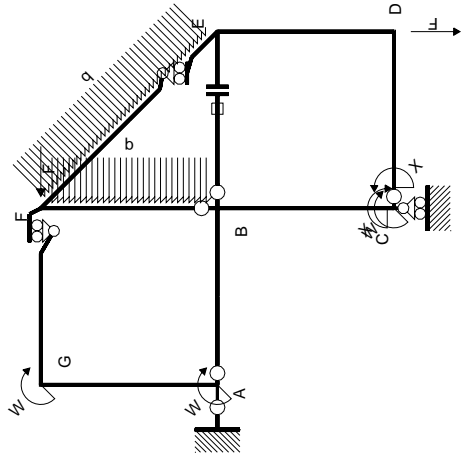
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

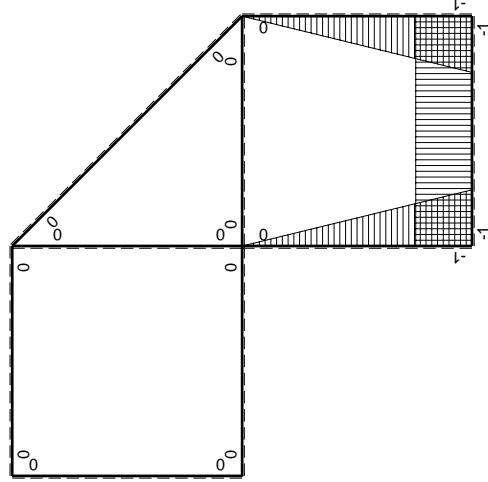
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M₀ flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M _x /EJdx
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta N _{1, BE-E} L _{BE}				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

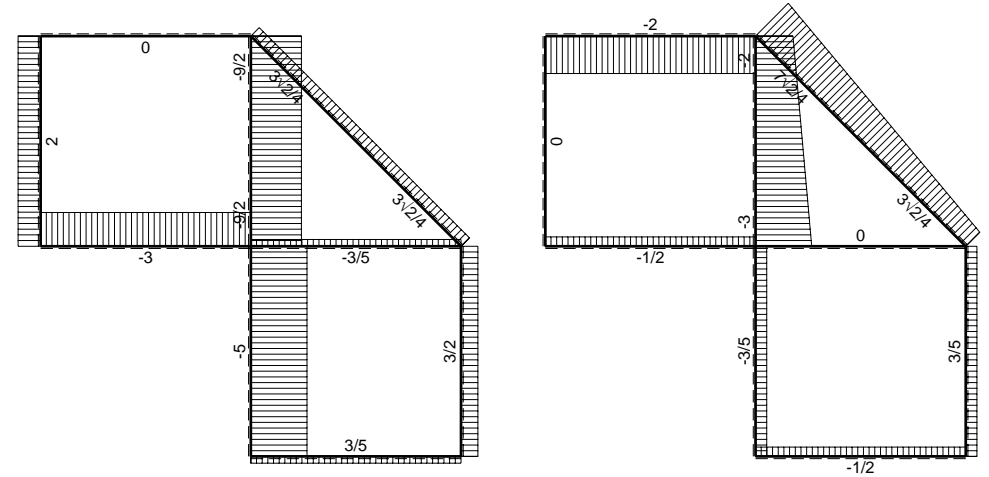
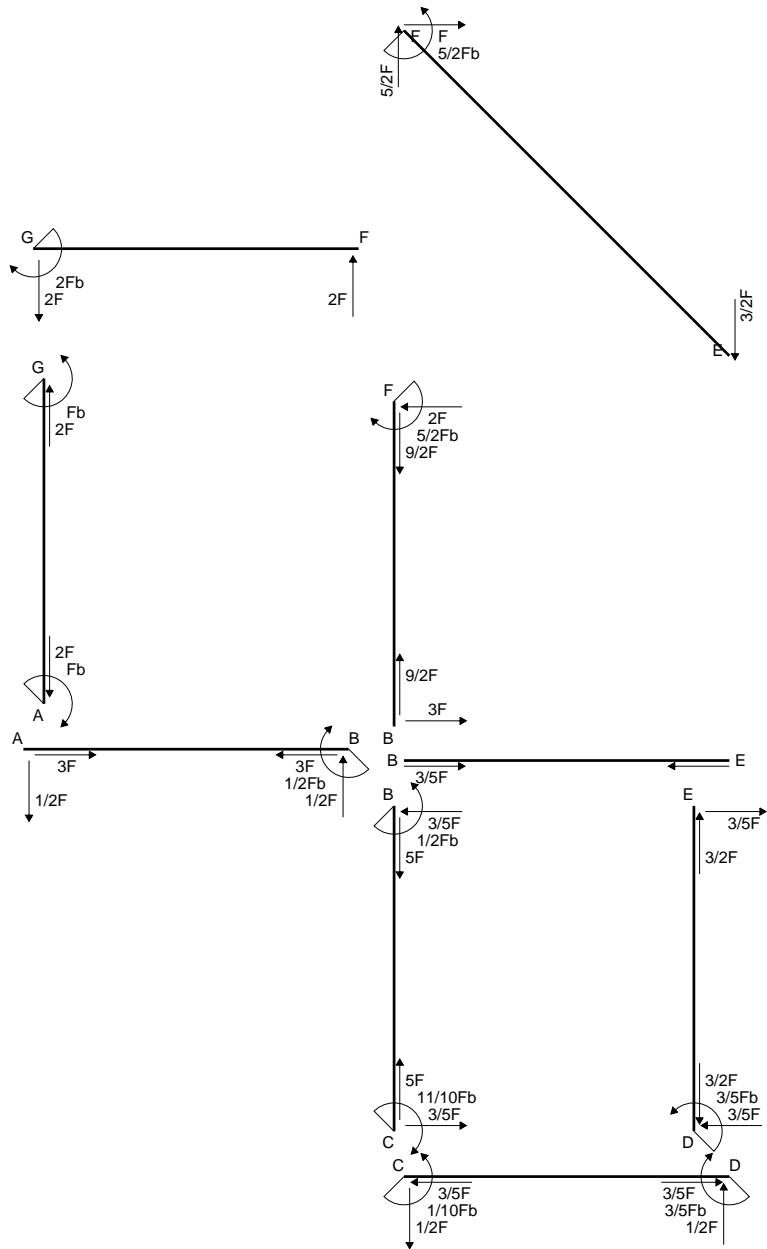
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

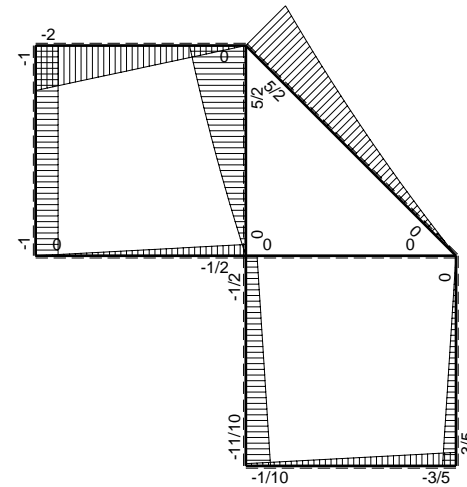
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

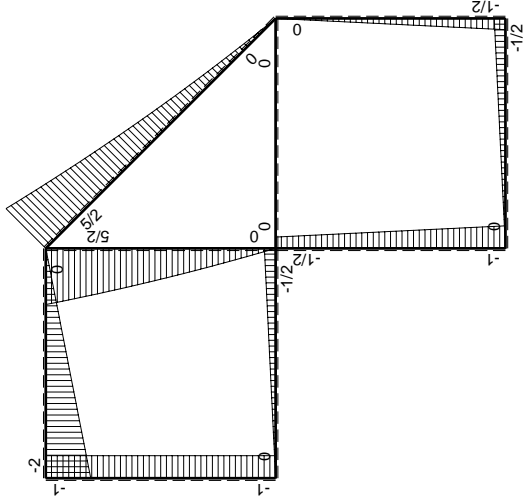
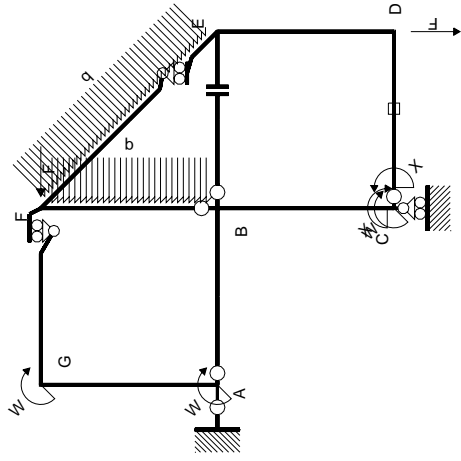


← ⊕ → F

↑ ⊕ ↓ F

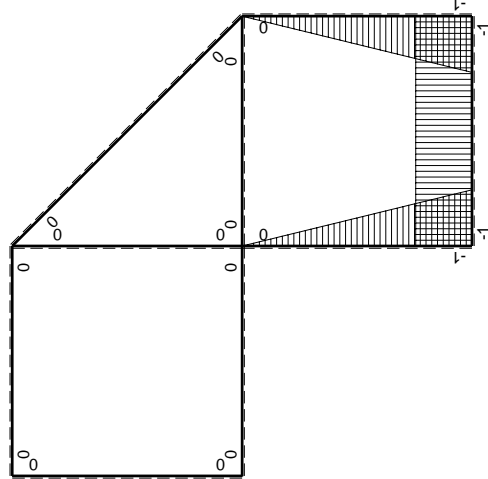


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx+1/2qx ²	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	5/2Fb-2Fx-1/2qx ²	0	0	0	0
BF b	0	-3Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

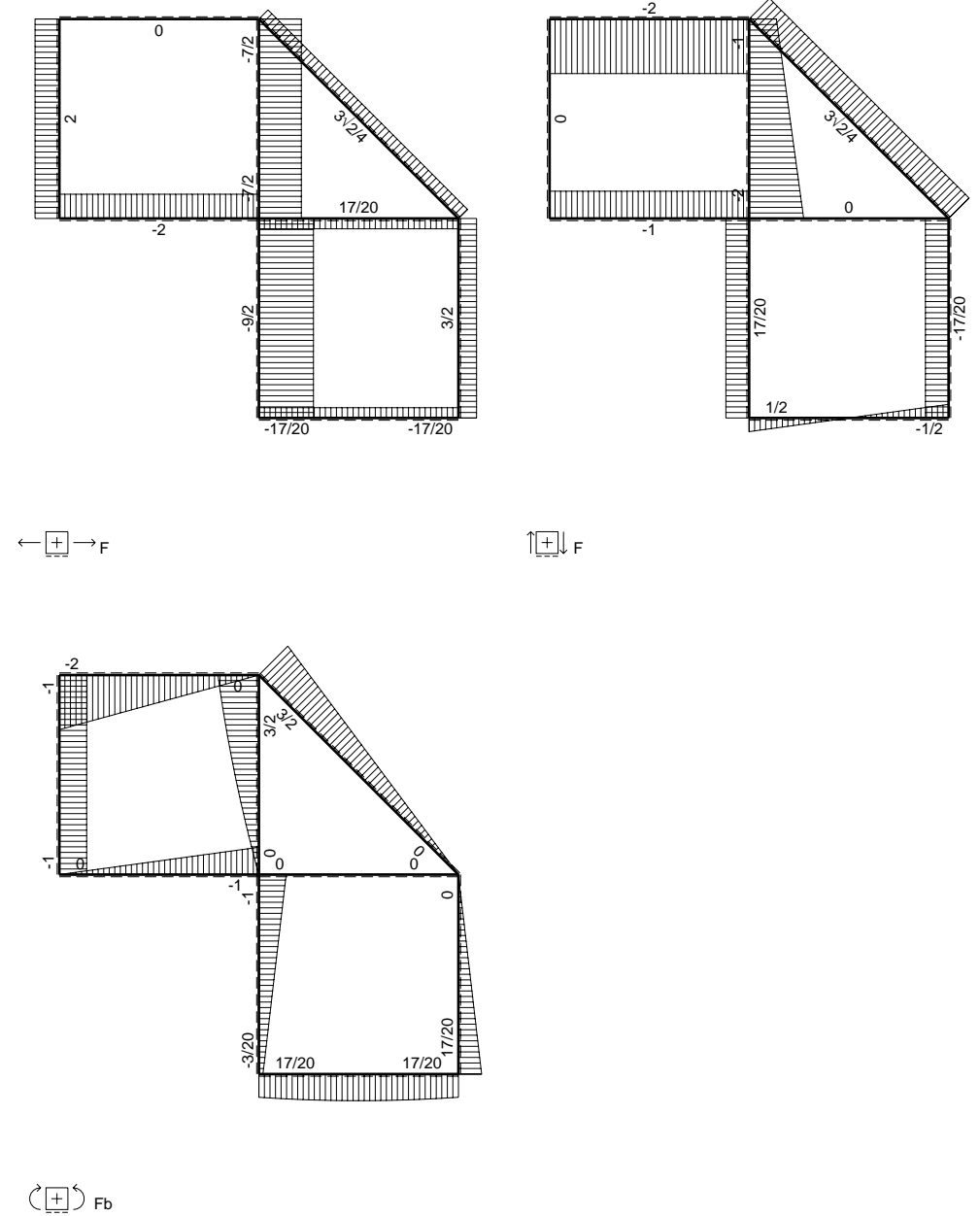
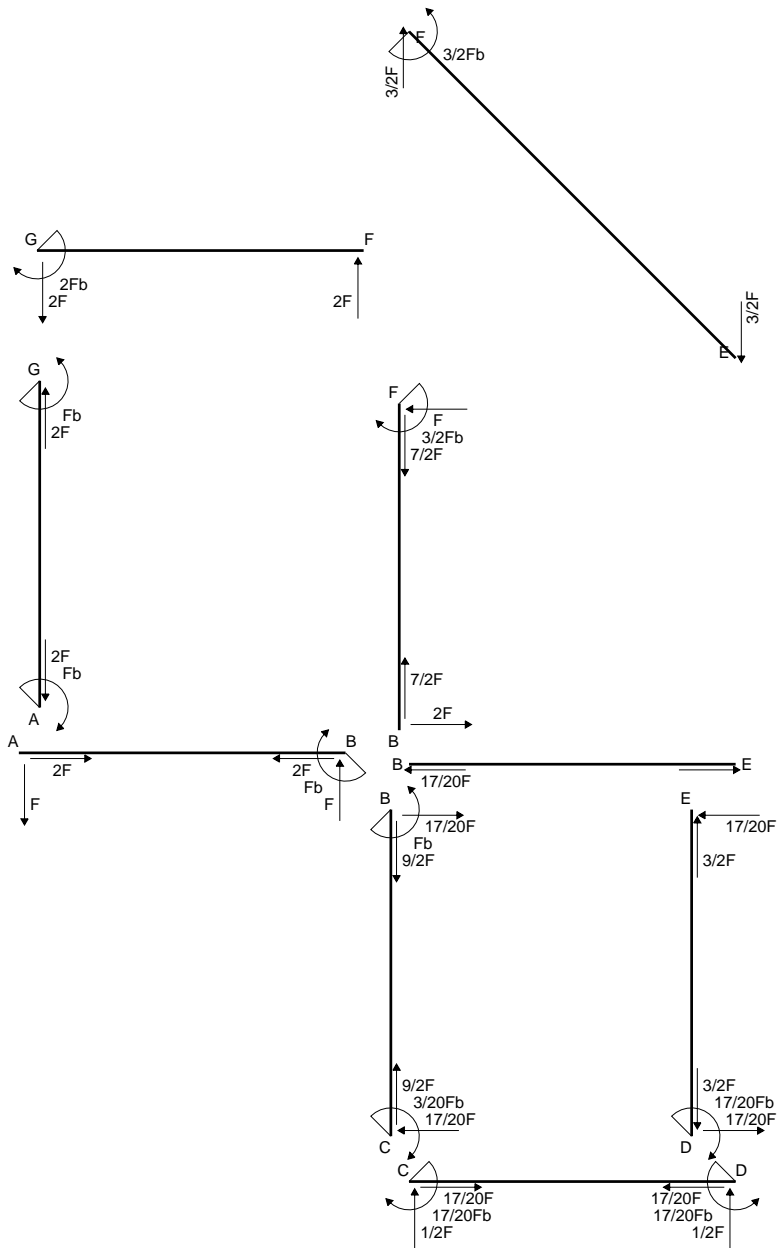
$$= (1/2 b - 1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

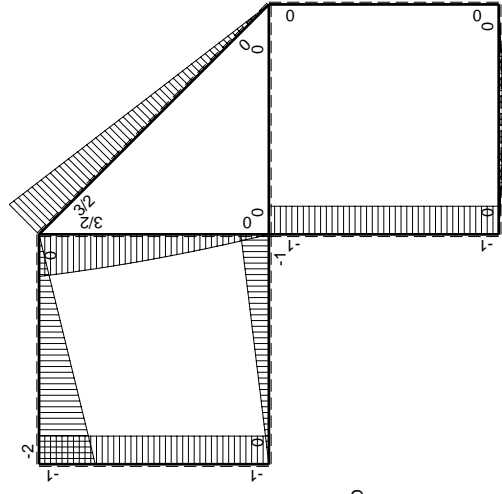
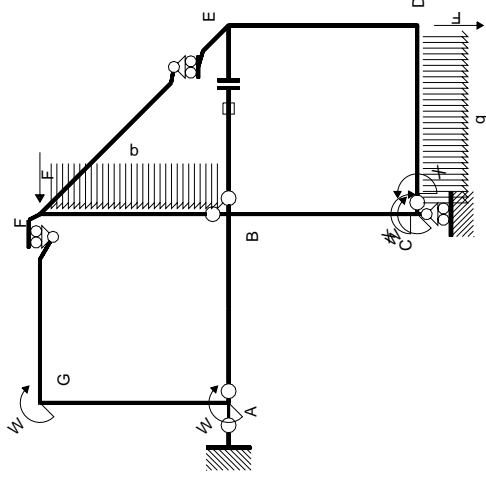
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

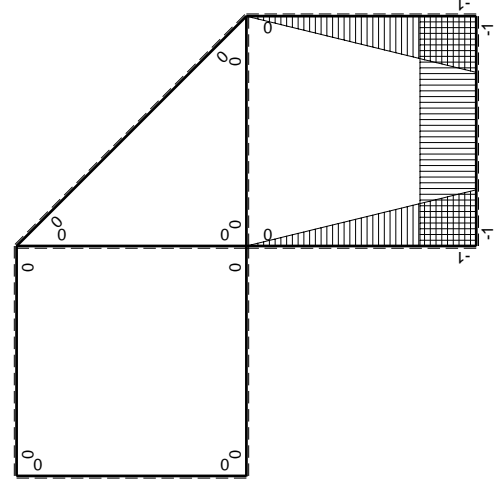
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - N_{BE}^E$			0	Fb^2/EJ	$5/3Xb/EJ$
	totali				$17/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-17/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

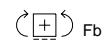
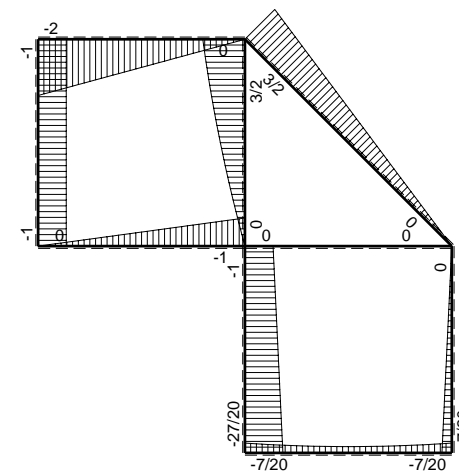
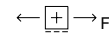
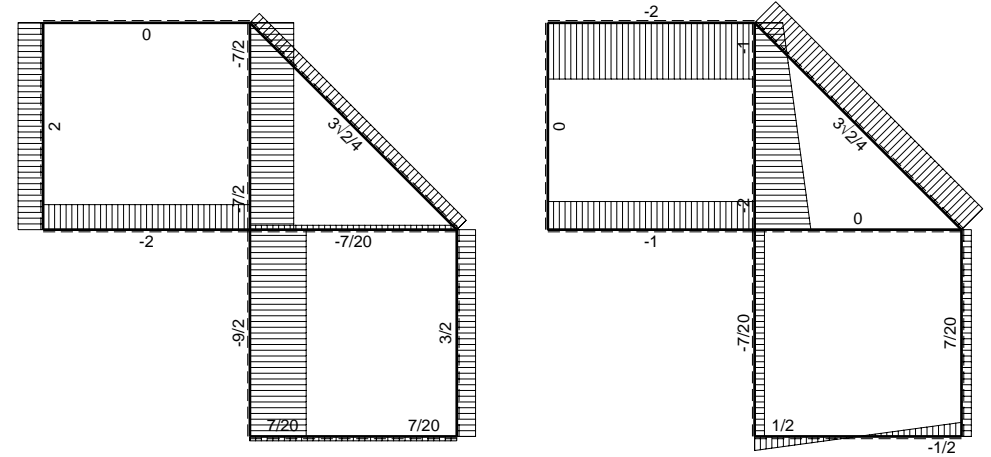
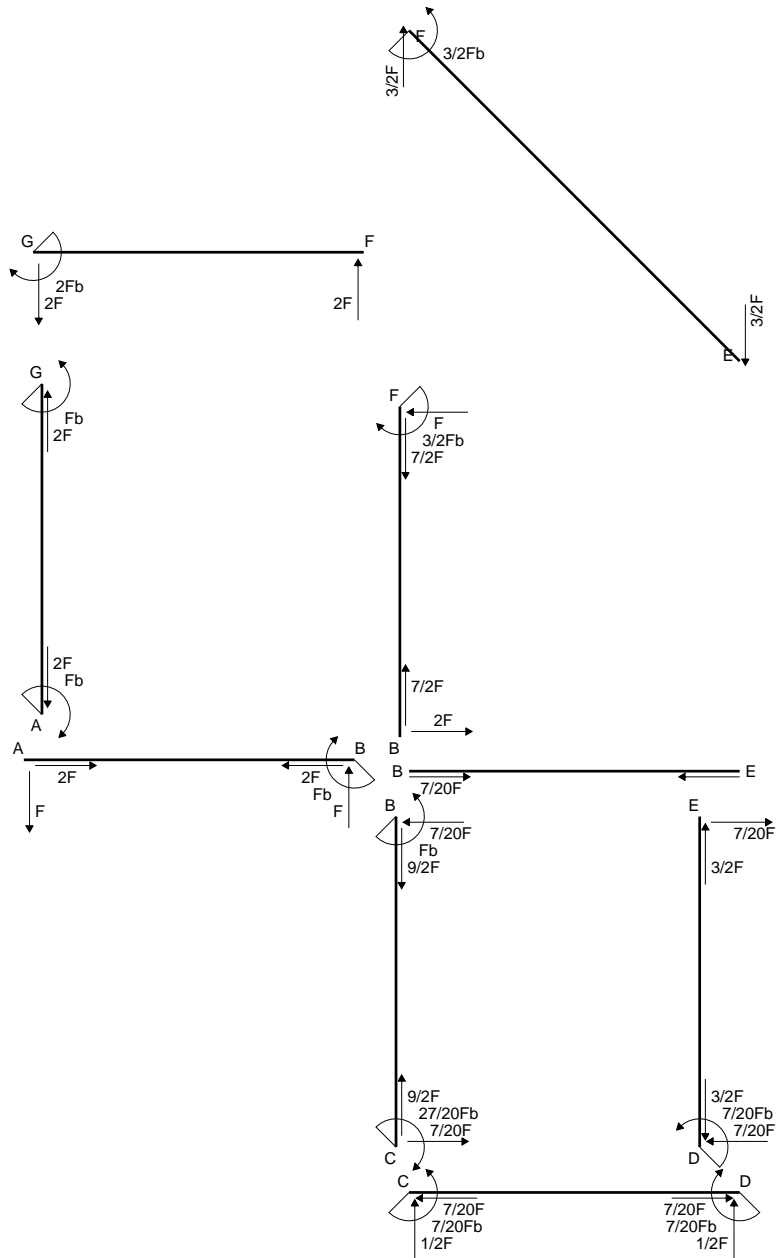
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

