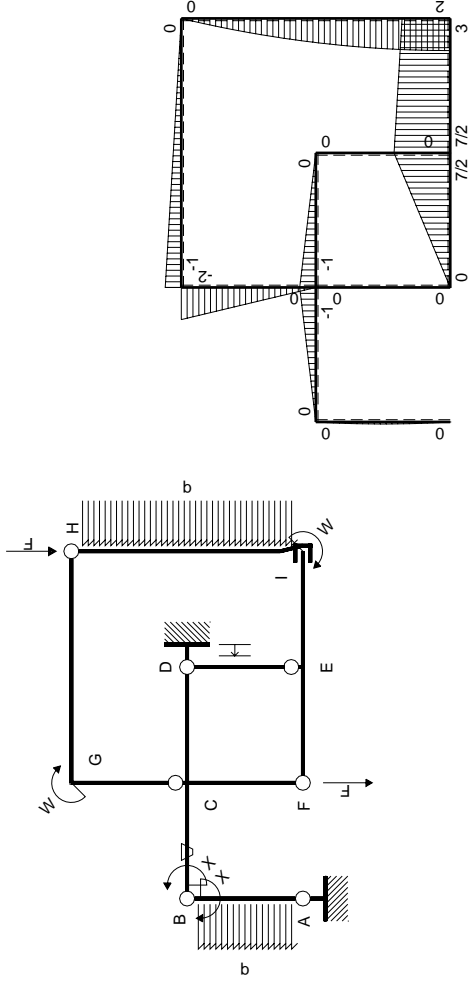
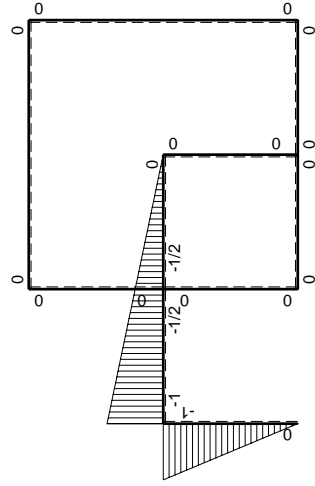


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$7/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-7/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

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

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

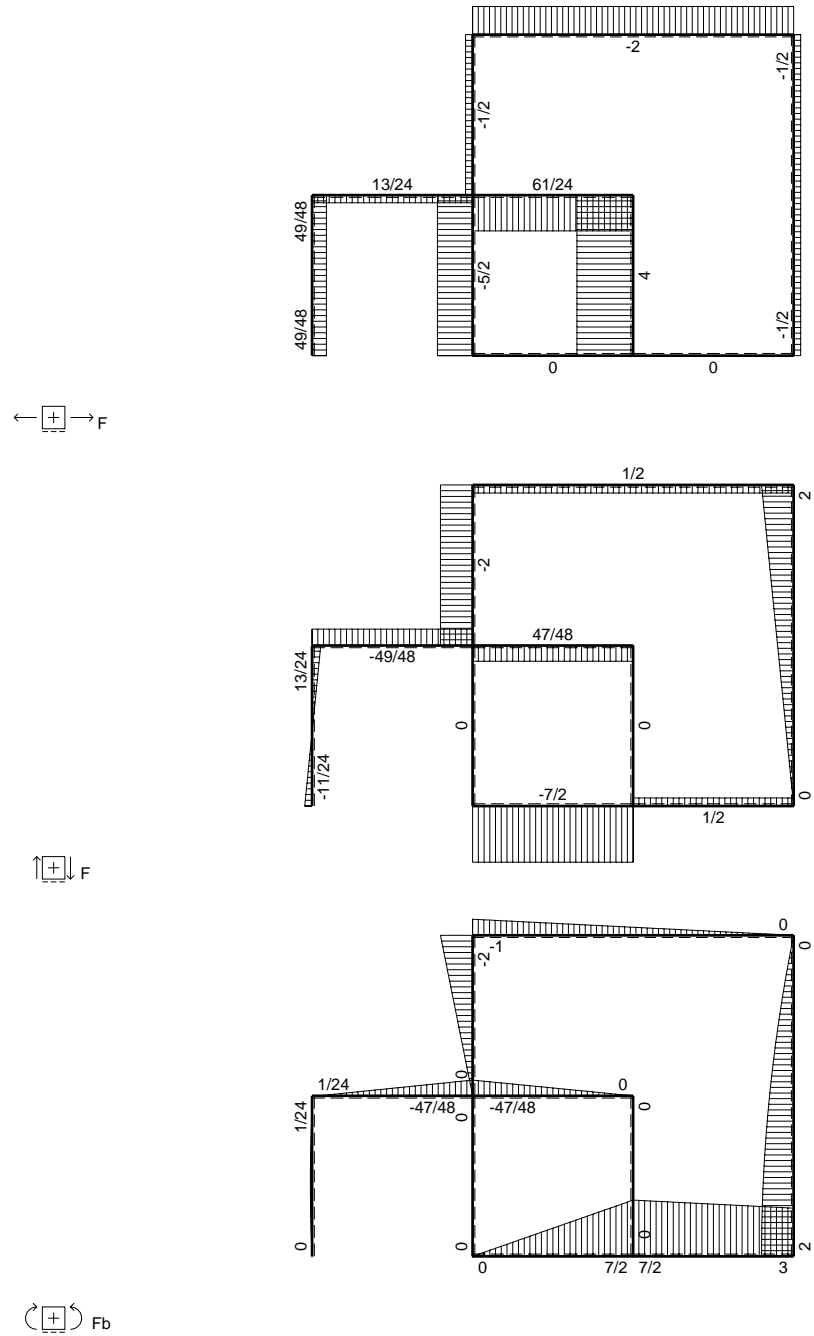
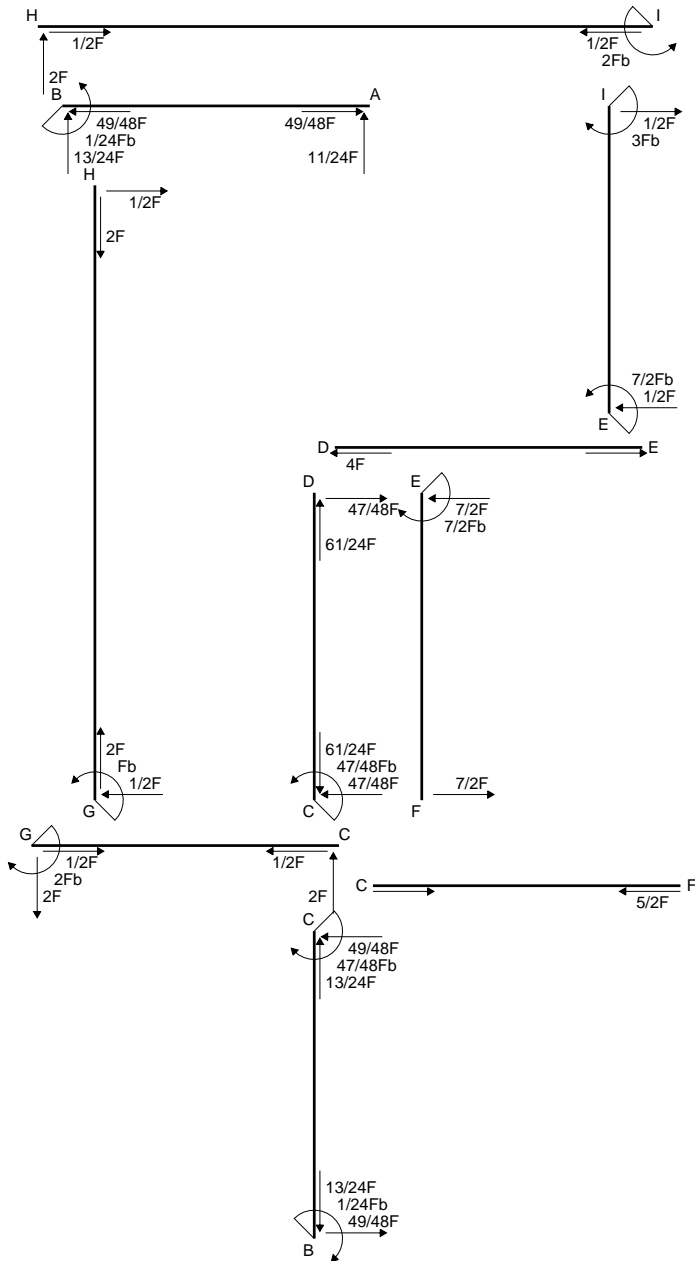
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

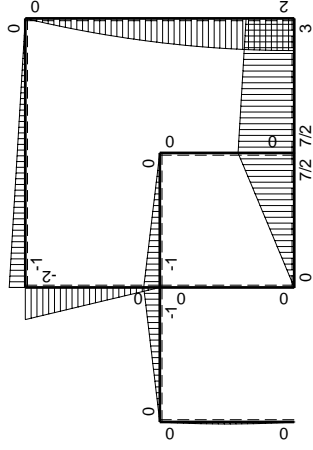
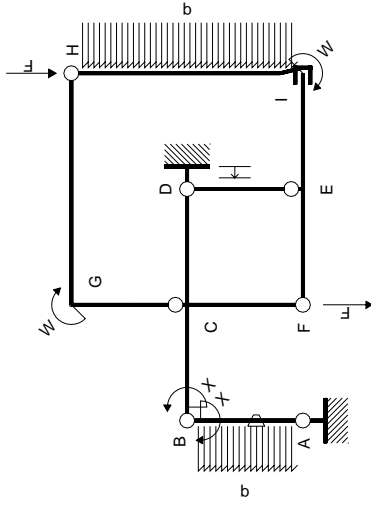
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

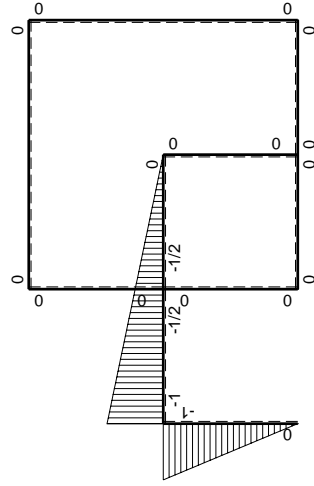
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$		
	totali						$1/24Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-1/24Fb$		

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

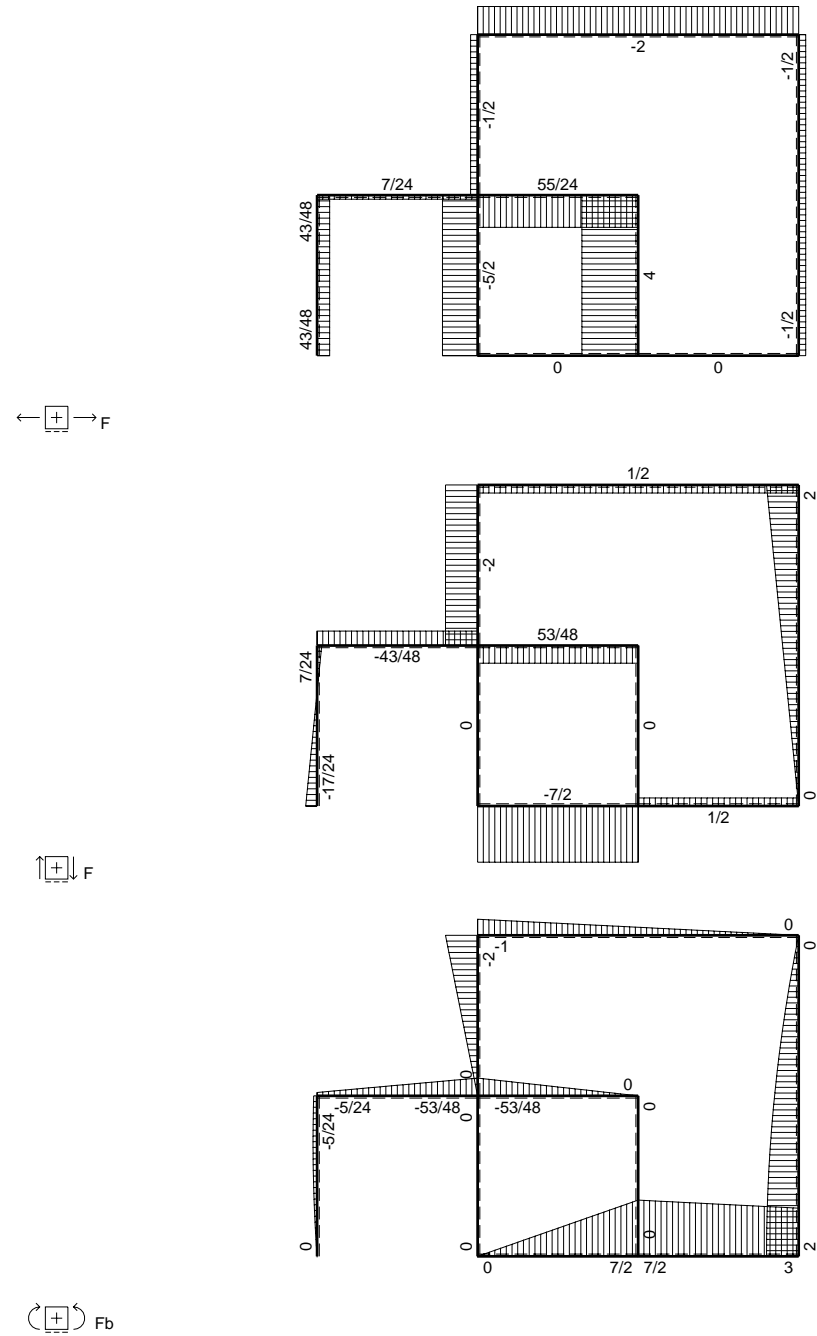
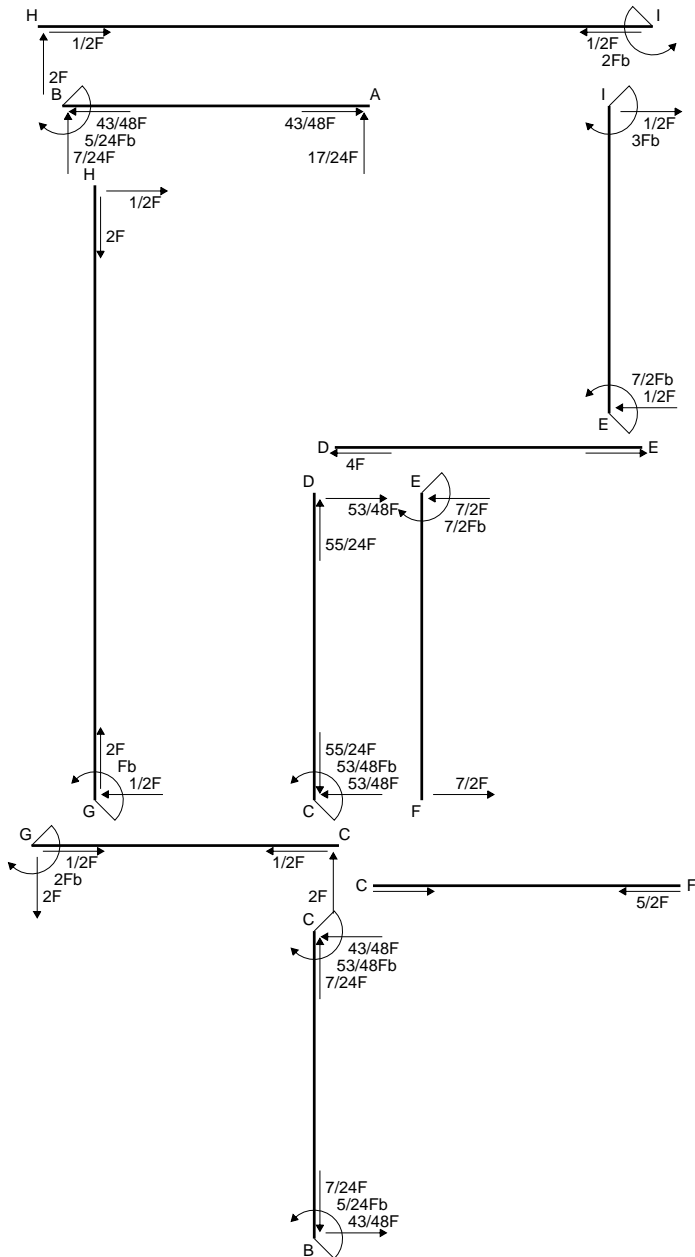
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

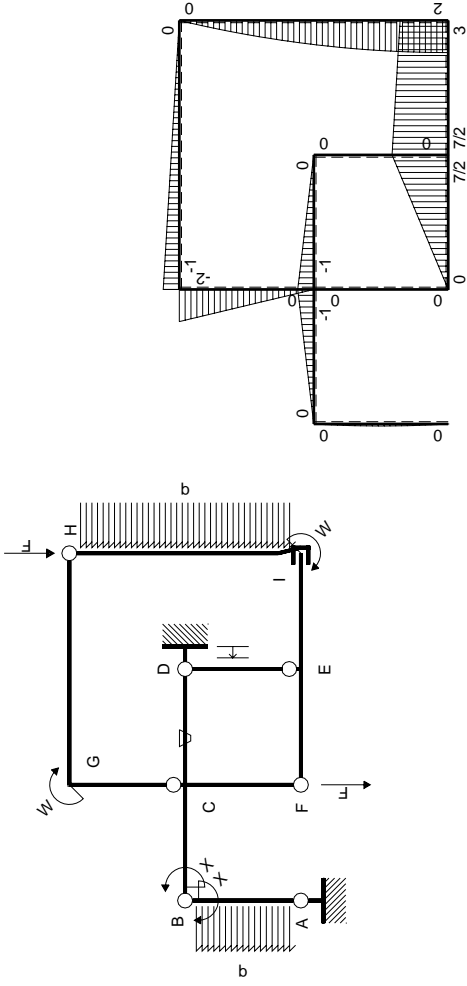
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

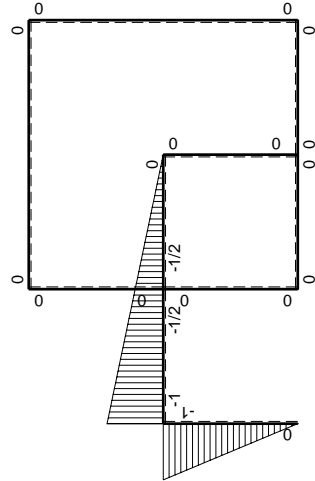
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0
FE b	0	$-7/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-5/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$5/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

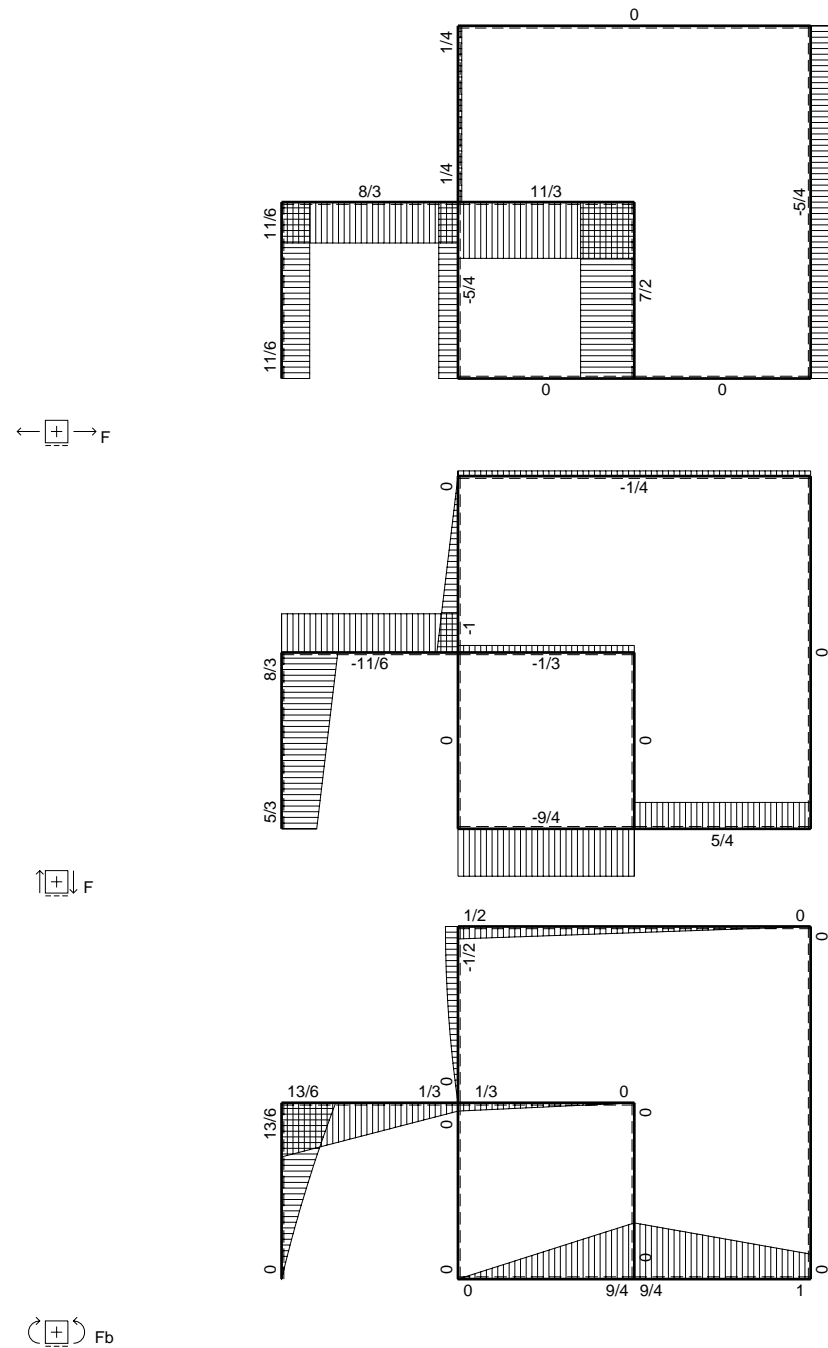
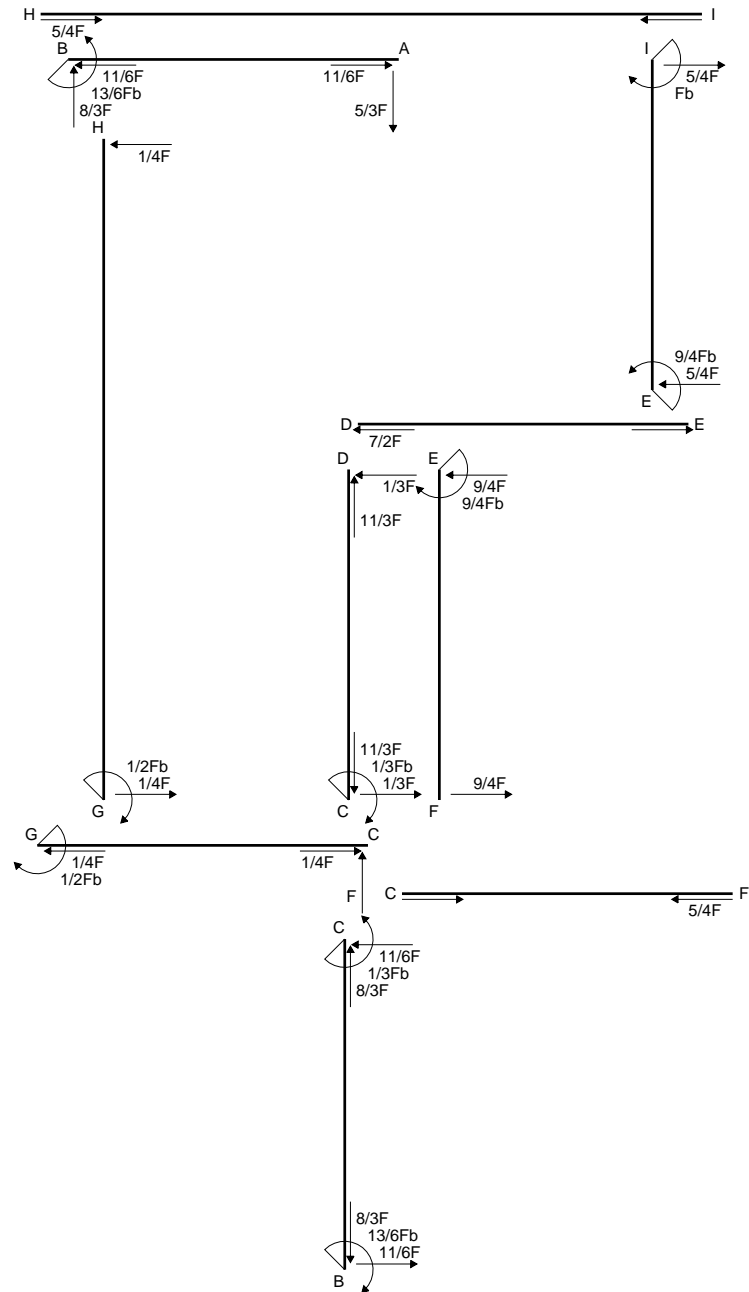
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

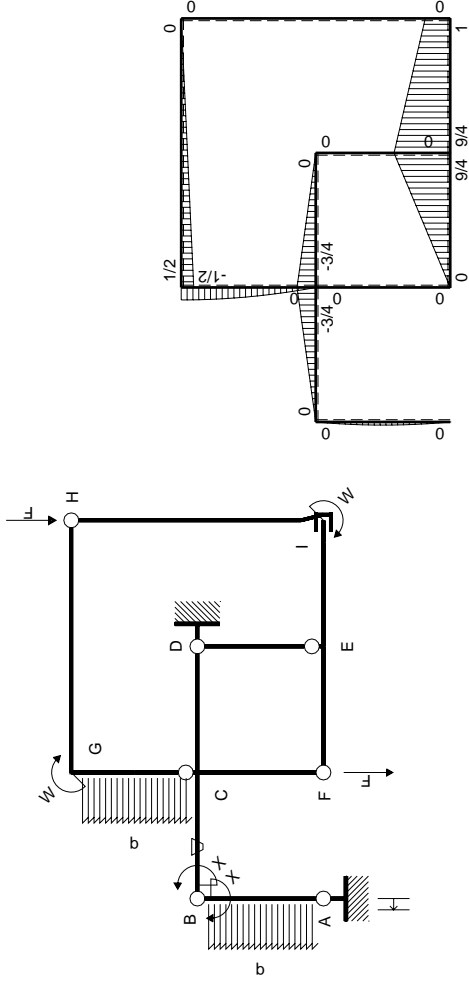
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

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

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

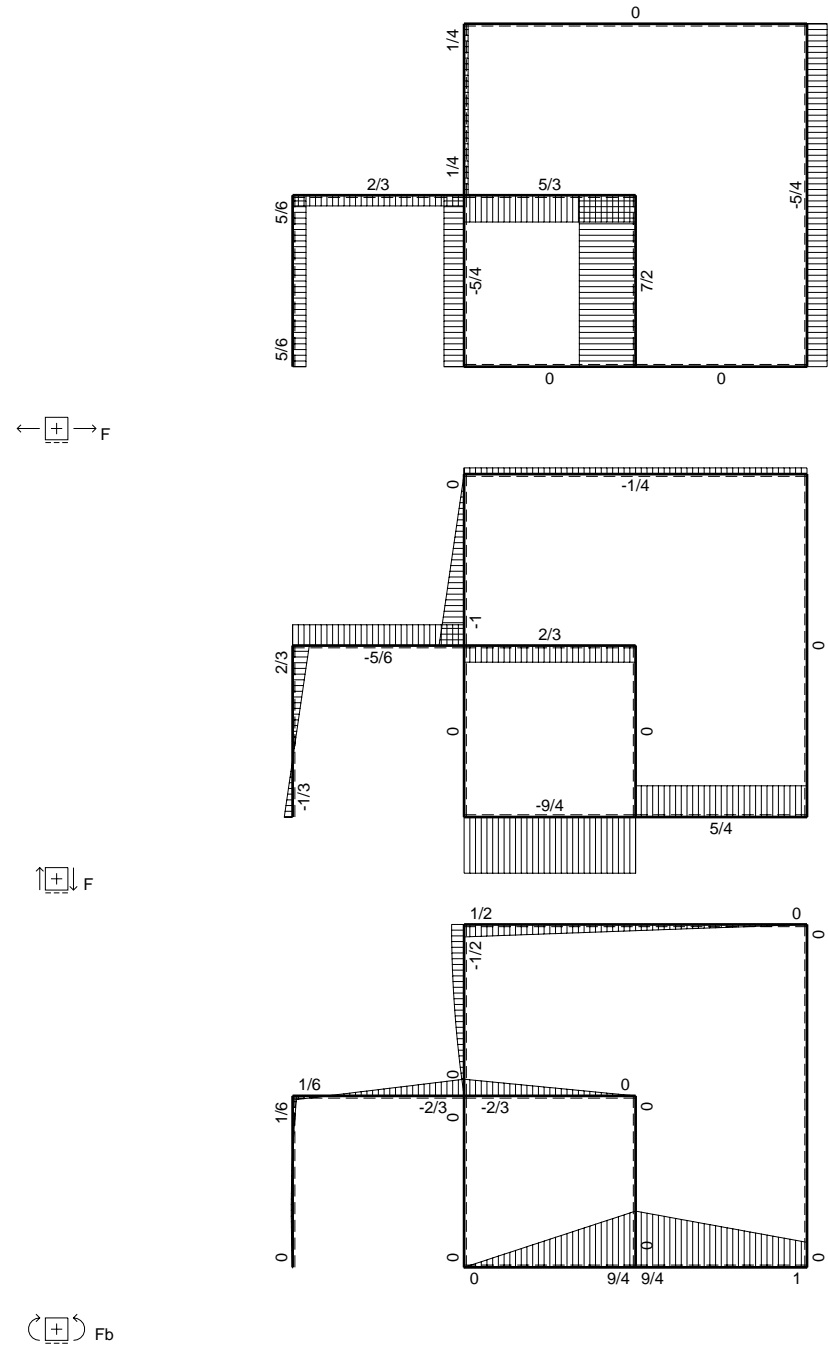
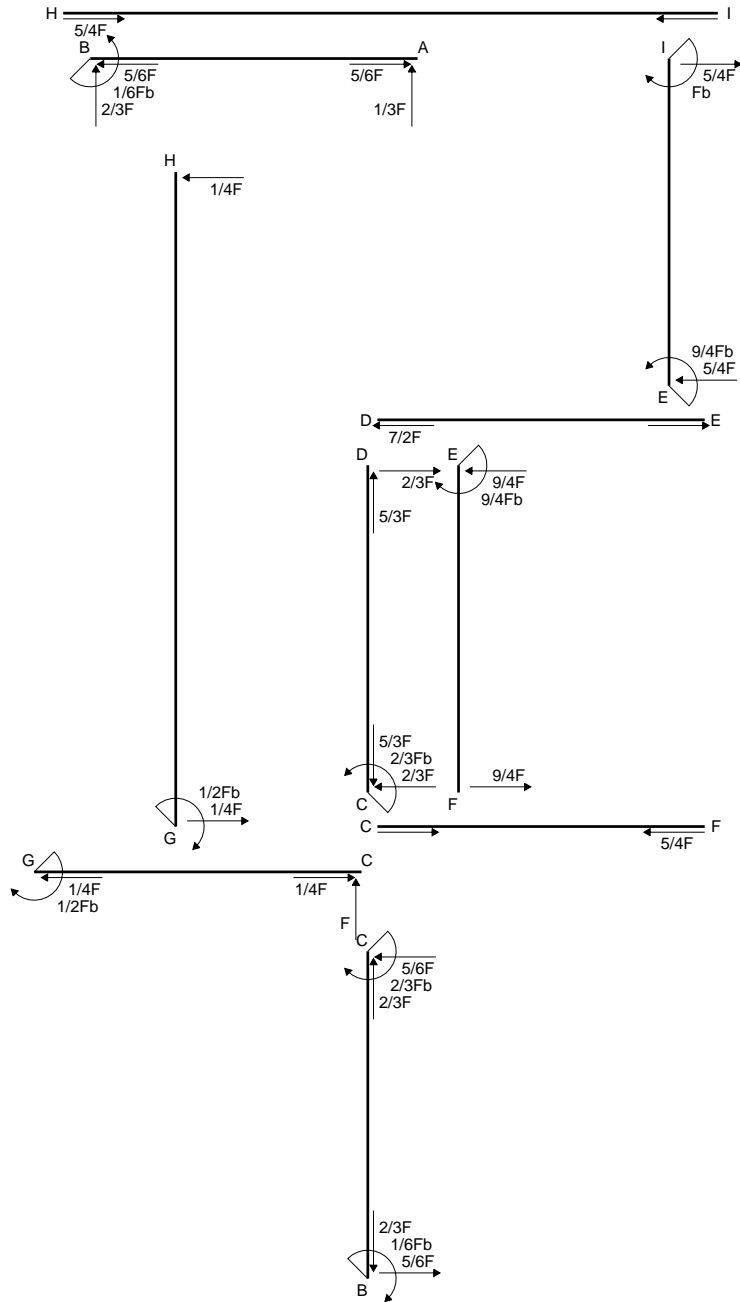
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

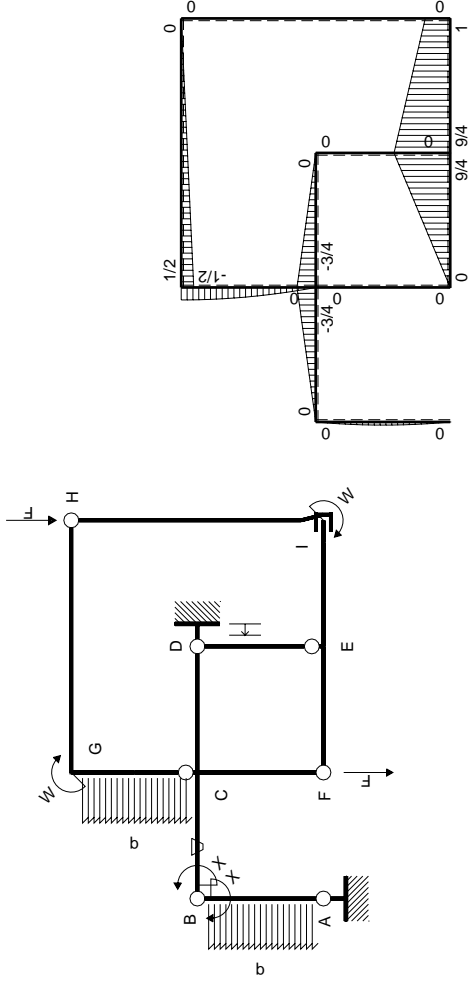
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

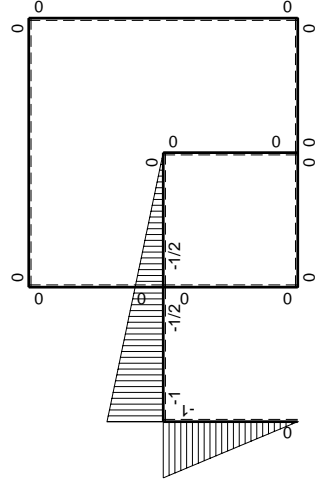
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

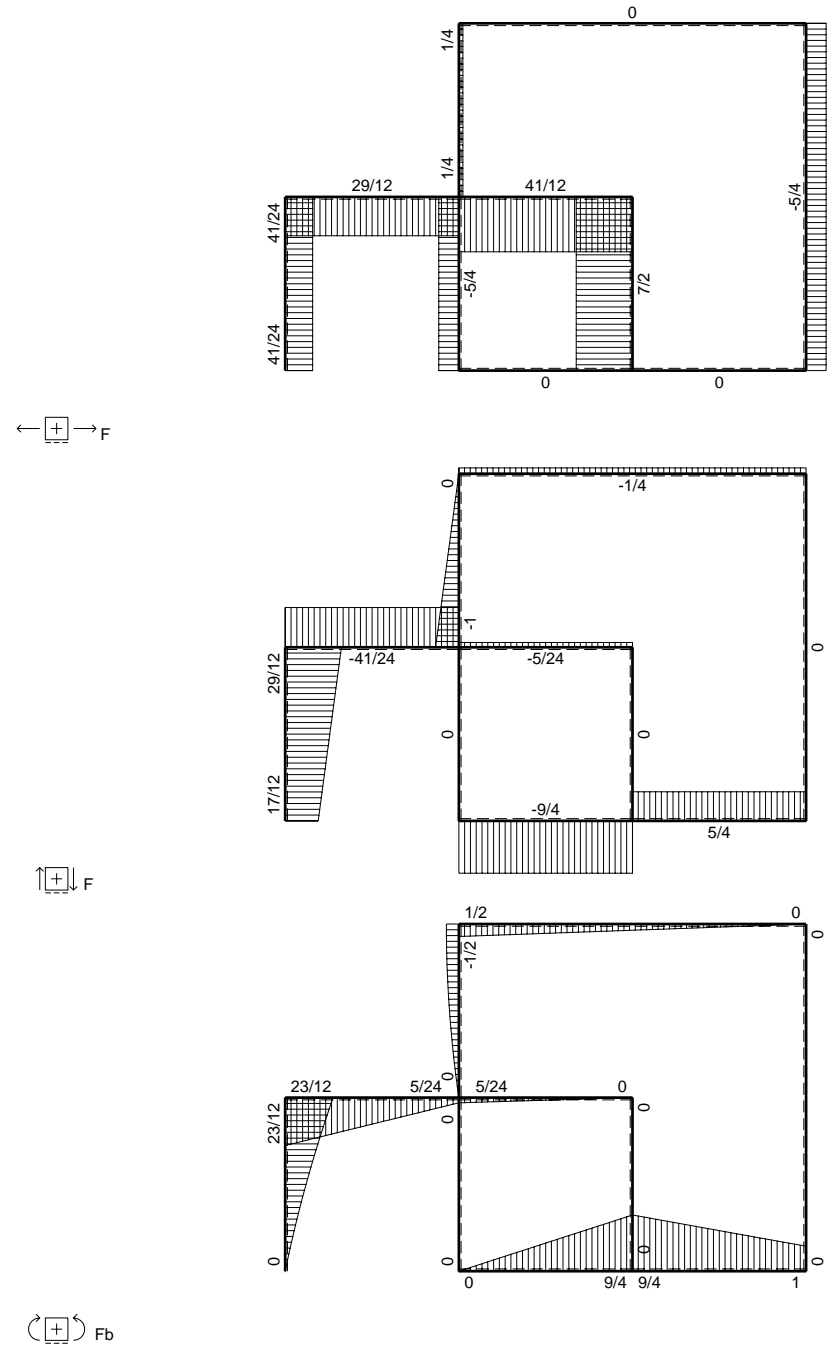
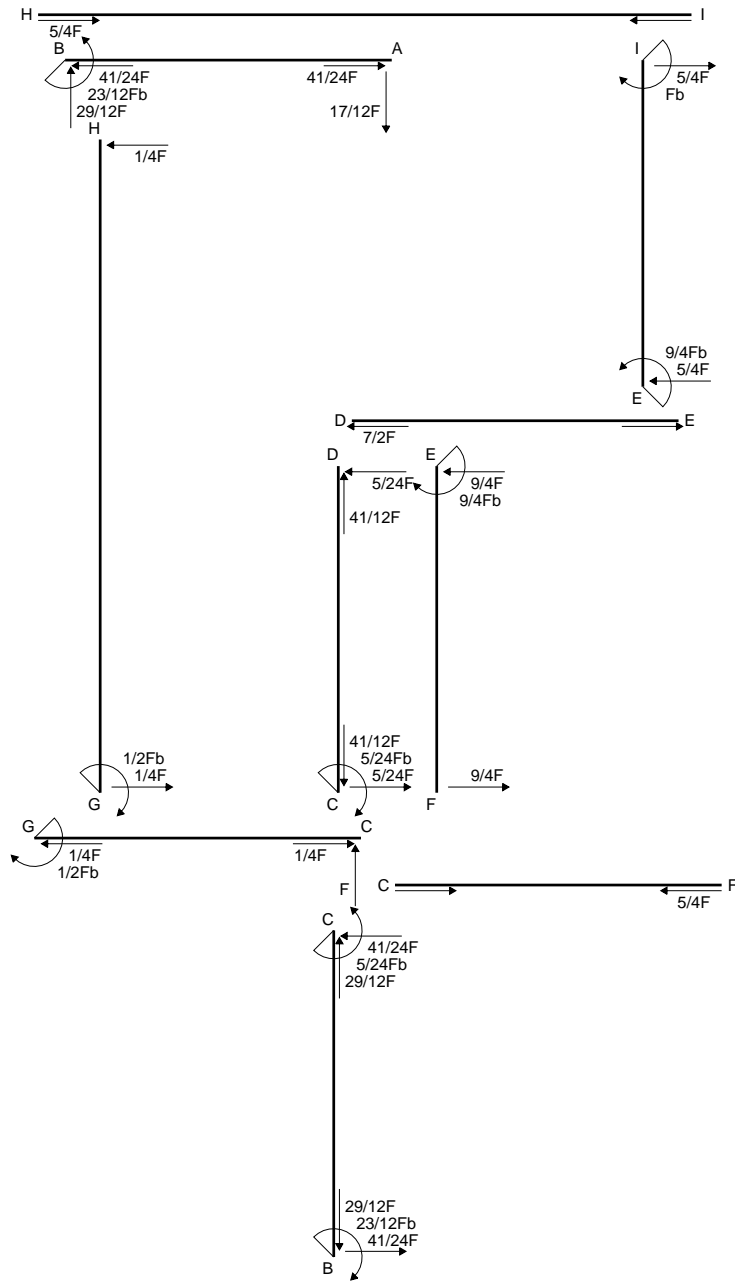
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

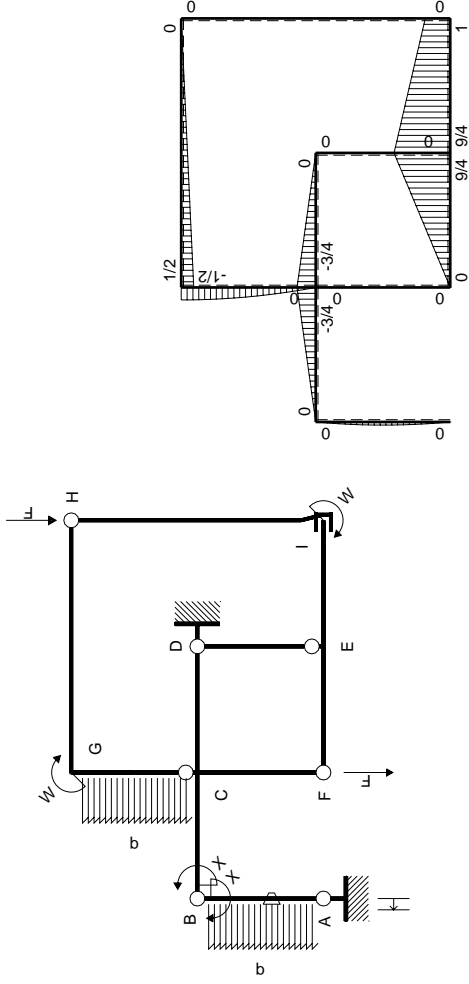
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

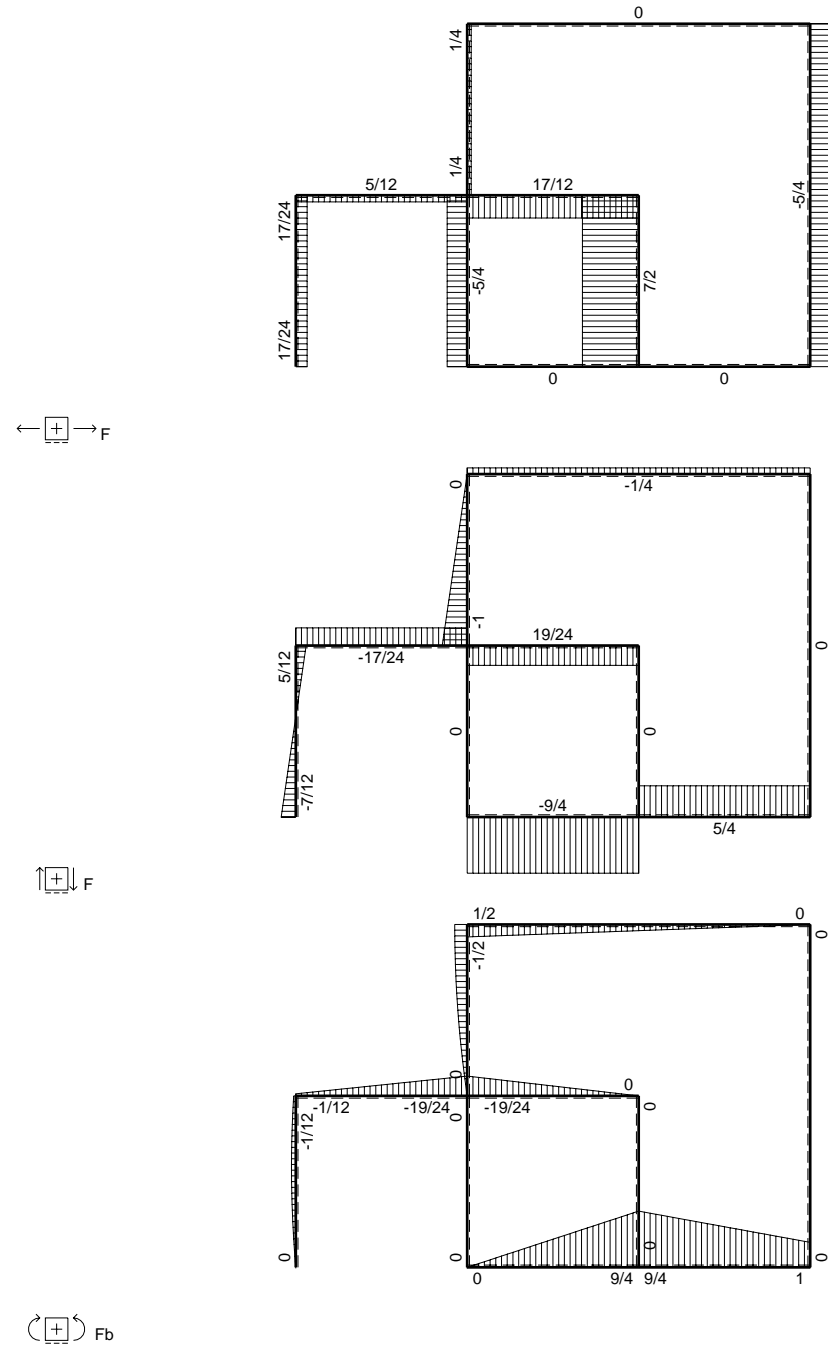
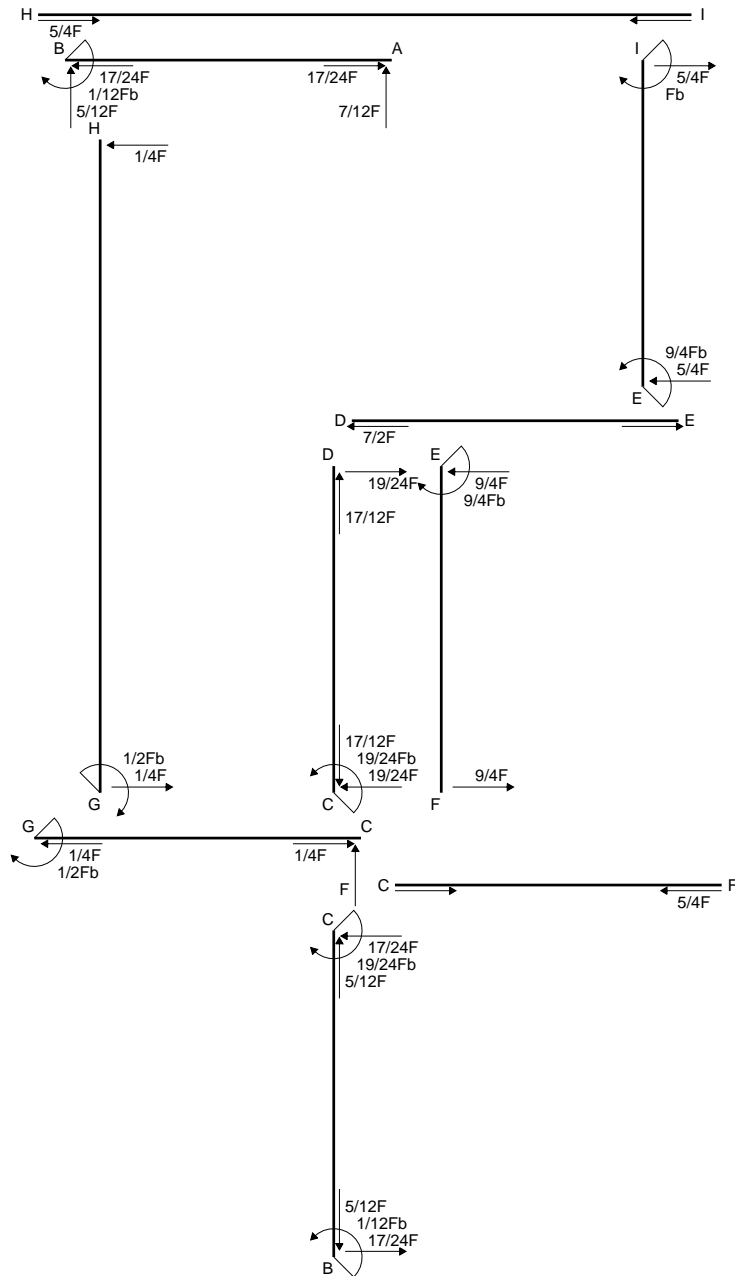
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

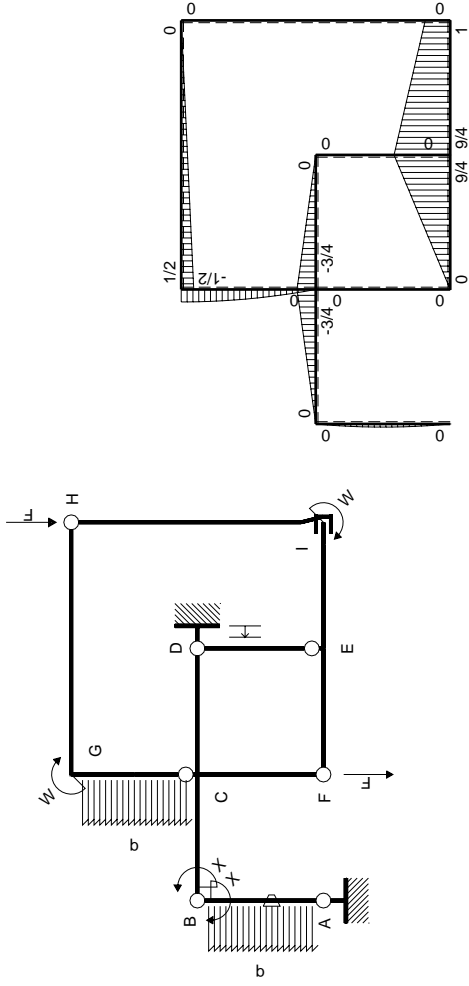
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

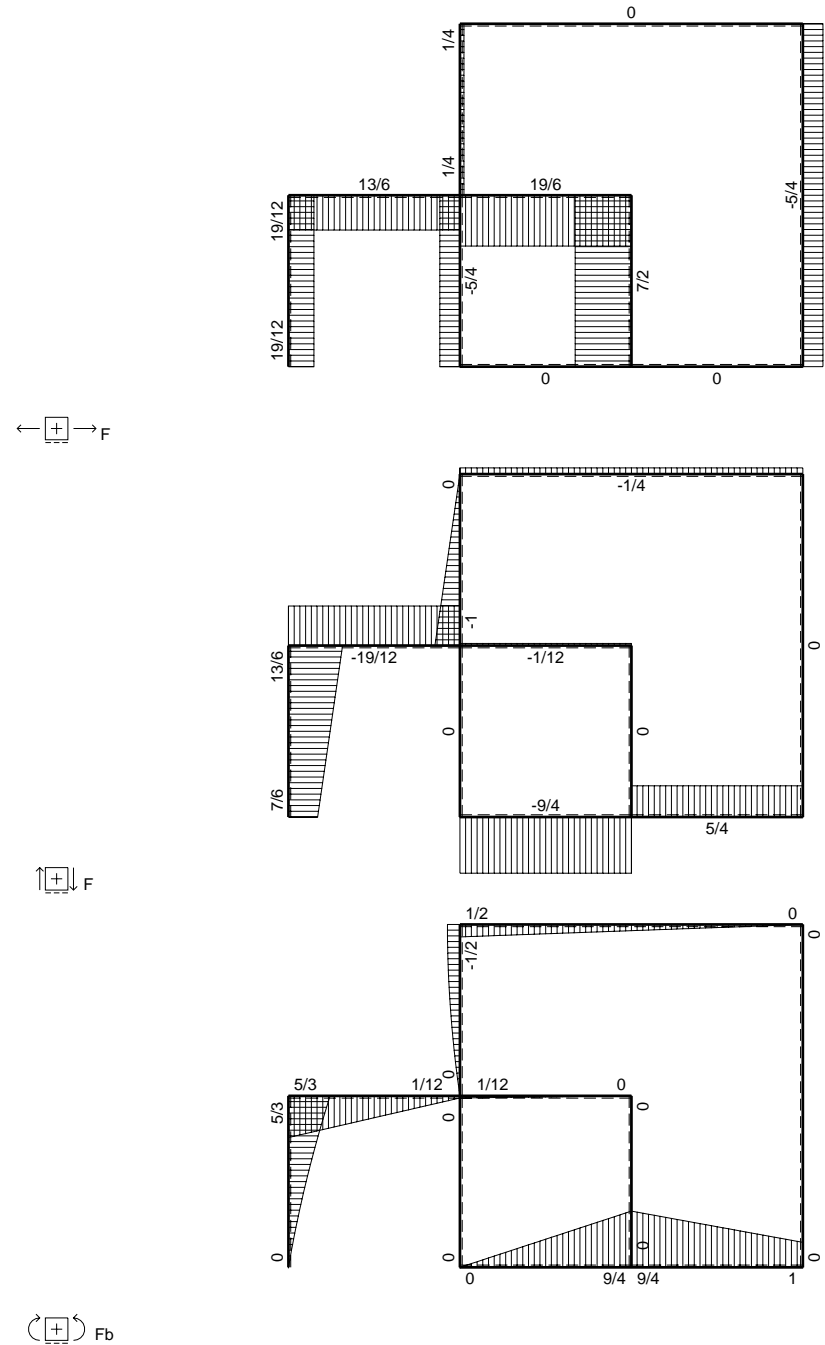
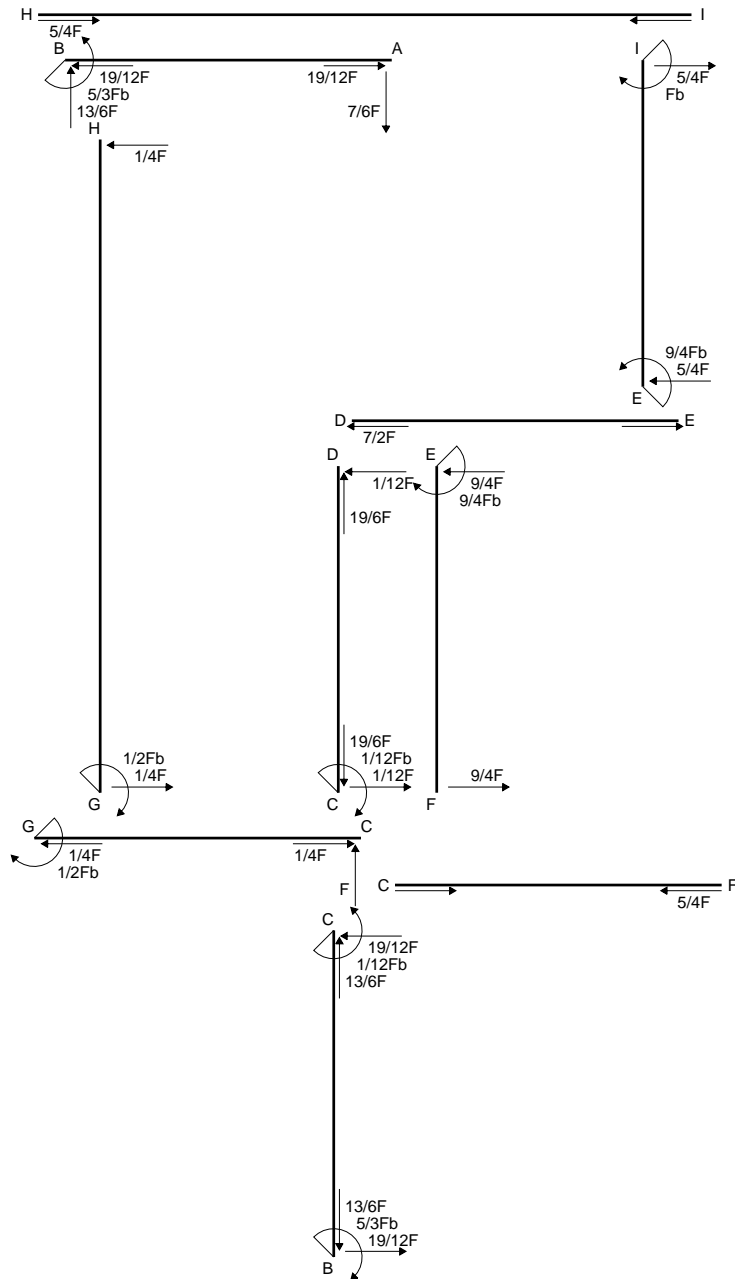
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

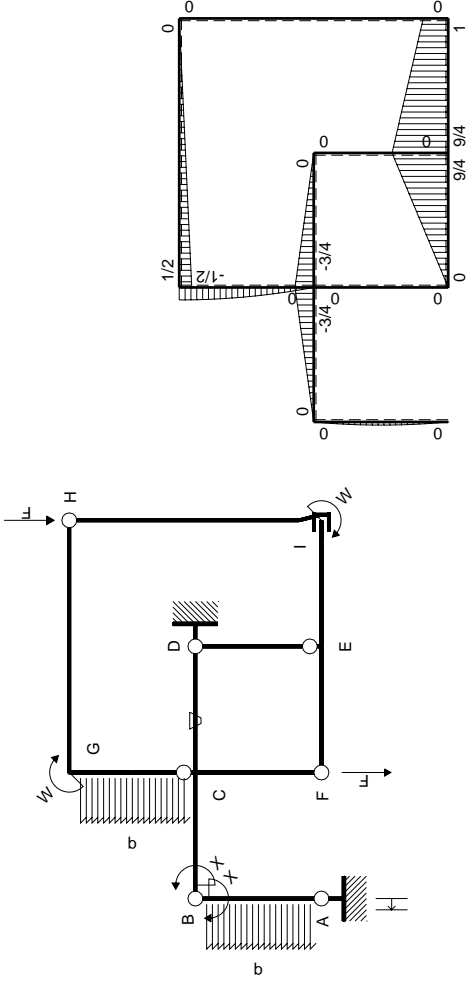
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-5/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

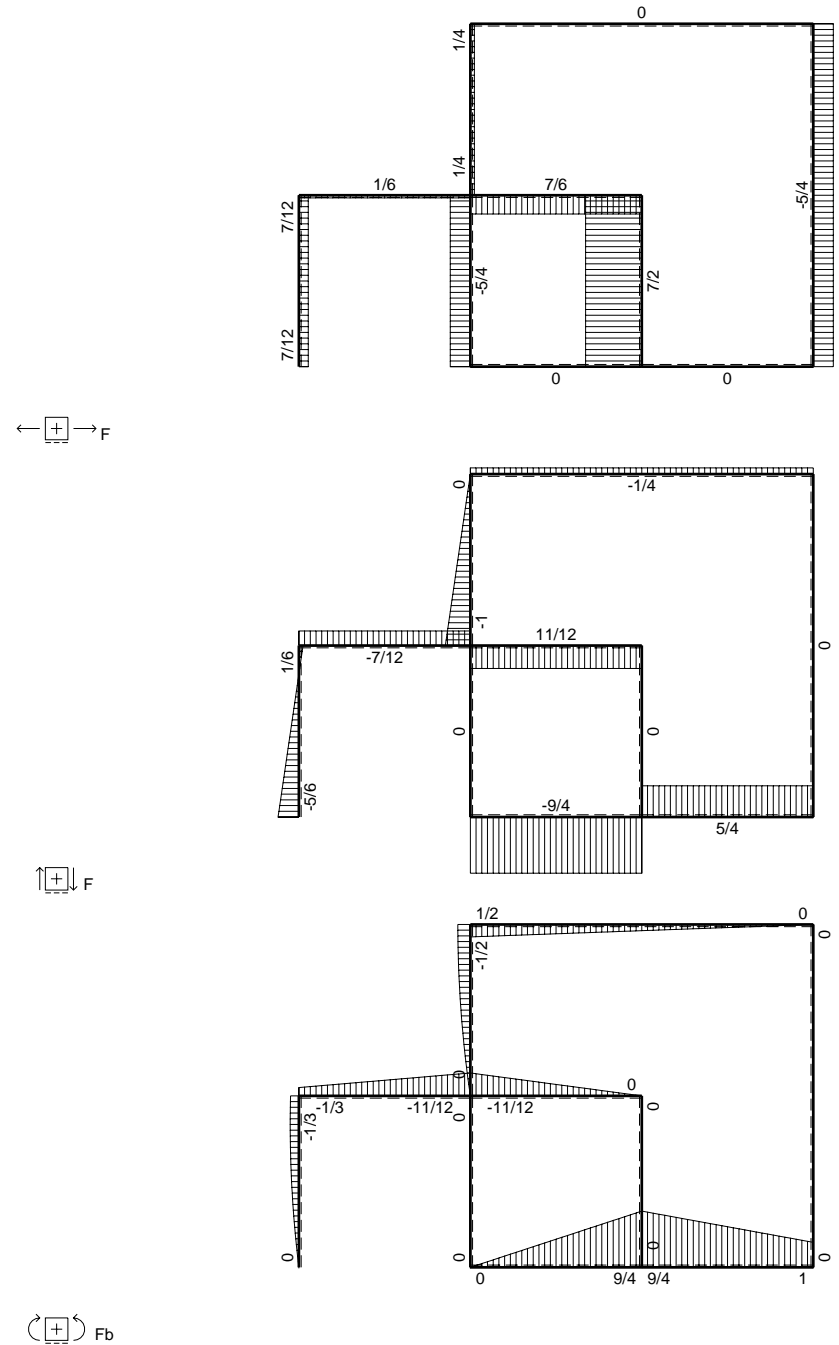
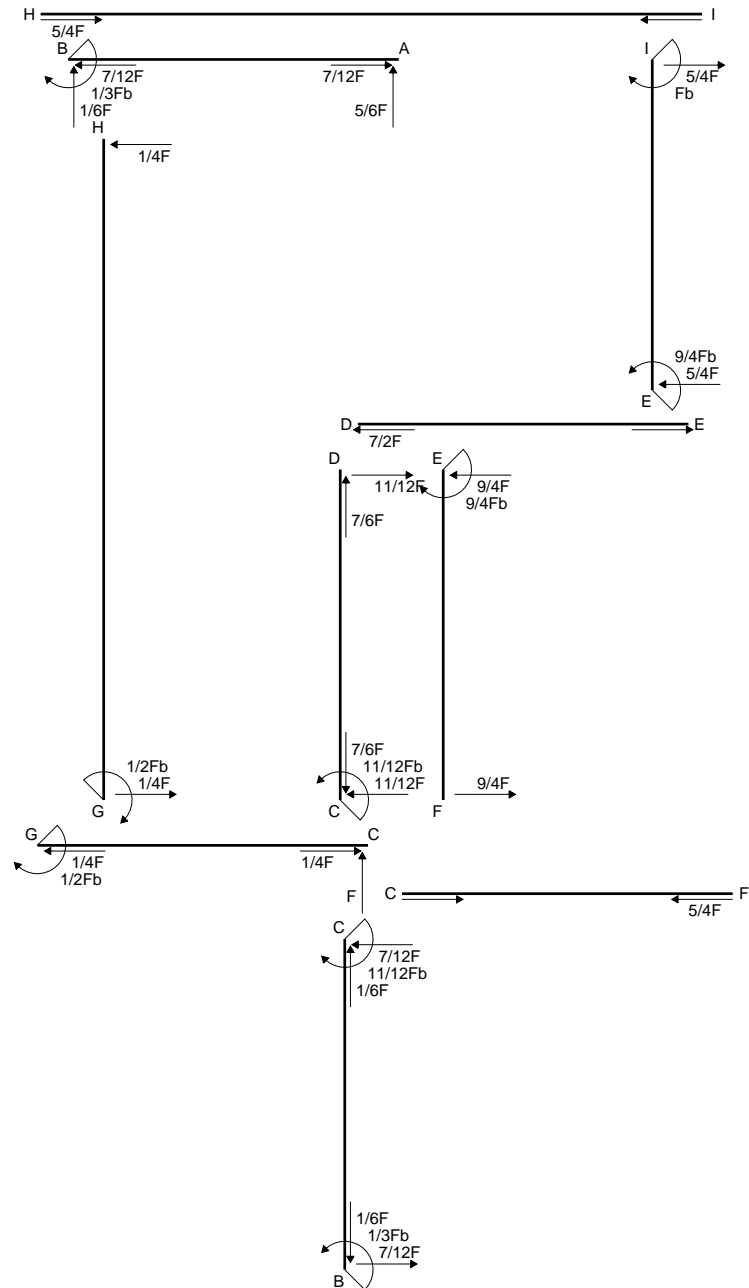
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

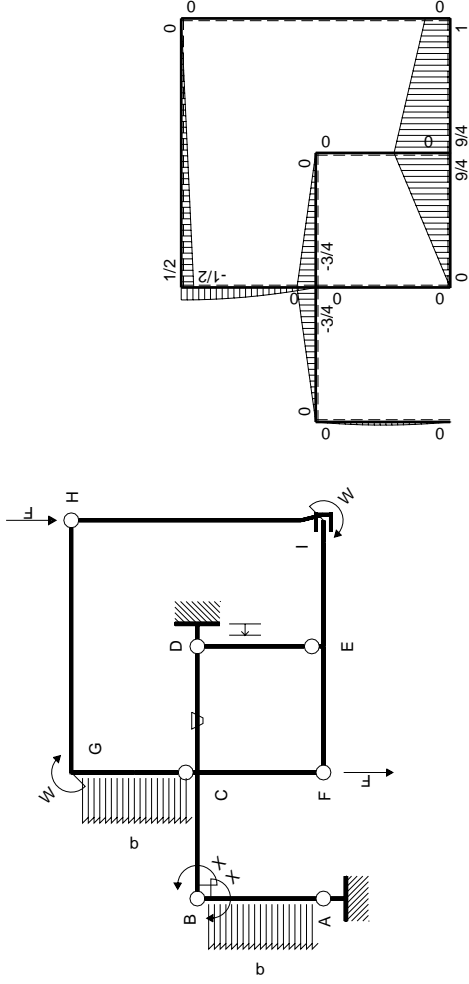
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

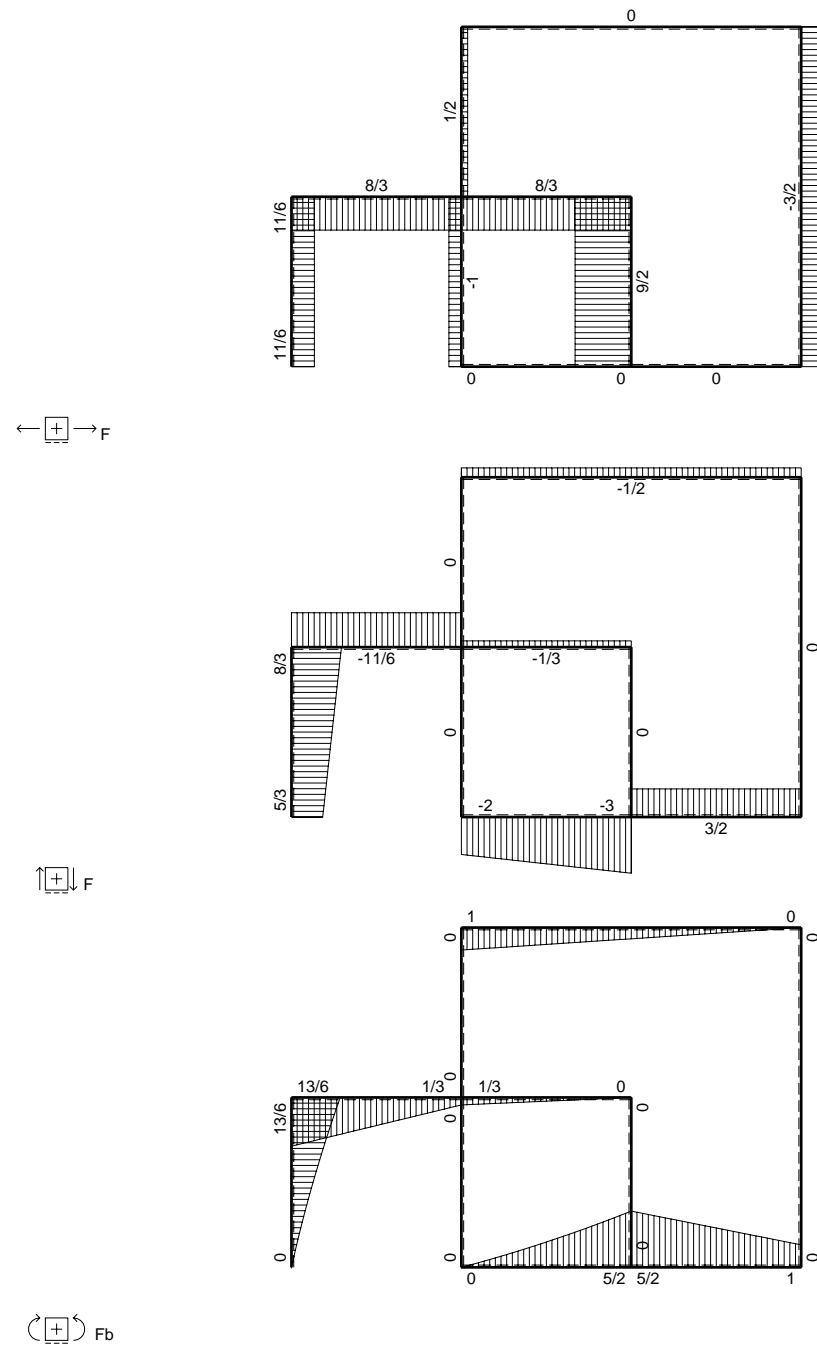
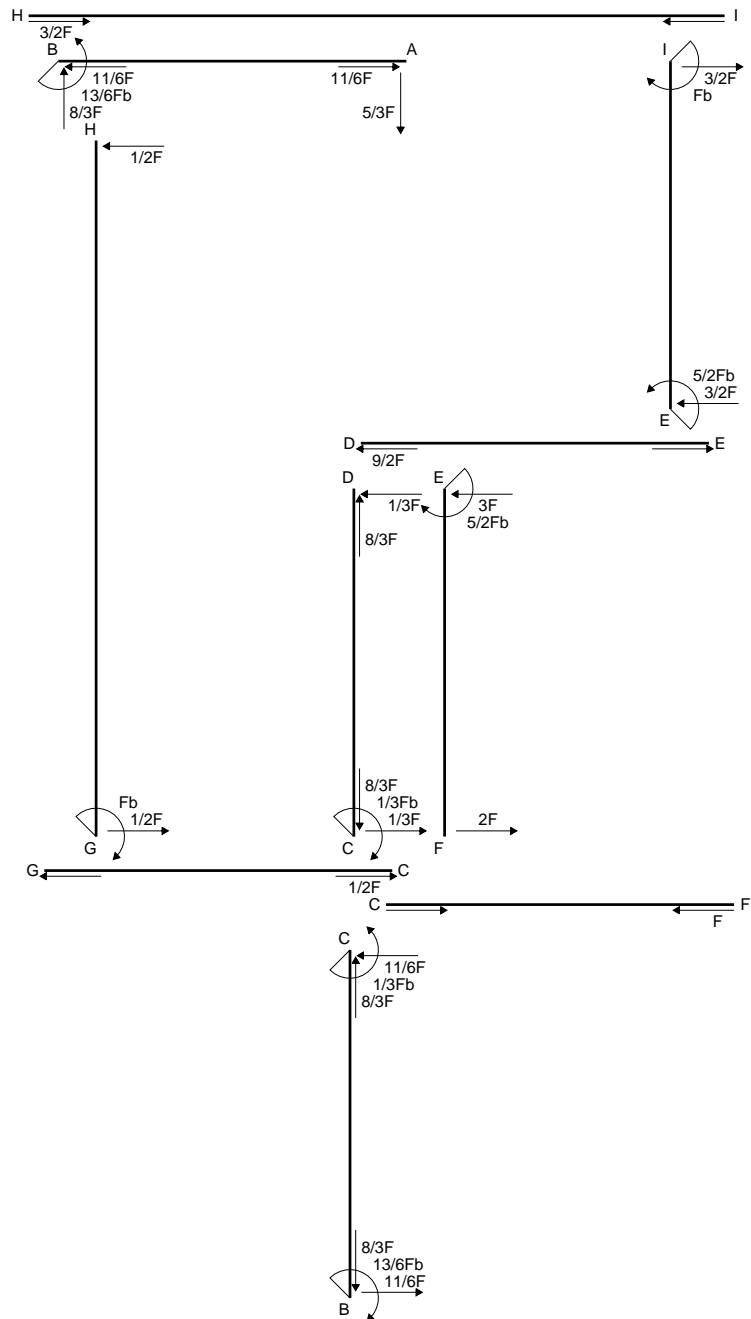
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

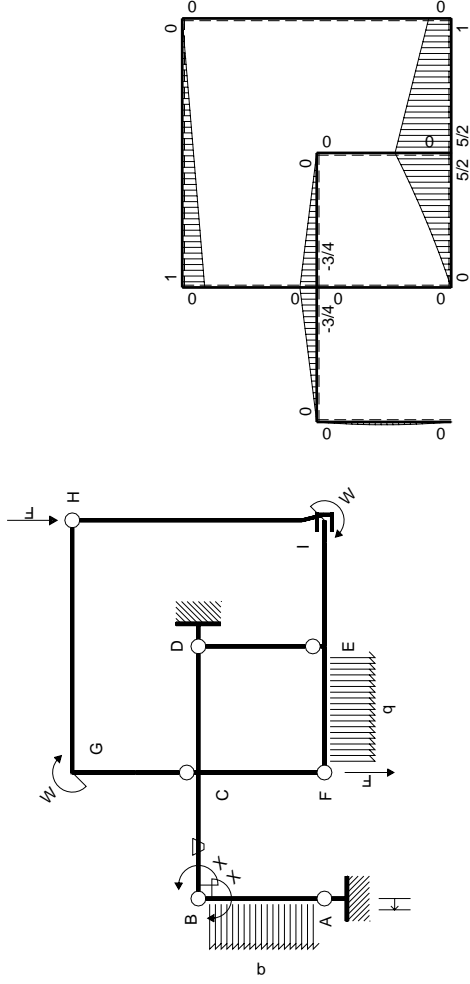
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

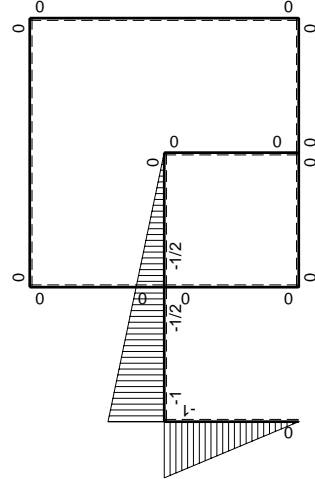
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

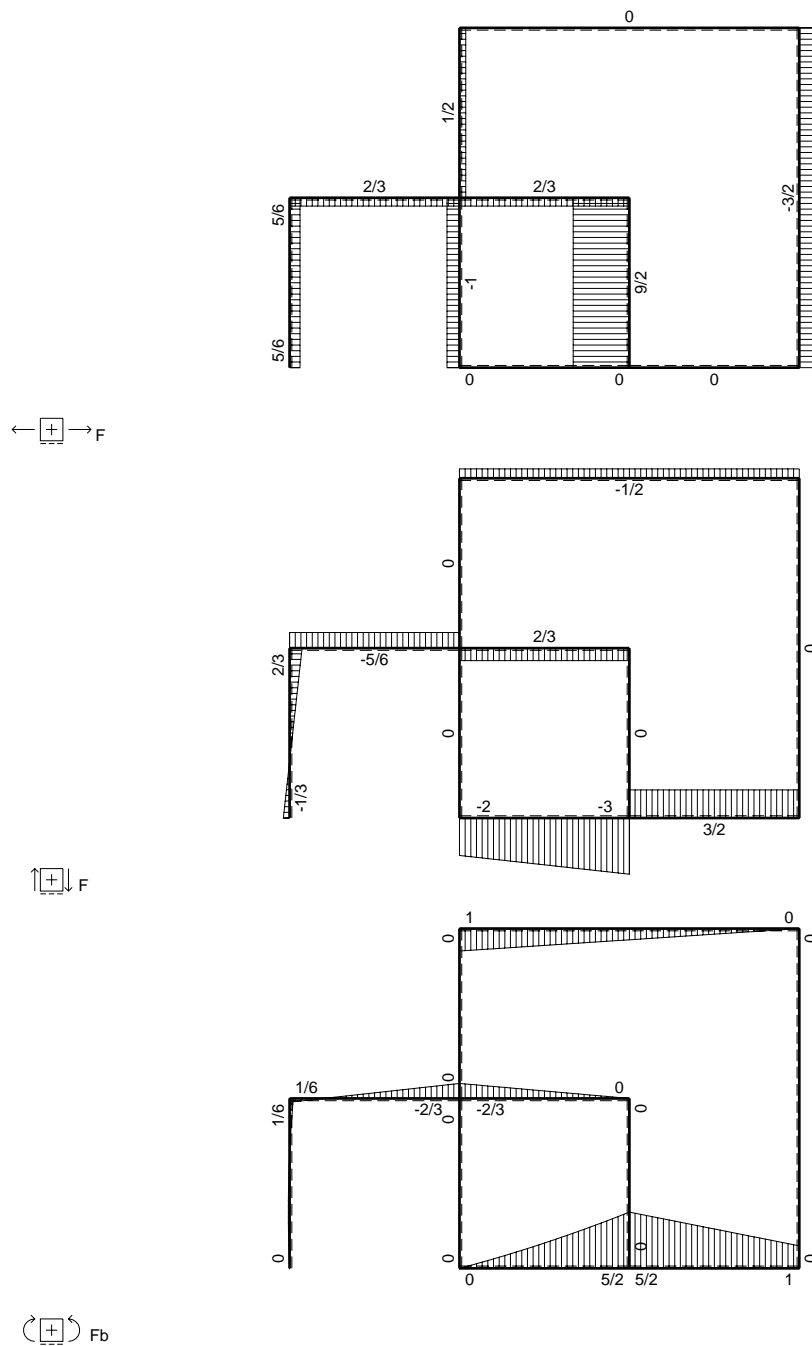
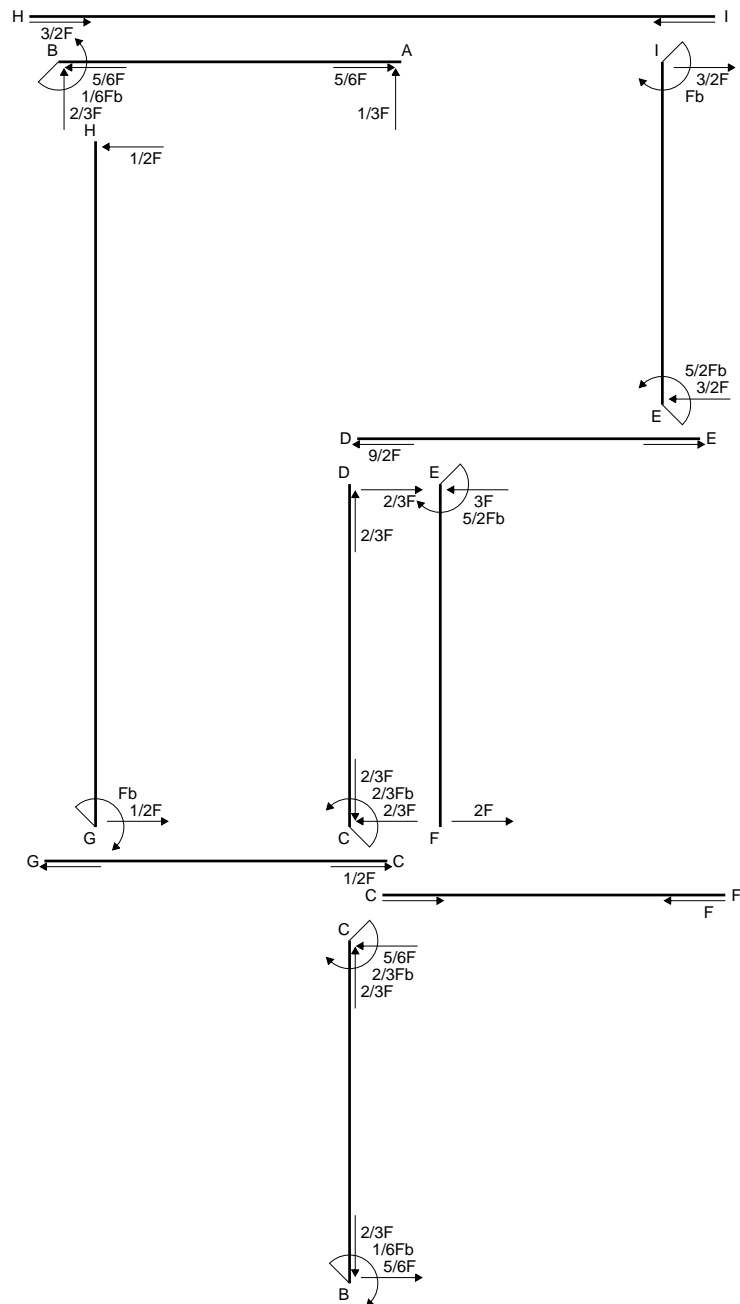
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

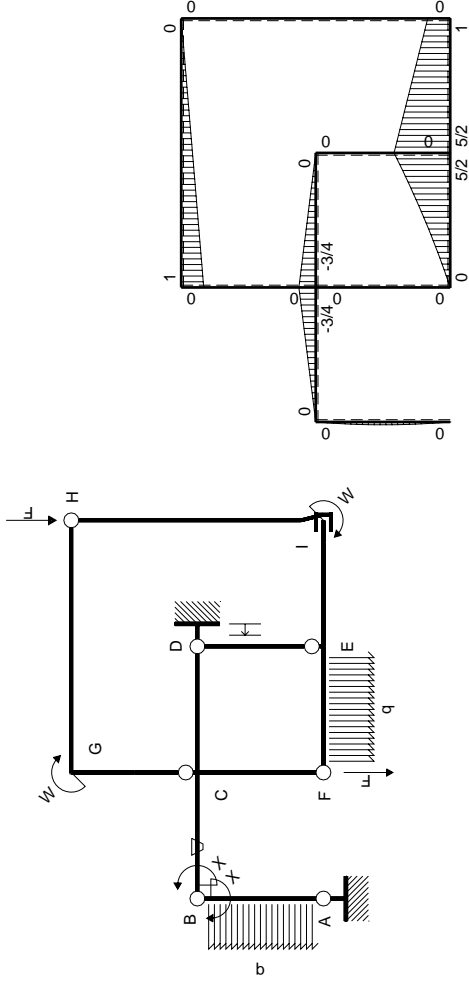
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

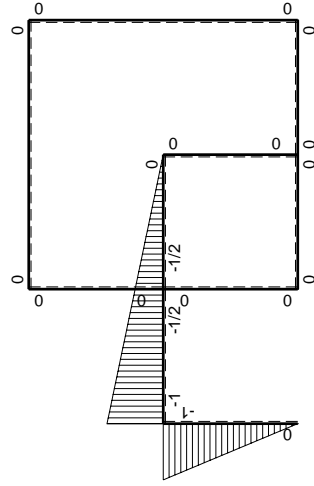
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0			
ED b	0	0	0	0	0	0	0+0	0	
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0			
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0	0+0	0	
FC b	0	0	0	0	0	0			
CF b	0	0	0	0	0	0	0+0	0	
CG b	0	0	0	0	0	0			
GC b	0	0	0	0	0	0	0+0	0	
GH 2b	0	$Fb-1/2Fx$	0	0	0	0			
HG 2b	0	$-1/2Fx$	0	0	0	0	0+0	0	
HI 2b	0	0	0	0	0	0			
IH 2b	0	0	0	0	0	0	0+0	0	
IE b	0	$Fb+3/2Fx$	0	0	0	0			
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0	0+0	0	
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