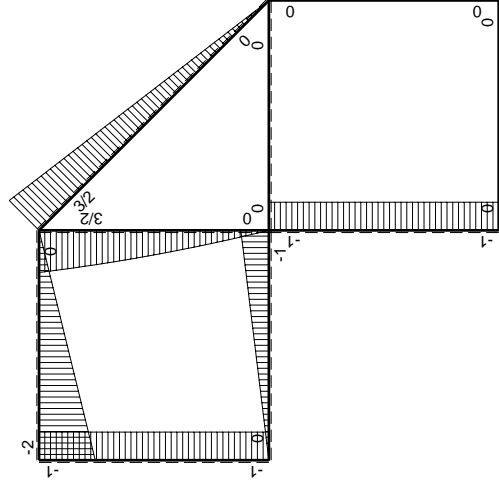
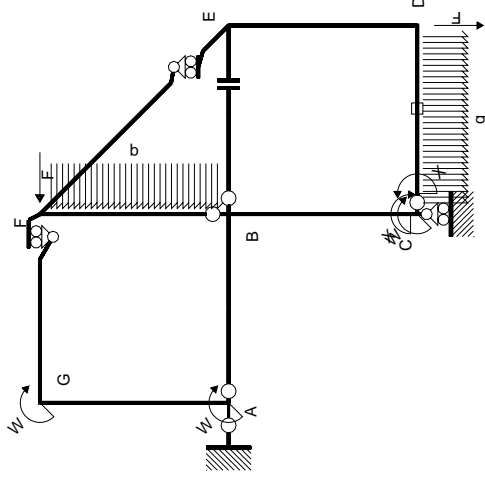
$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/6 b) Fb 1/EJ = -1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

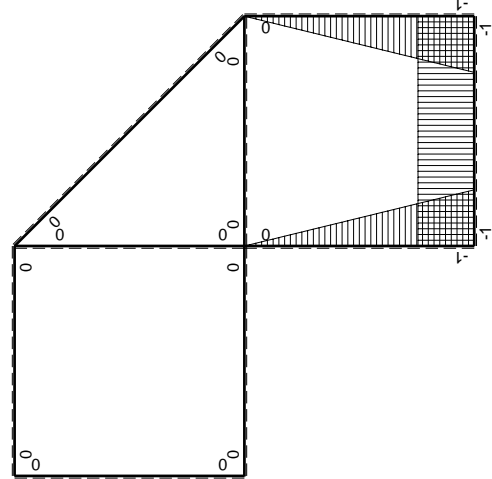
$$= (-1/4 b + 1/6 b) Fb 1/EJ = -1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$7/20Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

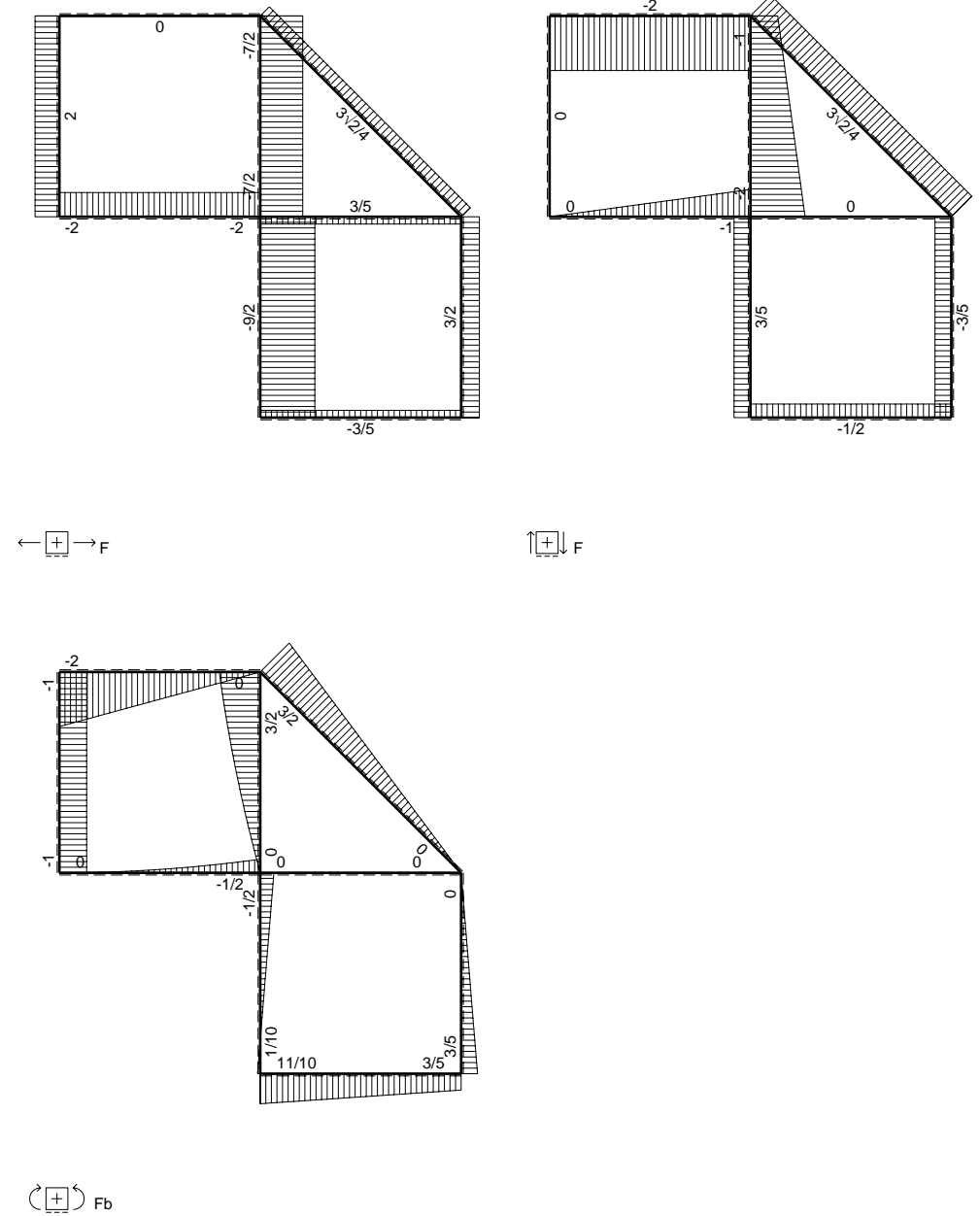
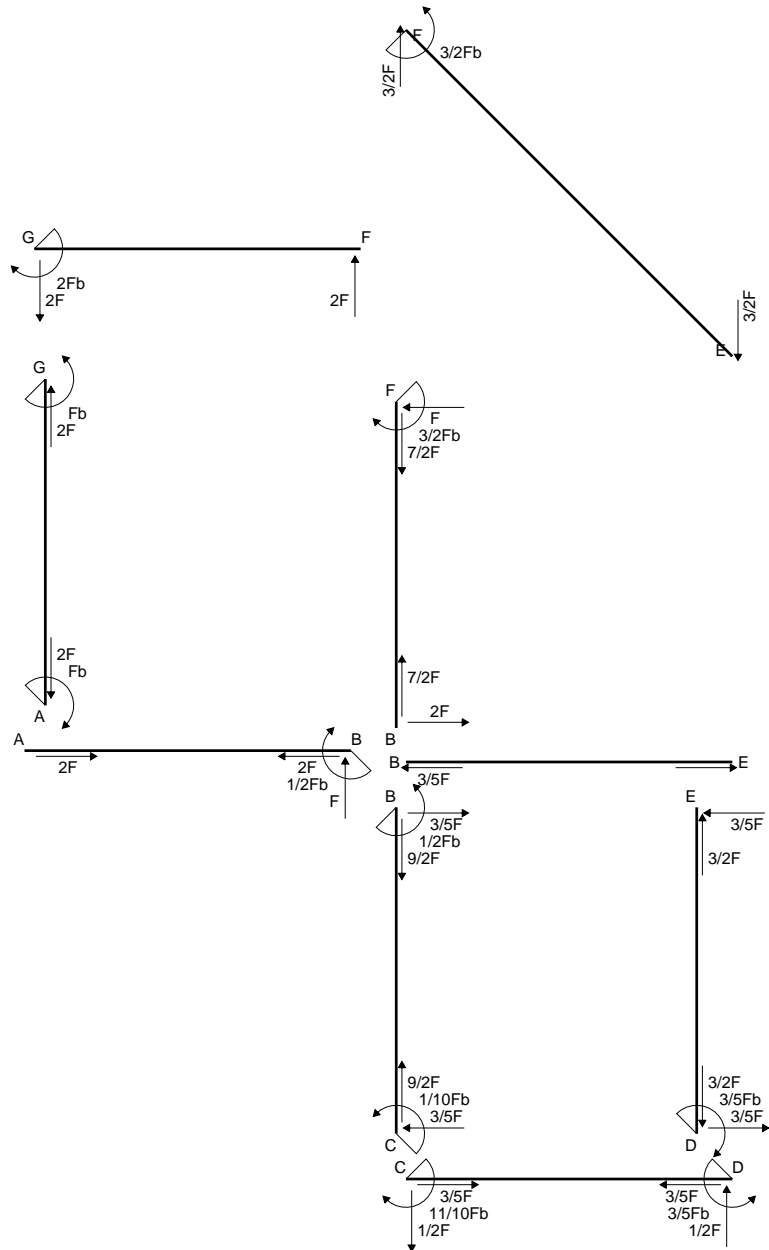
$$= [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

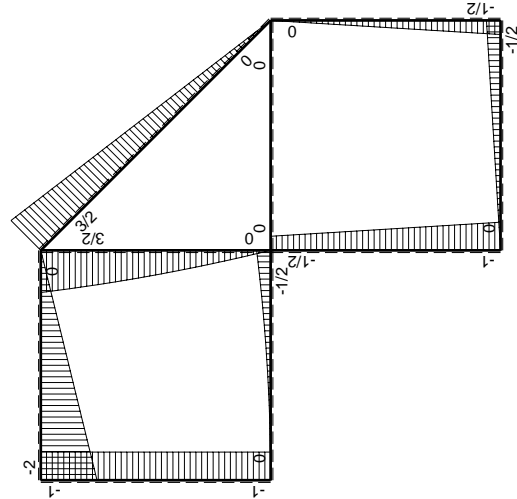
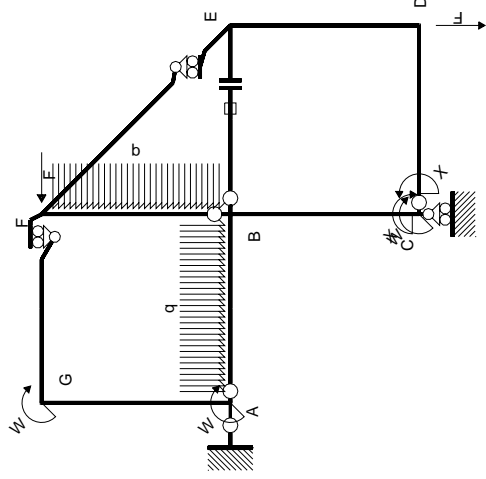
$$= (-1/4 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -13/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

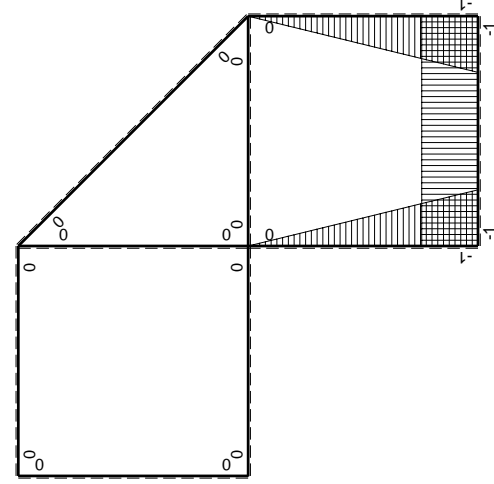
$$= (-1/4 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -13/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-1/2Fb-1/2Fx$	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb-1/2Fx$	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	Xb/EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$-1/2Fb+1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE}^{\epsilon_{BE}} L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{cd}				$-11/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

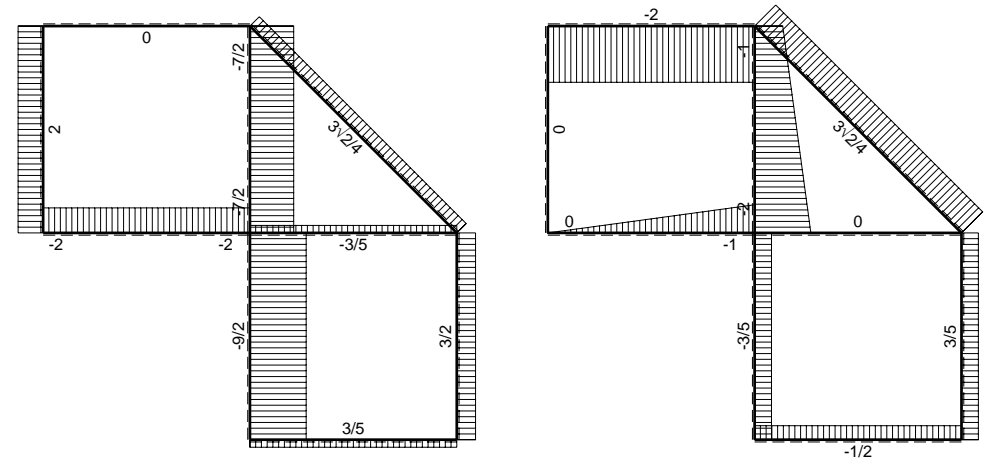
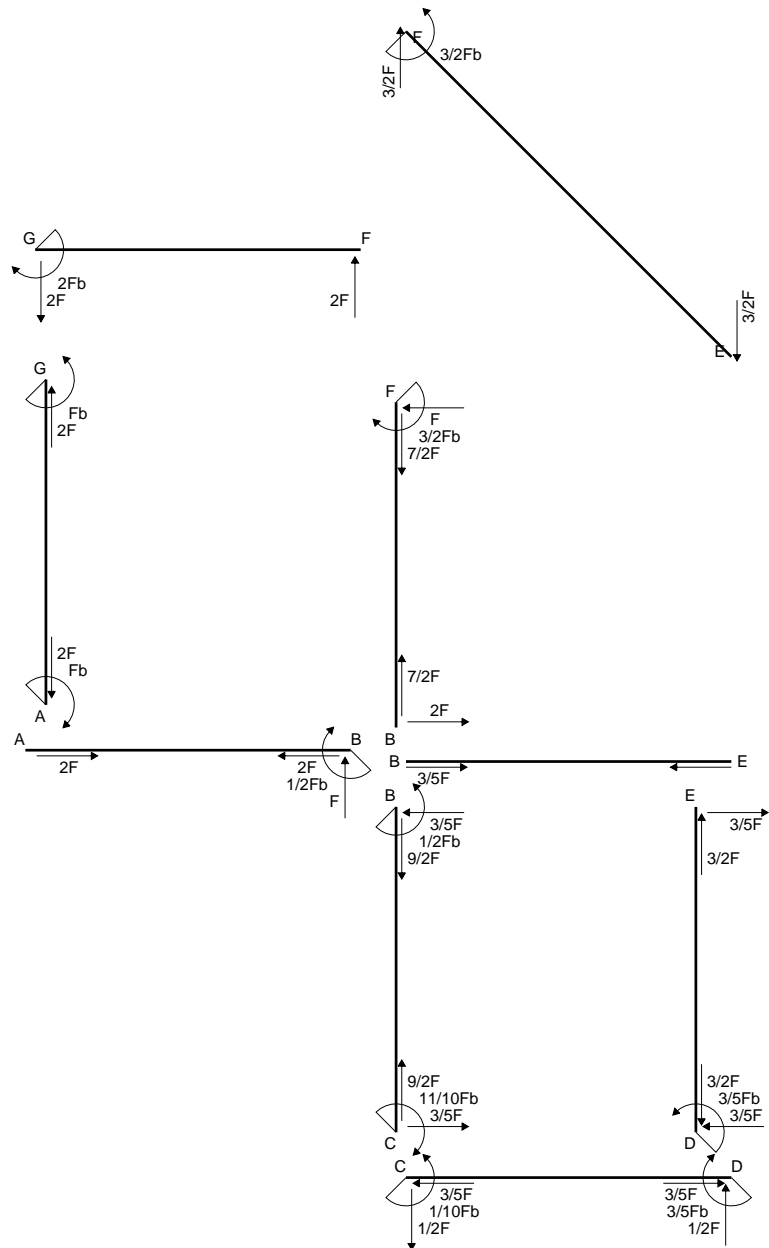
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

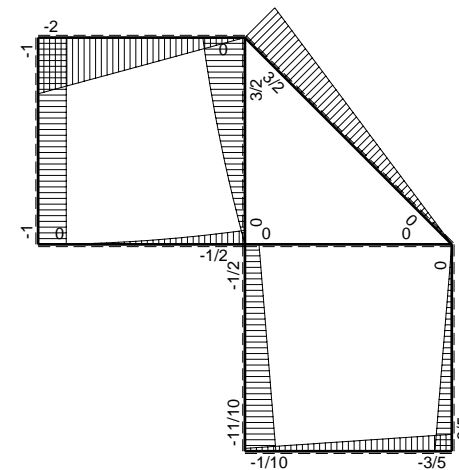
$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

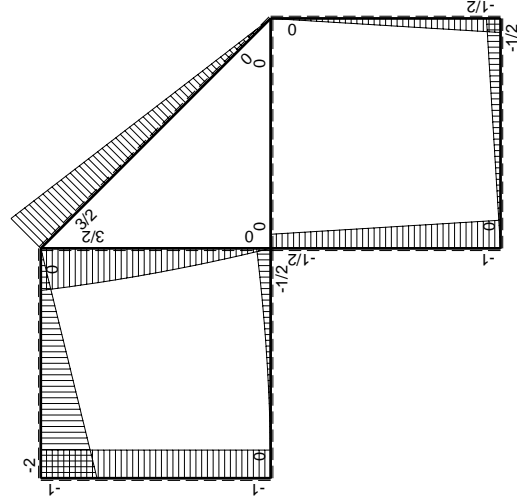
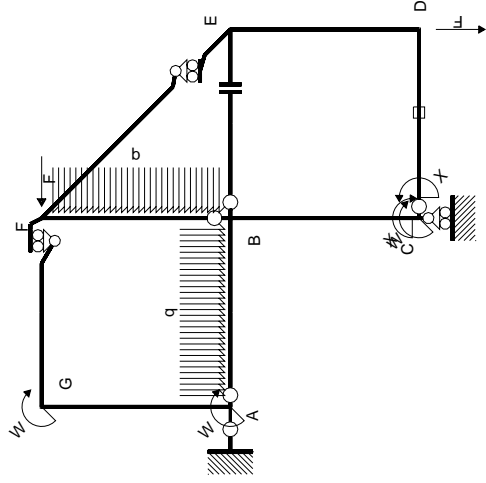


← ⊕ → F

↑ ⊕ ↓ F



⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-1/2Fb-1/2Fx$	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	$Fb-1/2Fx$	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	Xb/EJ
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/6Fb^2/EJ$	$1/3Xb/EJ$
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DE b	$-1+x/b$	$-1/2Fb+1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fx$	$1/2Fx^2/b$	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$			0	$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{cd}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

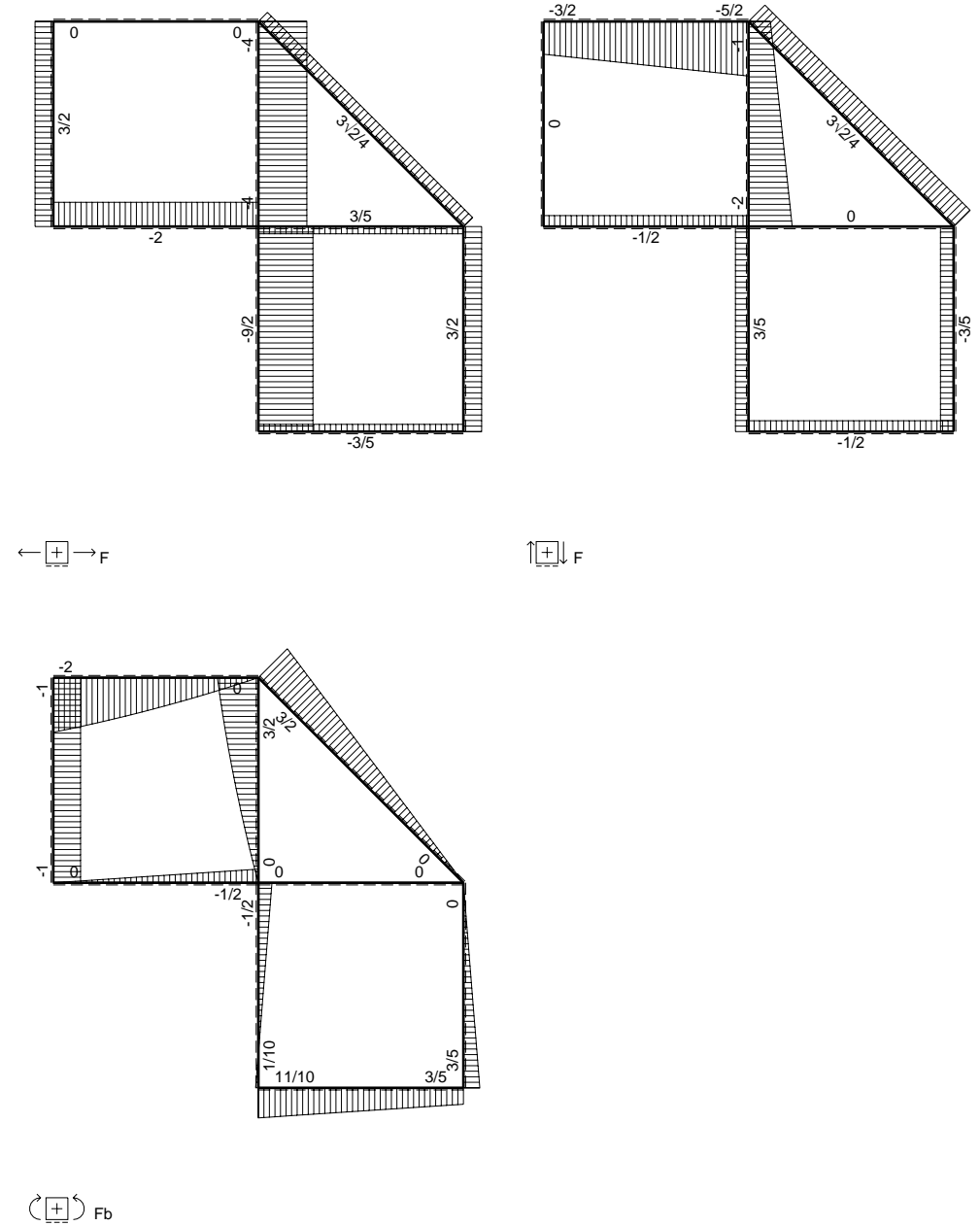
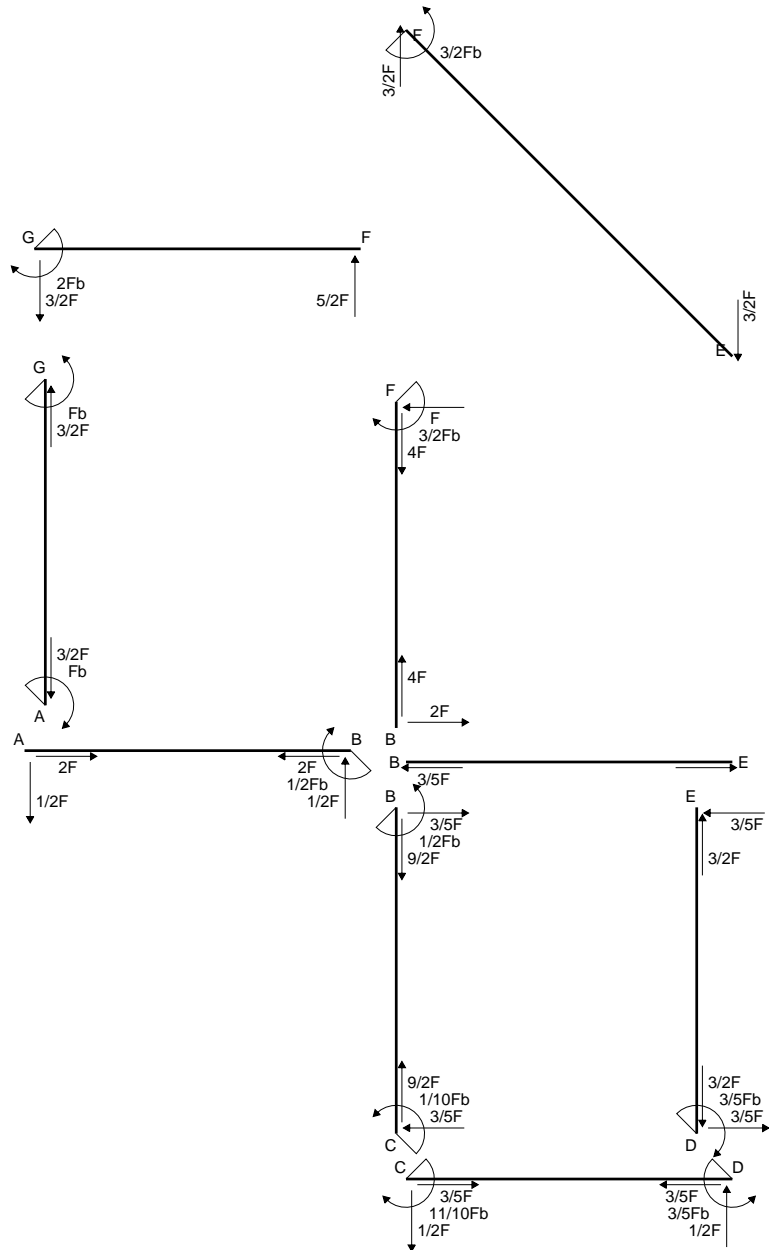
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