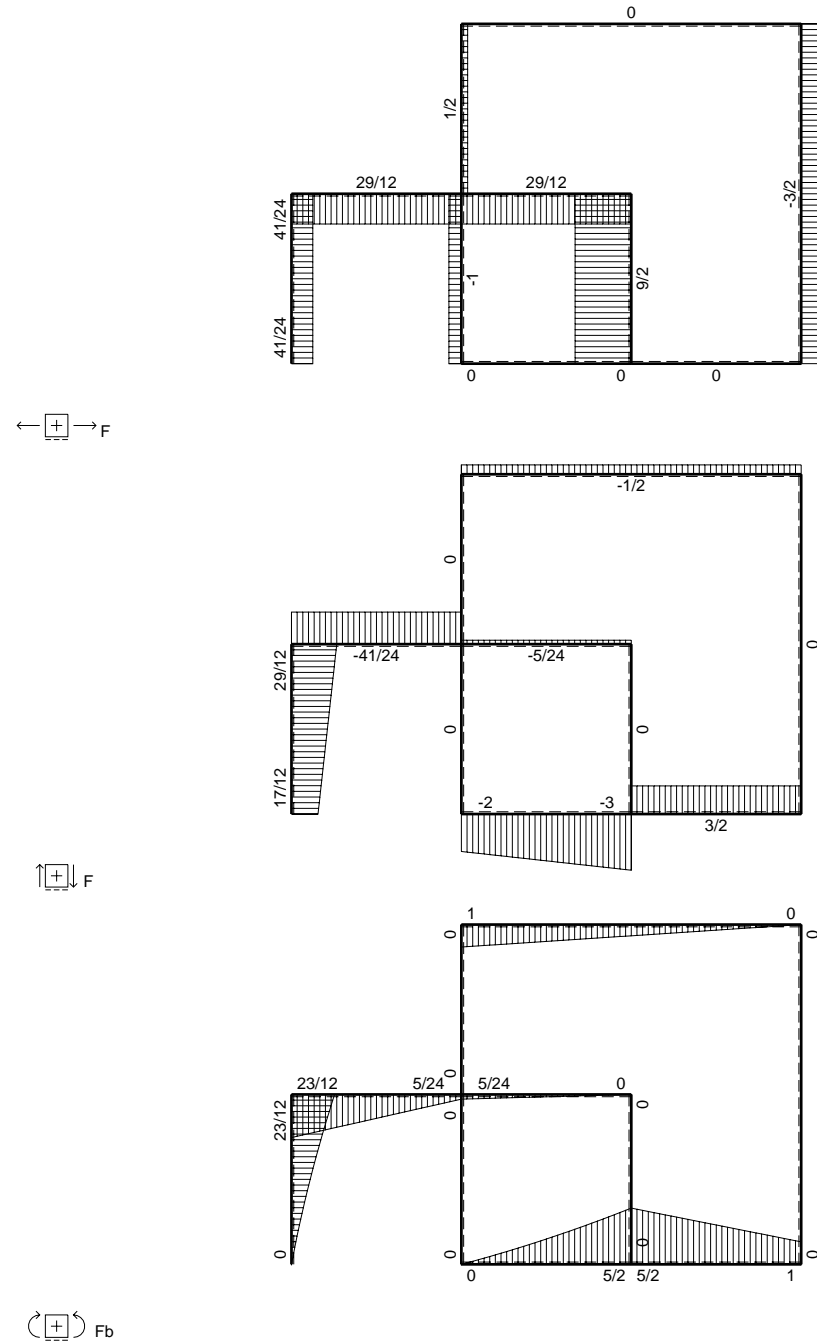
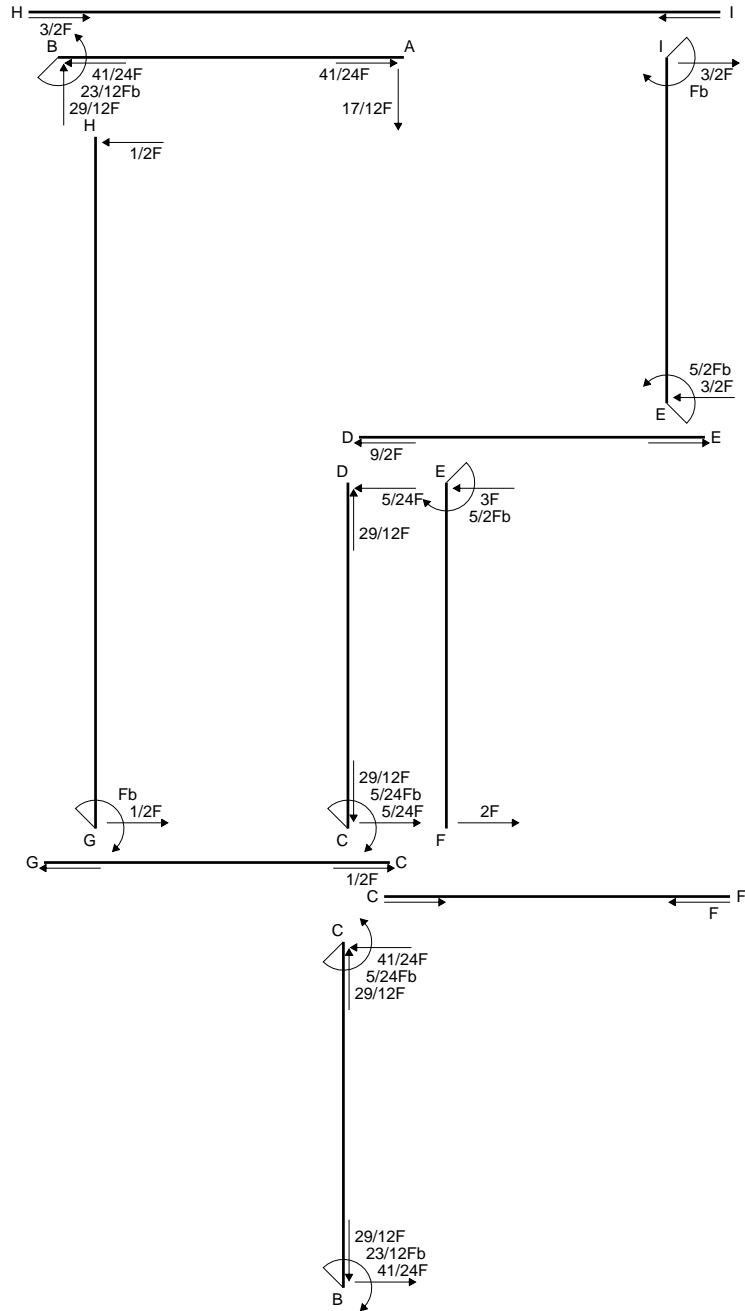
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

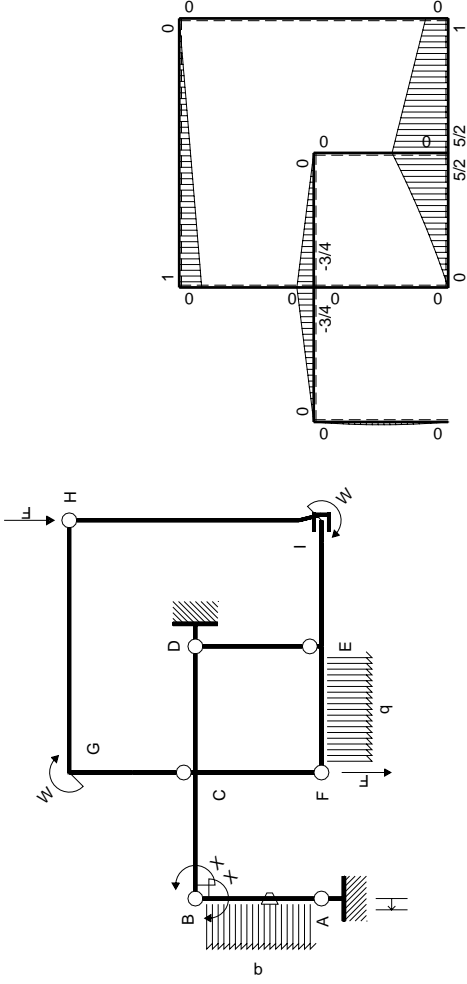
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

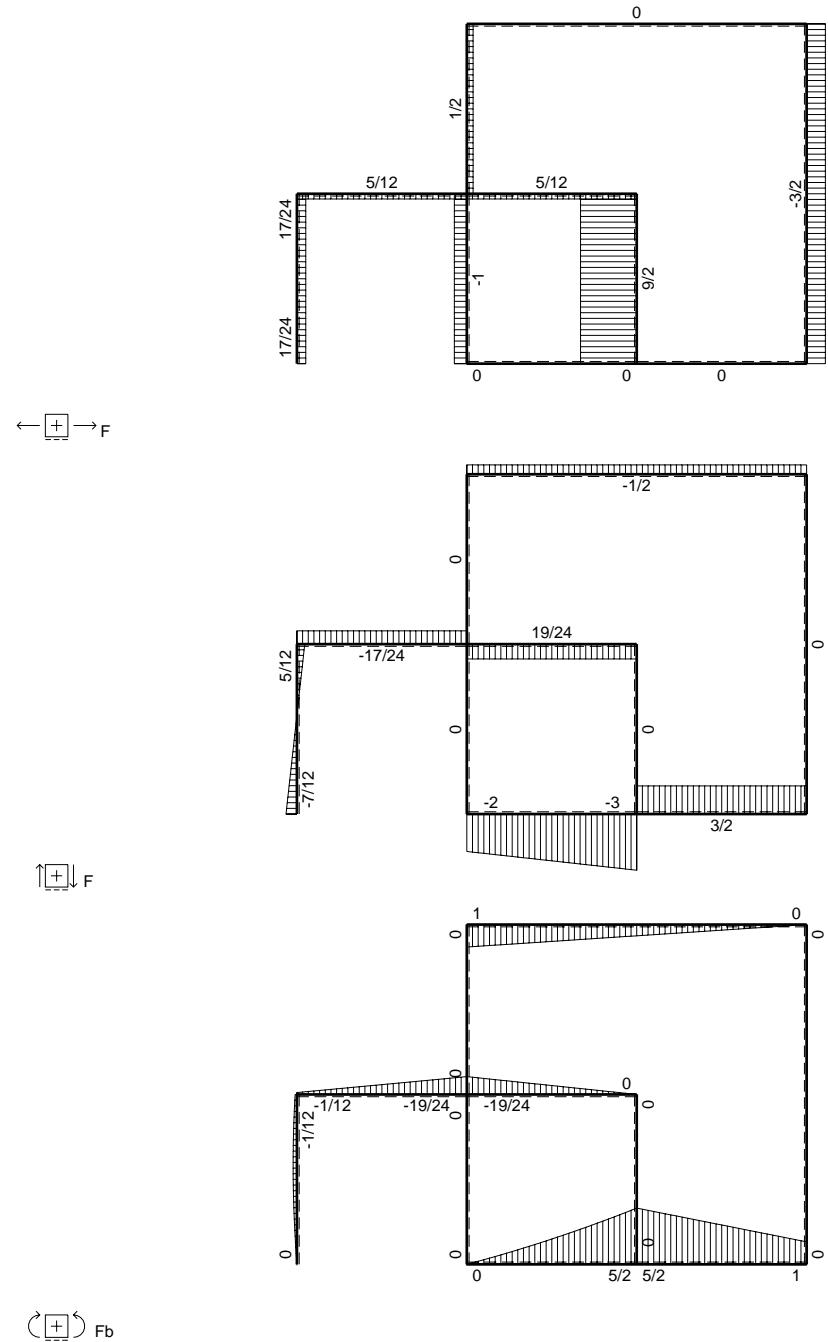
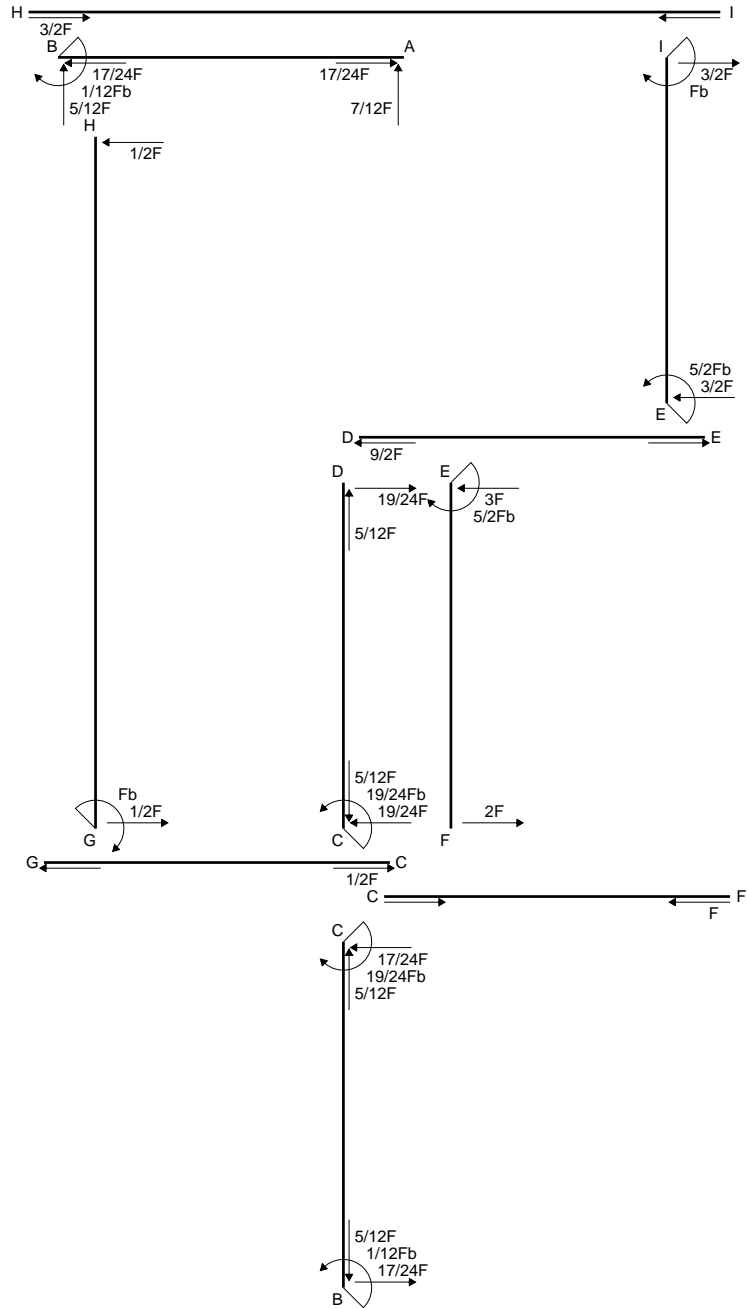
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

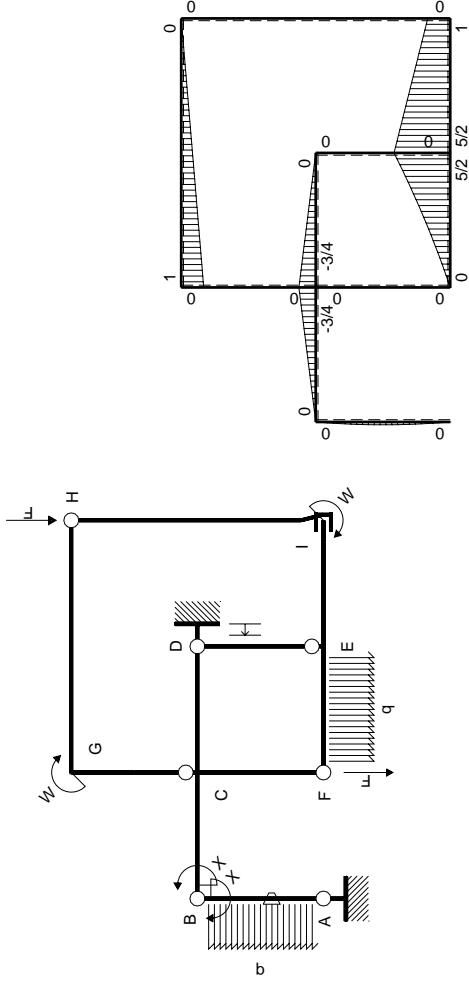
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

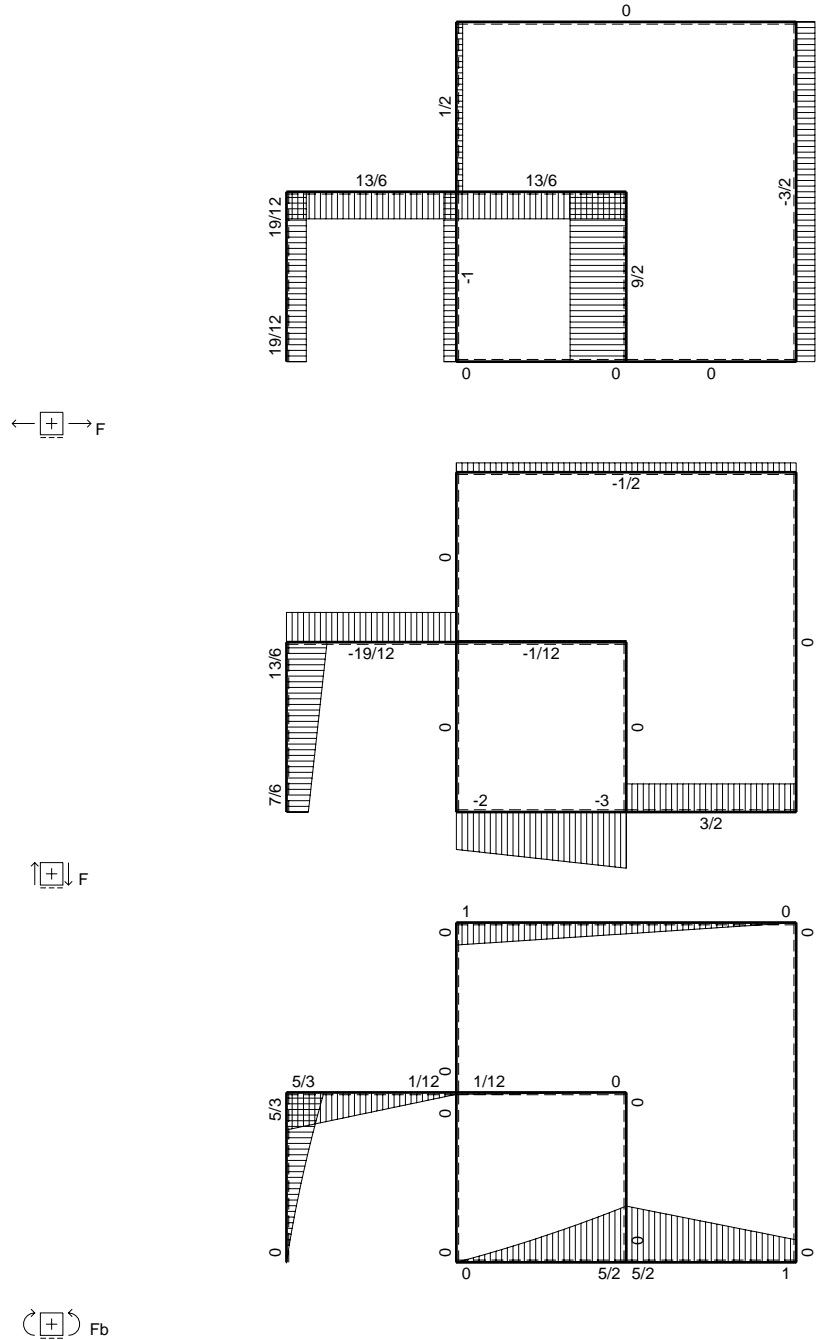
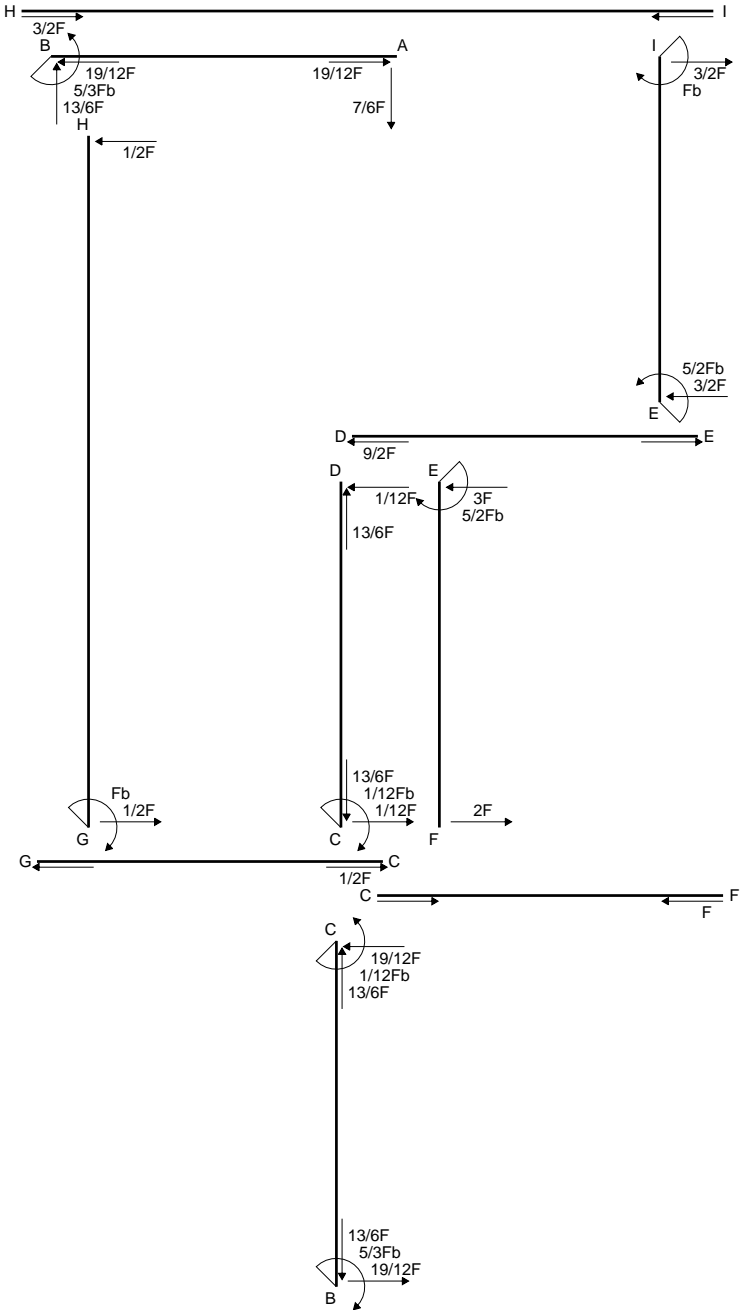
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

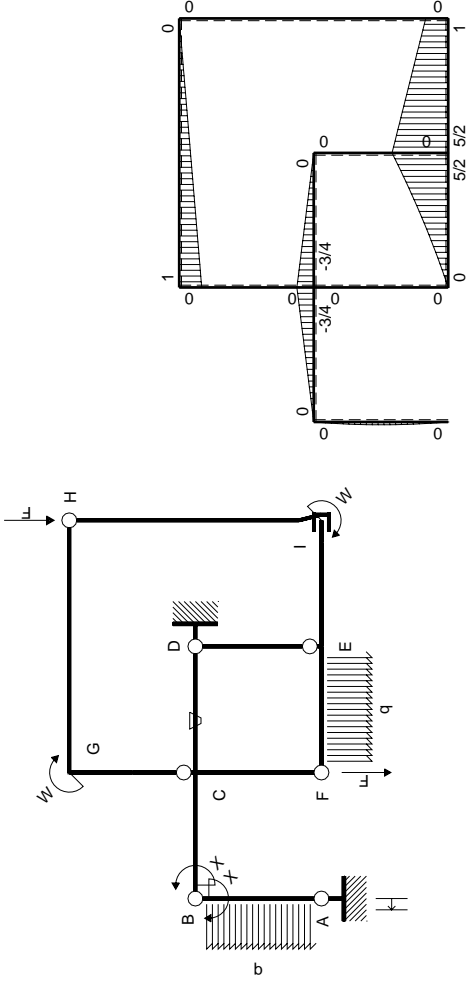
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-5/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

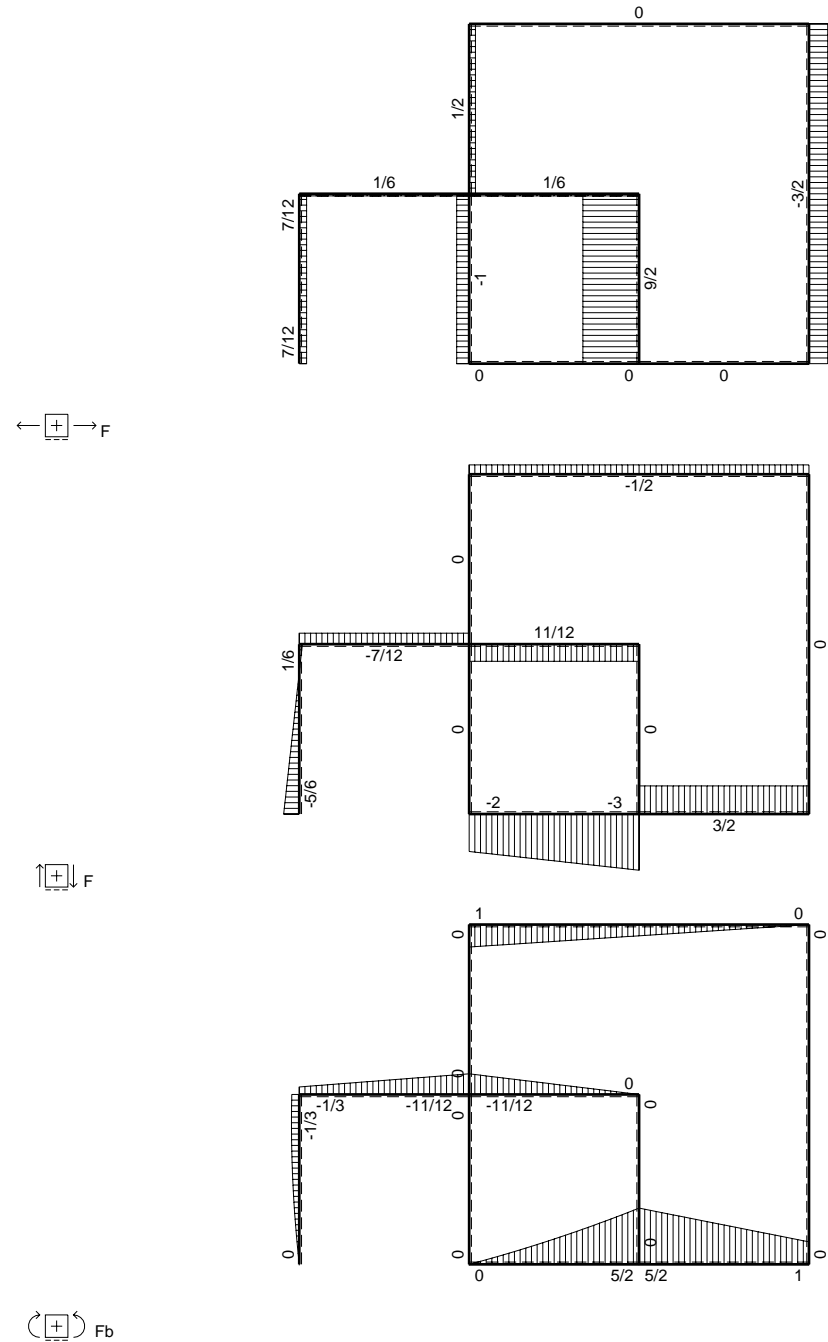
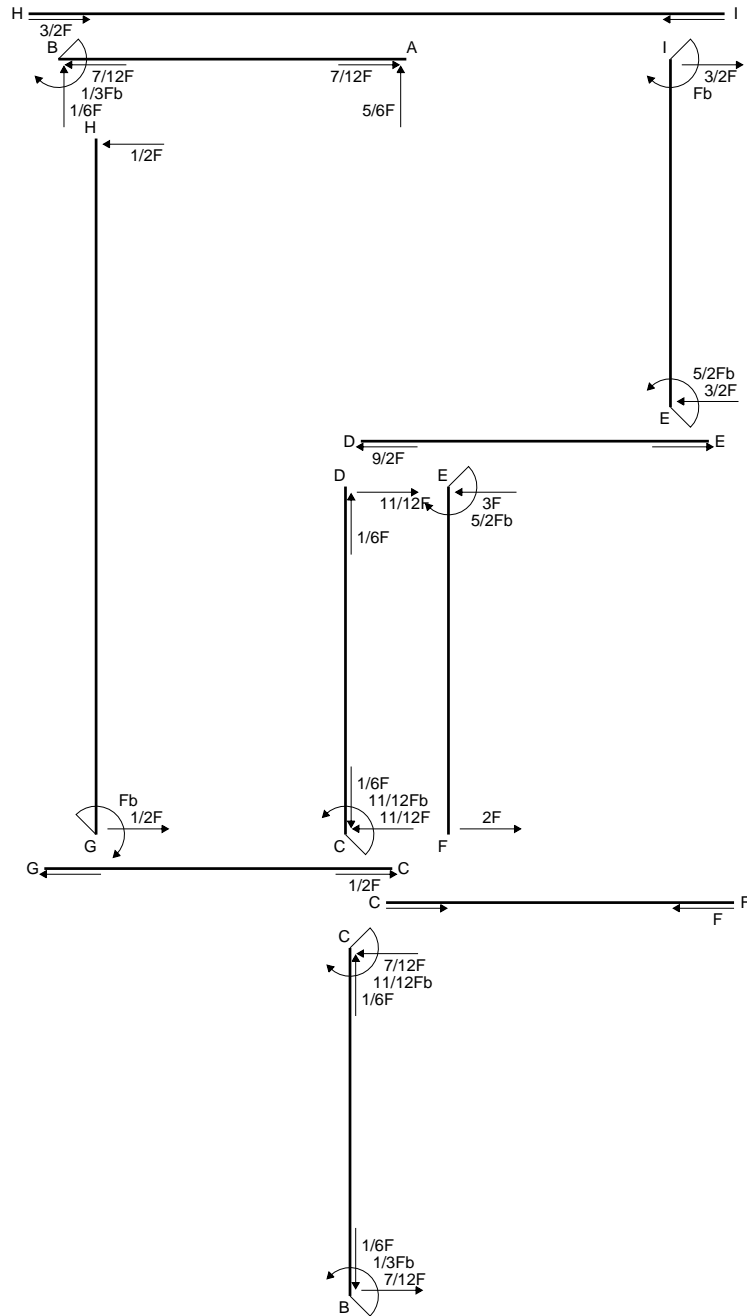
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

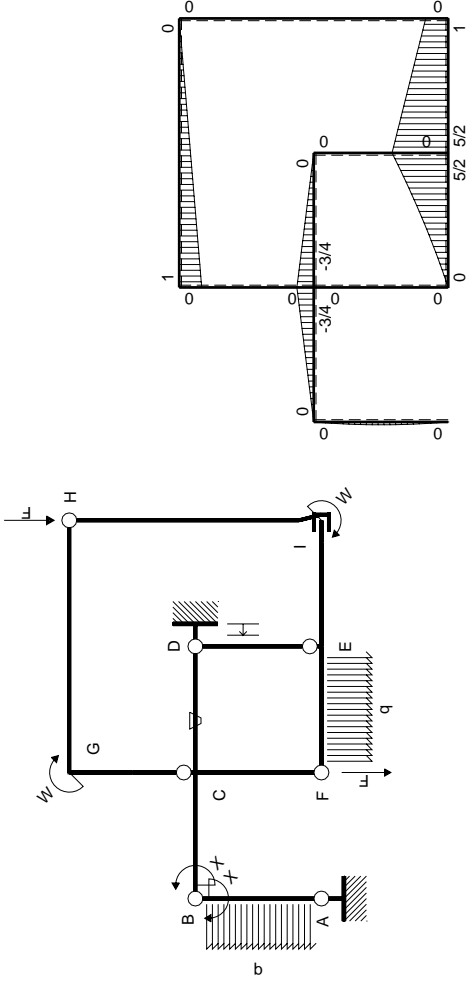
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

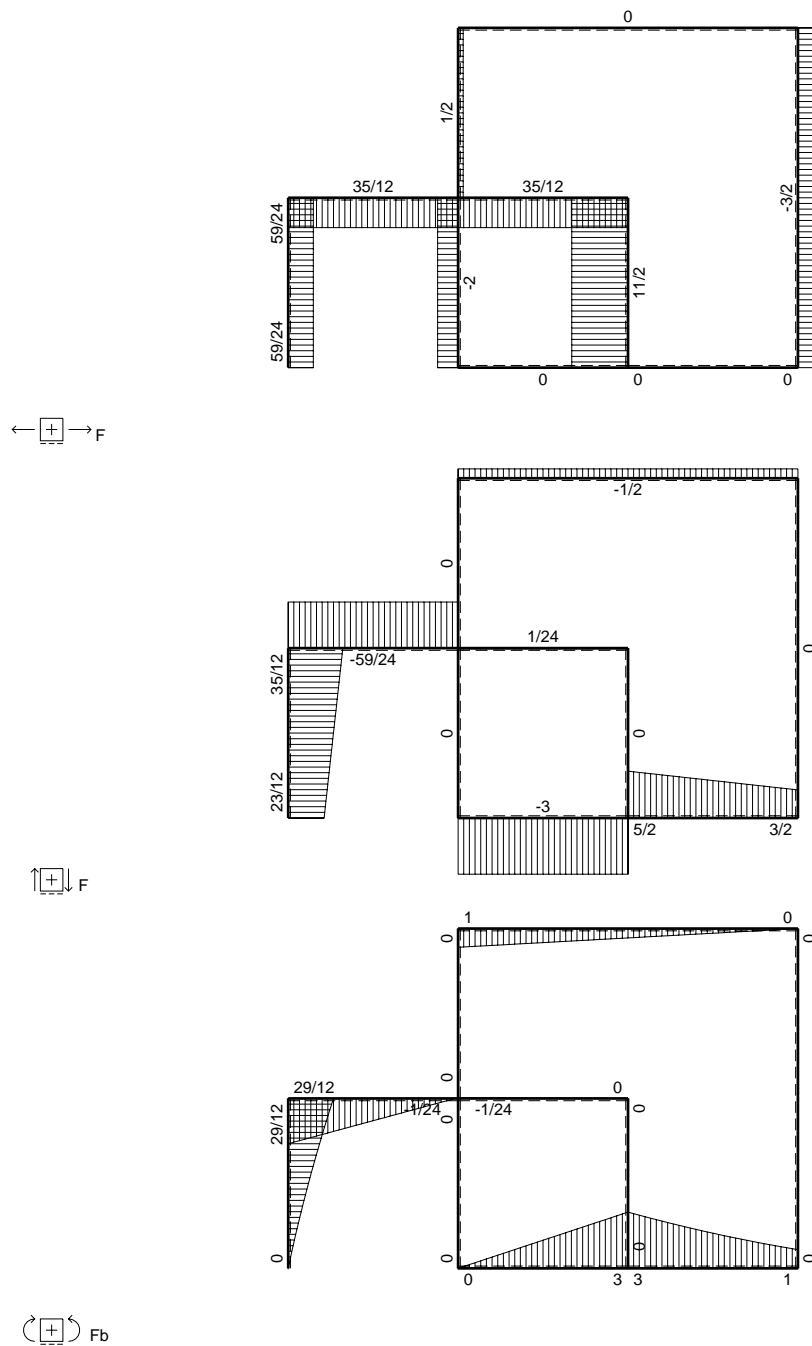
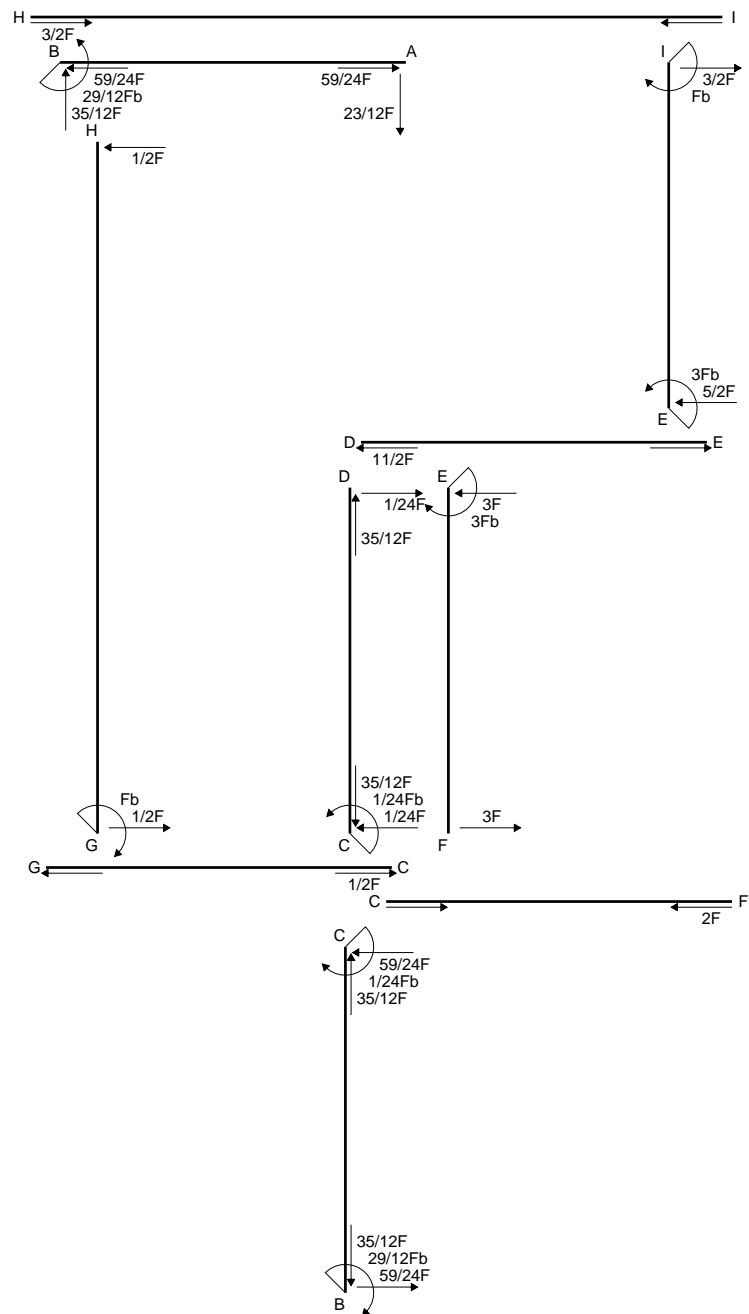
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

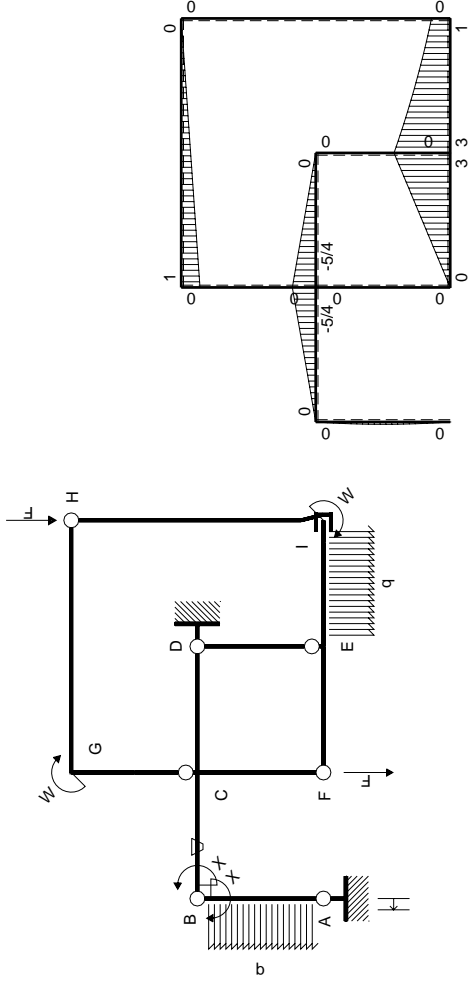
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$29/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-29/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

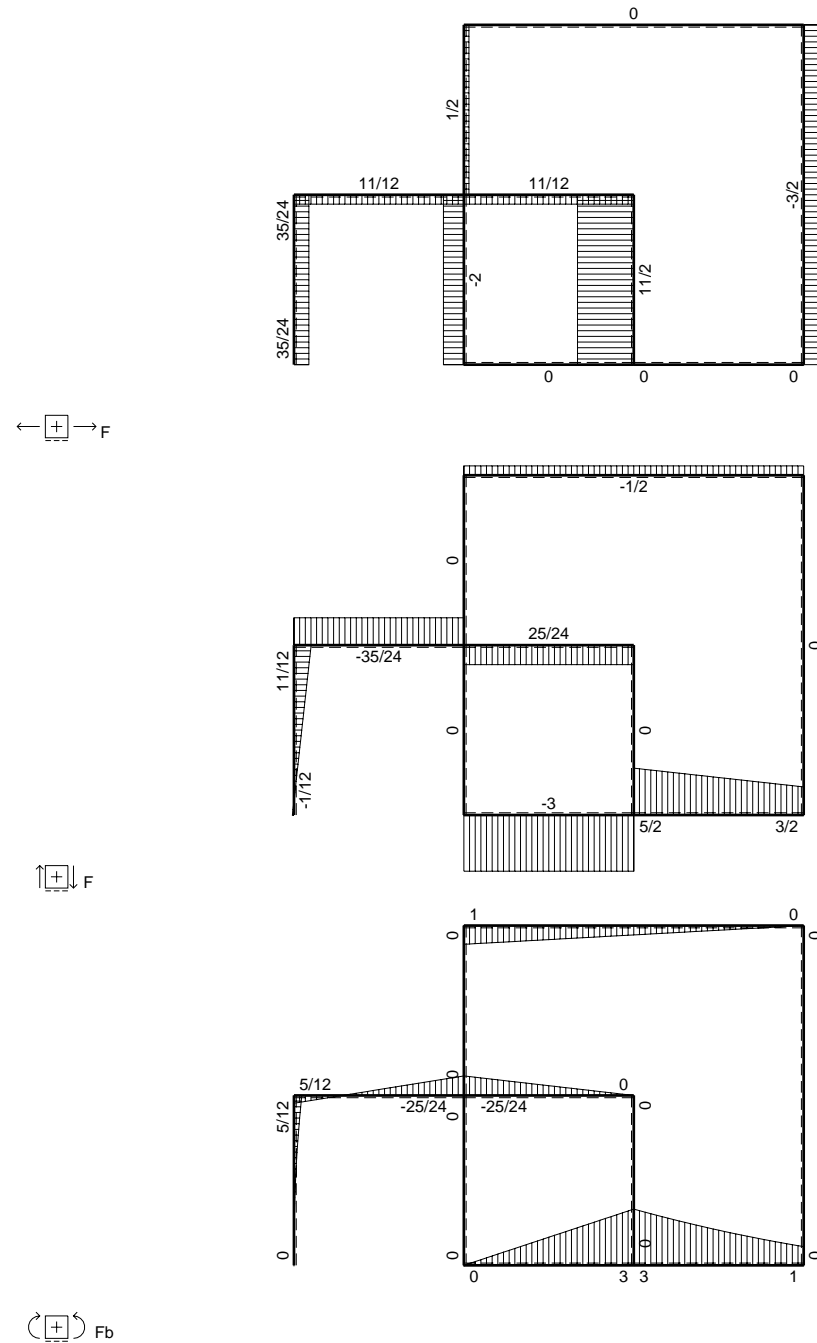
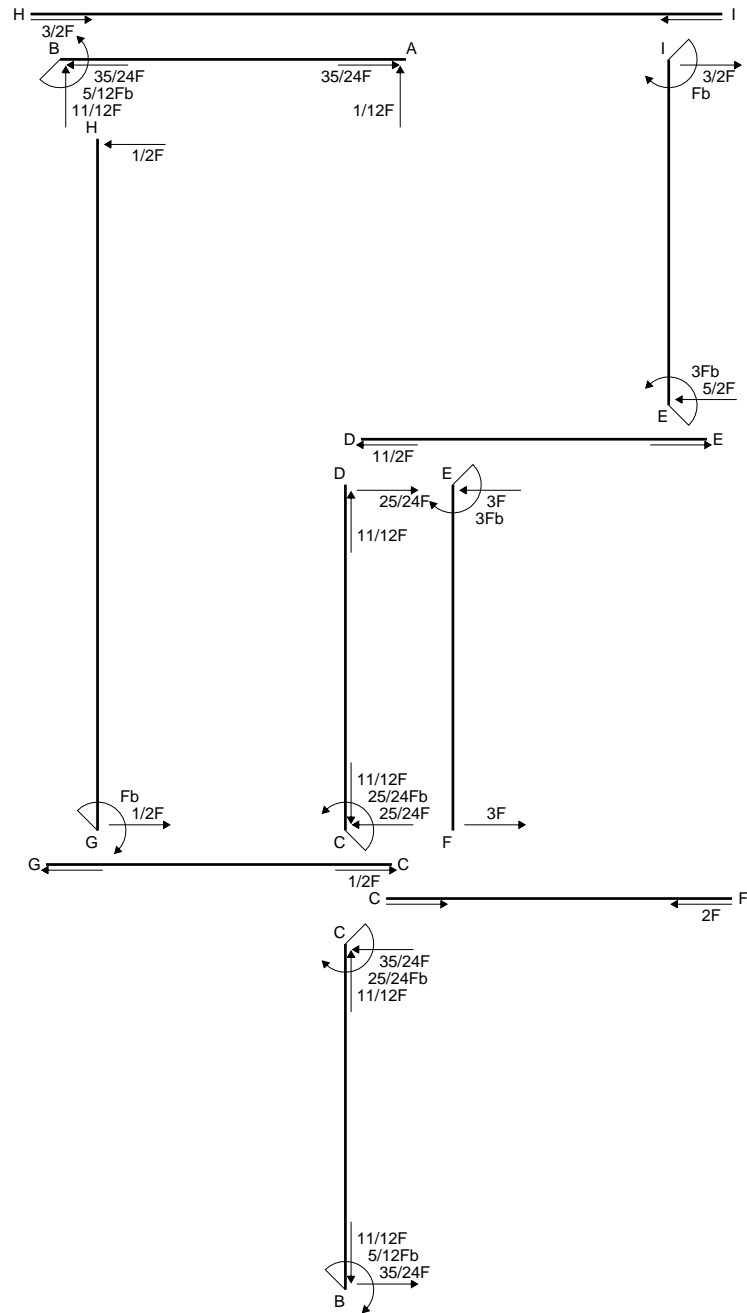
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

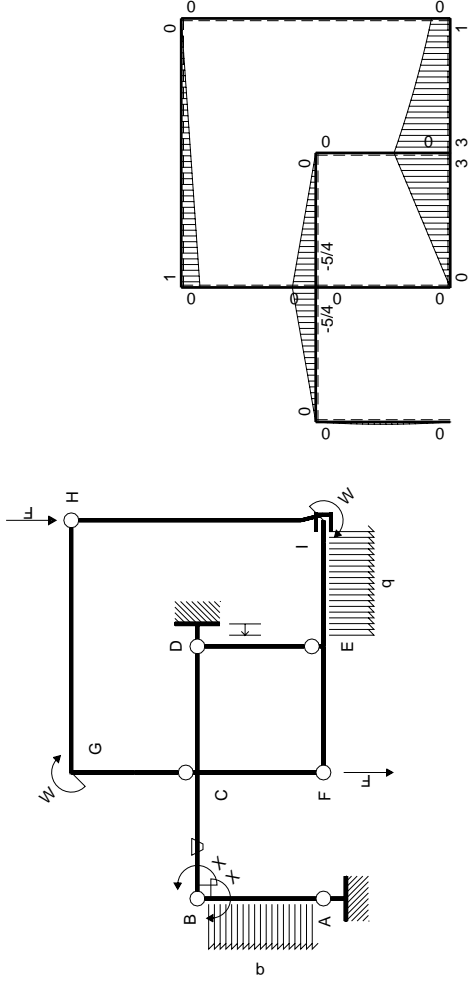
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$5/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-5/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

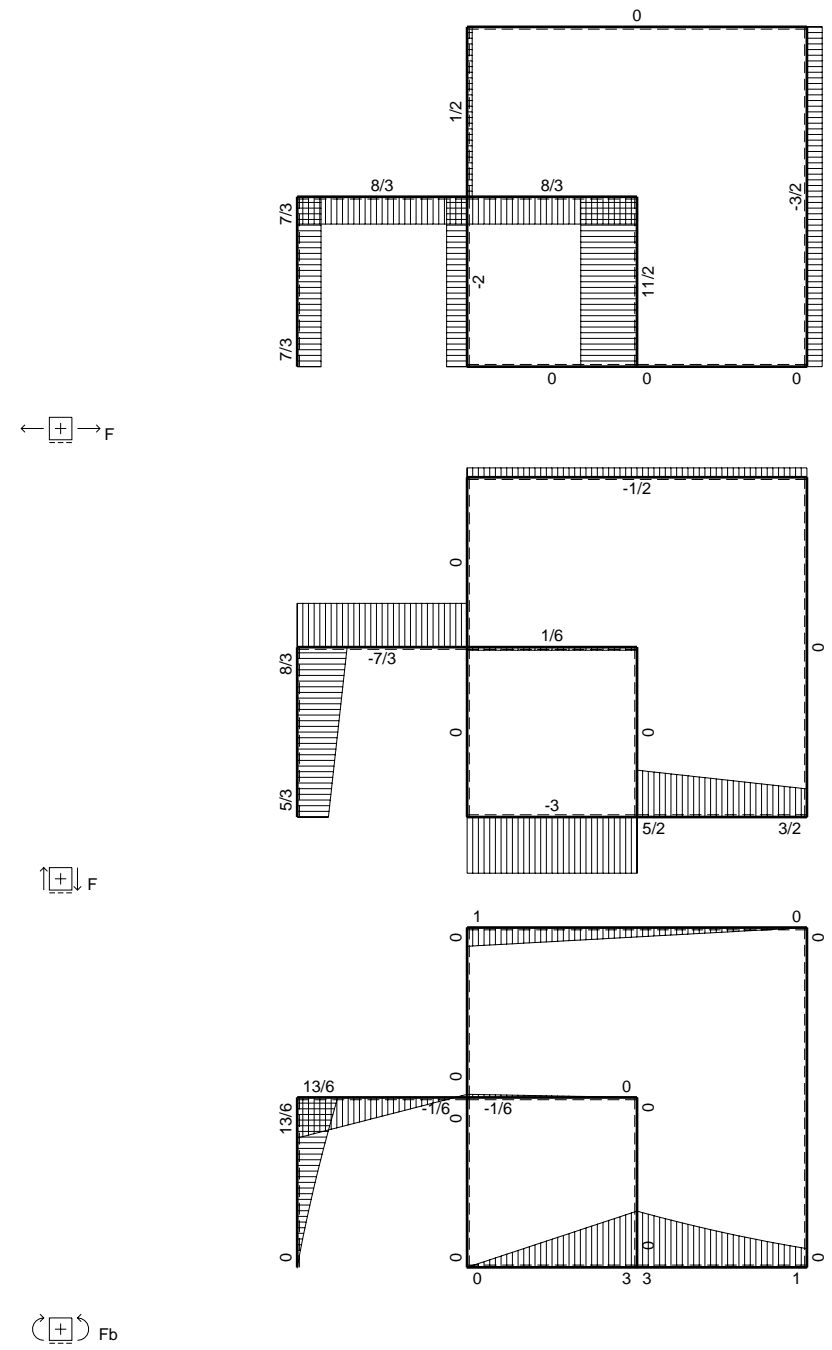
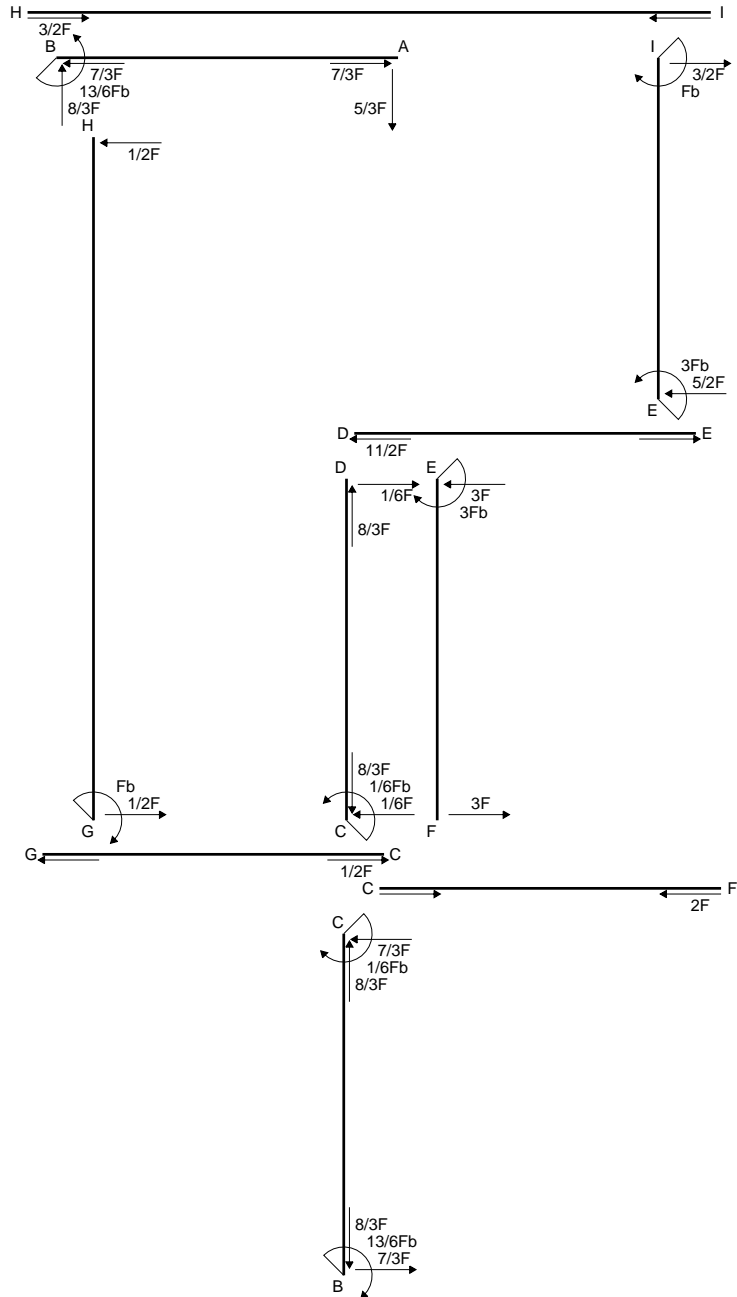
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

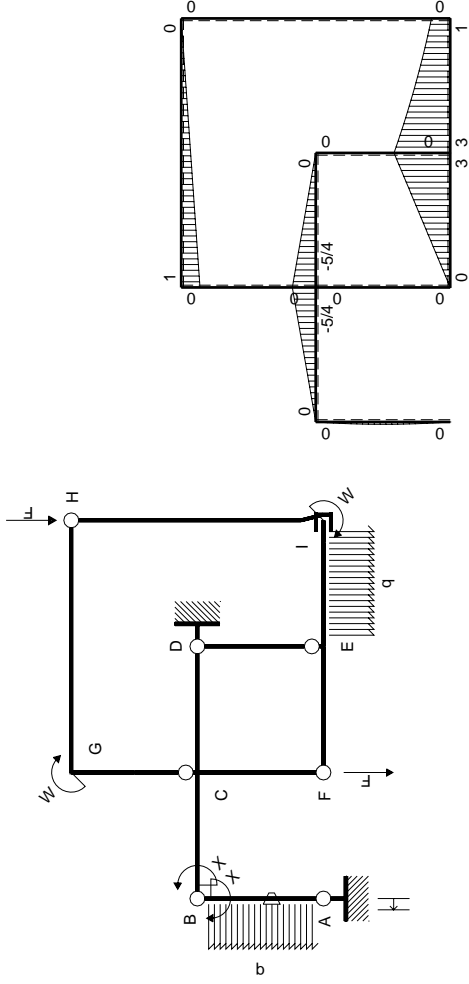
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

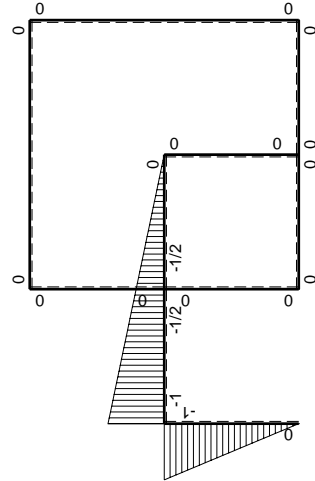
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ		
	totali						$13/6Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-13/6Fb$		

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

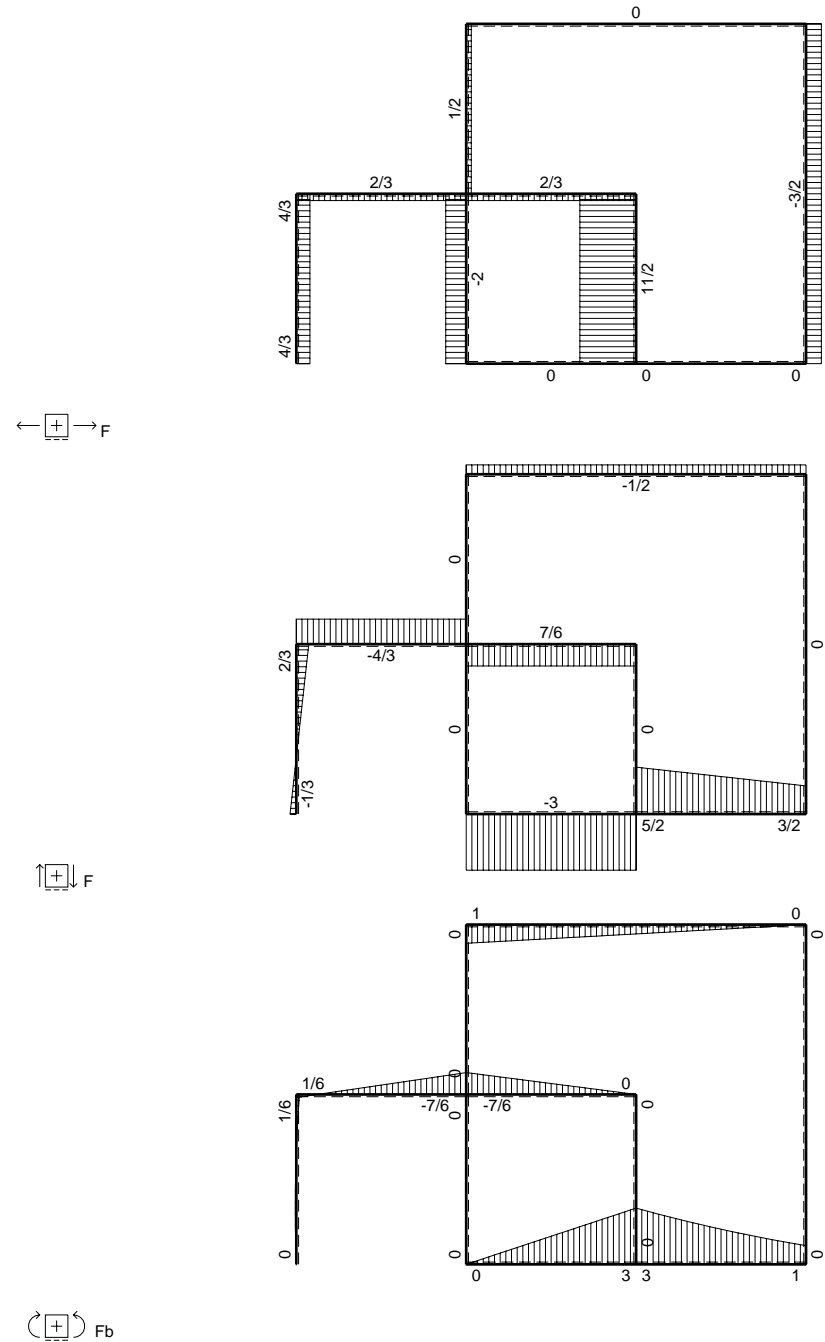
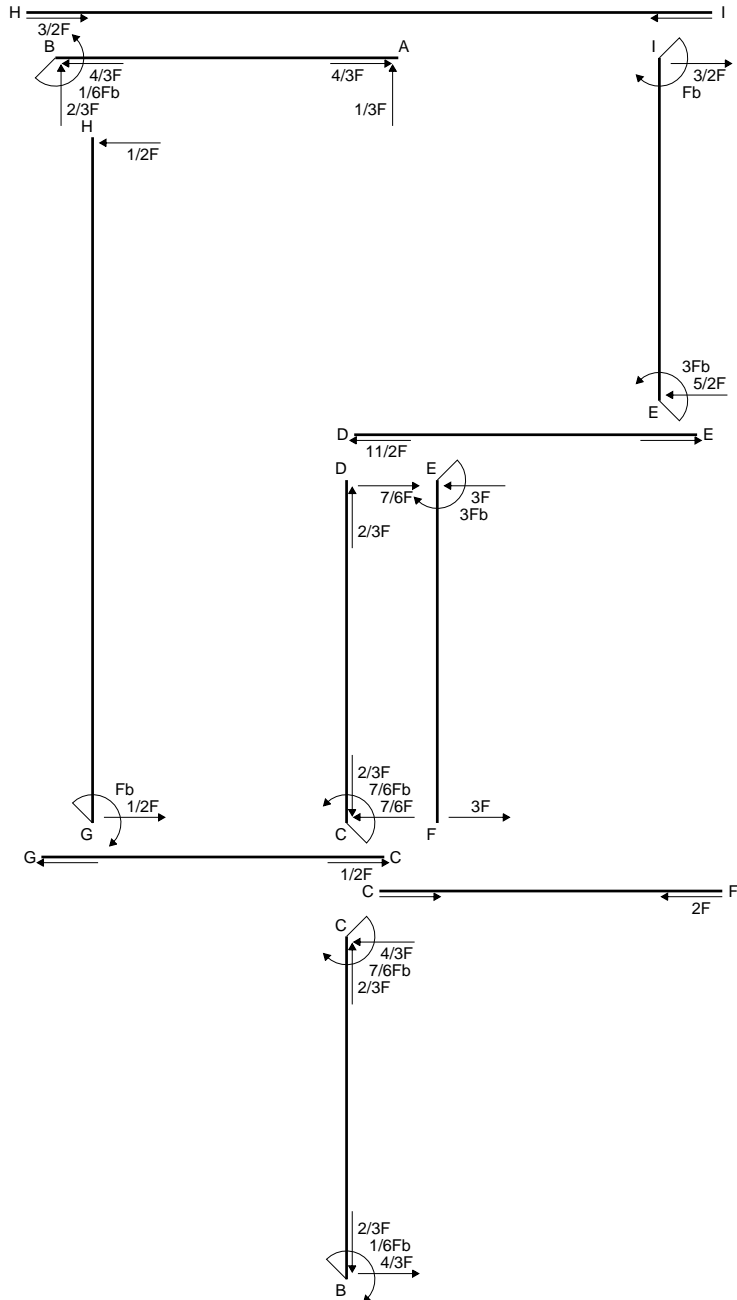
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

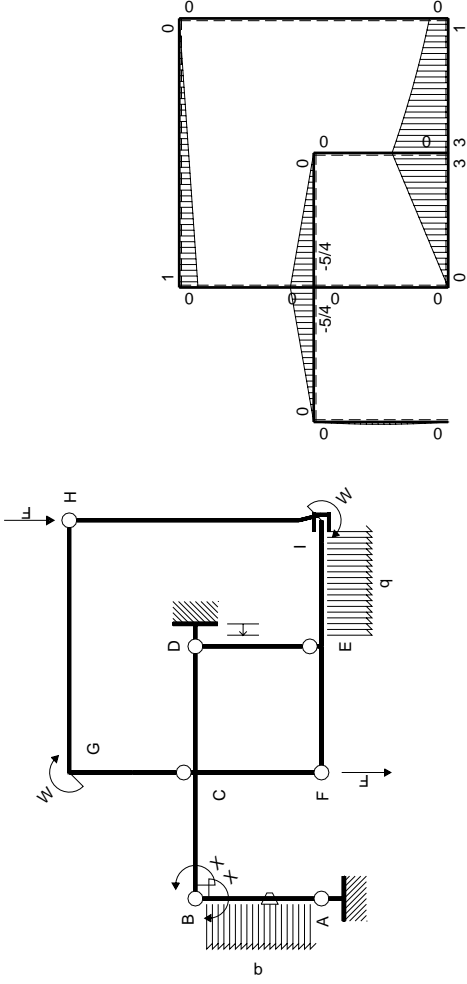
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

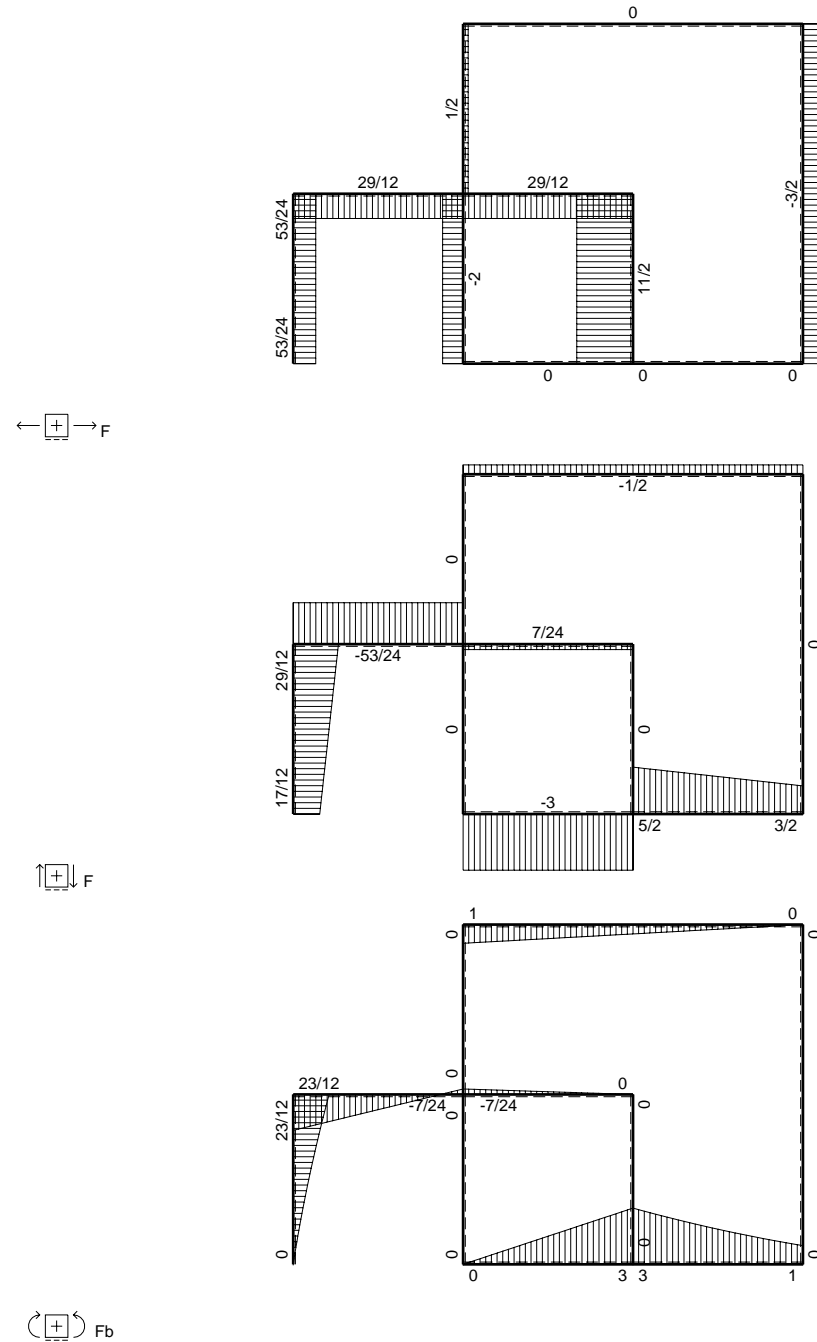
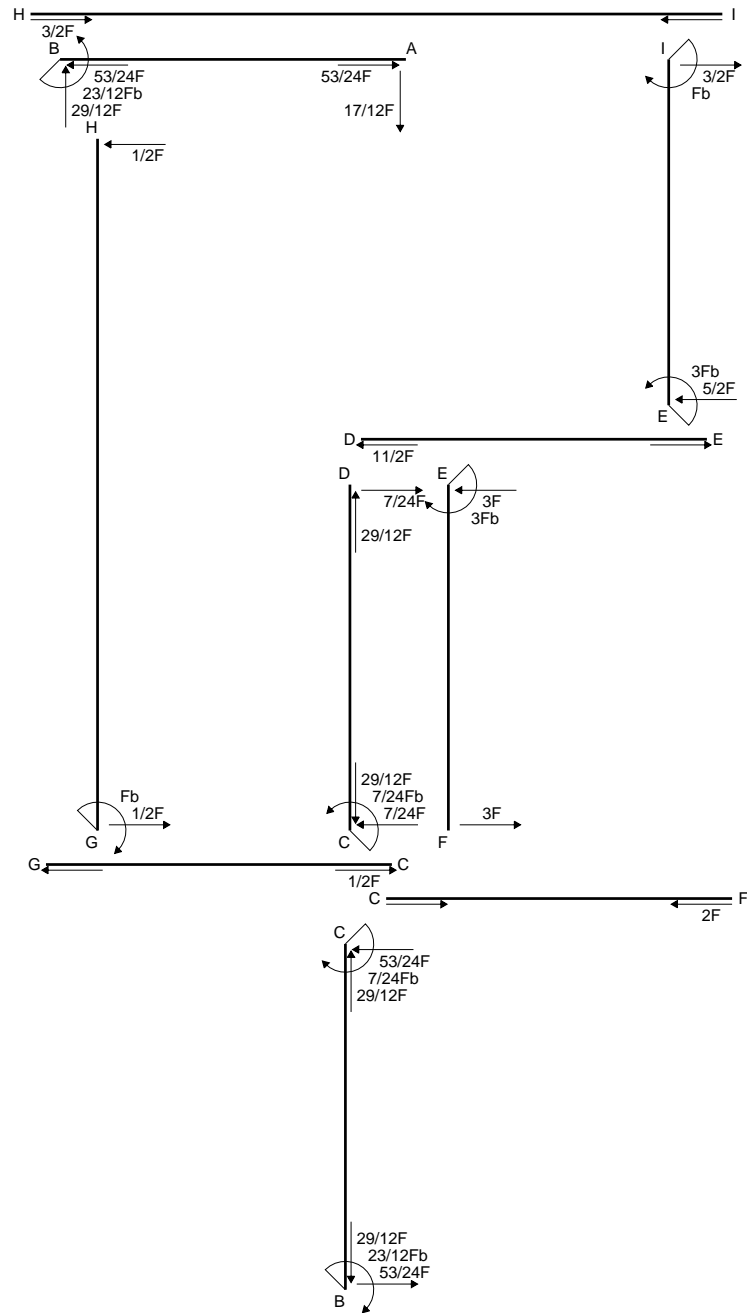
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

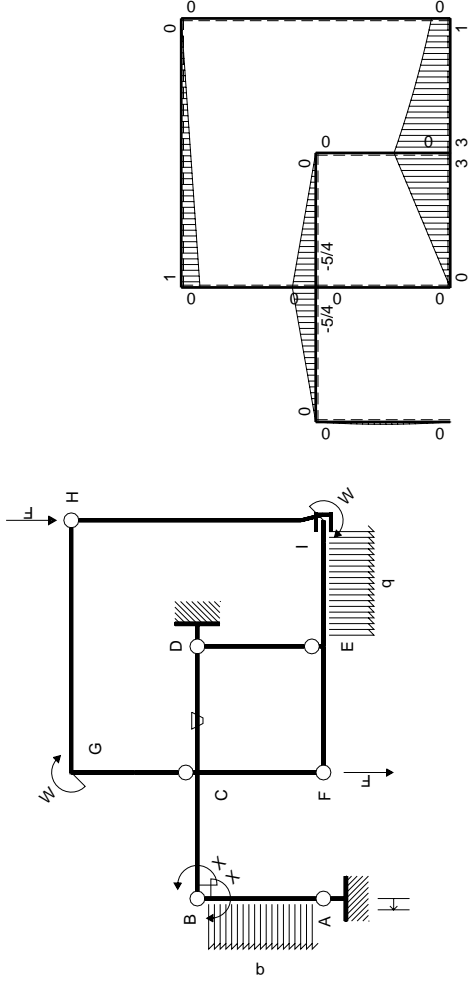
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

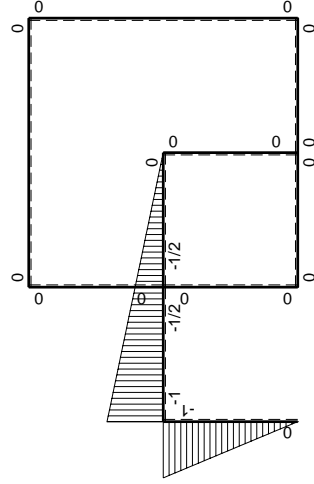
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

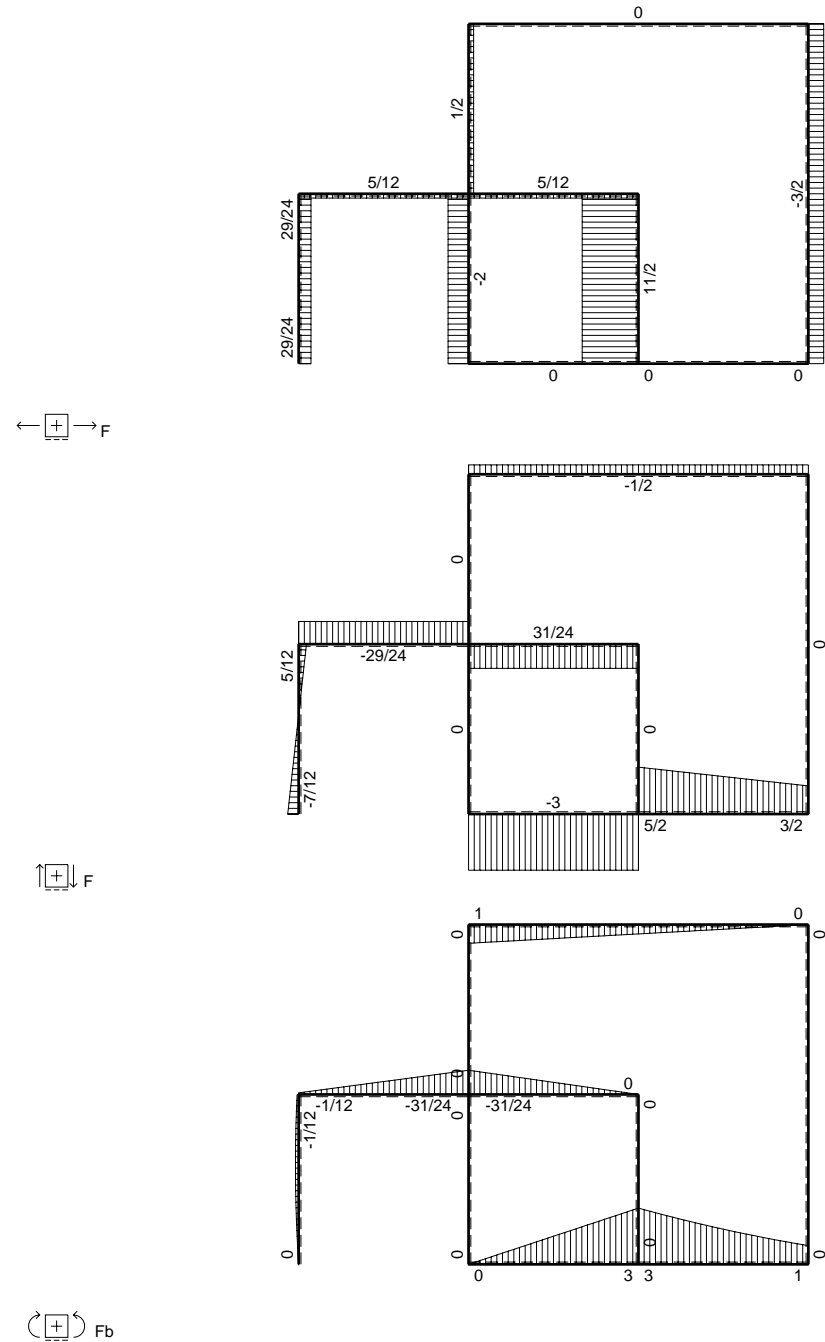
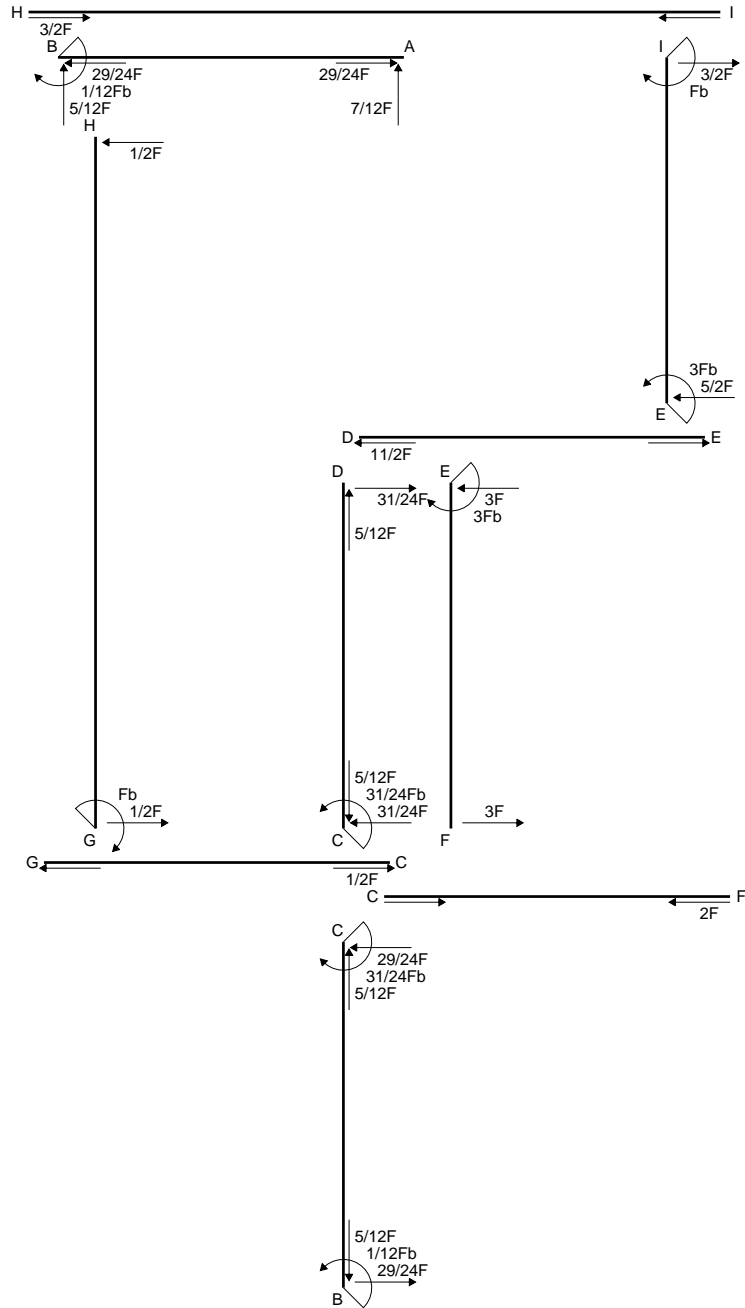
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

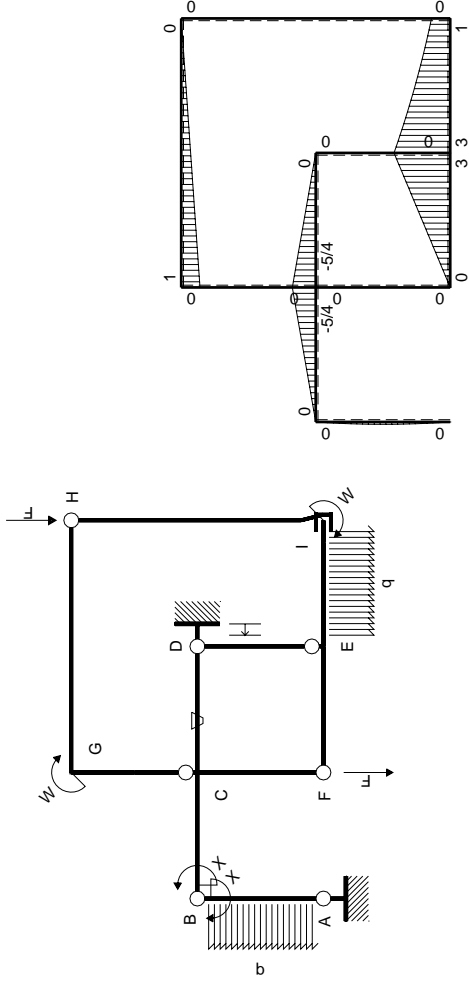
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

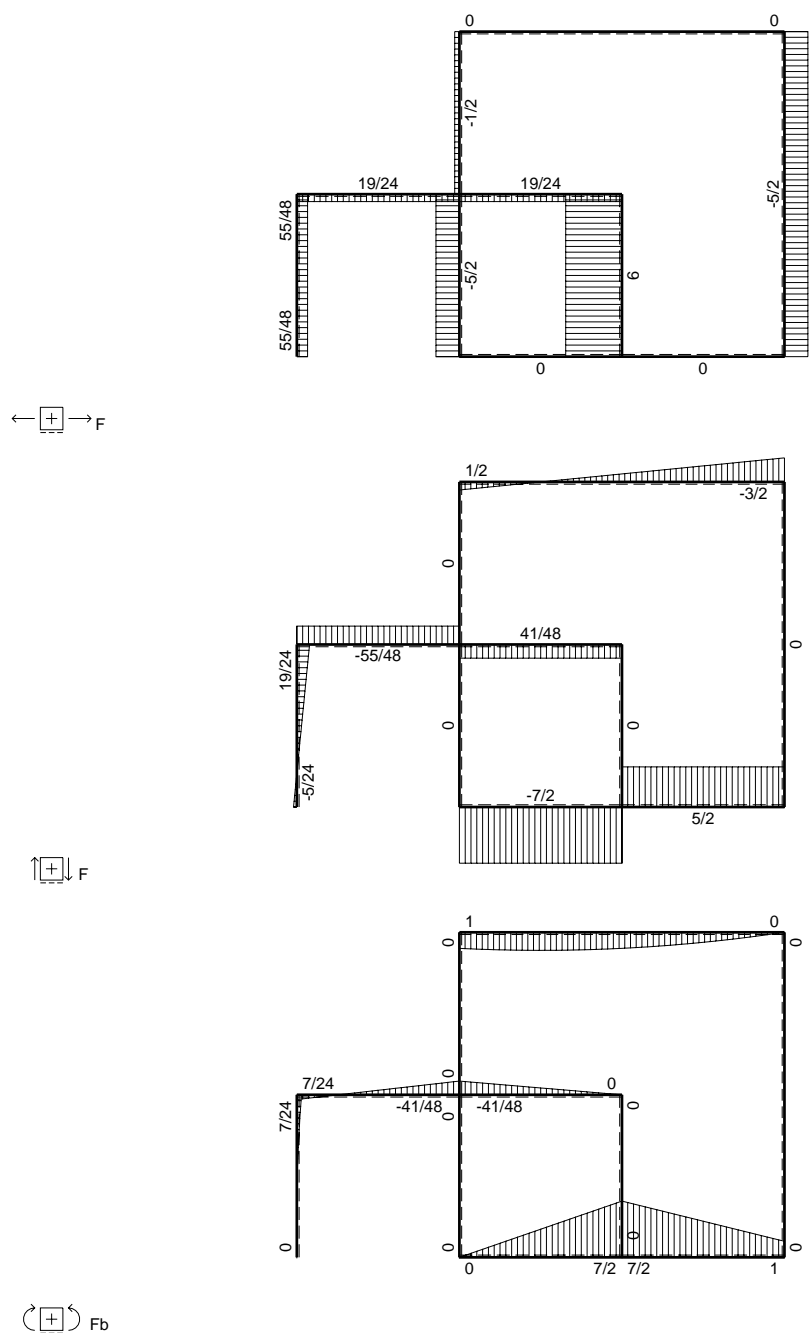
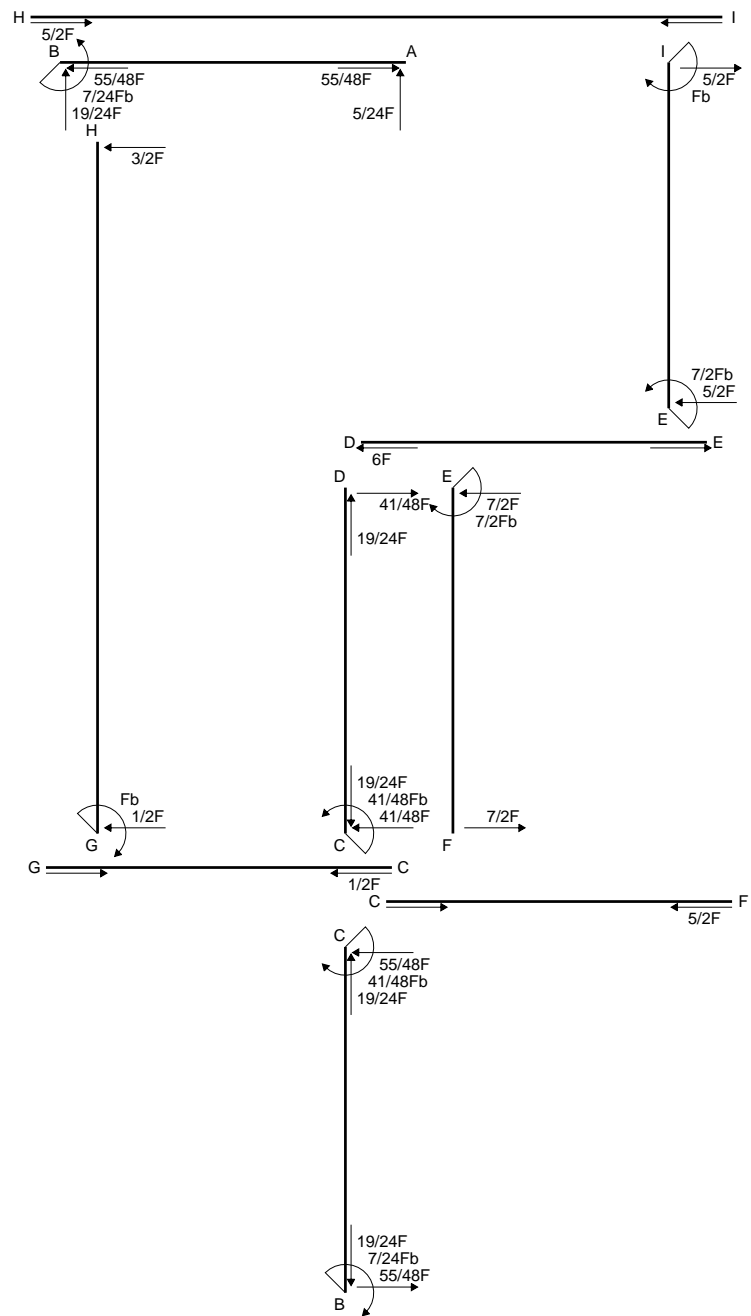
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