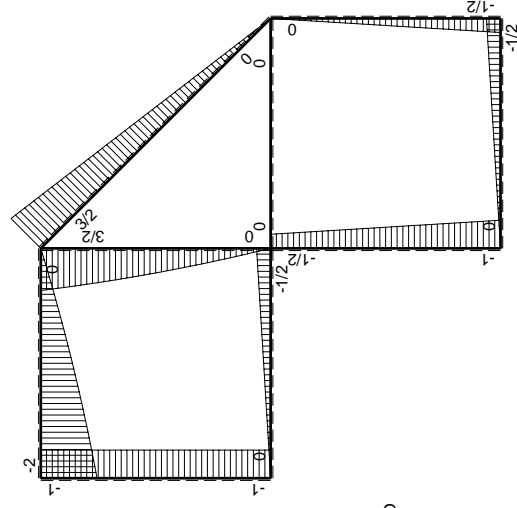
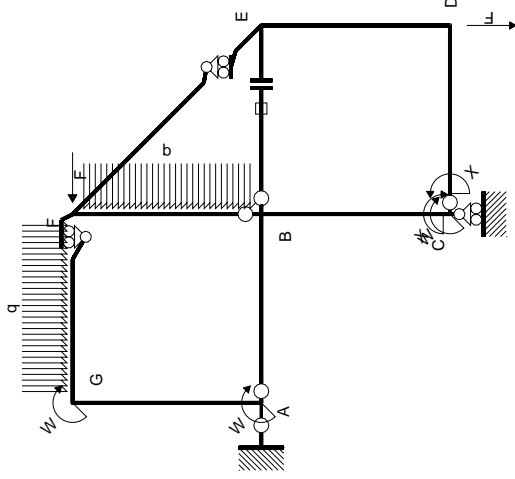
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

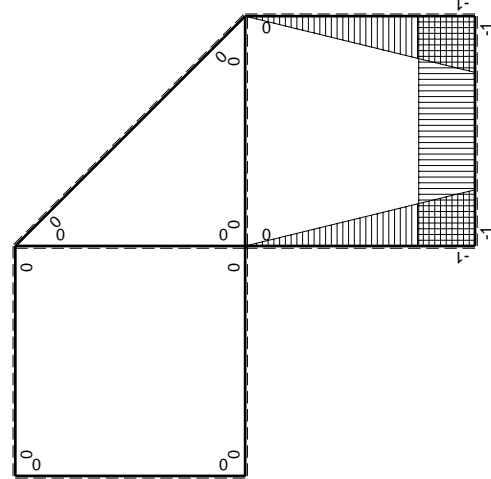
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

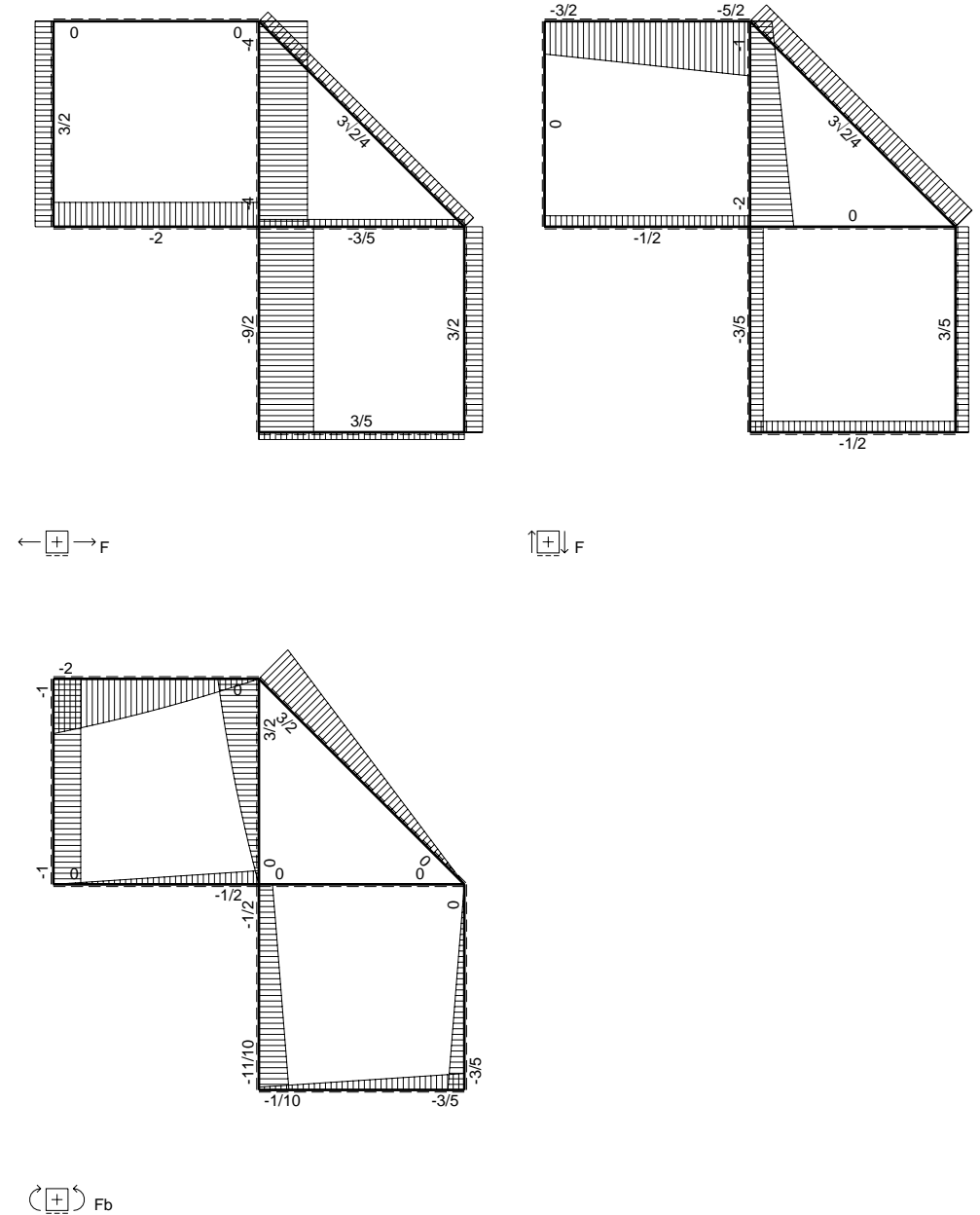
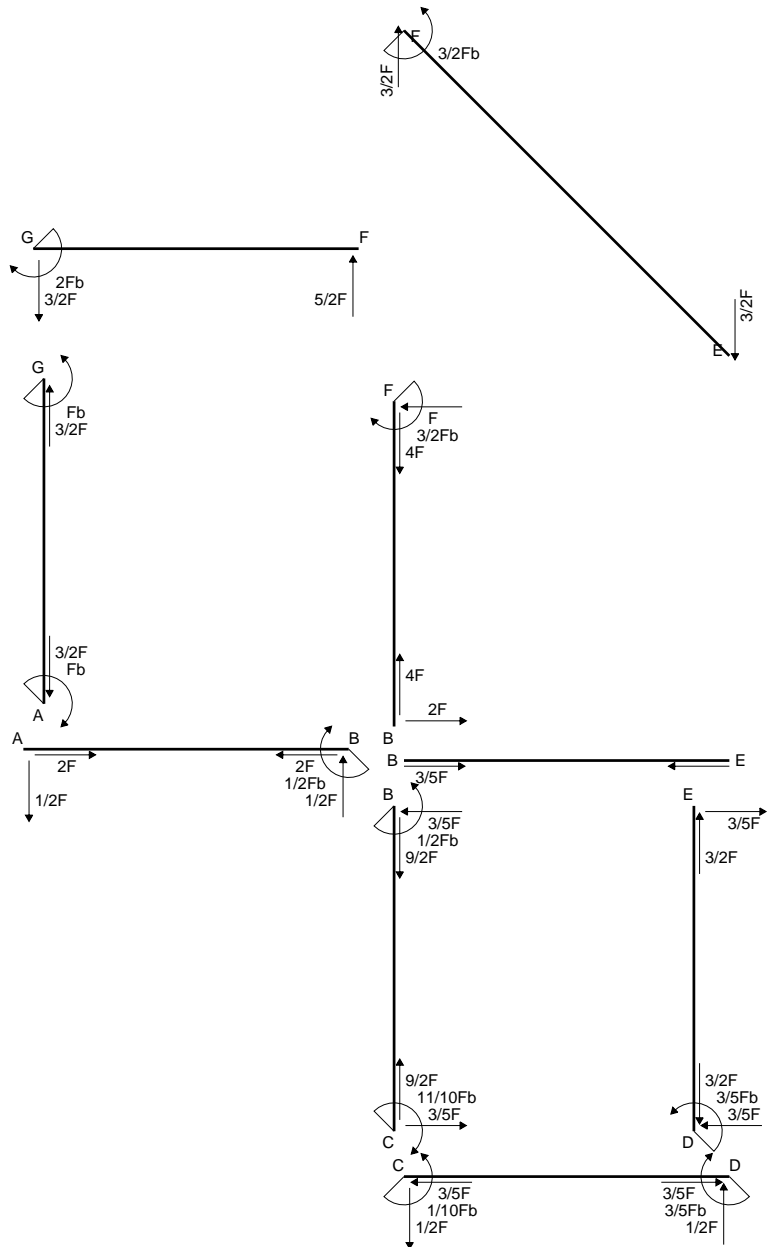
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

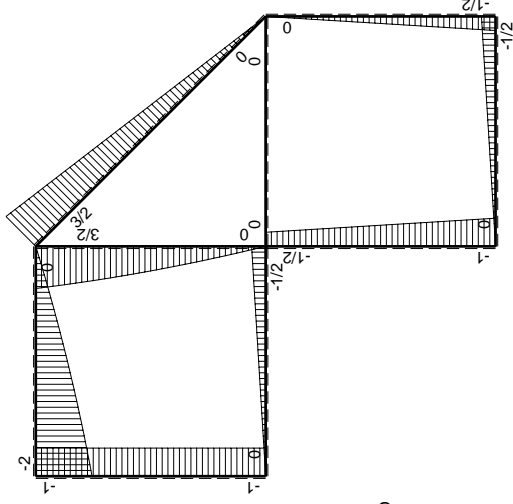
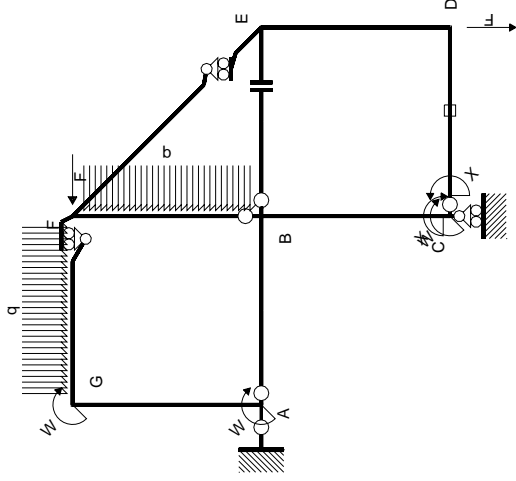
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

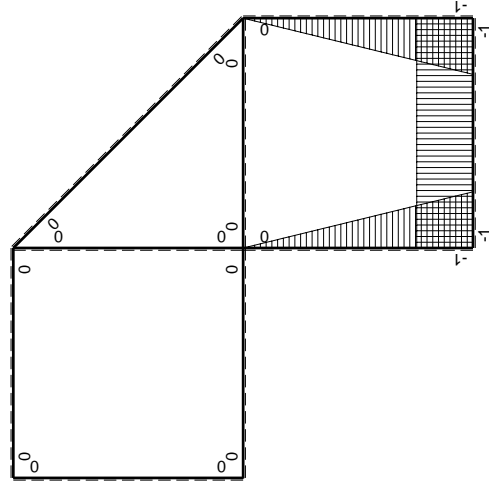
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				1/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

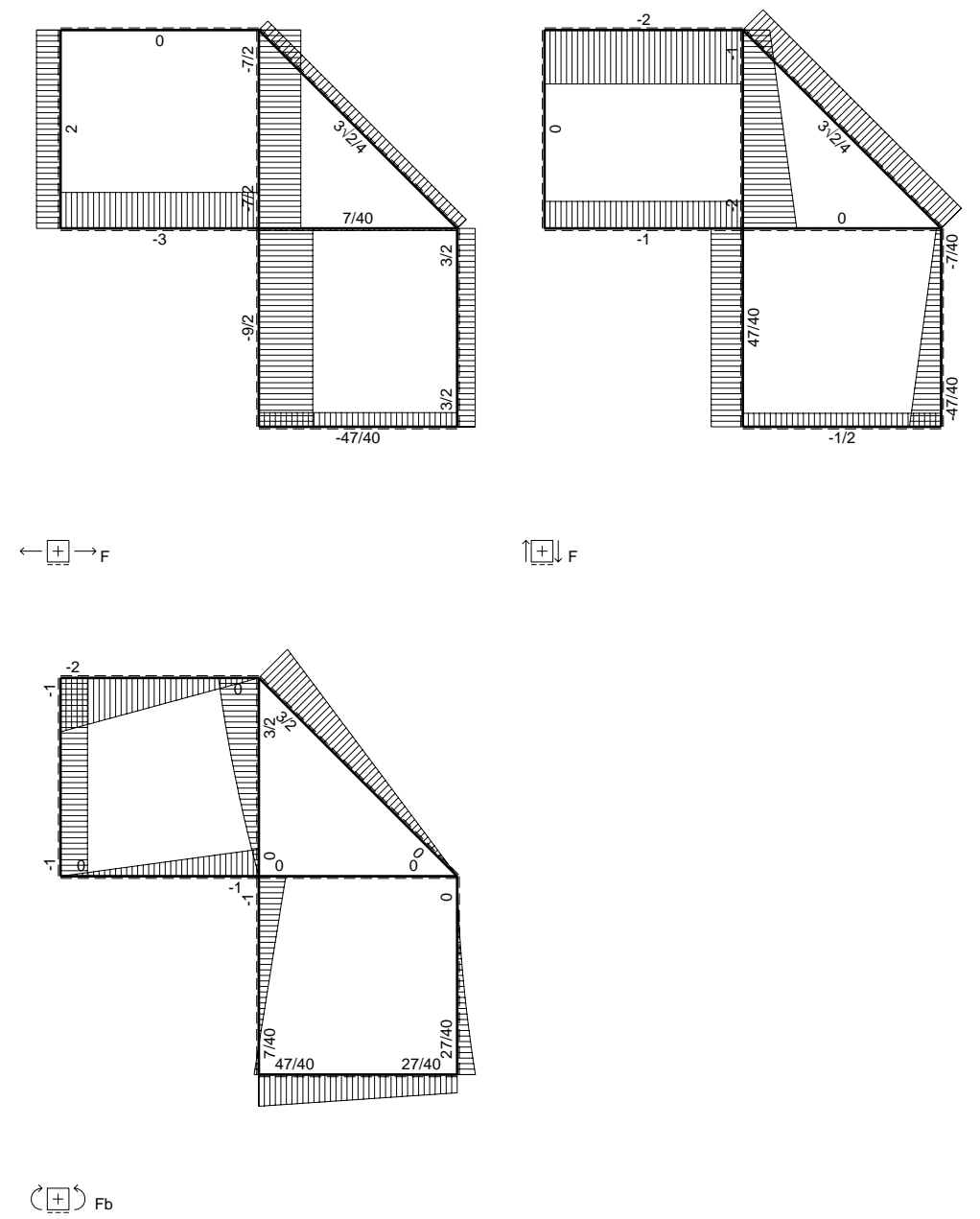
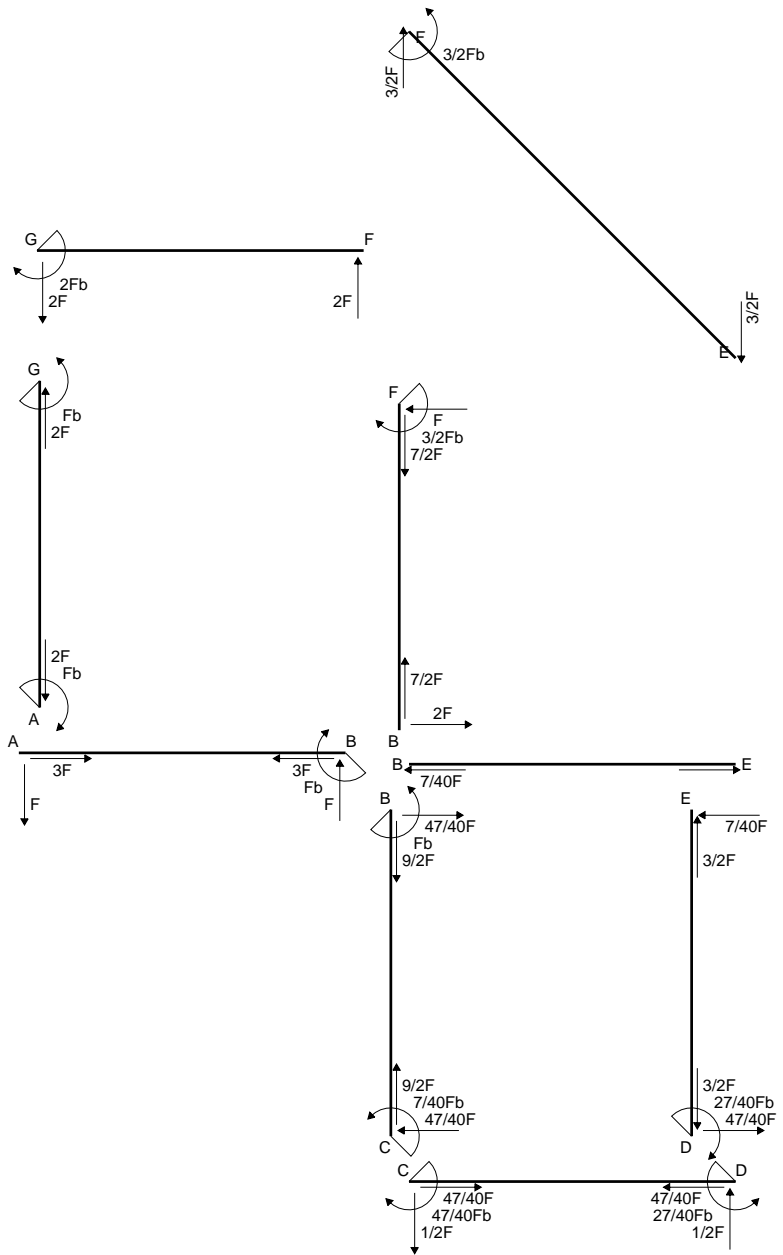
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

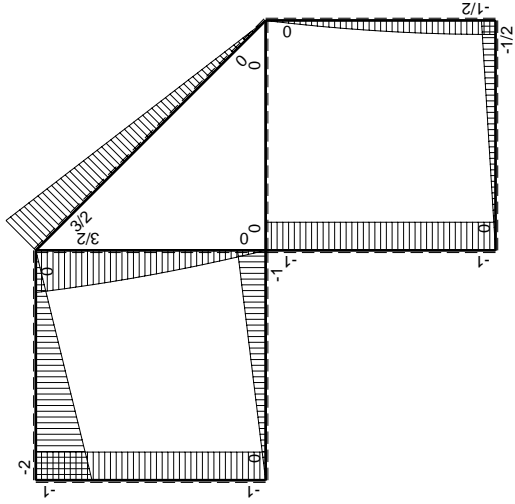
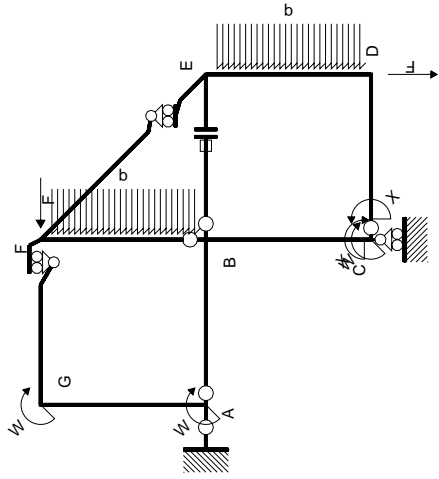
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

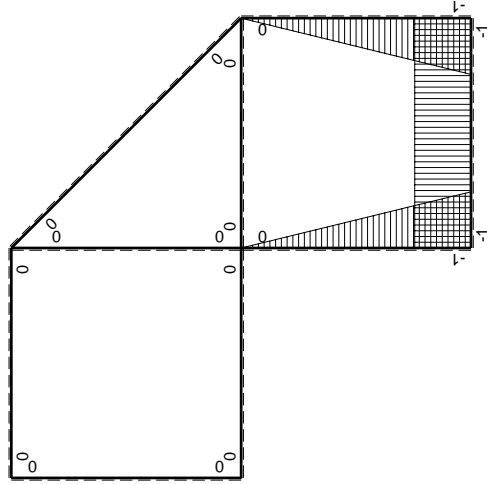
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb+1/2qx ²	$1/2Fb-1/2Fx-1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fx-1/2qx ²	$Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$47/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-47/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b) \cdot Fb \cdot 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) \cdot Fb \cdot 1/EJ \, dx = [x - 1/2 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

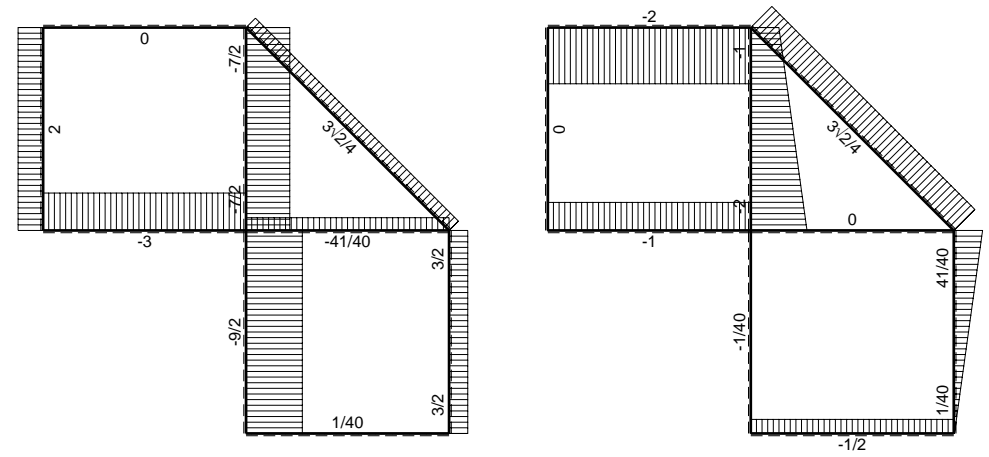
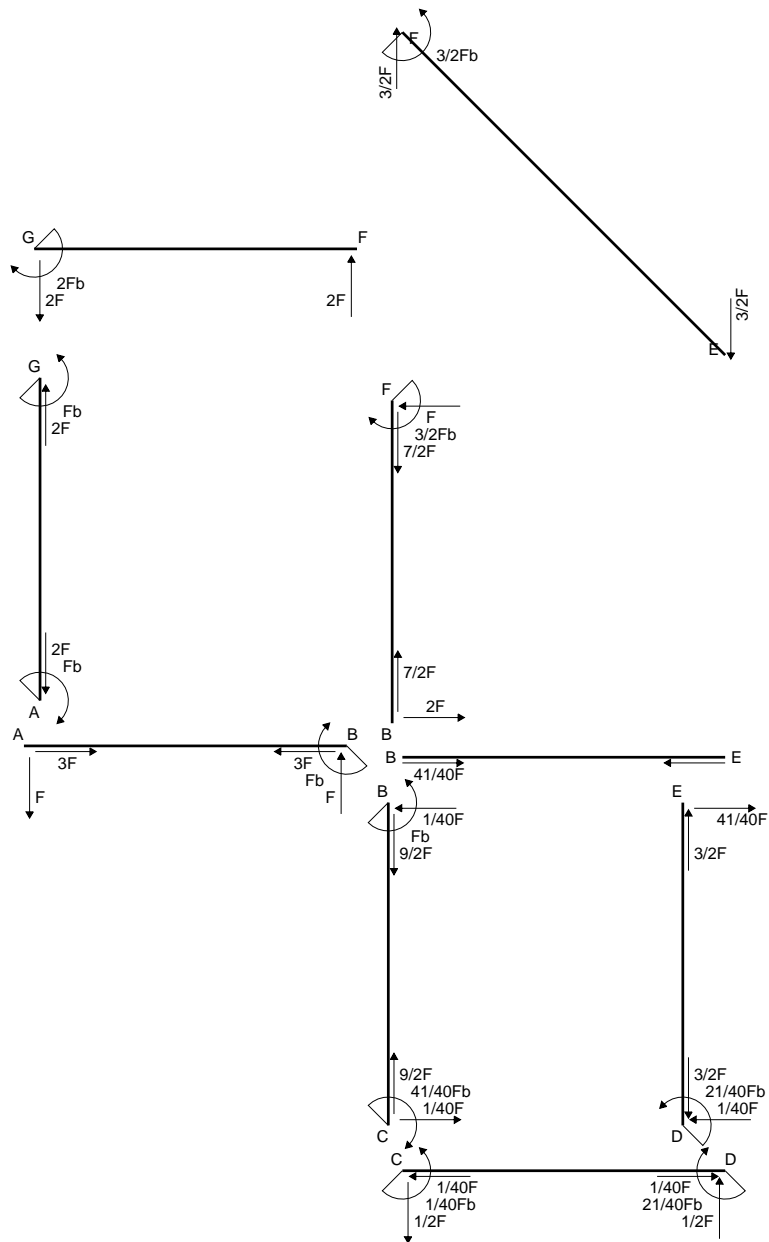
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x/b - 1/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

$$= [1/2 x - 1/4 x^2/b - 1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/4 b - 1/6 b + 1/8 b) \cdot Fb \cdot 1/EJ = 5/24 Fb^2/EJ$$

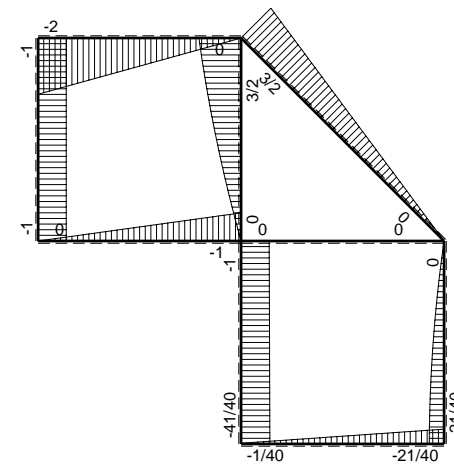
$$L_{ED}^{xo} = \int_0^b (x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = [1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/3 b - 1/8 b) \cdot Fb \cdot 1/EJ = 5/24 Fb^2/EJ$$

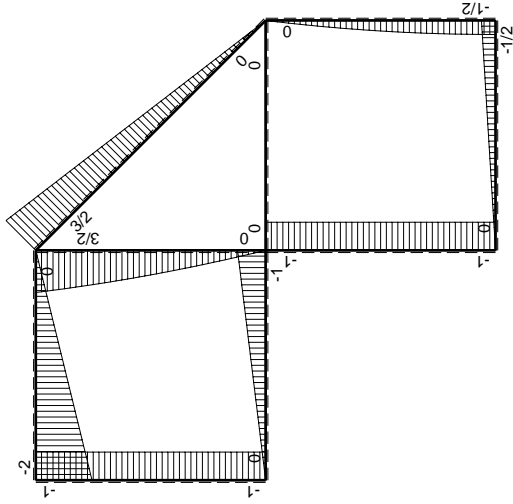
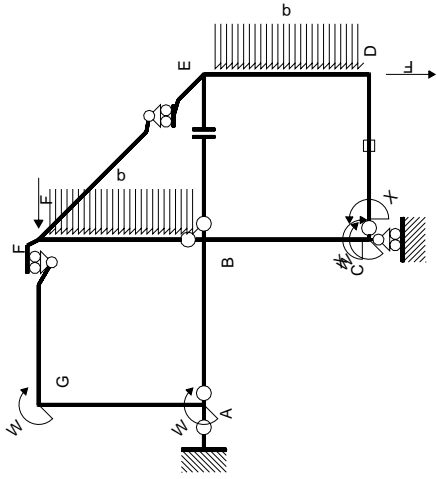


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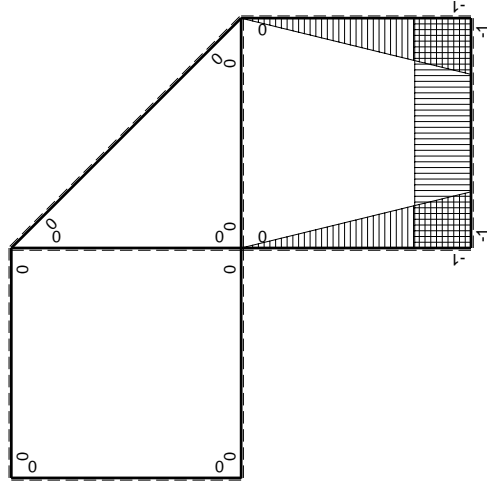


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_1 flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb+1/2qx ²	$1/2Fb-1/2Fx-1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fx-1/2qx ²	$Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD} \epsilon_{CD} L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/40Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (1/2 b - 1/4 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -3/4 Fb^2/EJ$$

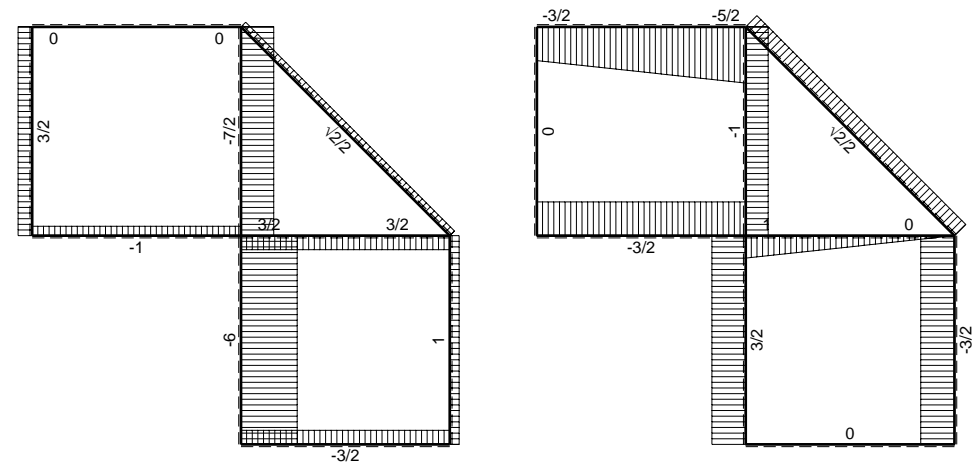
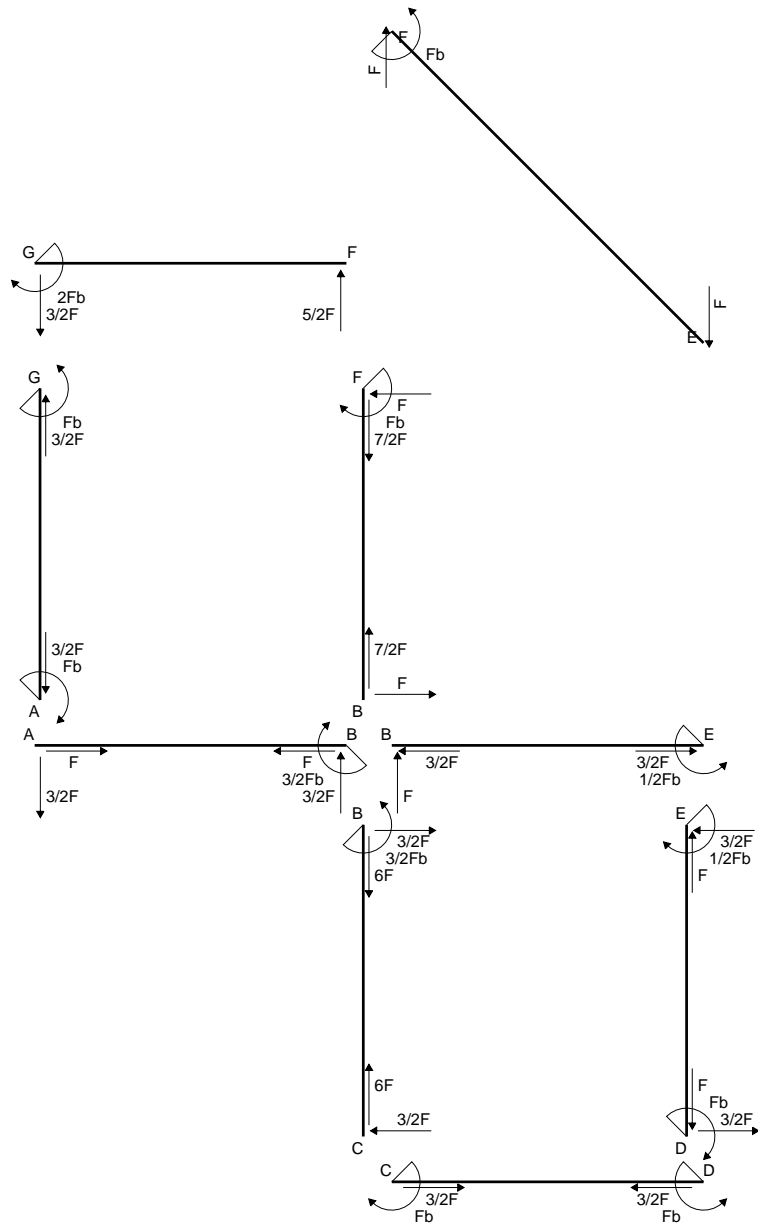
$$L_{DE}^{xo} = \int_0^b (1/2 - 1/2 x/b - 1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

$$= [1/2 x - 1/4 x^2/b - 1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/4 b - 1/6 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

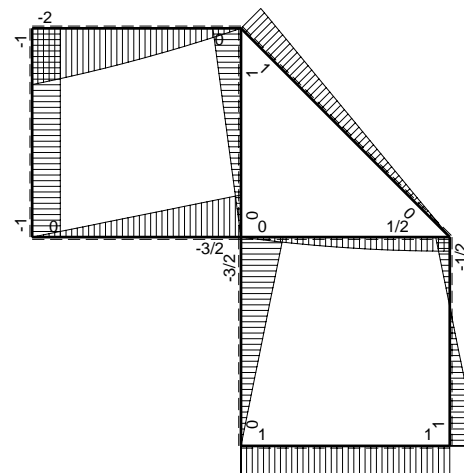
$$L_{ED}^{xo} = \int_0^b (x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/3 b - 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

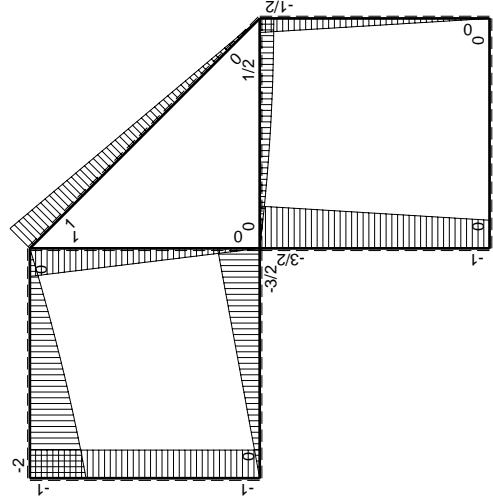
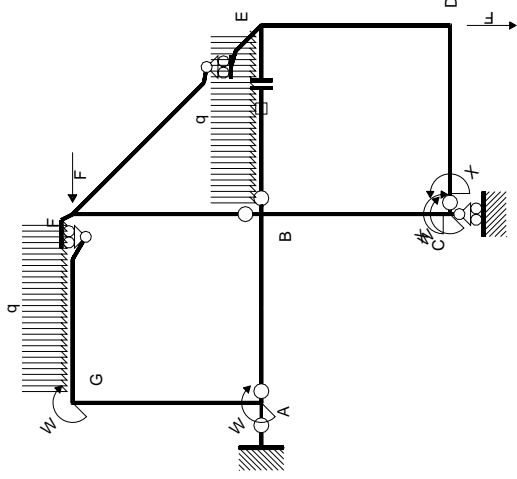


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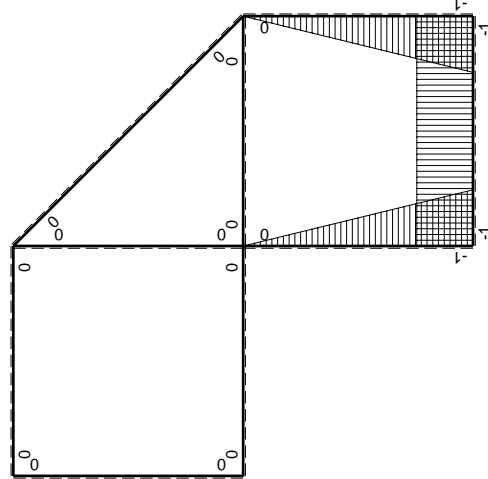


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Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
BE	elongazione asta $N_{1, BE}^E - N_{1, BE}^B$				Fb ² /EJ	
	totali				5/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + \frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 \, b) \cdot 1/EJ = 1/3 \, b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 7/12 \, Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 \, x^2/b - 1/6 \, x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

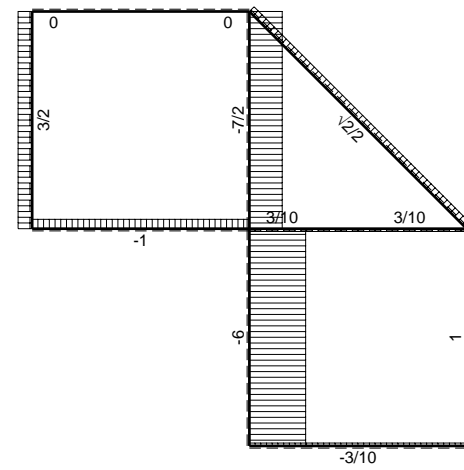
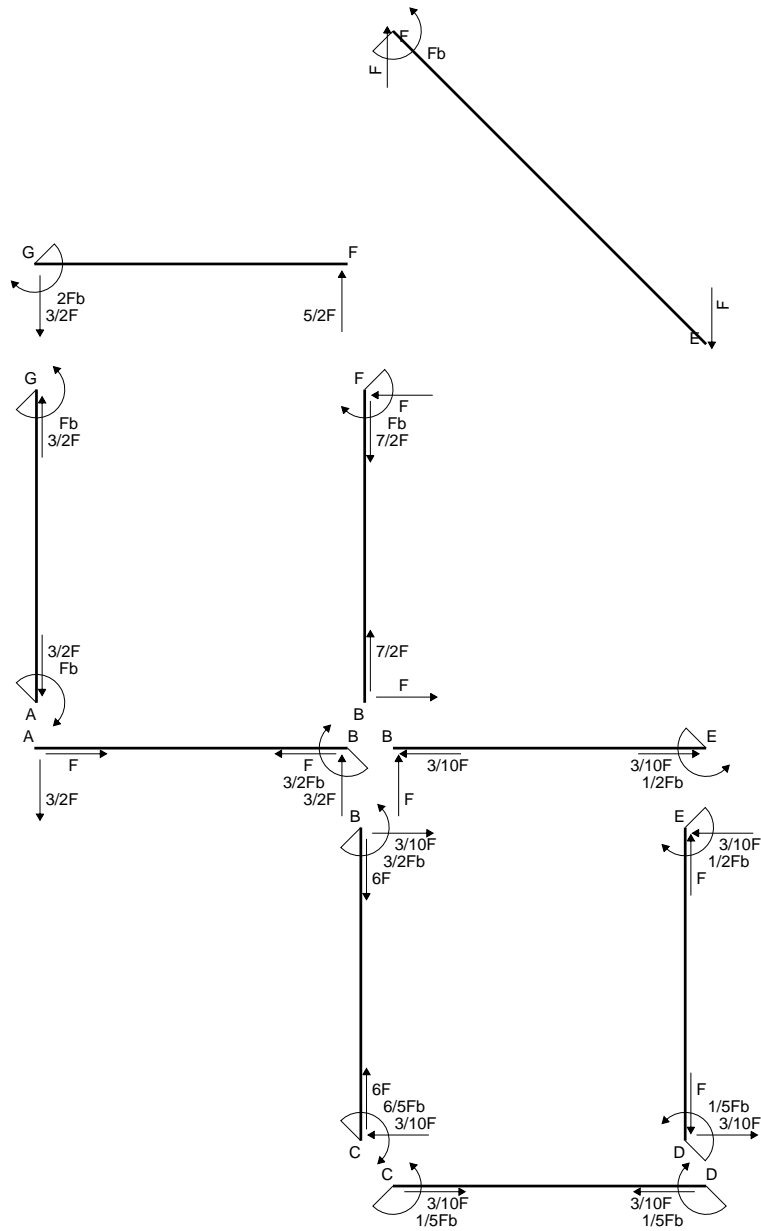
$$= (b - 1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 7/12 \, Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

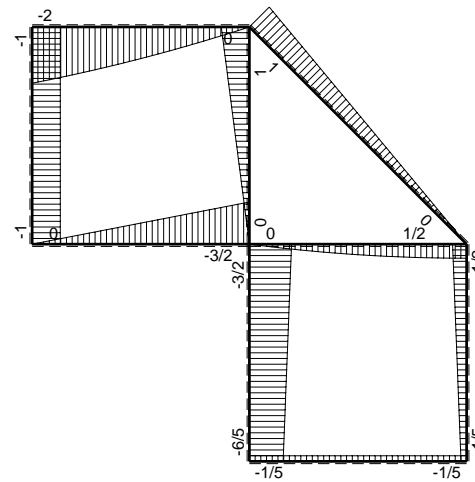
$$= (1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 1/12 \, Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 \, x/b - 1/2 \, x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - \frac{1}{6} x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

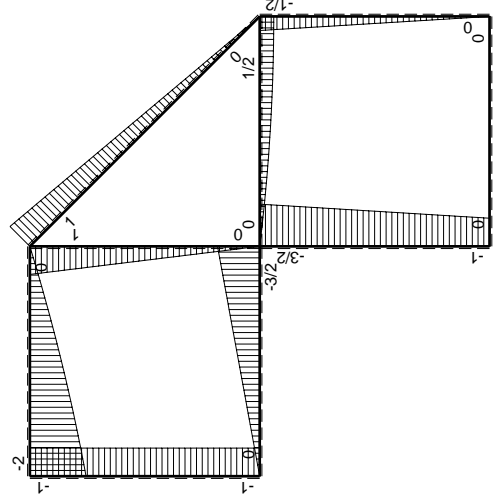
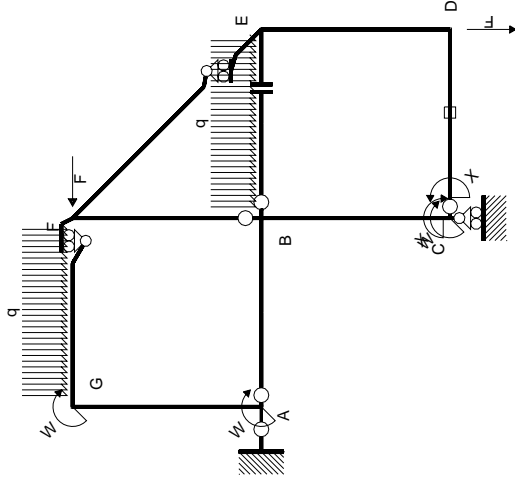
$$= (1/4 \, b - 1/6 \, b) \cdot Fb \cdot 1/EJ = 1/12 \, Fb^2/EJ$$



← (+) → F

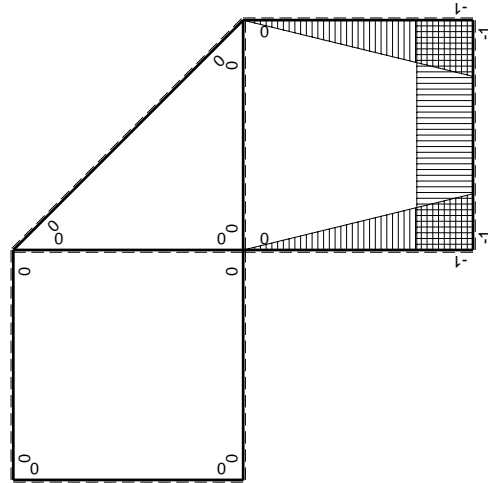


⊕ (+) ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²	0	0
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	Fx-1/2qx ²	0	0	0	0
EB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD	elongazione asta $N_{1,CD} \epsilon_{CD} L_{CD}$				-Fb ² /EJ	
	totali				-1/3Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				1/5Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[\frac{1}{3} x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{3}{4} x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - 1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