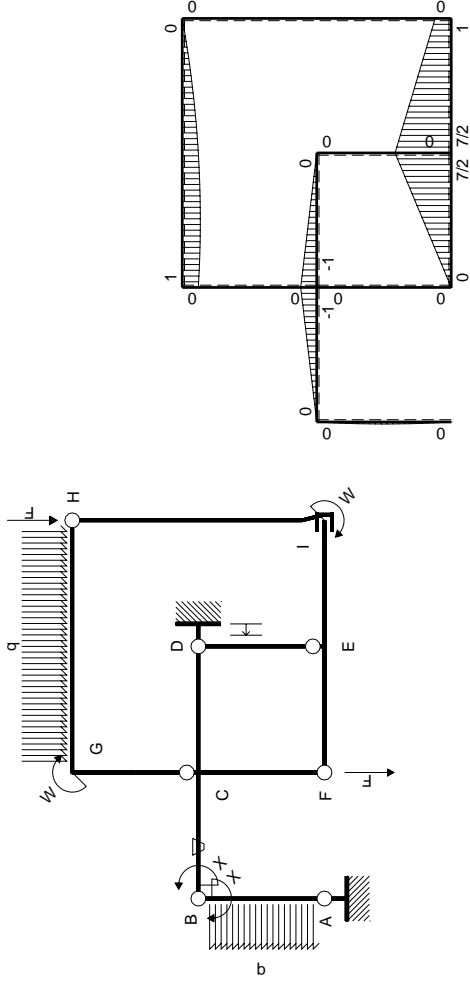
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0			
ED b	0	0	0	0	0	0	0+0	0	
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0			
FE b	0	$-7/2Fx$	0	0	0	0	0+0	0	
FC b	0	0	0	0	0	0			
CF b	0	0	0	0	0	0	0+0	0	
CG b	0	0	0	0	0	0			
GC b	0	0	0	0	0	0	0+0	0	
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0			
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
HI 2b	0	0	0	0	0	0			
IH 2b	0	0	0	0	0	0	0+0	0	
IE b	0	$Fb+5/2Fx$	0	0	0	0			
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0	0+0	0	
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$		
	totali						$7/24Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-7/24Fb$		

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

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

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

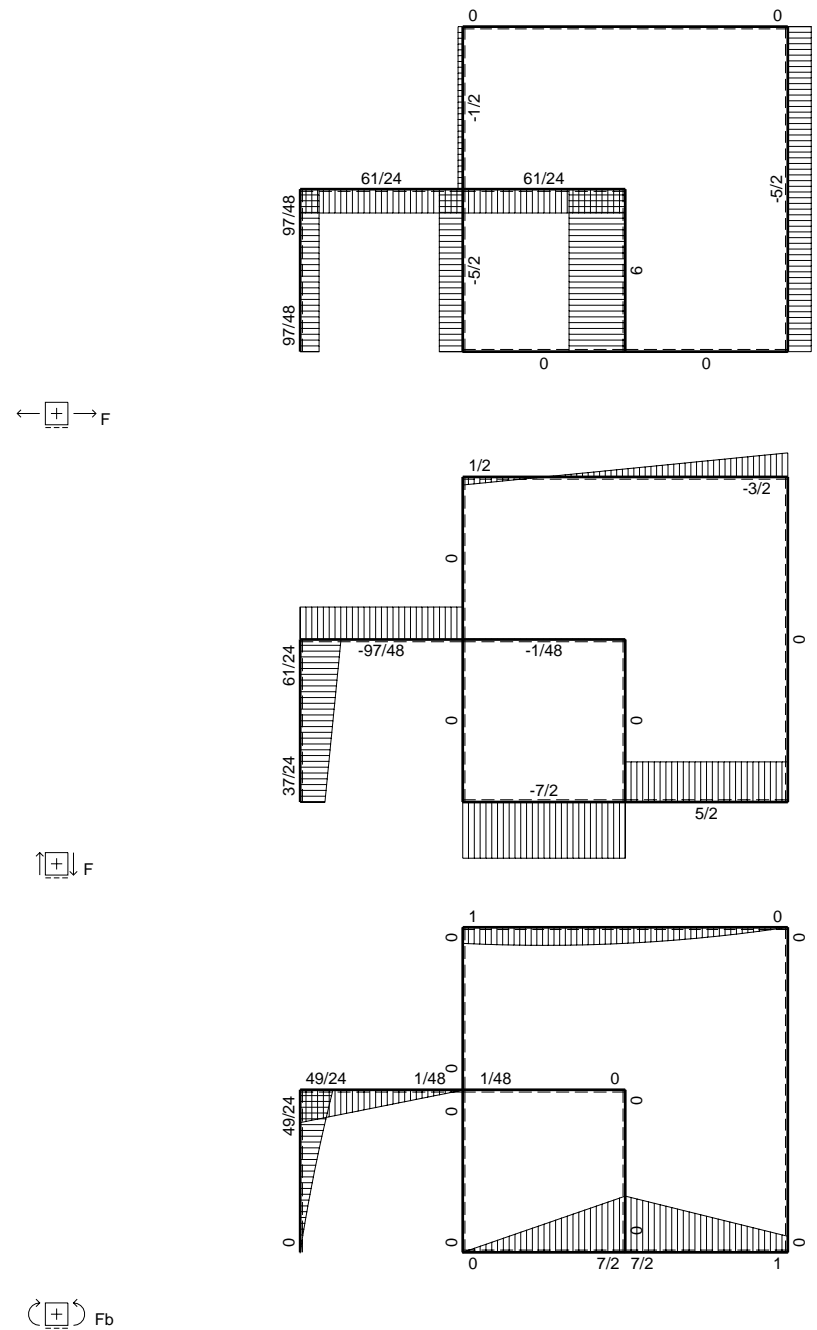
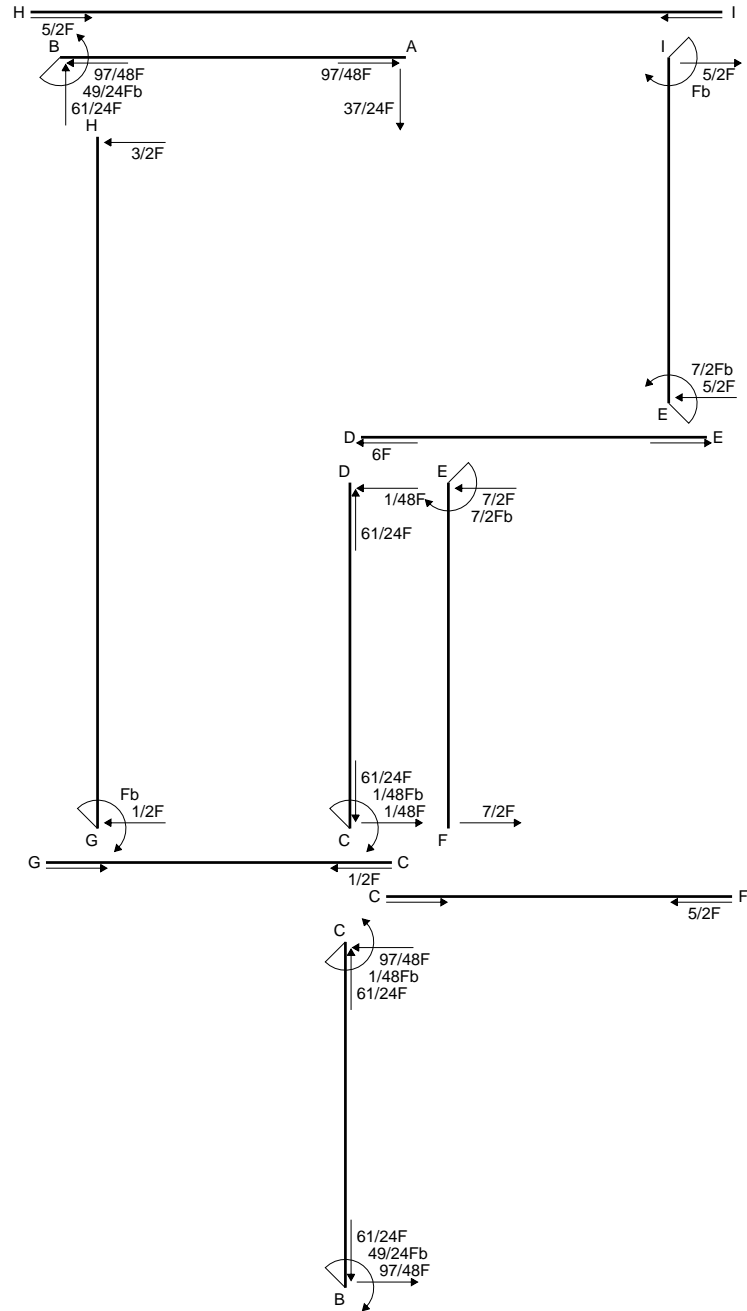
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

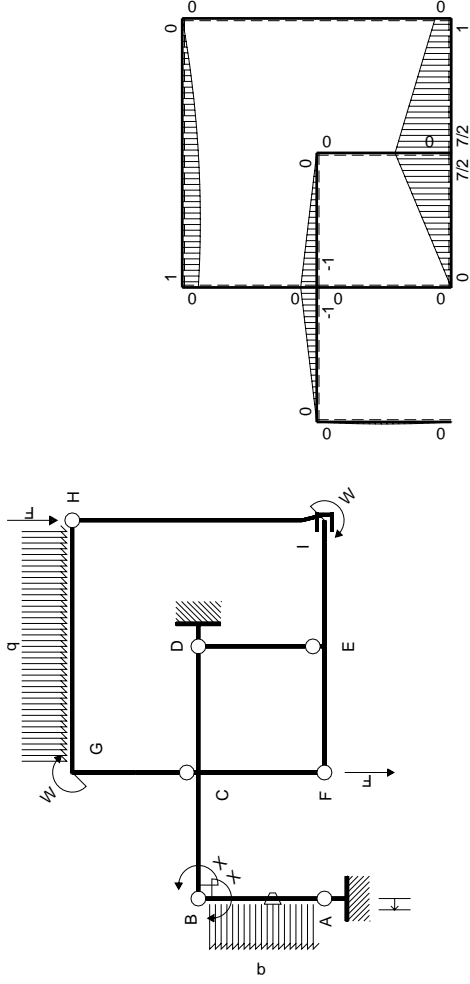
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ		
	totali						$49/24Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-49/24Fb$		

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

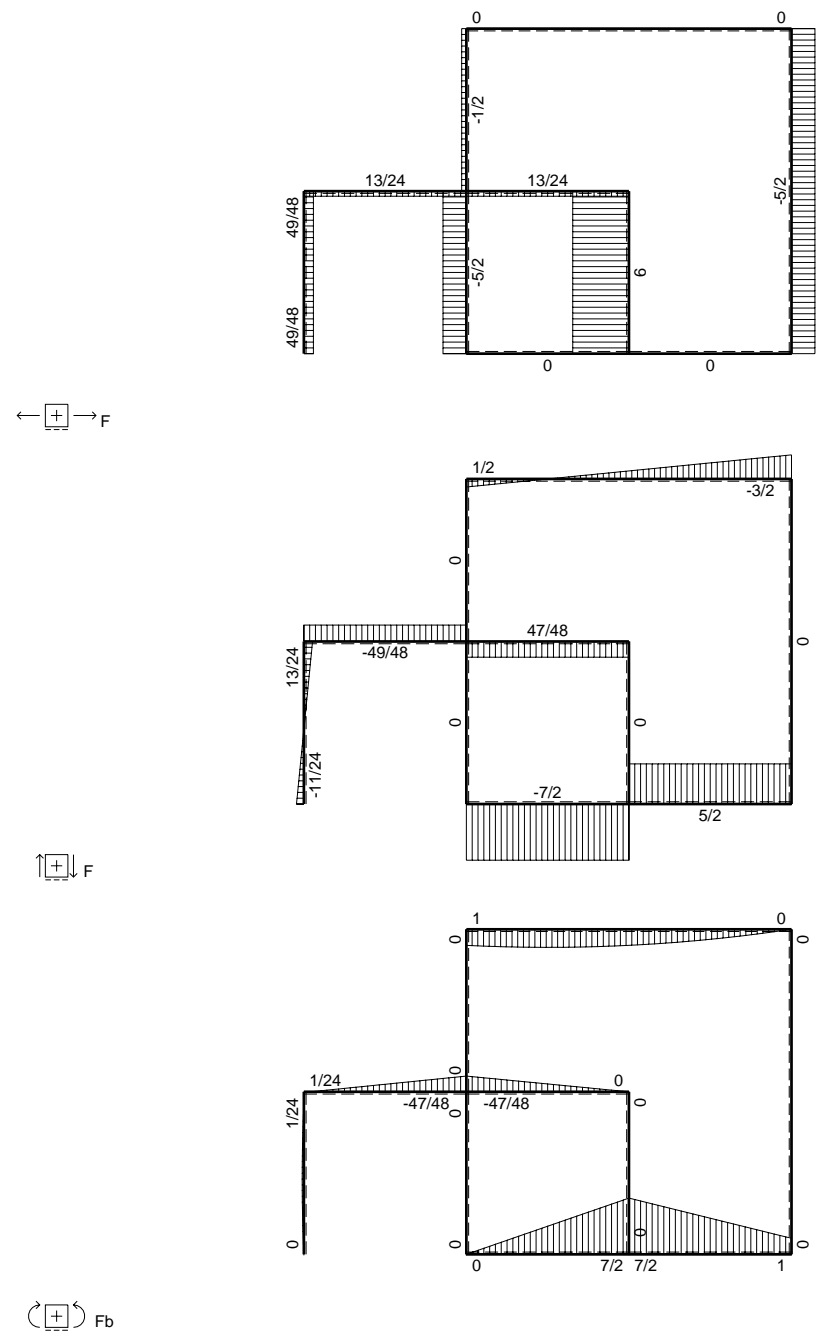
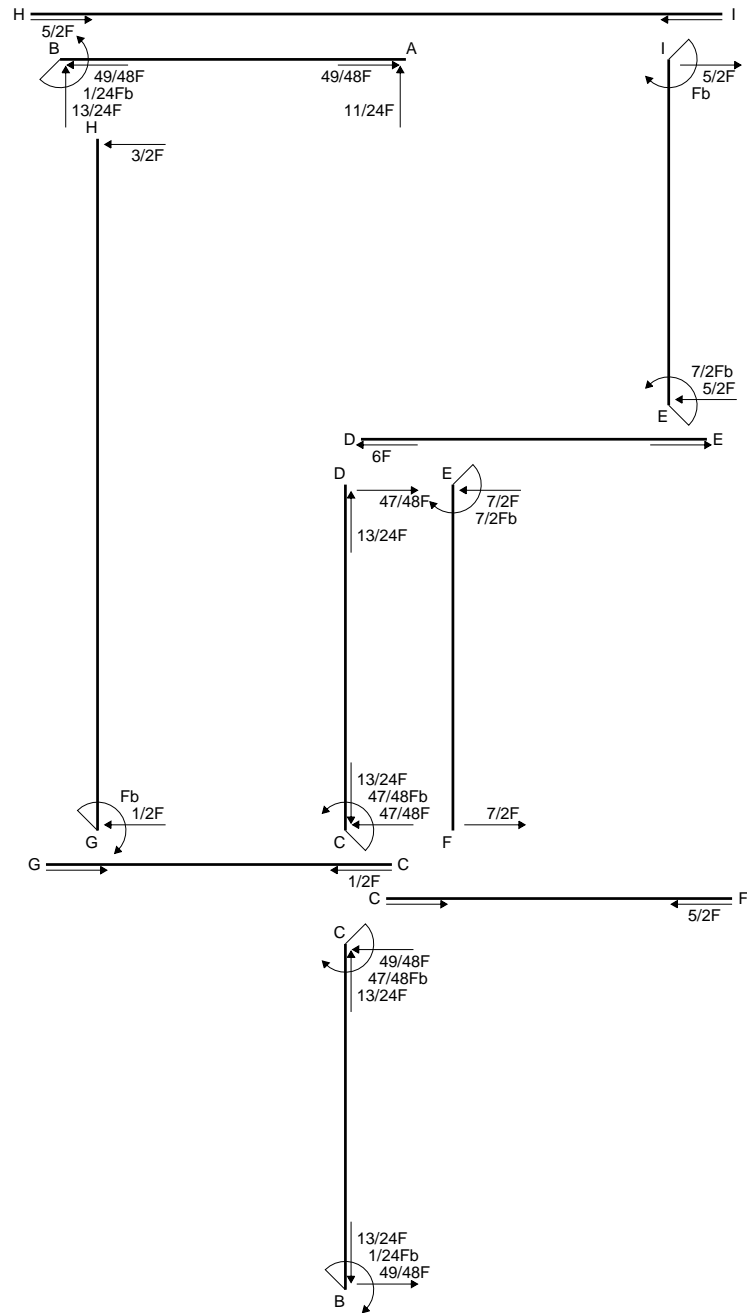
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

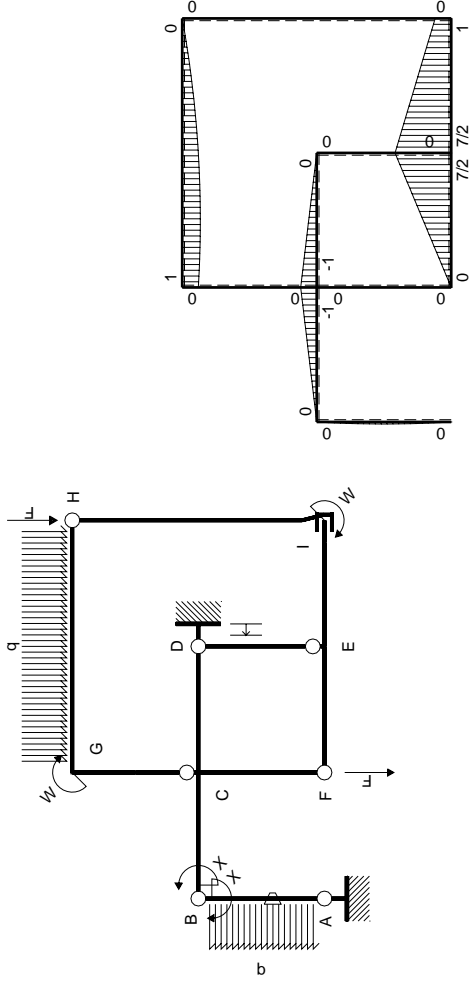
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

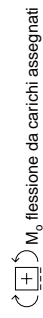
$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

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





Schema di calcolo iperstatico

 M_0 flessione da carichi assegnati



 M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

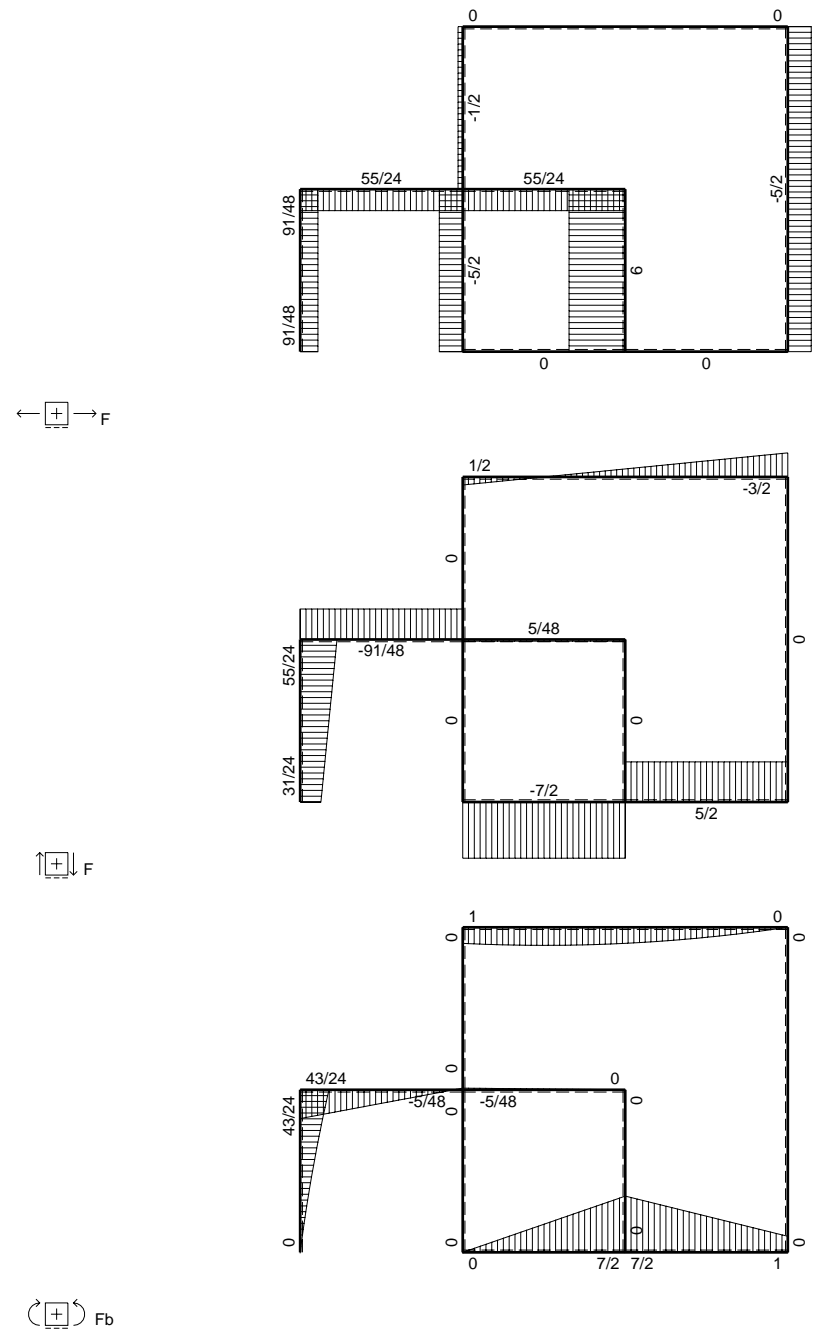
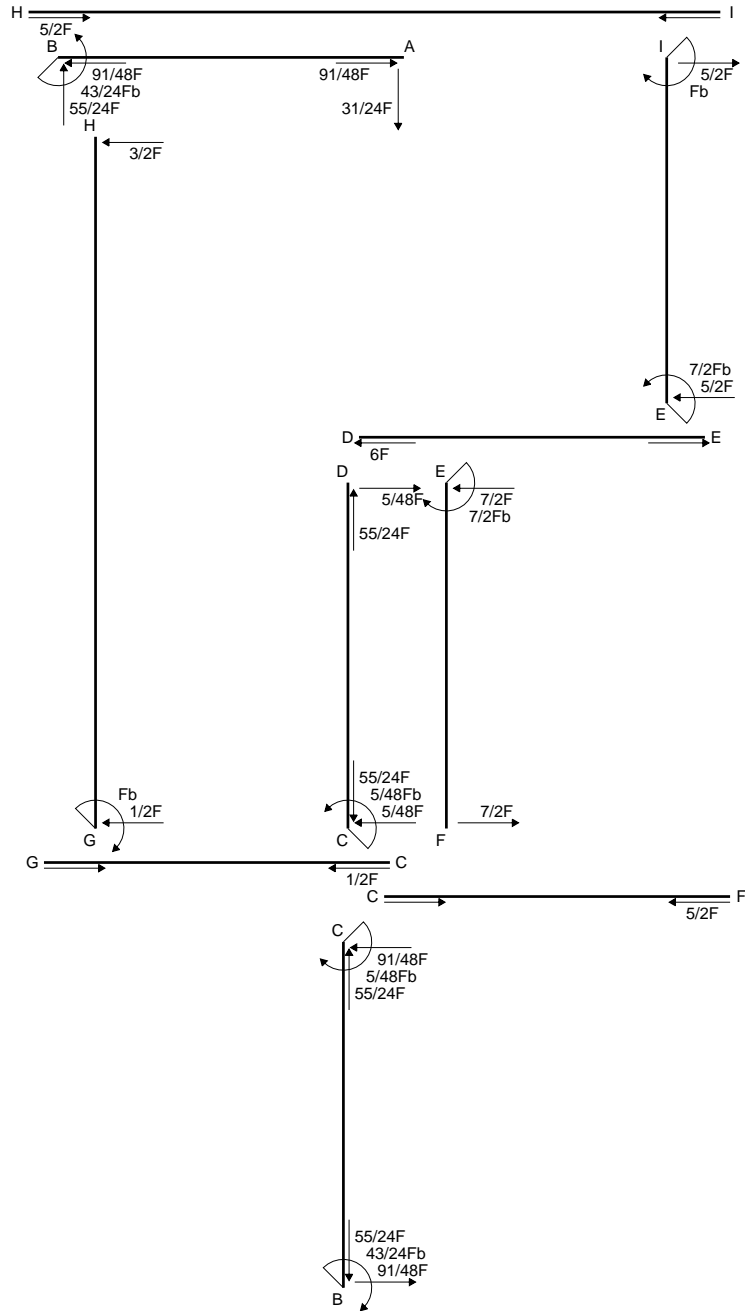
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

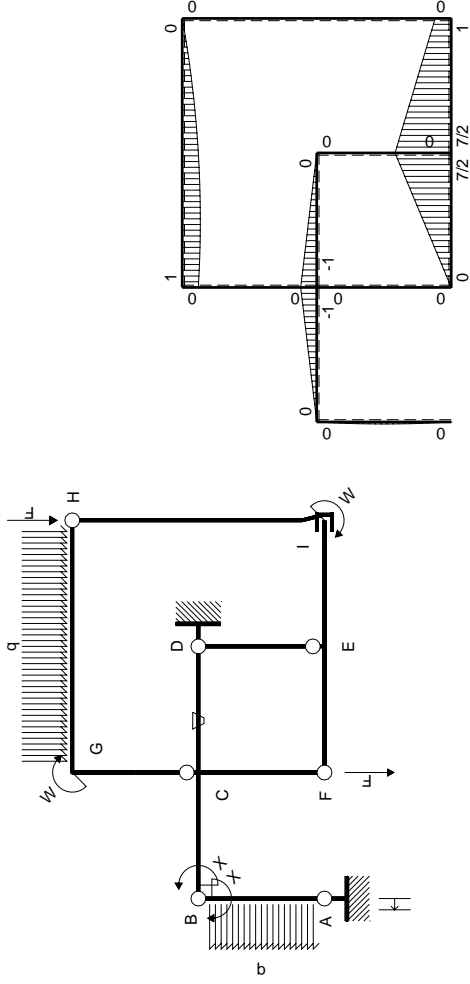
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0
FE b	0	$-7/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$43/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-43/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

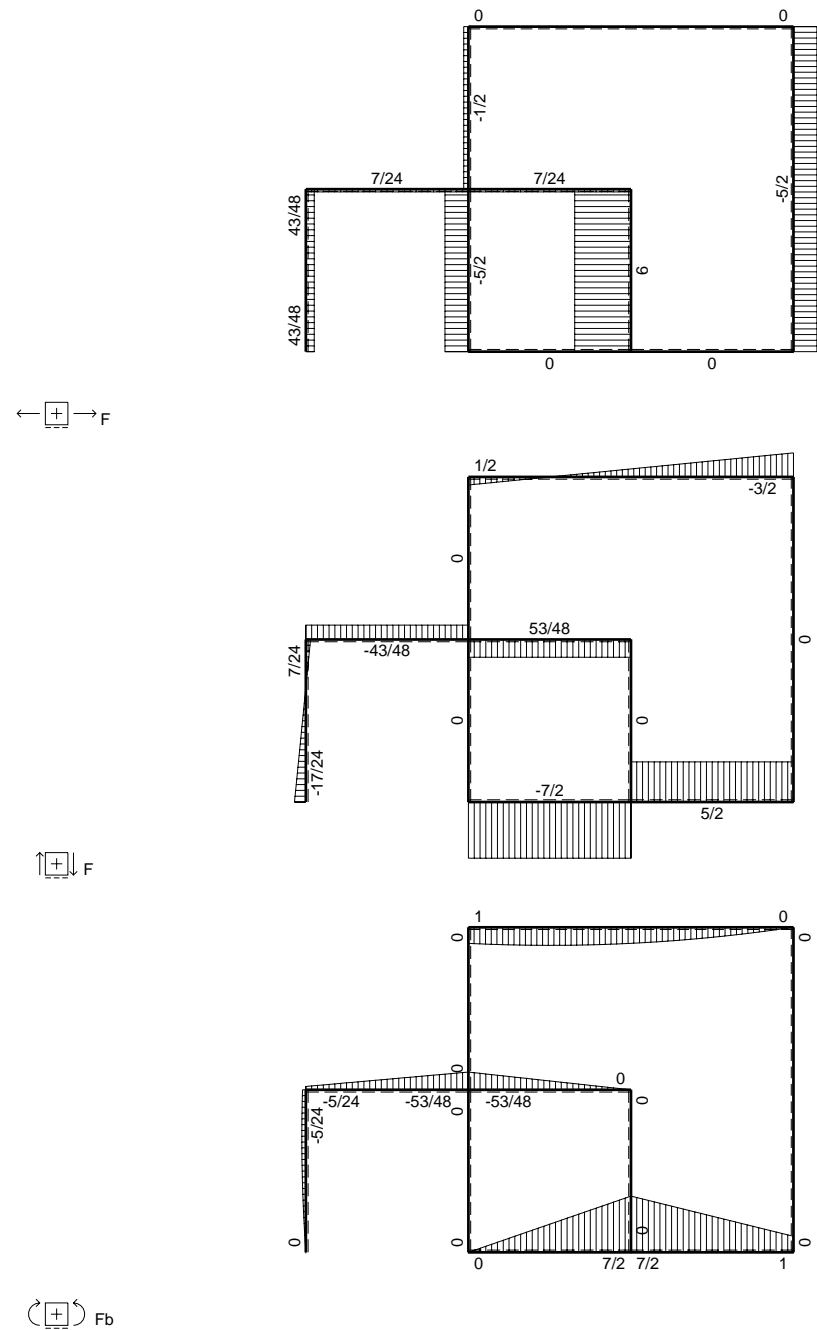
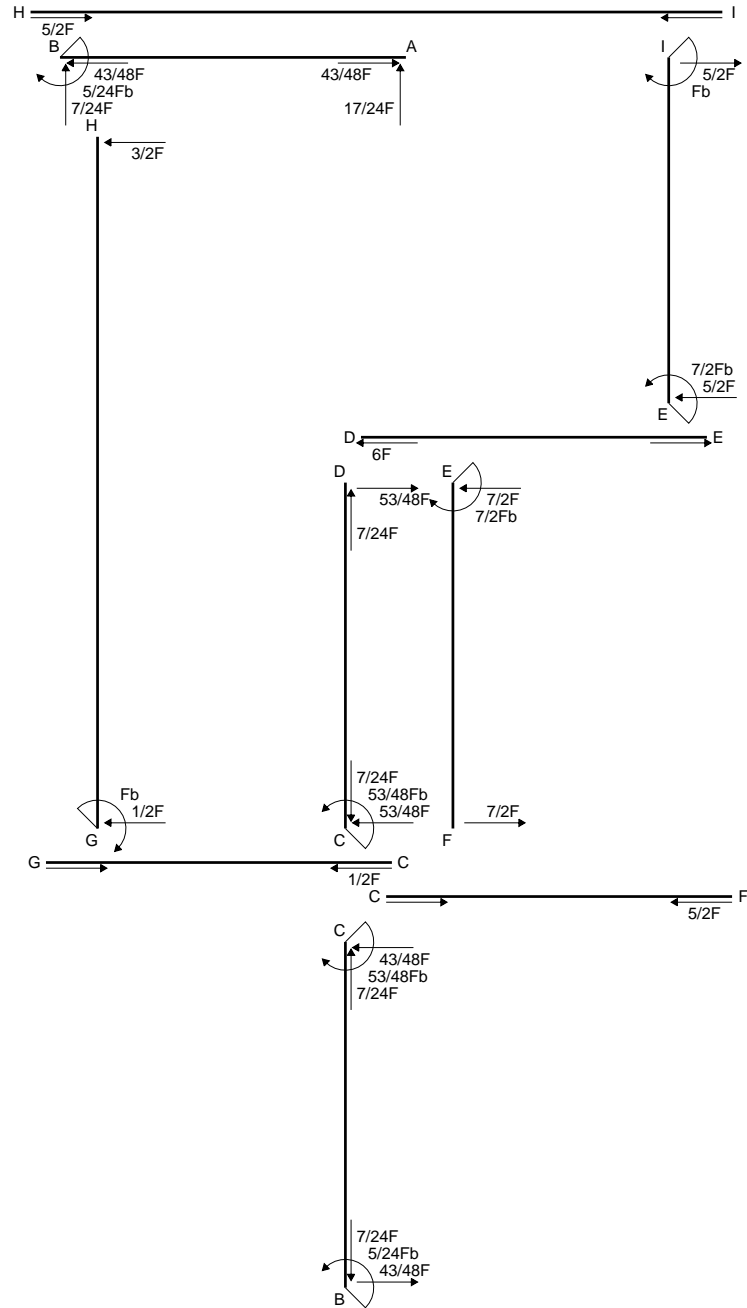
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

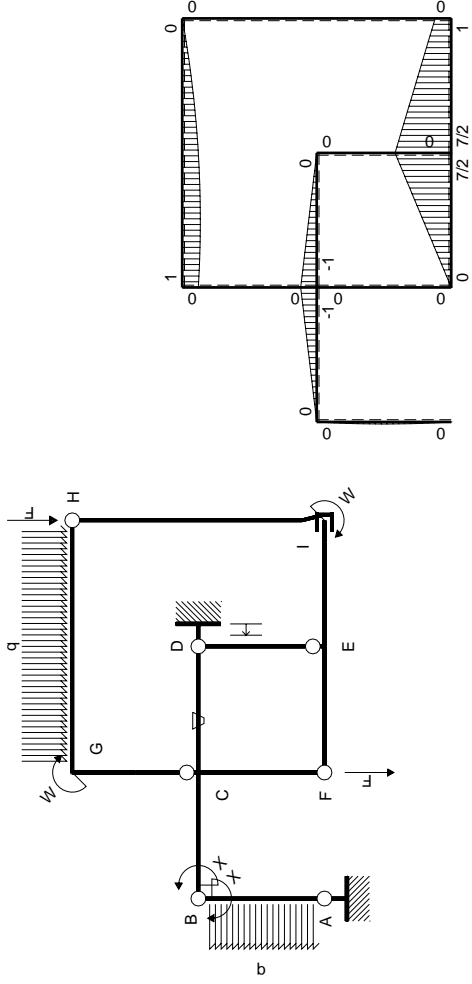
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

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

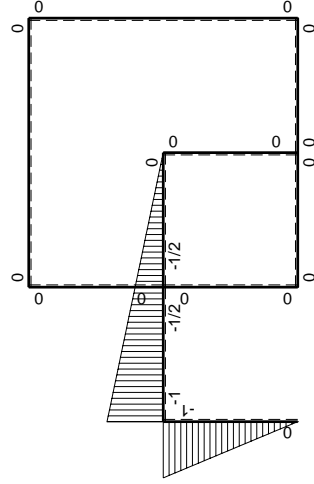
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-5/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$5/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

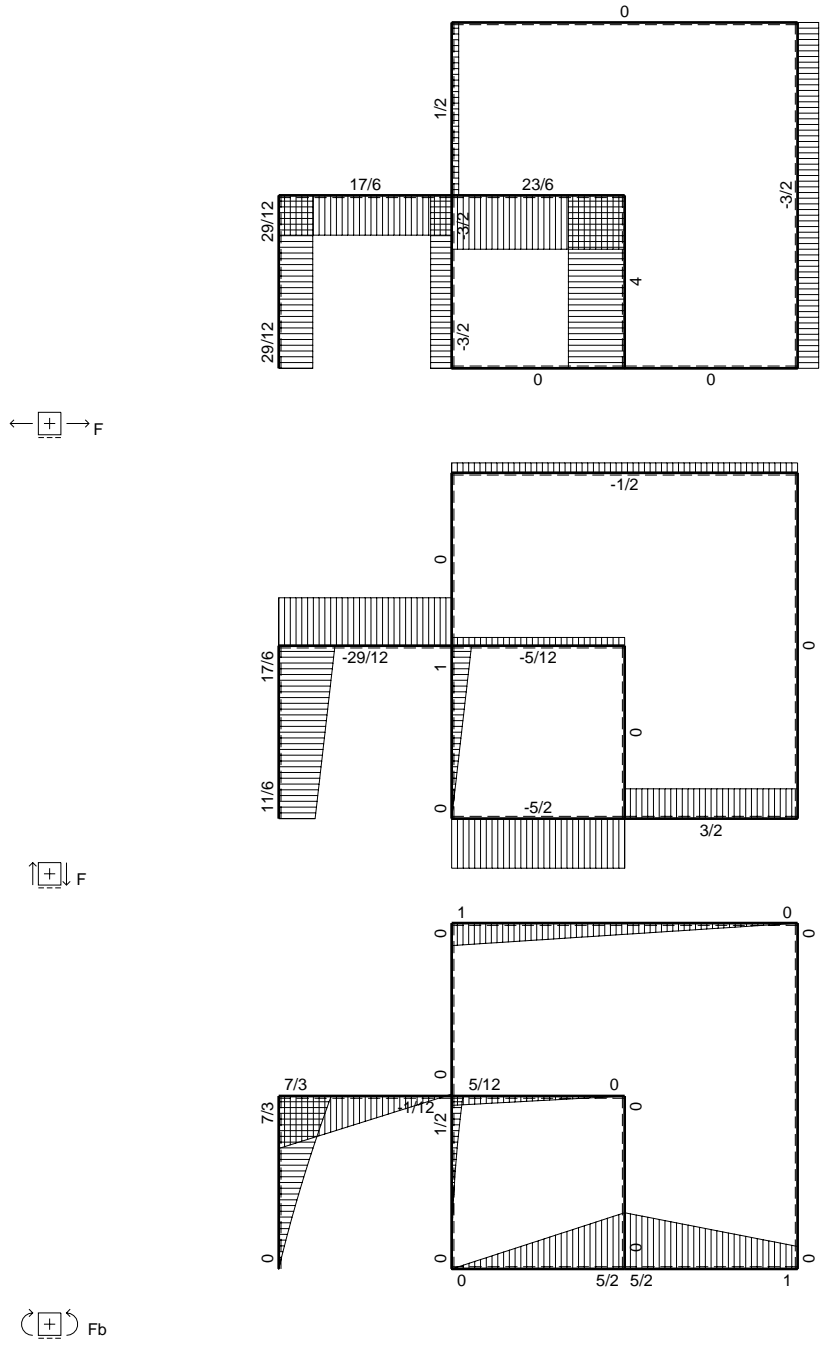
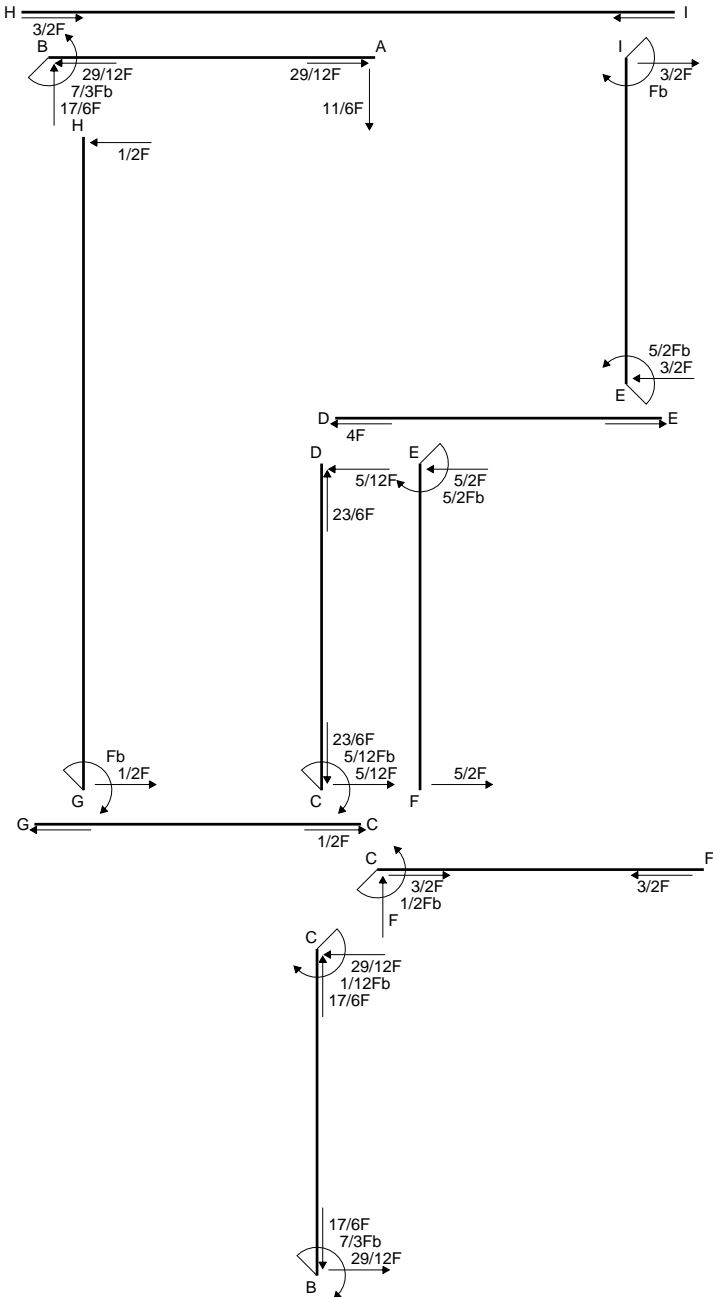
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

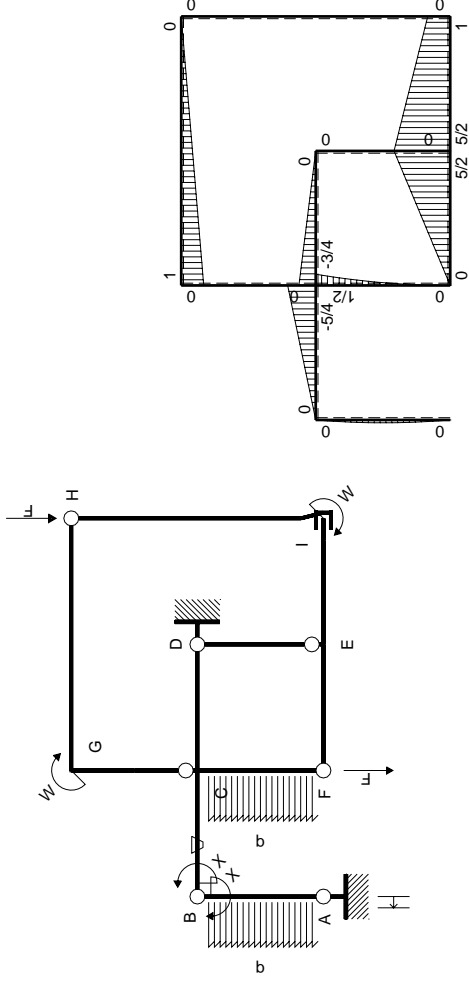
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

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

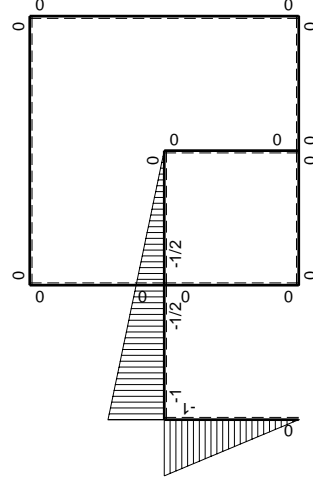
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

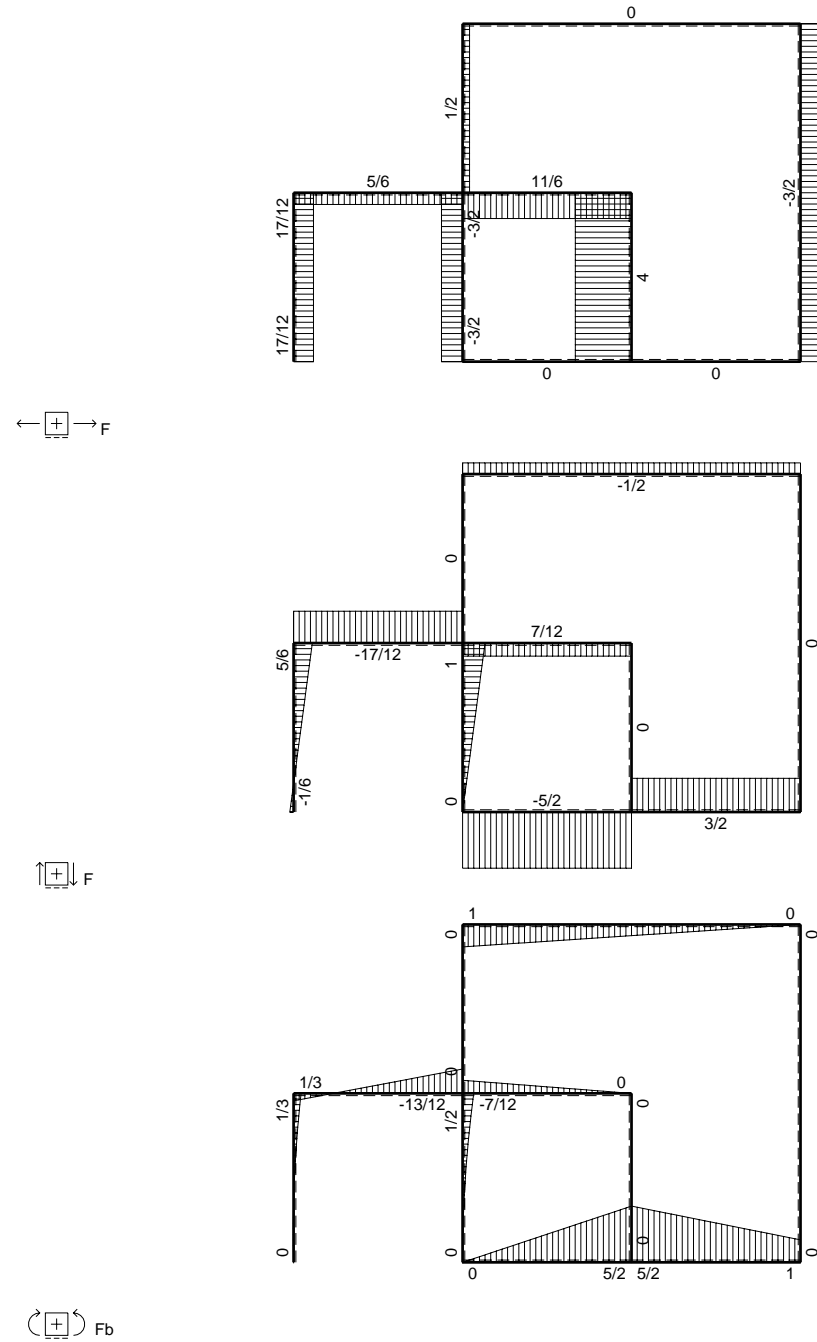
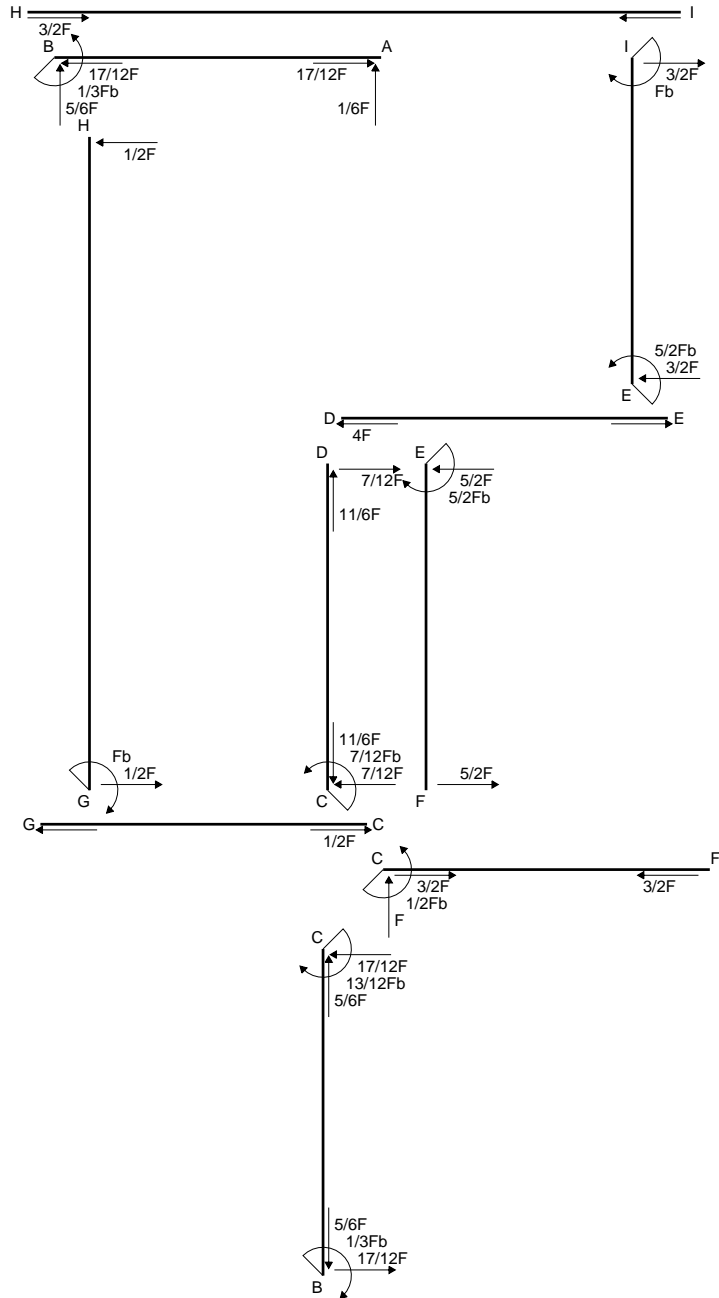
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

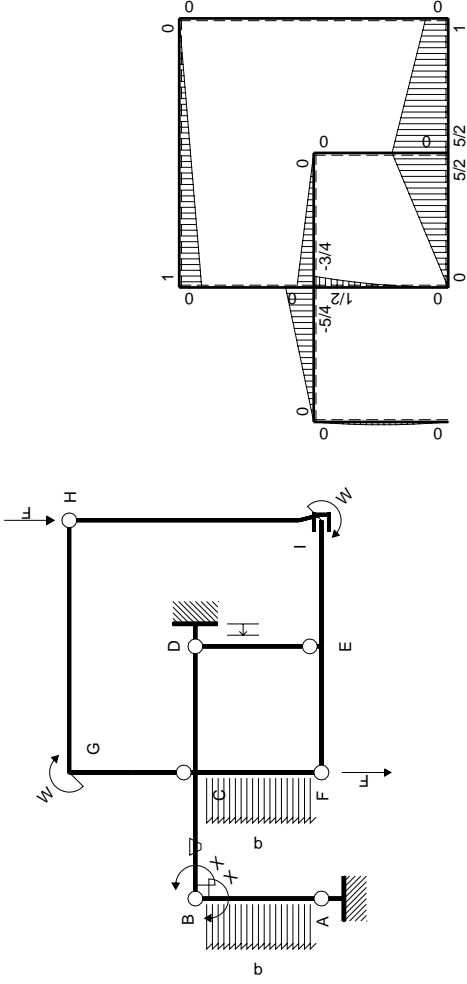
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

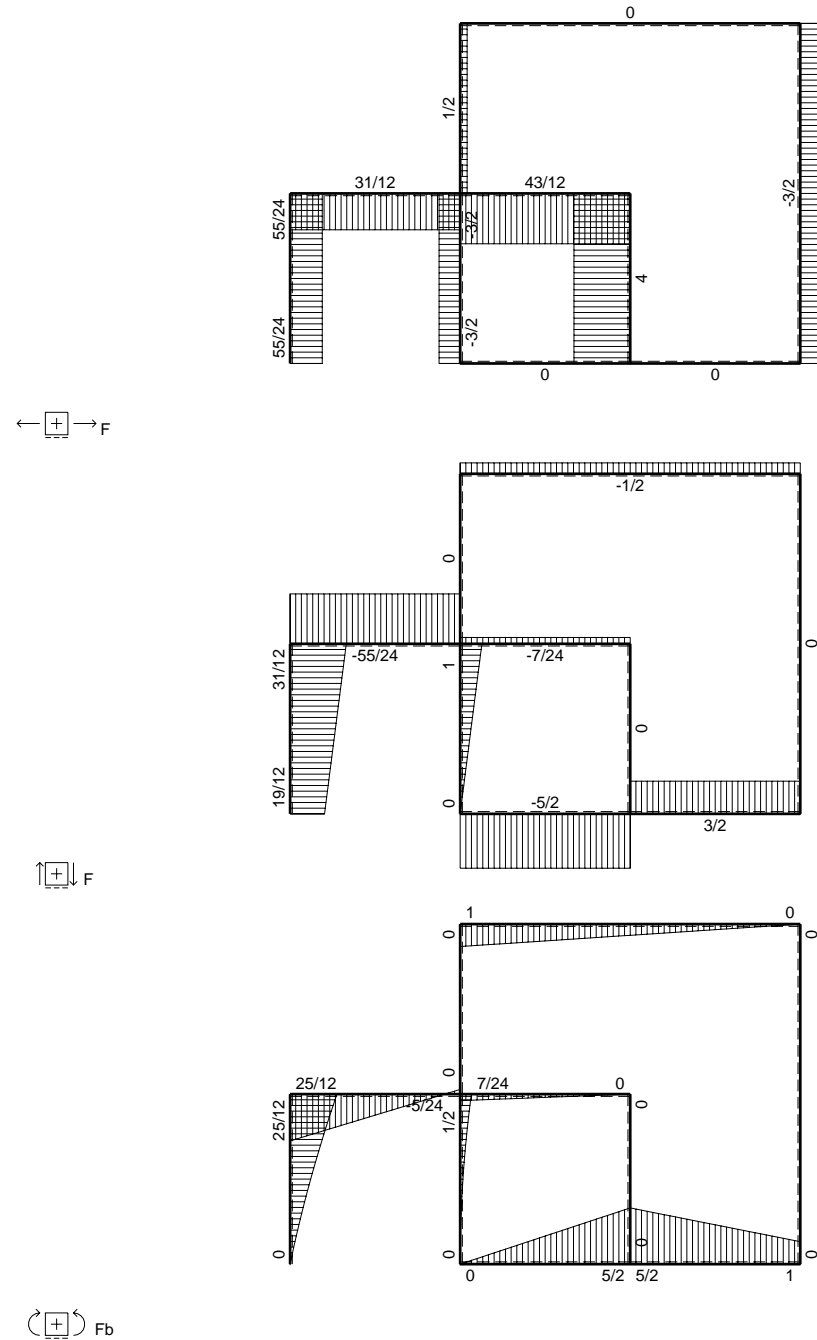
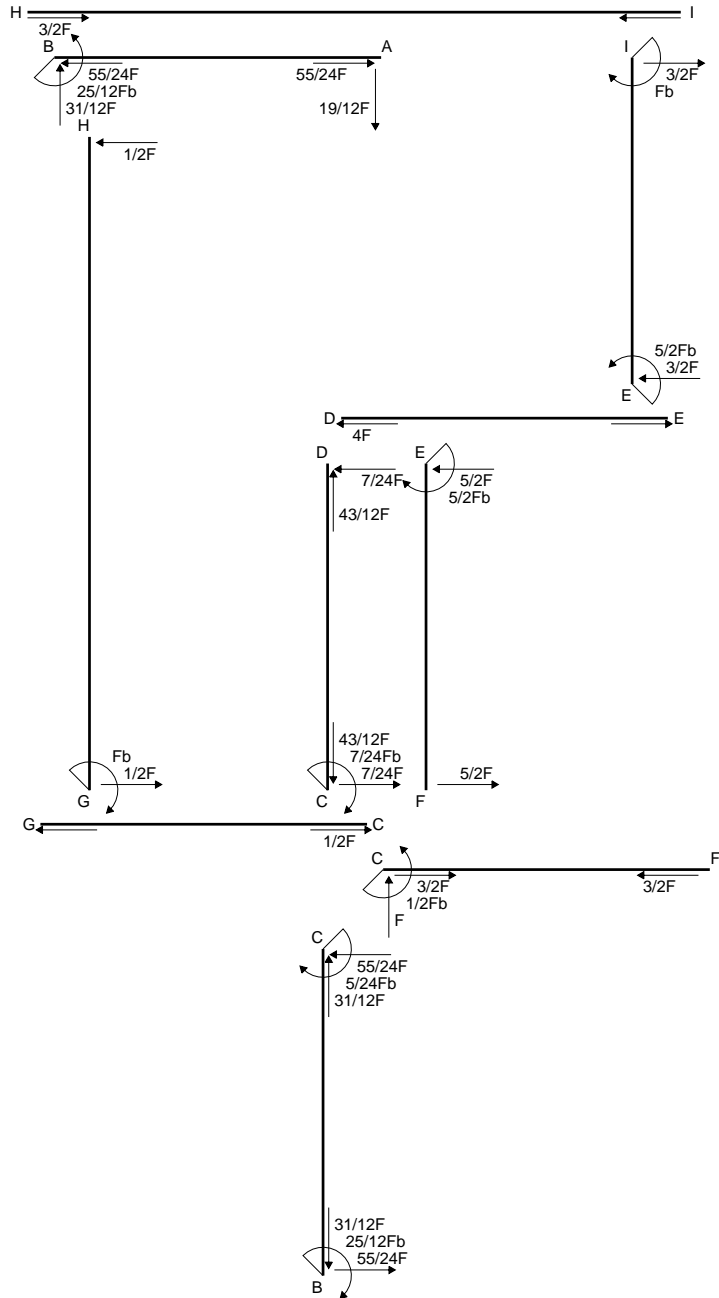
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

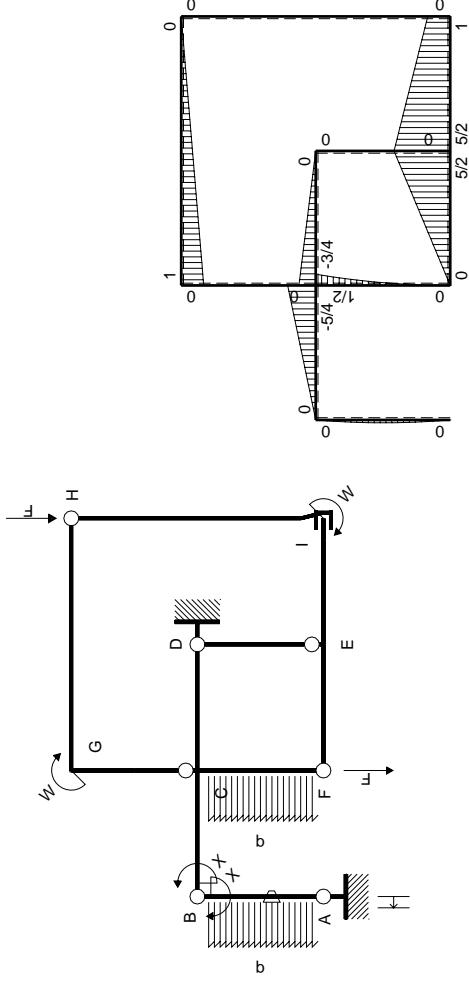
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

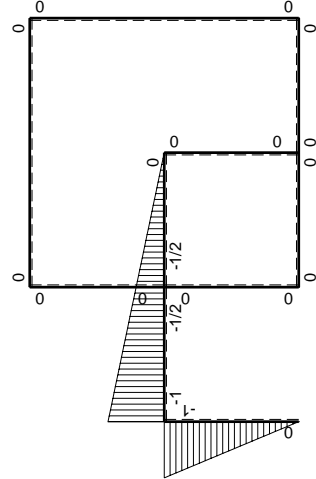
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$25/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-25/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

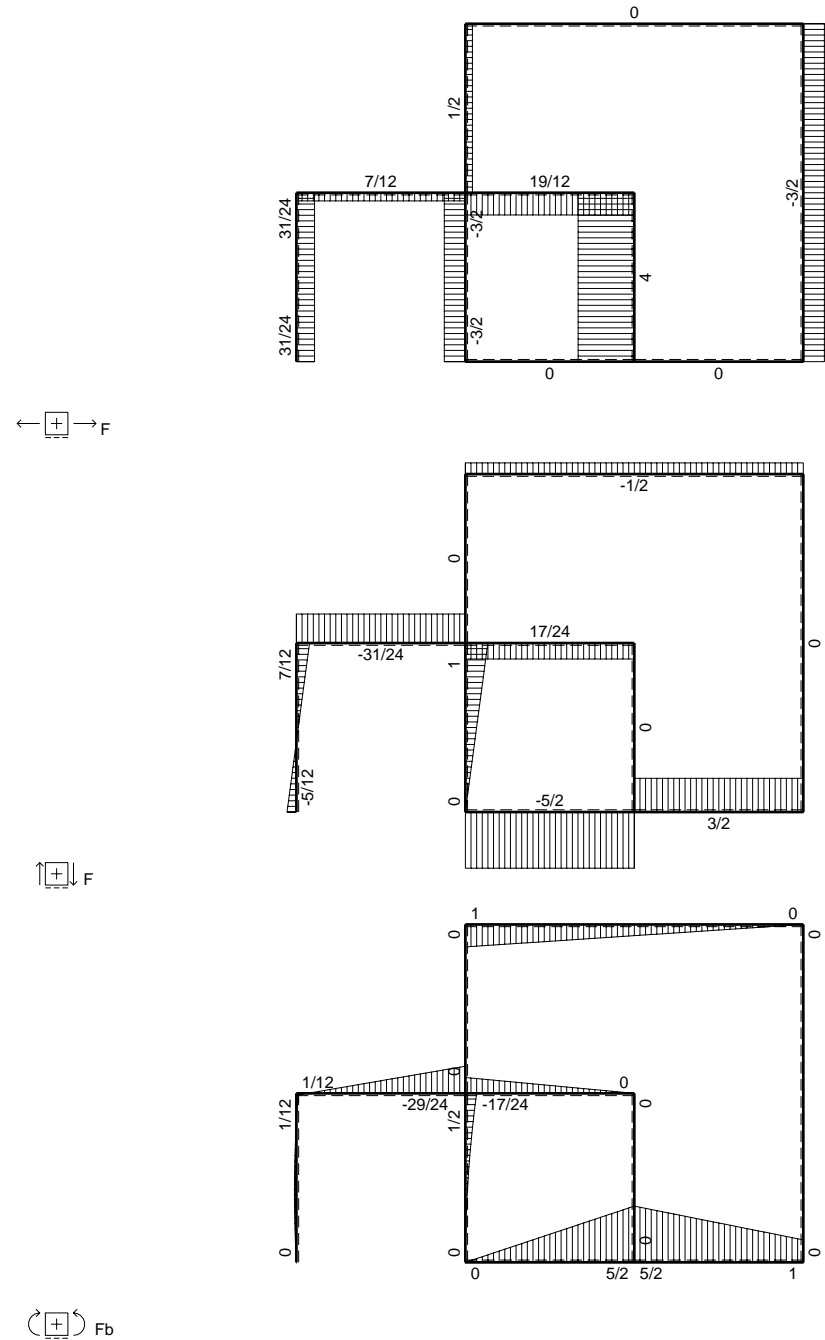
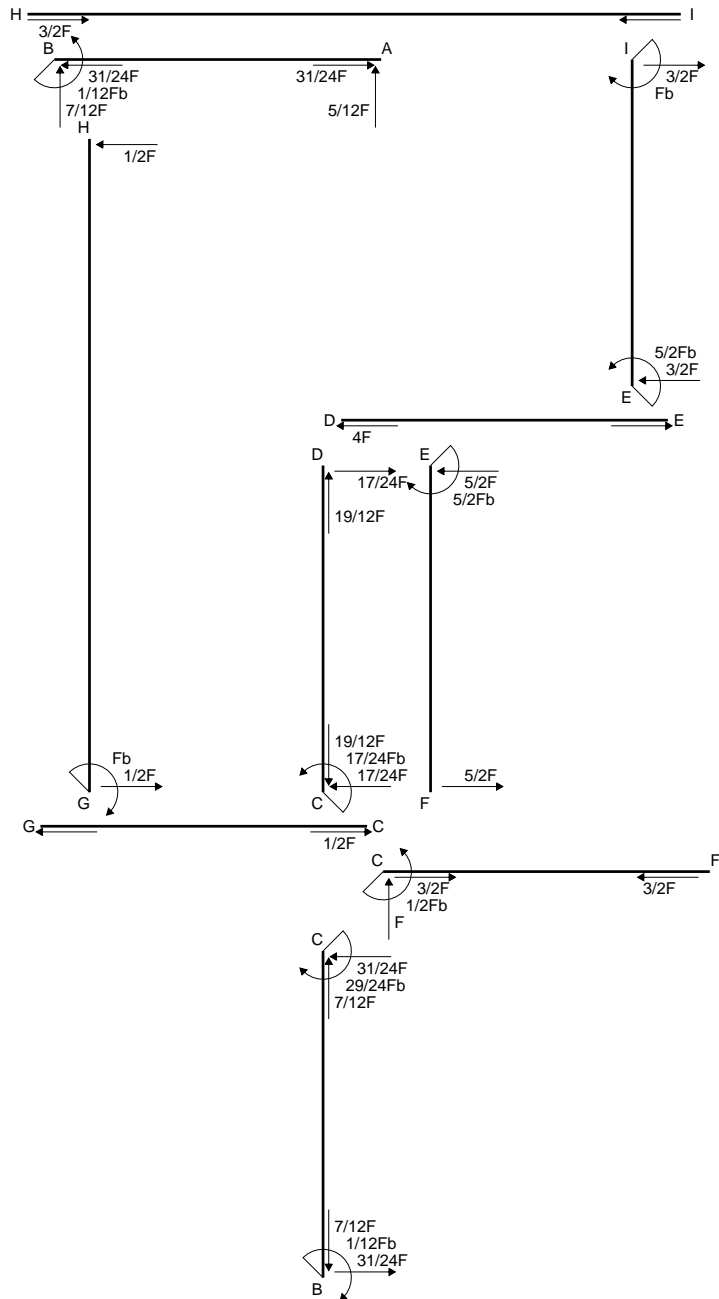
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

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

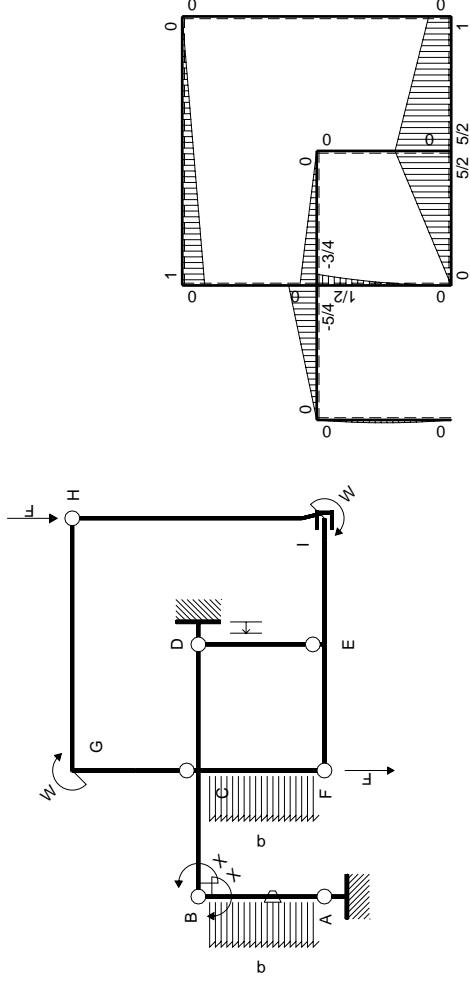
$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

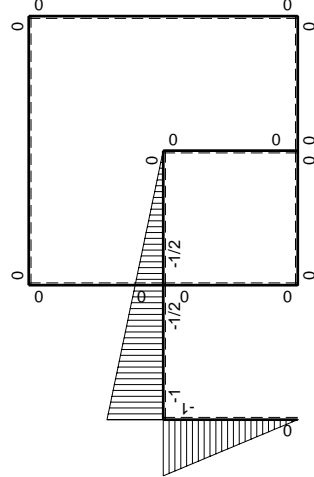


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

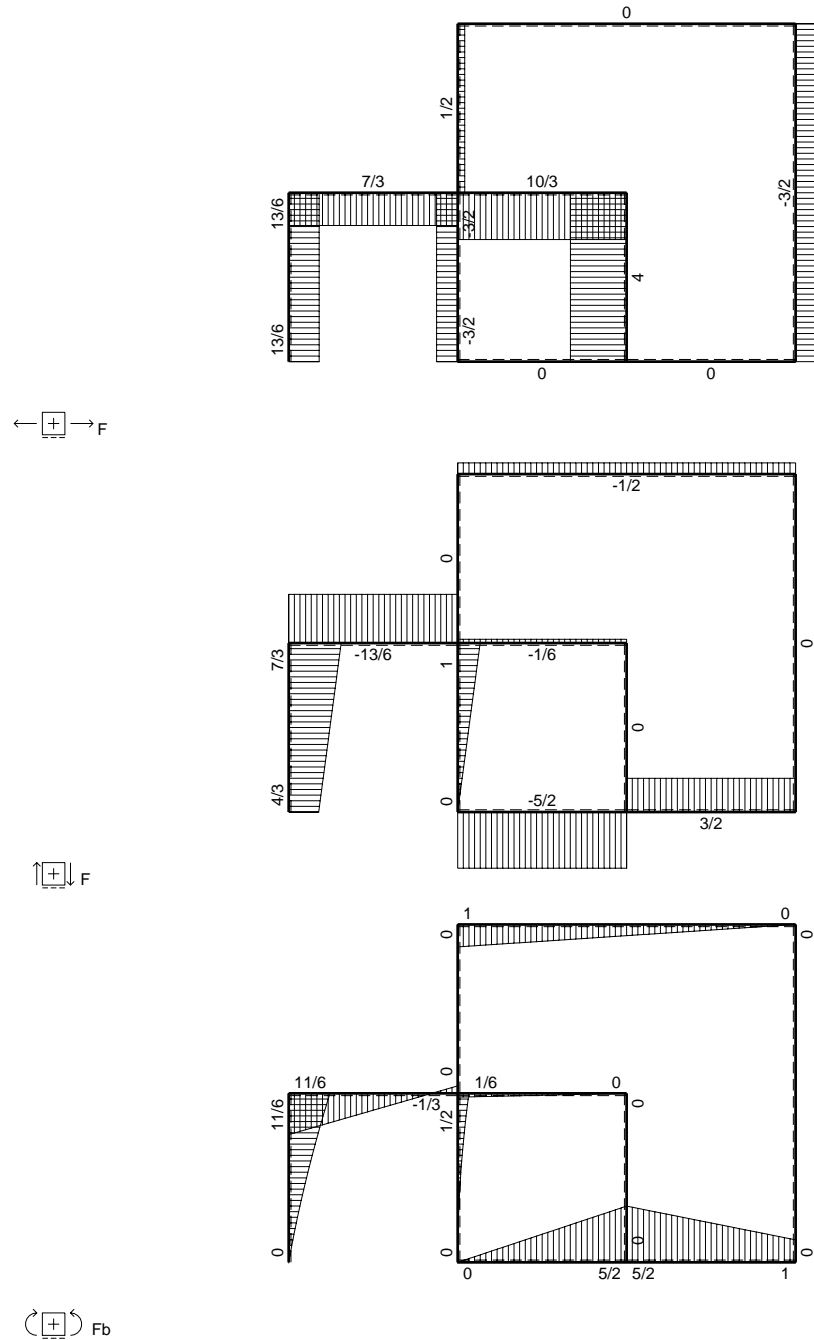
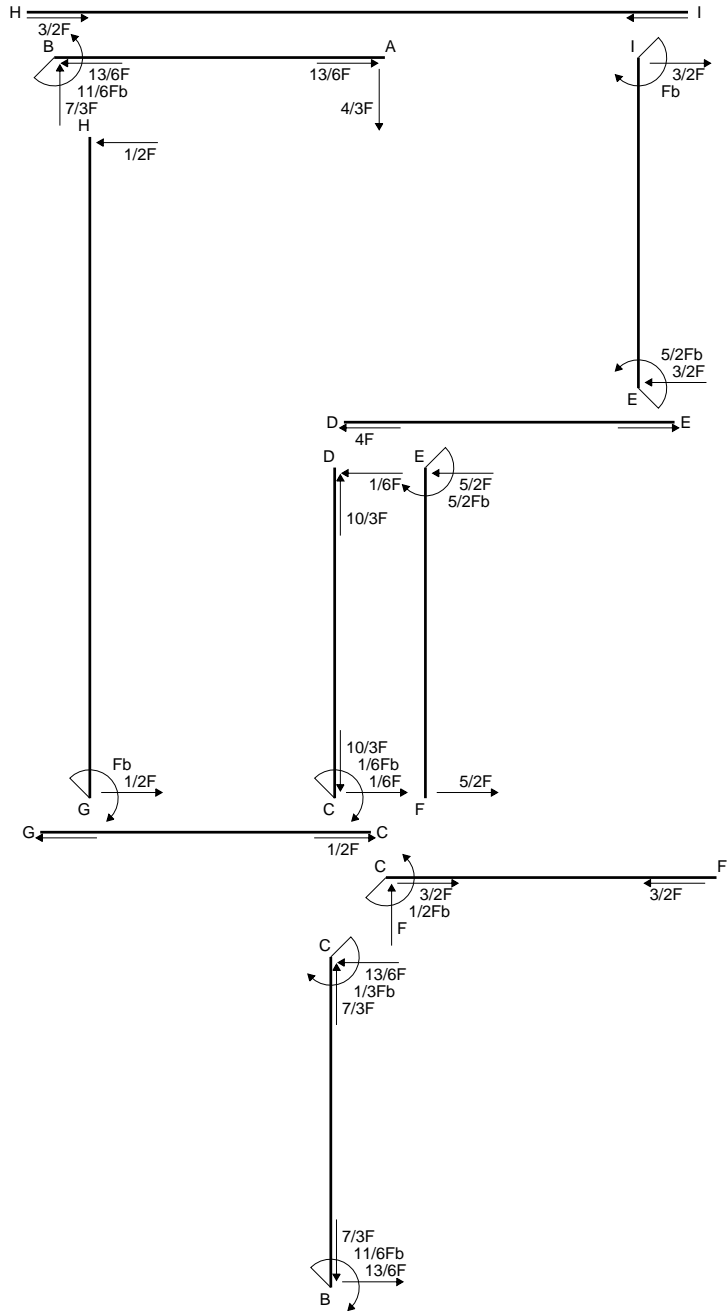
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

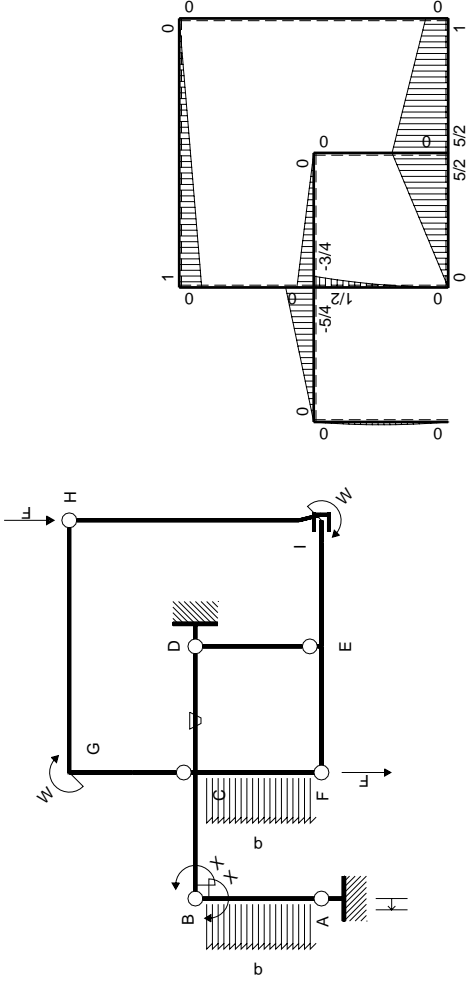
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$11/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-11/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

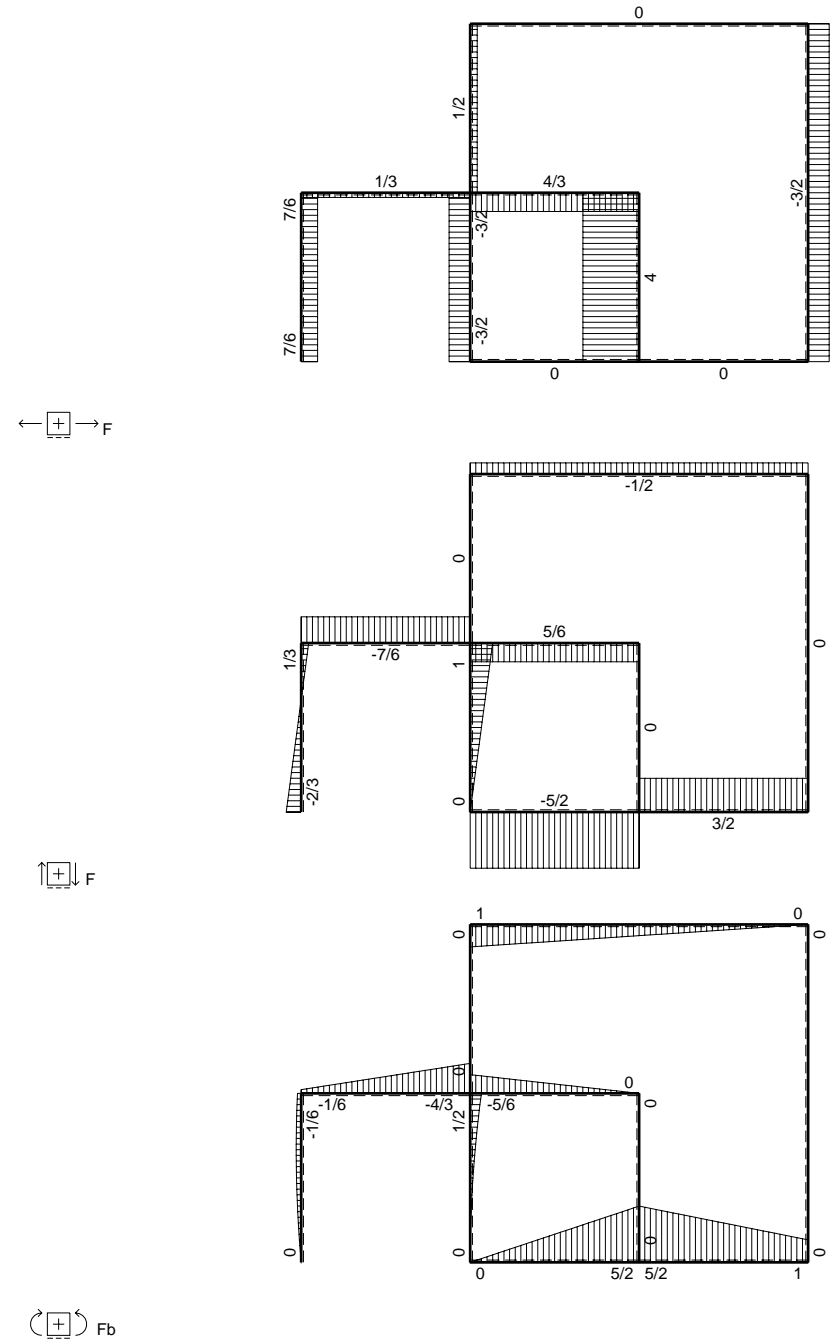
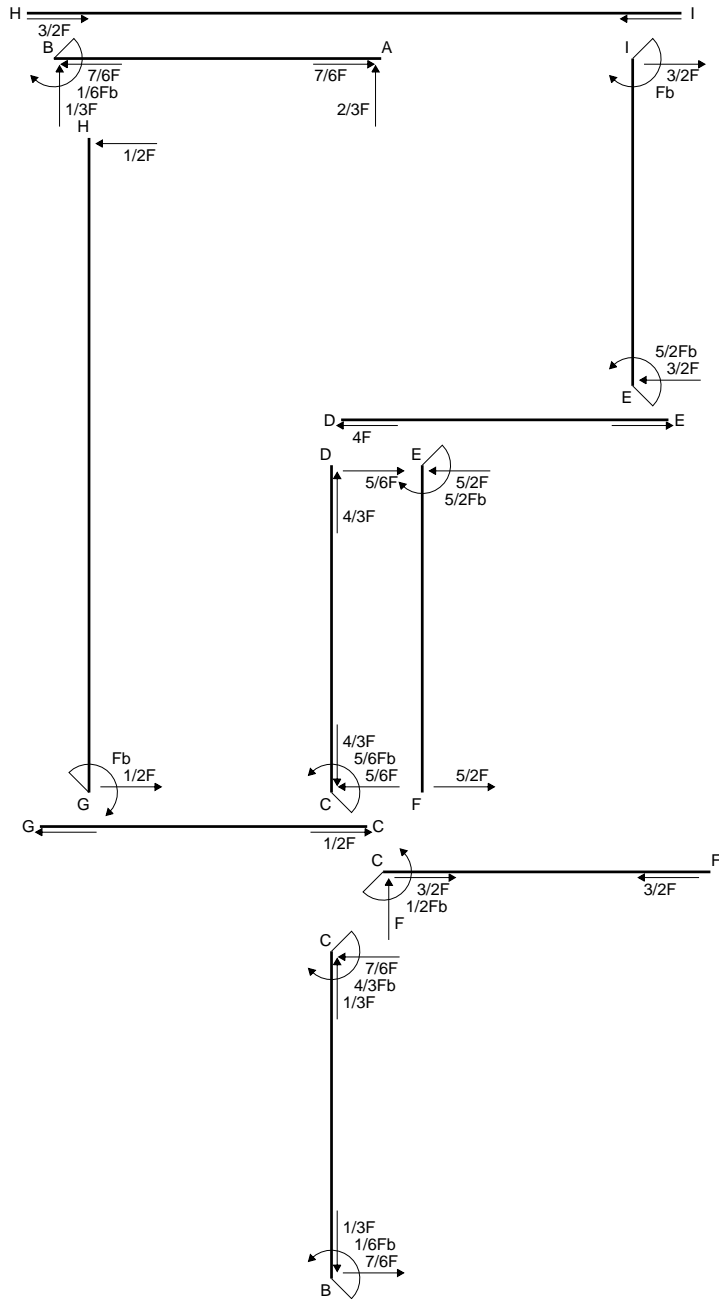
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

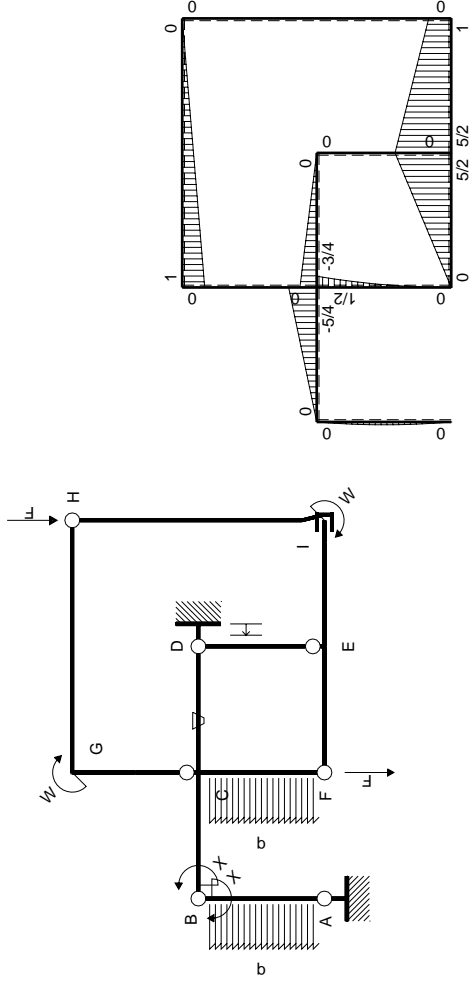
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

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





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

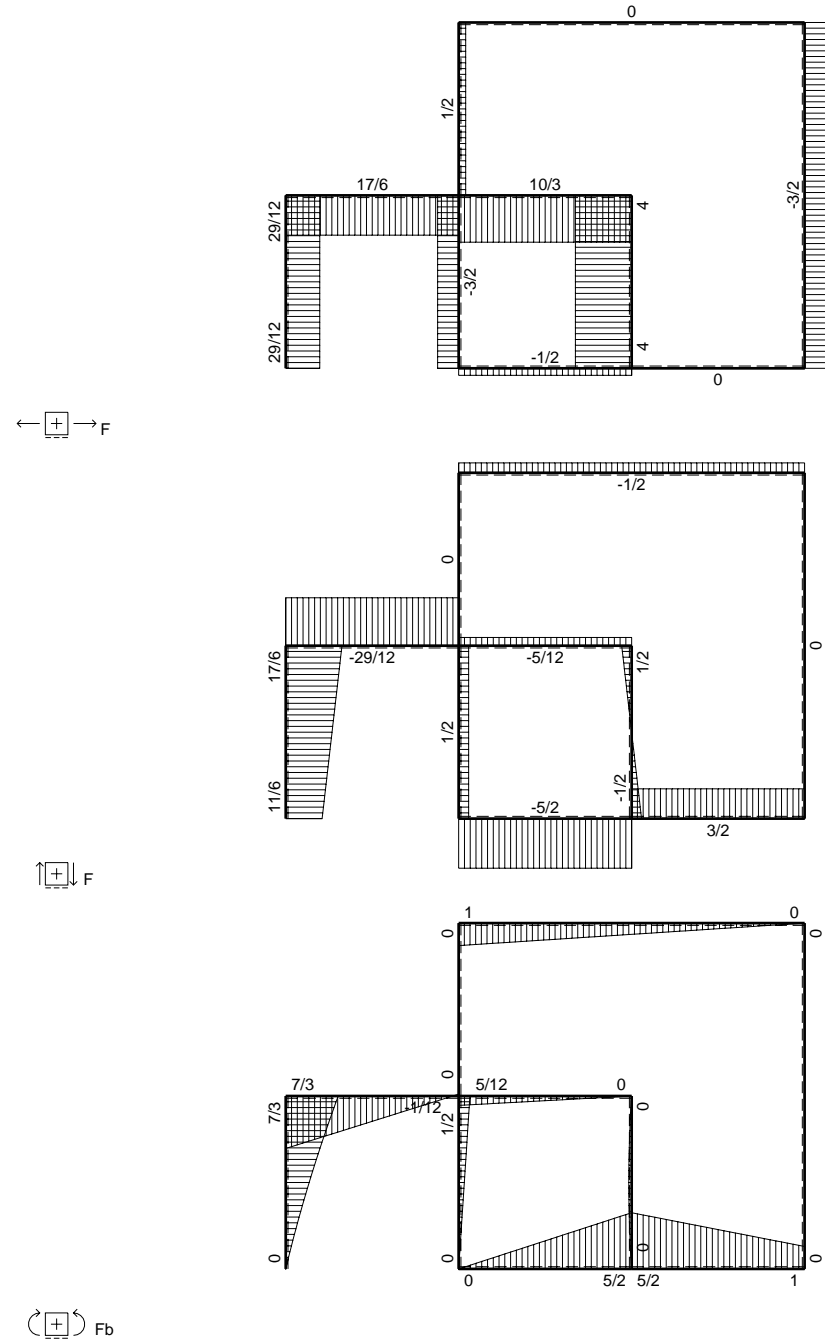
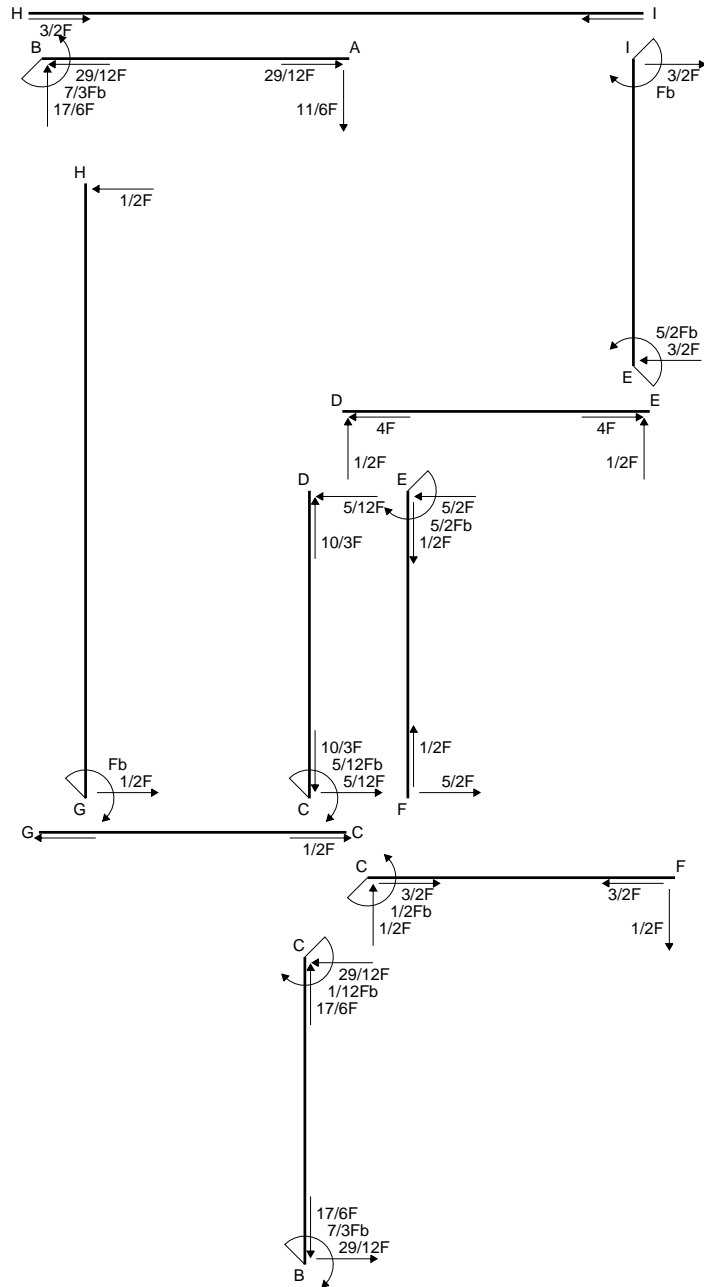
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

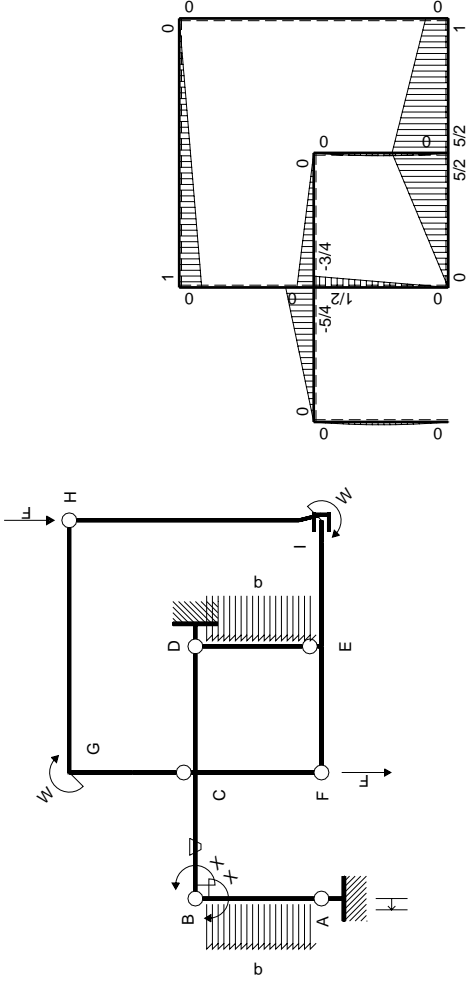
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

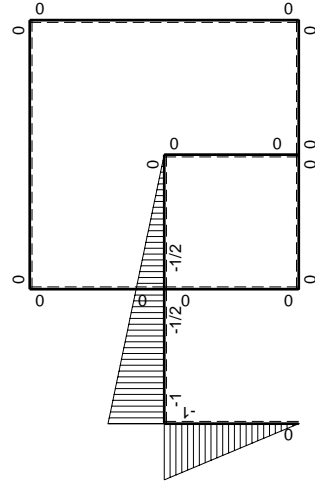
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

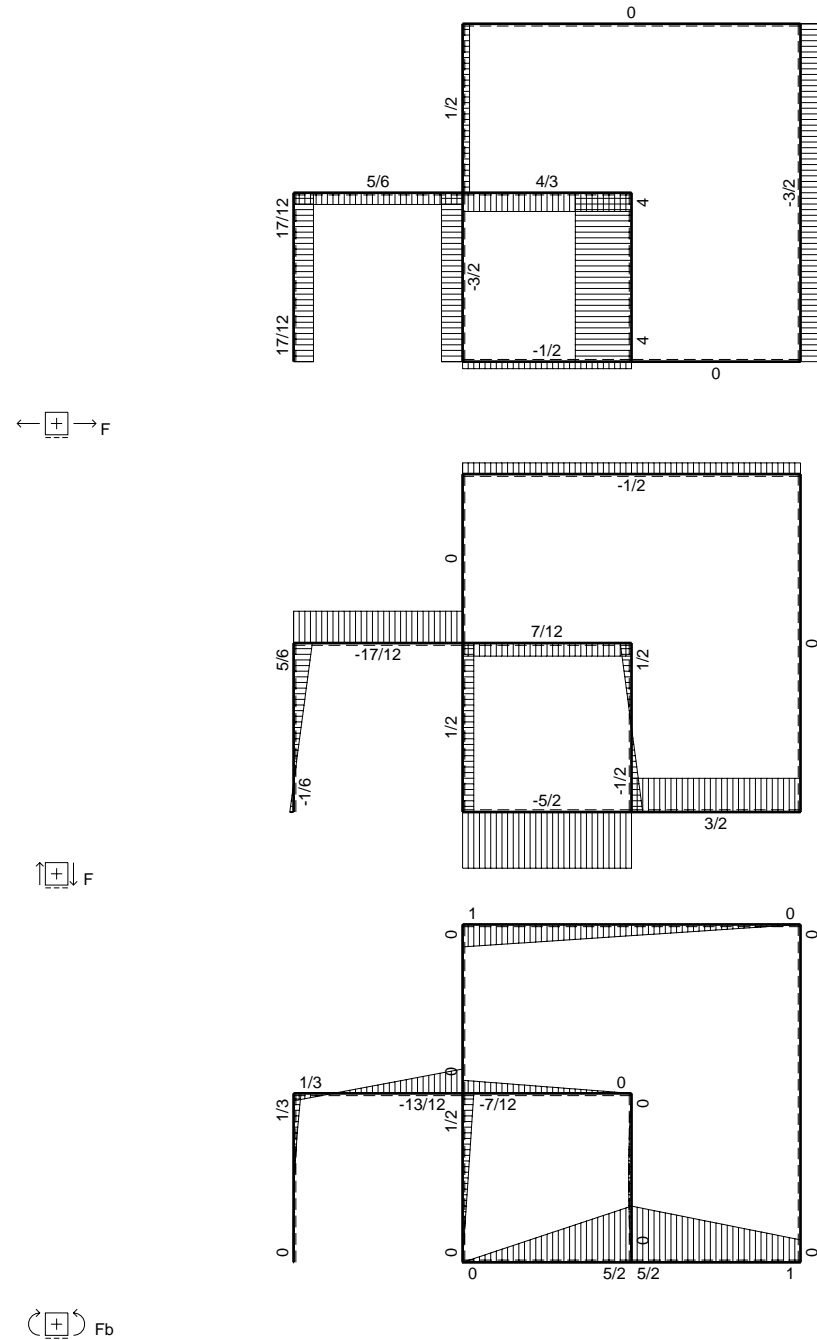
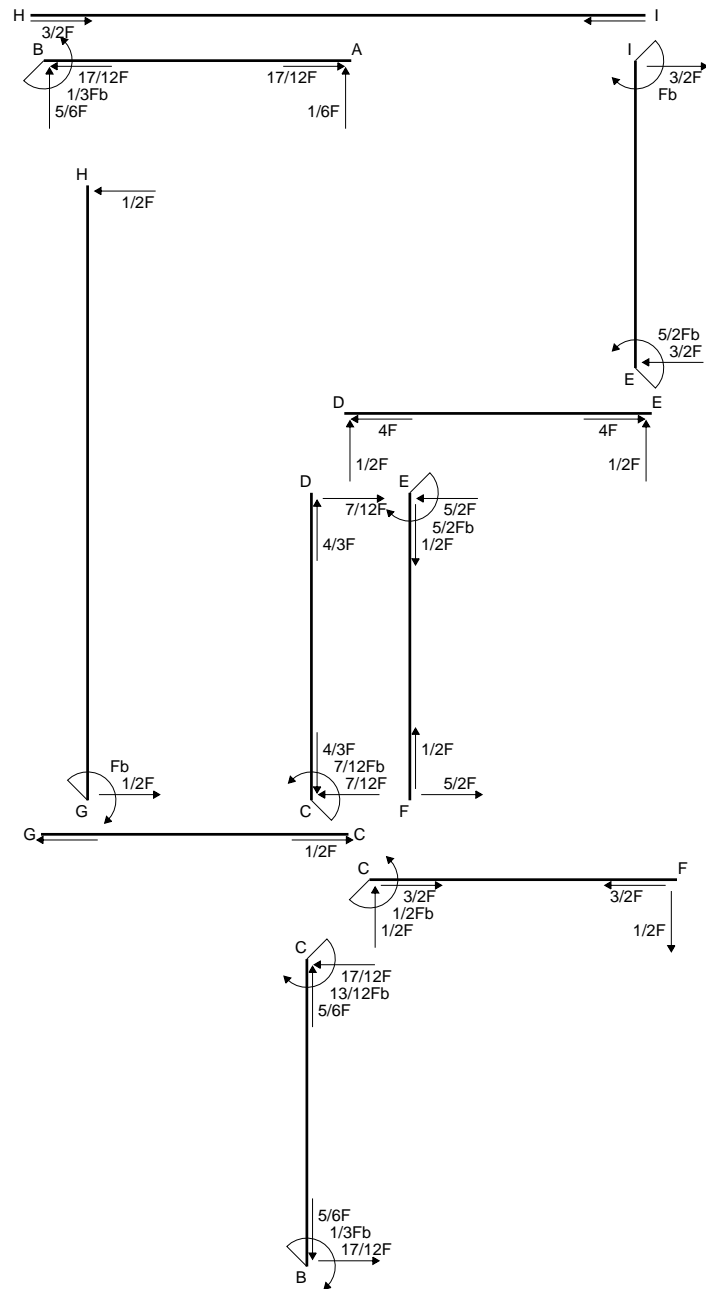
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

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

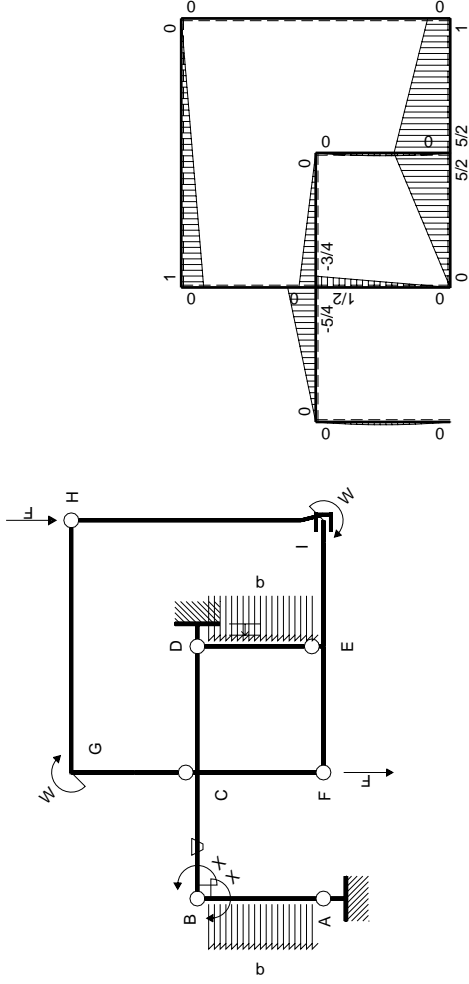
$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$



$\left[\begin{array}{c} + \\ - \end{array} \right] F_b$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/3Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

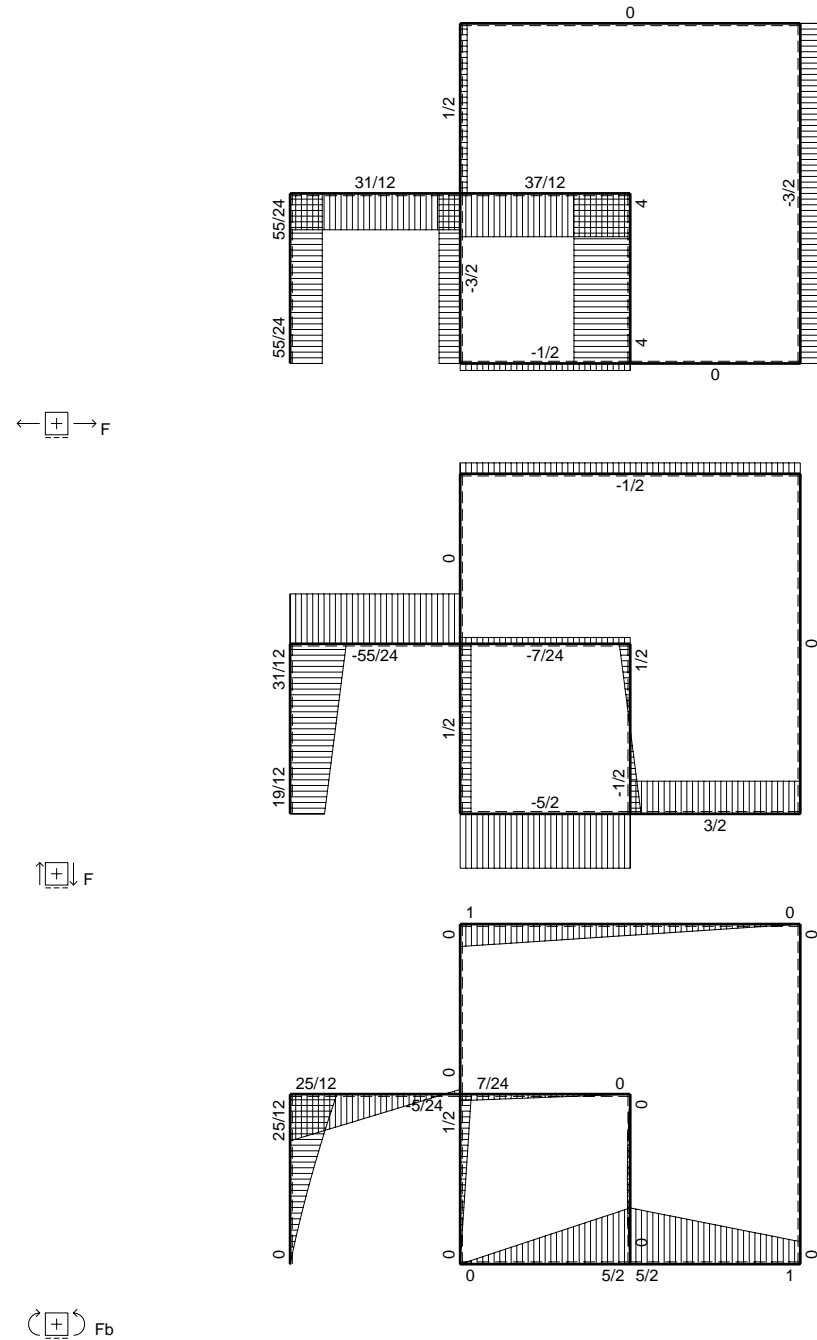
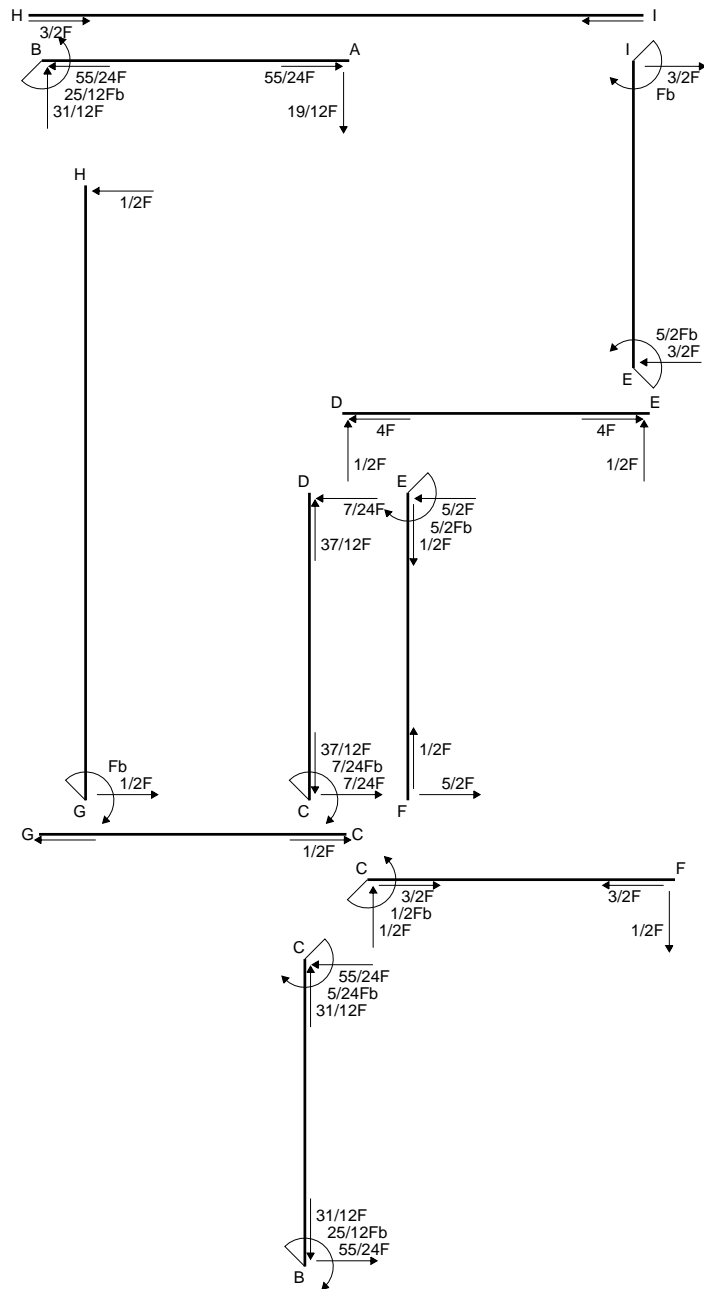
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

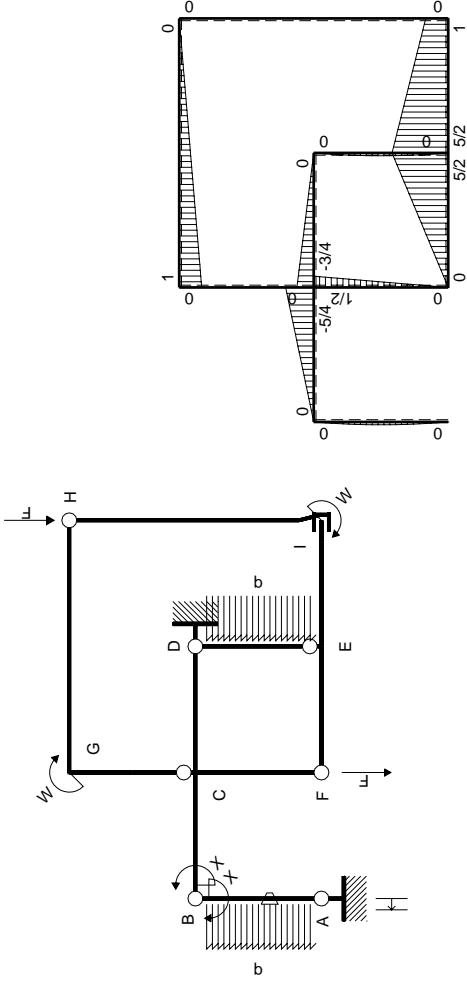
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$25/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-25/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

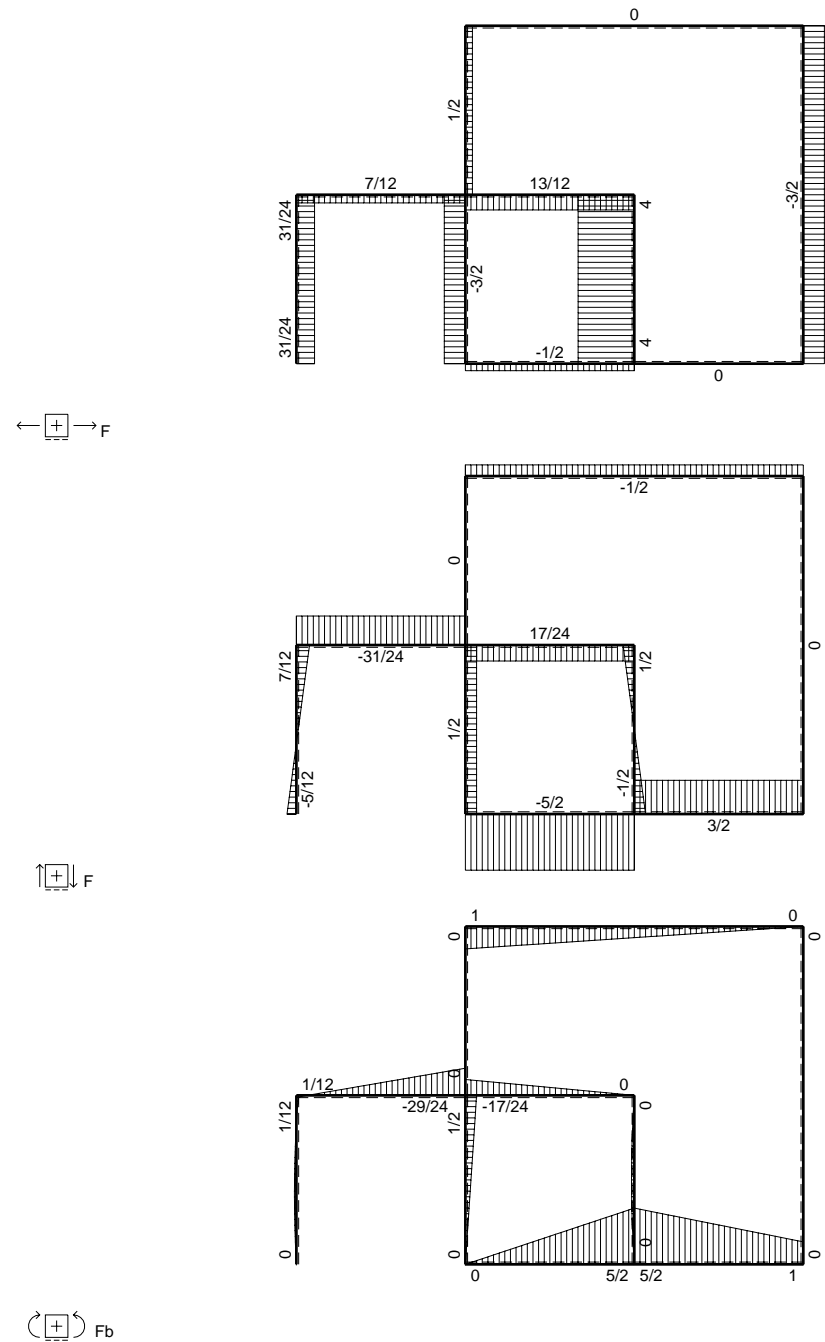
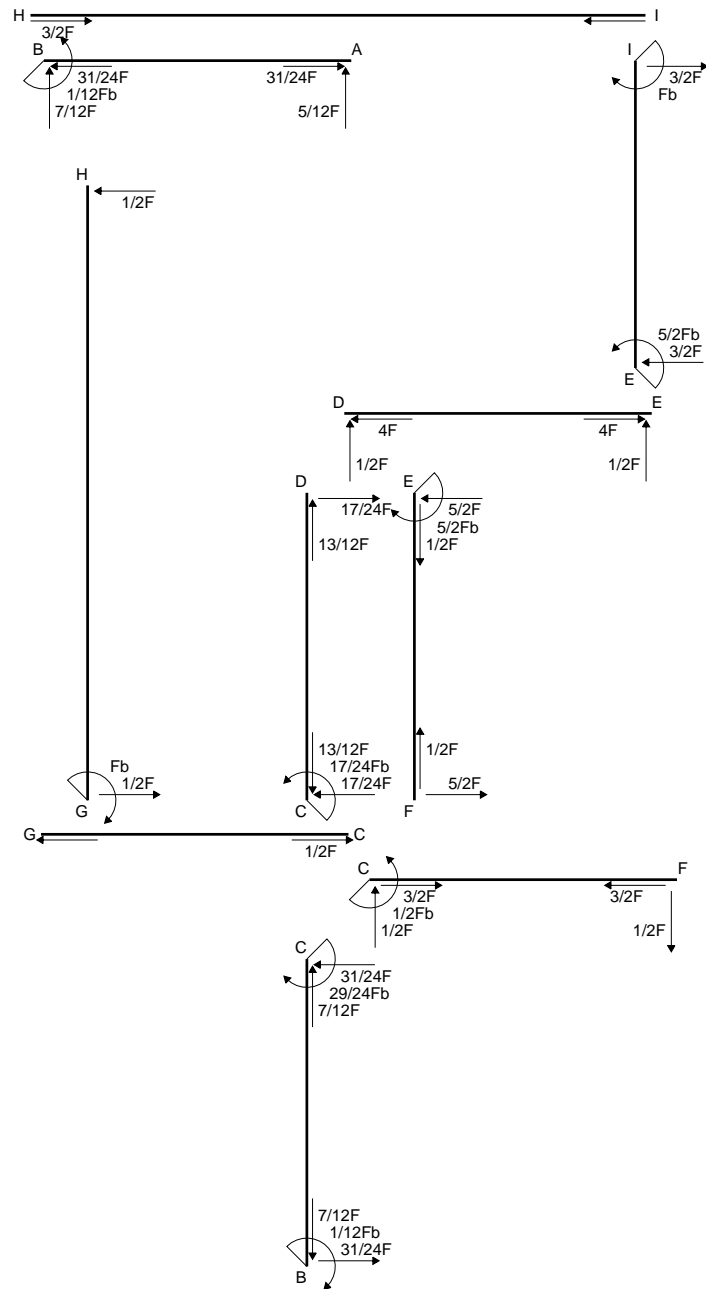
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

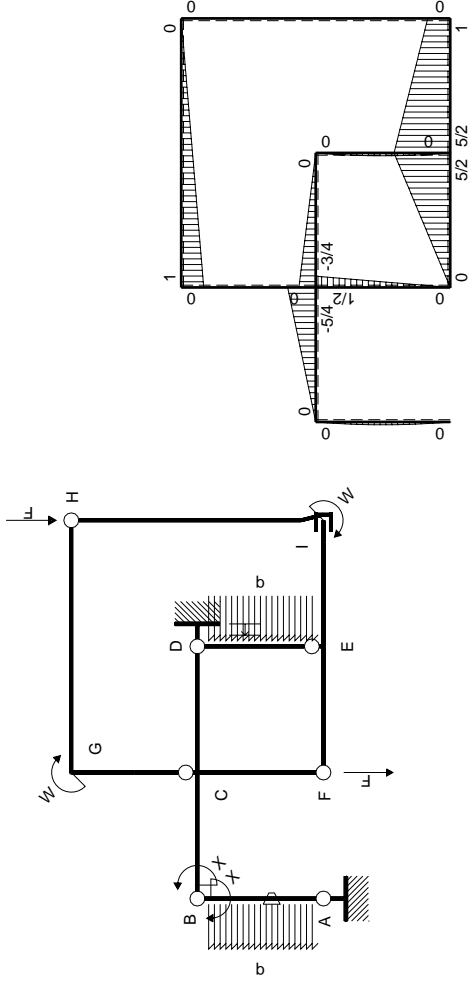
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/12Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

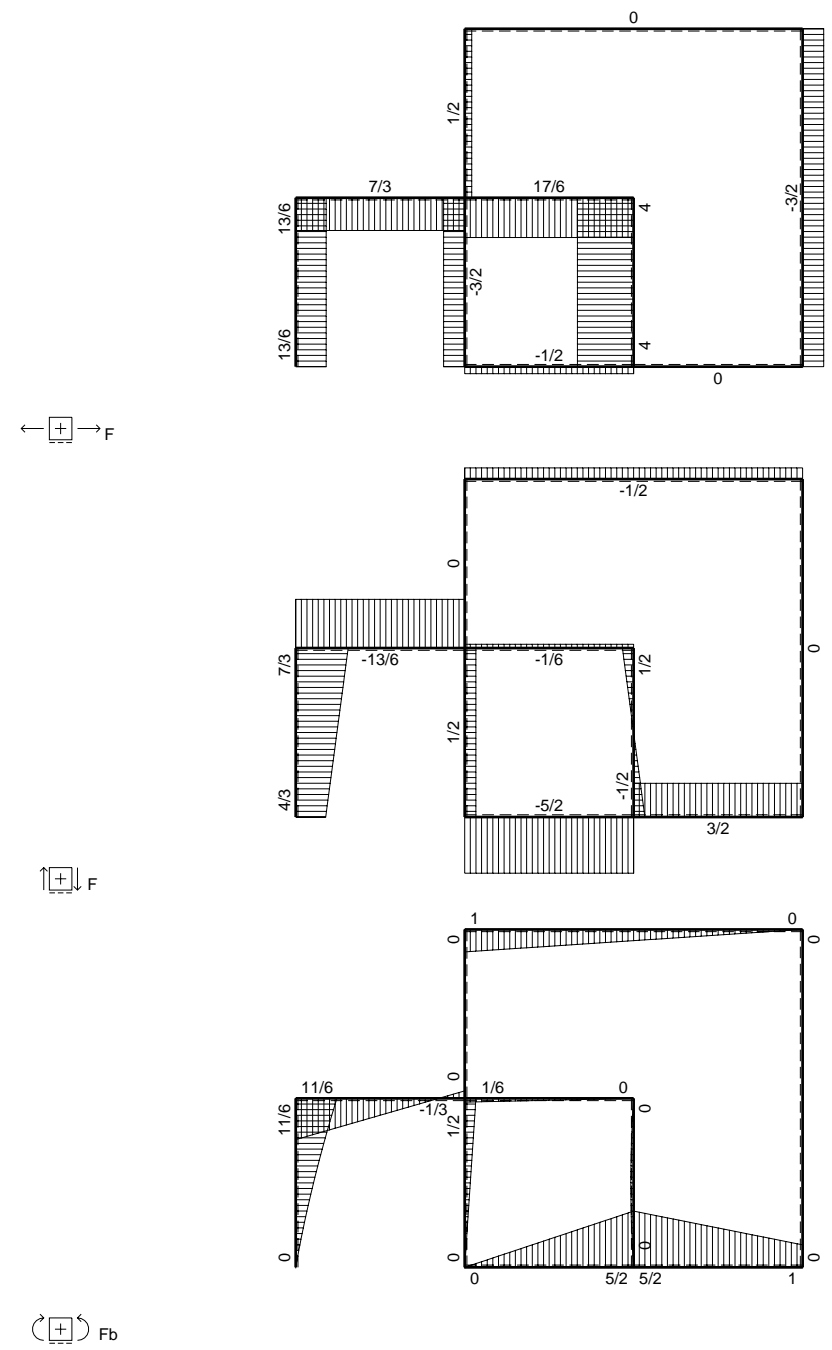
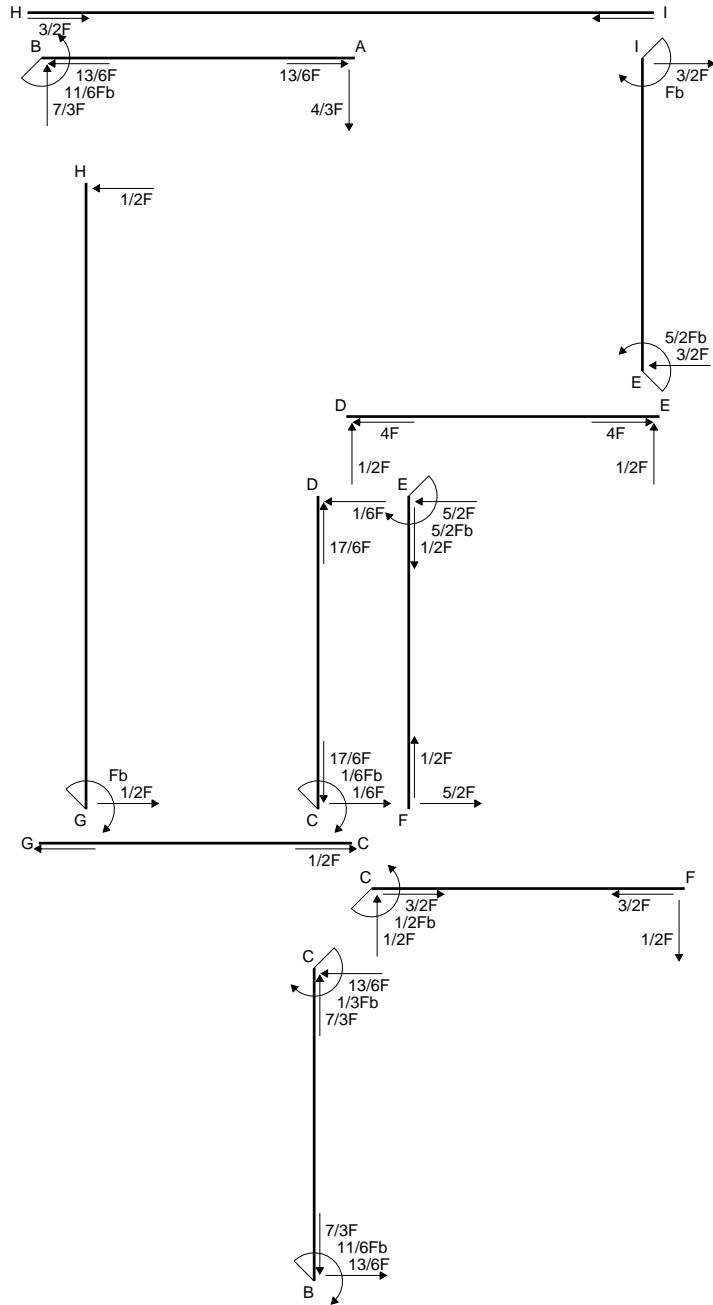
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

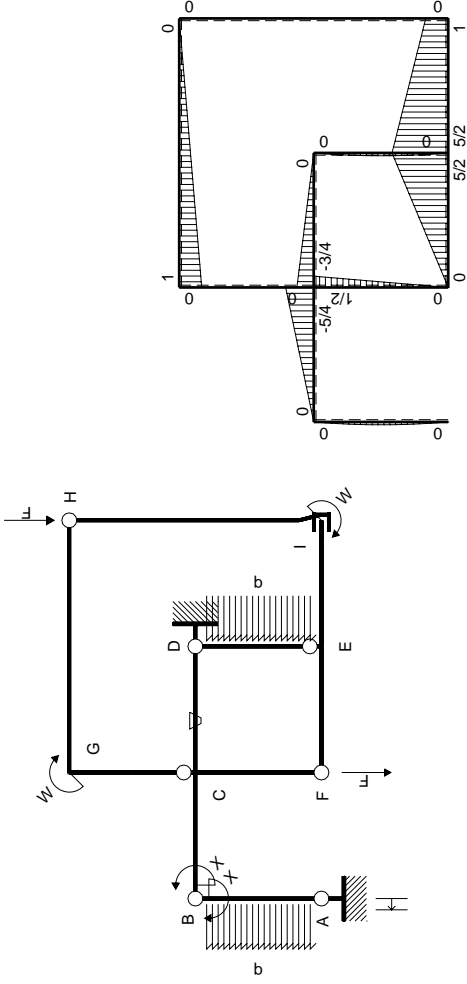
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

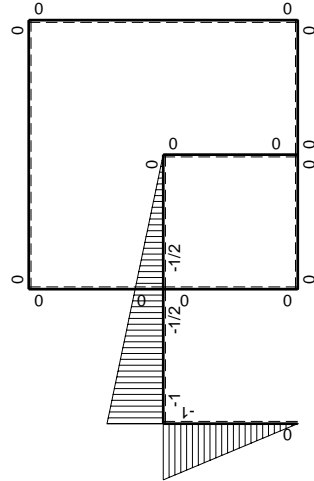
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$11/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-11/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

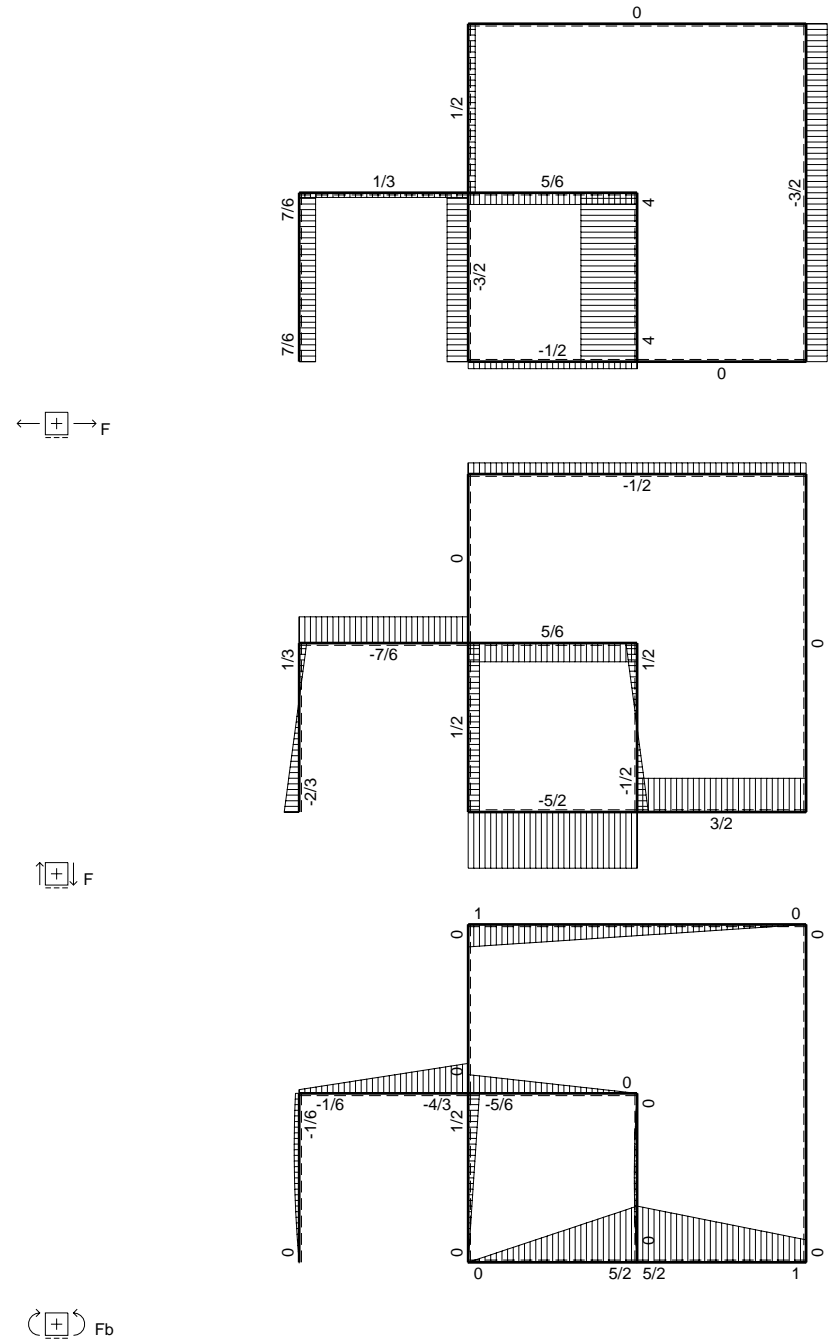
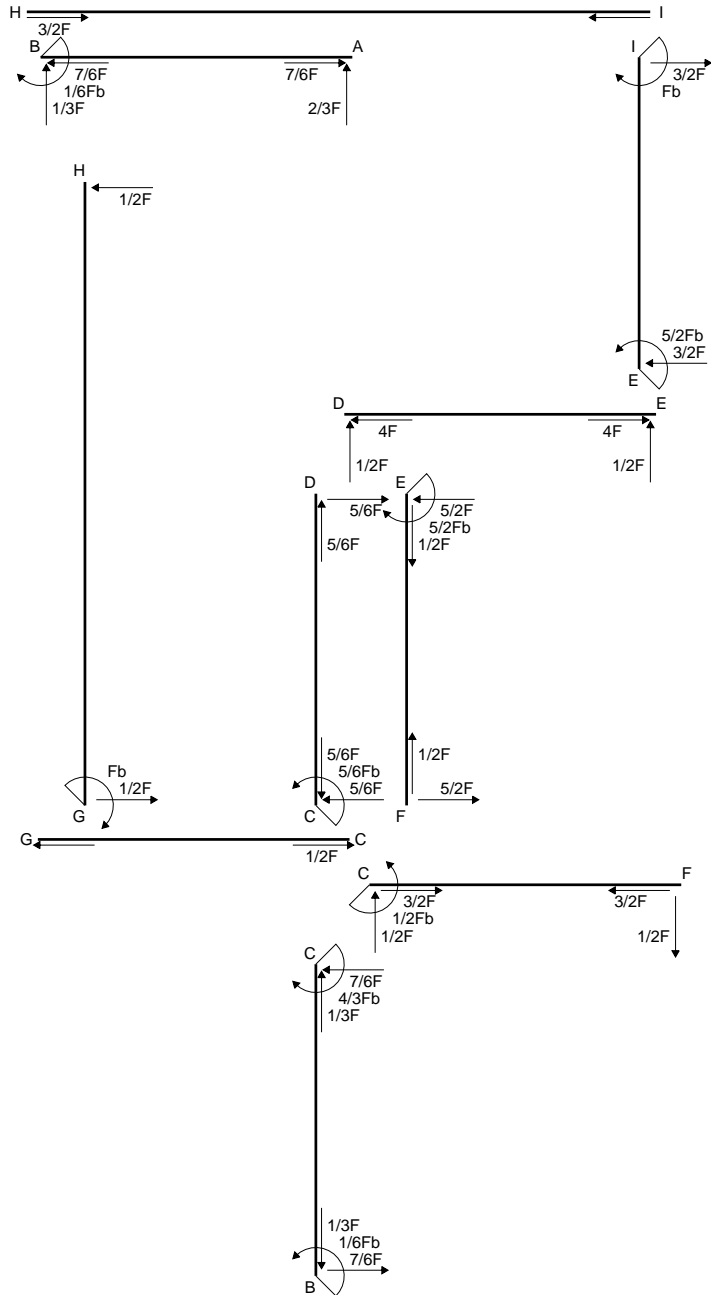
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

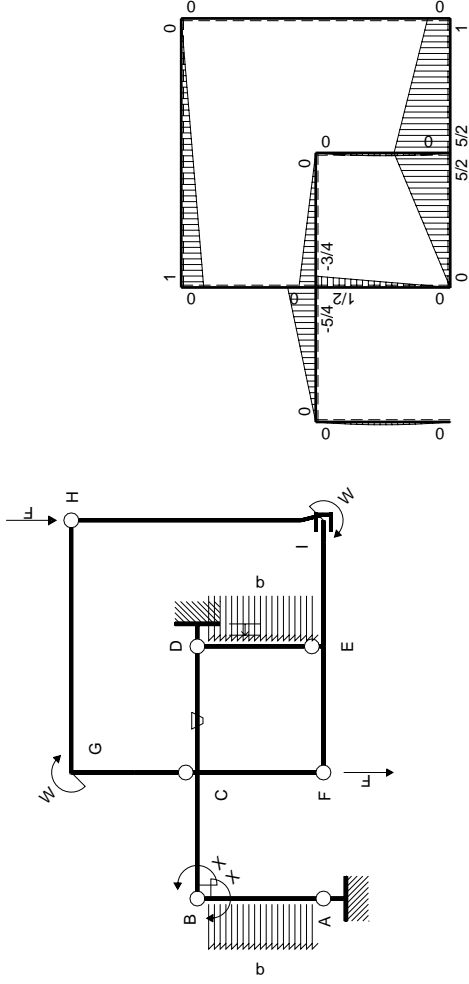
$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

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

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

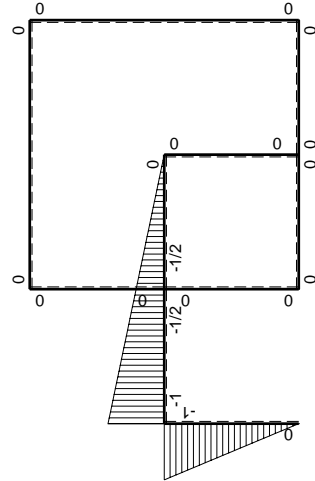


$\left[\begin{matrix} + \\ + \end{matrix} \right] F_b$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$5/2Fb-5/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/6Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

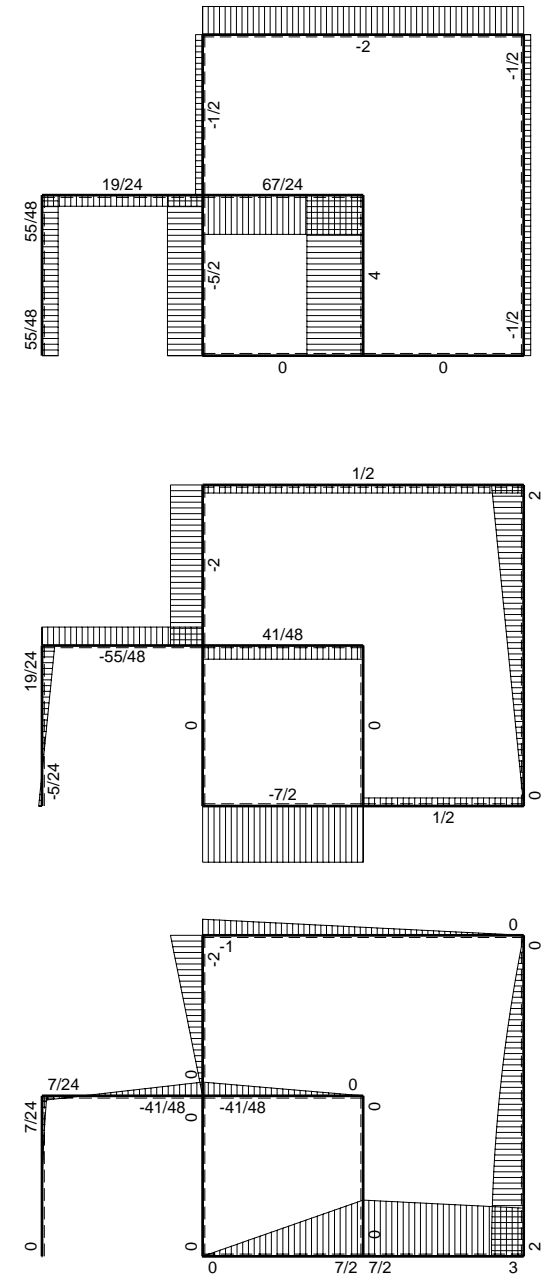
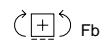
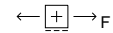
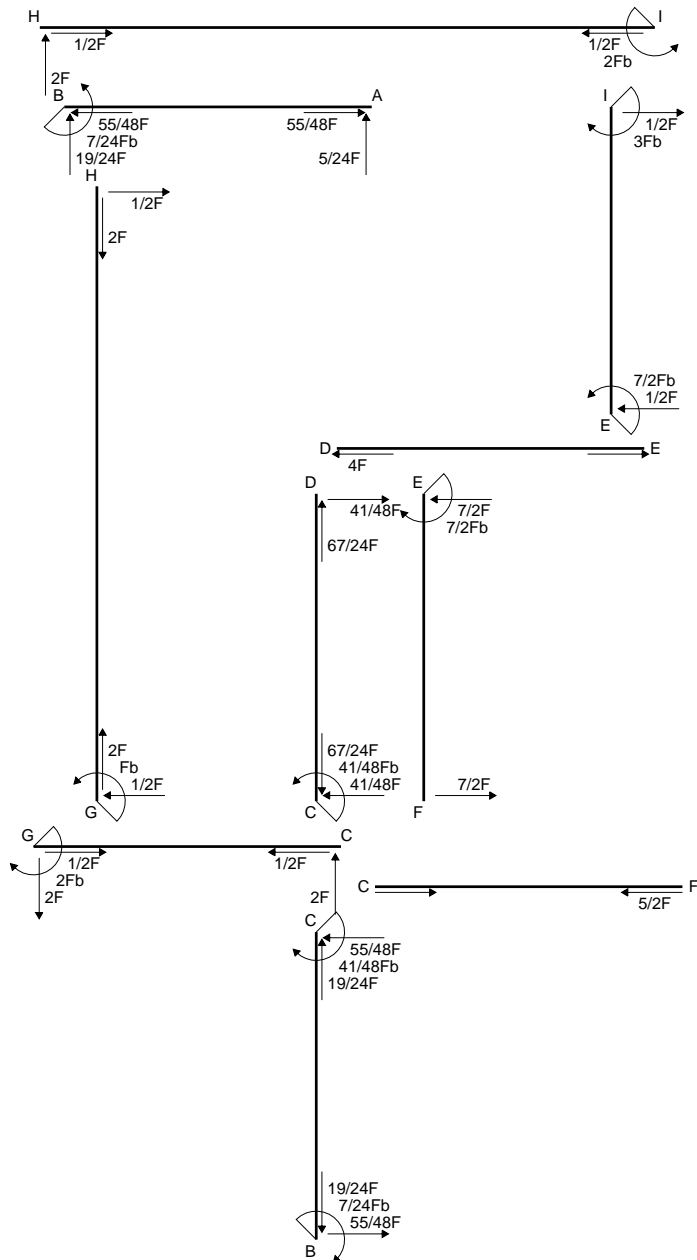
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

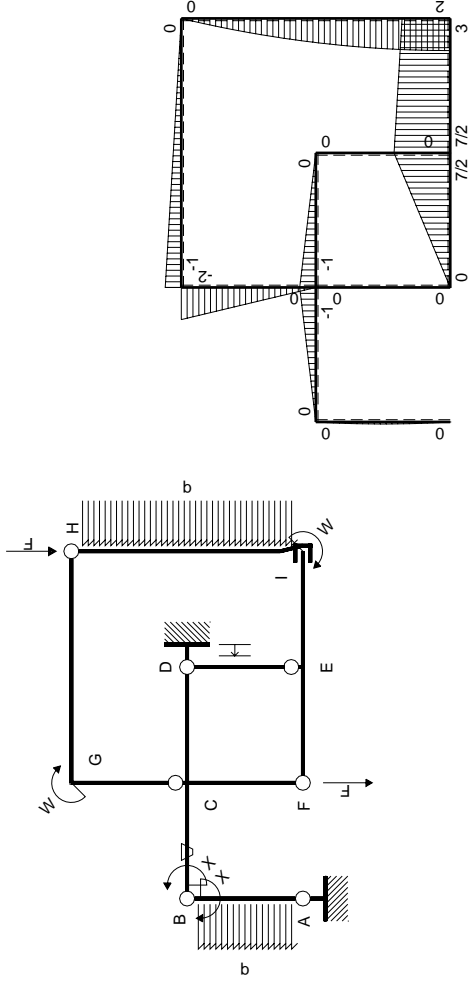
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

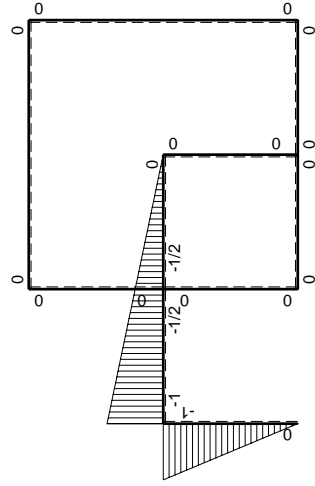
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$7/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-7/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

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

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

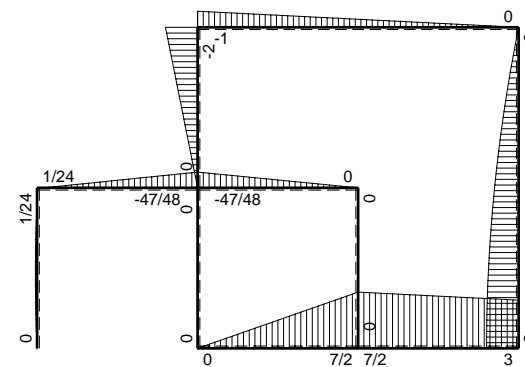
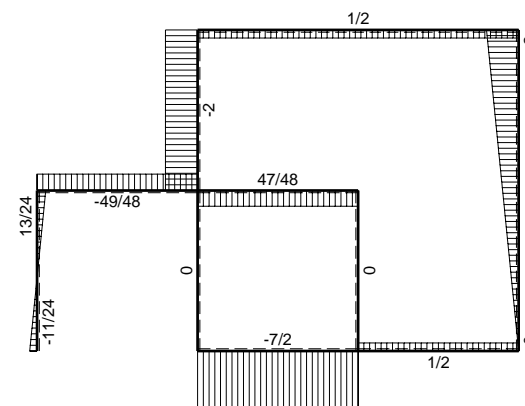
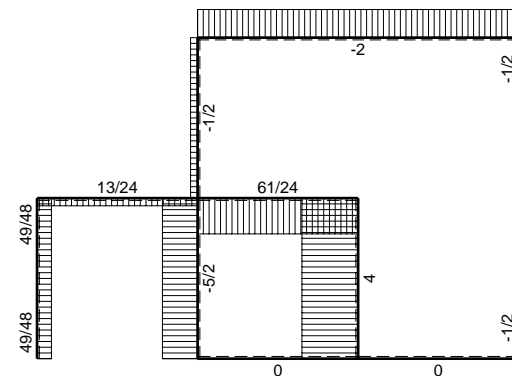
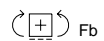
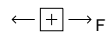
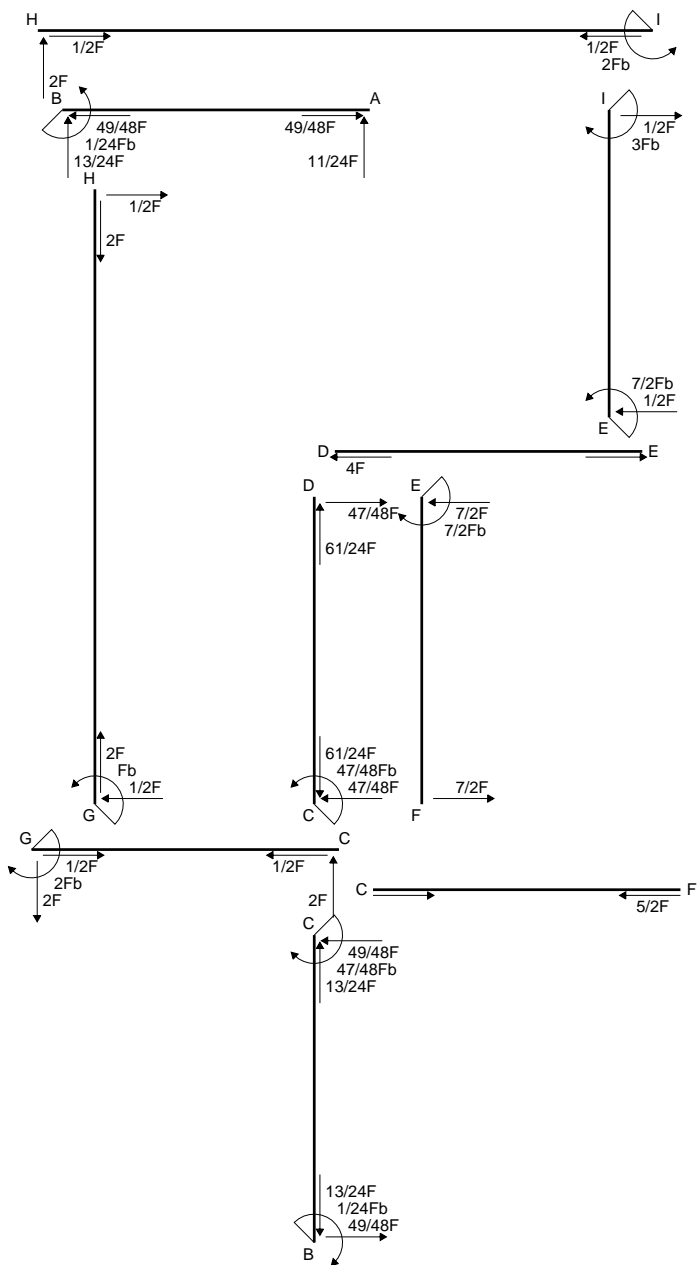
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

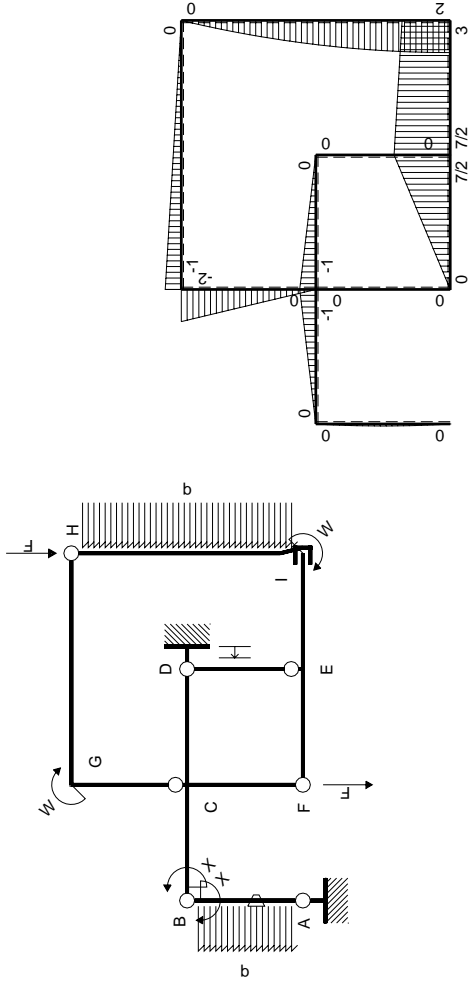
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

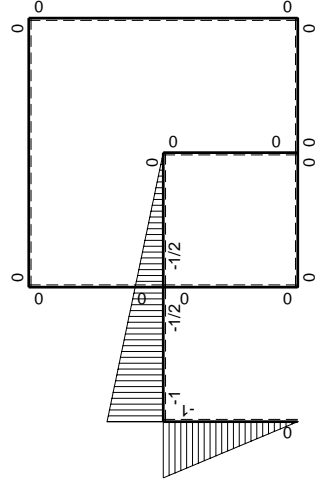
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$		
	totali						$1/24Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-1/24Fb$		

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

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

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

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

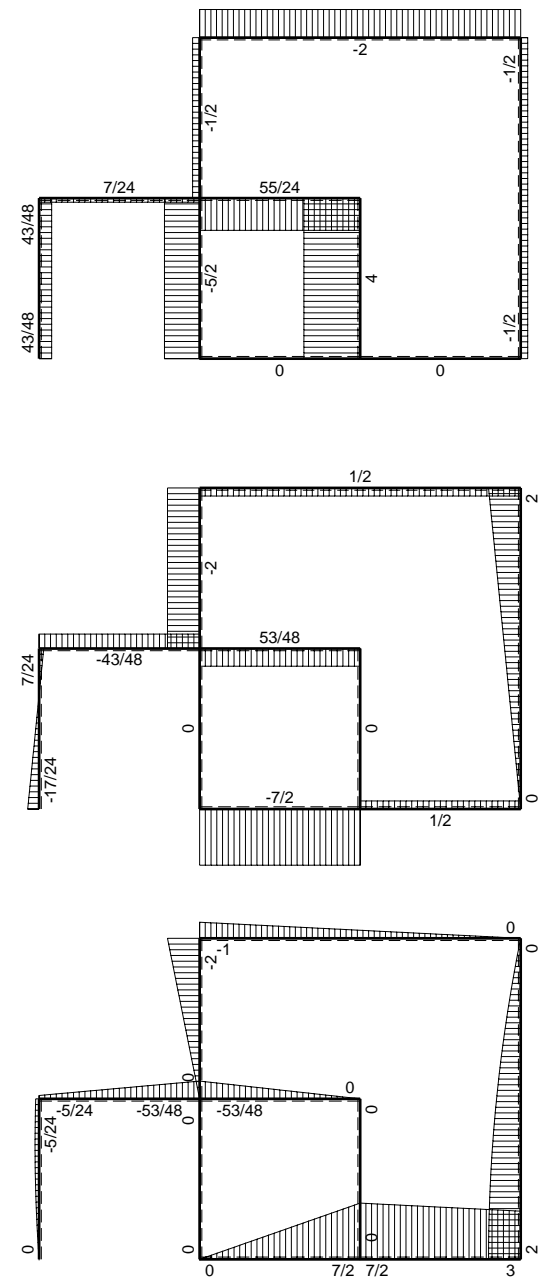
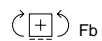
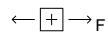
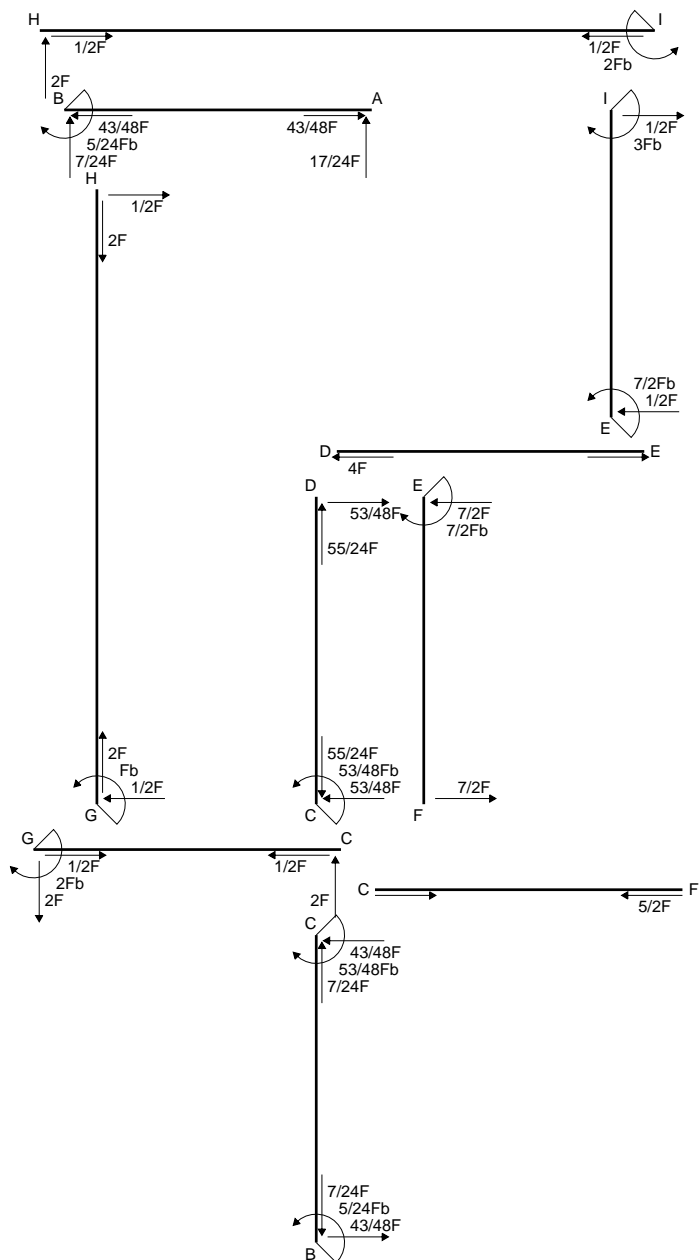
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

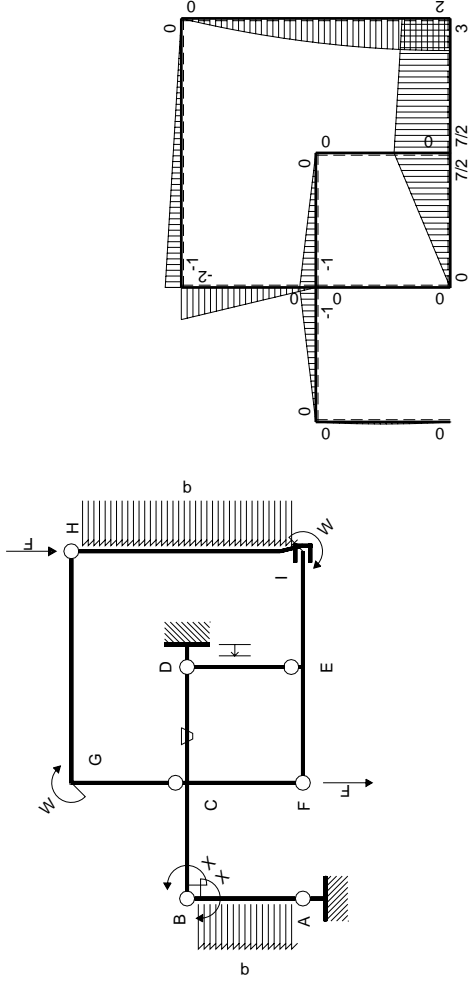
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

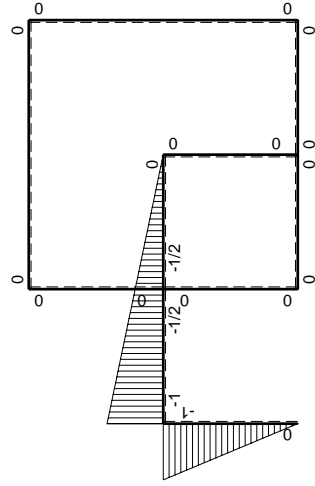
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-5/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$5/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

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

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

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

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

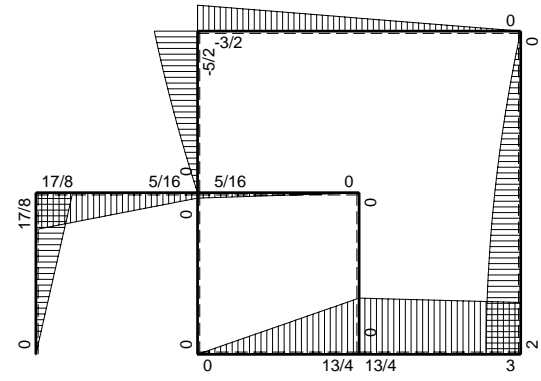
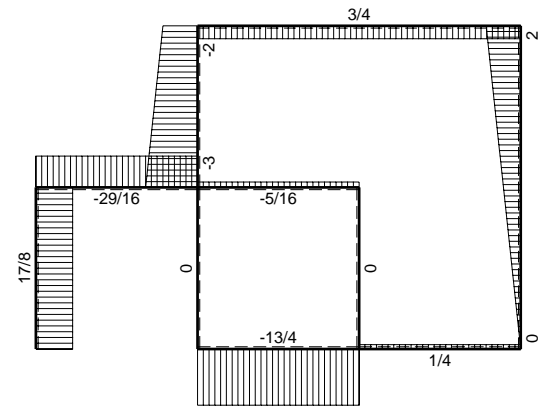
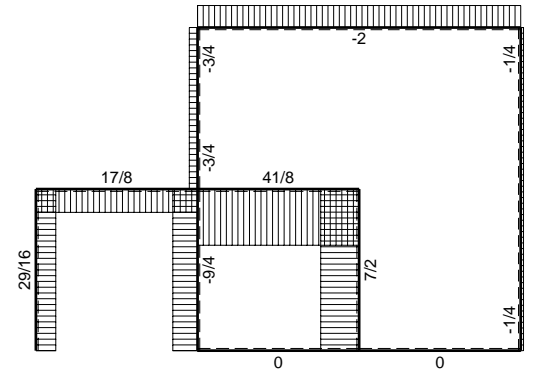
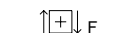
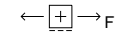
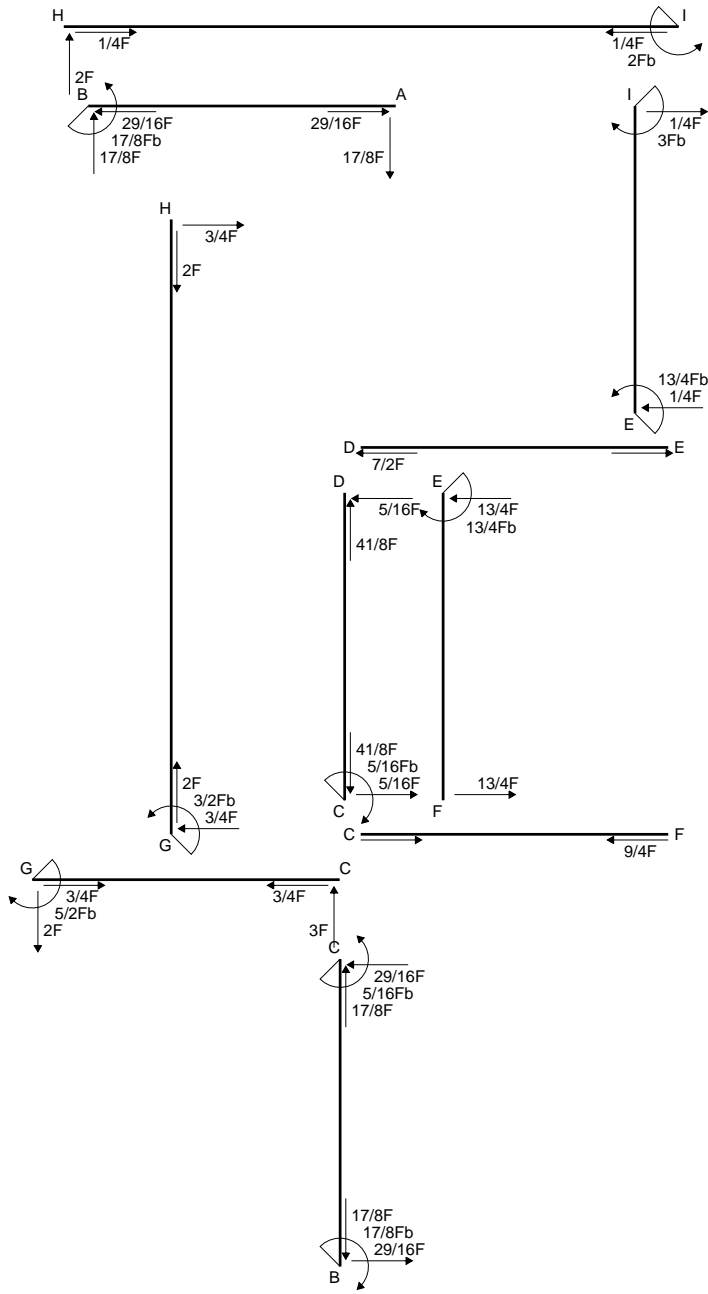
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

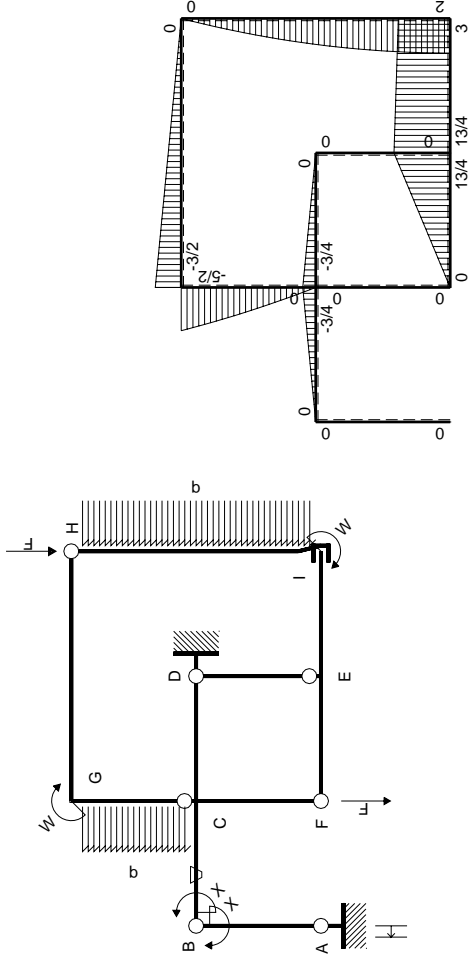
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

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

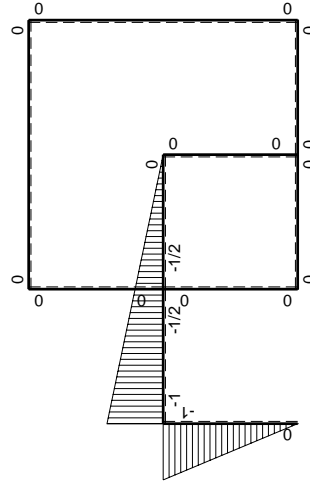
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0		
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$3/4Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

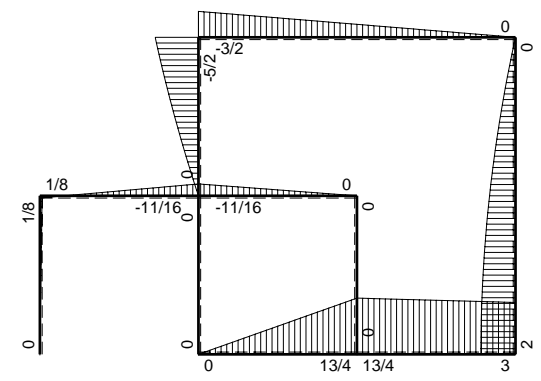
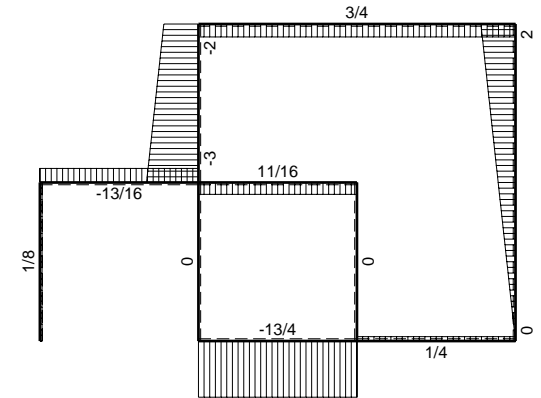
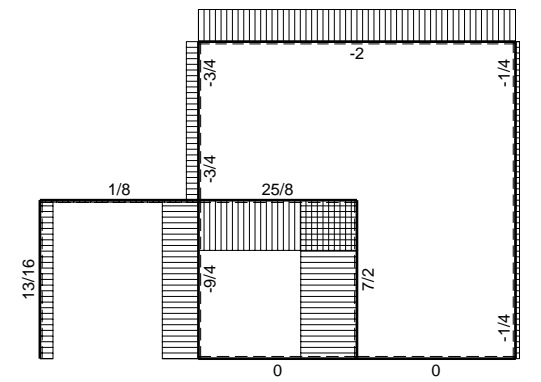
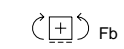
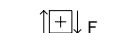
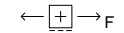
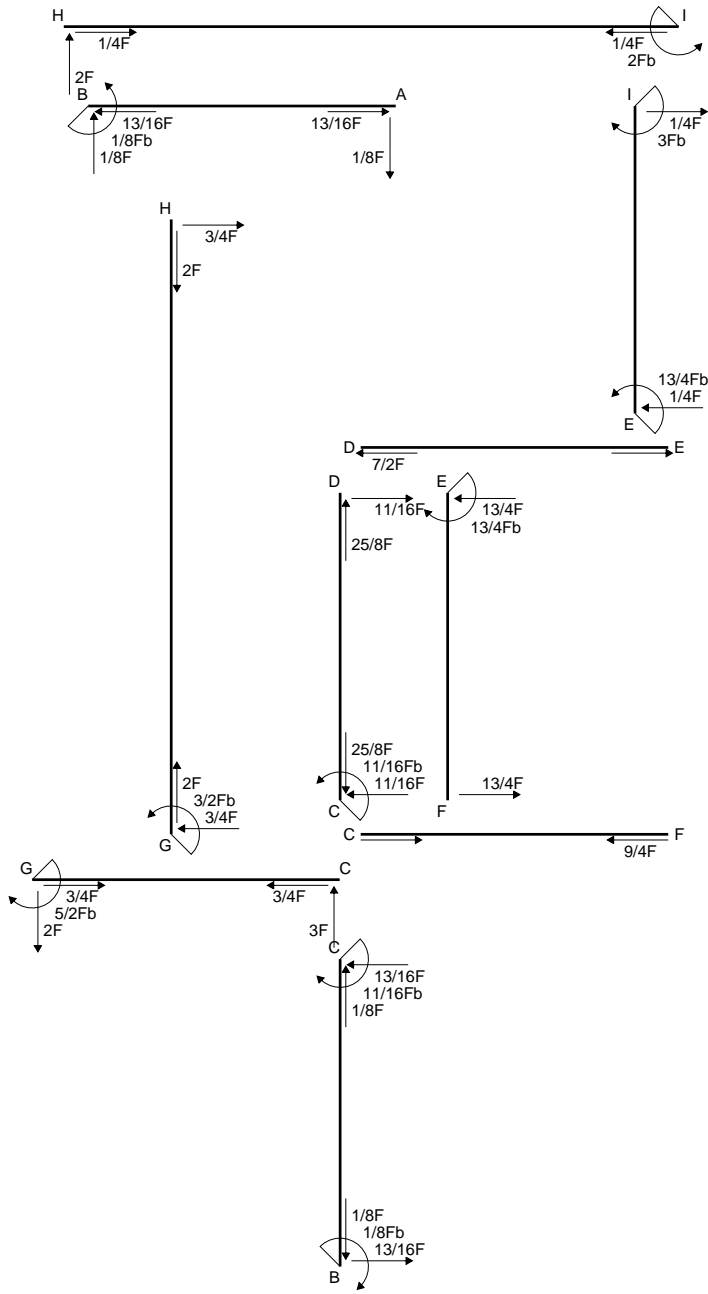
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

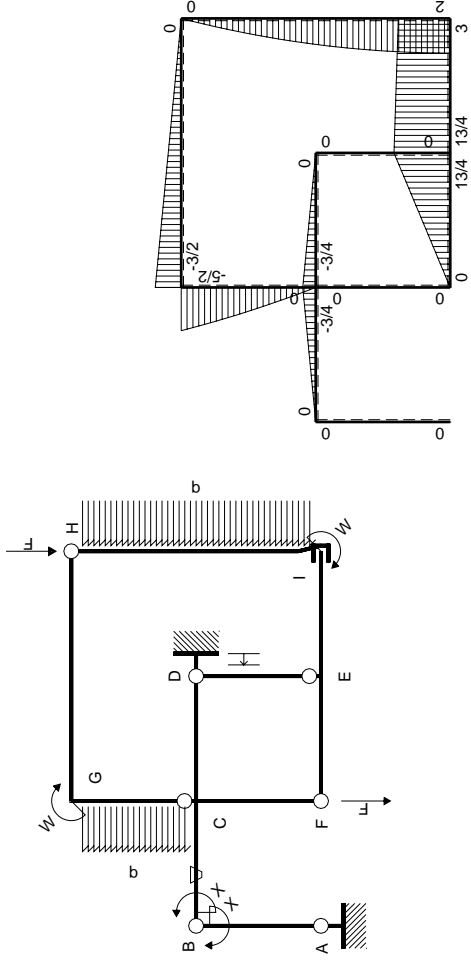
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

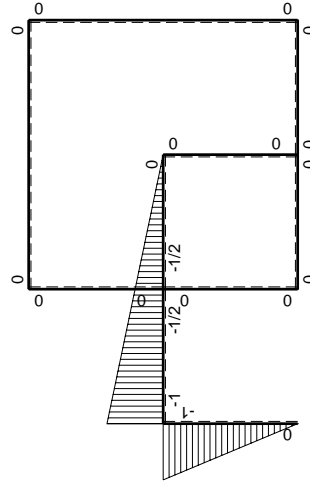
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0			
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$3/4Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$		
	totali						$1/8Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-1/8Fb$		

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

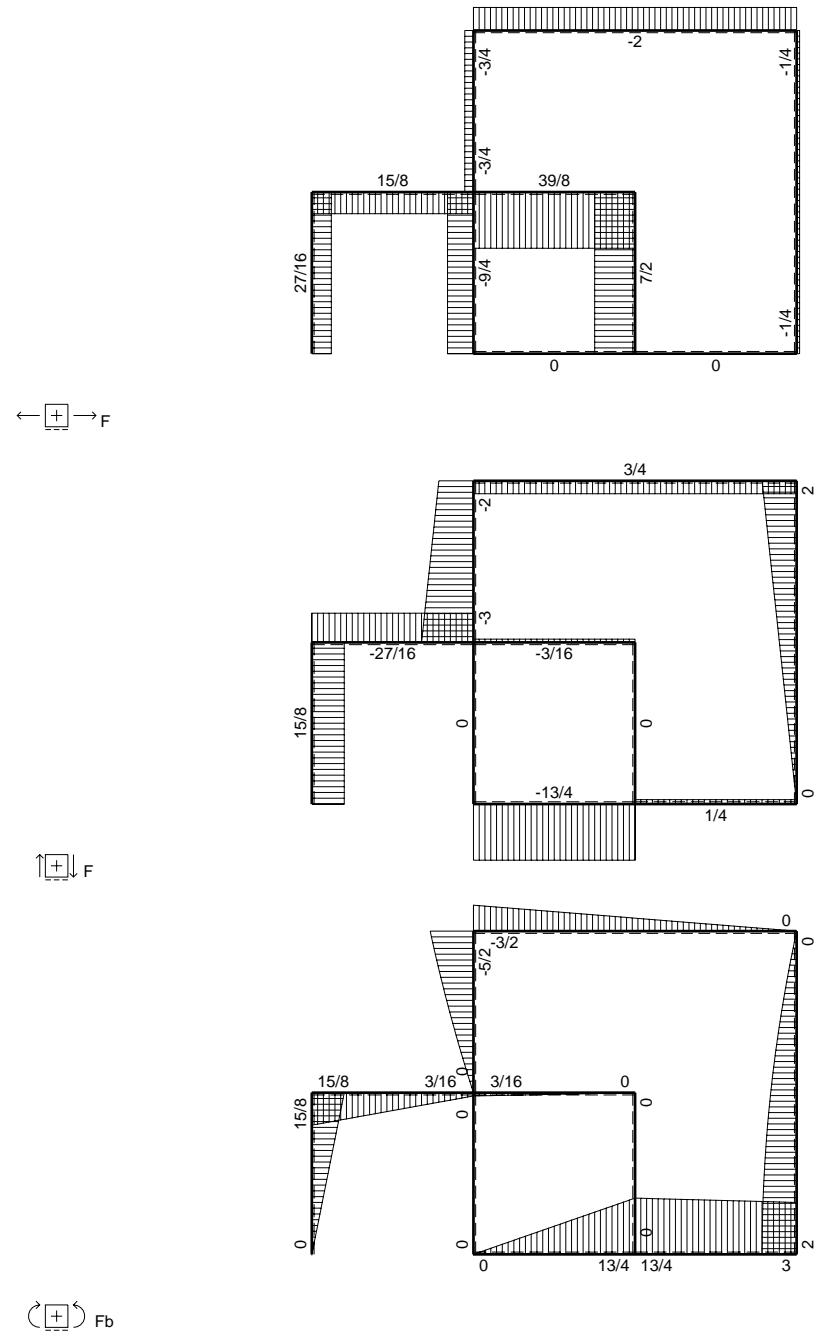
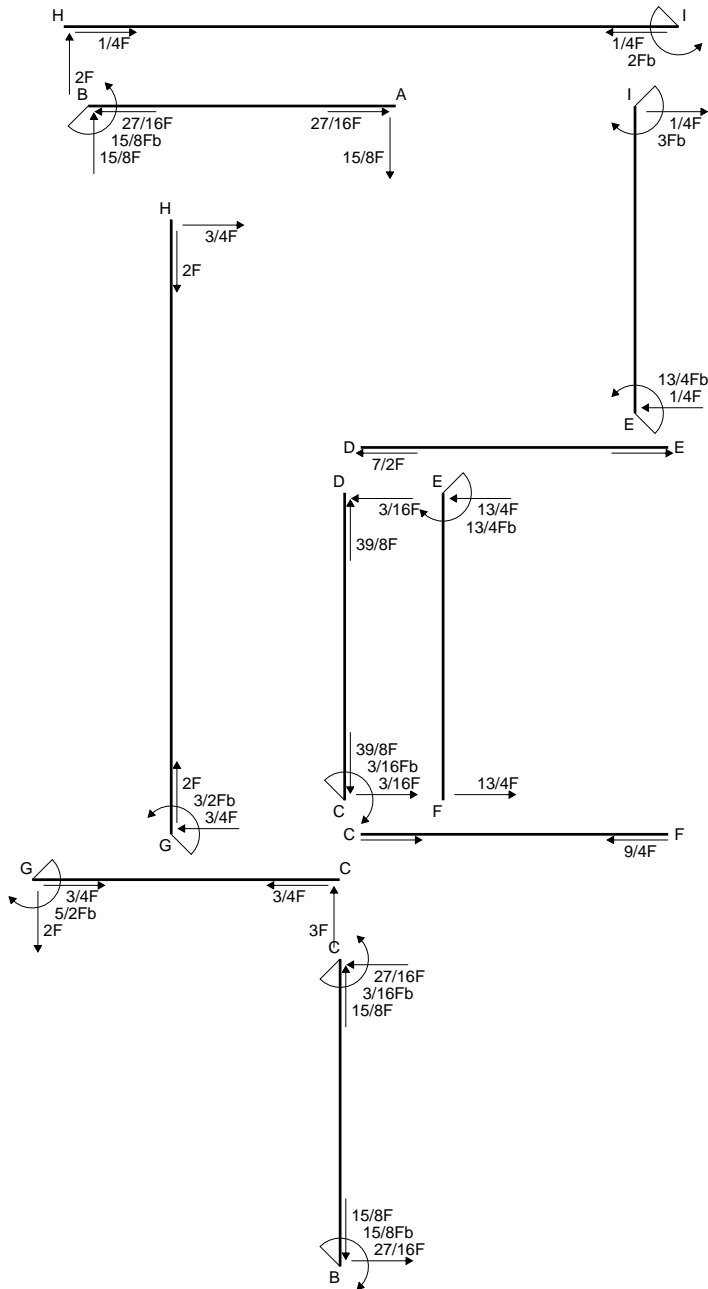
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