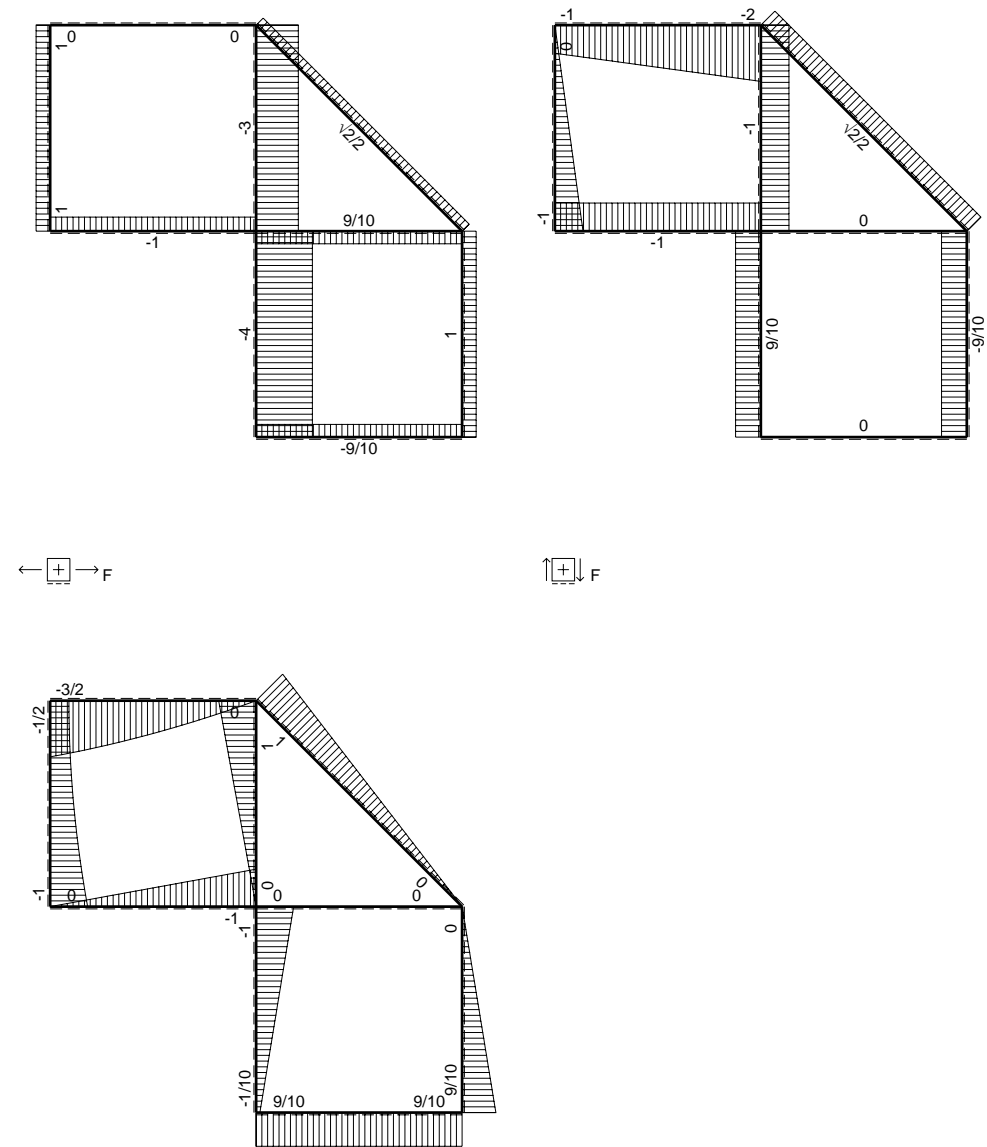
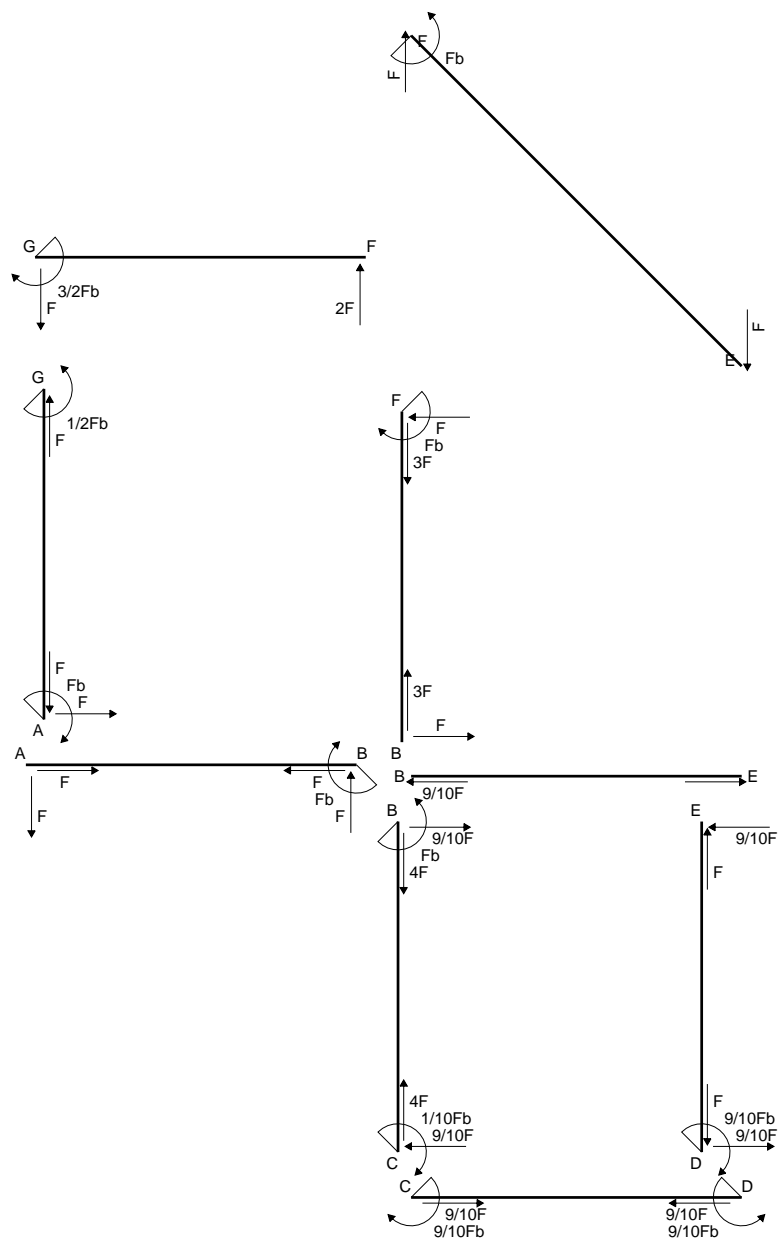
$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

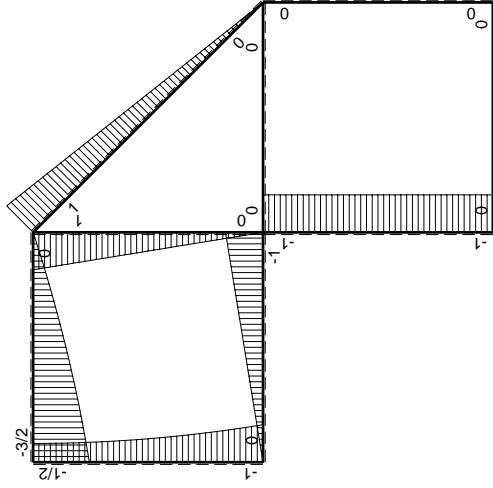
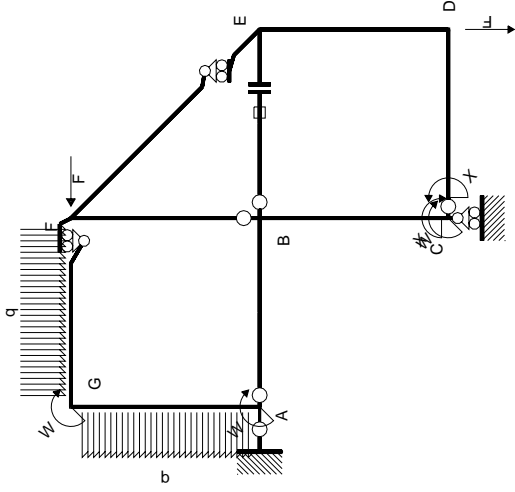
$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[\frac{1}{4} x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 Fb^2/EJ$$



⊕ ⊖ F_b



Schema di calcolo iperstatico

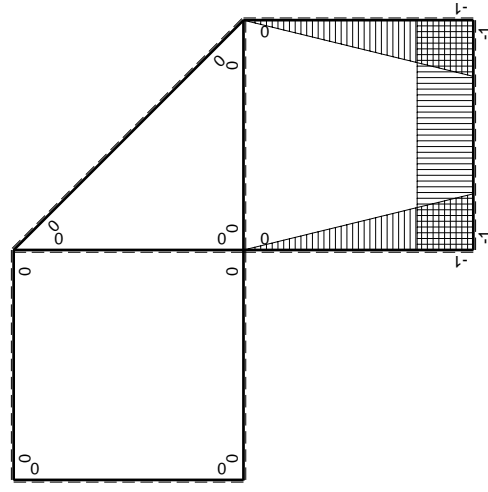
M_0 flessione da carichi assegnati

M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx$	0	0	0	0
FG b	0	$-2Fx+1/2qx^2$	0	0	0	0
GF b	0	$3/2 Fb-Fx-1/2qx^2$	0	0	0	0
GA b	0	$-1/2 Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2 Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica X=W _{CD}				$-9/10 Fb$	

Sviluppi di calcolo iperstatica



$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

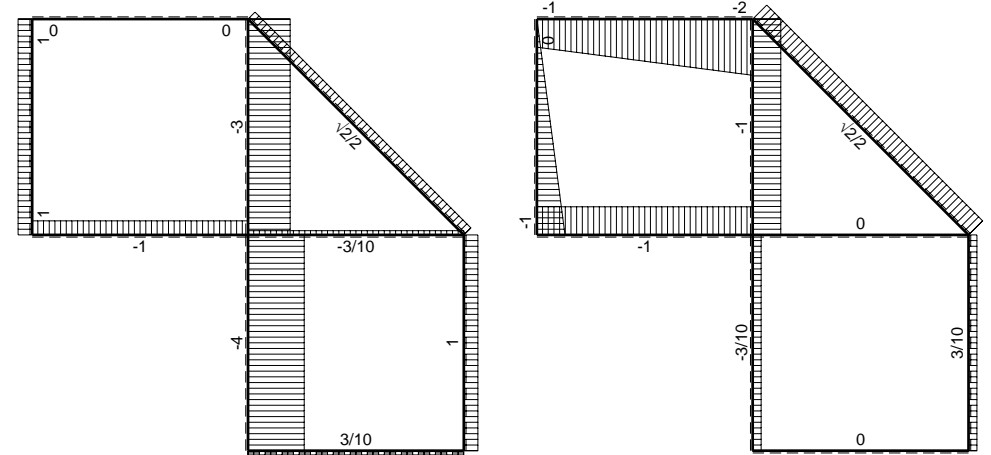
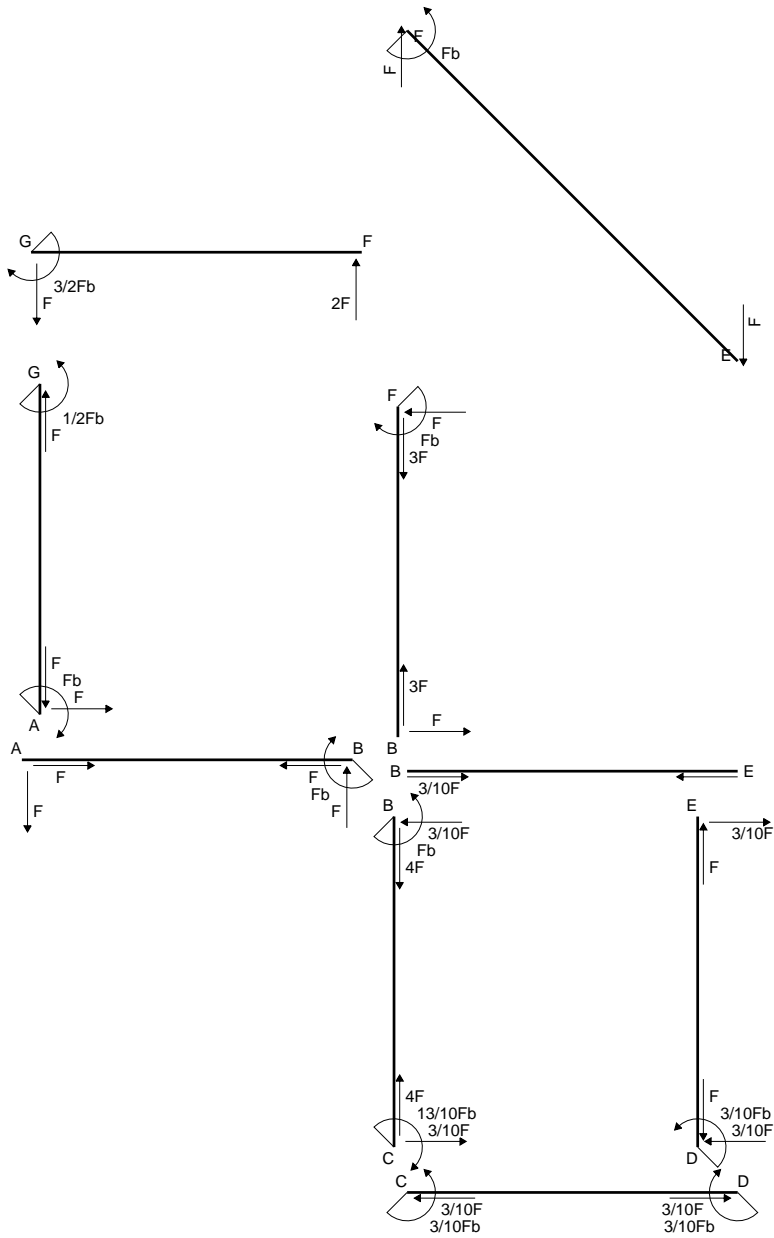
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

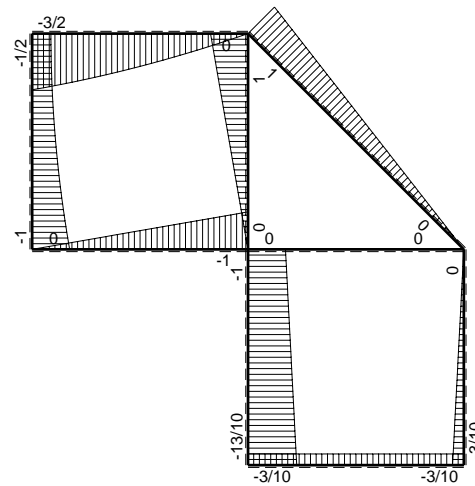
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

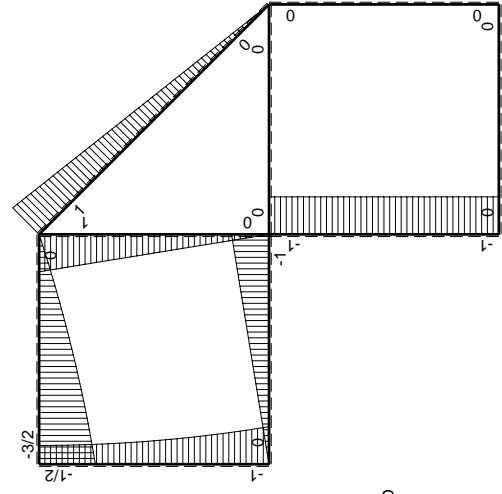
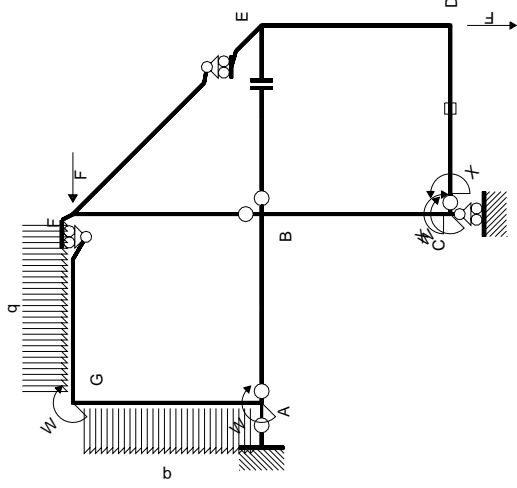


← (+) → F

↑ (+) ↓ F



↺ (+) ↻ Fb



Schema di calcolo iperstatico

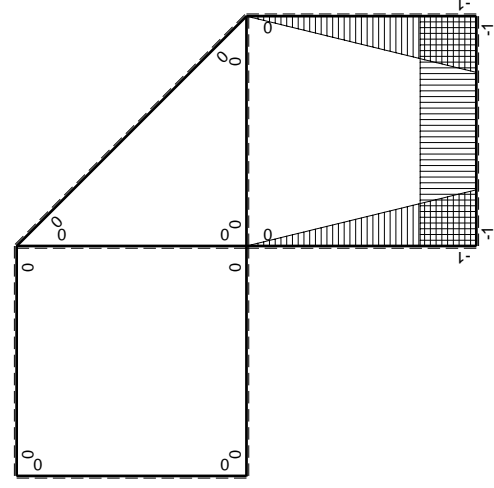
M_0 flessione da carichi assegnati

M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb^2/EJ$
CB b	$1-x/b$	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb^2/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx$	0	0	0	0
FG b	0	$-2Fx+1/2qx^2$	0	0	0	0
GF b	0	$3/2 Fb-Fx-1/2qx^2$	0	0	0	0
GA b	0	$-1/2 Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/2 Fb^2/EJ$	$5/3 Xb^2/EJ$
	iperstatica $X=W_{cd}$				$3/10 Fb$	

Sviluppi di calcolo iperstatica



M_x flessione da iperstatica $X=1$

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

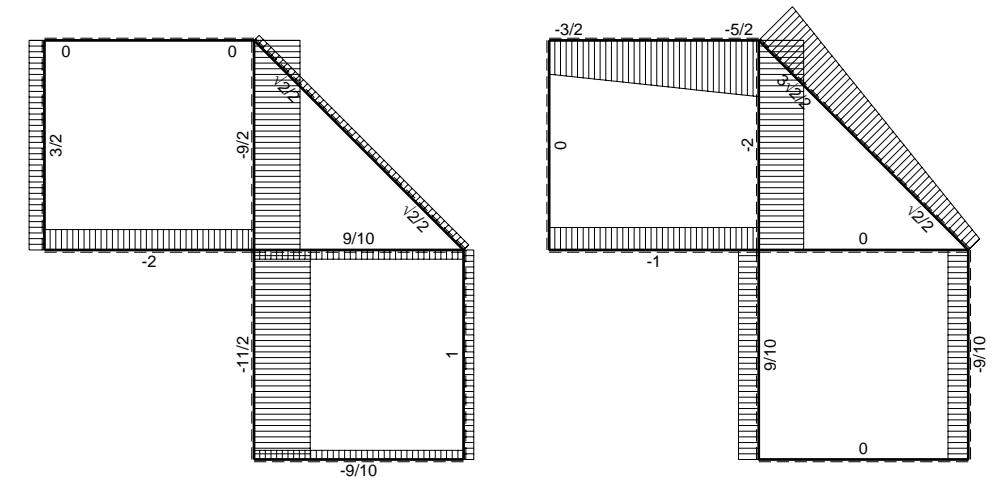
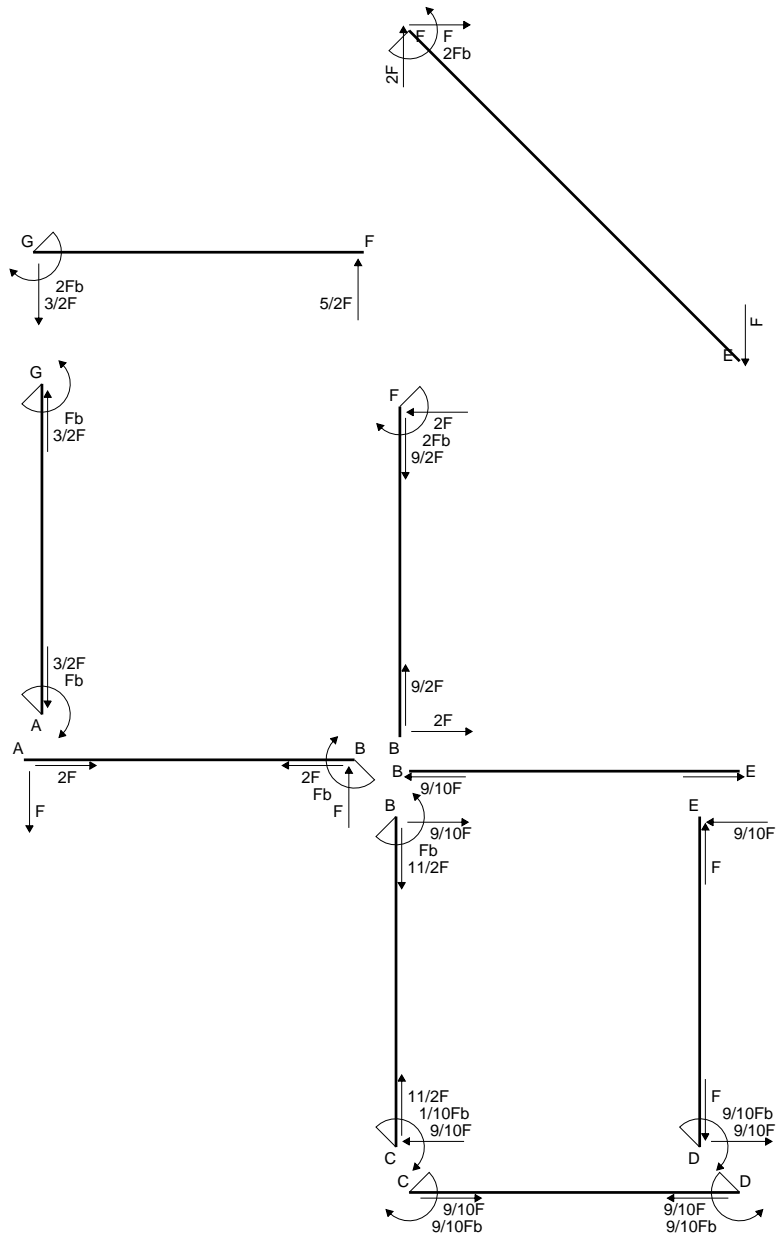
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

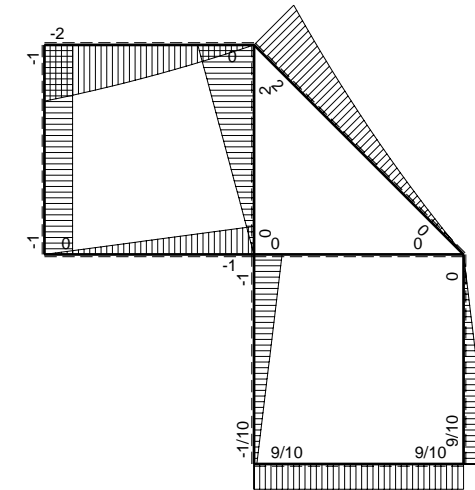
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

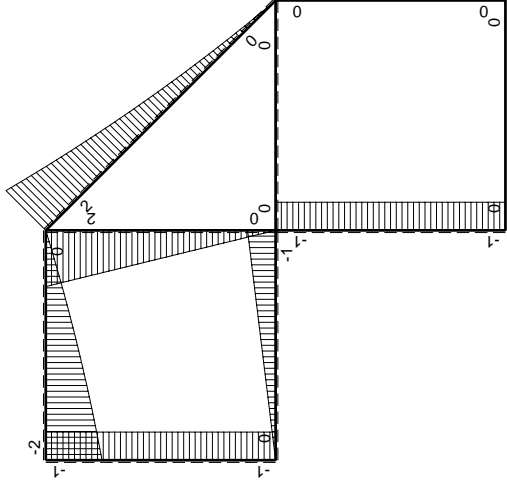
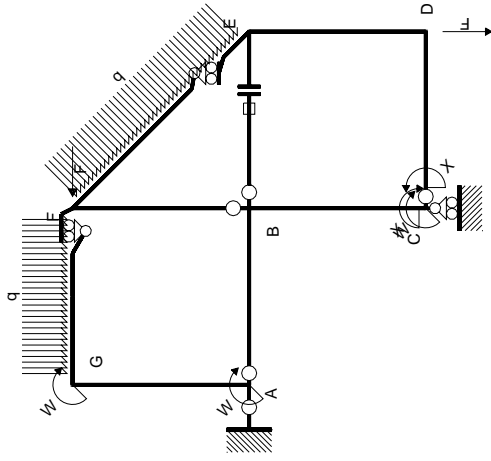