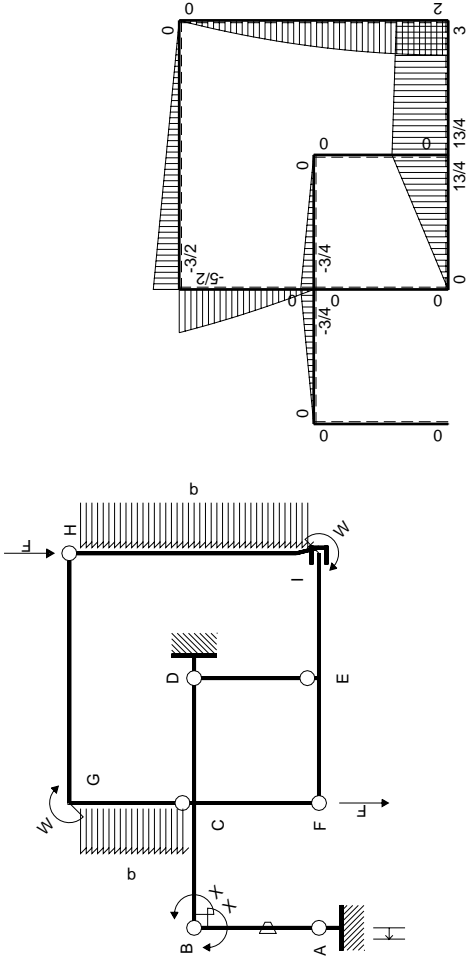
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

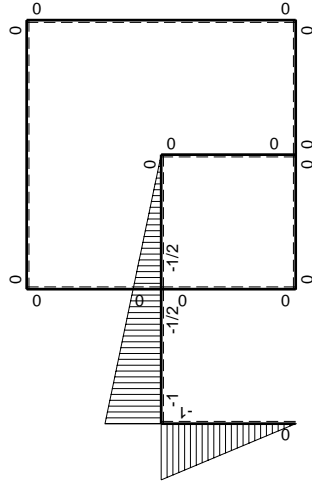
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0		
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$3/4Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

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

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

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

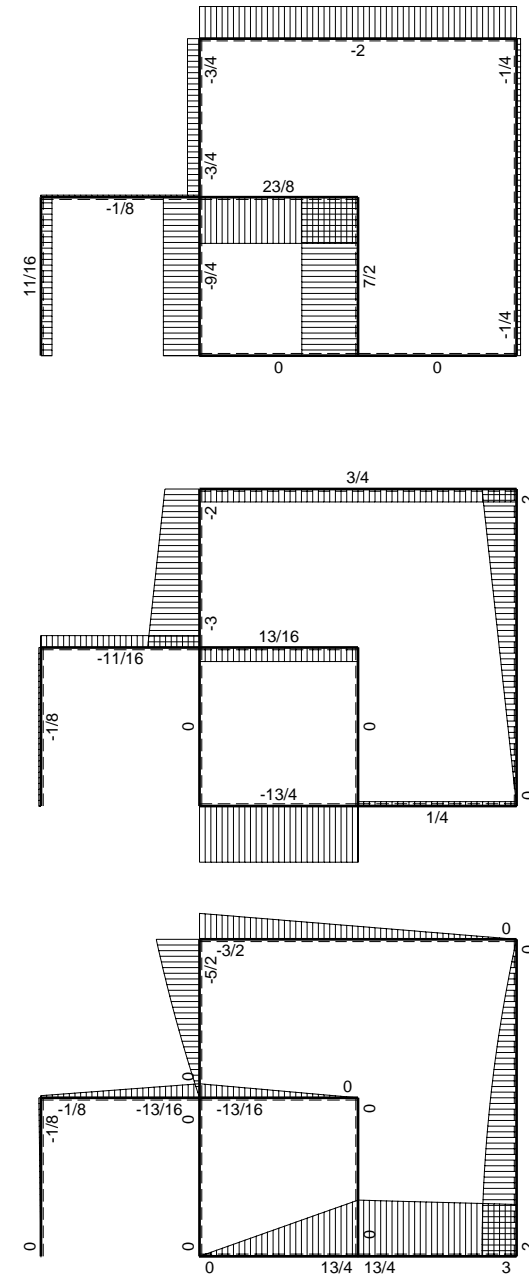
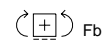
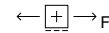
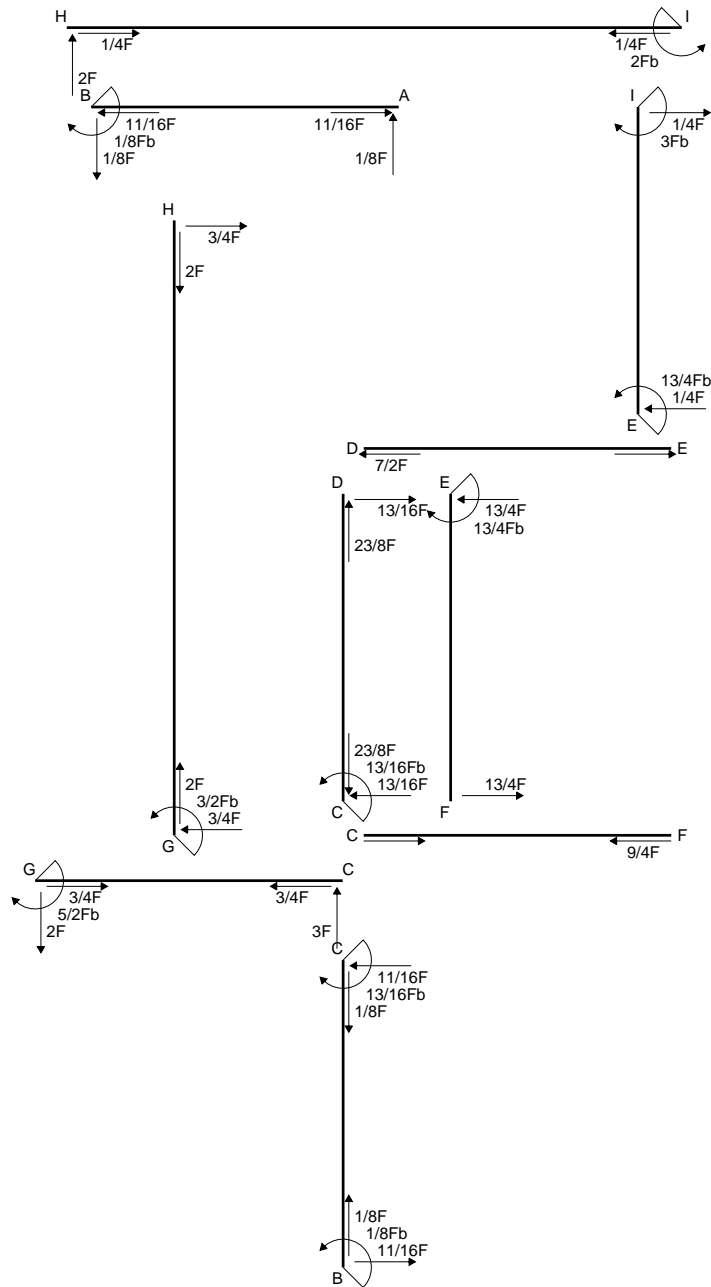
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

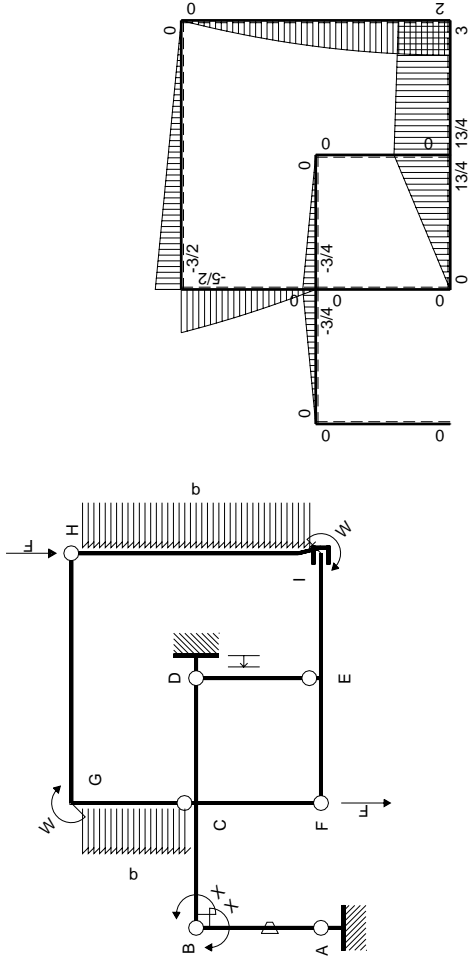
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

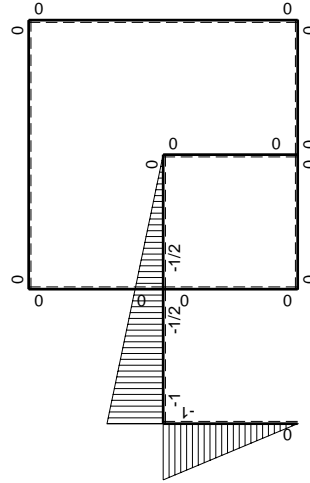
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0			
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$3/4Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

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

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

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

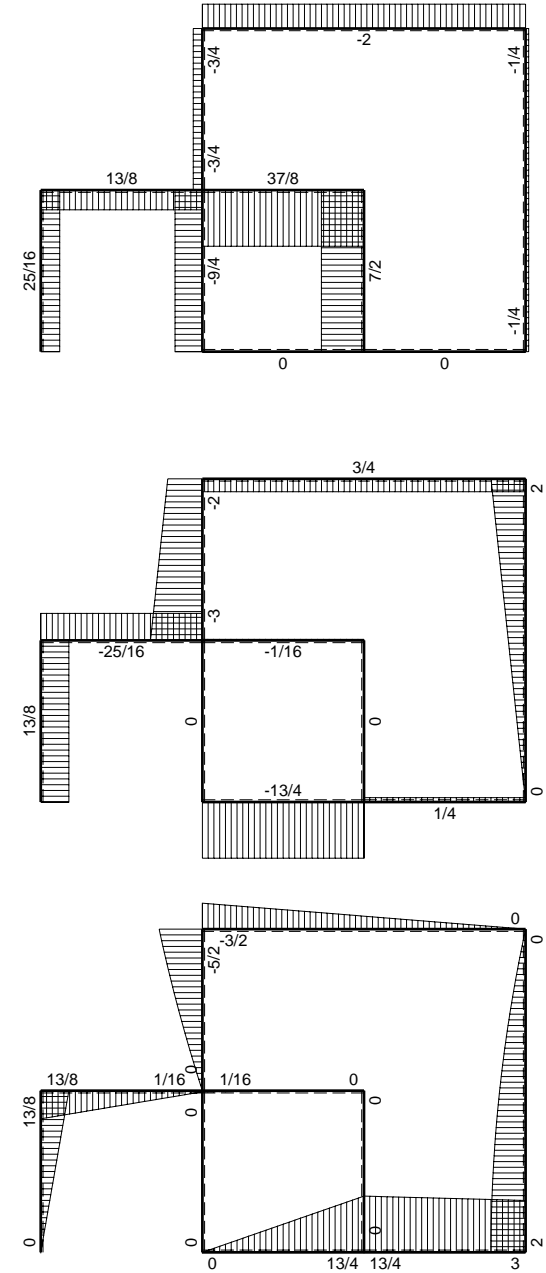
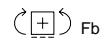
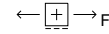
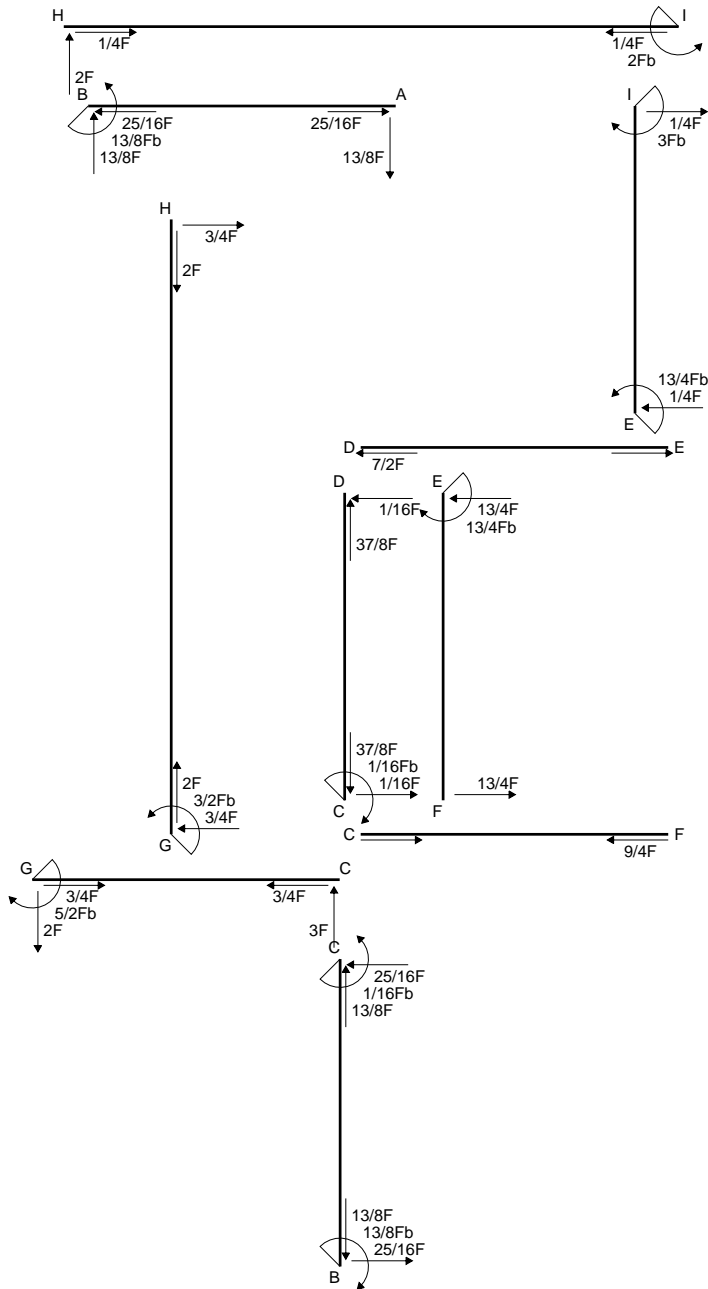
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

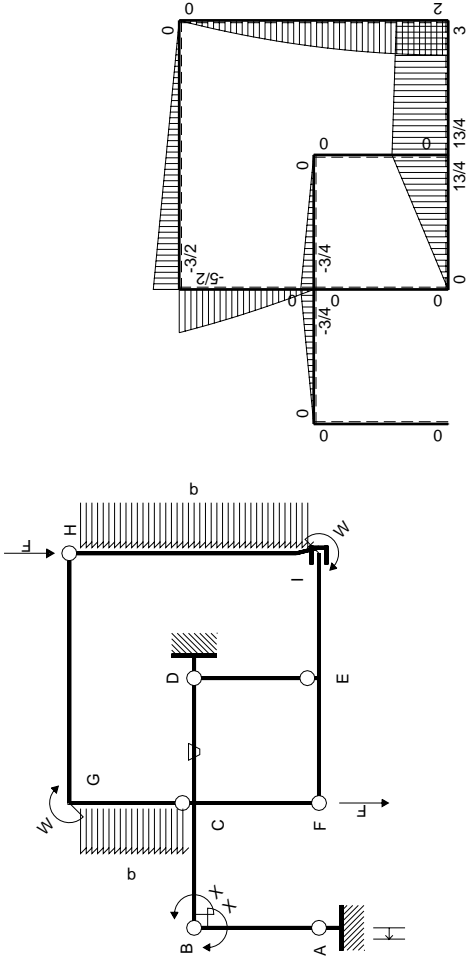
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

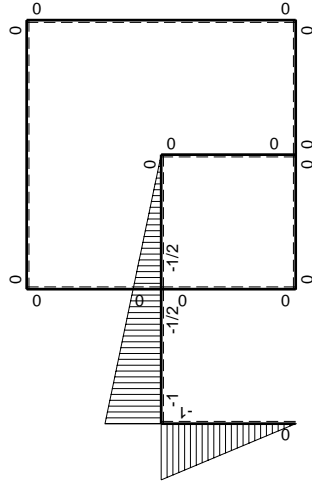
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0		
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$3/4Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

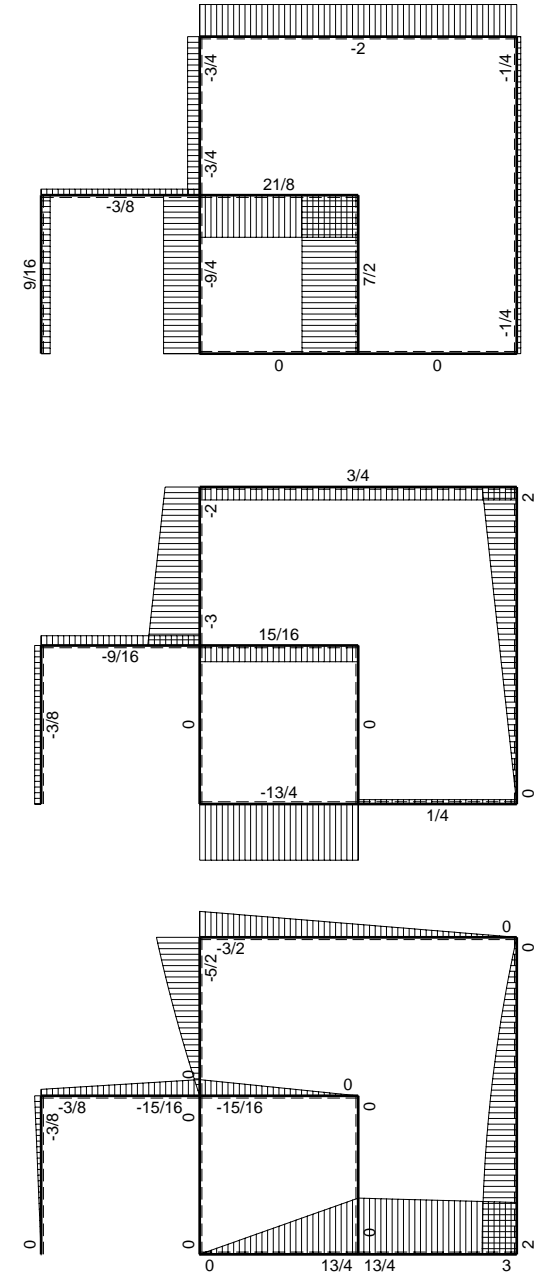
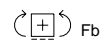
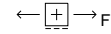
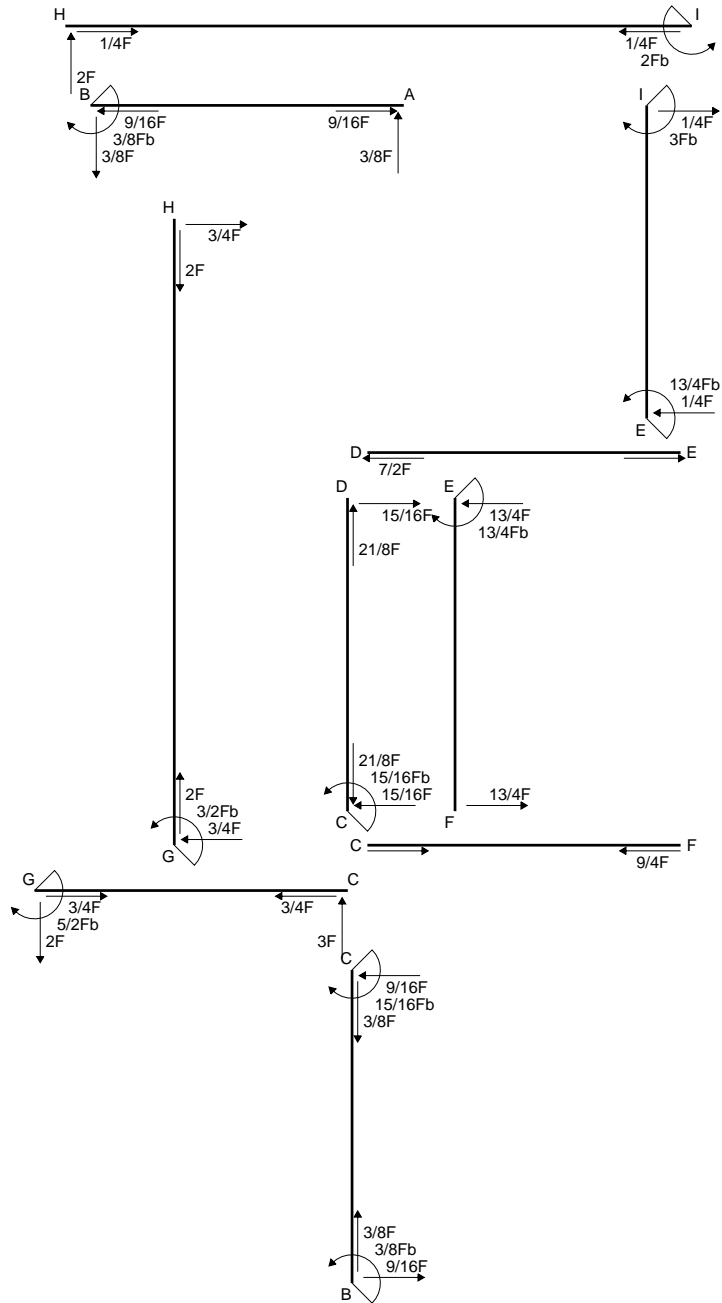
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

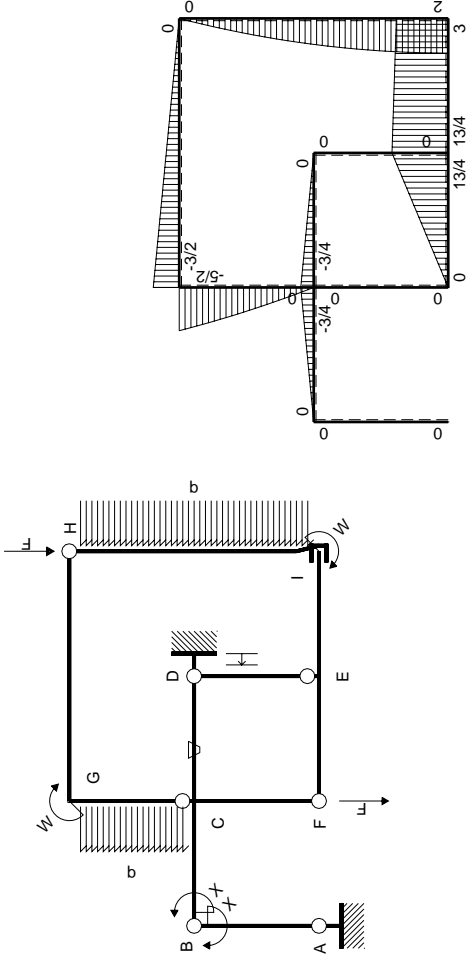
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

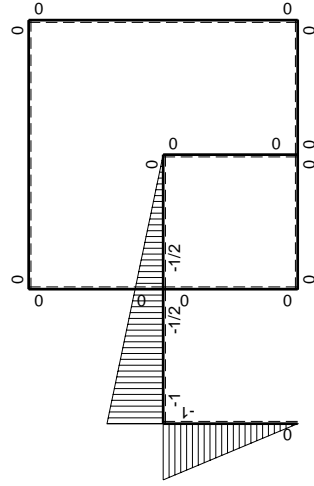
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0			
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$3/4Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$3/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

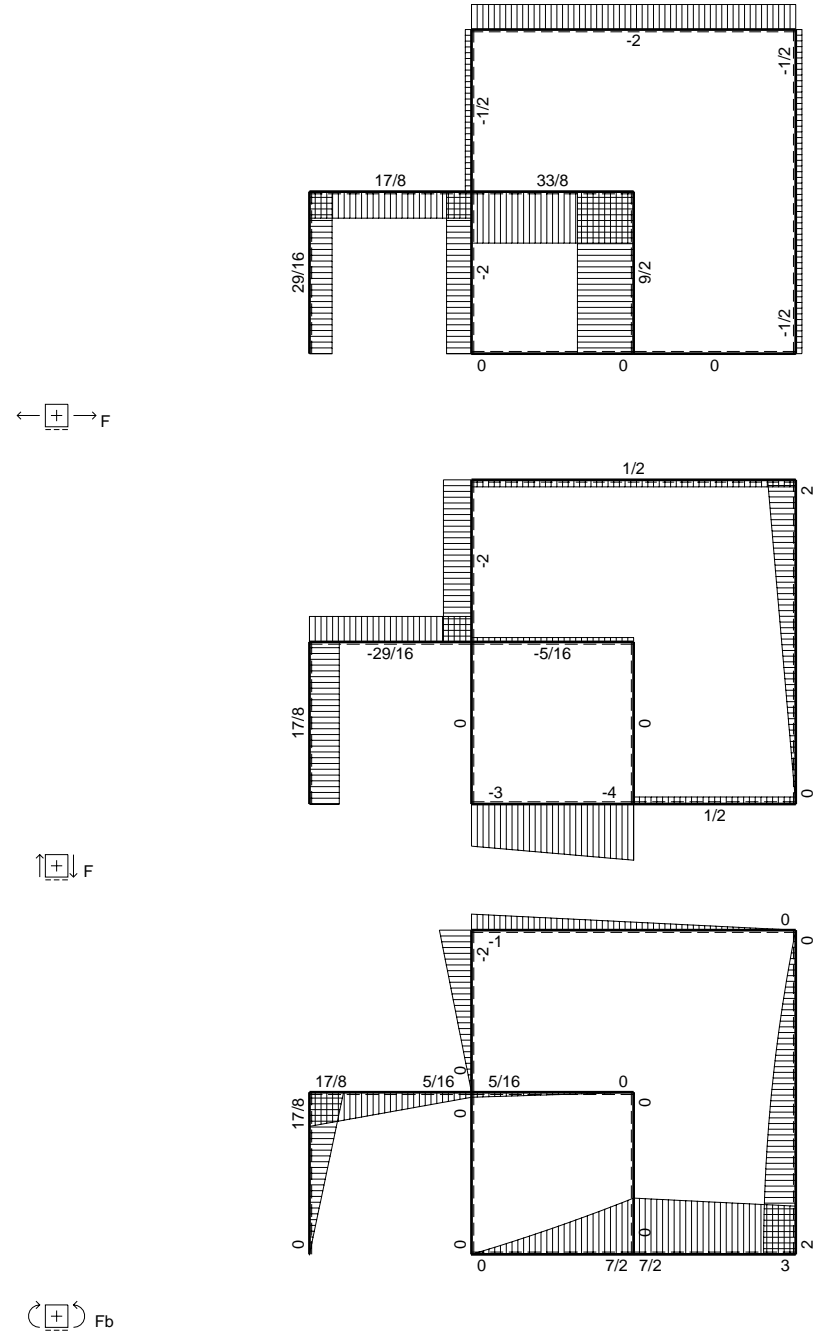
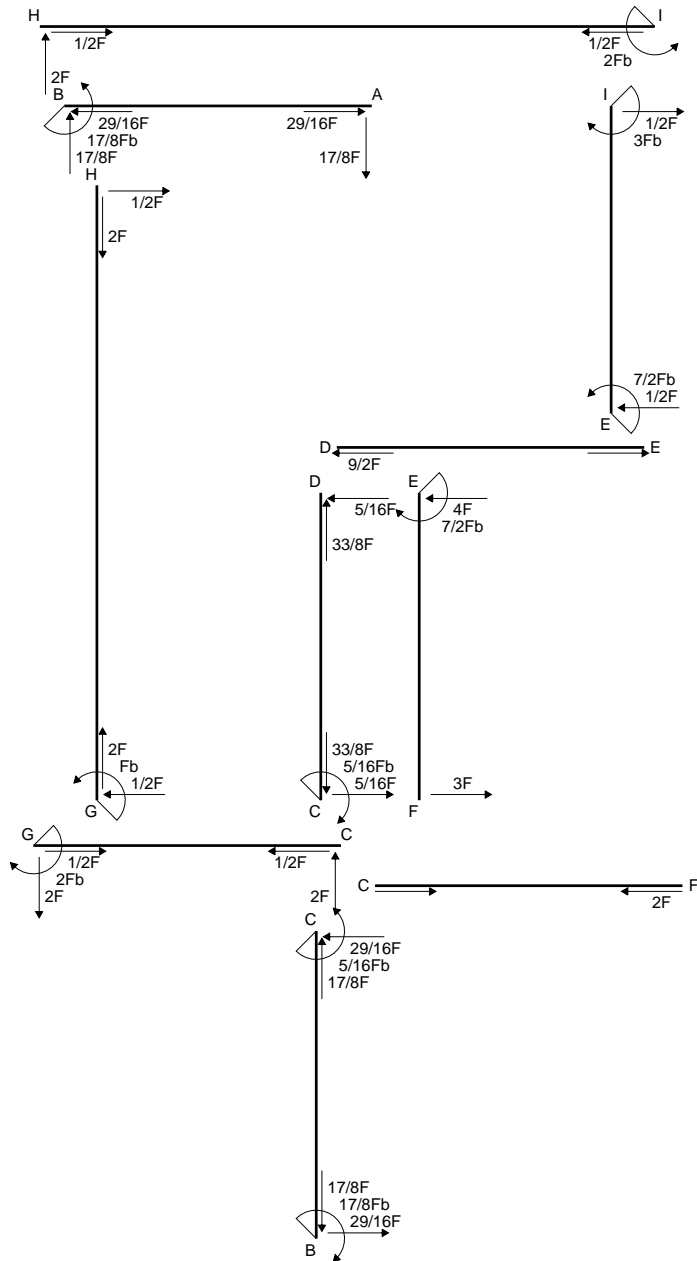
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

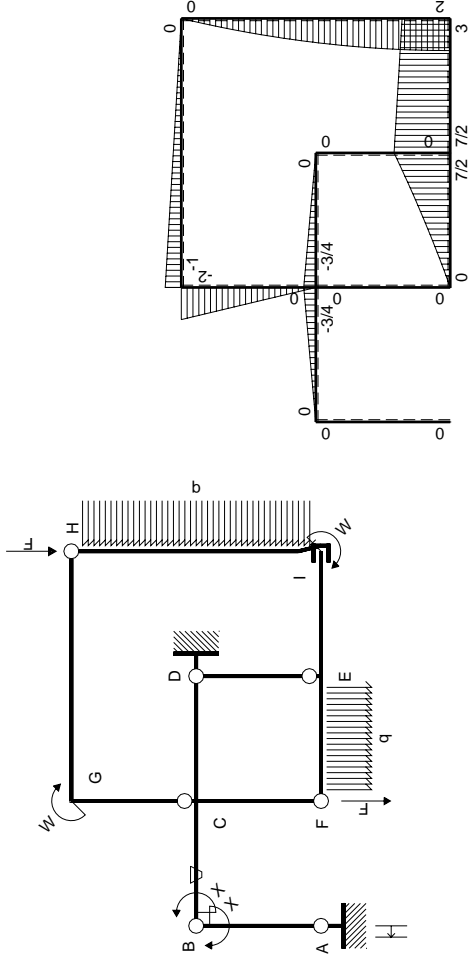
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

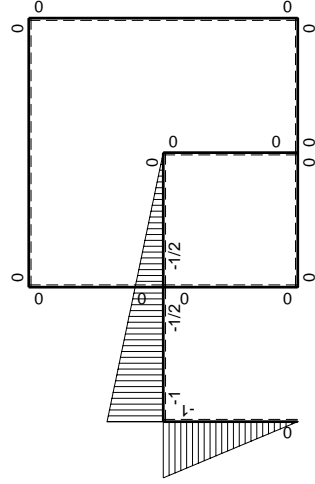
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

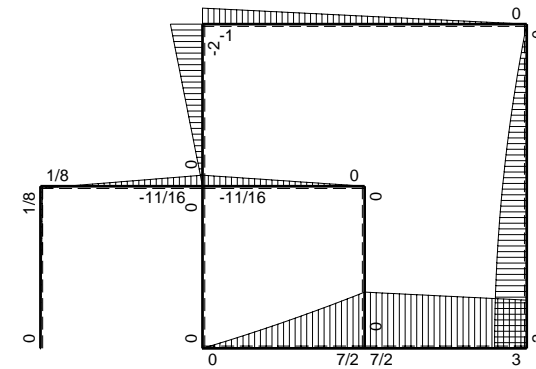
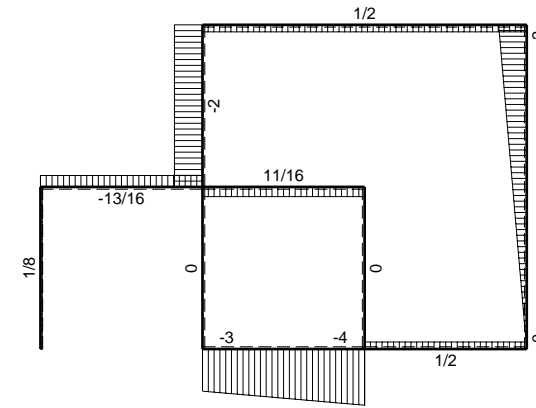
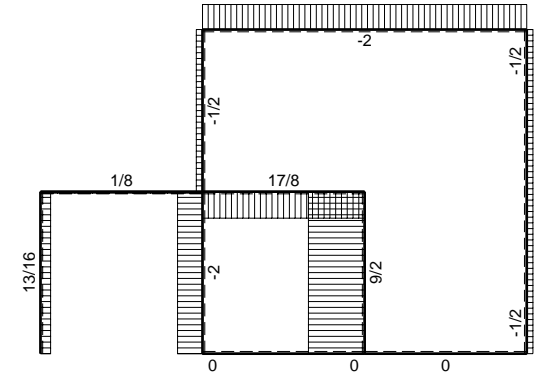
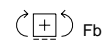
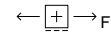
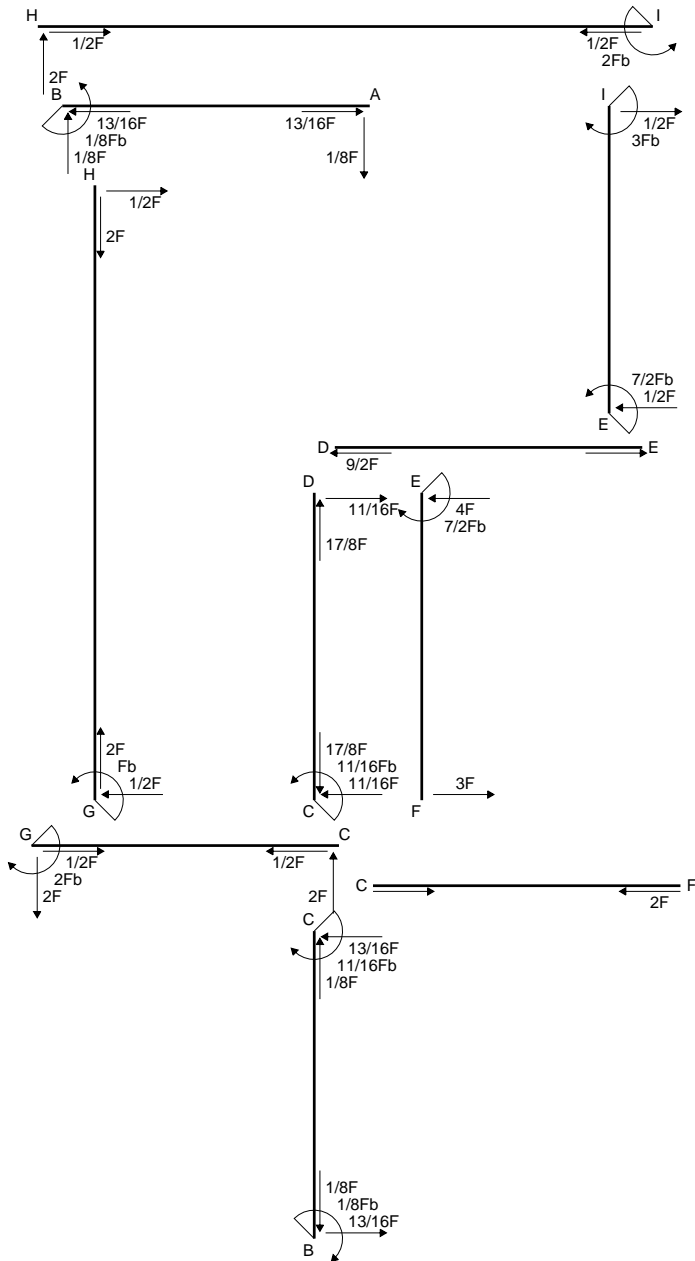
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

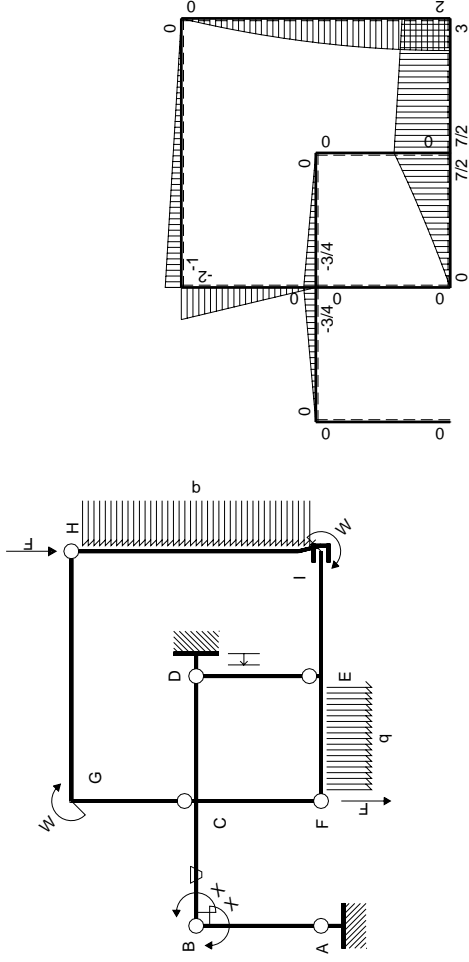
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

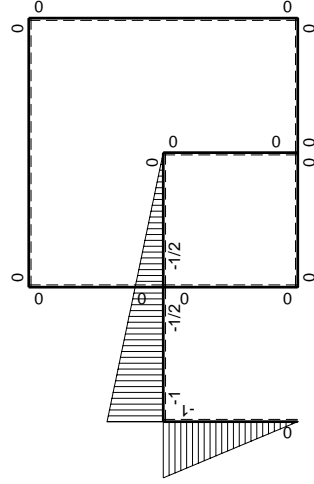
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

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

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

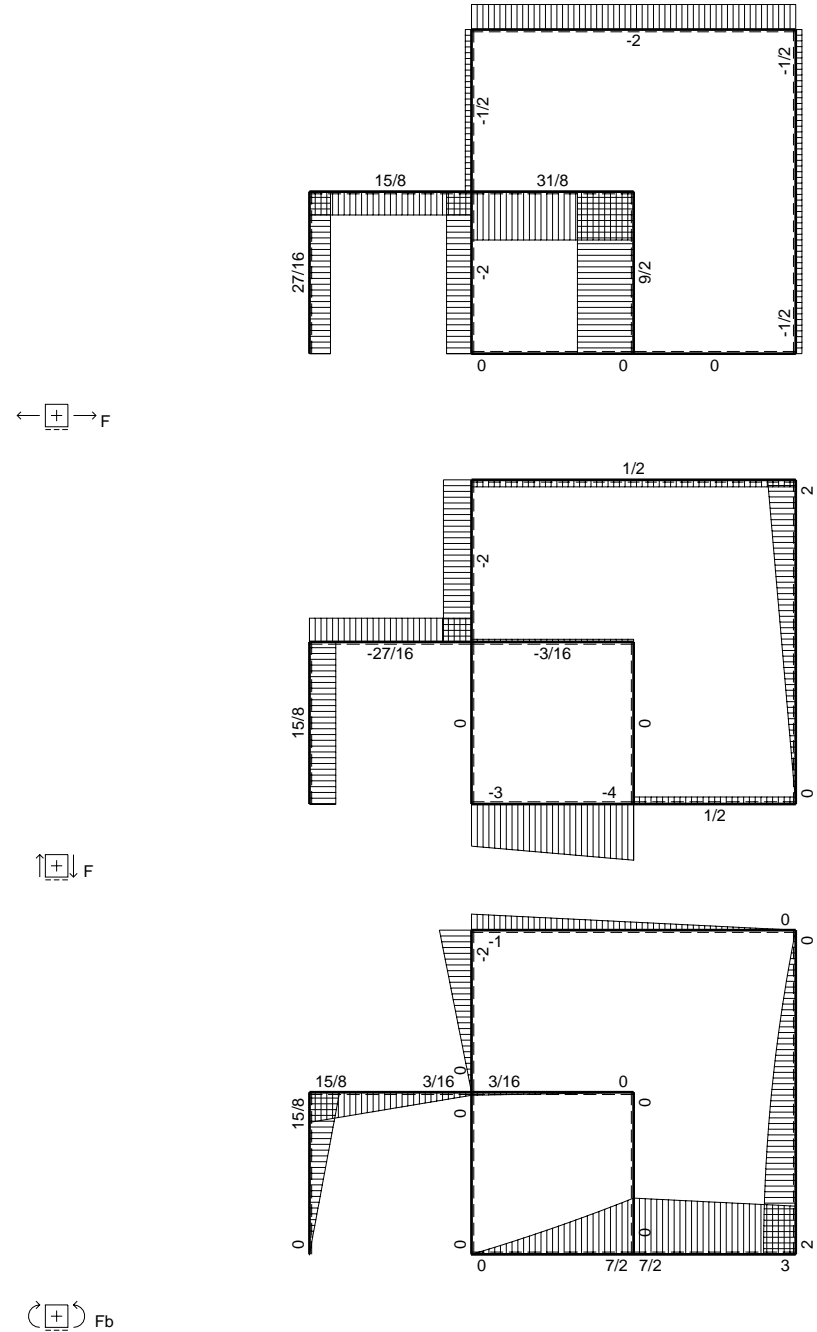
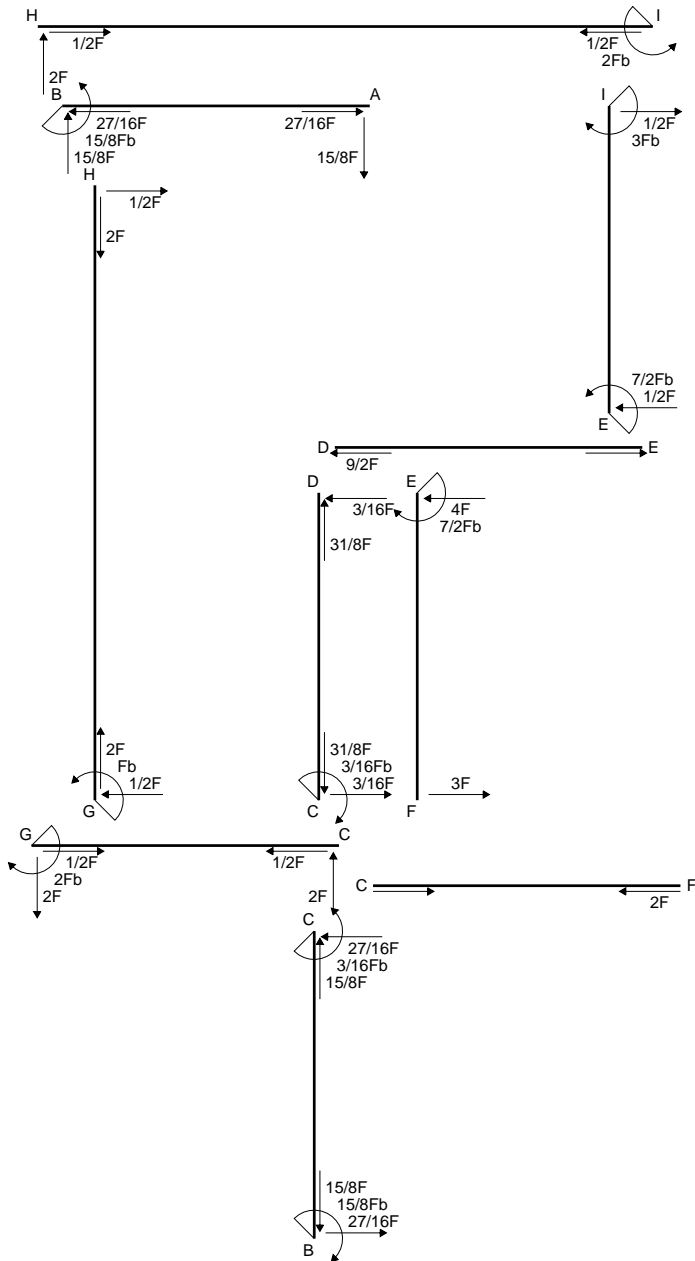
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

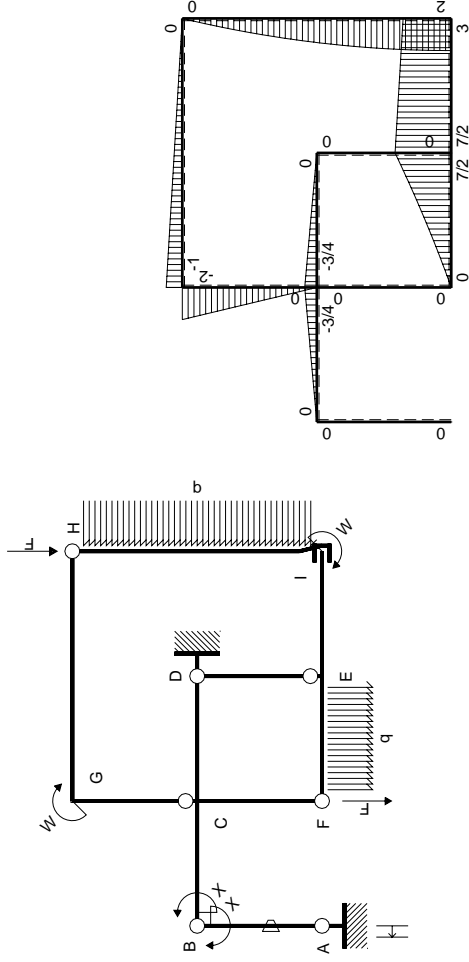
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

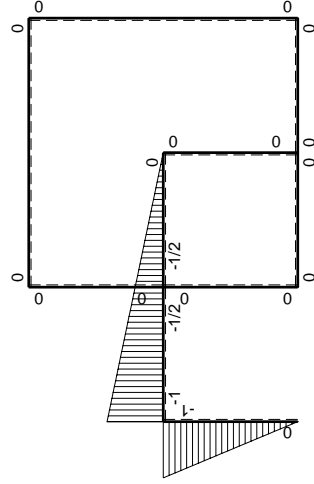
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

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

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

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

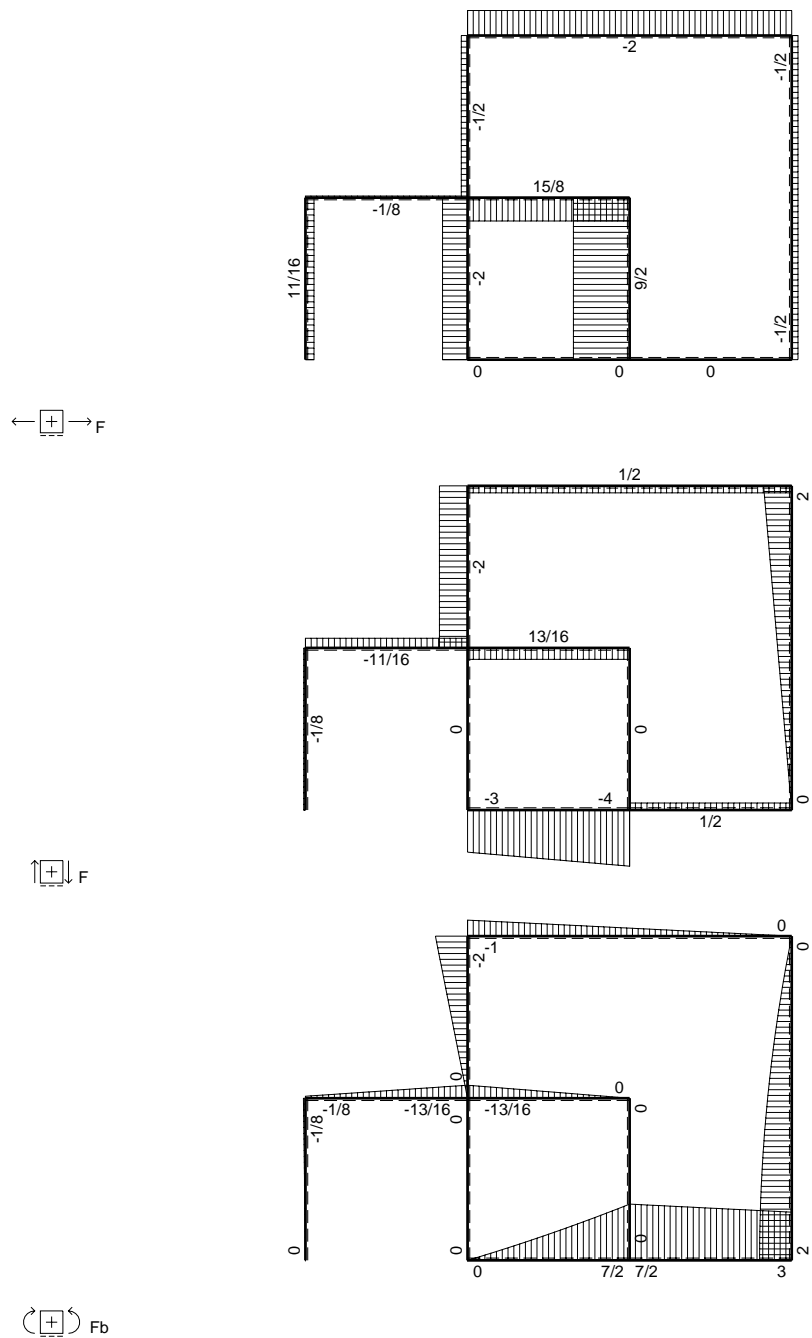
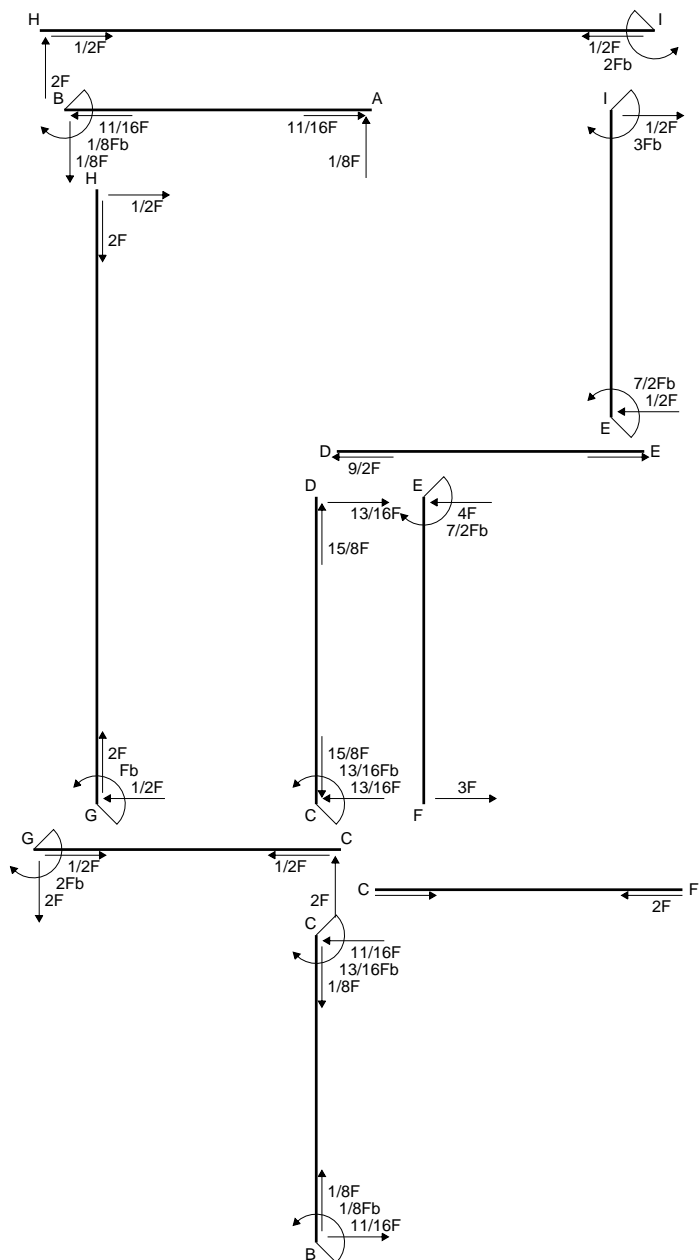
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

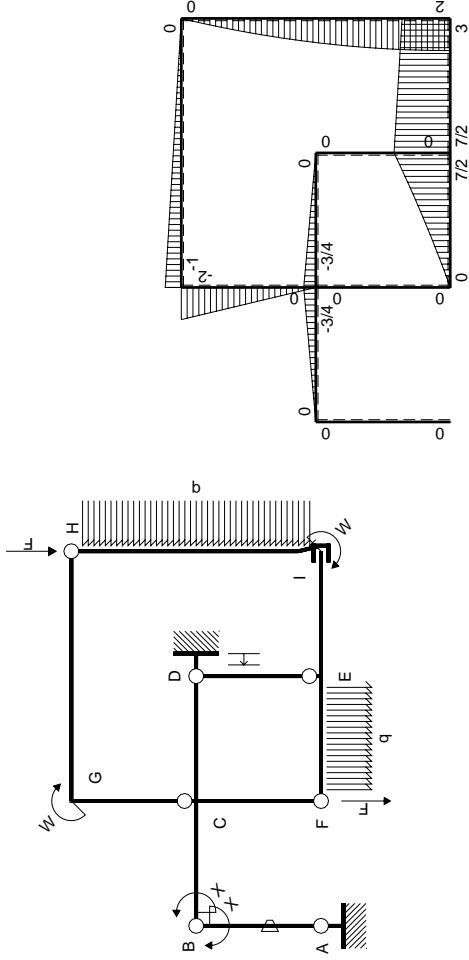
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

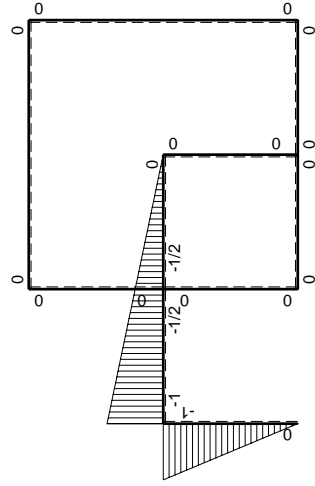
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

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

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

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

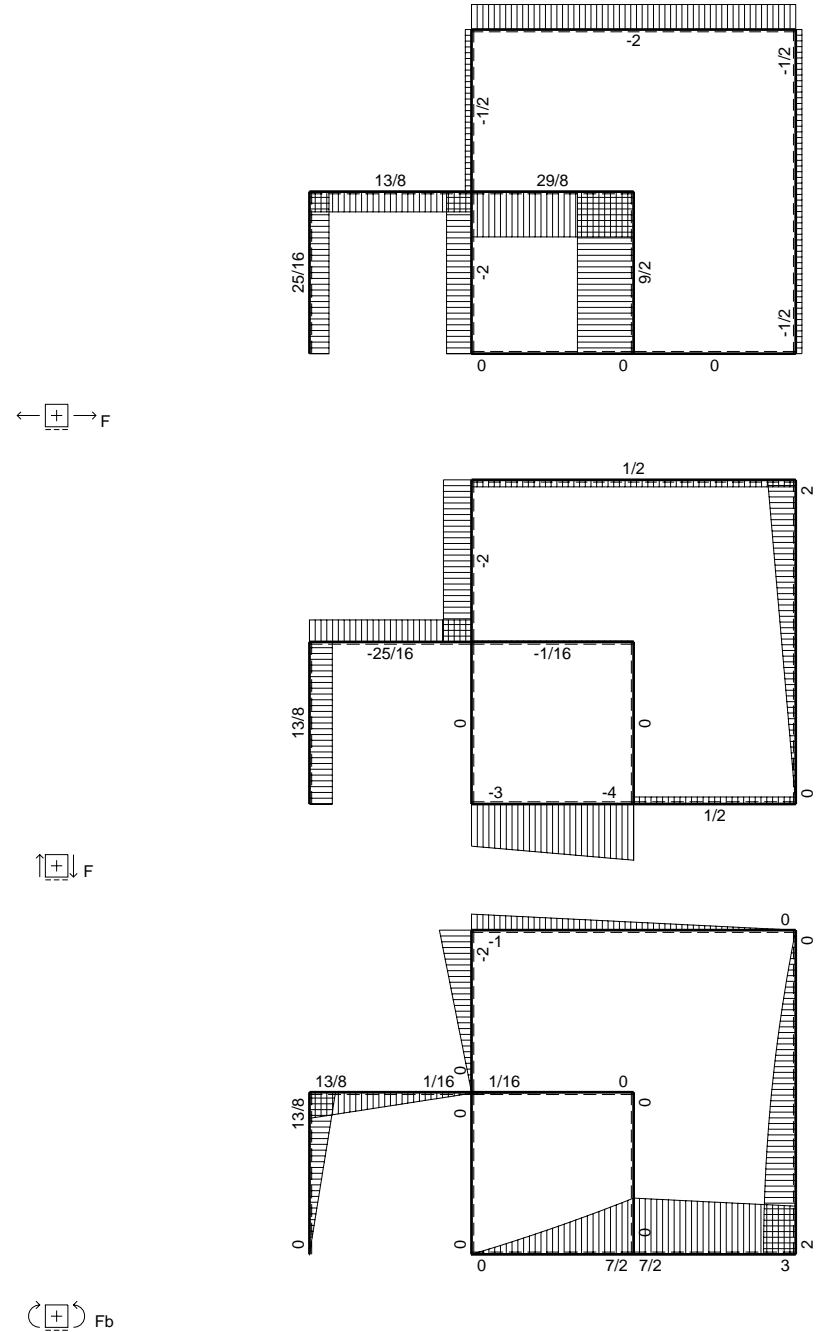
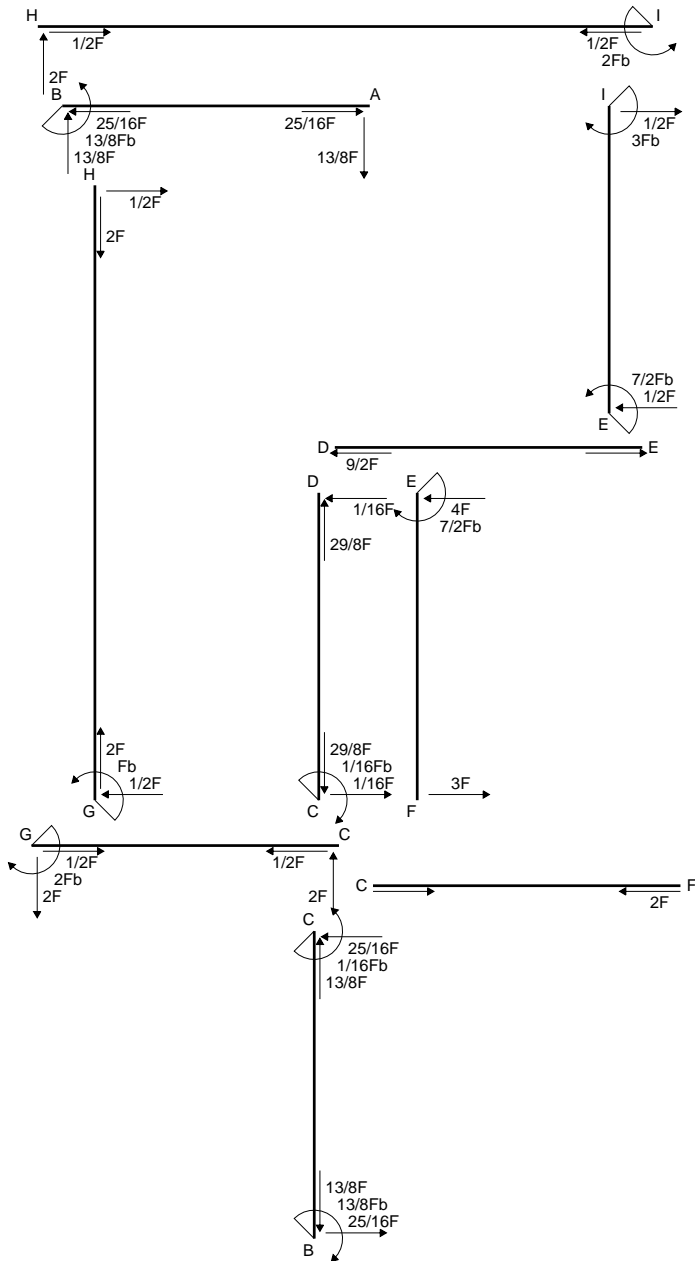
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

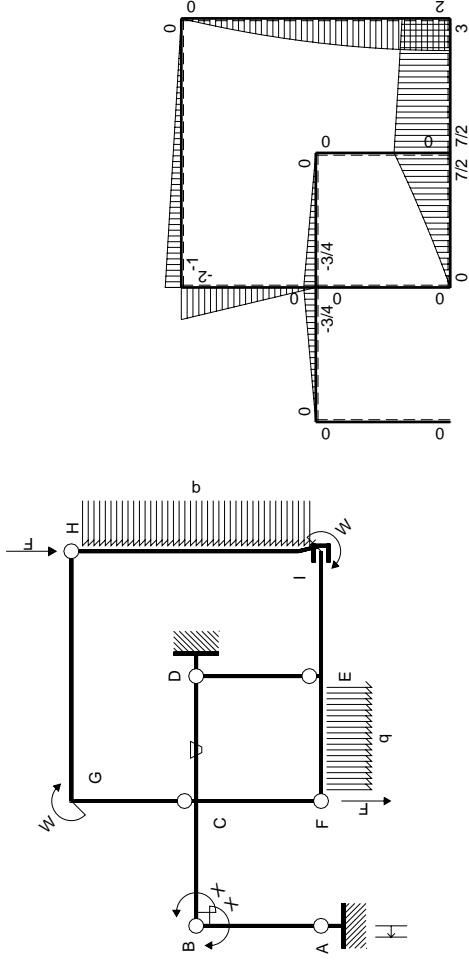
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

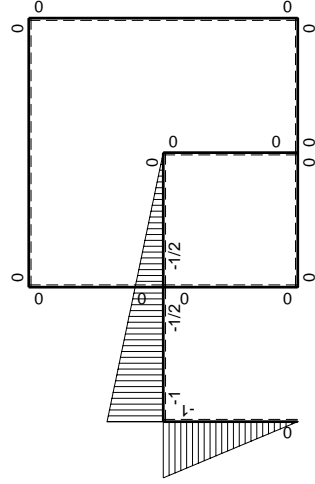
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$13/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-13/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

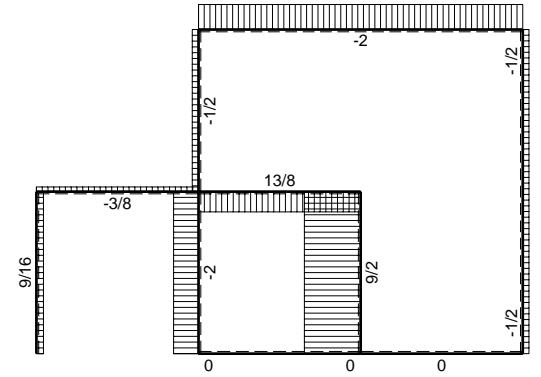
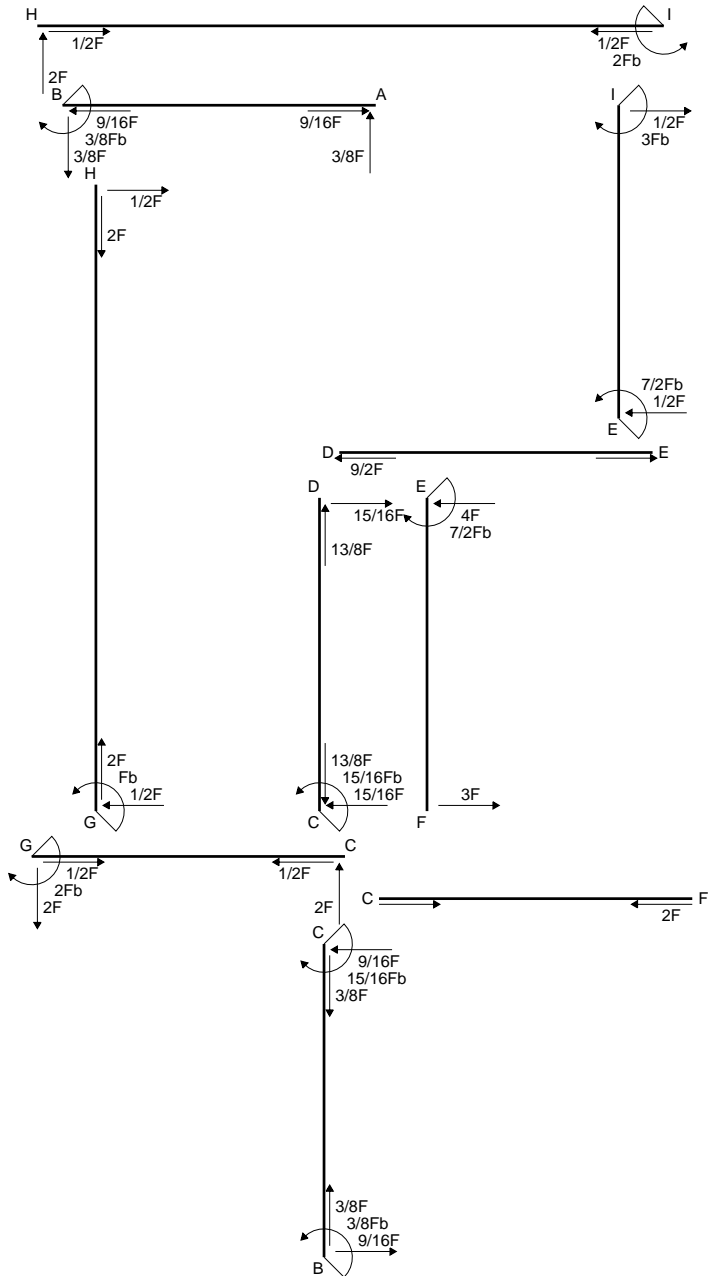
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

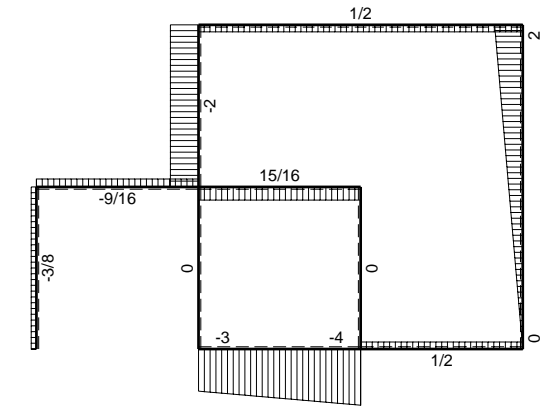
$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

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

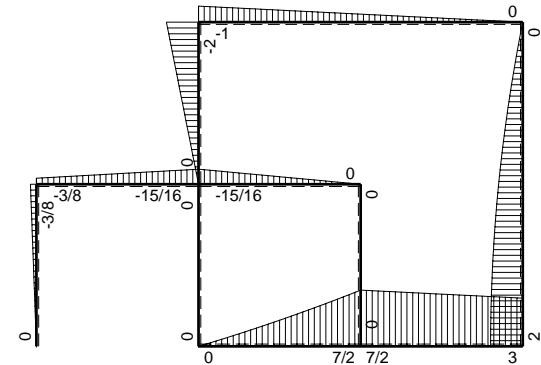
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$



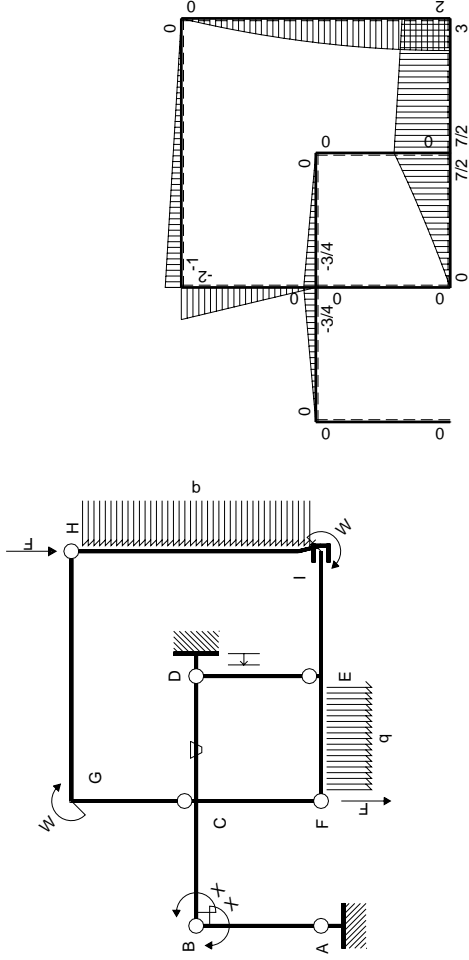
← ⊕ → F



↑ ⊕ ↓ F

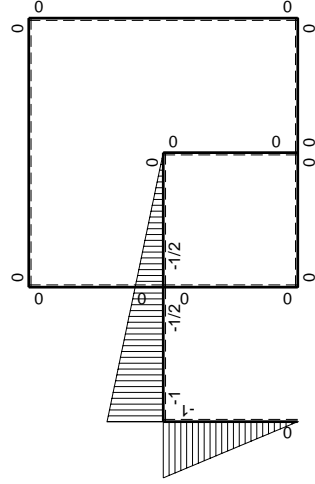


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$3/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

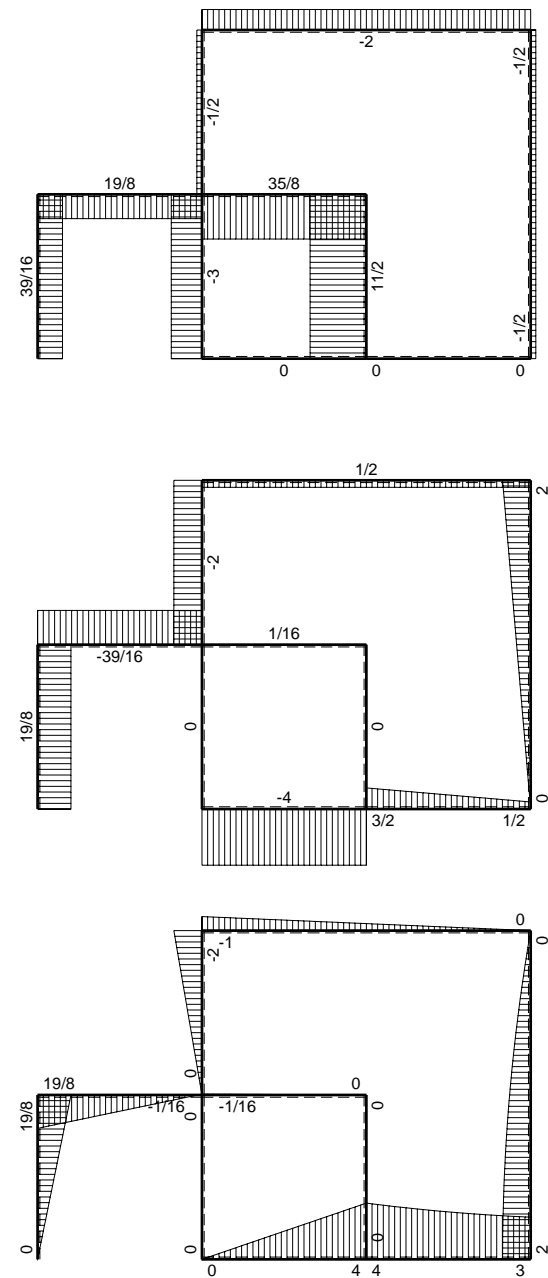
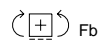
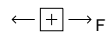
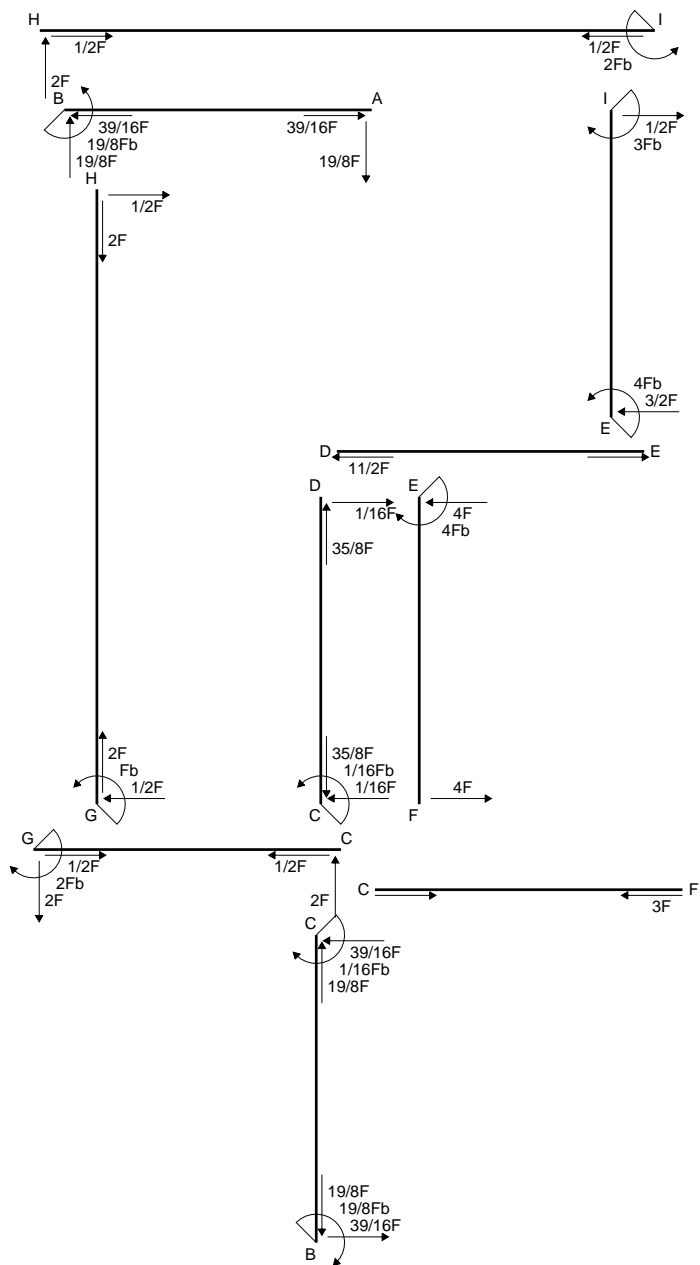
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

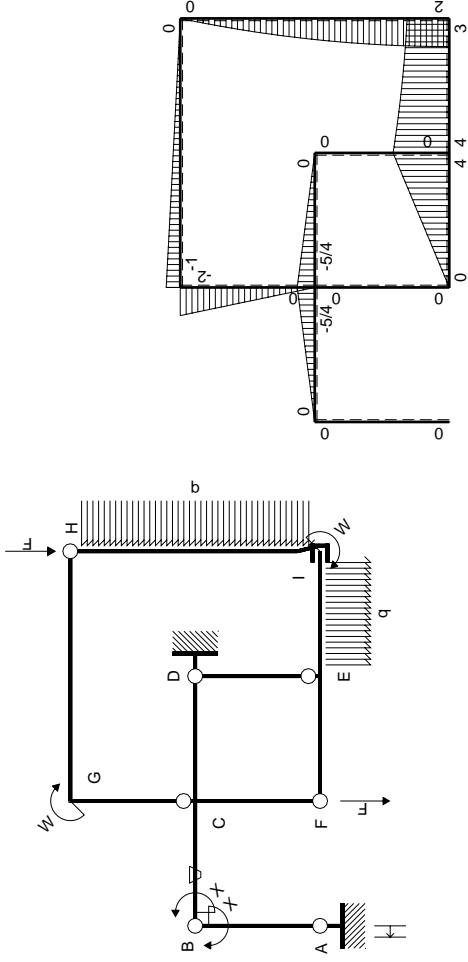
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

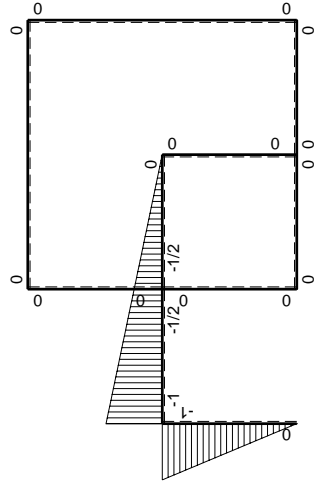
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ		
	totali						$19/8Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-19/8Fb$		

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

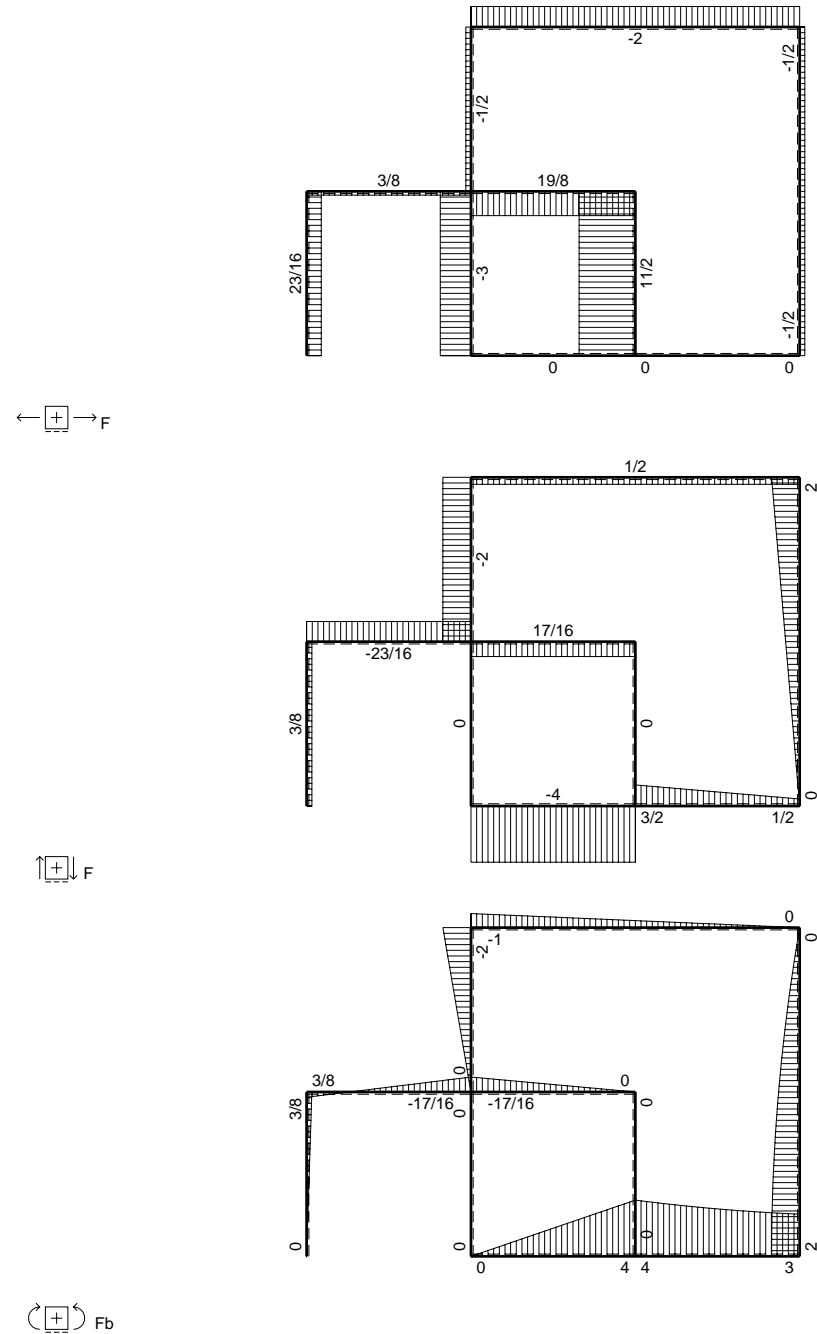
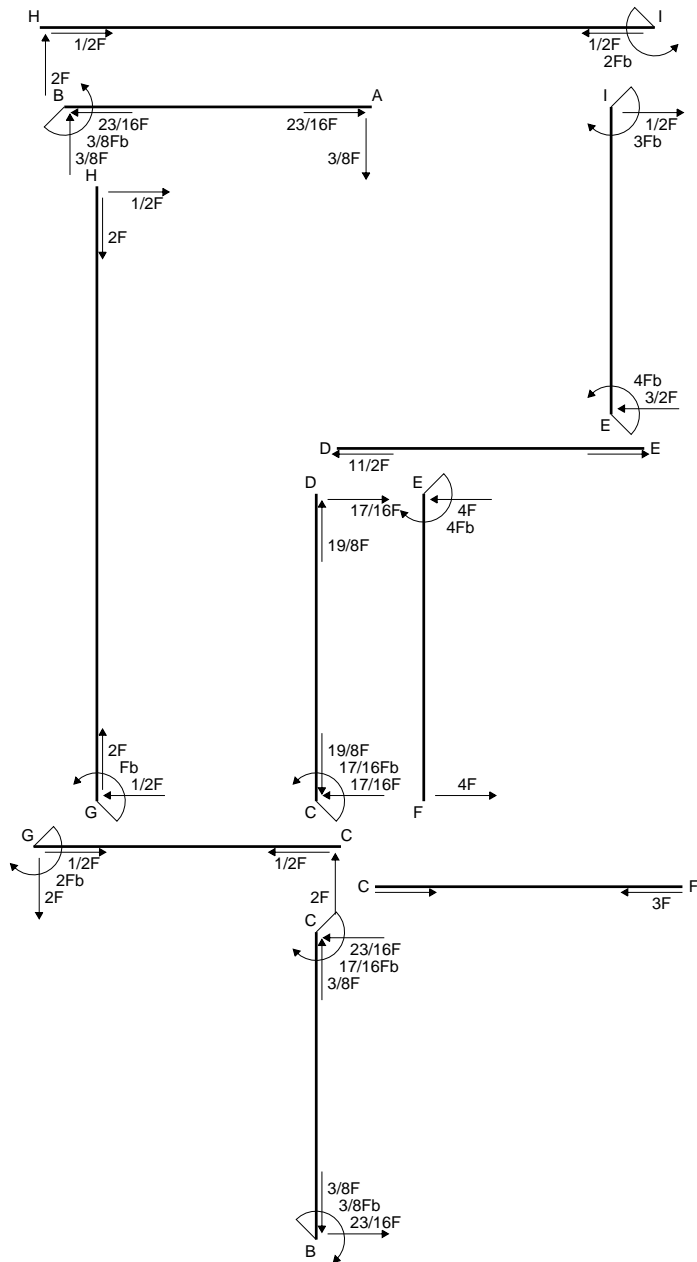
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

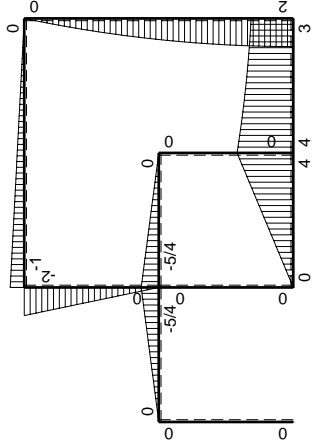
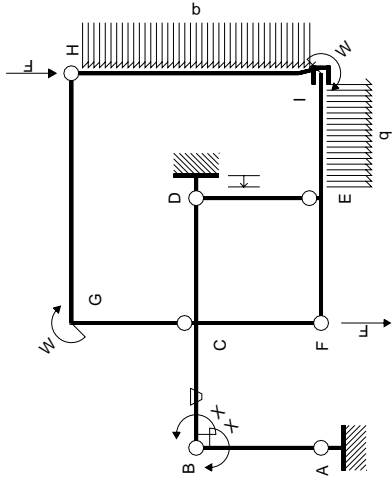
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

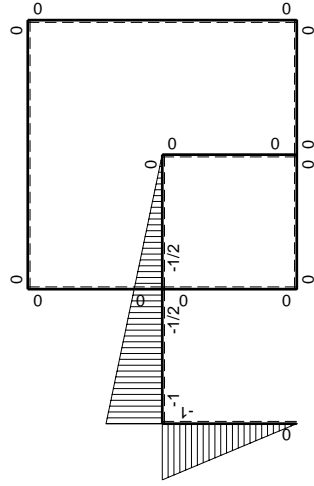
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-3/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

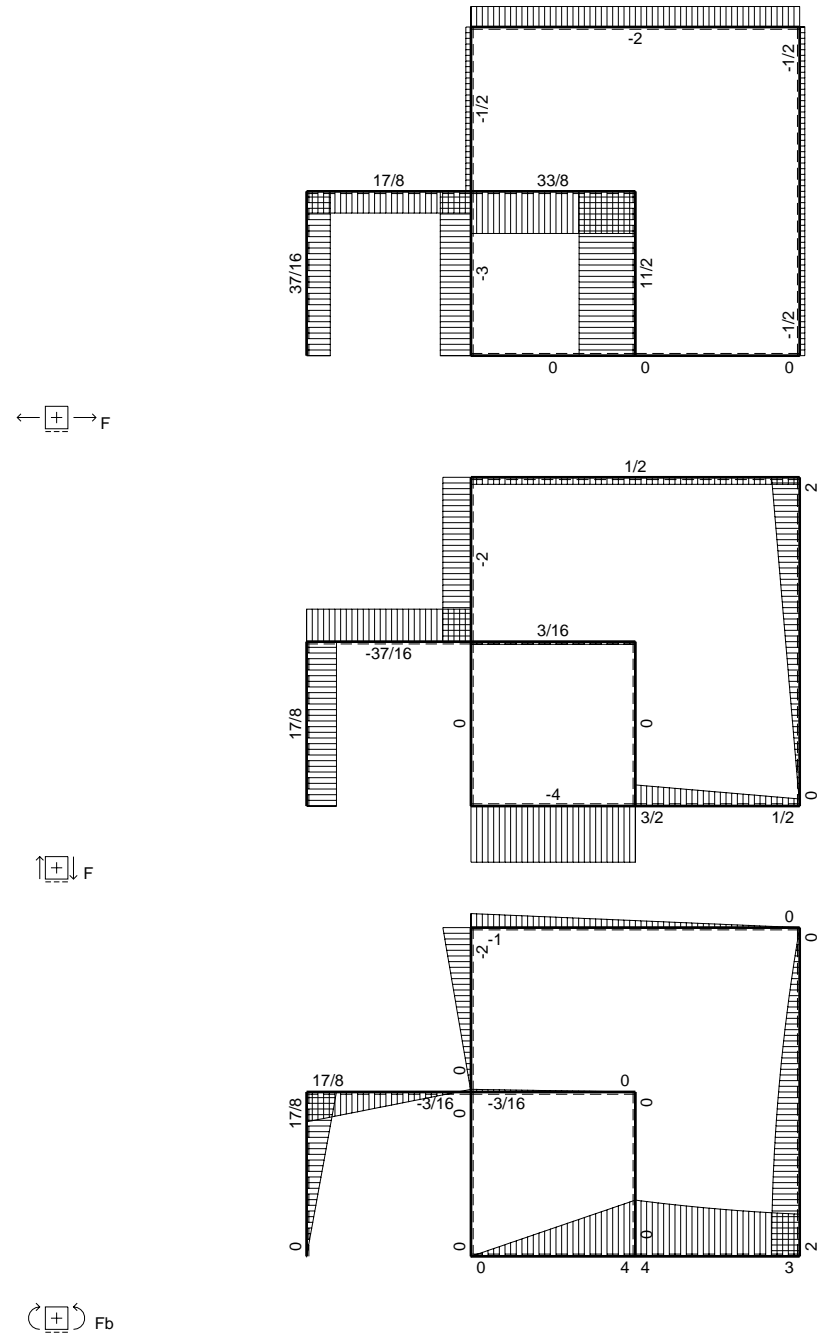
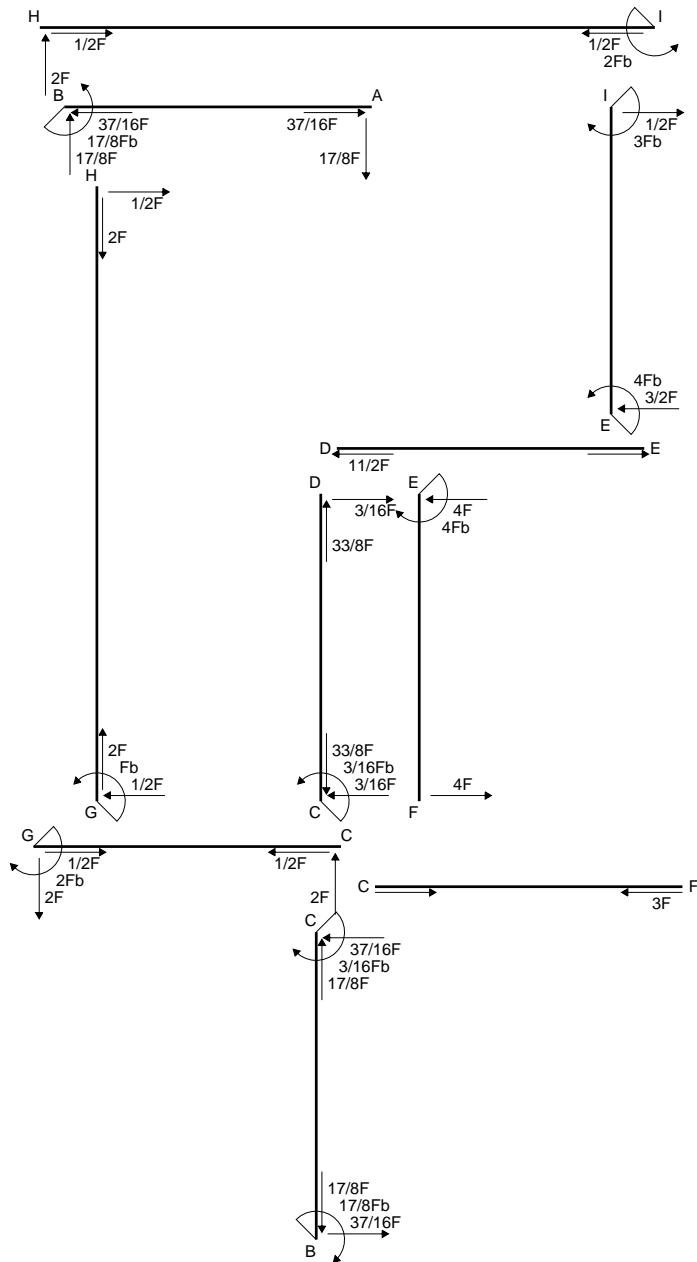
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

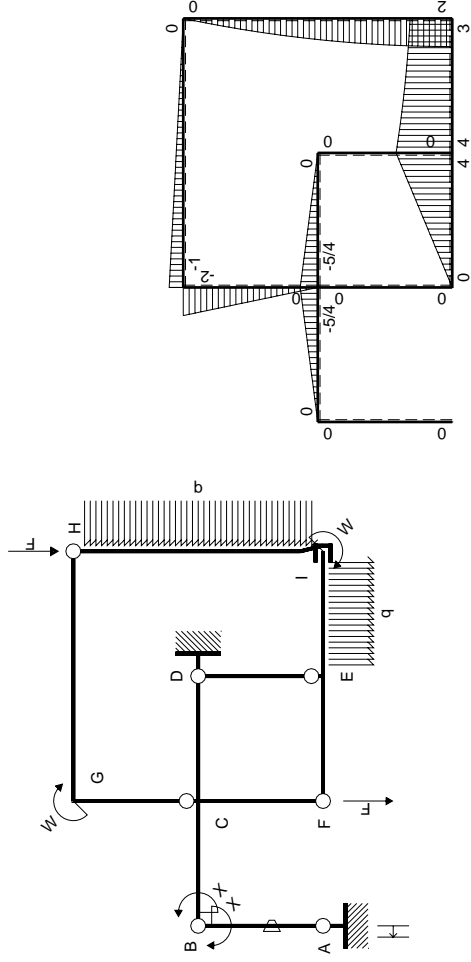
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

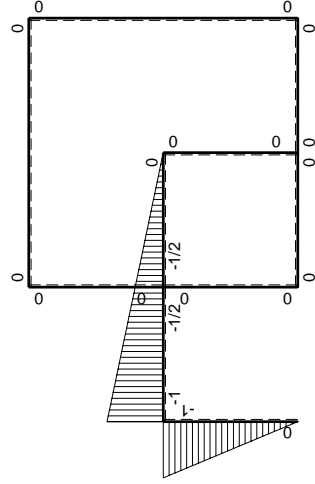
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

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

$$= \left(\frac{1}{3} b \right) \frac{1}{EJ} = \frac{1}{3} \frac{b}{EJ}$$

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

$$= \left(b - b + \frac{1}{3} b \right) \frac{1}{EJ} = \frac{1}{3} \frac{b}{EJ}$$

$$L_{BC}^{xx} = \int_0^b \left(1 - \frac{x}{b} + \frac{1}{4} \frac{x^2}{b^2} \right) \frac{1}{EJ} dx = \left[x - \frac{1}{2} \frac{x^2}{b} + \frac{1}{12} \frac{x^3}{b^2} \right]_0^b \frac{1}{EJ}$$

$$= \left(b - \frac{1}{2} b + \frac{1}{12} b \right) \frac{1}{EJ} = \frac{7}{12} \frac{b}{EJ}$$

$$L_{CB}^{xx} = \int_0^b \left(\frac{1}{4} + \frac{1}{2} \frac{x}{b} + \frac{1}{4} \frac{x^2}{b^2} \right) \frac{1}{EJ} dx = \left[\frac{1}{4} x + \frac{1}{4} \frac{x^2}{b} + \frac{1}{12} \frac{x^3}{b^2} \right]_0^b \frac{1}{EJ}$$

$$= \left(\frac{1}{4} b + \frac{1}{4} b + \frac{1}{12} b \right) \frac{1}{EJ} = \frac{7}{12} \frac{b}{EJ}$$

$$L_{CD}^{xx} = \int_0^b \left(\frac{1}{4} - \frac{1}{2} \frac{x}{b} + \frac{1}{4} \frac{x^2}{b^2} \right) \frac{1}{EJ} dx = \left[\frac{1}{4} x - \frac{1}{4} \frac{x^2}{b} + \frac{1}{12} \frac{x^3}{b^2} \right]_0^b \frac{1}{EJ}$$

$$= \left(\frac{1}{4} b - \frac{1}{4} b + \frac{1}{12} b \right) \frac{1}{EJ} = \frac{1}{12} \frac{b}{EJ}$$

$$L_{DC}^{xx} = \int_0^b \left(\frac{1}{4} \frac{x^2}{b^2} \right) \frac{1}{EJ} dx = \left[\frac{1}{12} \frac{x^3}{b^2} \right]_0^b \frac{1}{EJ}$$

$$= \left(\frac{1}{12} b \right) \frac{1}{EJ} = \frac{1}{12} \frac{b}{EJ}$$

$$L_{AB}^{xo} = \int_0^b \left(\frac{x}{b} \right) \theta dx = \left[\frac{1}{2} \frac{x^2}{b} \right]_0^b \theta$$

$$= \left(\frac{1}{2} b \right) \theta = \frac{1}{2} \frac{Fb^2}{EJ}$$

$$L_{BA}^{xo} = \int_0^b \left(-1 + \frac{x}{b} \right) \theta dx = \left[-x + \frac{1}{2} \frac{x^2}{b} \right]_0^b \theta$$

$$= \left(-b + \frac{1}{2} b \right) \theta = \frac{1}{2} \frac{Fb^2}{EJ}$$

$$L_{BC}^{xo} = \int_0^b \left(\frac{5}{4} \frac{x}{b} - \frac{5}{8} \frac{x^2}{b^2} \right) Fb \frac{1}{EJ} dx = \left[\frac{5}{8} \frac{x^2}{b} - \frac{5}{24} \frac{x^3}{b^2} \right]_0^b Fb \frac{1}{EJ}$$

$$= \left(\frac{5}{8} b - \frac{5}{24} b \right) Fb \frac{1}{EJ} = \frac{5}{12} \frac{Fb^2}{EJ}$$

$$L_{CB}^{xo} = \int_0^b \left(\frac{5}{8} - \frac{5}{8} \frac{x^2}{b^2} \right) Fb \frac{1}{EJ} dx = \left[\frac{5}{8} x - \frac{5}{24} \frac{x^3}{b^2} \right]_0^b Fb \frac{1}{EJ}$$

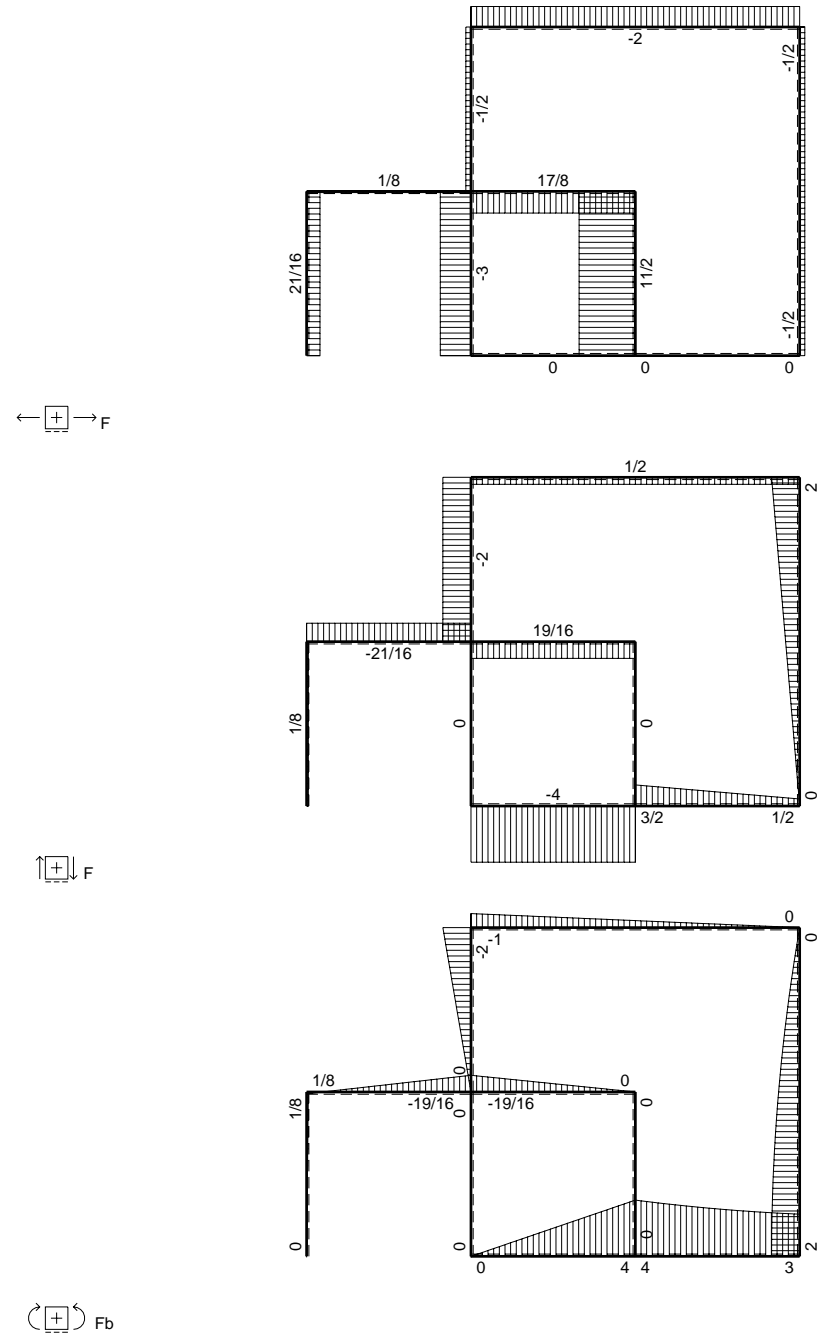
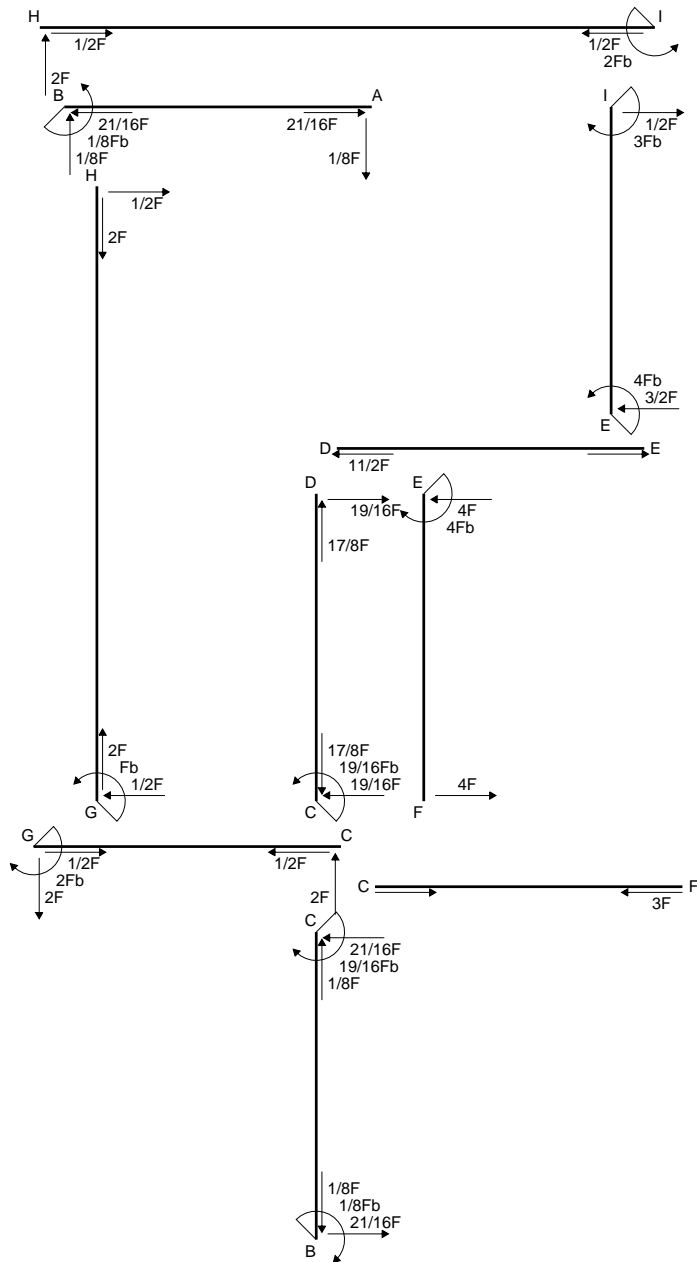
$$= \left(\frac{5}{8} b - \frac{5}{24} b \right) Fb \frac{1}{EJ} = \frac{5}{12} \frac{Fb^2}{EJ}$$

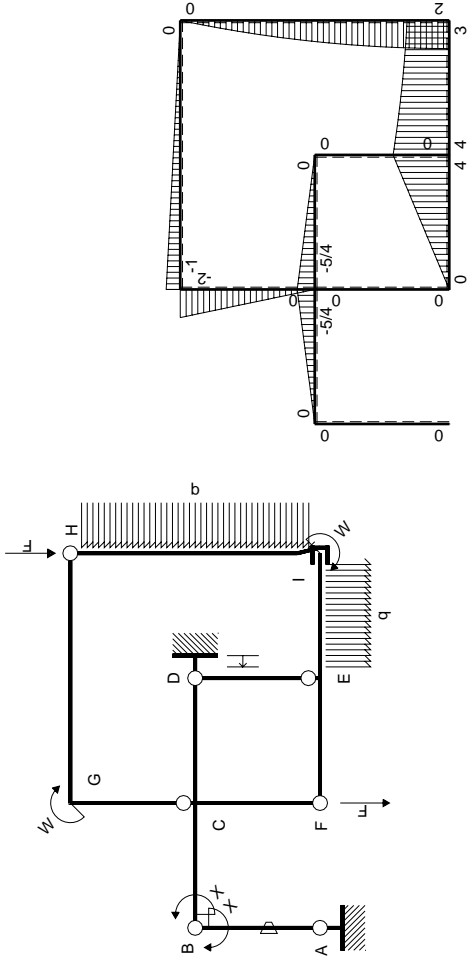
$$L_{CD}^{xo} = \int_0^b \left(\frac{5}{8} - \frac{5}{4} \frac{x}{b} + \frac{5}{8} \frac{x^2}{b^2} \right) Fb \frac{1}{EJ} dx = \left[\frac{5}{8} x - \frac{5}{8} \frac{x^2}{b} + \frac{5}{24} \frac{x^3}{b^2} \right]_0^b Fb \frac{1}{EJ}$$

$$= \left(\frac{5}{8} b - \frac{5}{8} b + \frac{5}{24} b \right) Fb \frac{1}{EJ} = \frac{5}{24} \frac{Fb^2}{EJ}$$

$$L_{DC}^{xo} = \int_0^b \left(\frac{5}{8} \frac{x^2}{b^2} \right) Fb \frac{1}{EJ} dx = \left[\frac{5}{24} \frac{x^3}{b^2} \right]_0^b Fb \frac{1}{EJ}$$

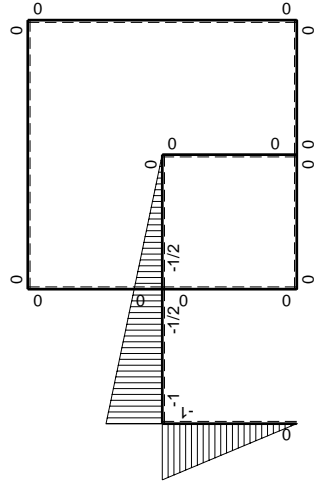
$$= \left(\frac{5}{24} b \right) Fb \frac{1}{EJ} = \frac{5}{24} \frac{Fb^2}{EJ}$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

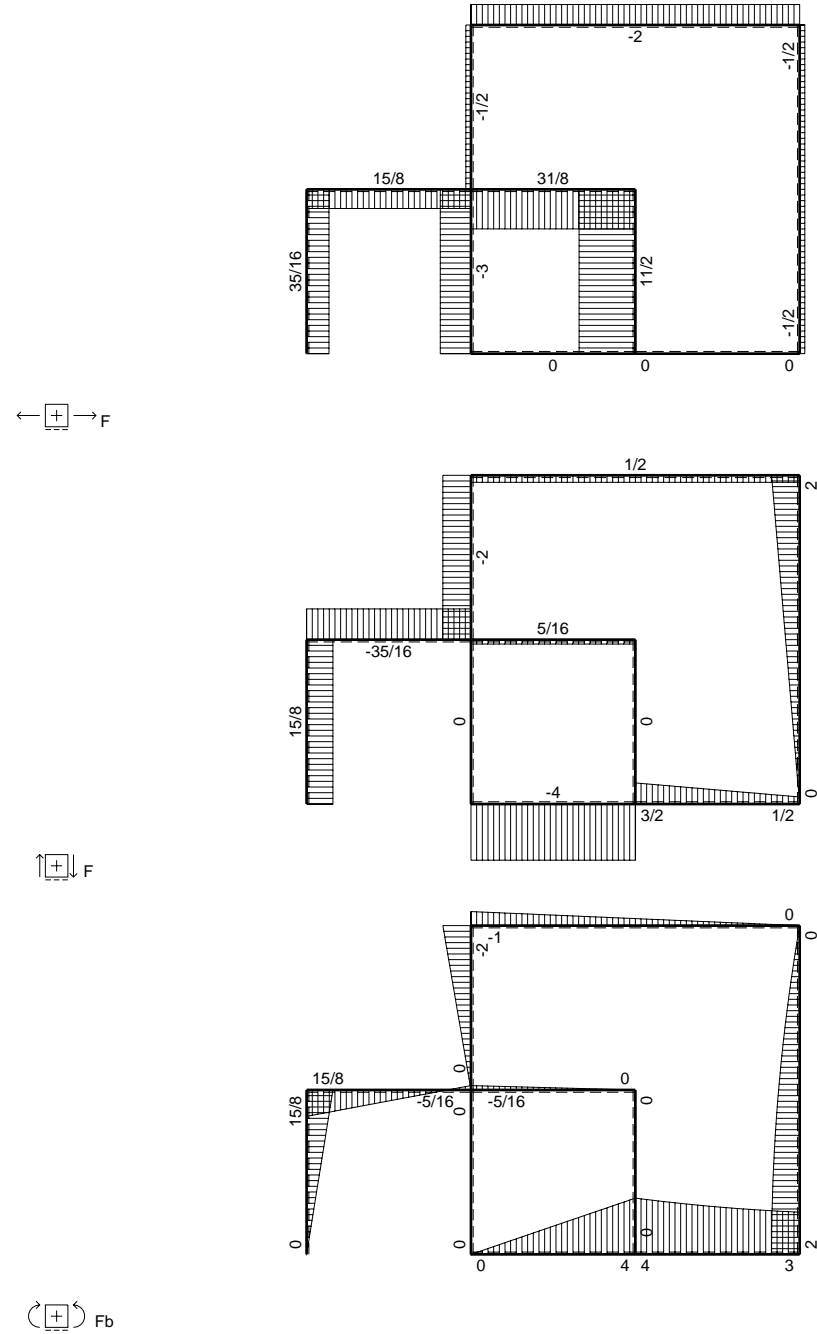
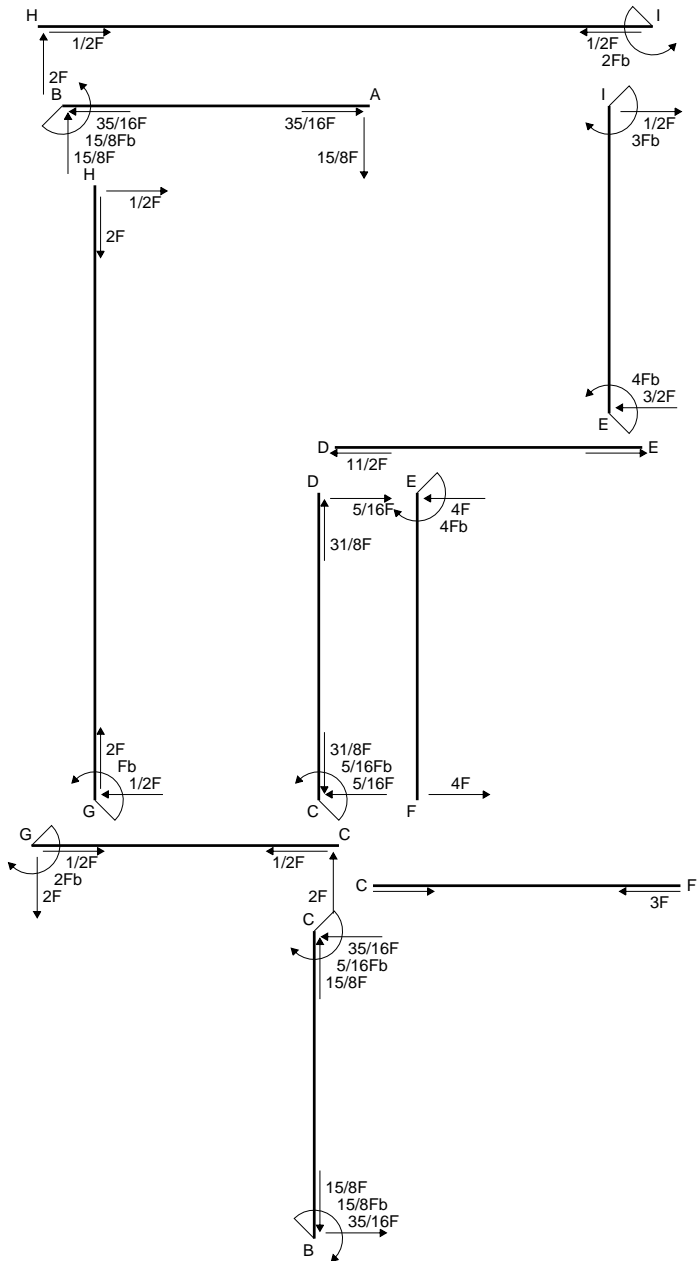
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

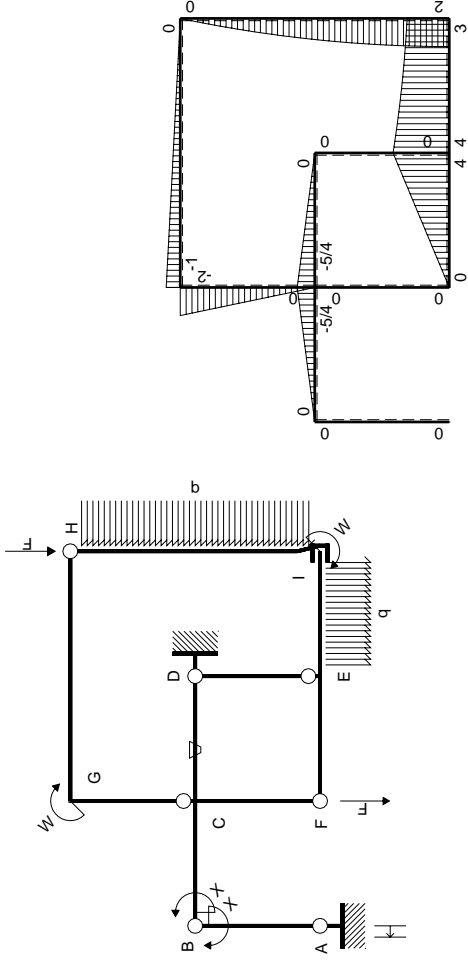
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

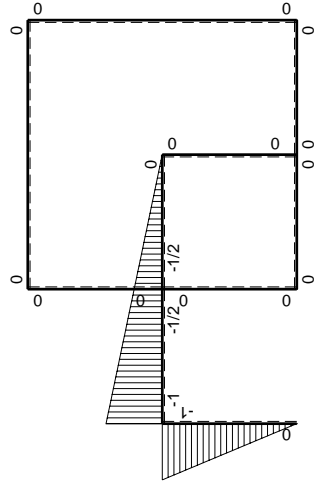
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

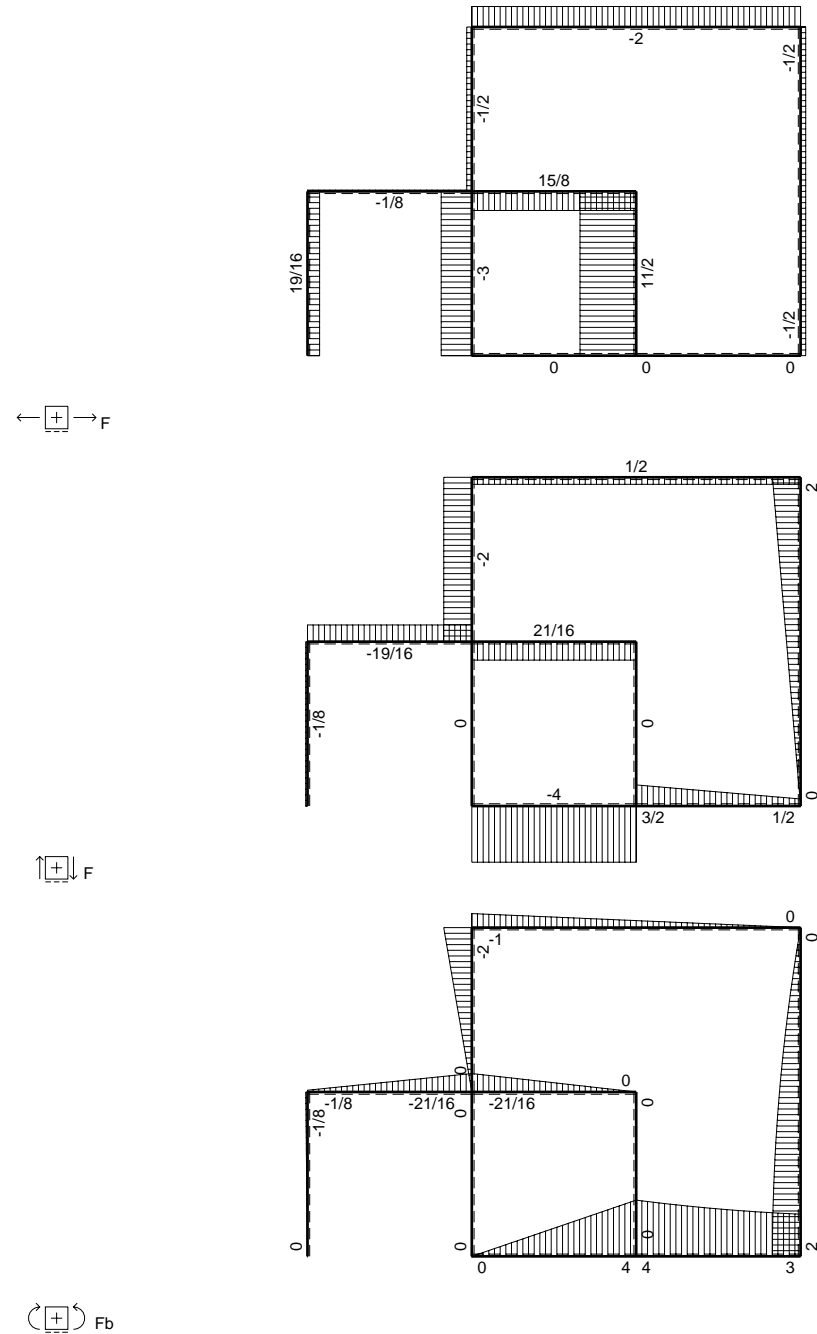
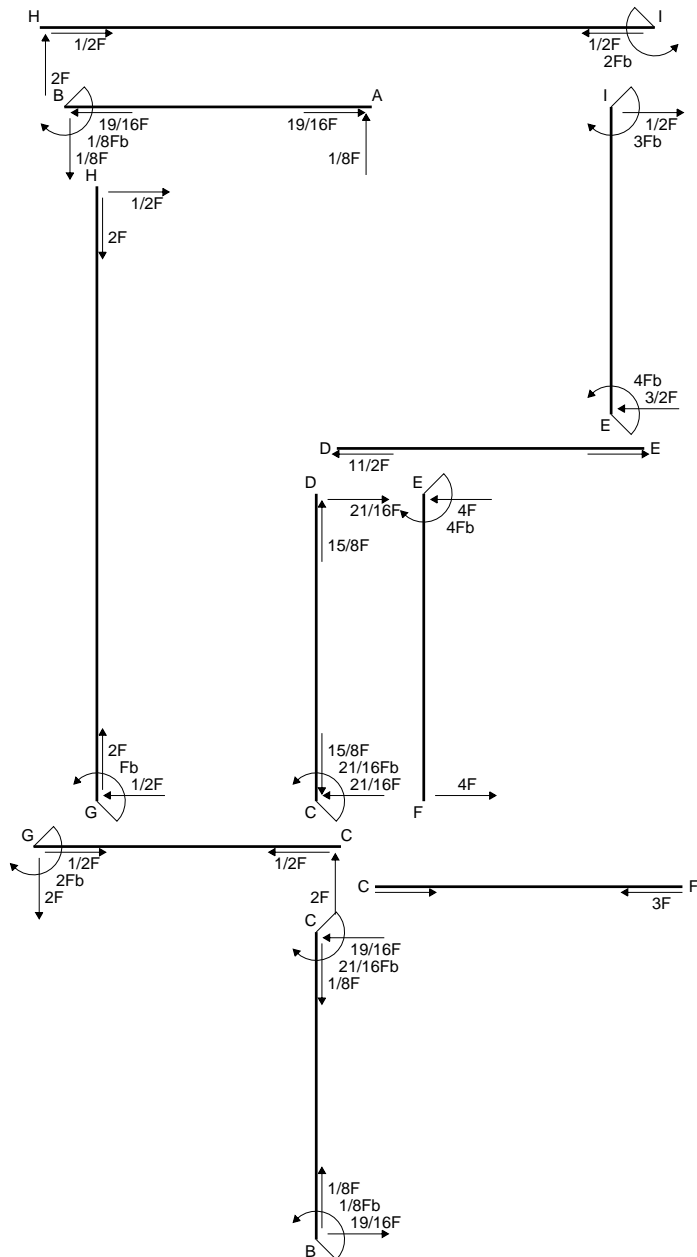
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

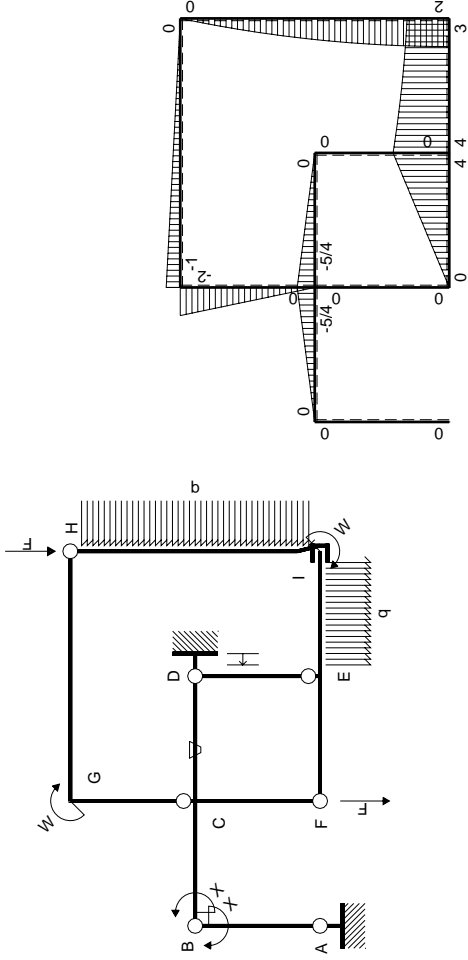
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

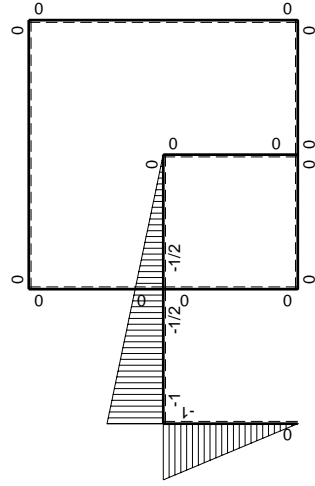
$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/8Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

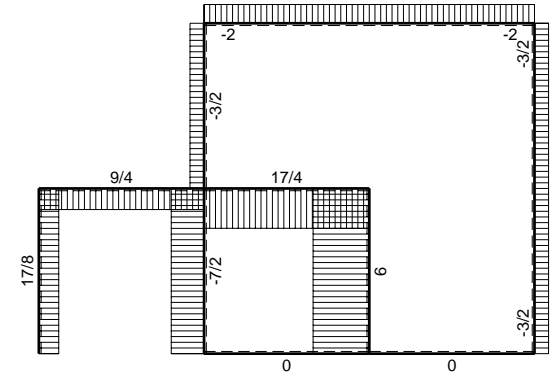
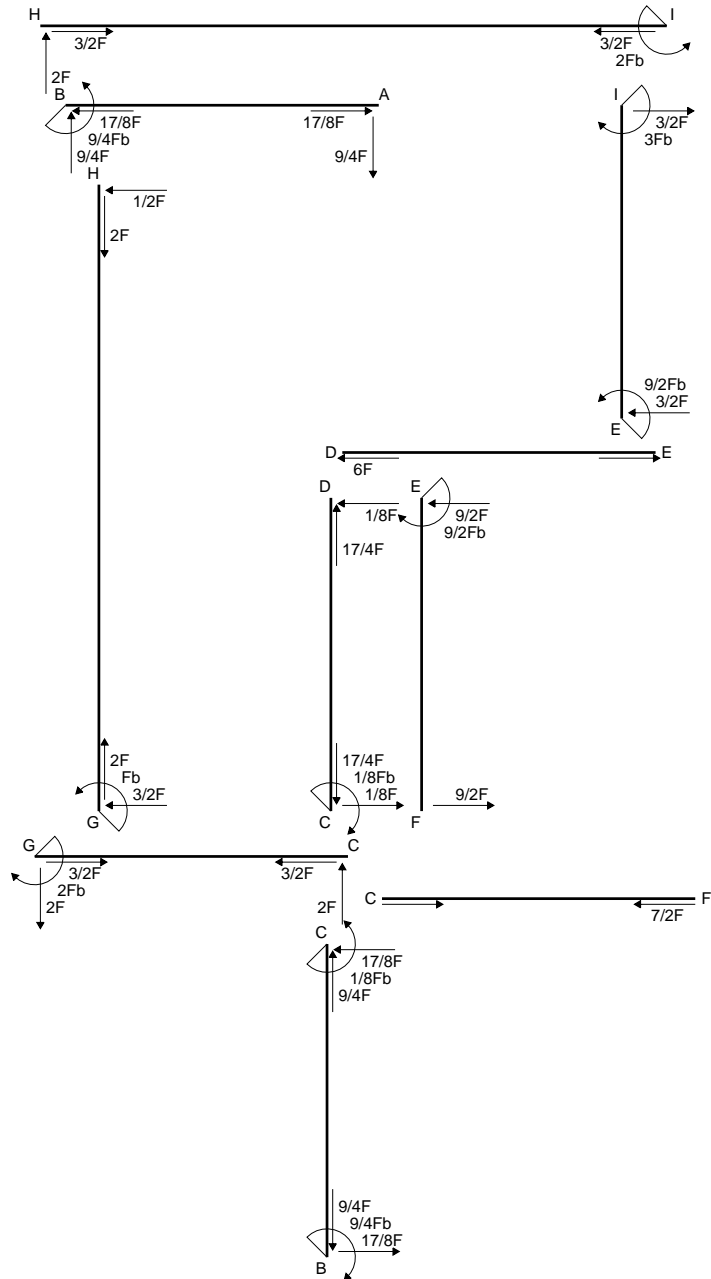
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

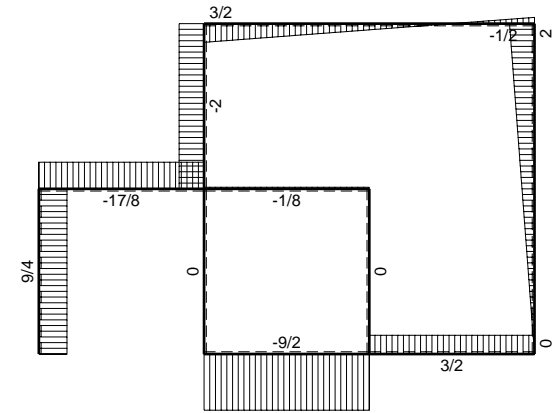
$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

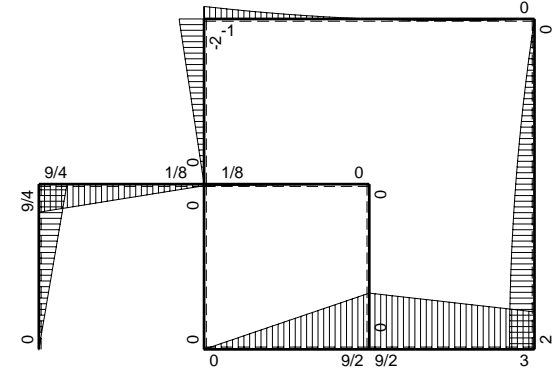
$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$



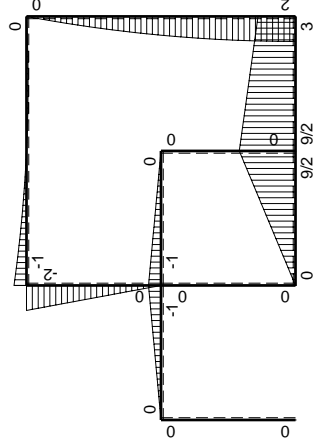
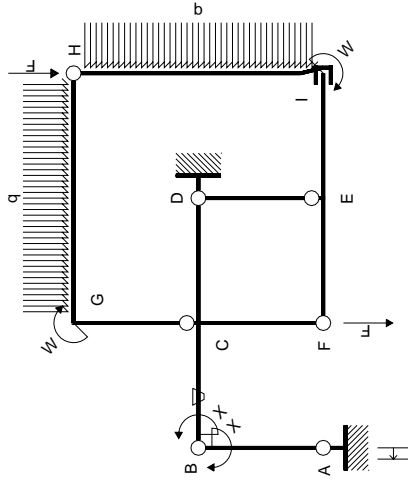
← ⊕ → F



↑ ⊕ ↓ F

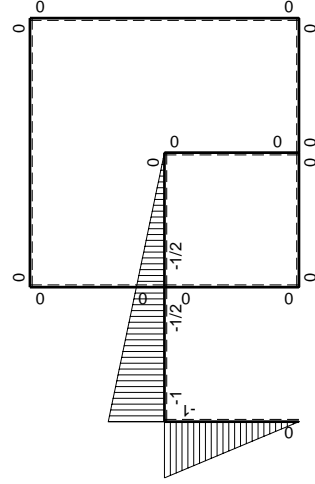


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0
FE b	0	$-9/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$9/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-9/4Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

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

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

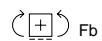
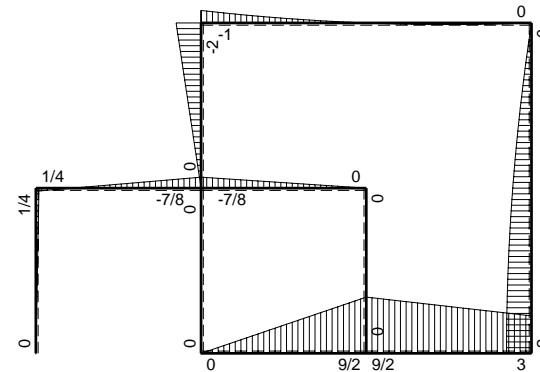
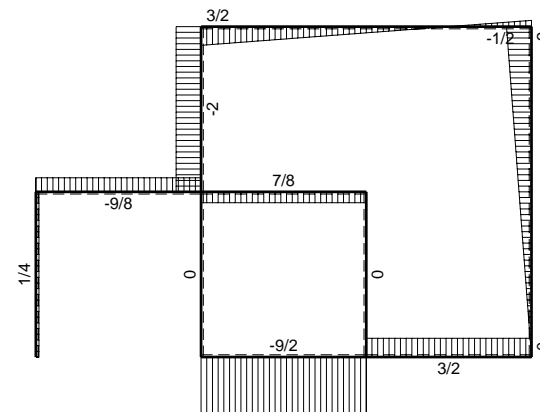
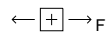
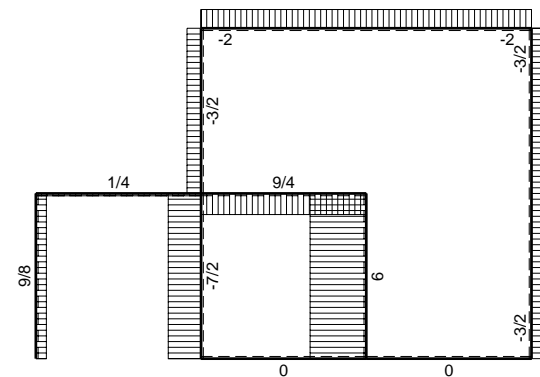
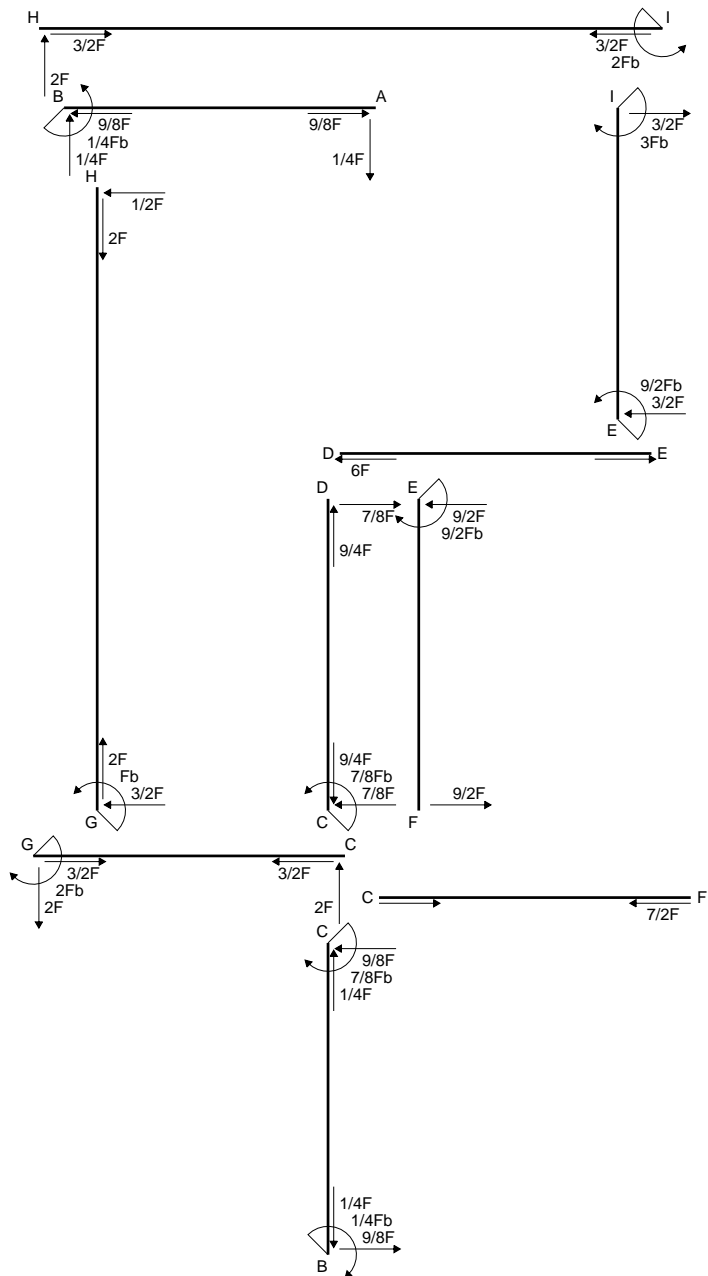
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

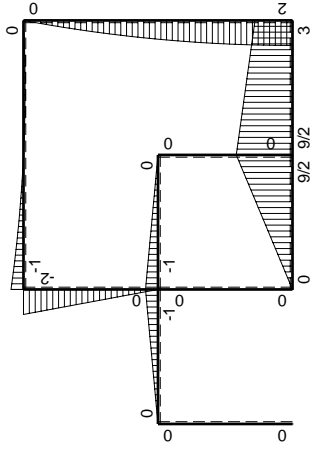
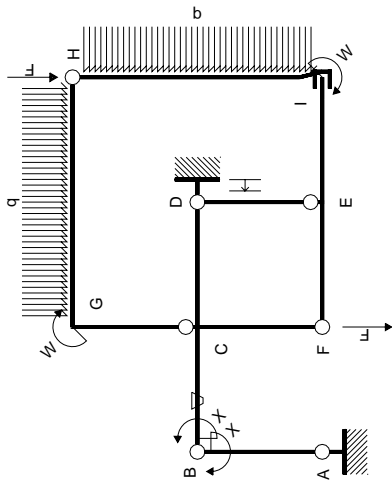
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

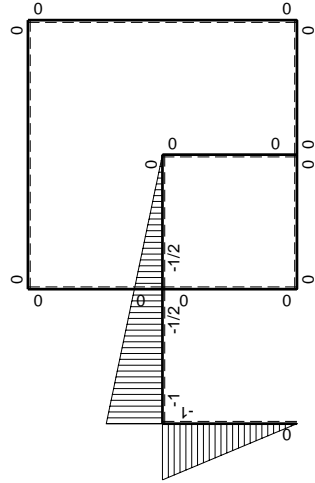
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/4Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

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

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

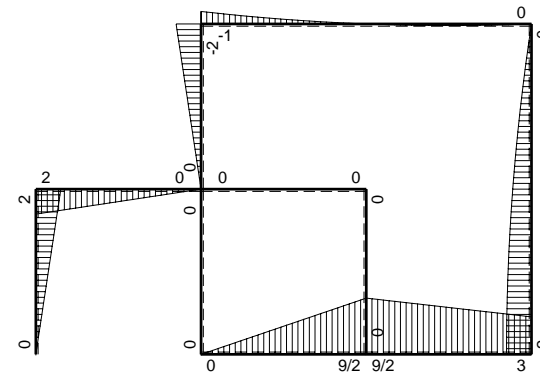
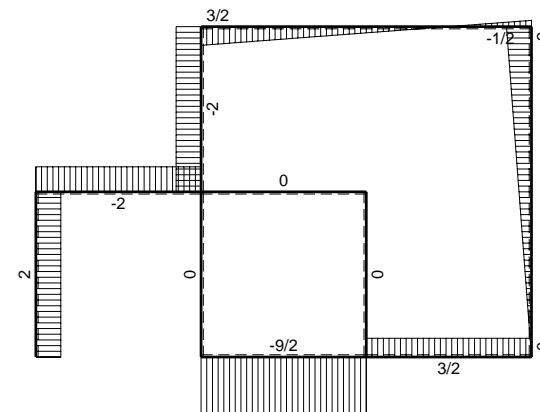
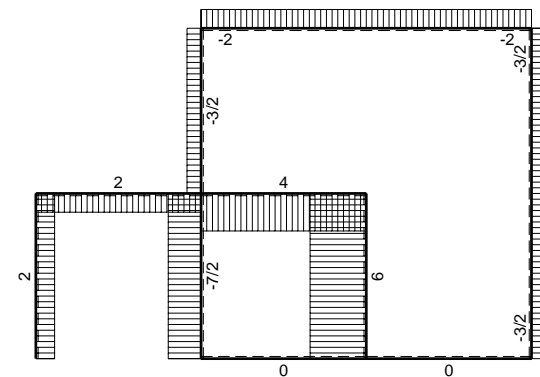
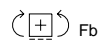
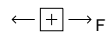
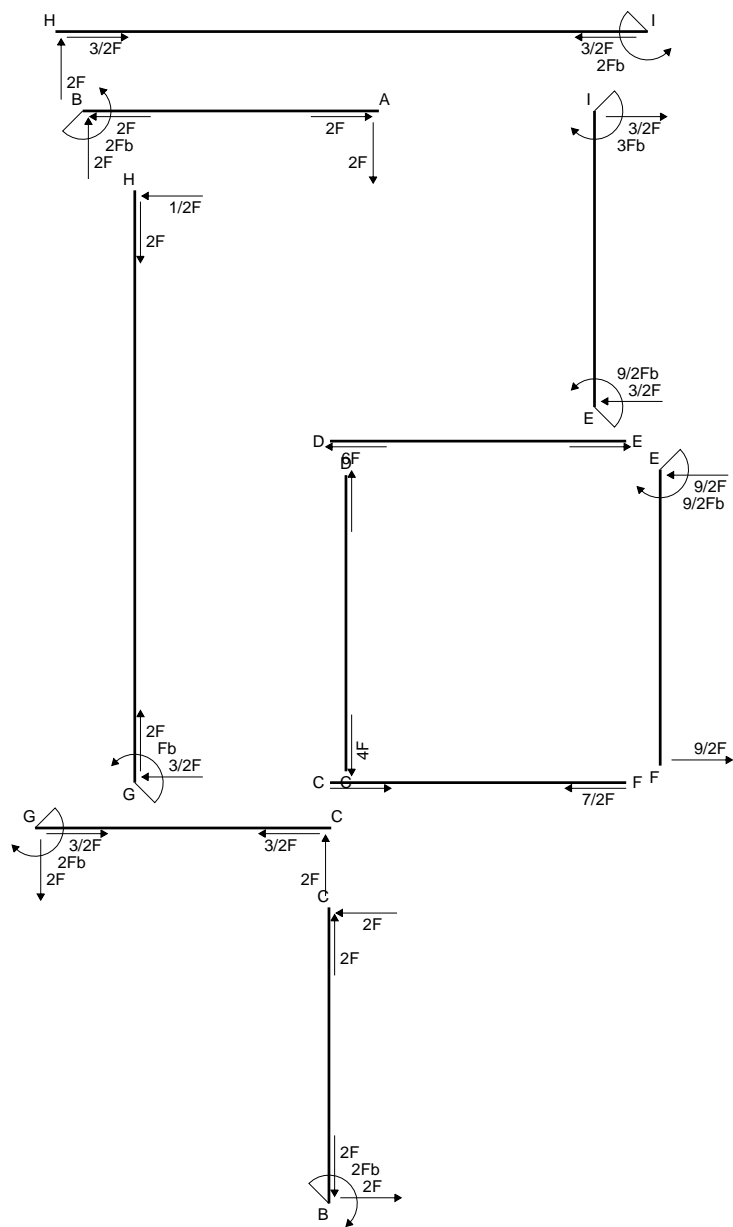
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

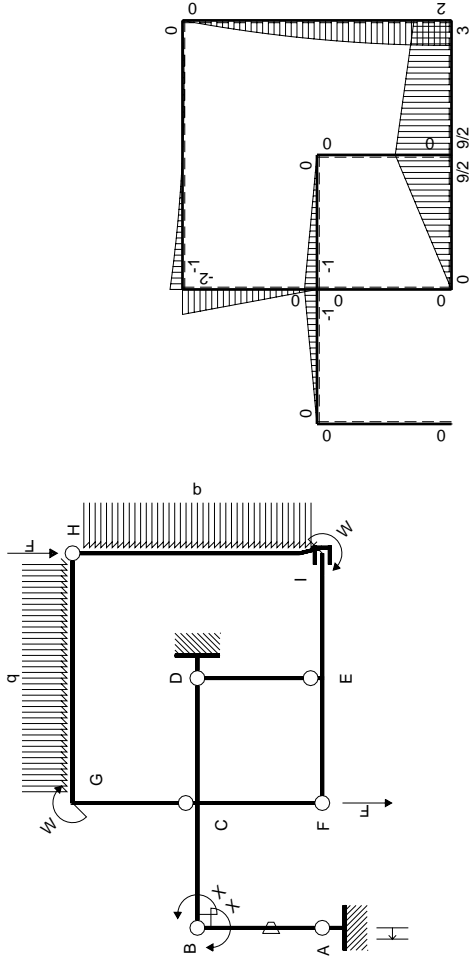
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

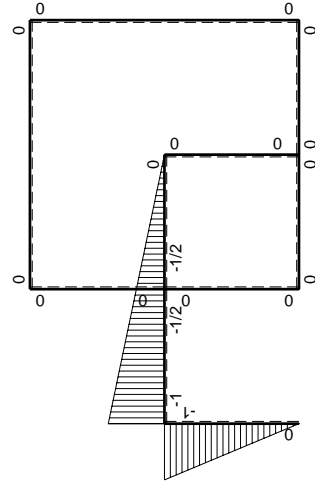
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0
FE b	0	$-9/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

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

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

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

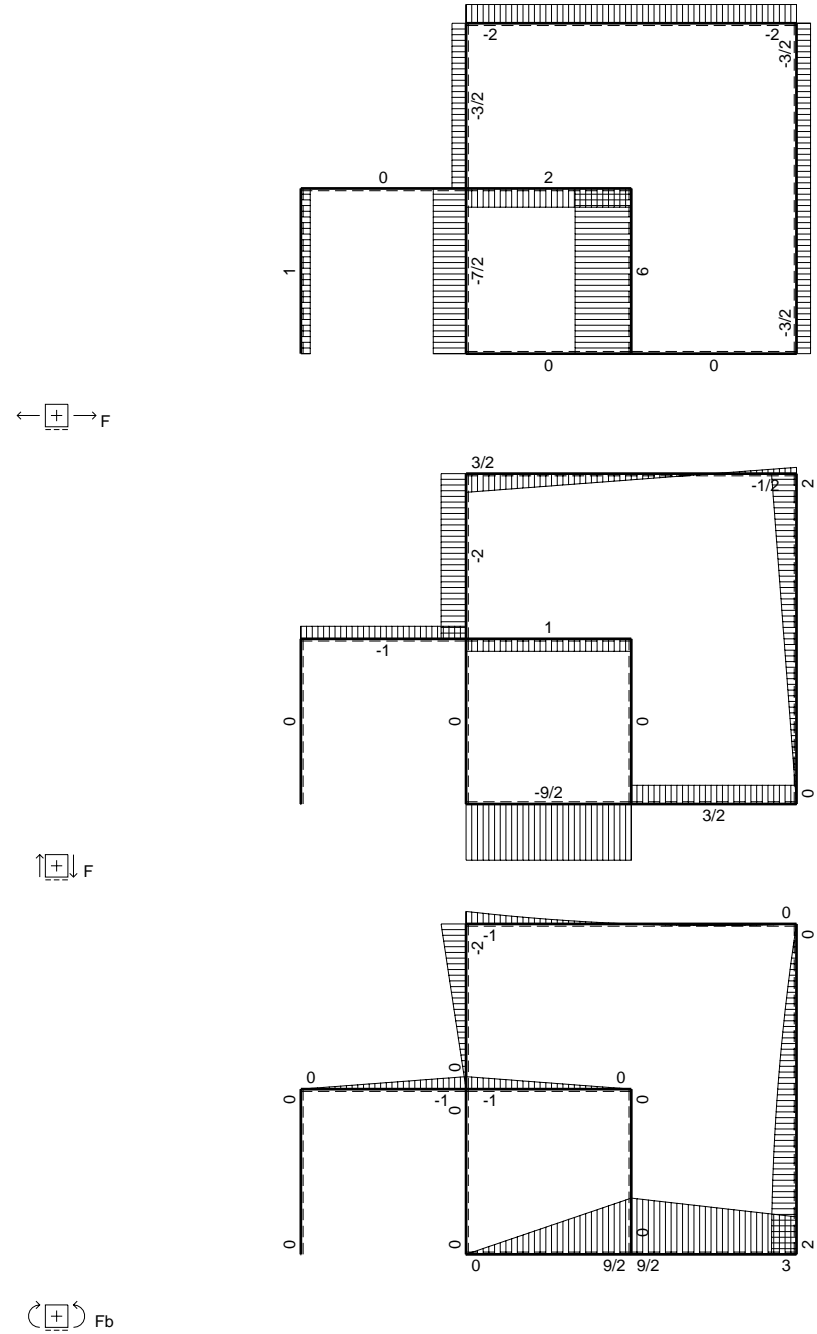
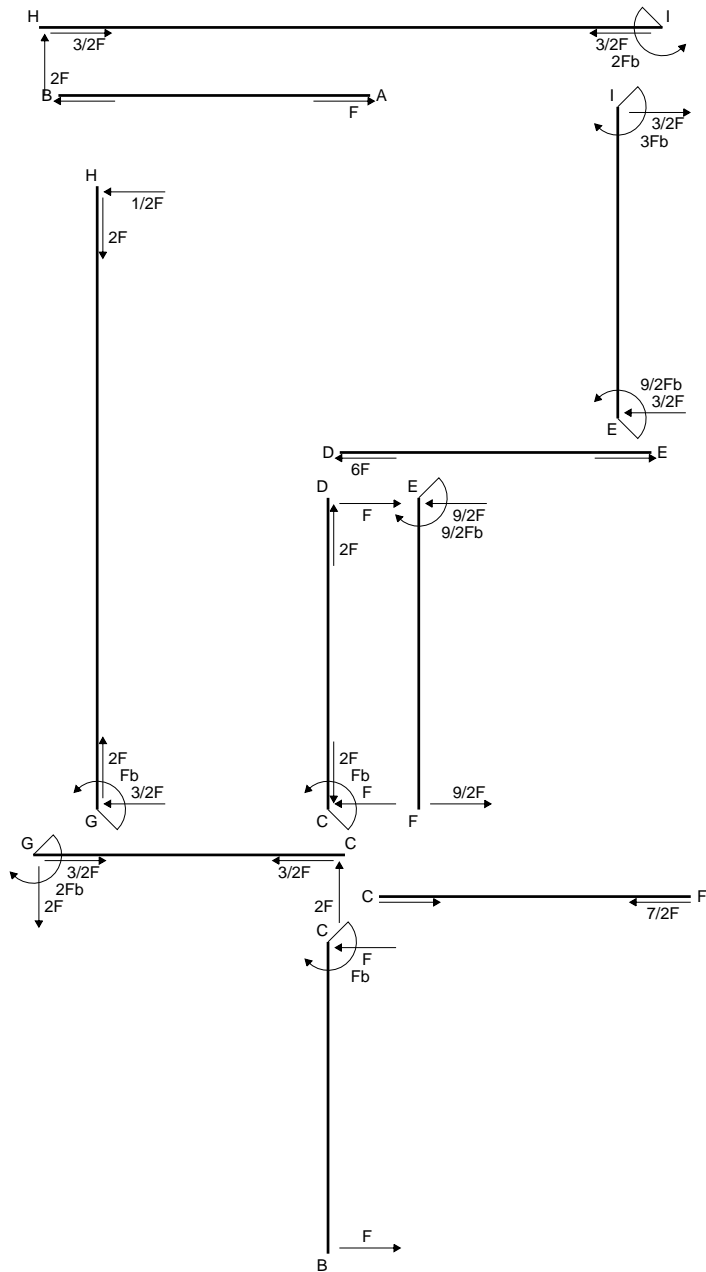
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

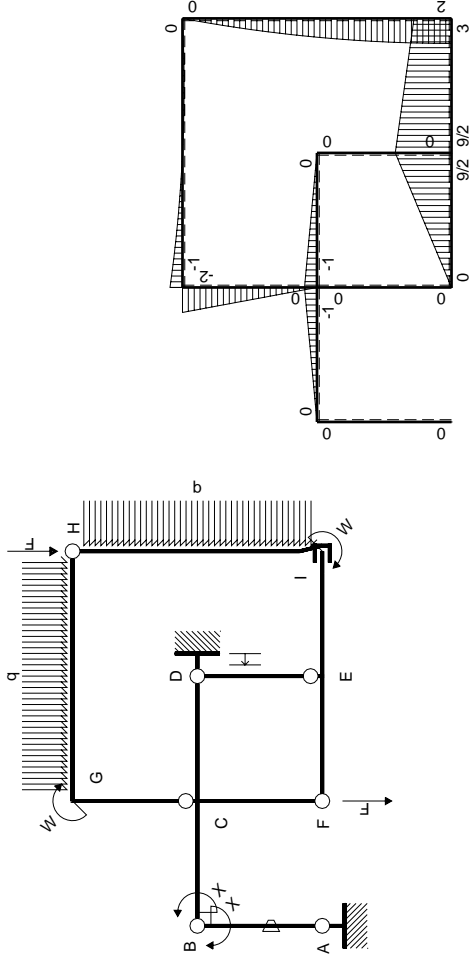
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

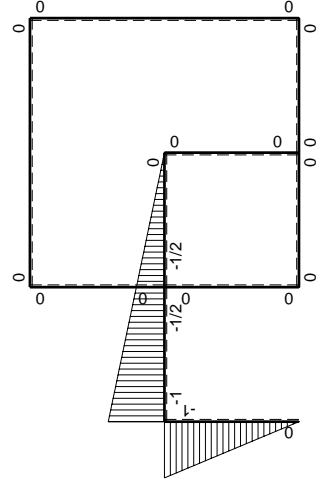
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0
FE b	0	$-9/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						0	Xb/EJ
	iperstatica $X=W_{BC}$						0	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

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

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

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

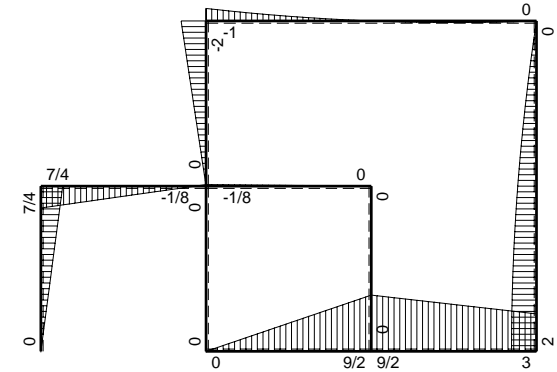
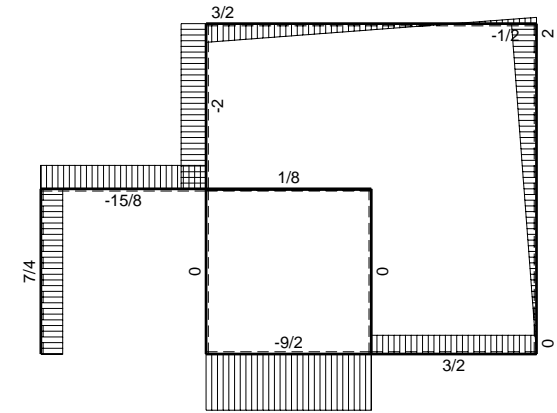
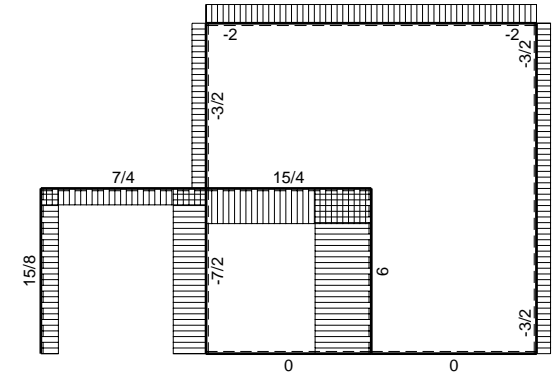
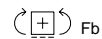
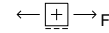
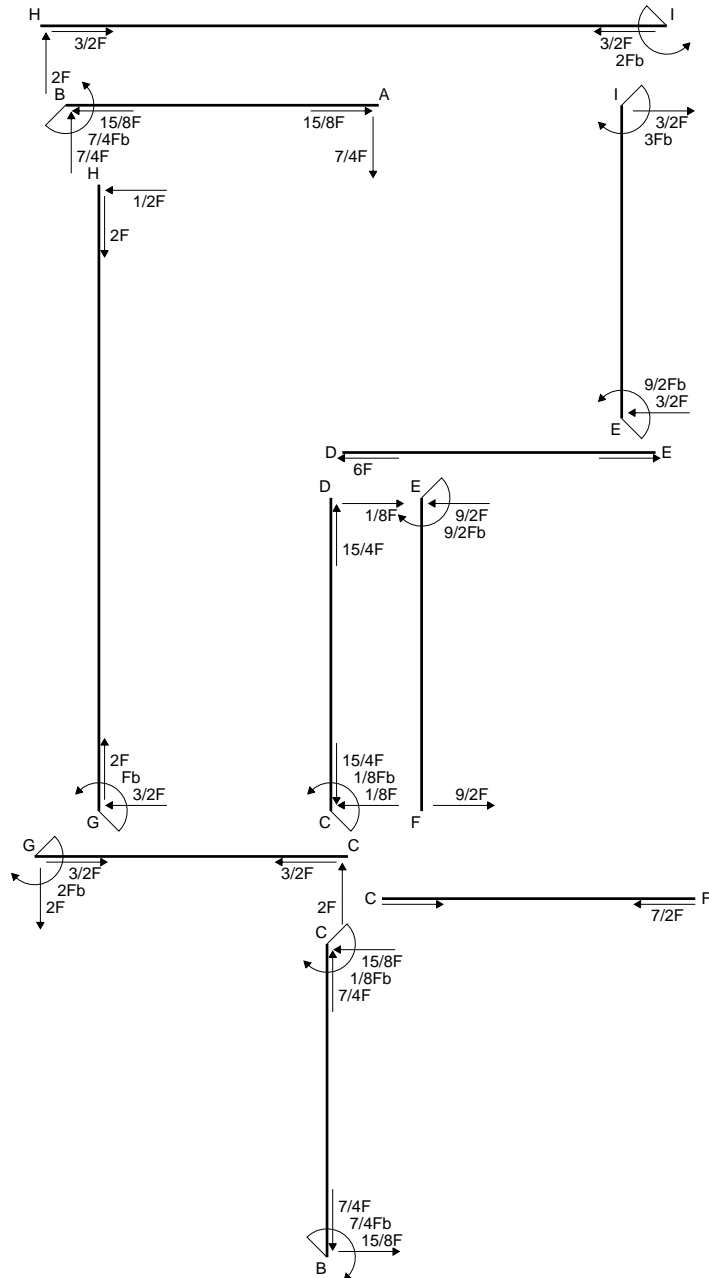
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

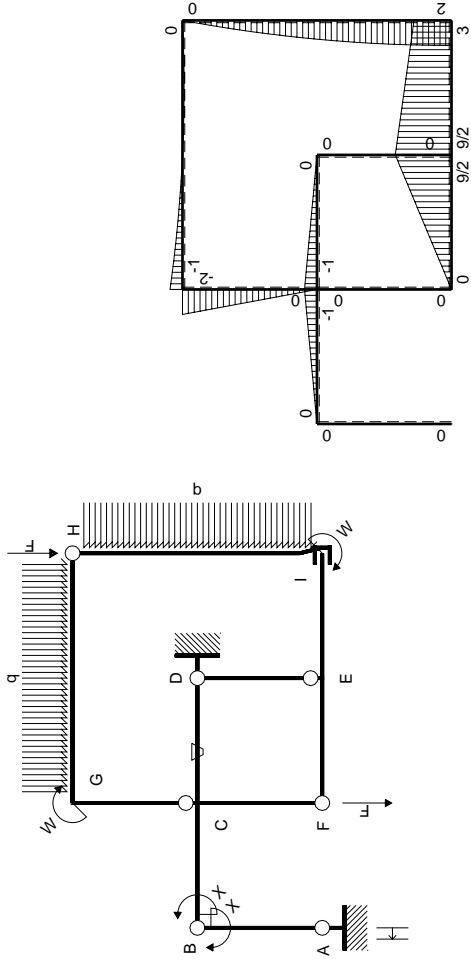
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

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

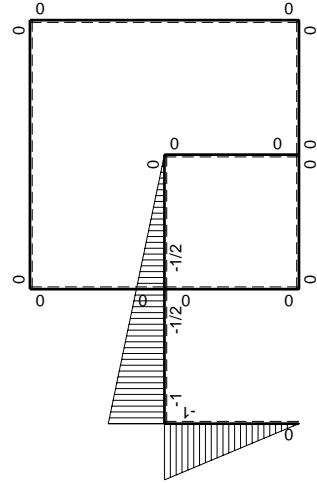
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-7/4Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

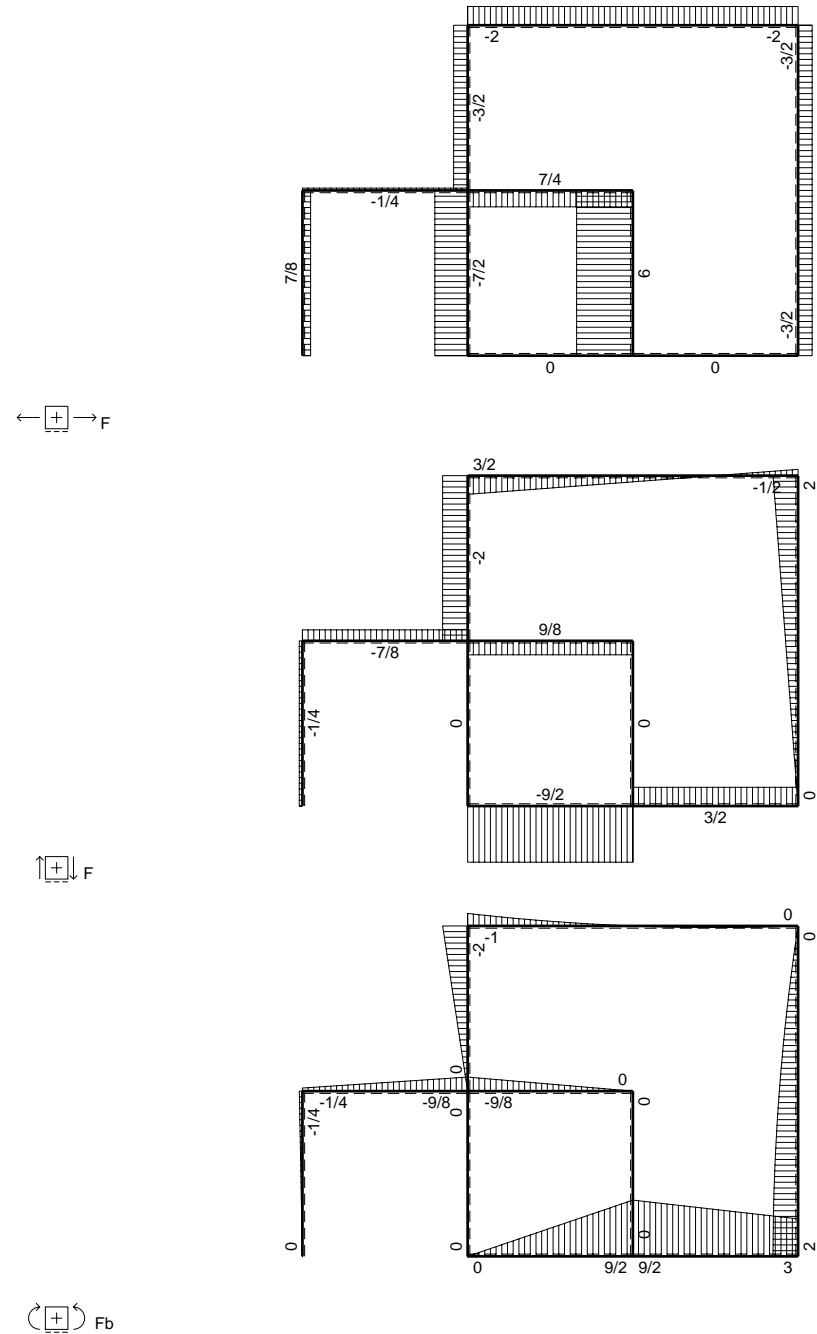
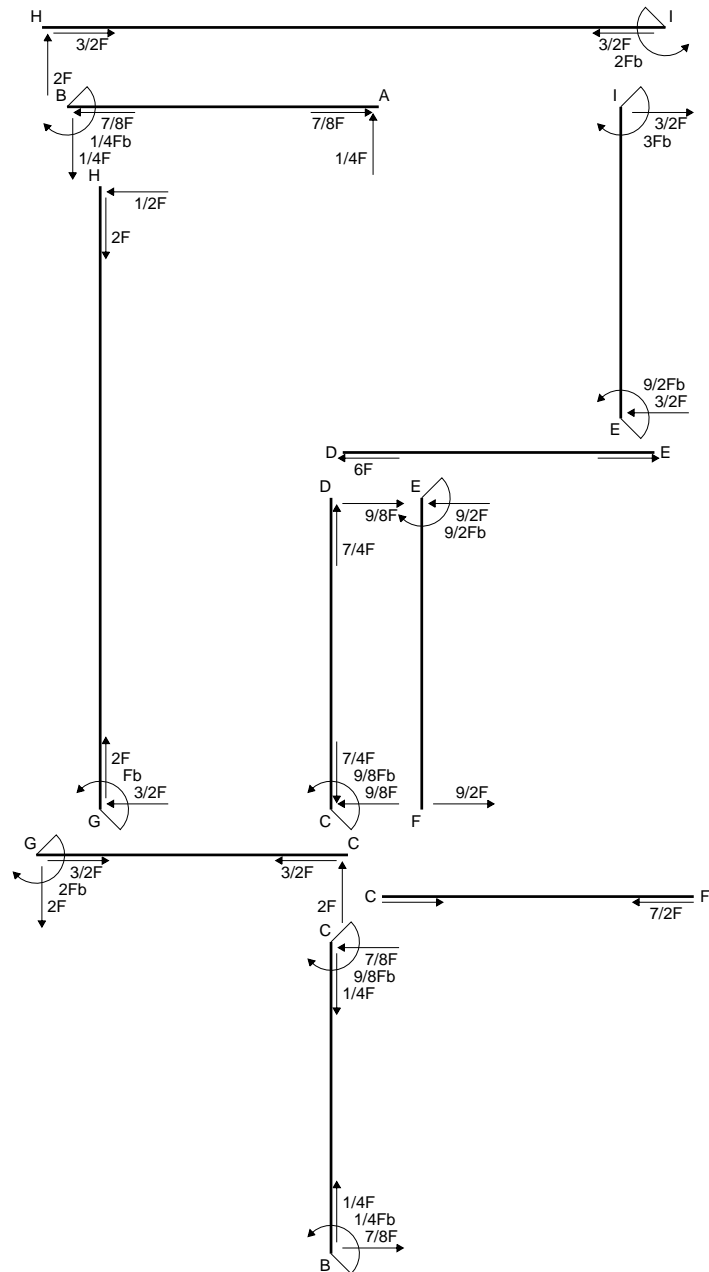
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

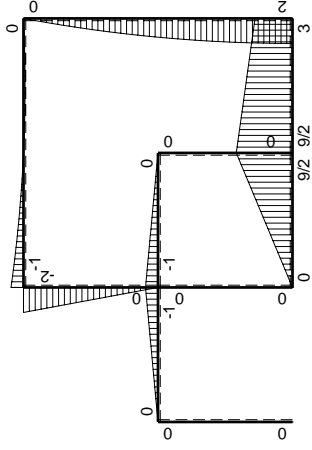
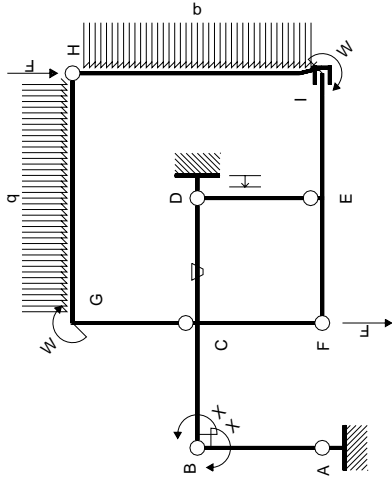
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

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

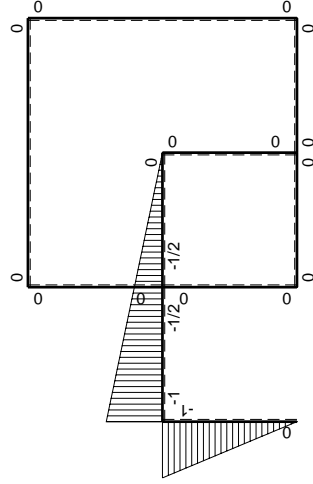
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/4Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

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

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

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

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

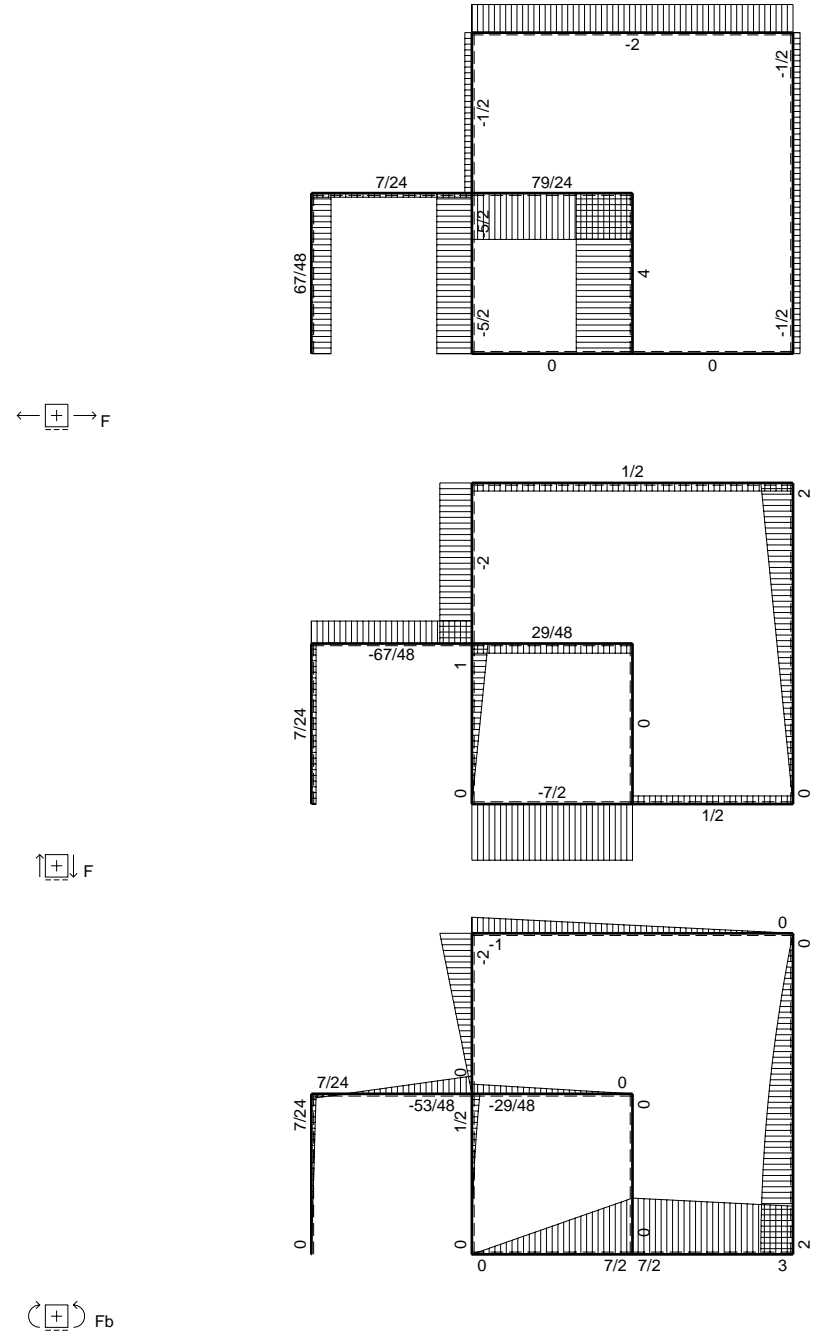
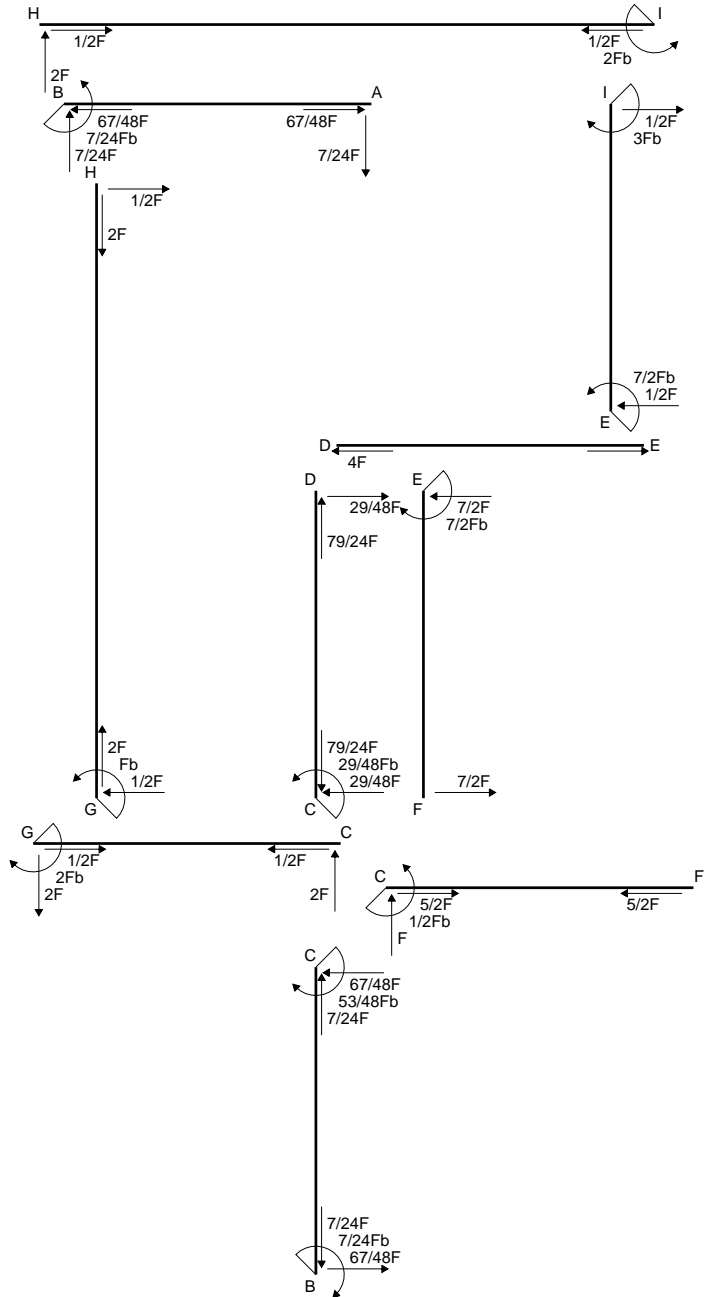
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