← ⊕ → F

↑ ⊕ ↓ F



← ⊕ → Fb



Schema di calcolo iperstatico

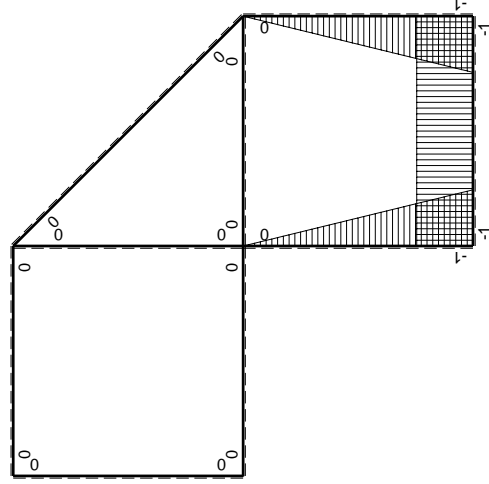
M_0 flessione da carichi assegnati

M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	$-5/2 Fx + 1/2 qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2 Fx - 1/2 qx^2$	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2 Fb^2/EJ$	$5/3 Xb/EJ$
	iperstatica X=W _{CD}				$-9/10 Fb$	

Sviluppi di calcolo iperstatica



M_x flessione da iperstatica X=1

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

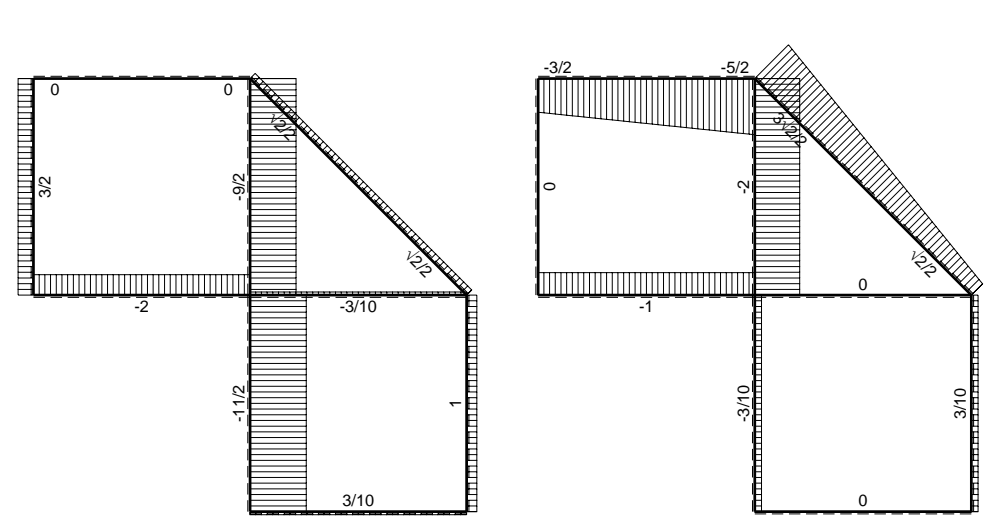
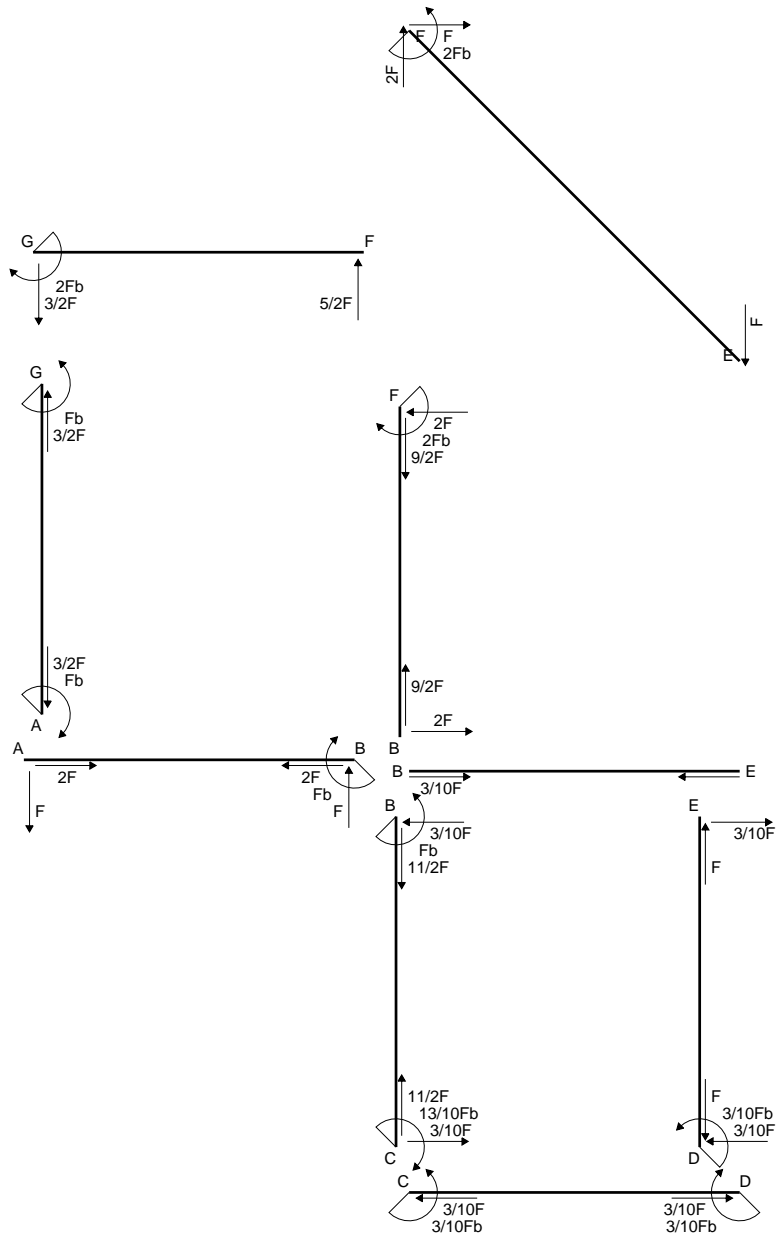
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

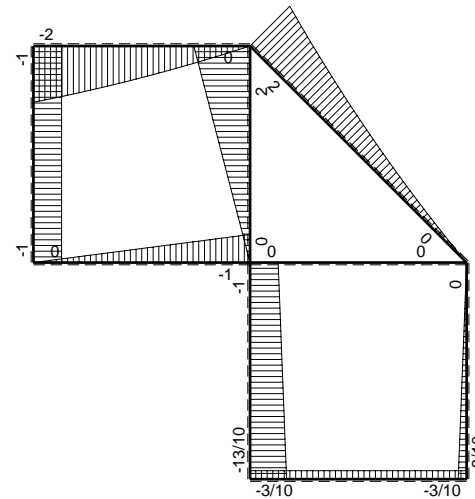
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

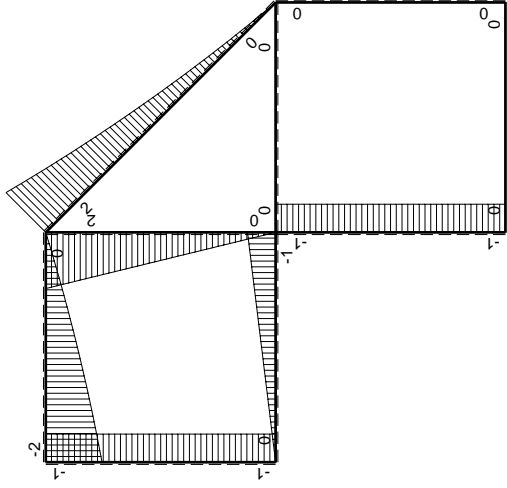
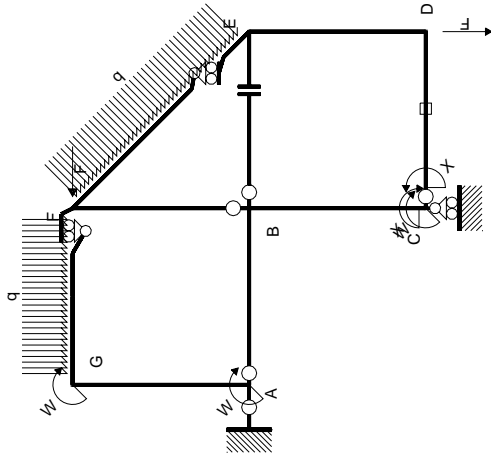


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⊕ ⊖ Fb



Schema di calcolo iperstatico

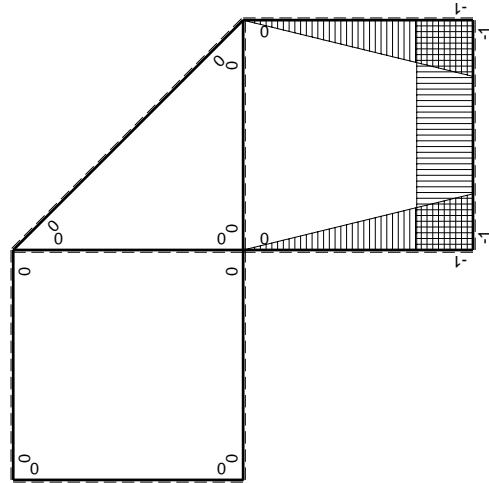
M_0 flessione da carichi assegnati

M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0	0	0
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2 Fb^2/EJ$	$1/3 Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3 Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2 Fx + 1/2 qx^2$	0	0	0	0
FG b	0	$-5/2 Fx + 1/2 qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2 Fx - 1/2 qx^2$	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-1/2 Fb ² /EJ	5/3 Xb/EJ
	iperstatica X=W _{cd}				3/10 Fb	

Sviluppi di calcolo iperstatica



$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

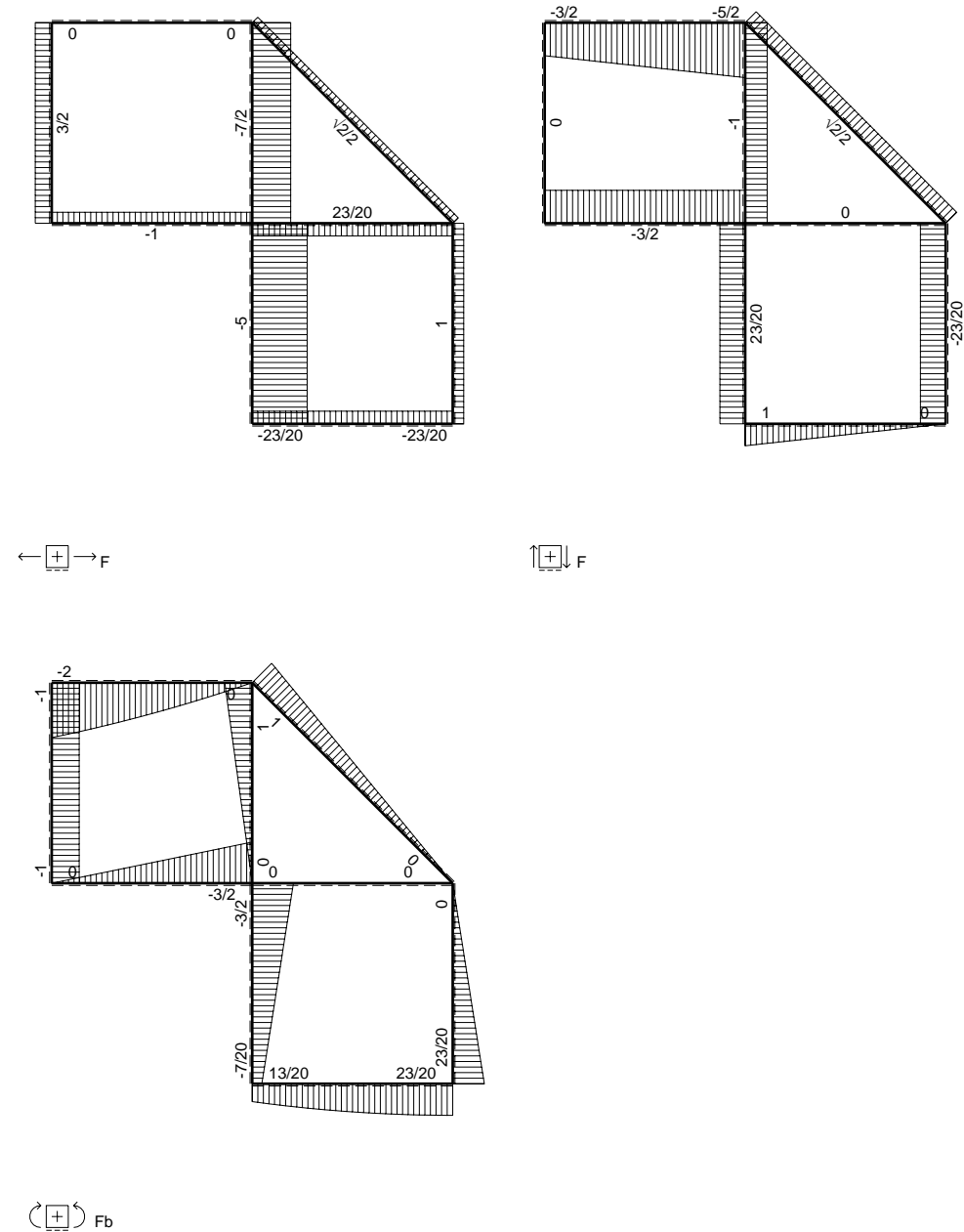
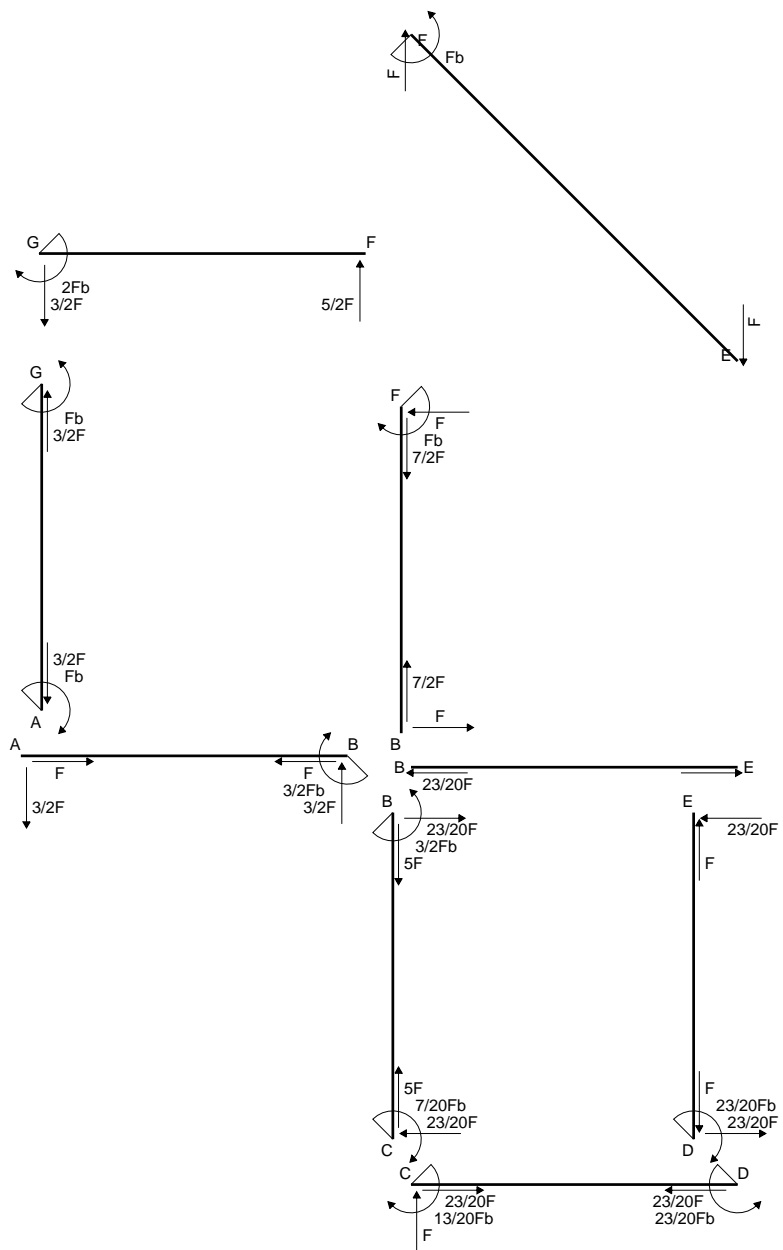
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

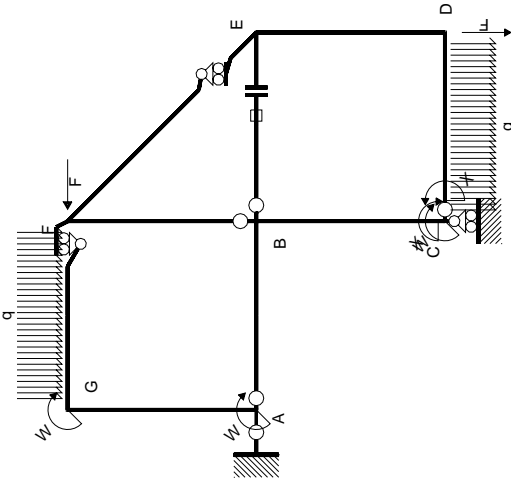
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

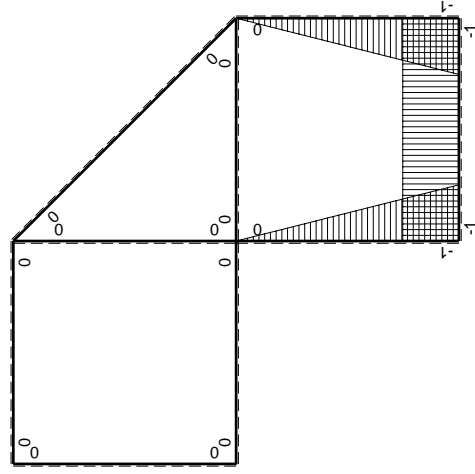
$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1		
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				13/12Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				-13/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (3/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

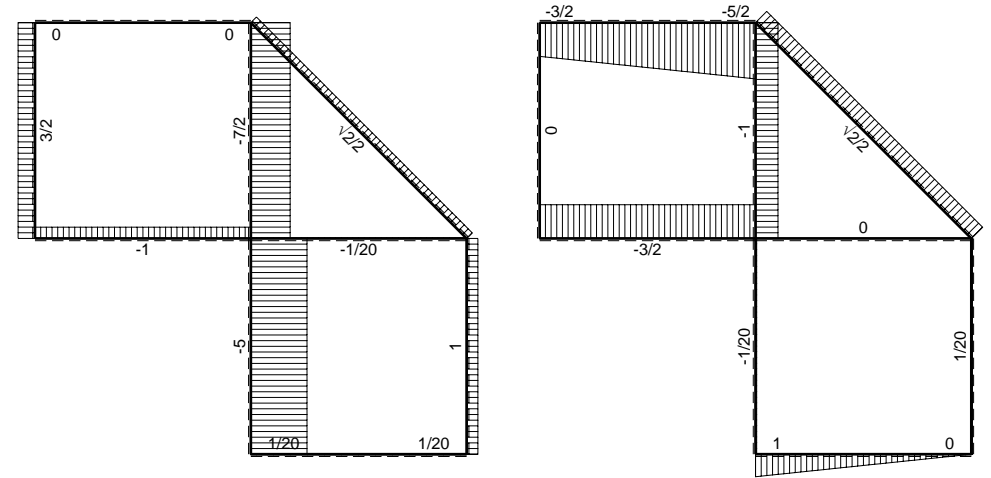
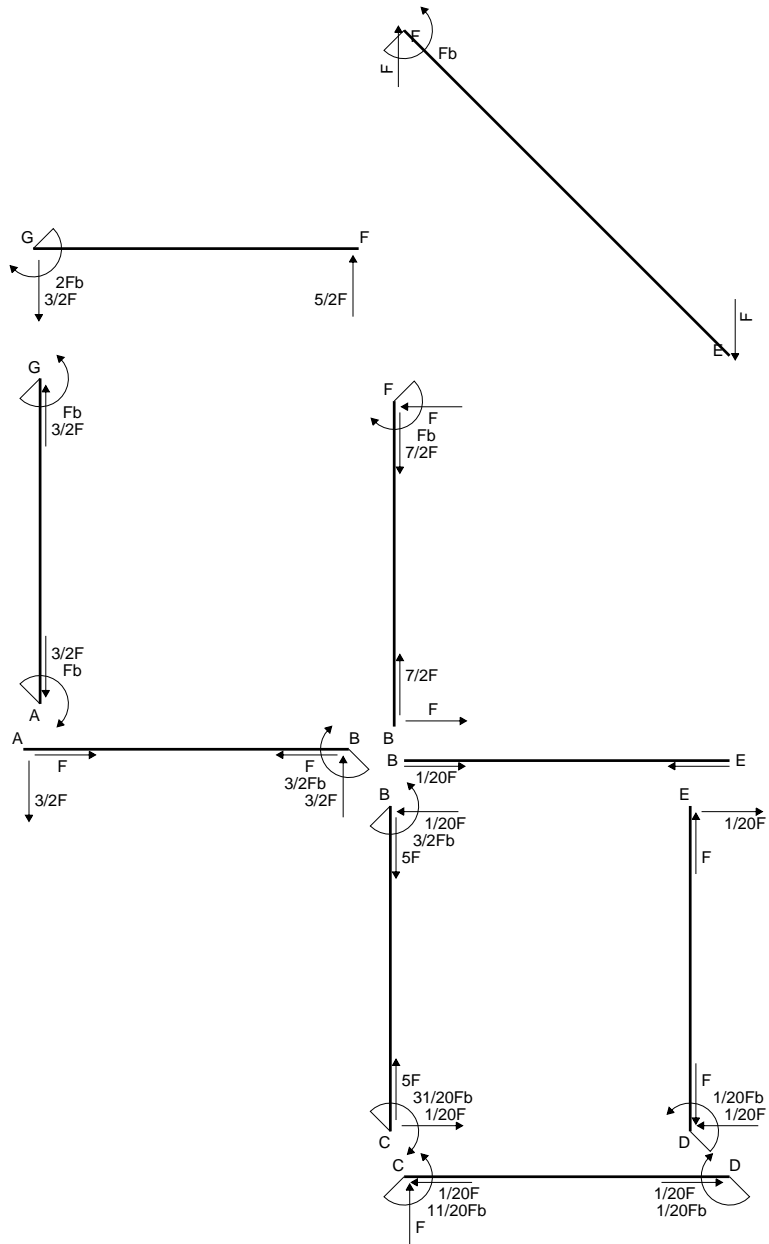
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

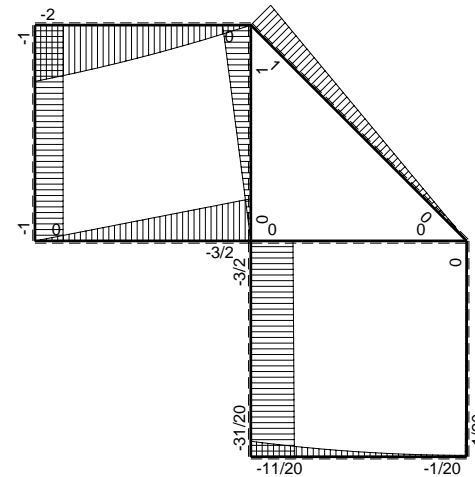
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [-1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/6 b) \cdot Fb \cdot 1/EJ = -1/6 Fb^2/EJ$$