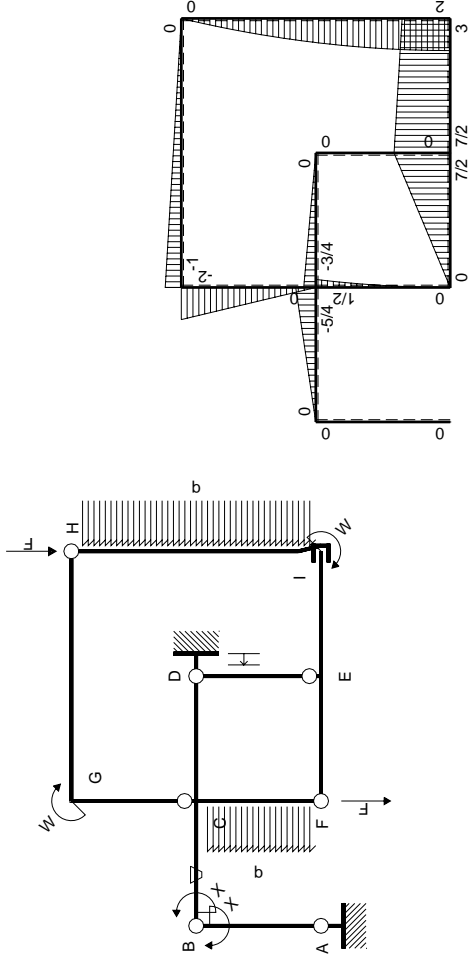
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

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

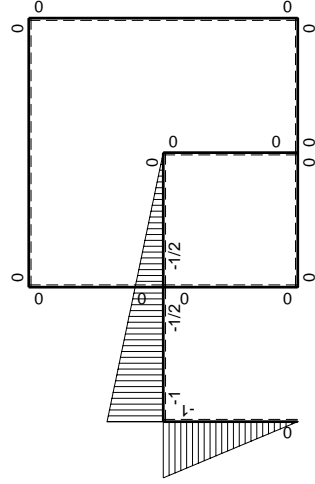
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0
FE b	0	$-7/2Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$7/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

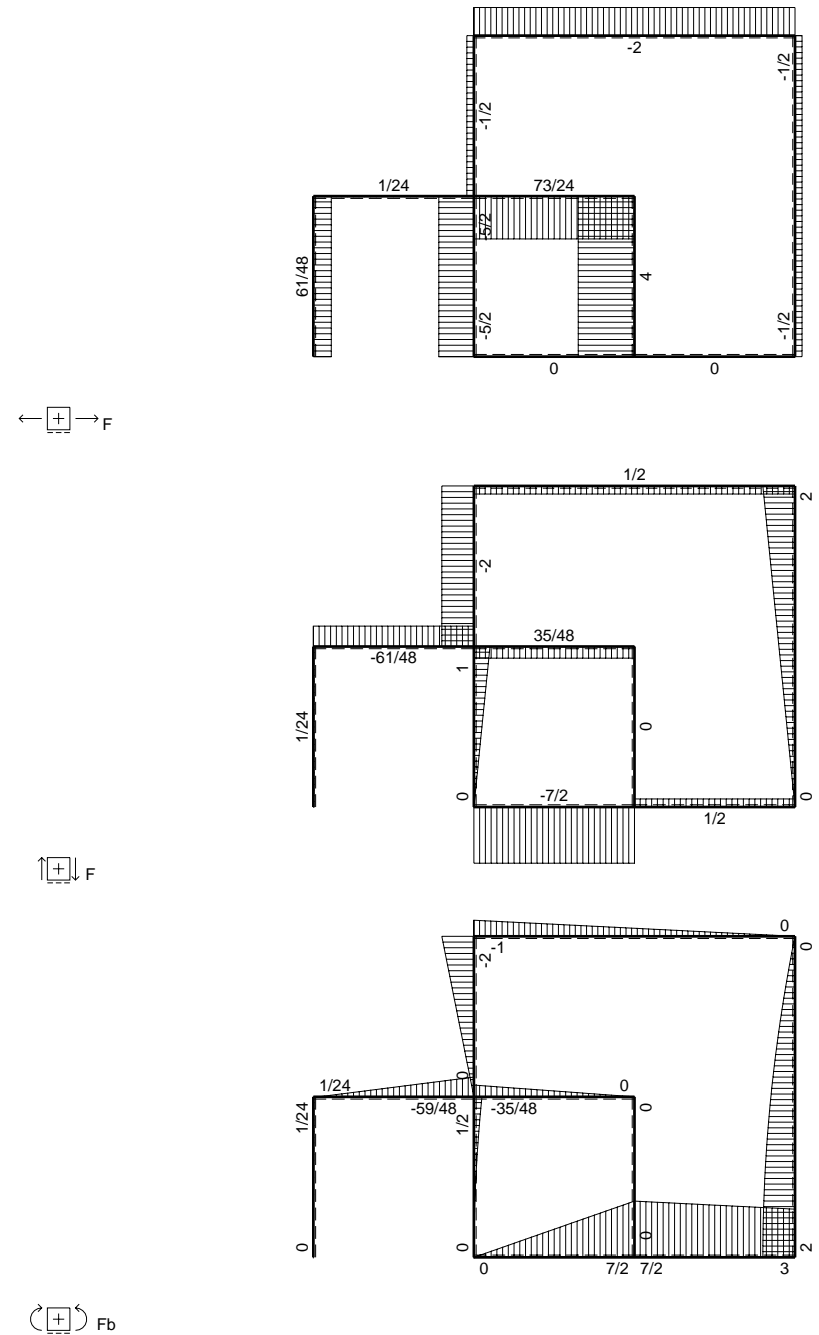
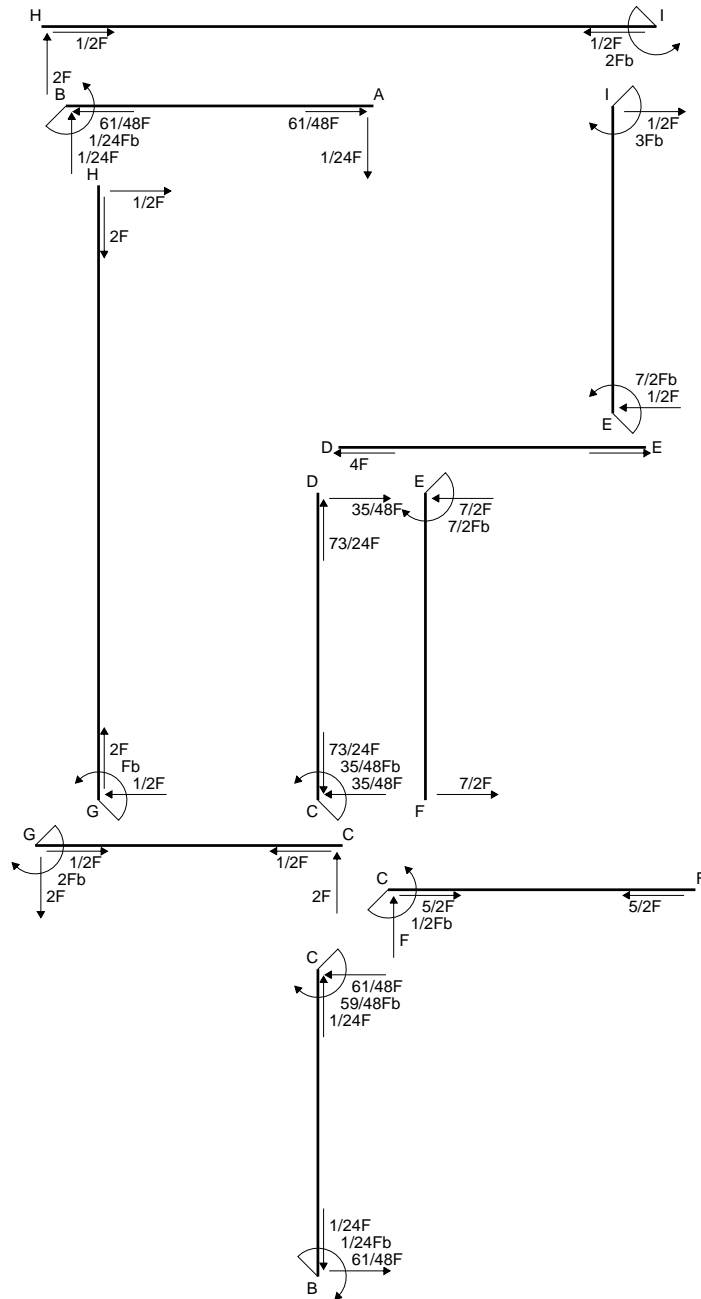
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

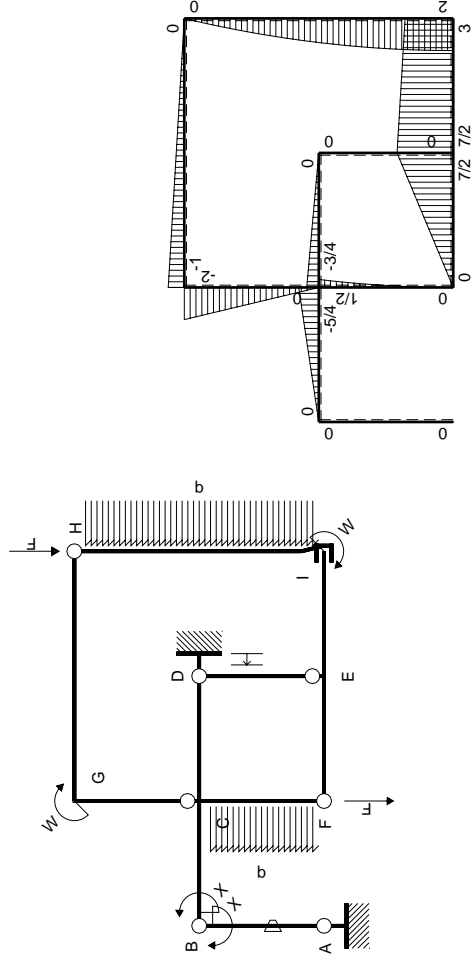
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

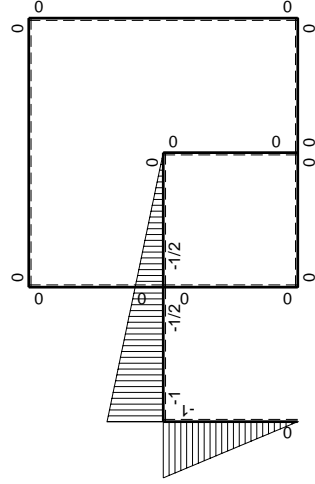
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

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

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

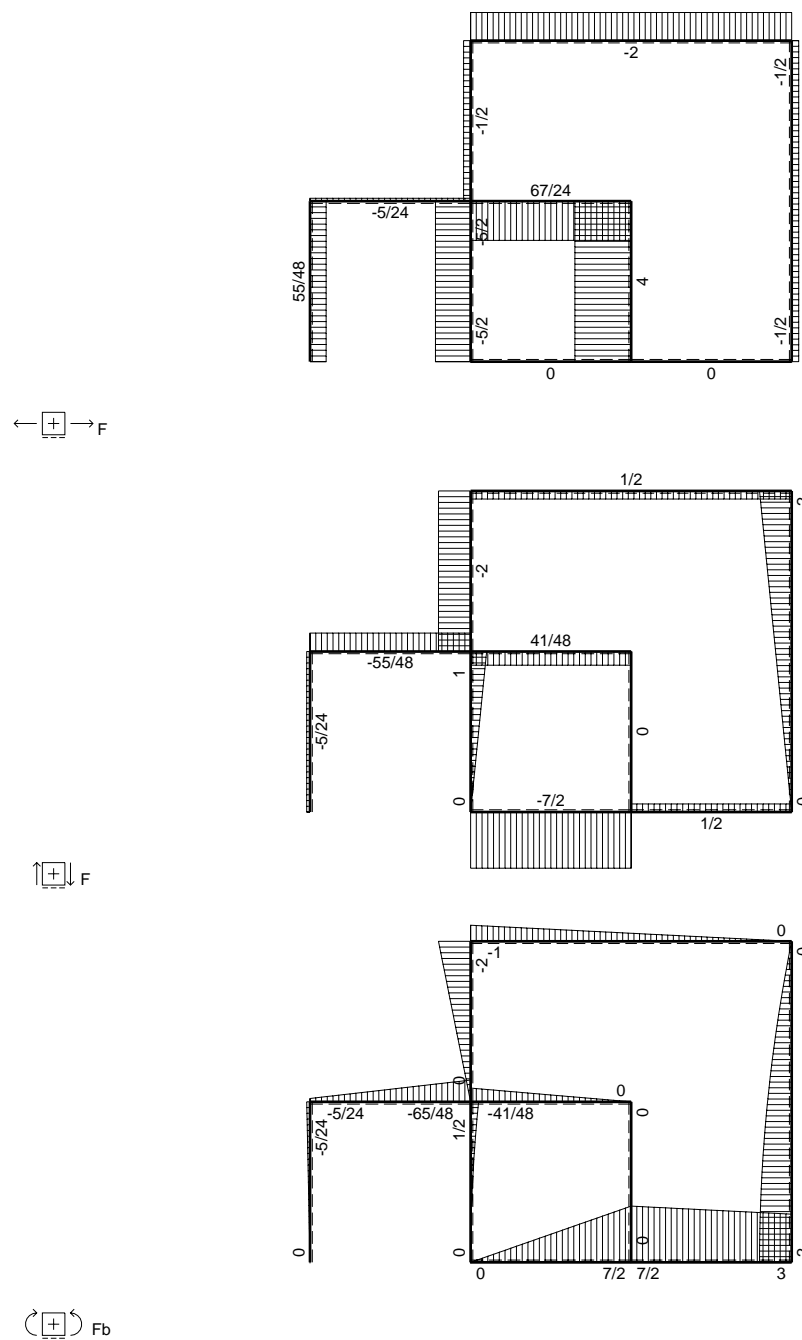
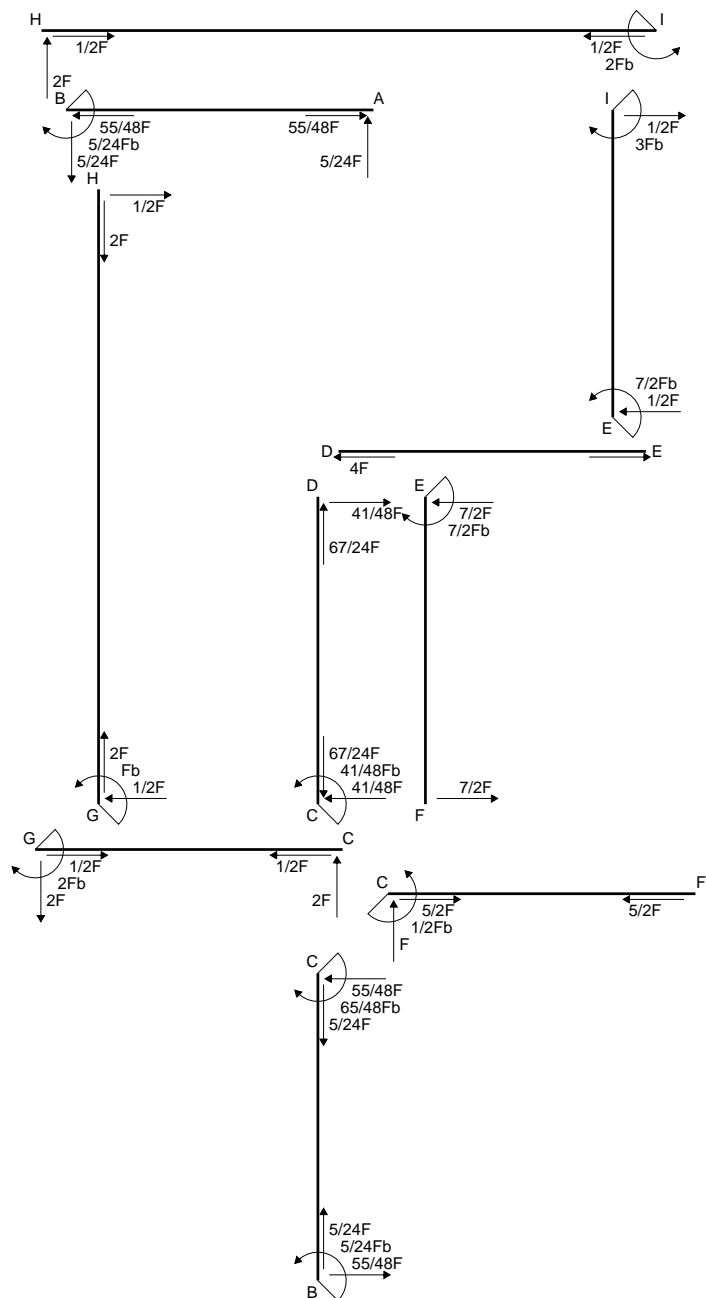
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

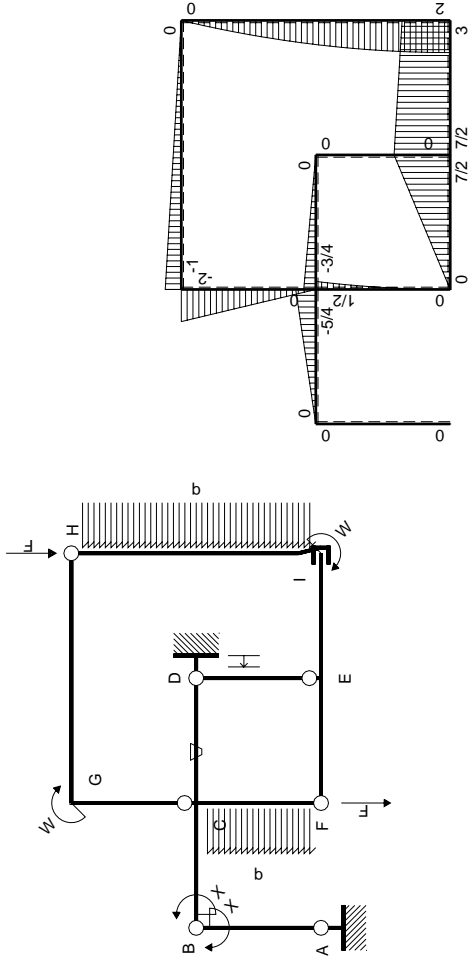
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

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

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

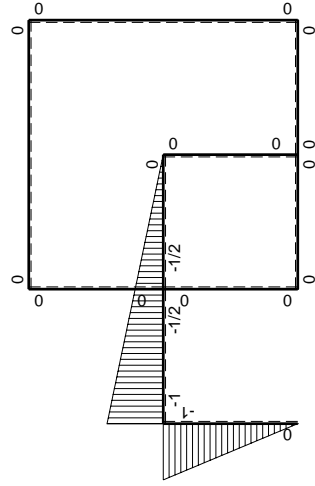
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-5/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$5/24Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

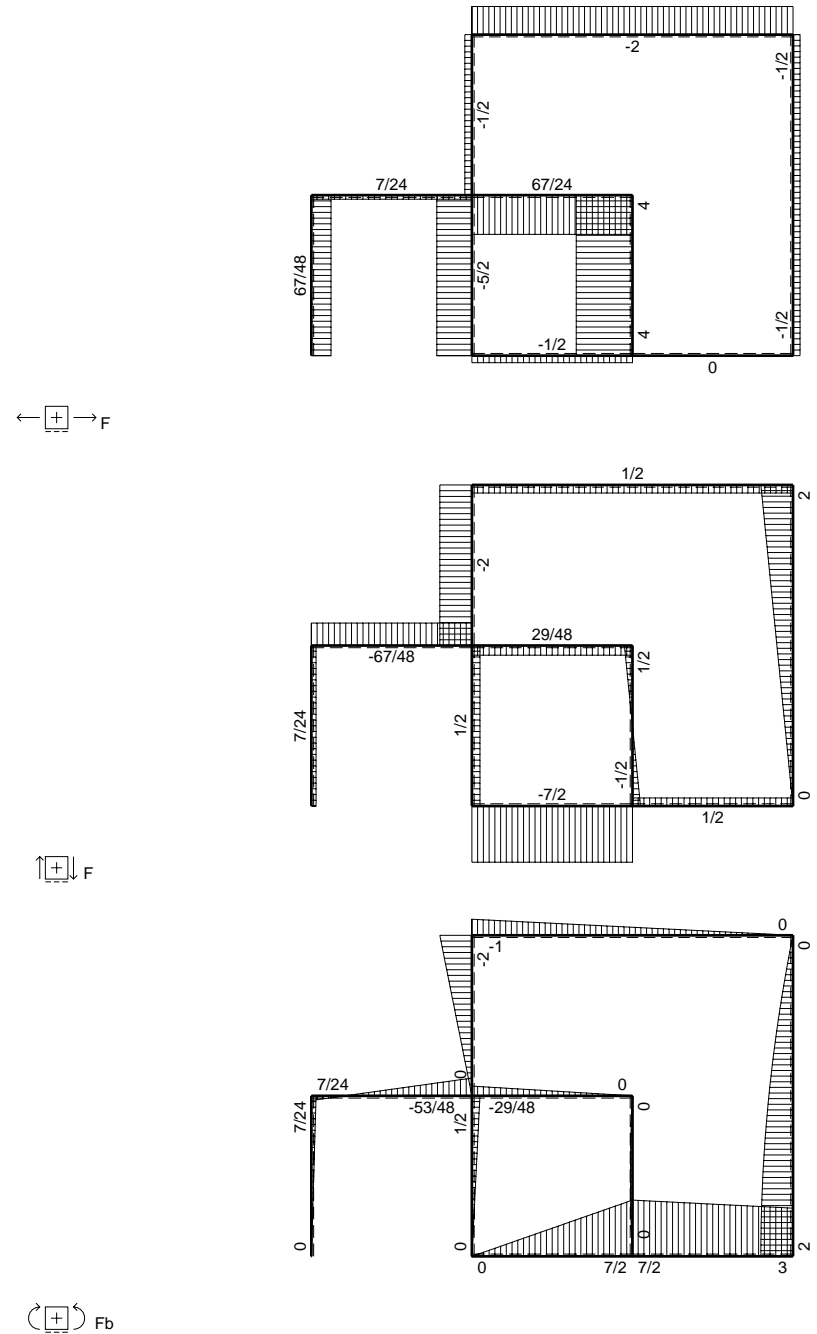
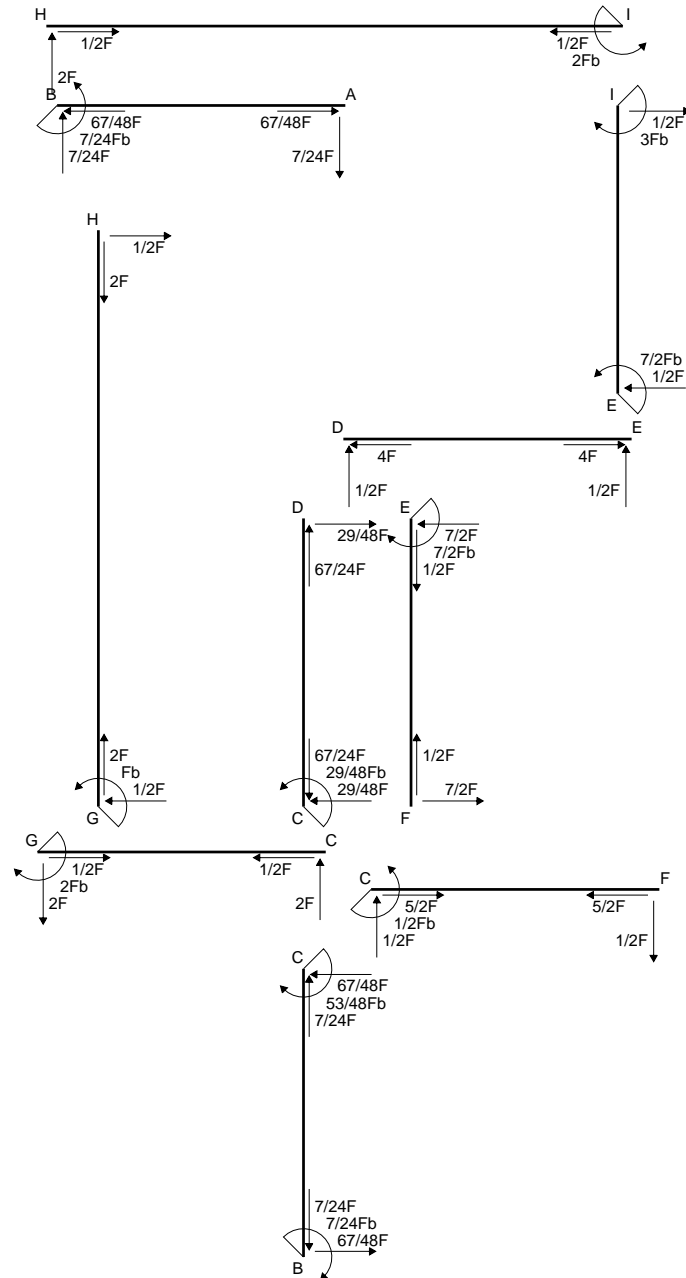
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

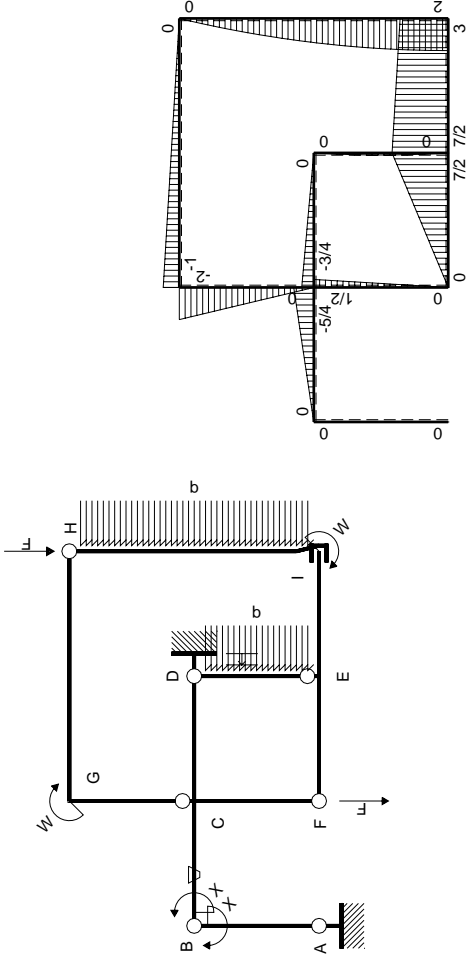
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

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

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

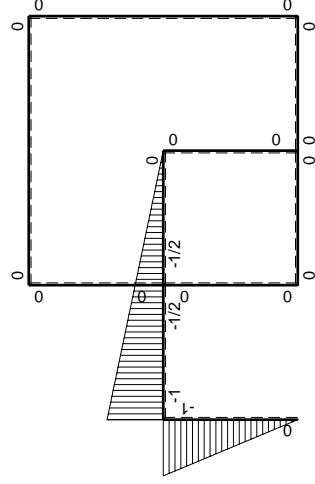
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0
FE b	0	$-7/2Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$7/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/24Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

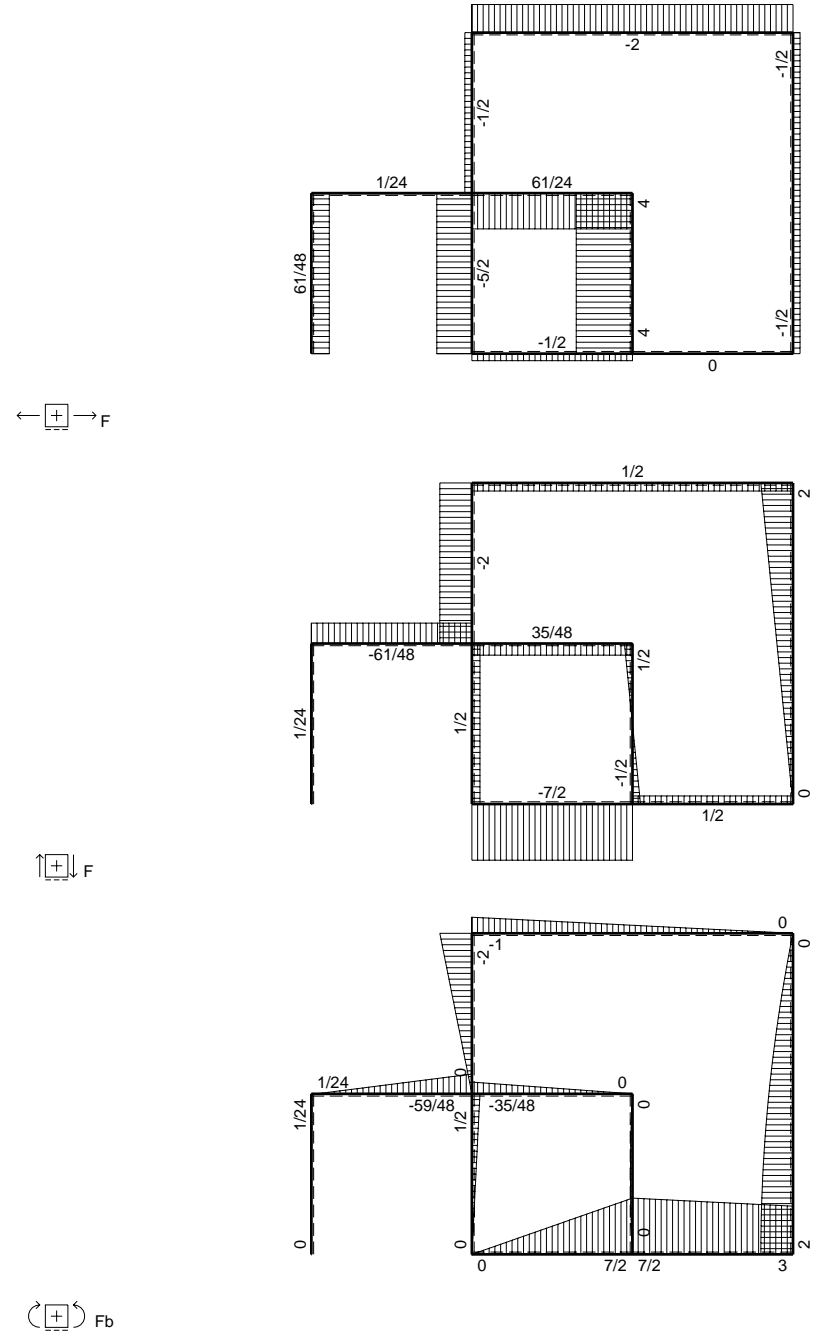
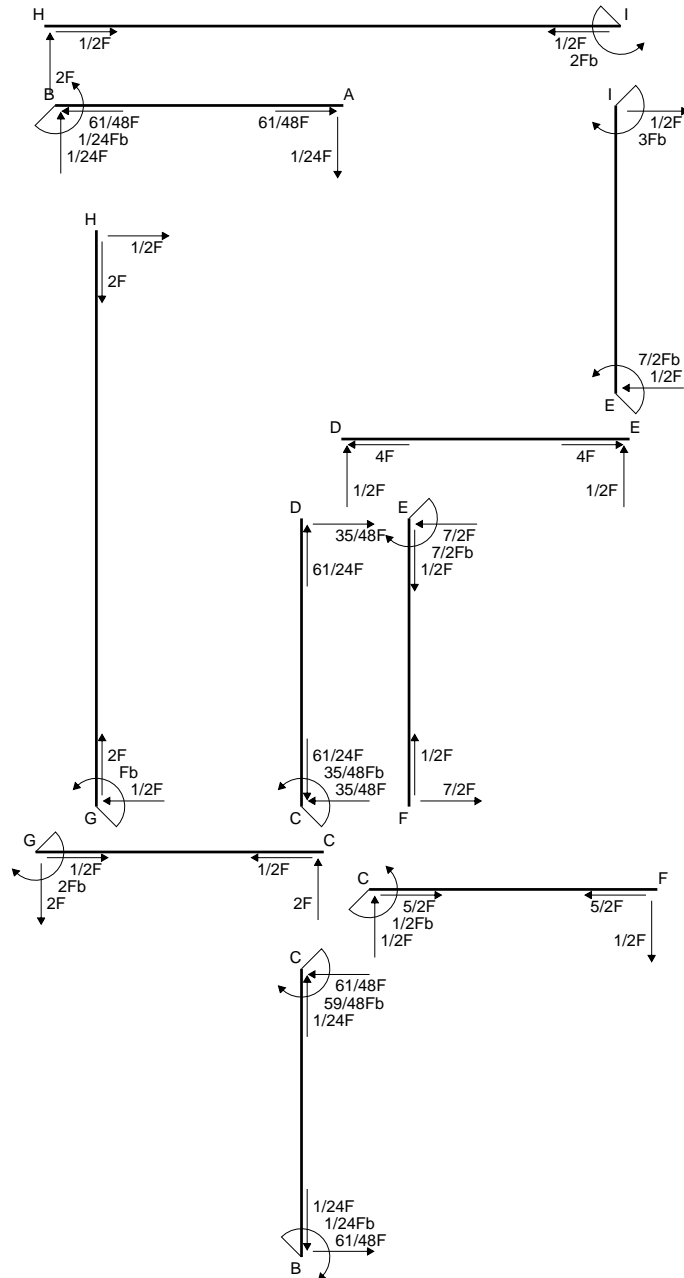
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

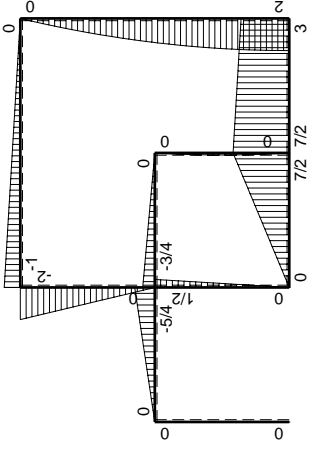
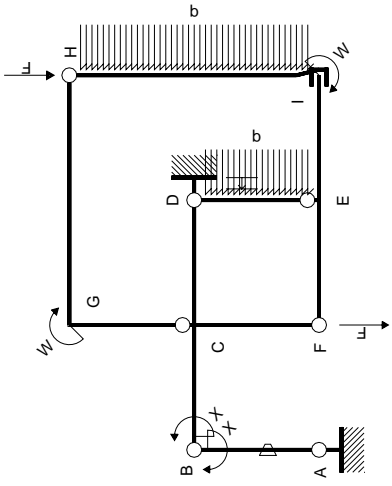
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

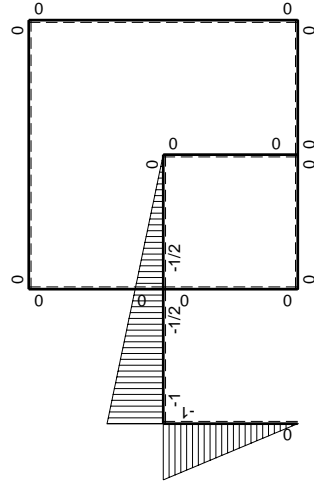
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0
FE b	0	$-7/2Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/24Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

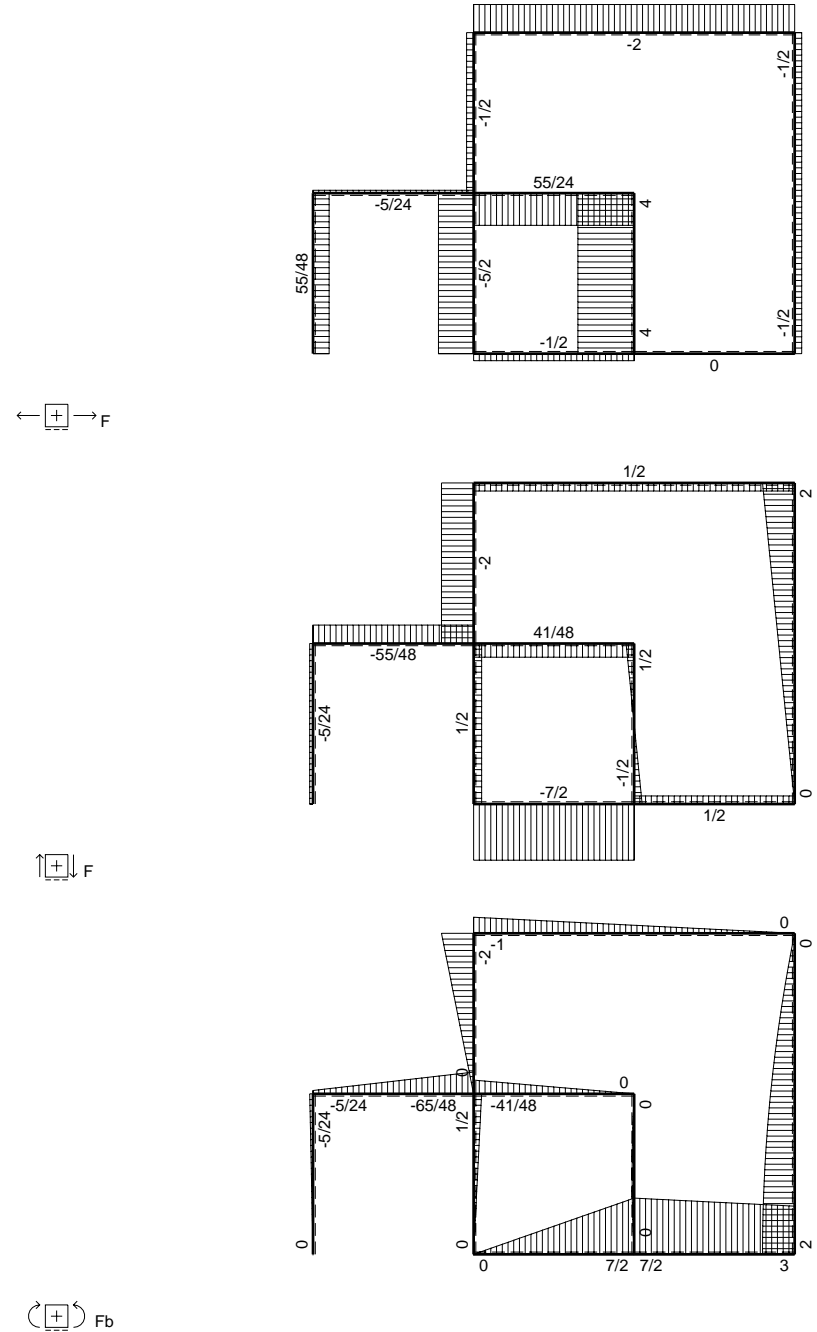
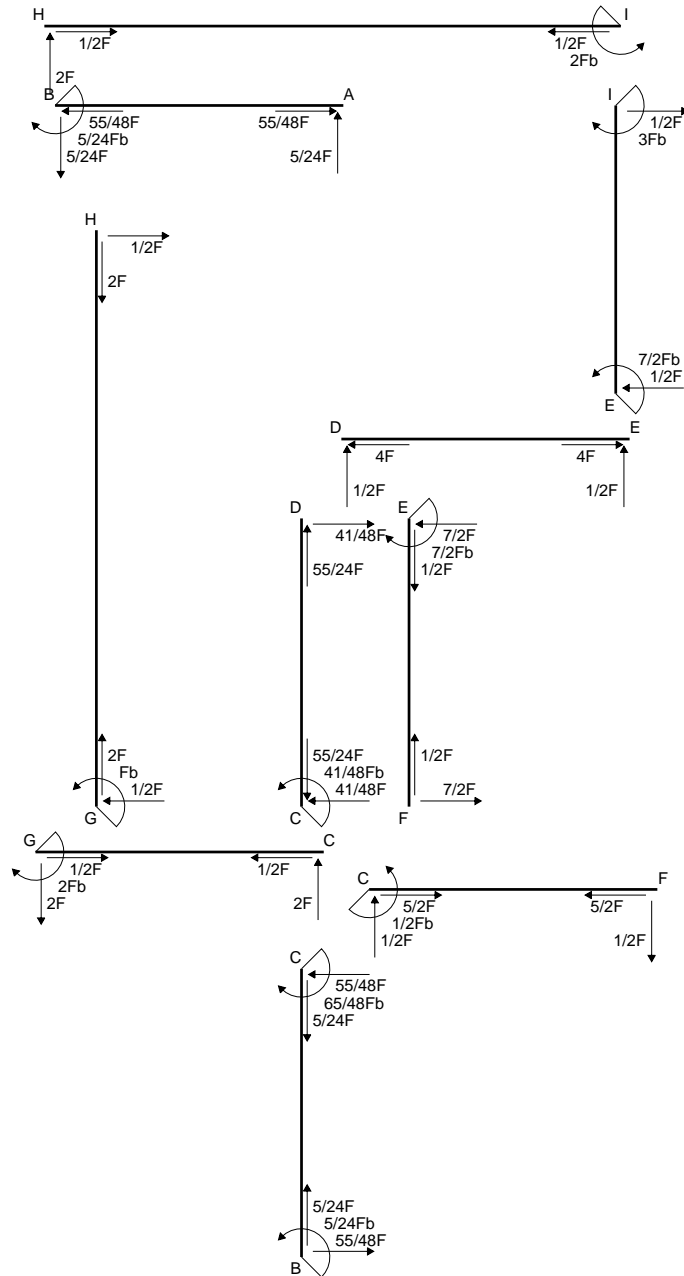
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

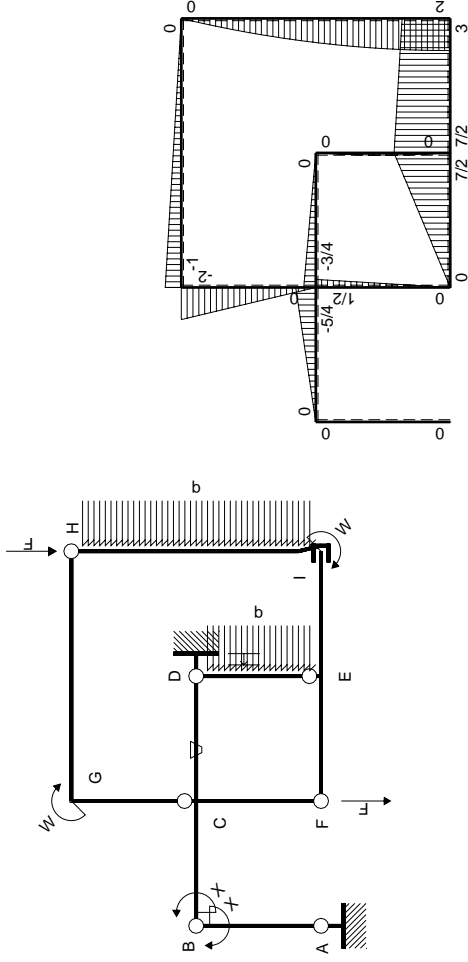
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

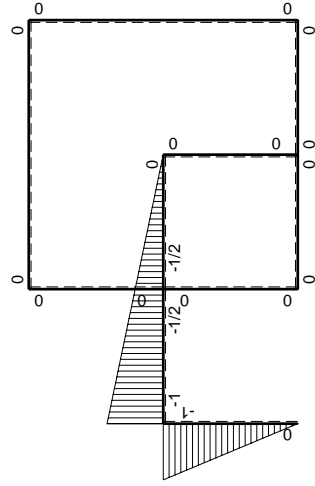
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-5/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$5/24Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

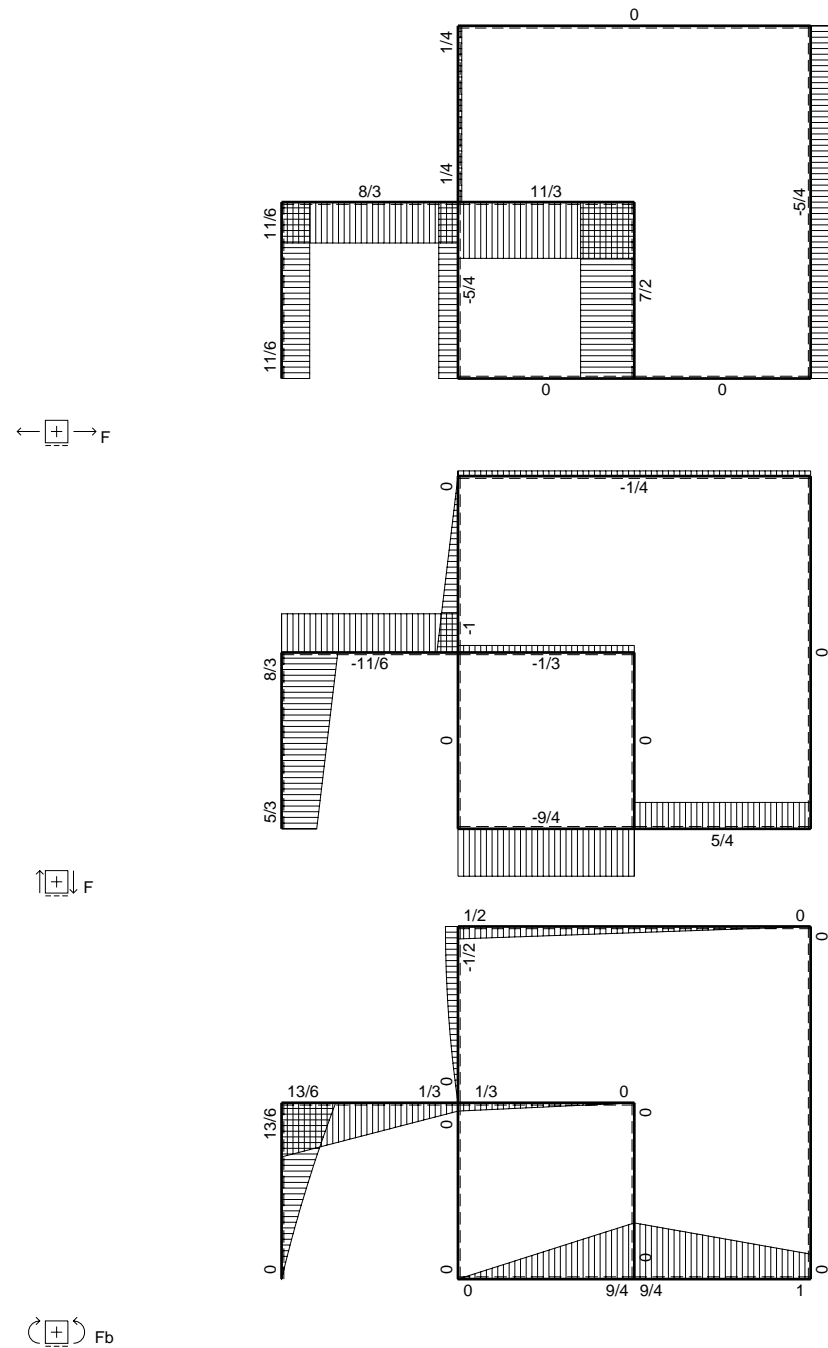
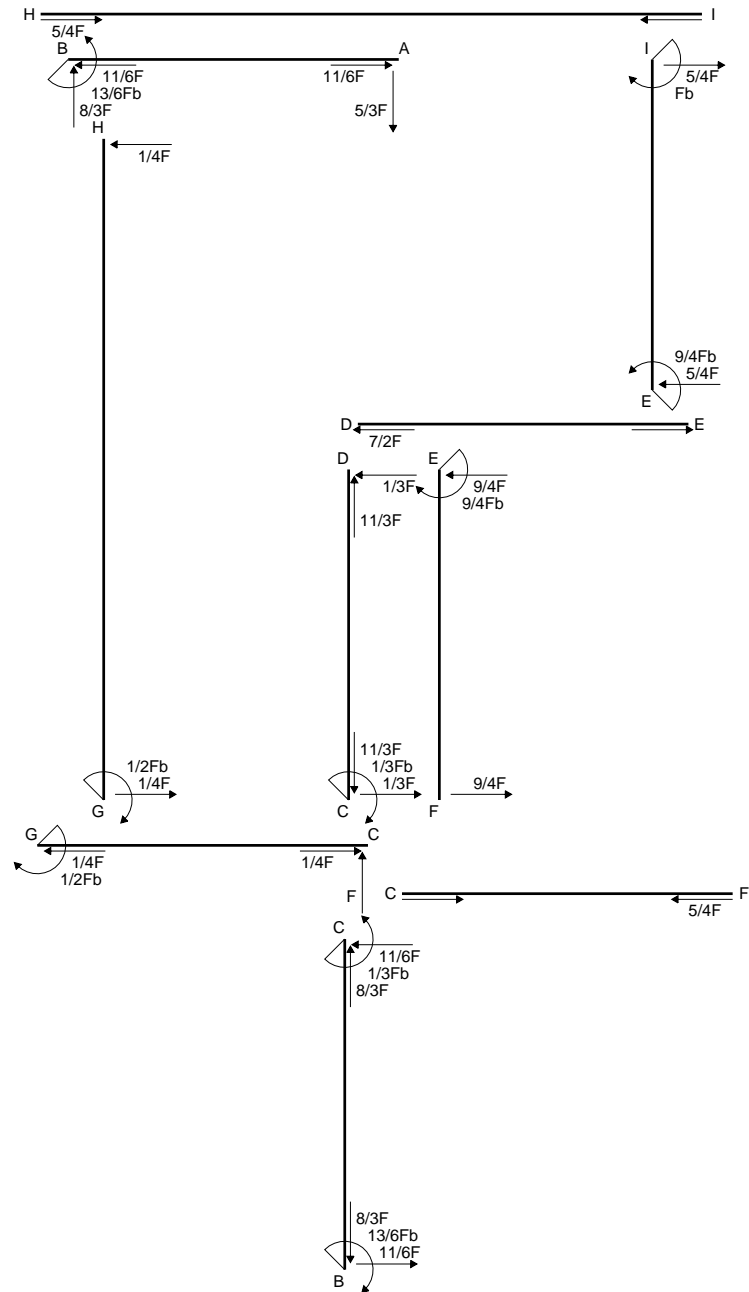
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

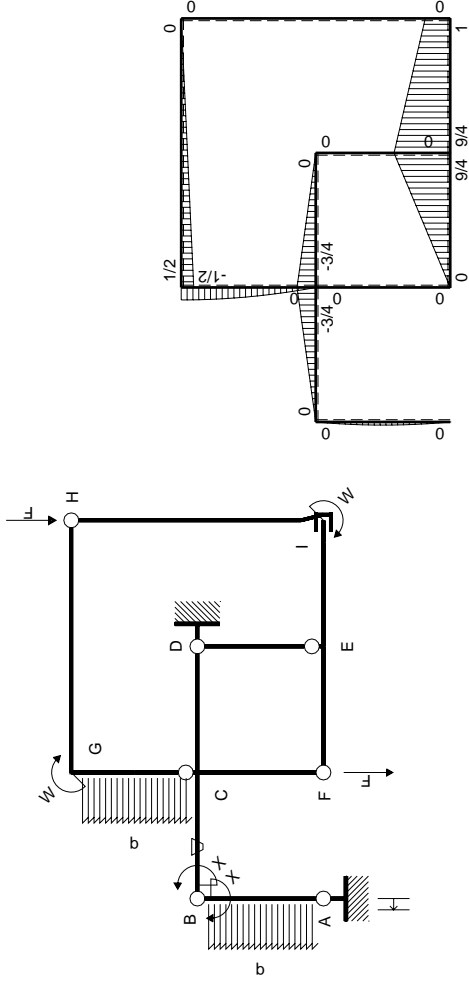
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

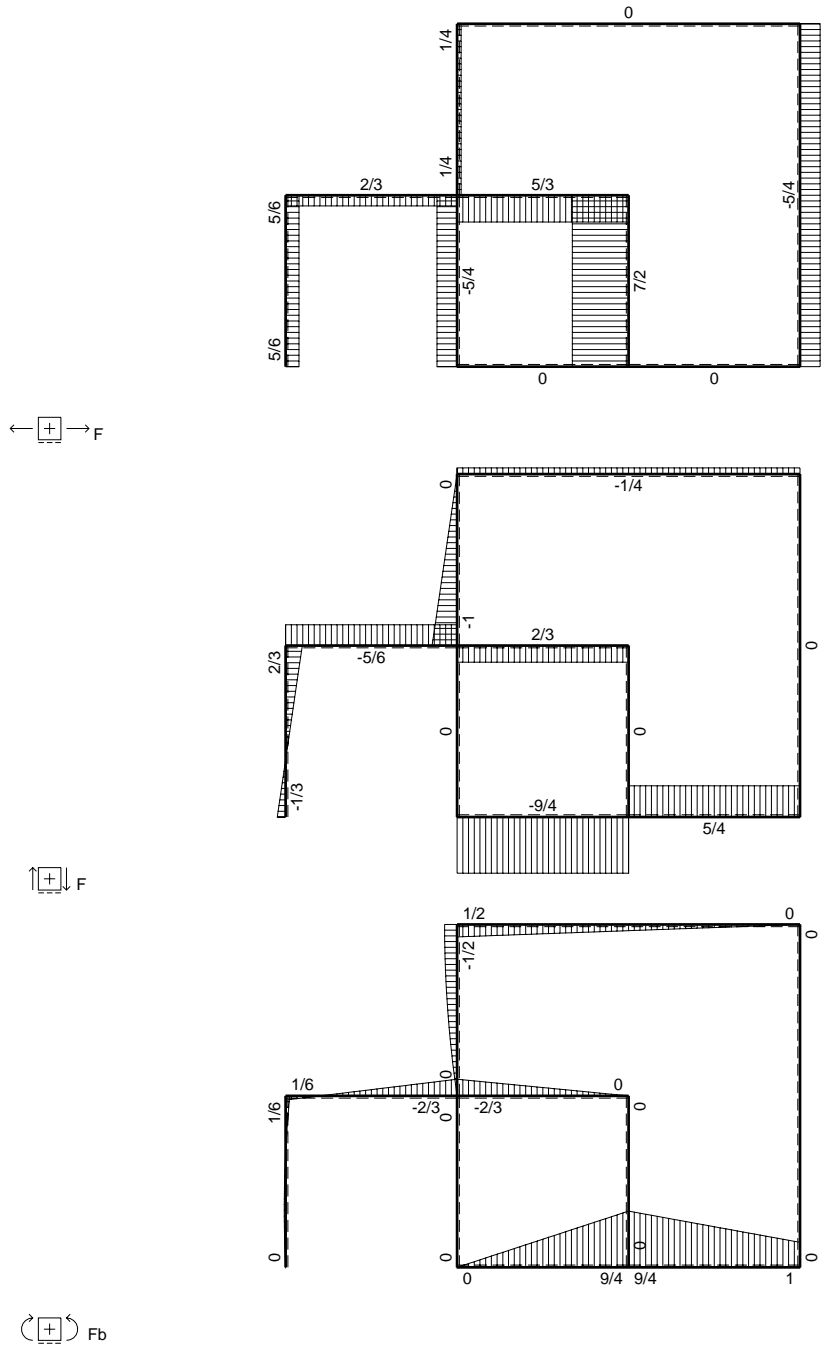
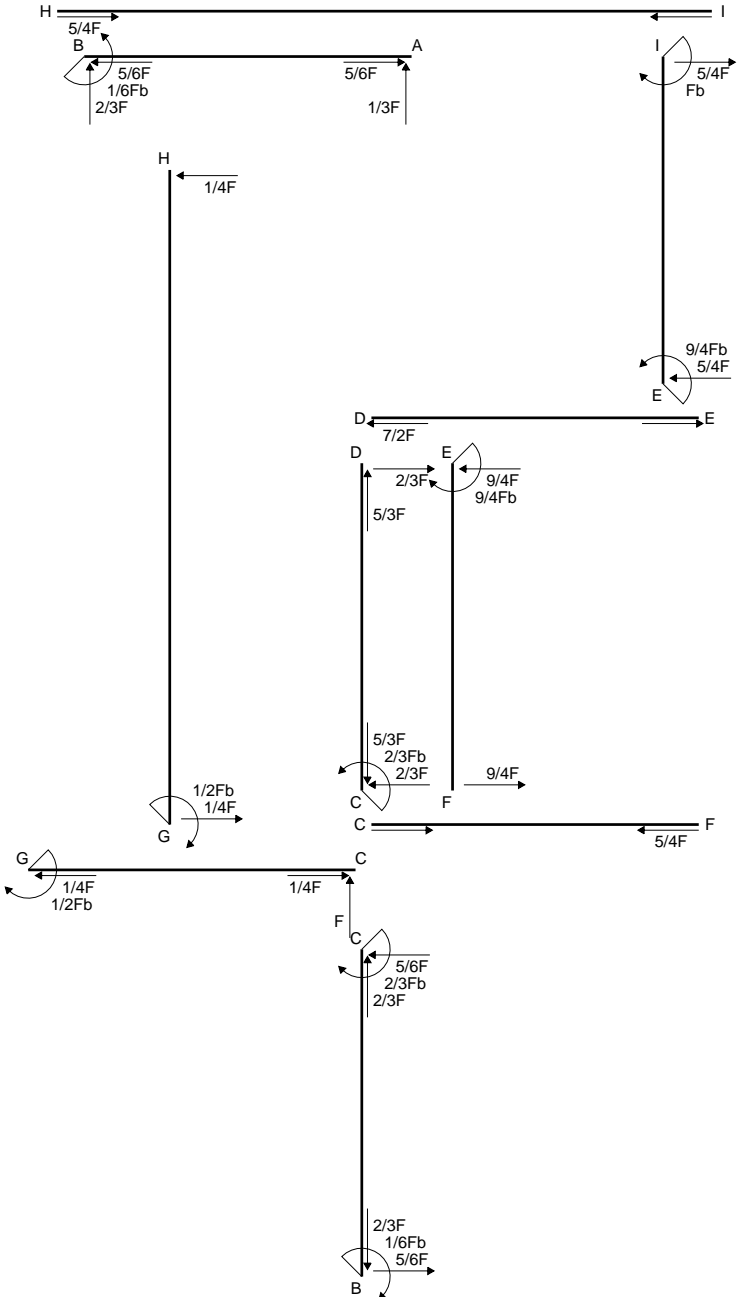
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

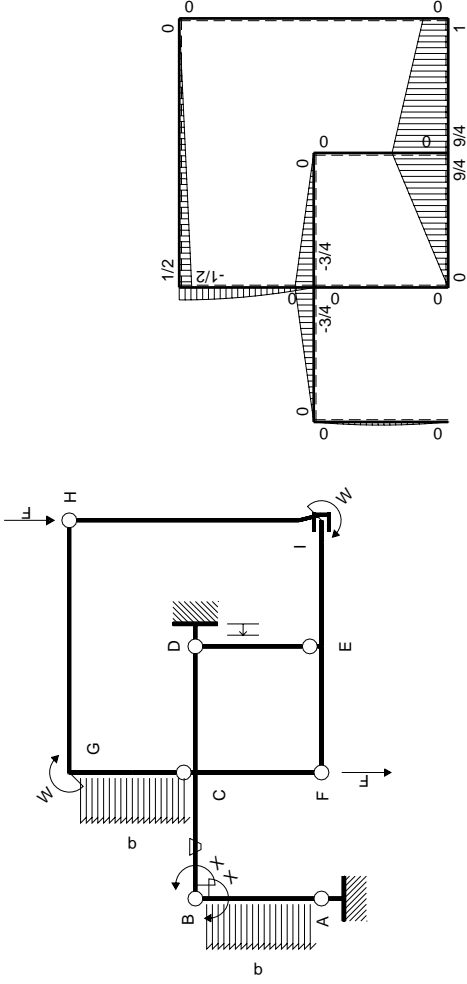
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

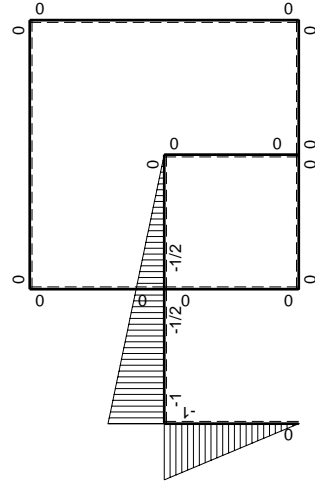
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

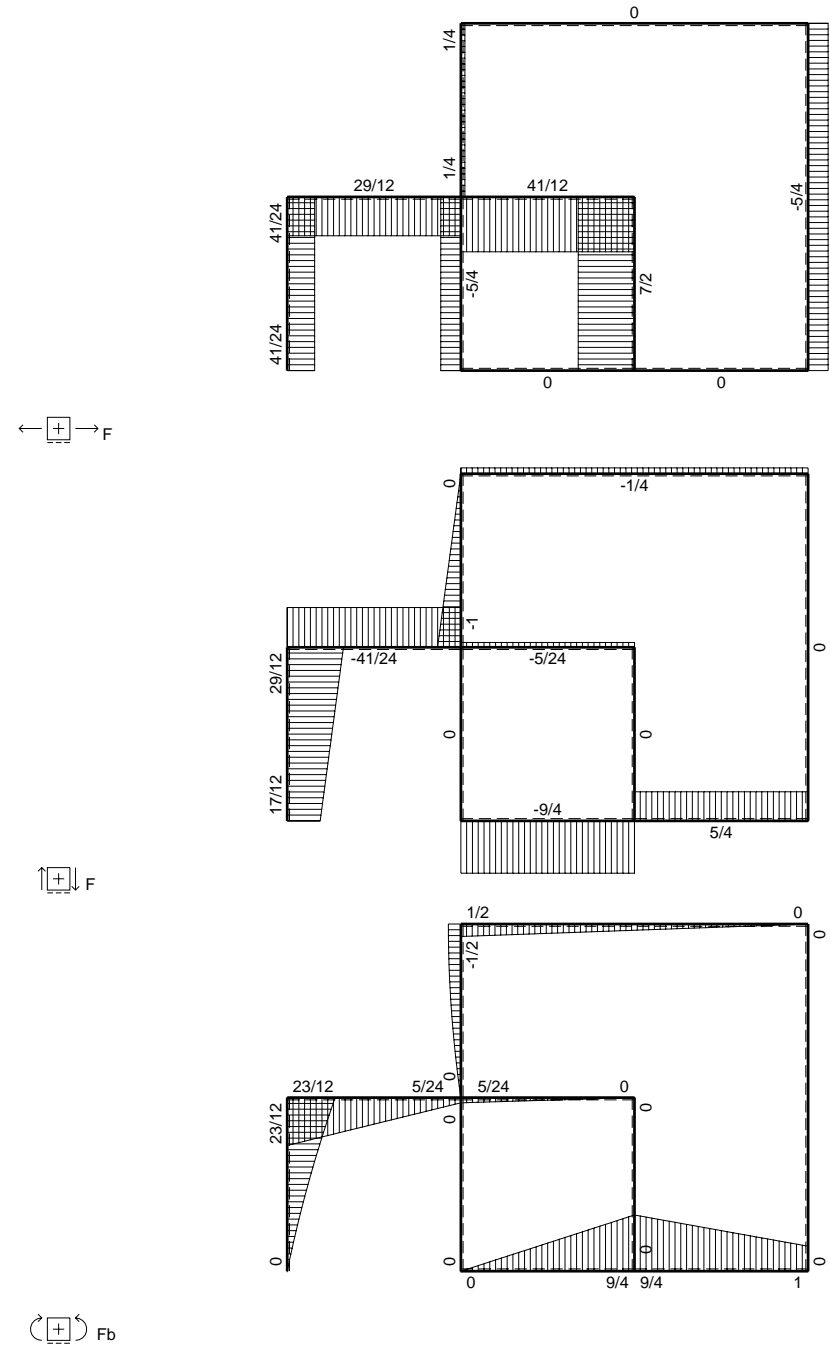
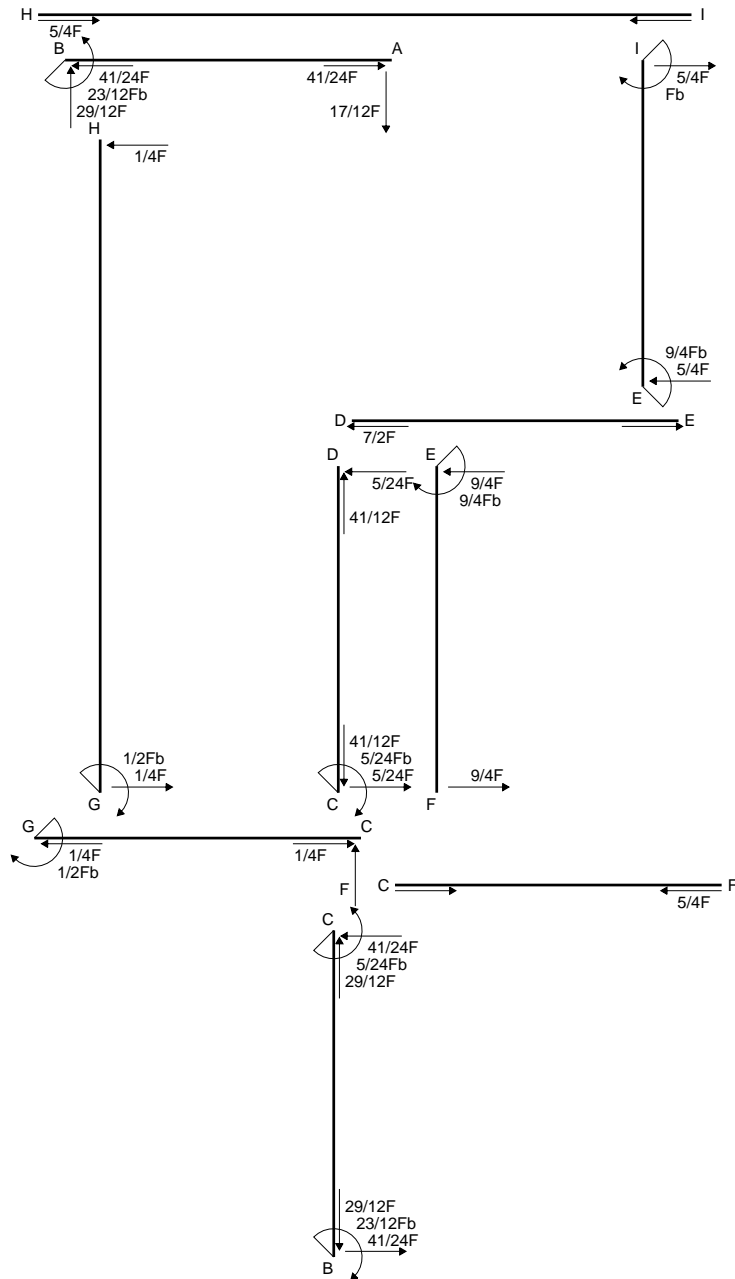
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

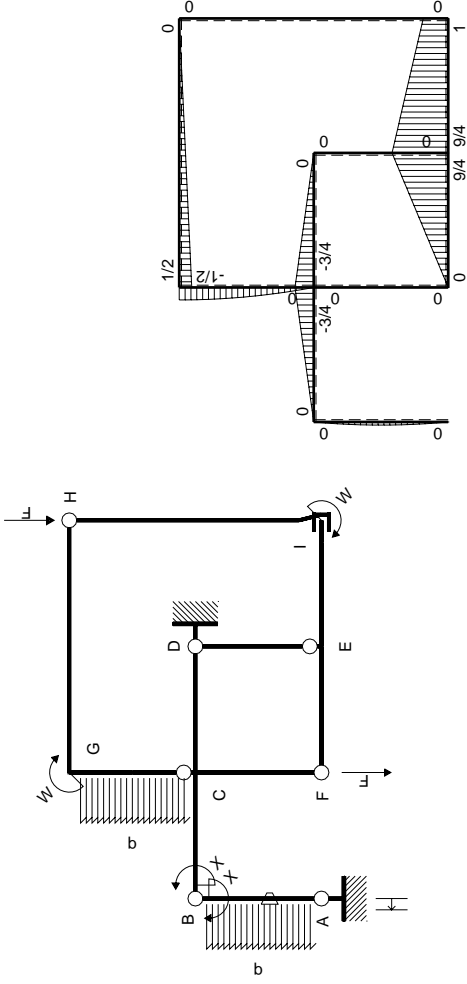
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

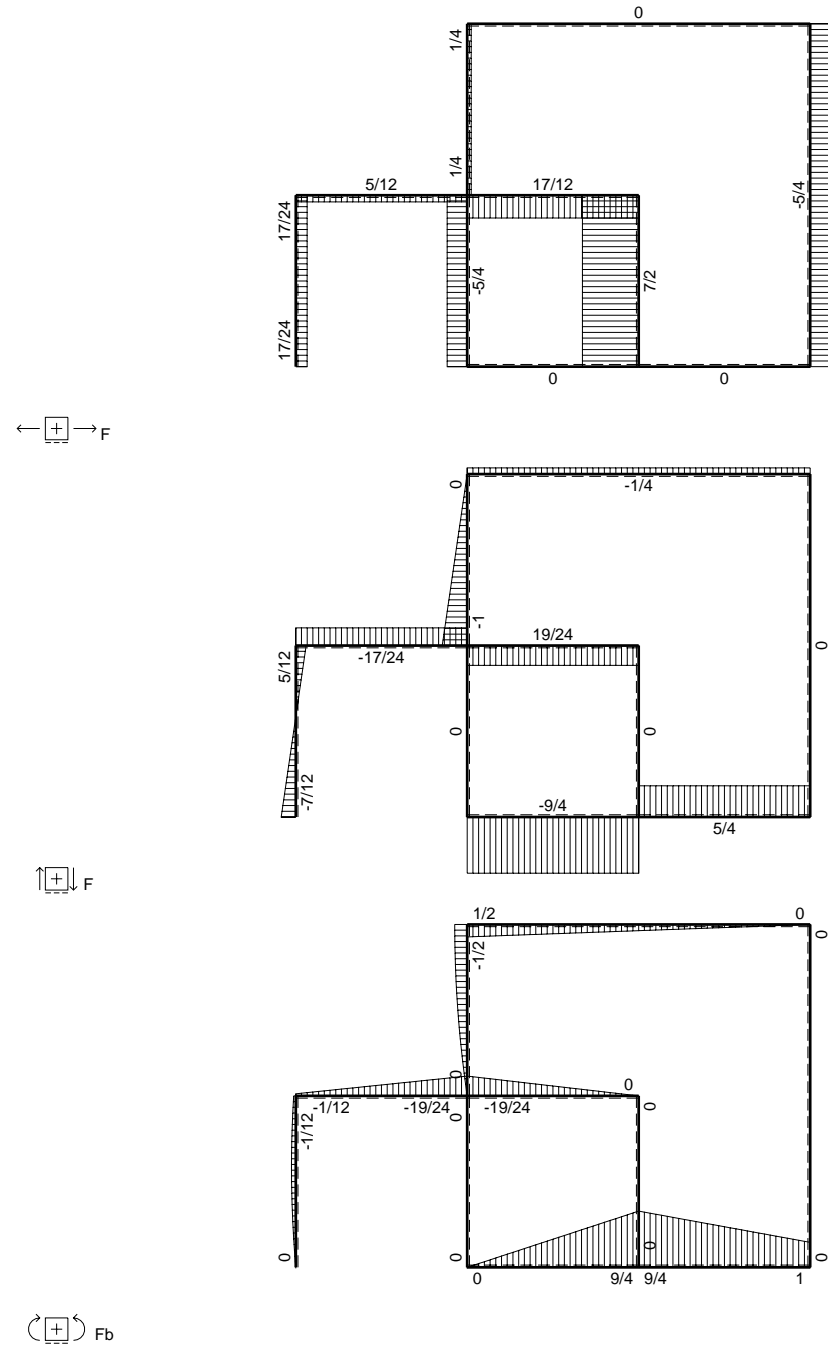
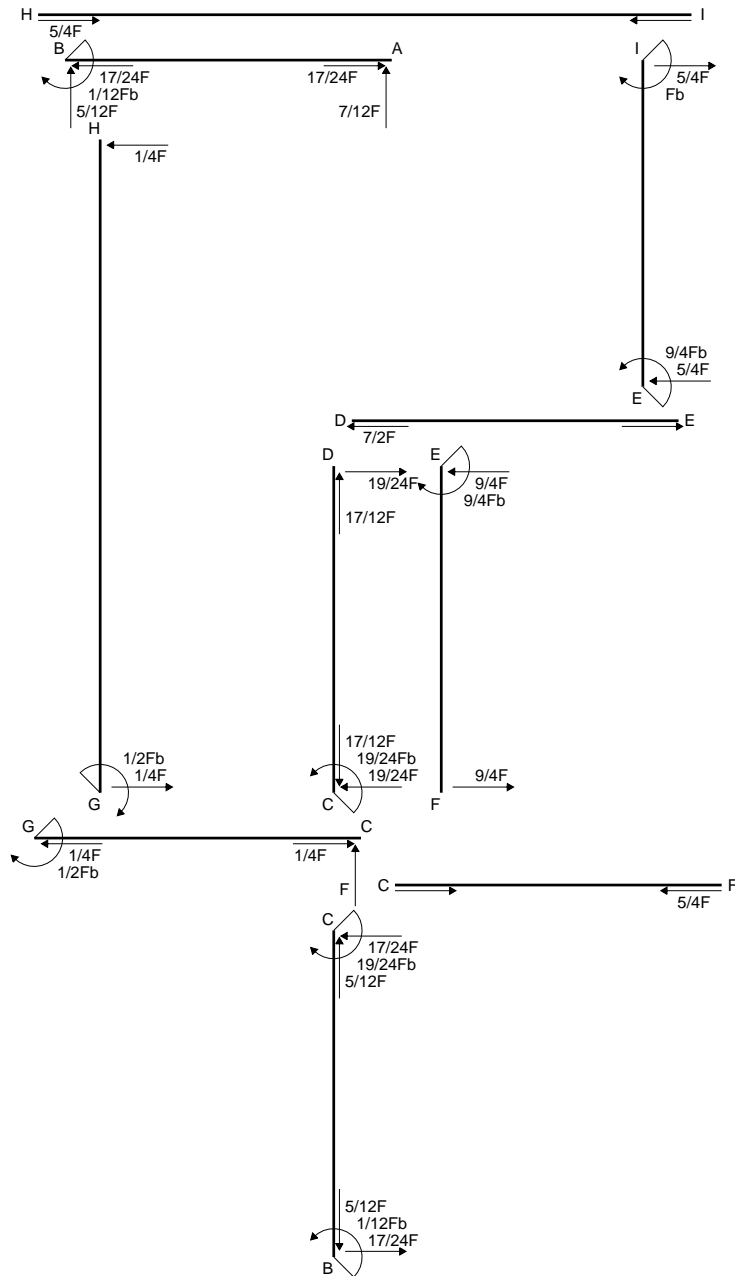
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

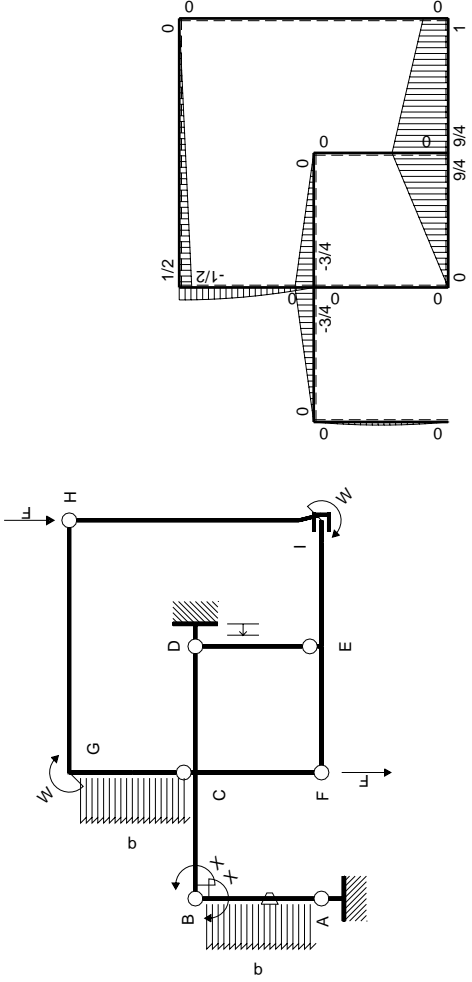
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

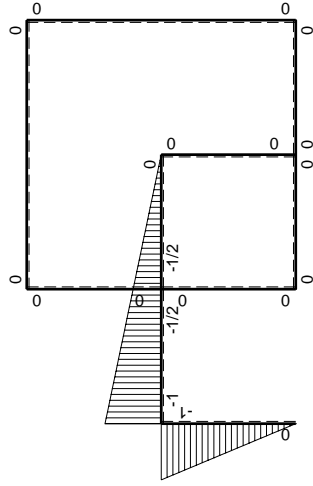
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

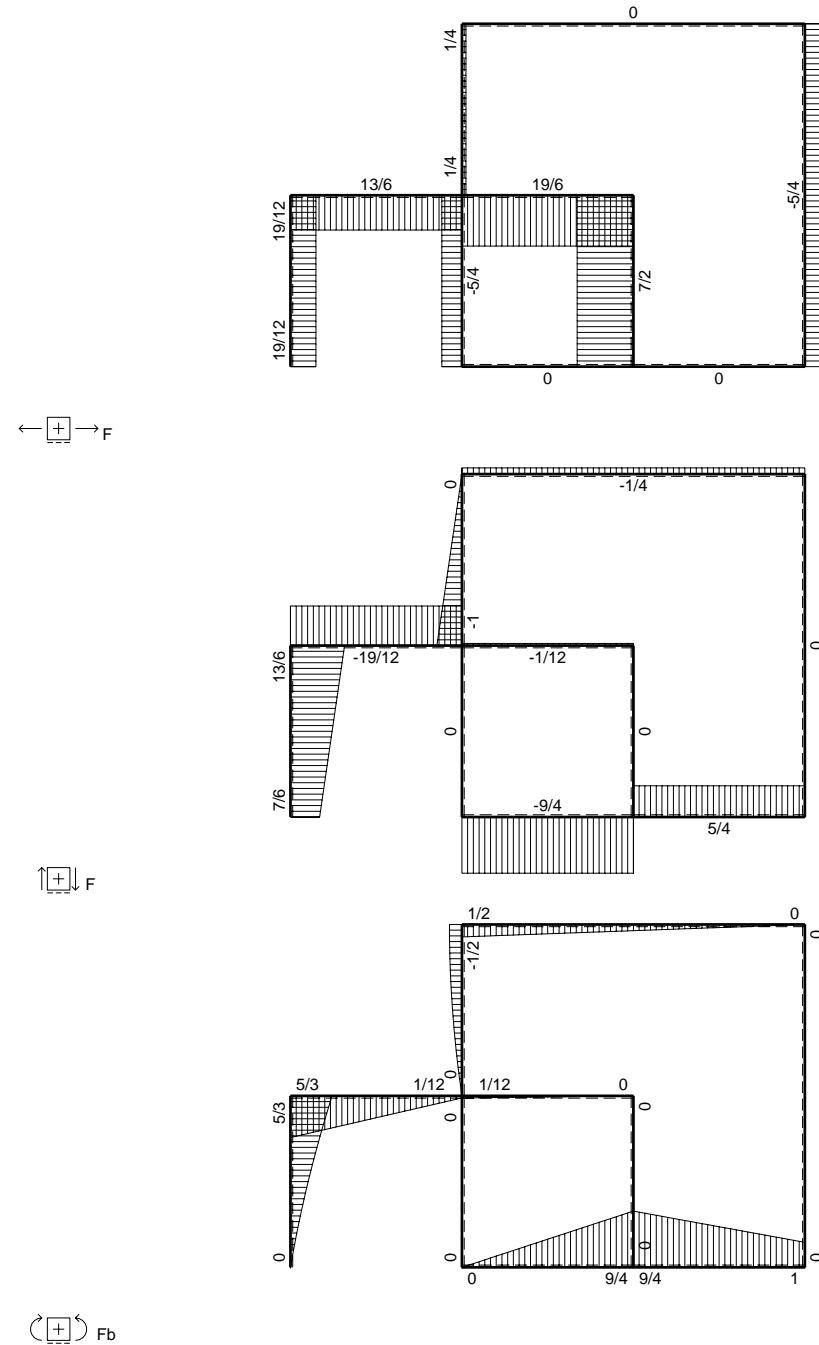
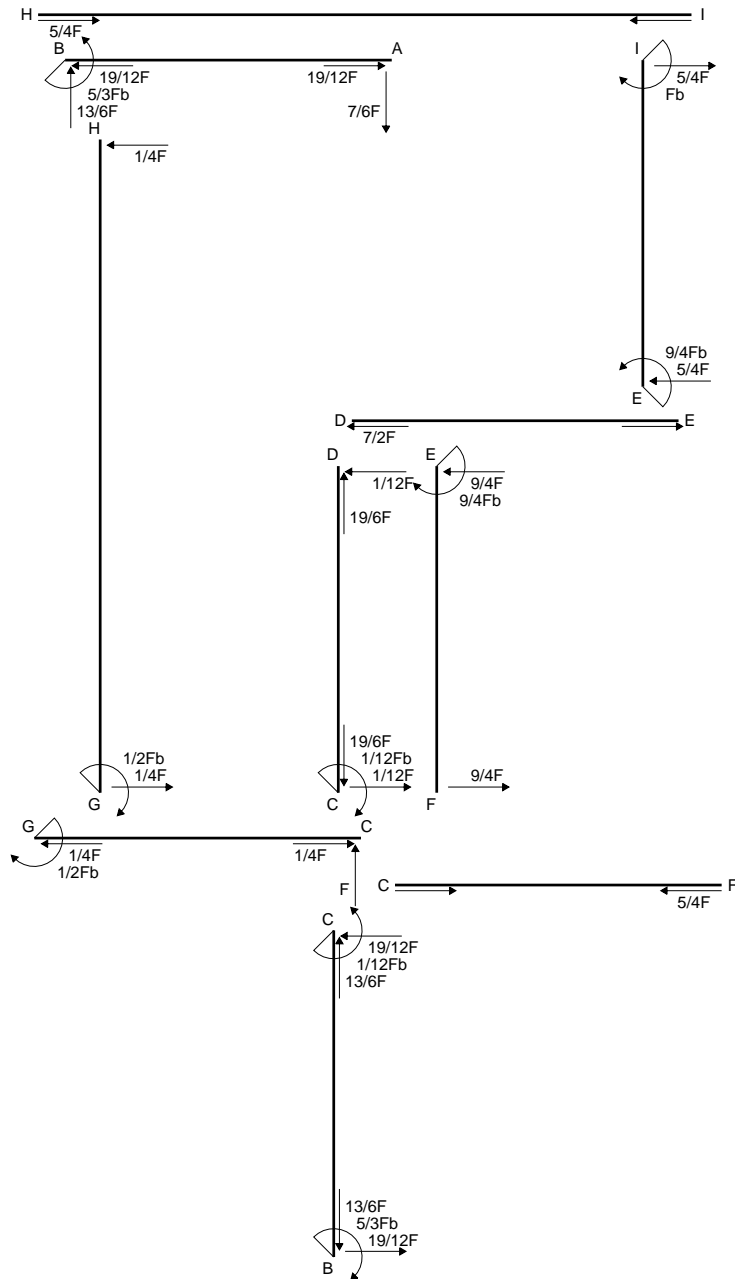
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

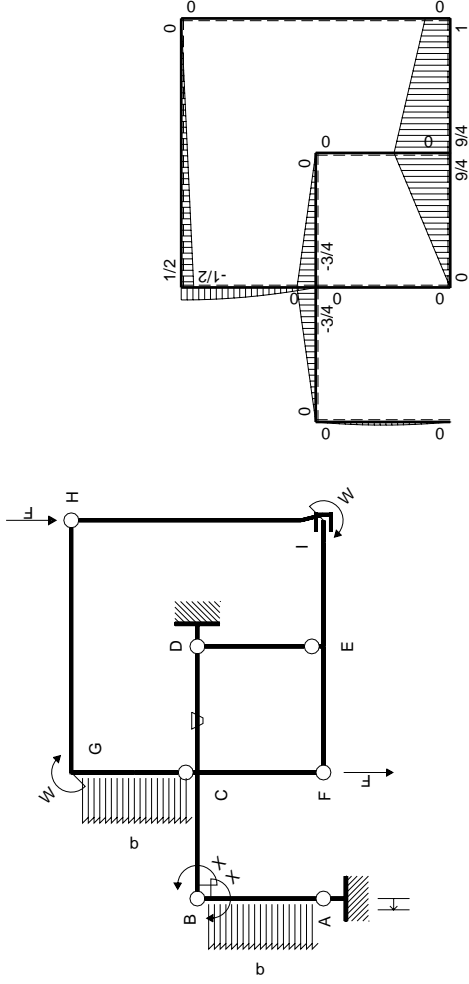
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-5/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