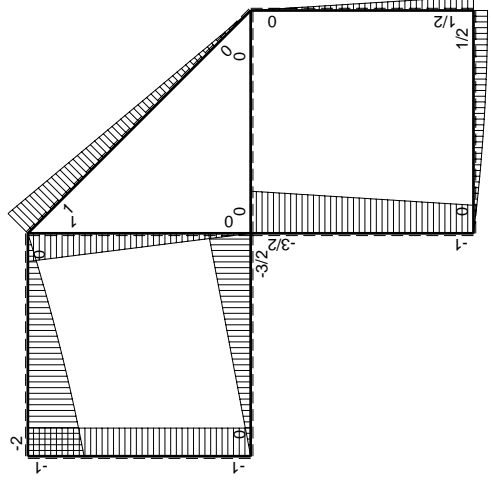
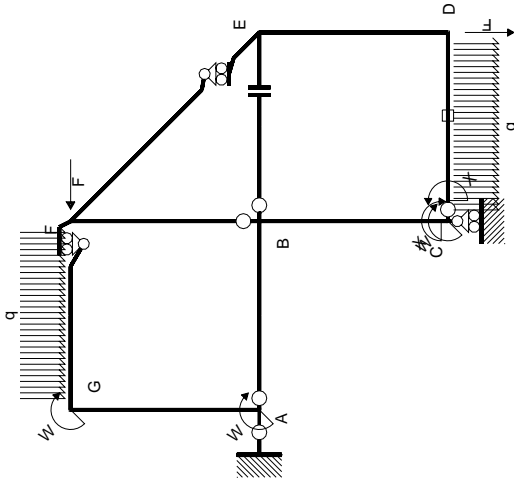


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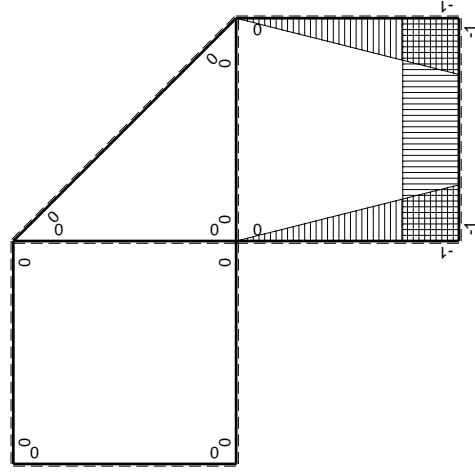
↑ ⊕ ↓ F



⊕ ⊖ Fb



(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²		
CD b	-1	Fx-1/2qx ²	-Fx+1/2Fx ² /b	1	-1/3Fb ² /EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx ²	-1/2Fb+1/2Fx ² /b	1		
DE b	-1+x/b	1/2Fb-1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	-1/2Fx	-1/2Fx ² /b	x ² /b ²		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				-Fb ² /EJ	
	totali				-11/12Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				11/20Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (-1/2 + 1/2 x^2/b^2) Fb 1/EJ dx + 1 (-1) 1 Fb^2/EJ$$

$$= [-1/2 x + 1/6 x^3/b^2]_0^b Fb 1/EJ + 1 (-1) 1 Fb^2/EJ$$

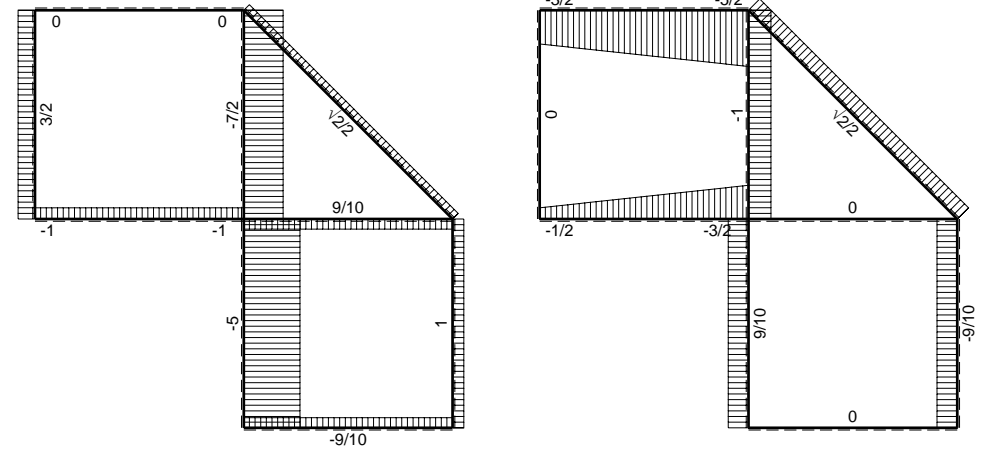
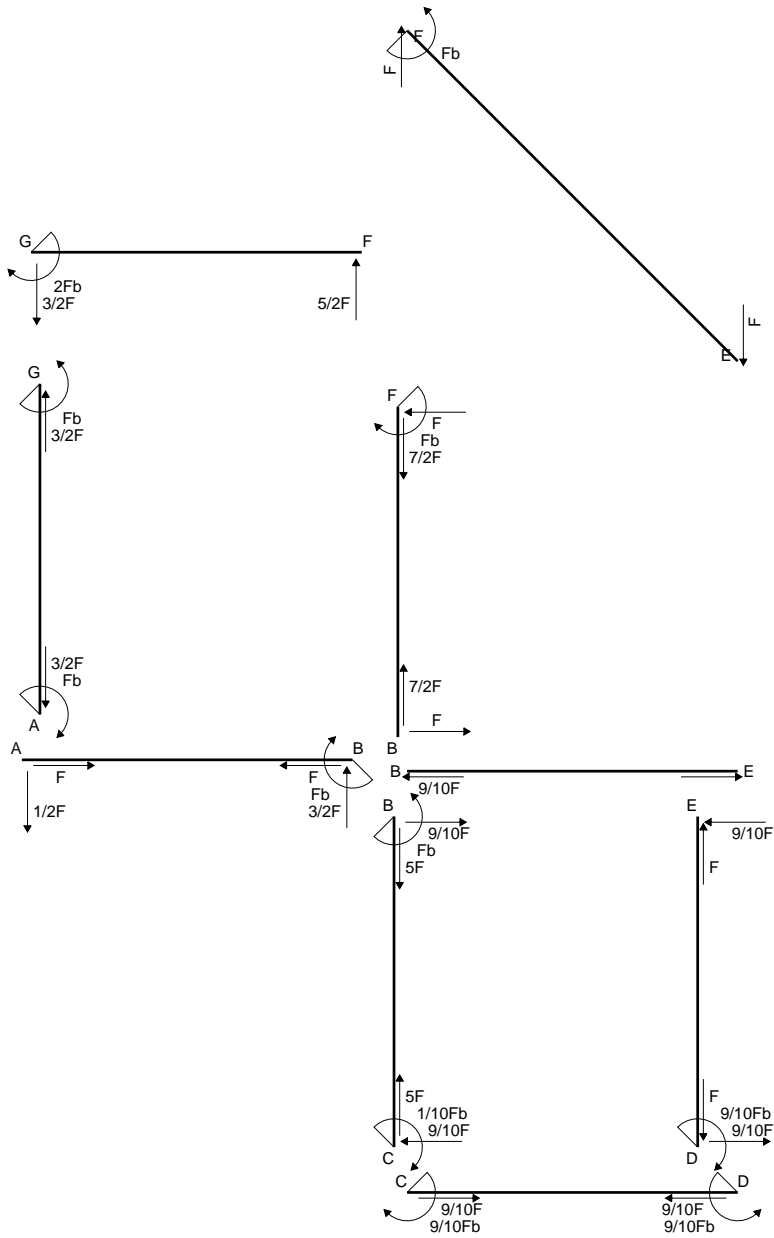
$$= (-1/2 b + 1/6 b) Fb 1/EJ + 1 (-1) 1 Fb^2/EJ = -4/3 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

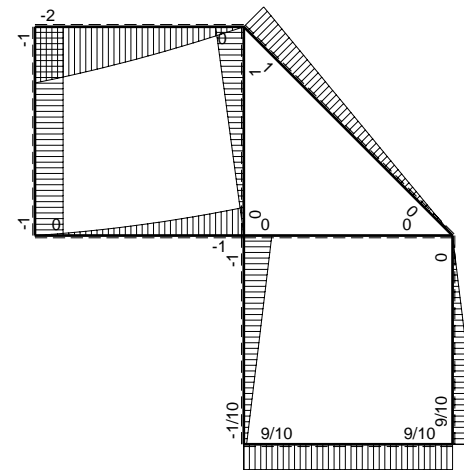
$$L_{ED}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

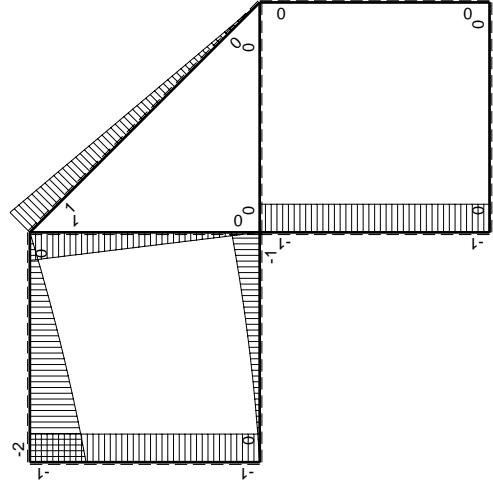
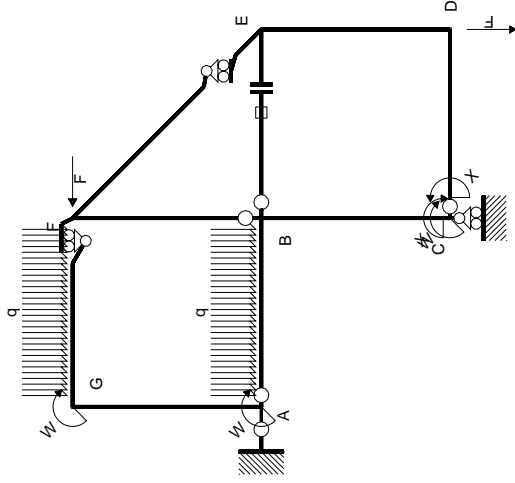


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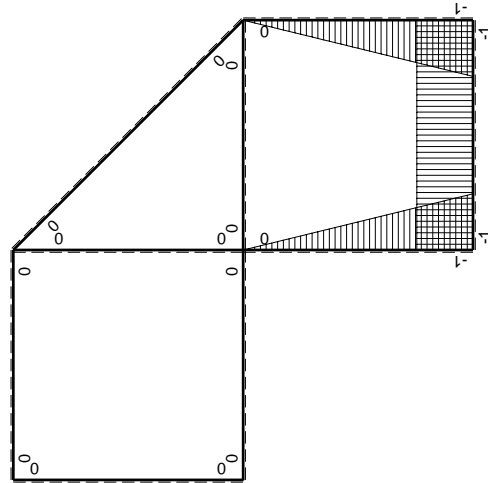


⊕ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$-9/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

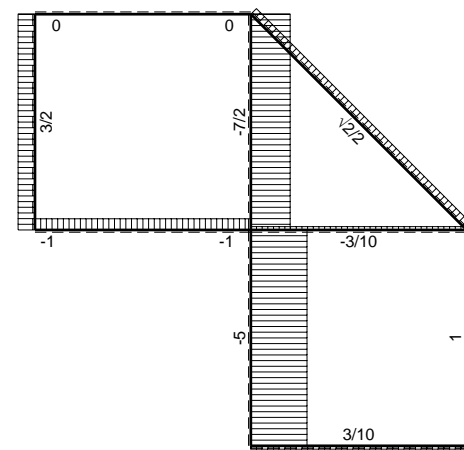
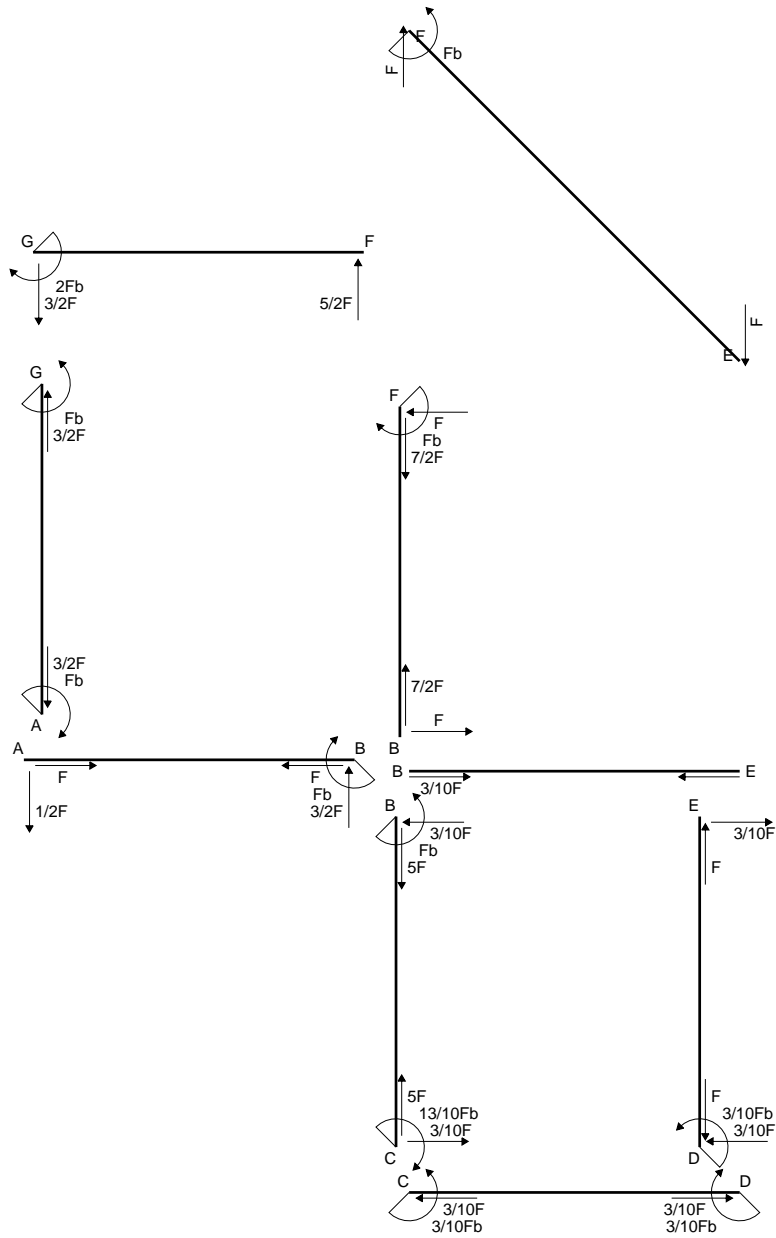
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

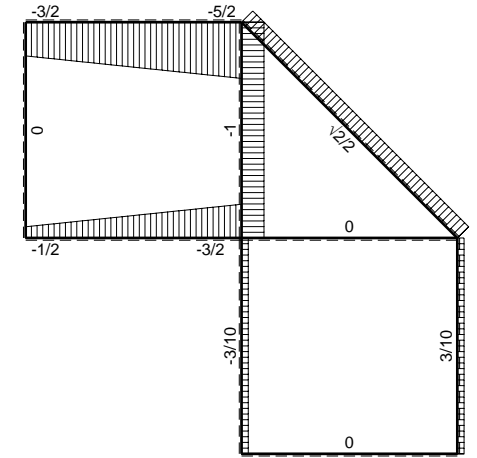
$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

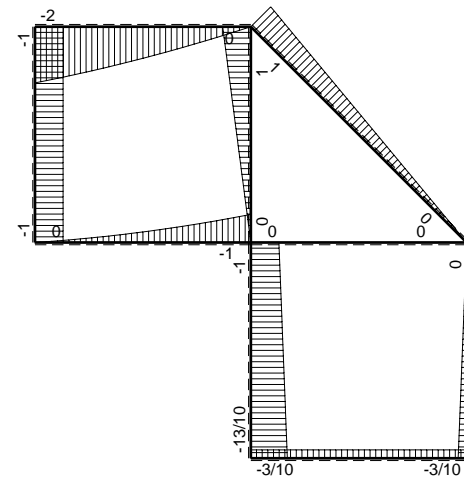
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$



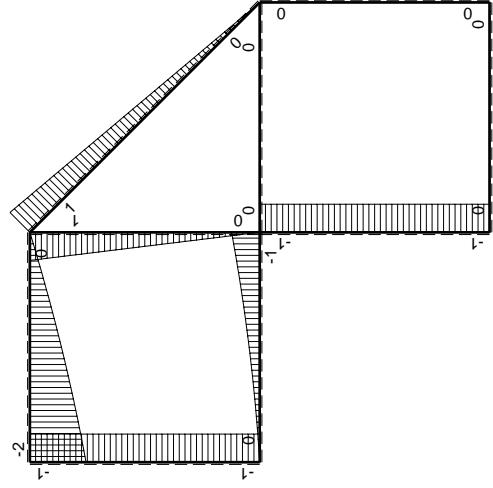
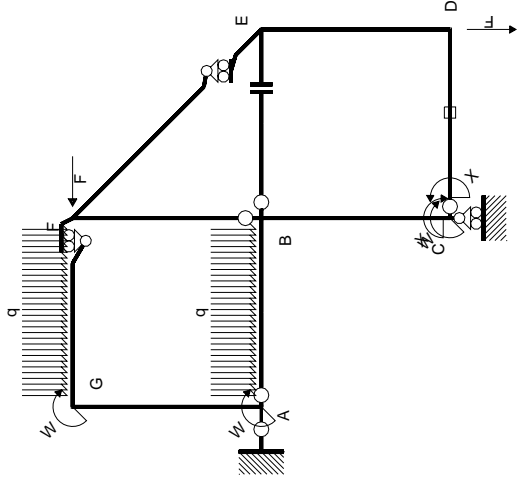
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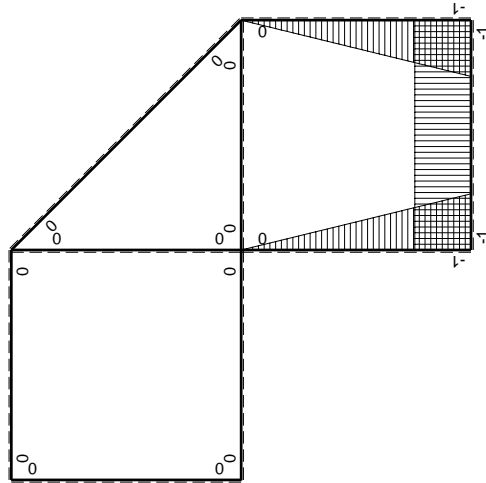


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fx - 1/2qx^2$	0	0	0	0
BA b	0	$Fb - 3/2Fx + 1/2qx^2$	0	0	0	0
BC b	$-x/b$	$-Fb$	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	$1-x/b$	Fb	$Fb-Fx$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1	0	
DE b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	$-5/2Fx + 1/2qx^2$	0	0	0	0
GF b	0	$2Fb - 3/2Fx - 1/2qx^2$	0	0	0	0
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta $N_{1,cd} \epsilon_{cd} L_{cd}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica X=W _{CD}				$3/10Fb$	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

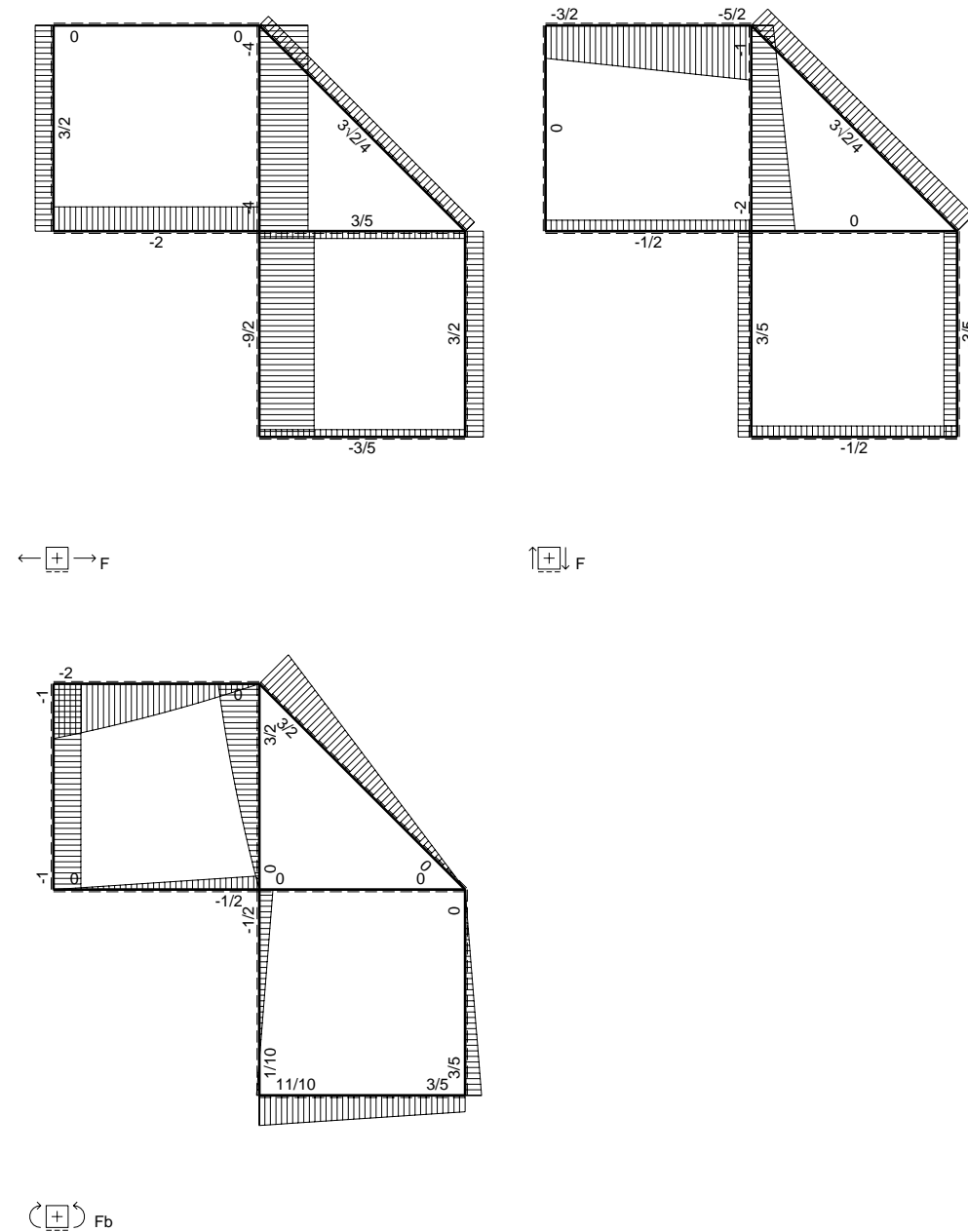
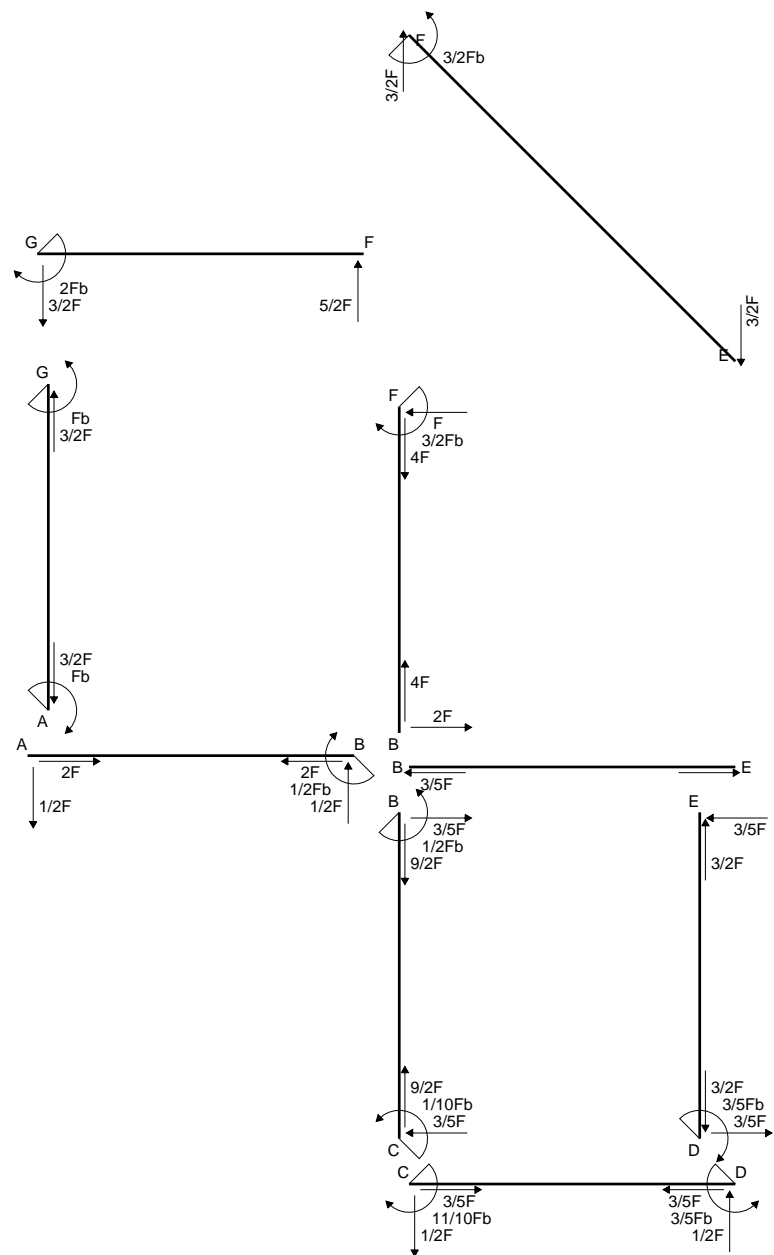
$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

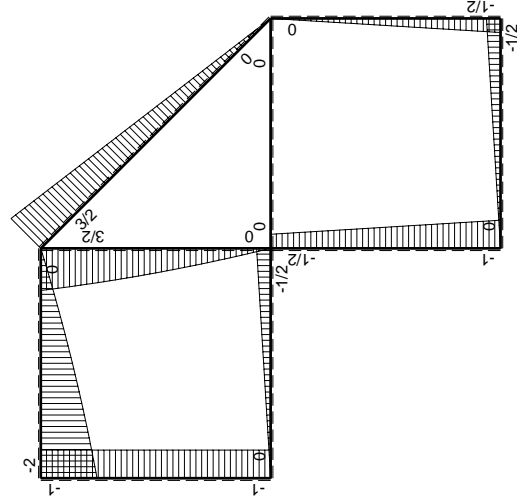
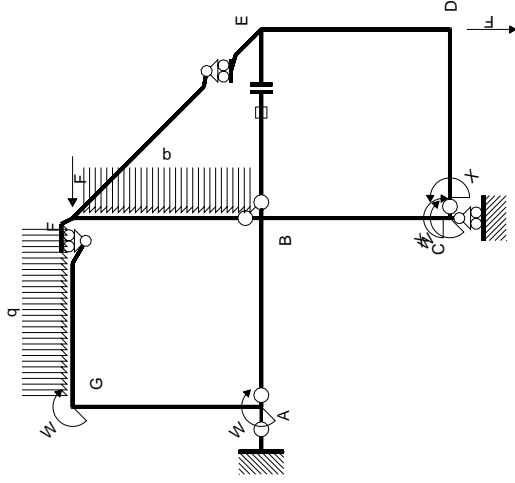
$$L_{BC}^{xo} = \int_0^b (x/b) Fb 1/EJ dx = [1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx = [x - 1/2 x^2/b]_0^b Fb 1/EJ$$

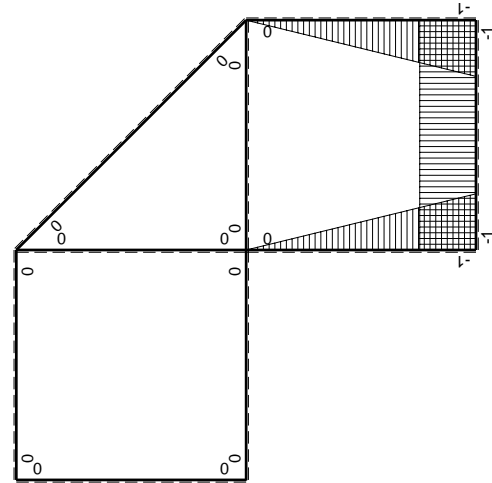
$$= (b - 1/2 b) Fb 1/EJ = 1/2 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{cd}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				11/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{cd}				-11/10Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ$$

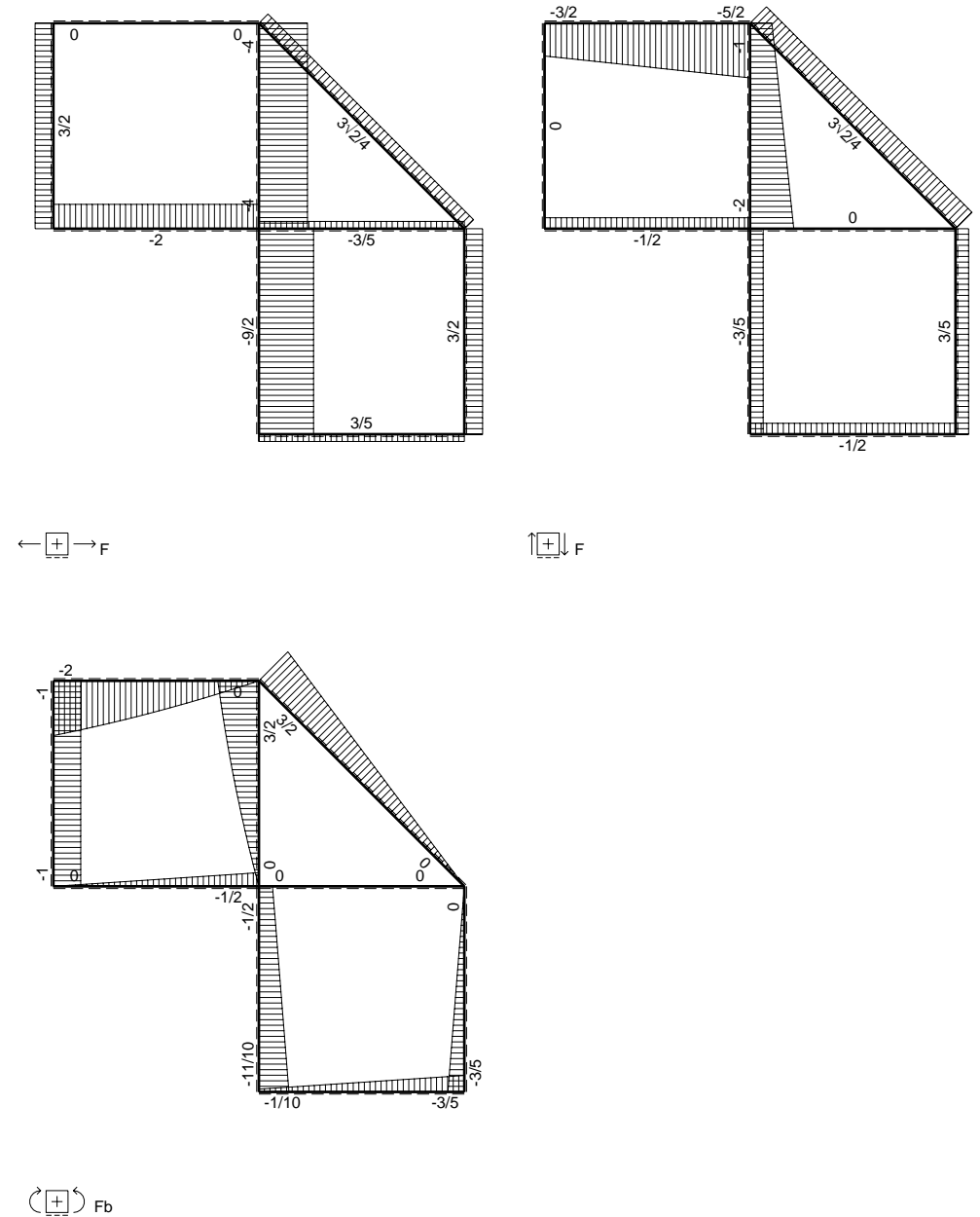
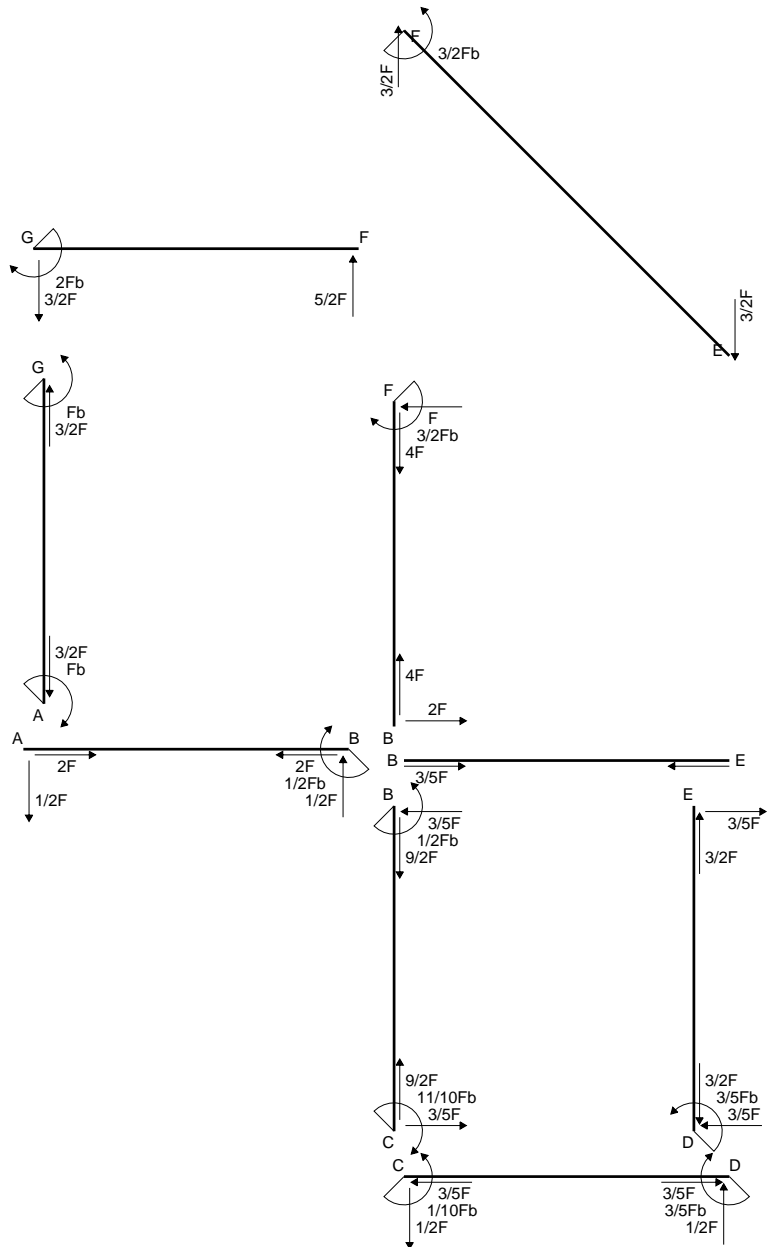
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ = 1/4 Fb^2/EJ$$

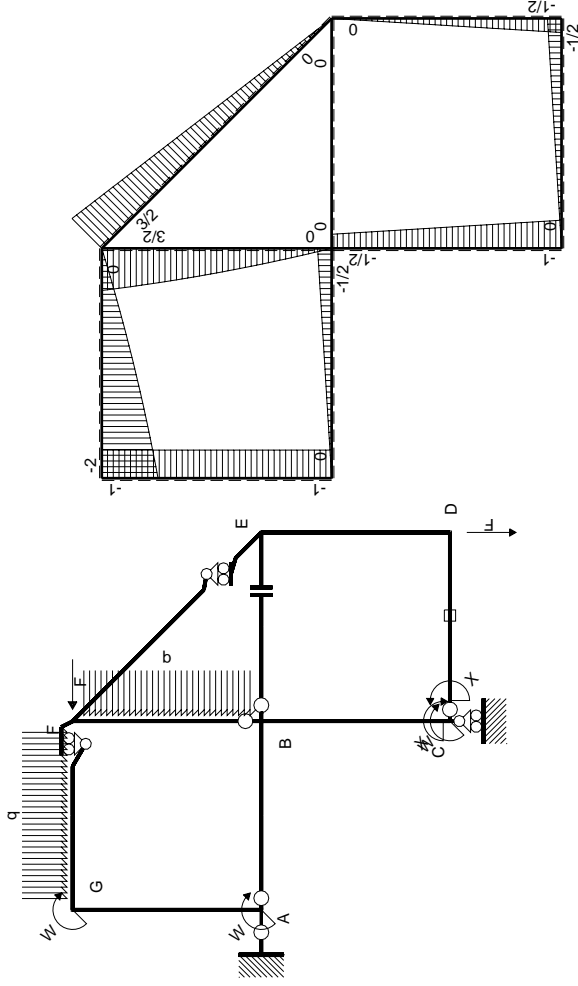
$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

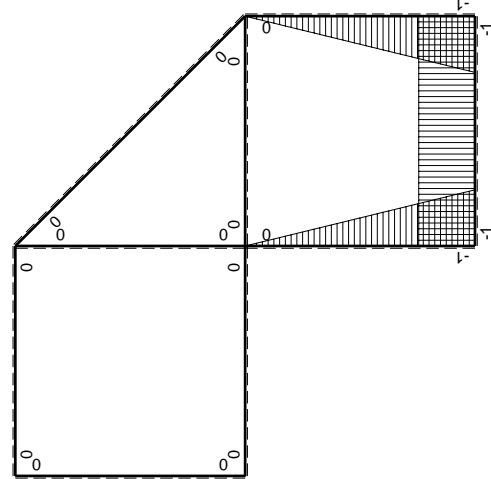
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

(+) M₀ flessione da carichi assegnati



(+) M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{CD}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M _x /EJdx
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0	0	0
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx ² /b	x ² /b ²	5/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/4Fb ² /EJ	Xb/EJ
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
DE b	-1+x/b	-1/2Fb+1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	3/2Fb-Fx-1/2qx ²	0	0	0	0
BF b	0	-2Fx+1/2qx ²	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
CD	elongazione asta N _{1,CD} ε _{CD} L _{CD}				-Fb ² /EJ	
	totali				-1/6Fb ² /EJ	5/3Xb/EJ
	iperstatica X=W _{CD}				1/10Fb	

Sviluppi di calcolo iperstatica

(+) M_x flessione da iperstatica X=1

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = [x]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = [x - x^2/b + 1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = [1/3 x^3/b^2]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

$$= (1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 - 1/2 x/b) \cdot Fb \cdot 1/EJ \, dx + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = [1/2 x - 1/4 x^2/b]_0^b \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ$$

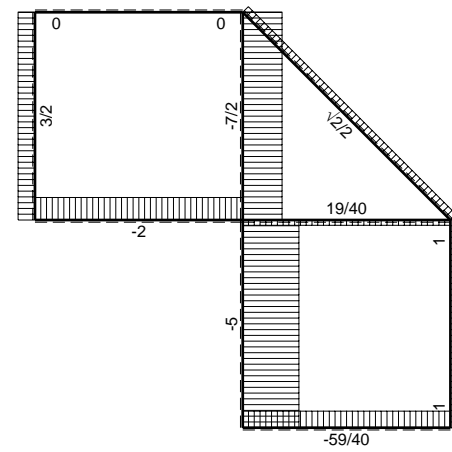
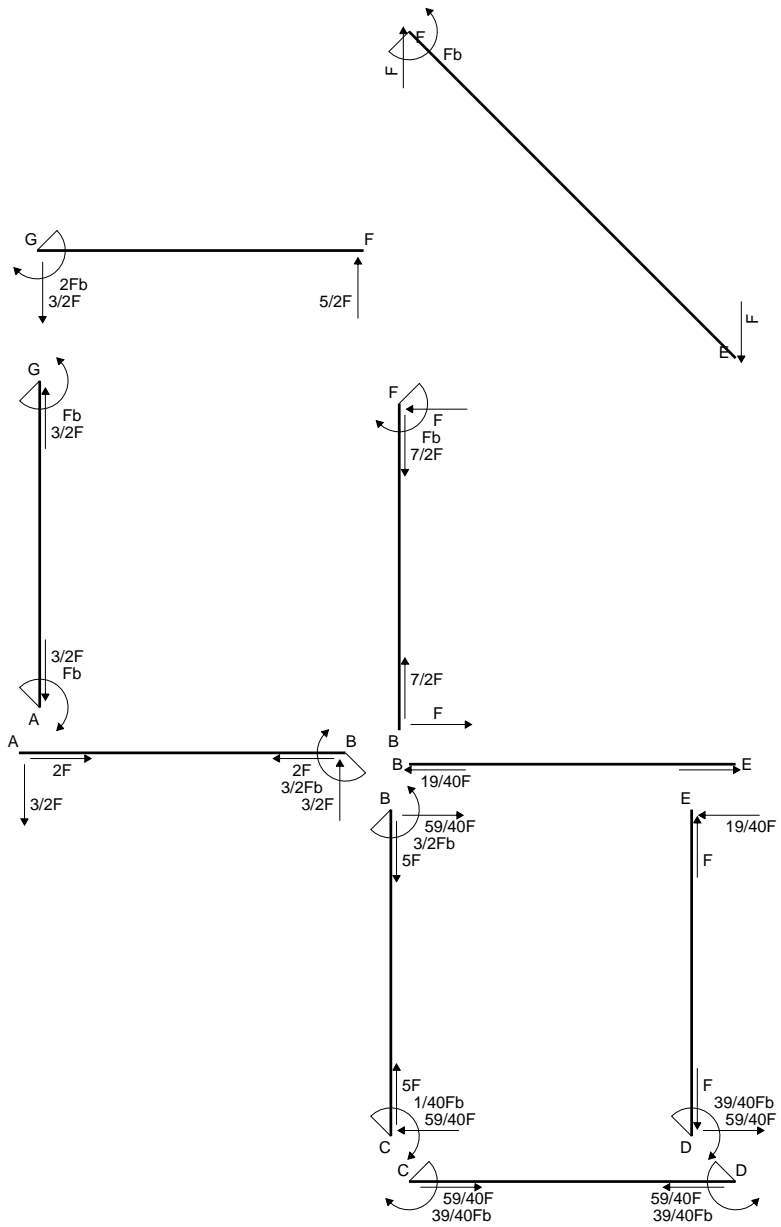
$$= (1/2 b - 1/4 b) \cdot Fb \cdot 1/EJ + 1 \cdot (-1) \cdot 1 \cdot Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

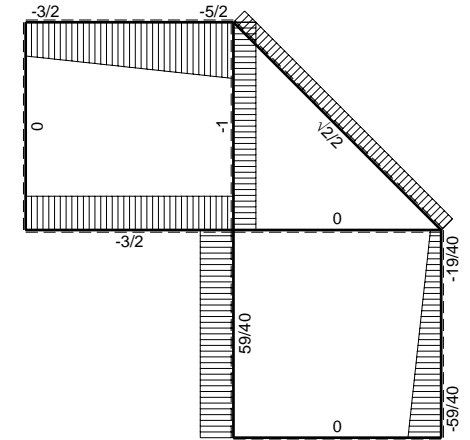
$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = [1/6 x^3/b^2]_0^b \cdot Fb \cdot 1/EJ$$

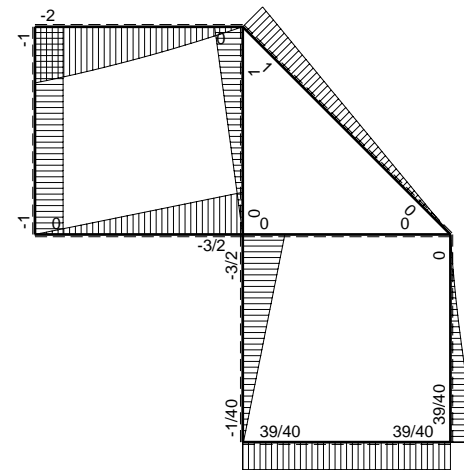
$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 Fb^2/EJ$$



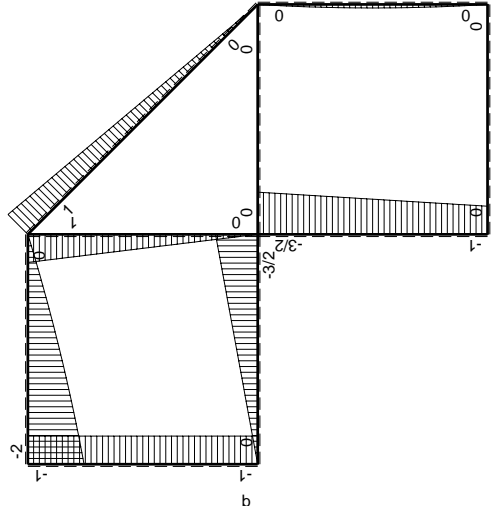
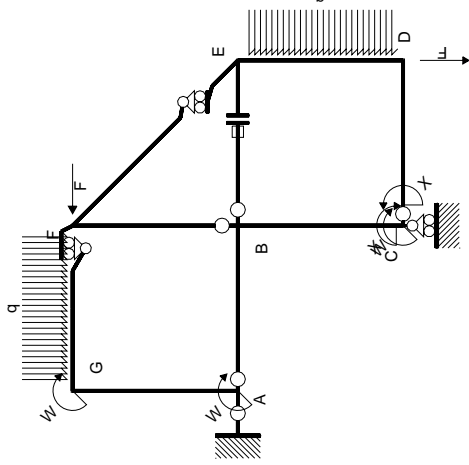
← ⊕ → F



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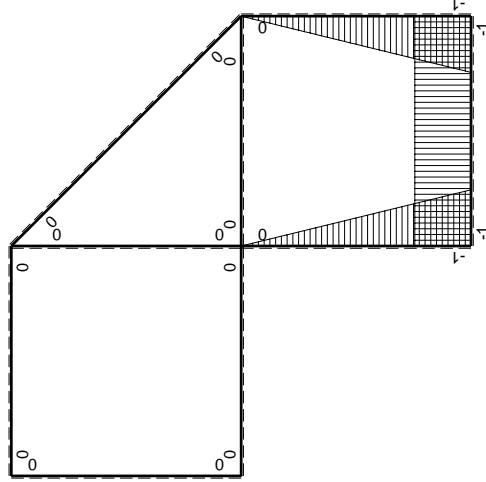


⊕ ⊖ F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



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

Quadro contribuiti PLV per iperstatica $X=W_{cd}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0	0	0
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx ² /b	x ² /b ²	7/12Fb ² /EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	0	Xb/EJ
CD b	-1	0	0	1	0	0
DC b	1	0	0	1	0	0
DE b	-1+x/b	-1/2Fx+1/2qx ²	1/2Fx-Fx ² /b+1/2qx ³ /b	1-2x/b+x ² /b ²	1/24Fb ² /EJ	1/3Xb/EJ
ED b	x/b	1/2Fx-1/2qx ²	1/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
EF $\sqrt{2}b$	0	$\sqrt{2}2Fx$	0	0	0	0
FG b	0	-5/2Fx+1/2qx ²	0	0	0	0
GF b	0	2Fb-3/2Fx-1/2qx ²	0	0	0	0
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0	0	0
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0	0	0
BE b	0	0	0	0	0	0
EB b	0	0	0	0	0	0
BE	elongazione asta $N_{1, BE} \epsilon_{BE} L_{BE}$				Fb ² /EJ	
	totali				13/8Fb ² /EJ	5/3Xb/EJ
	iperstatica $X=W_{cd}$				-39/40Fb	

Sviluppi di calcolo iperstatica

$$L_{BC}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{DE}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{ED}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1 - 1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [x - 1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 1/4 b - 1/6 b) Fb 1/EJ = 7/12 Fb^2/EJ$$

$$L_{DE}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{ED}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