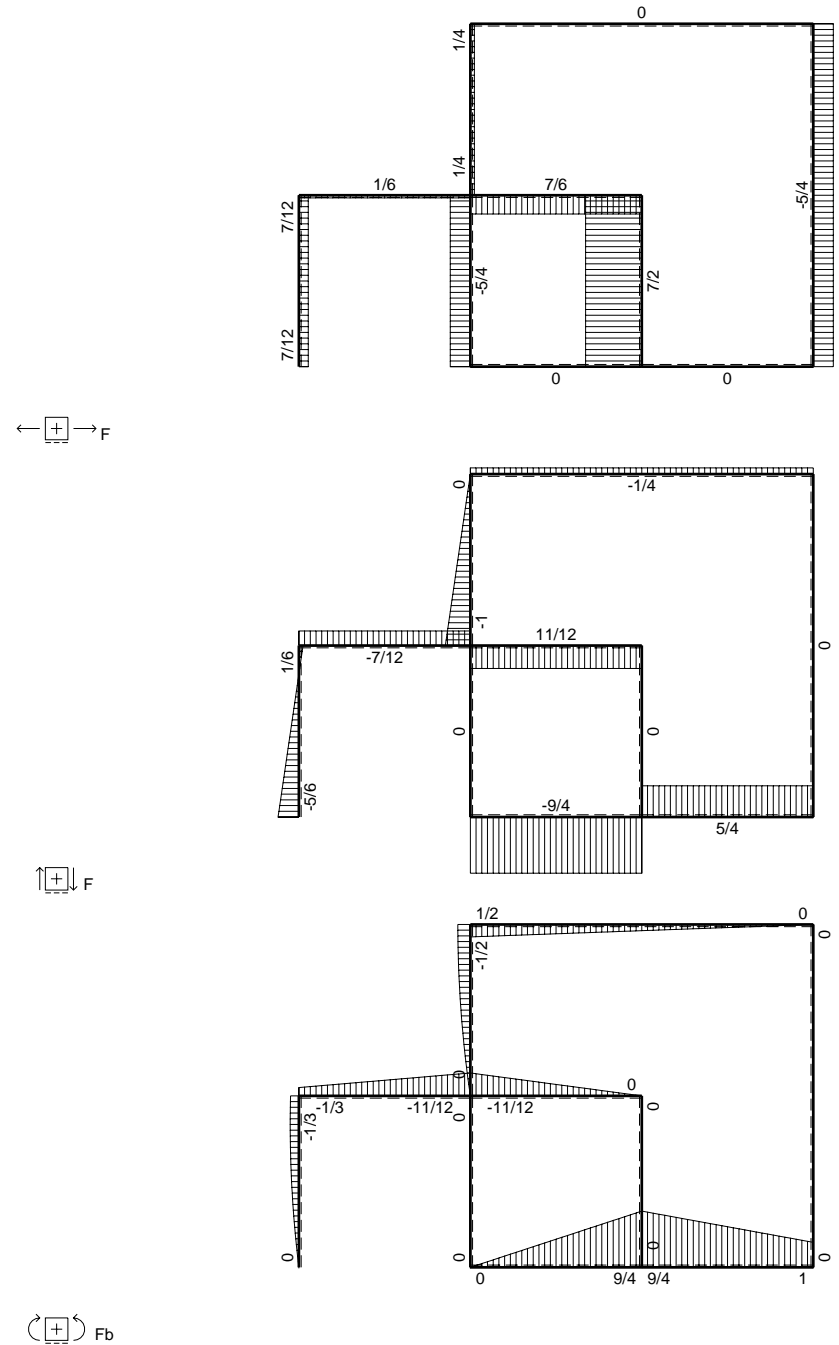
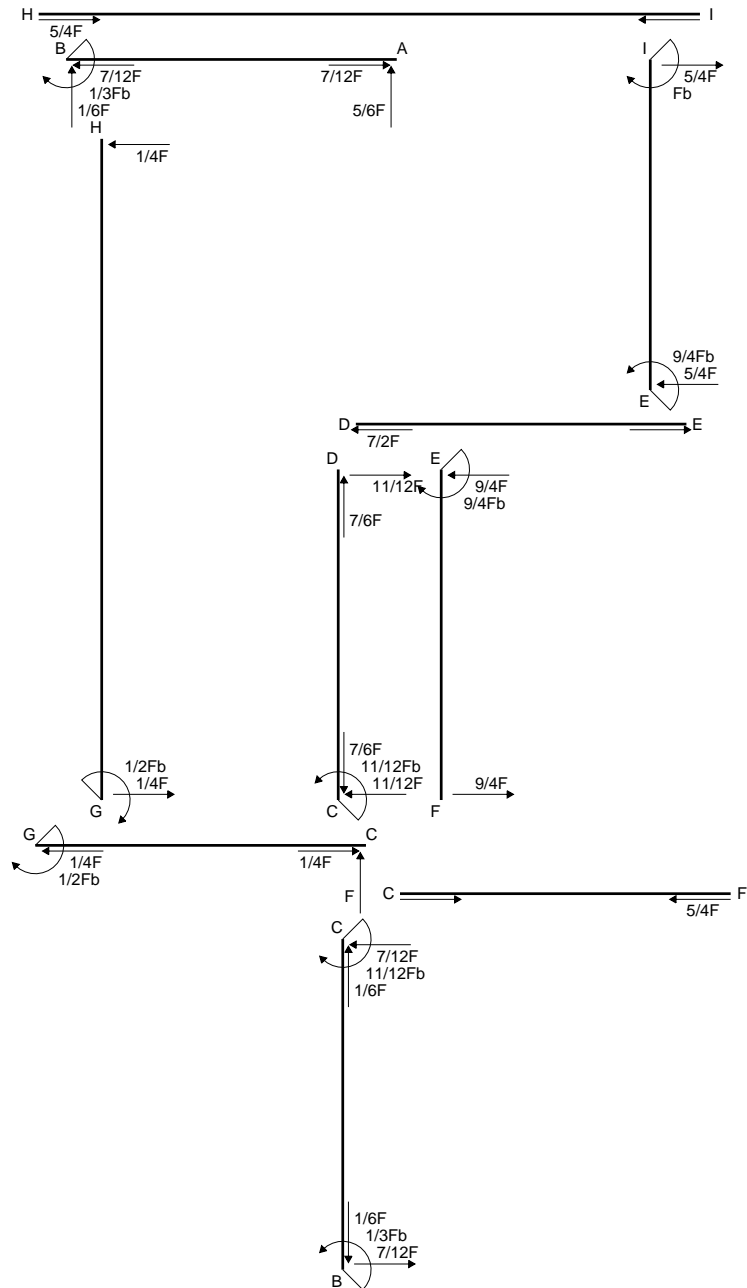
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

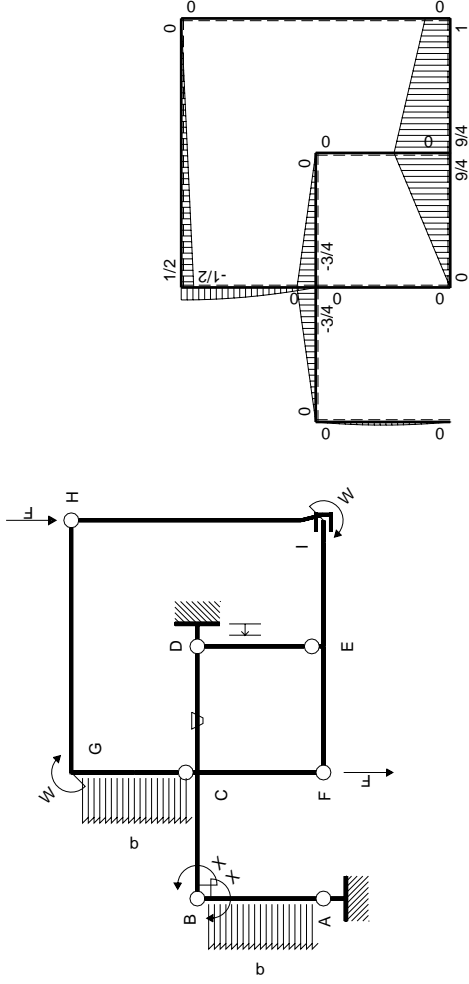
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

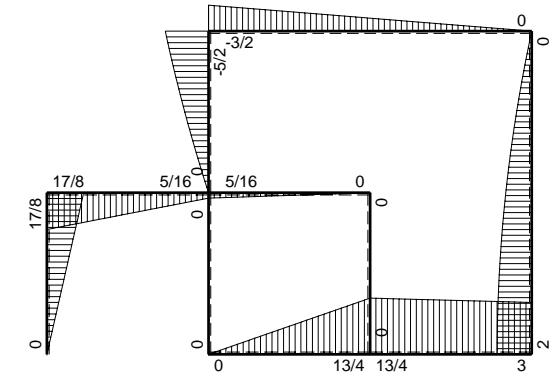
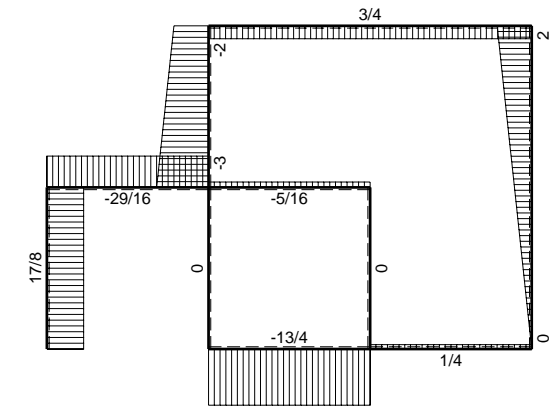
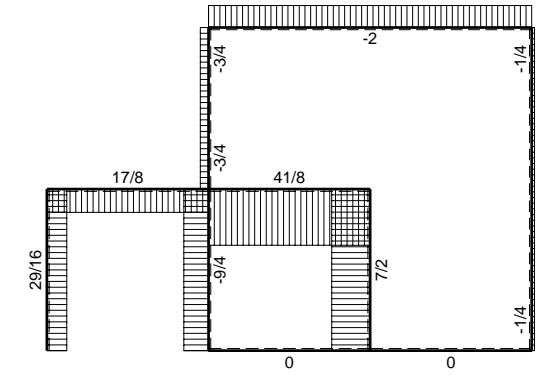
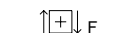
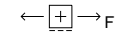
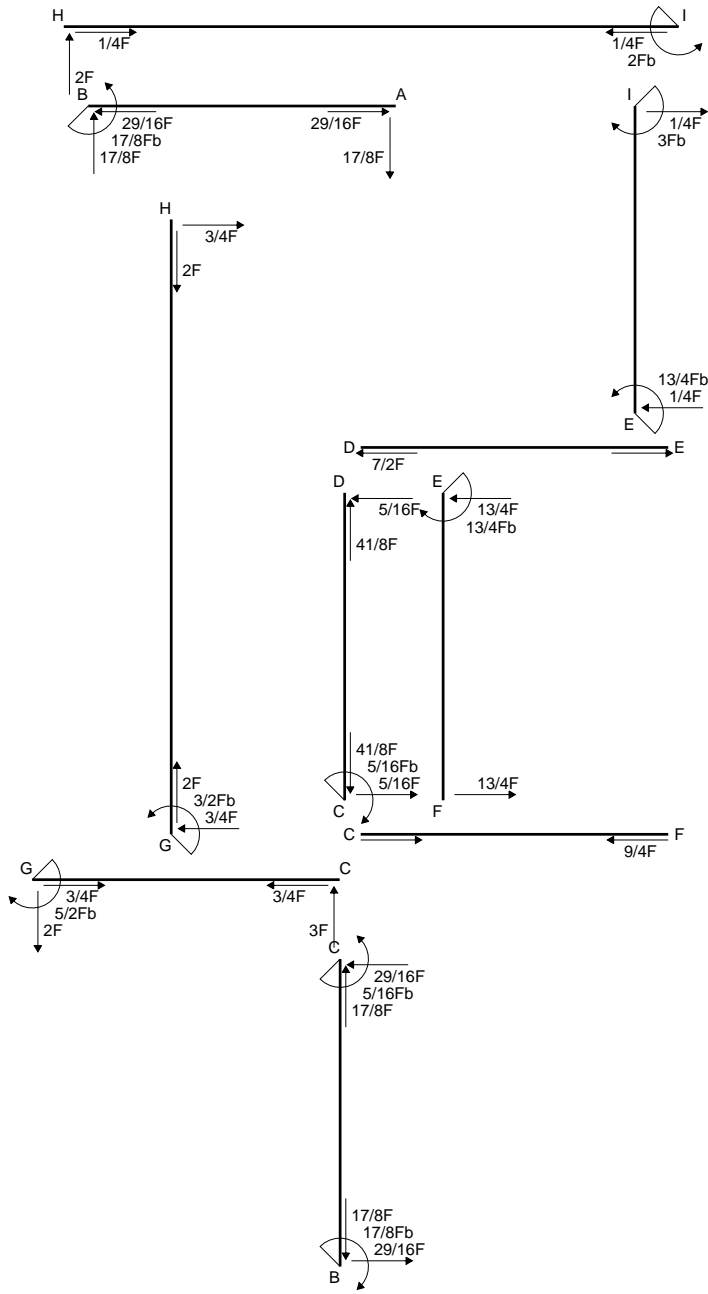
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

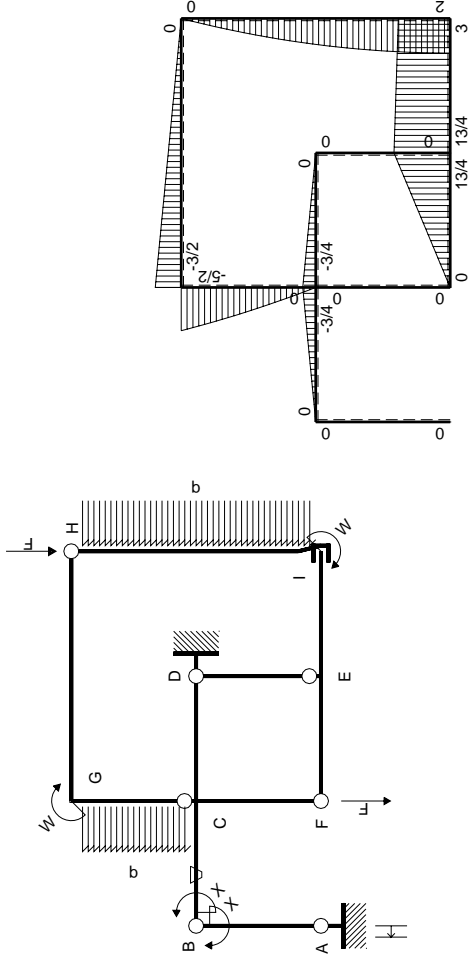
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

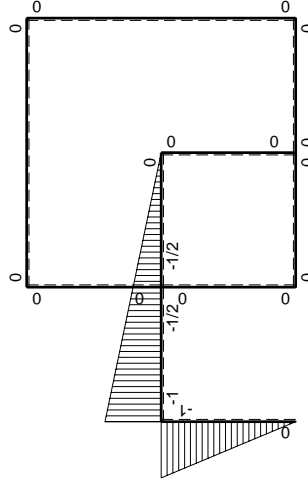
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0		
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$3/4Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

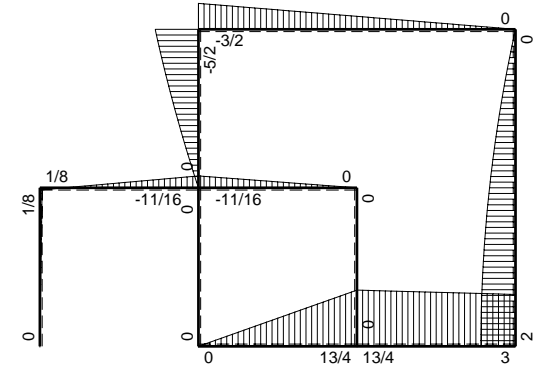
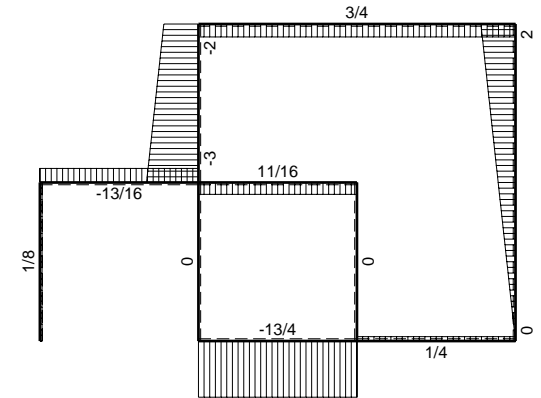
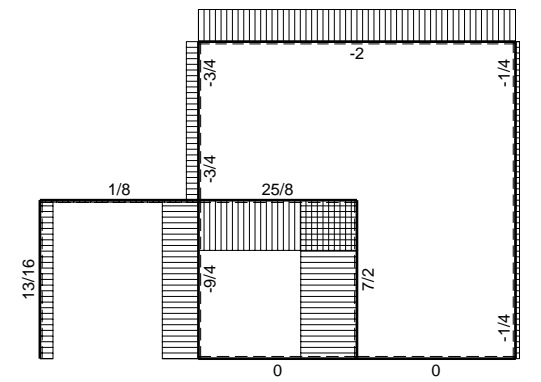
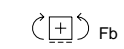
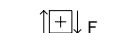
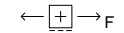
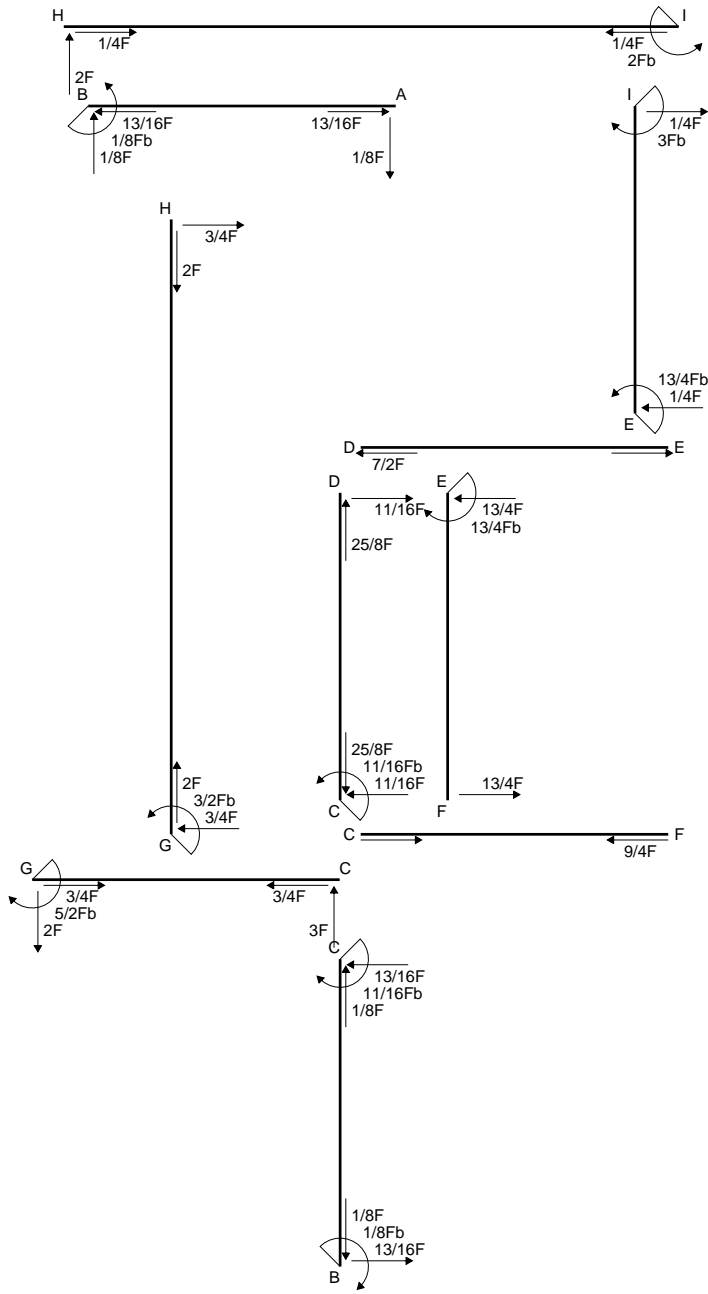
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

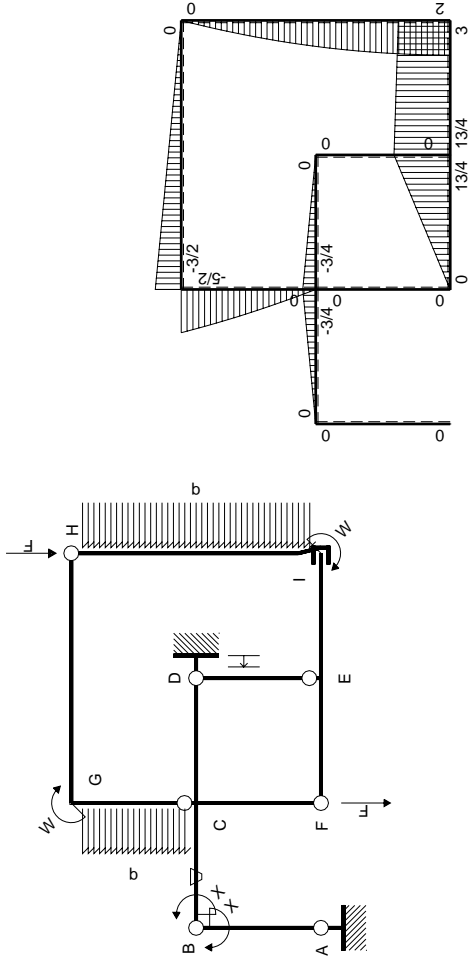
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

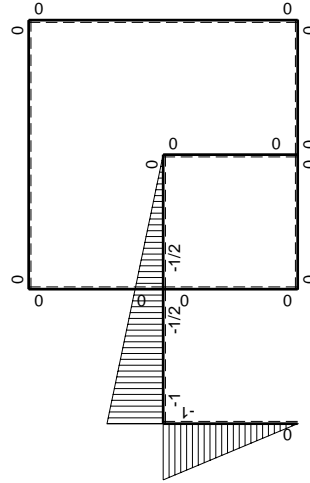
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0		
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$3/4Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

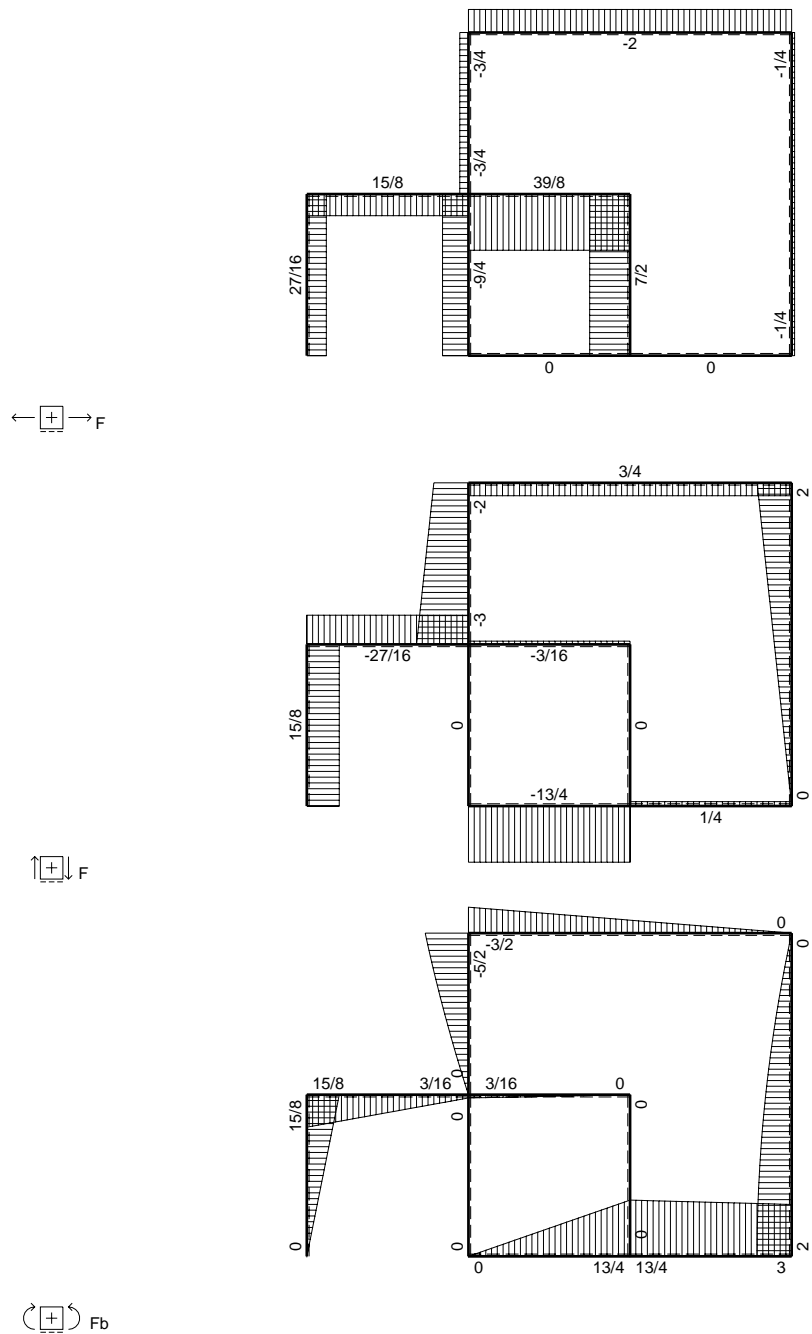
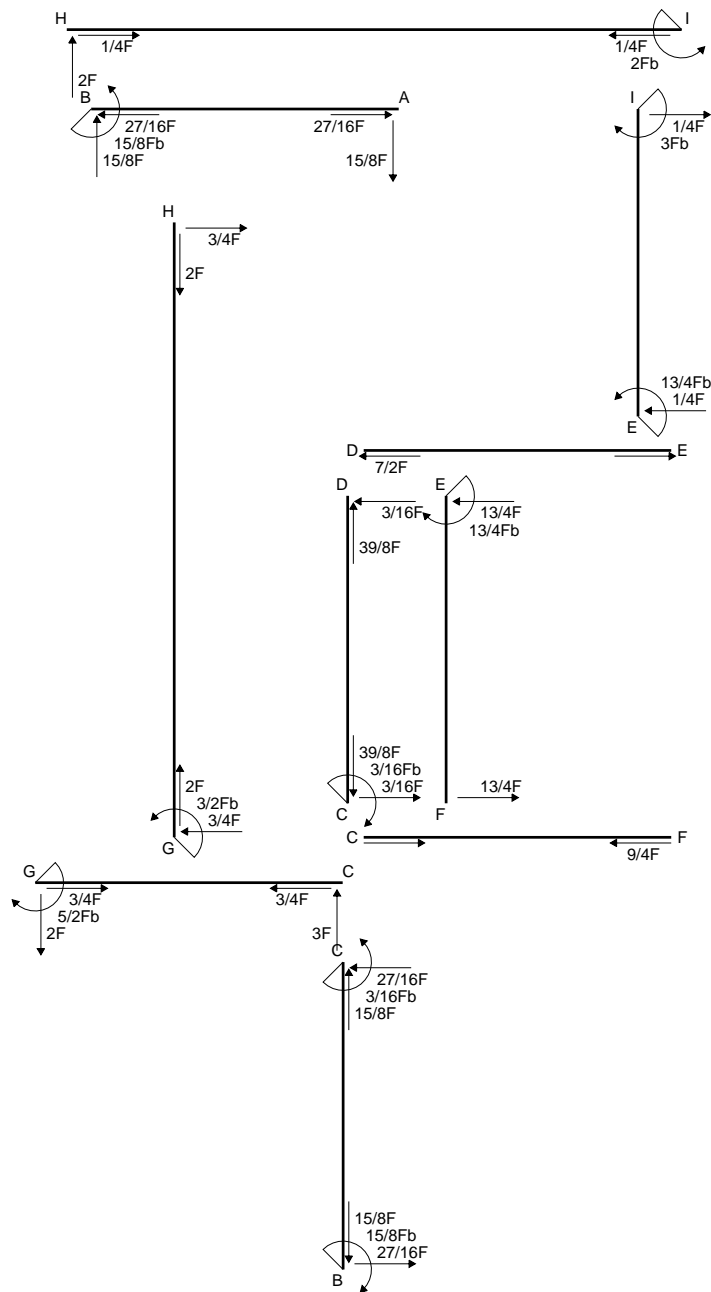
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

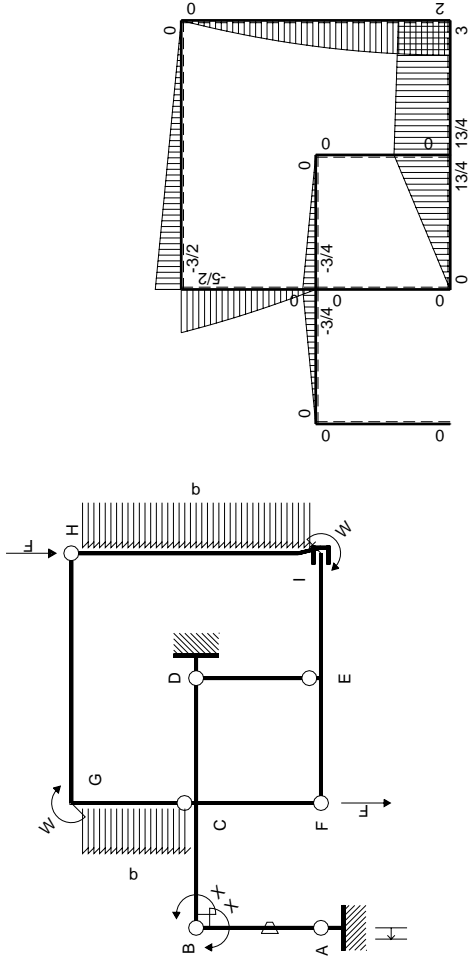
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

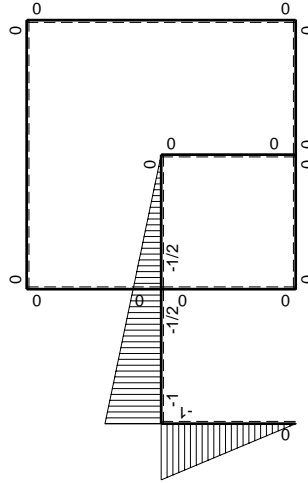
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0		
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$3/4Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

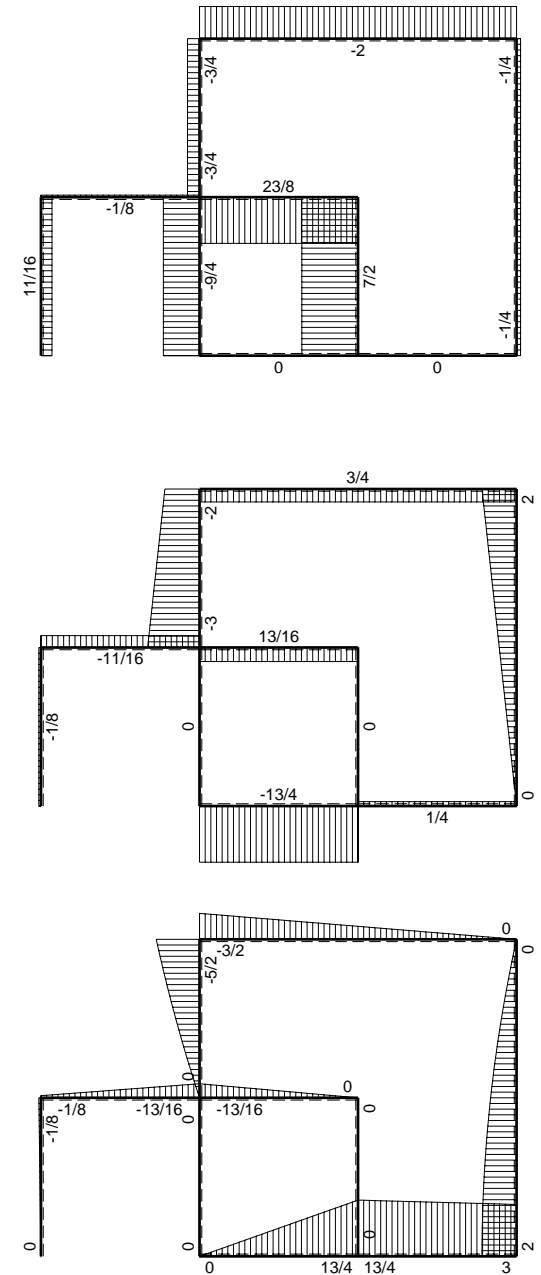
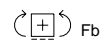
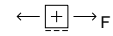
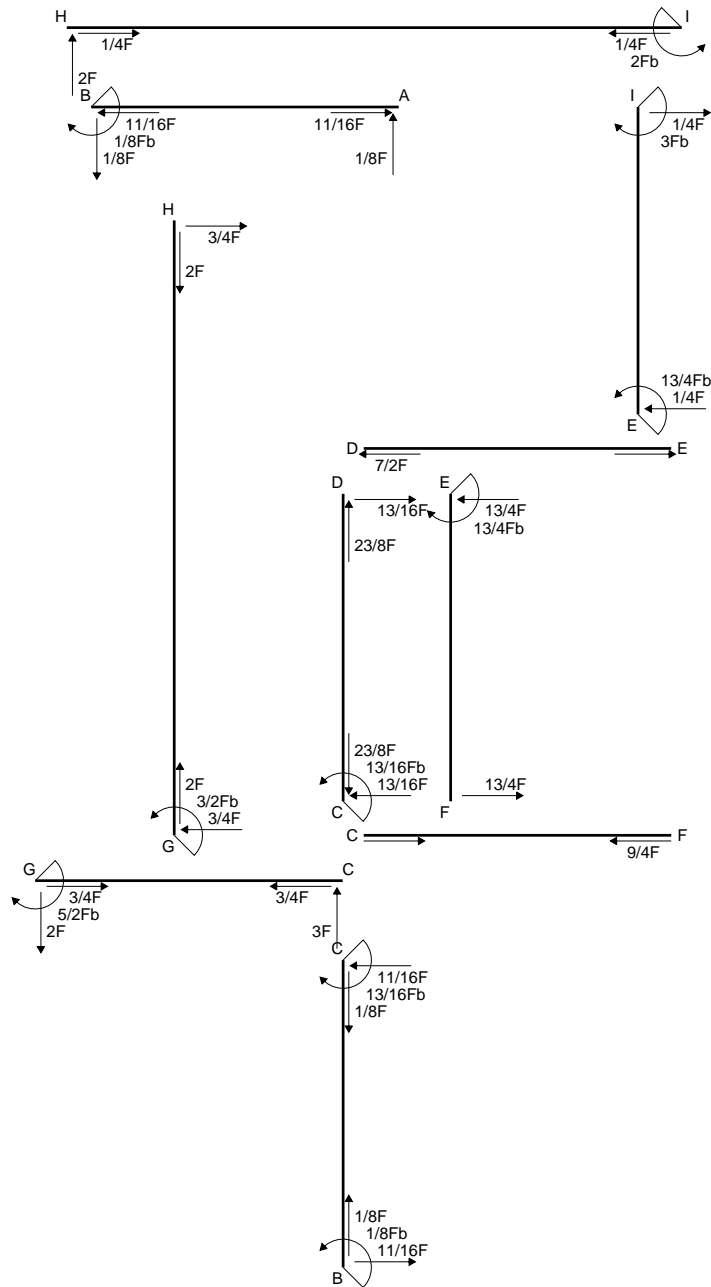
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

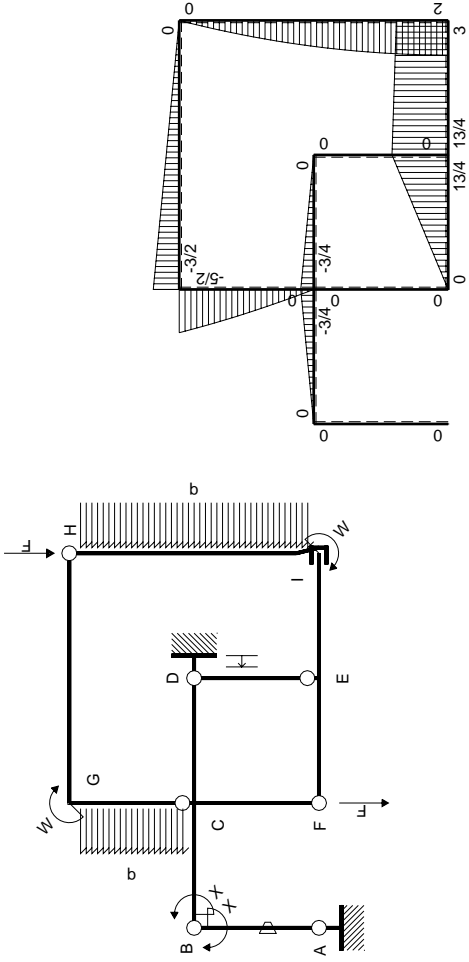
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

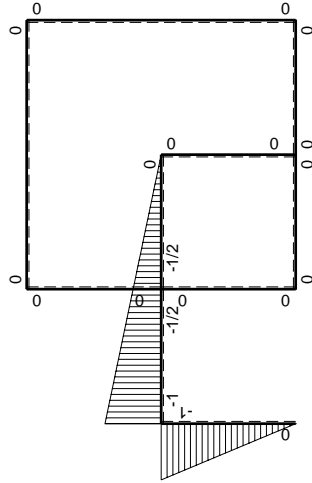
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0			
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$3/4Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

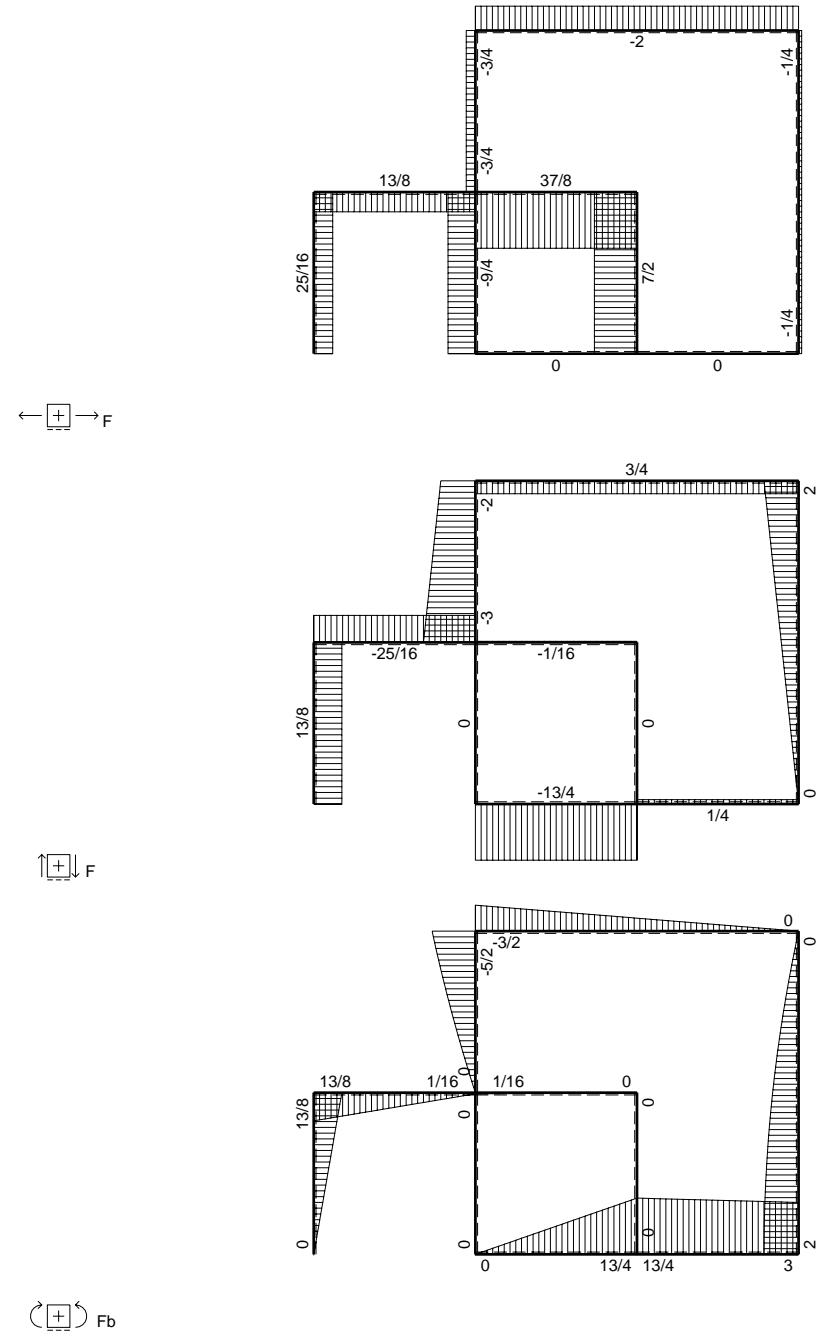
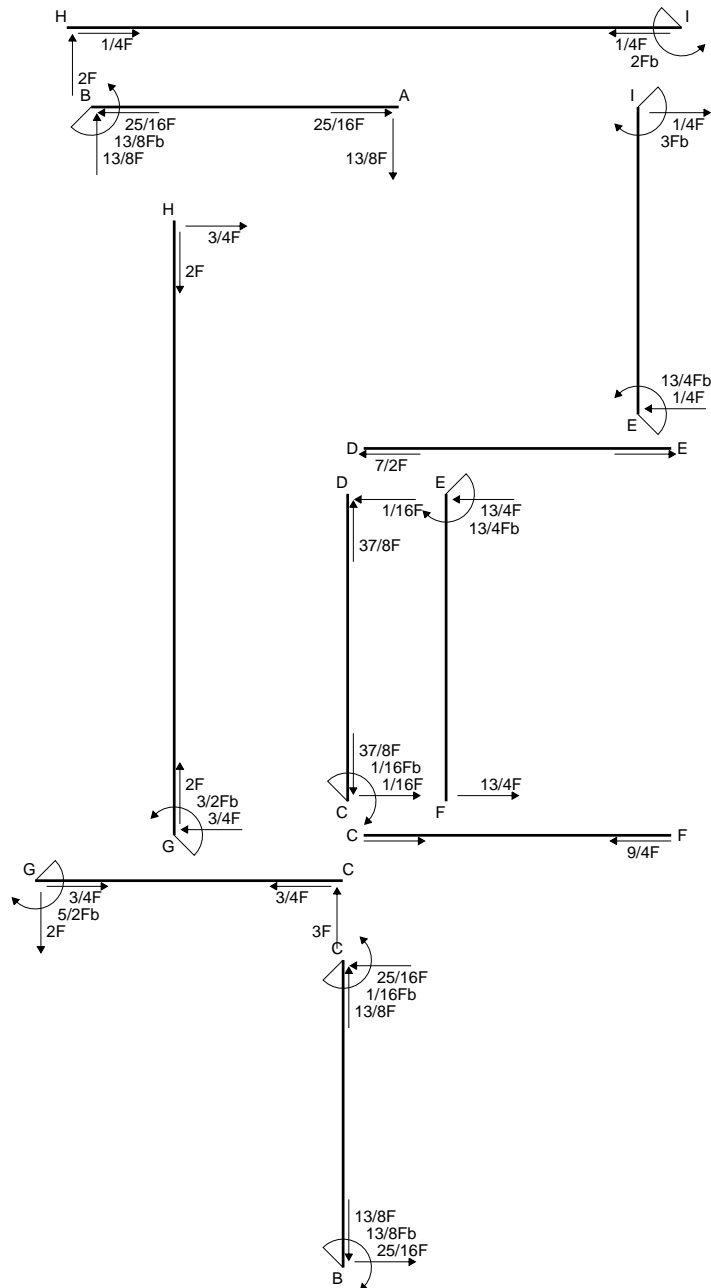
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

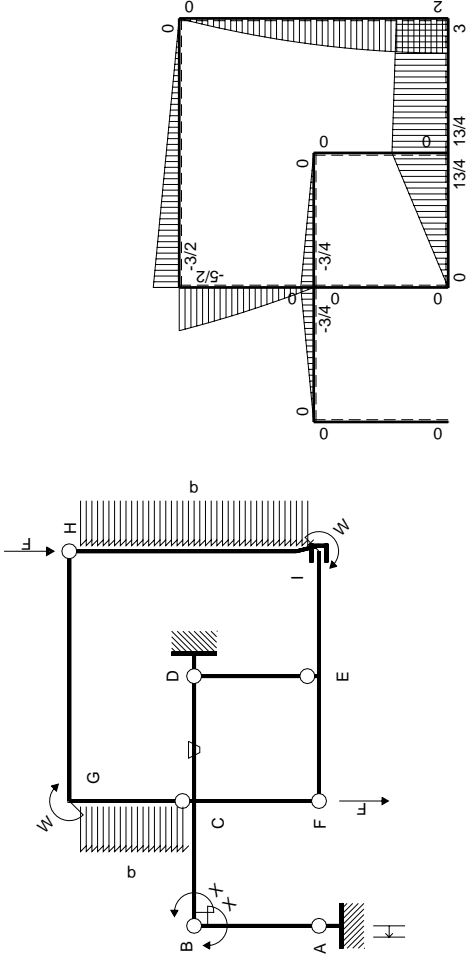
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

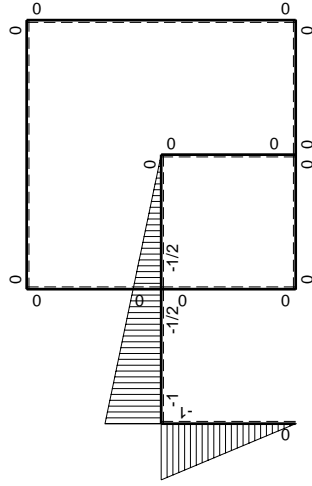
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0		
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$3/4Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

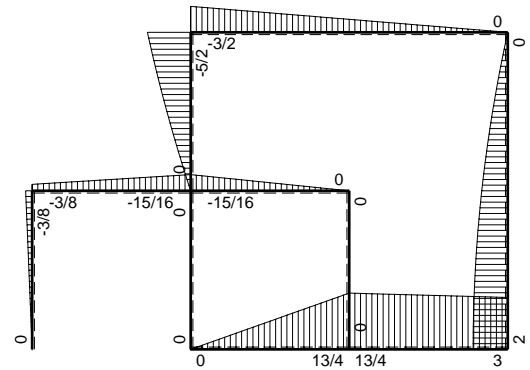
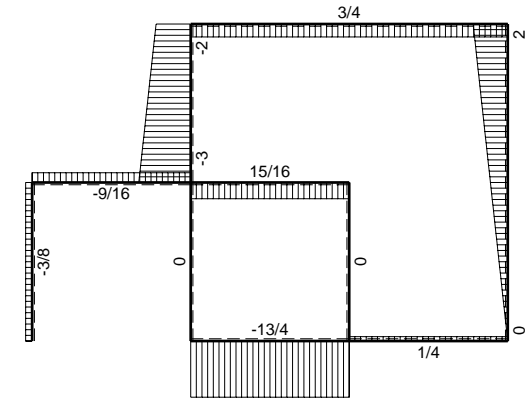
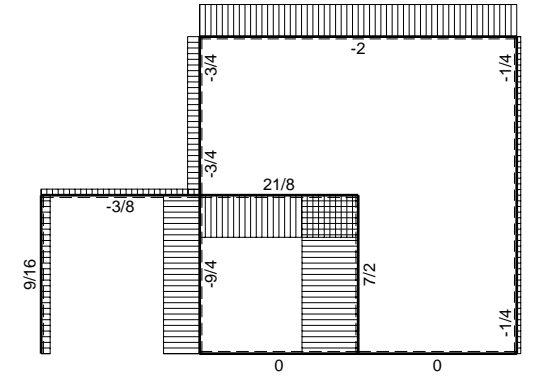
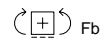
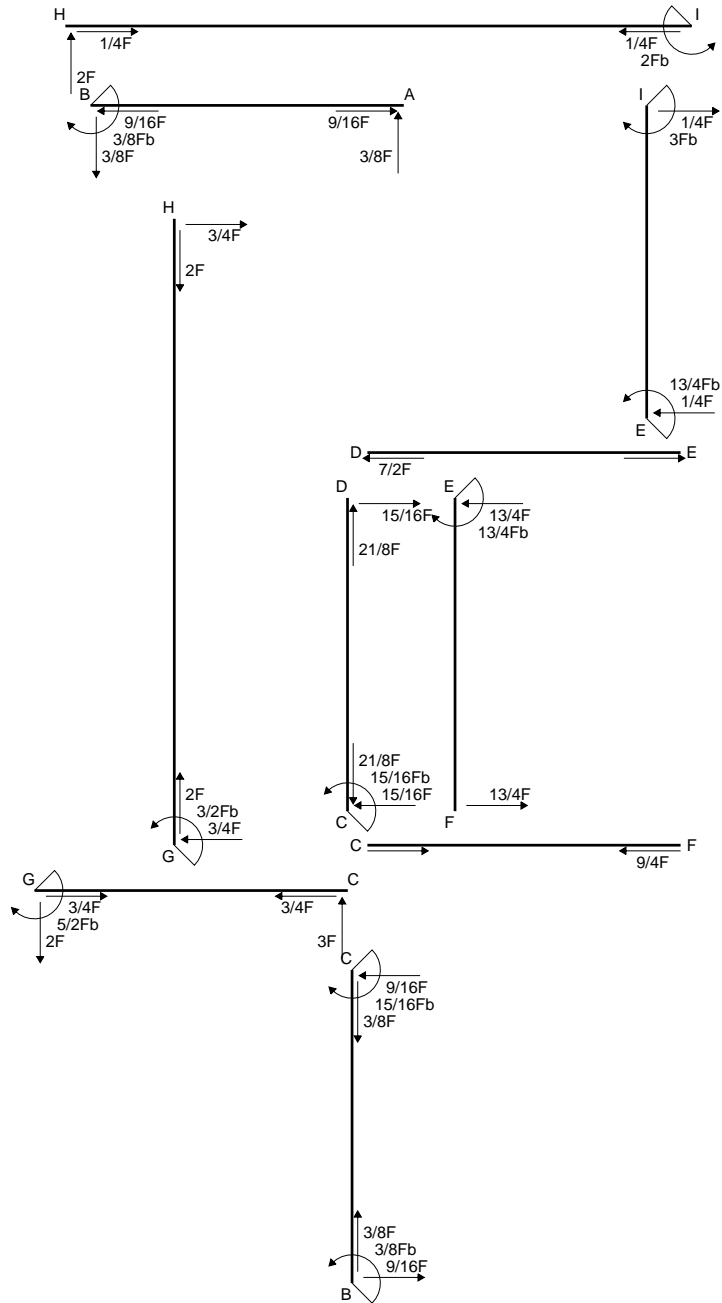
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

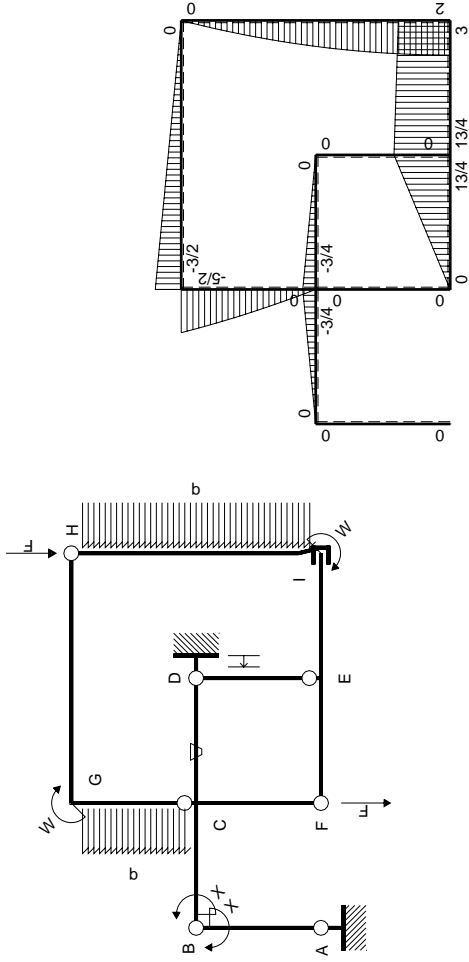
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

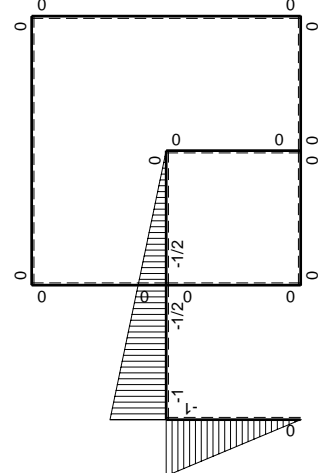
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0			
GH 2b	0	$-3/2Fb+3/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$3/4Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+1/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$3/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

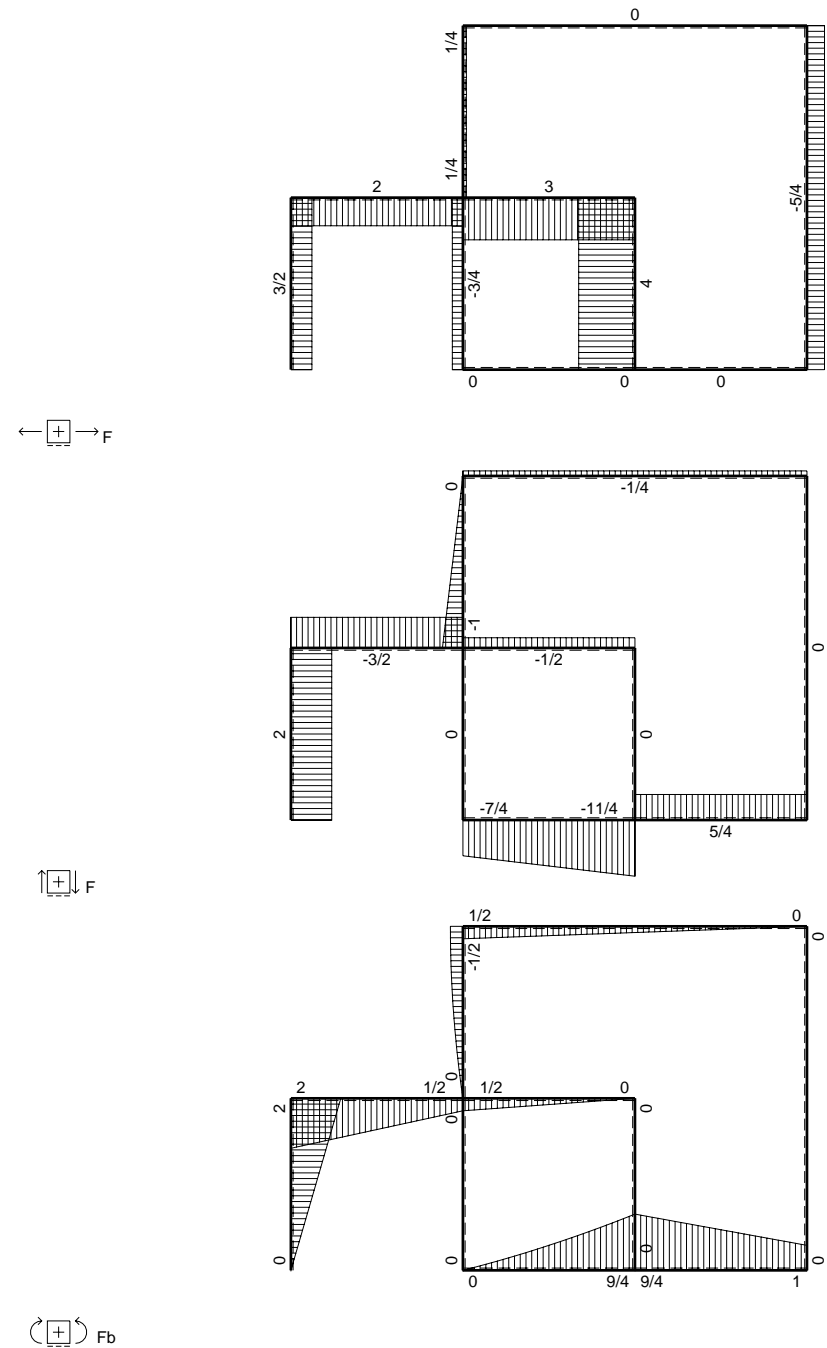
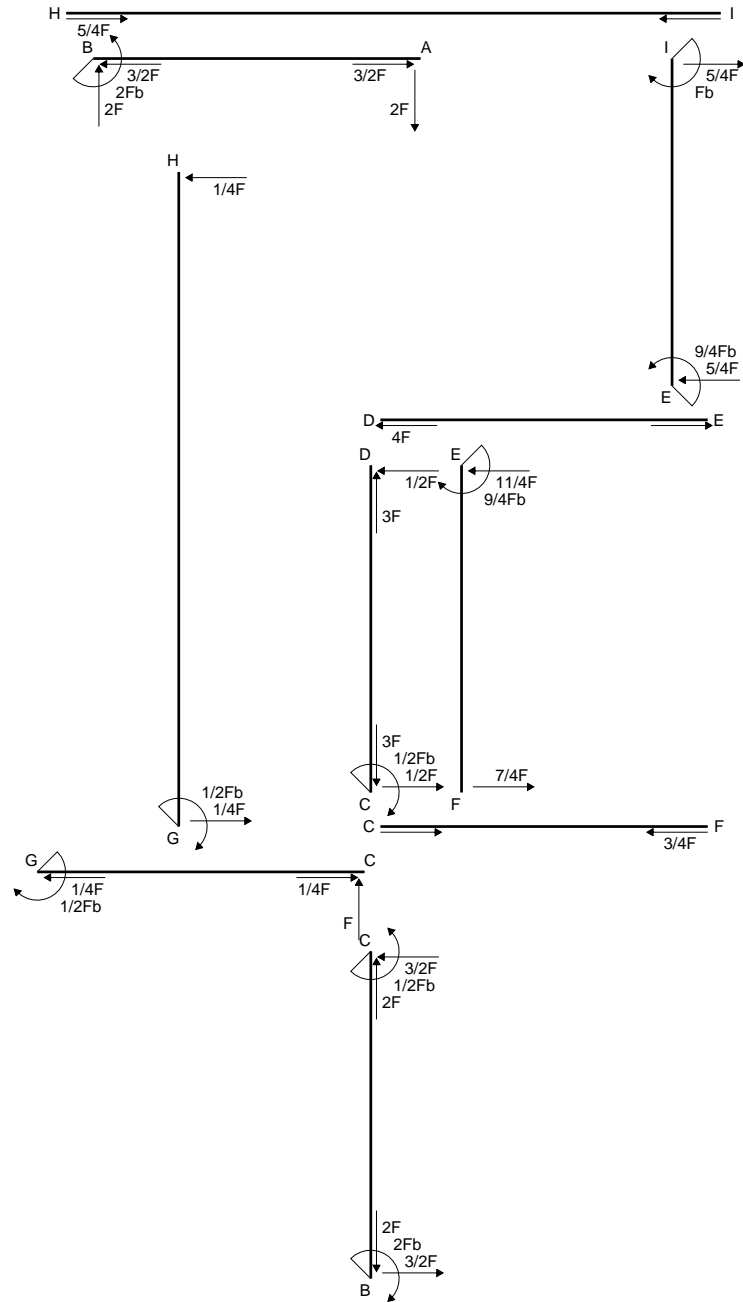
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

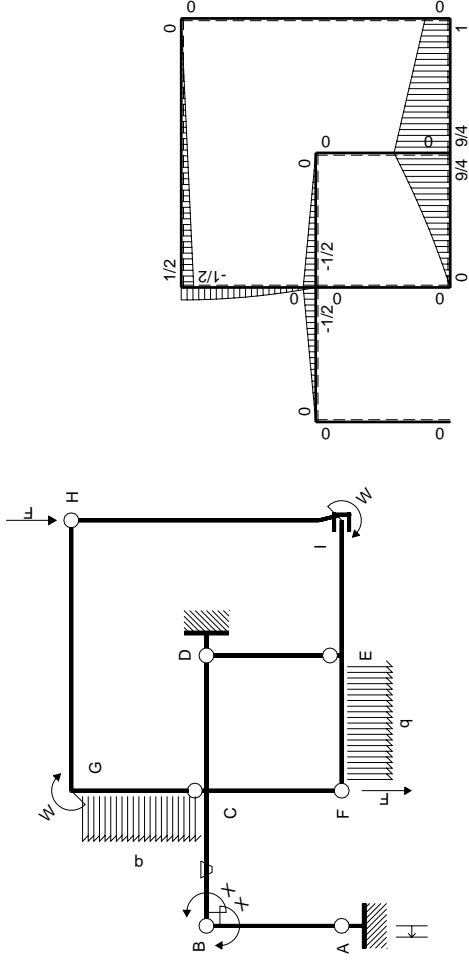
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

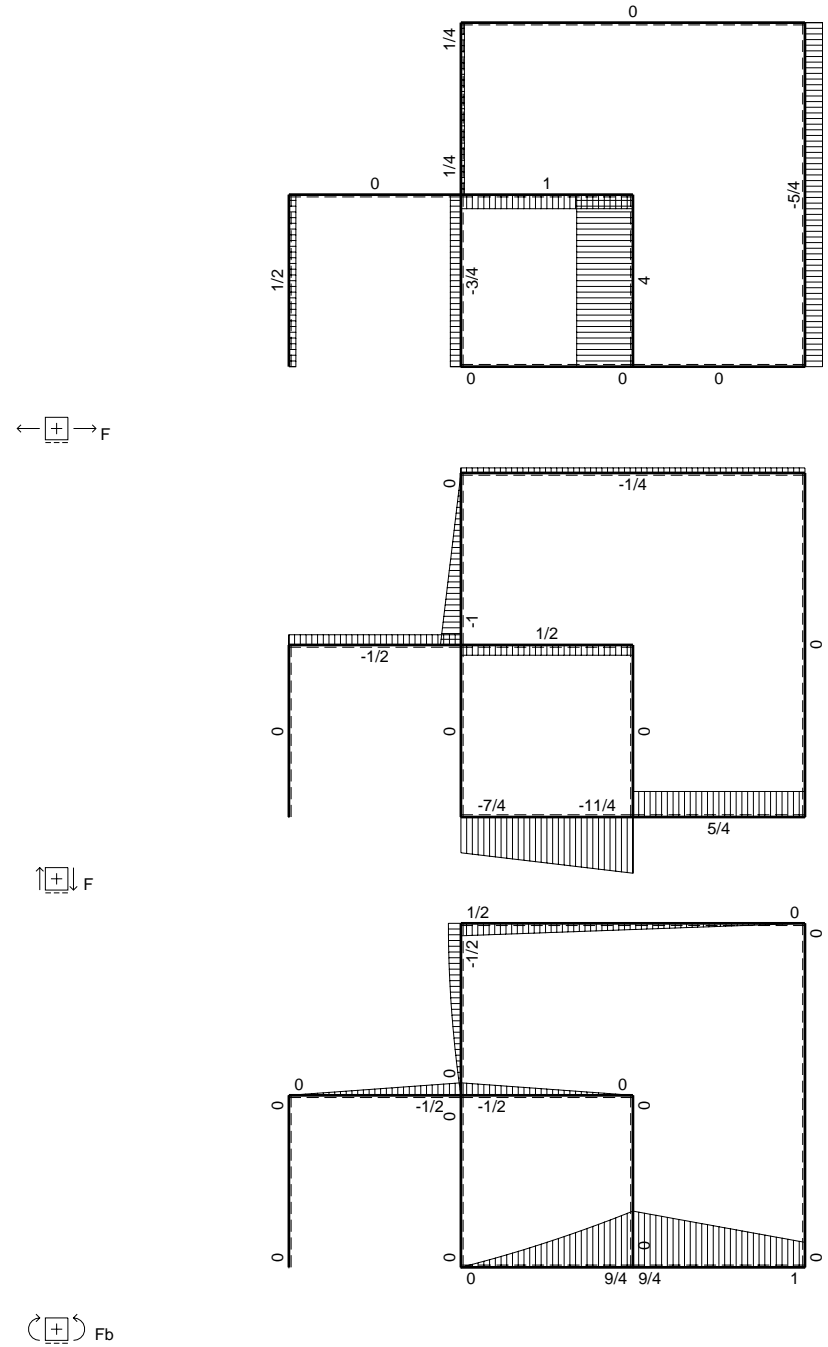
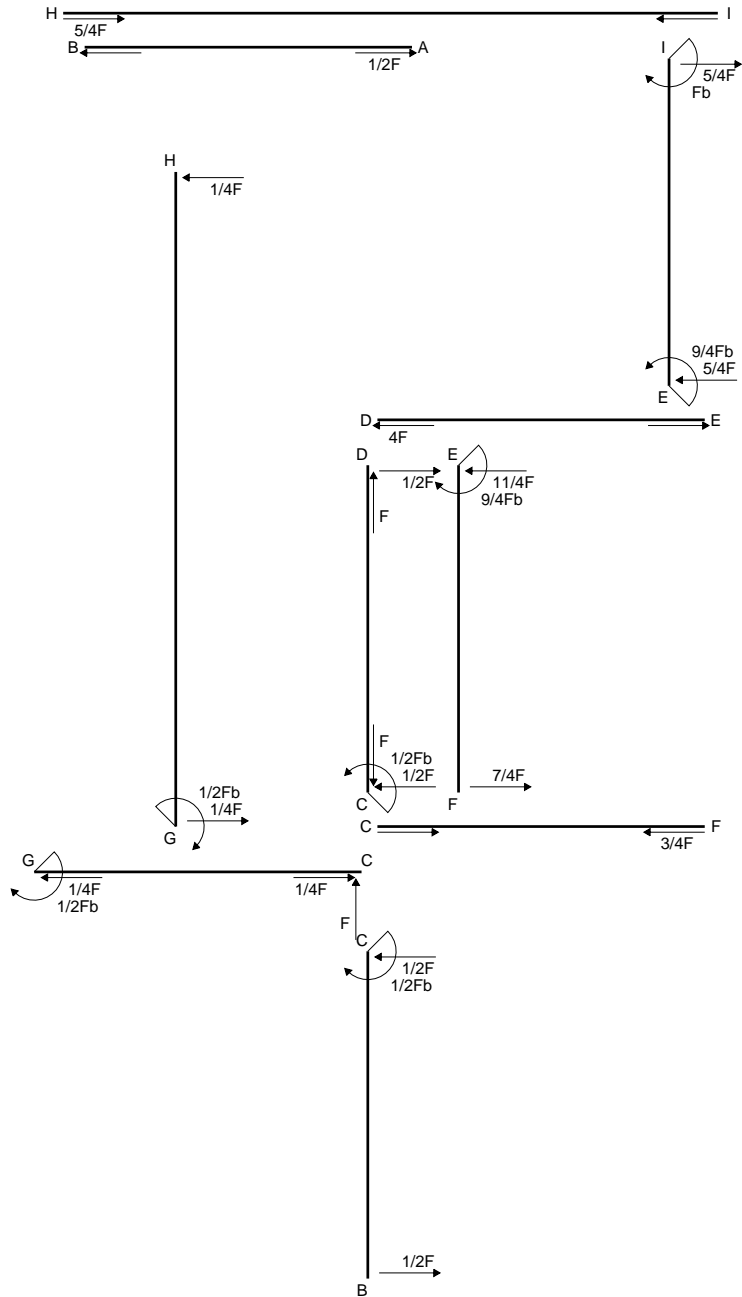
$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

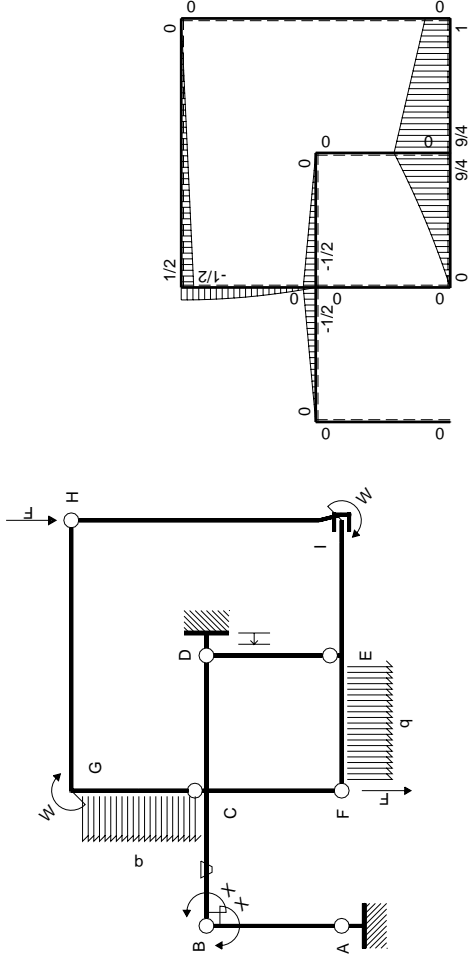
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

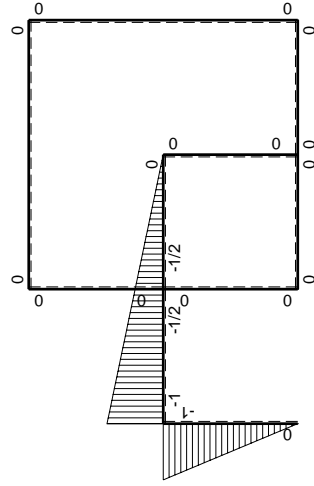
$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							0	Xb/EJ
	iperstatica $X=W_{BC}$							0	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

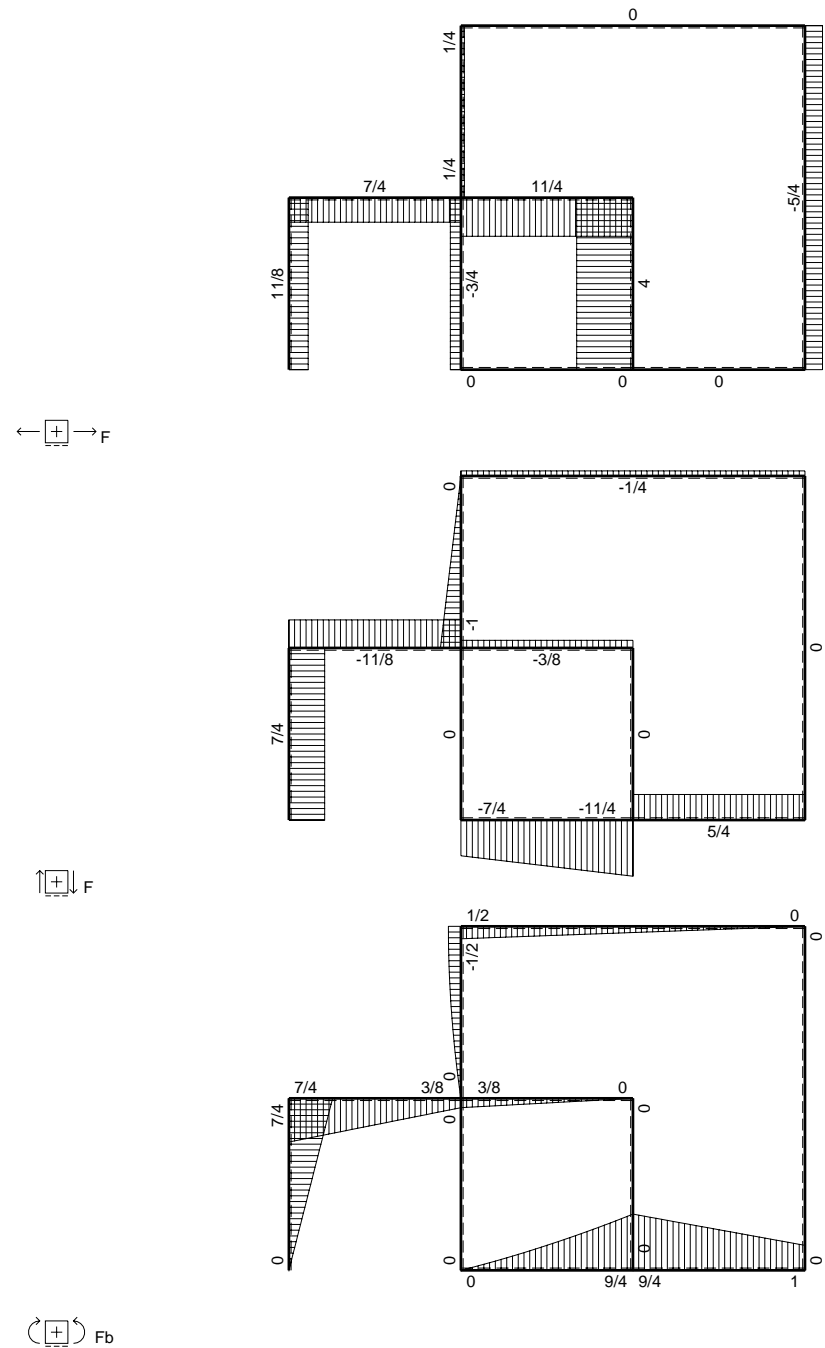
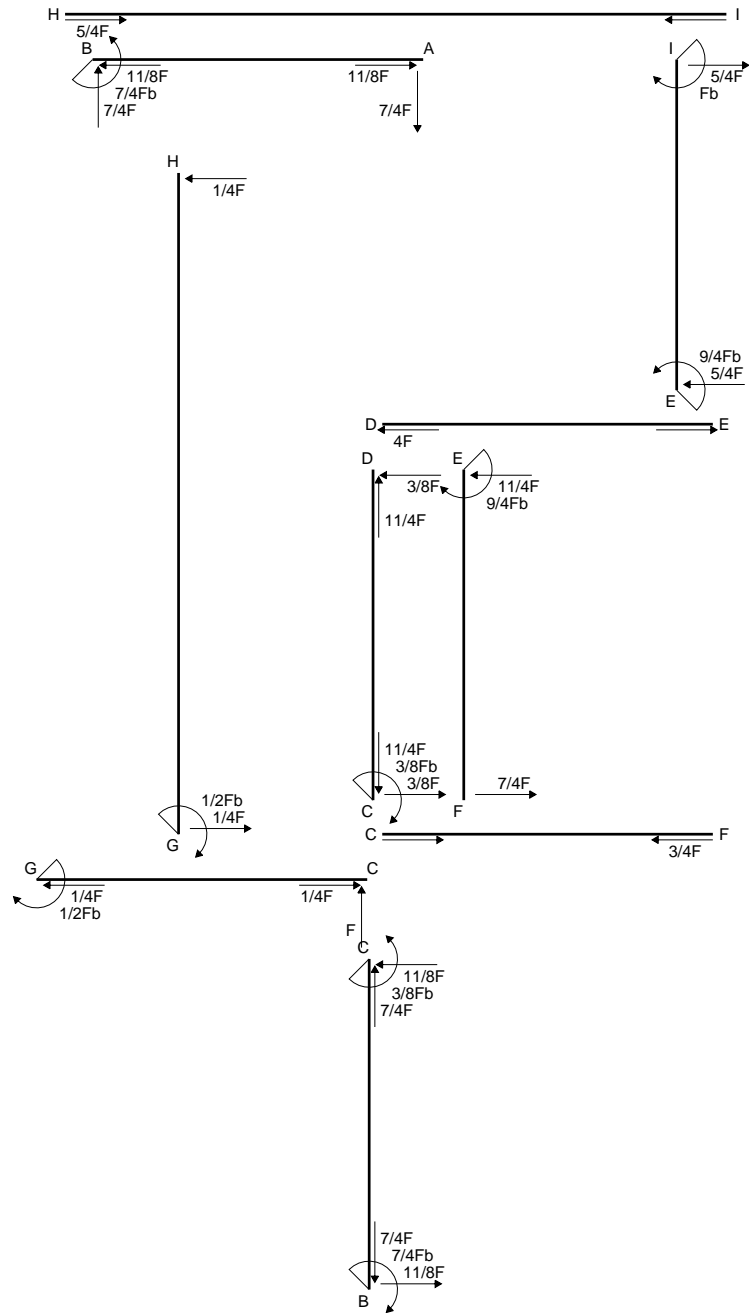
$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

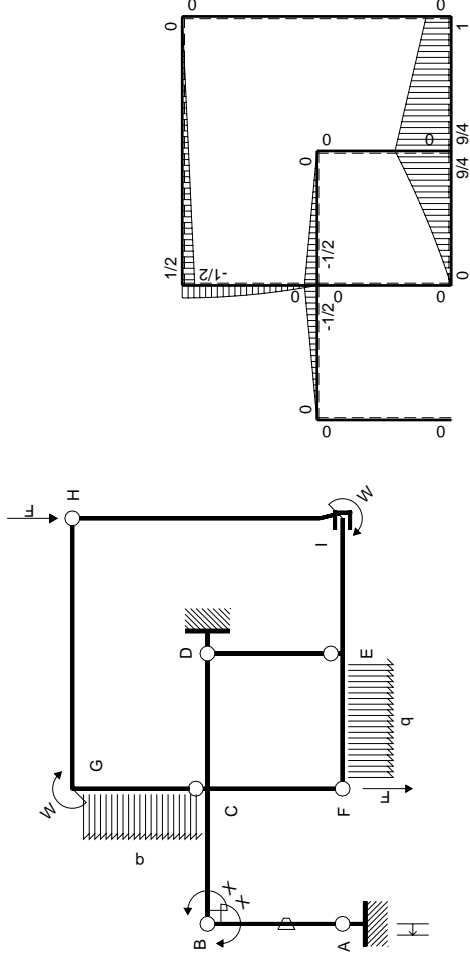
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

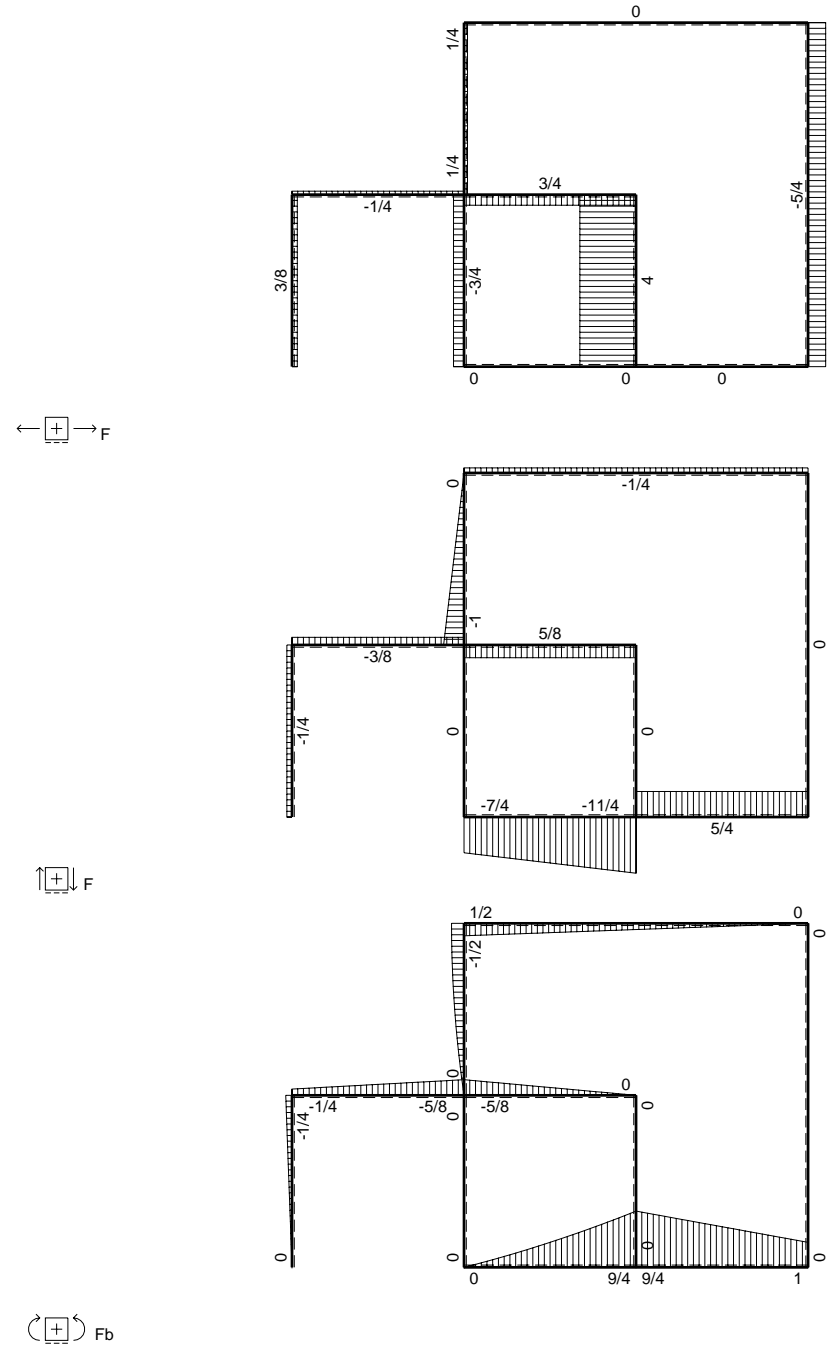
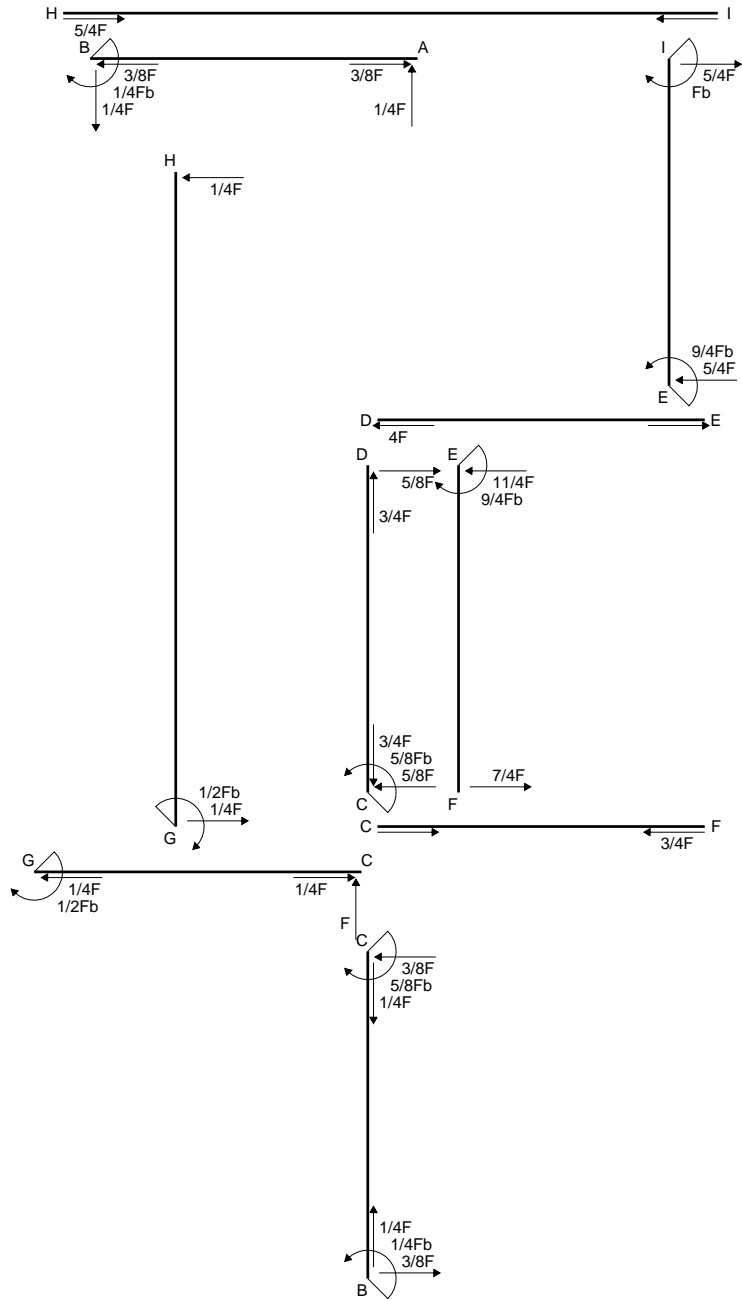
$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

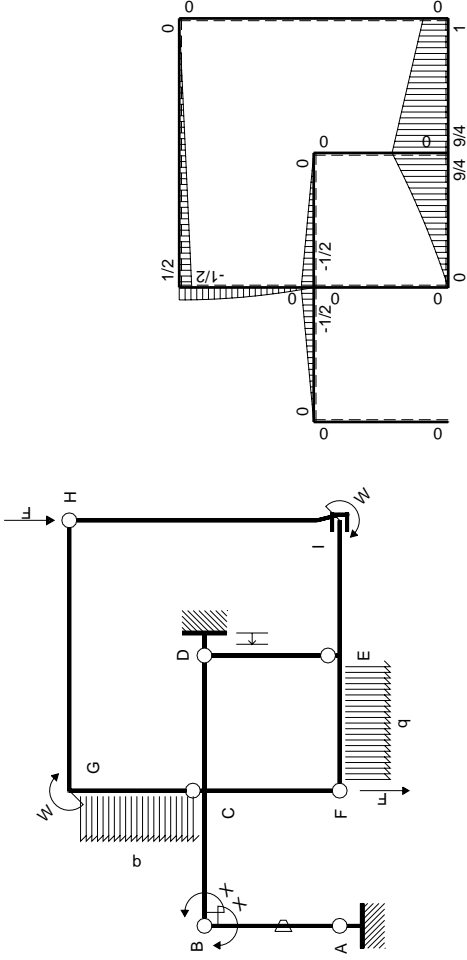
$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$



⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

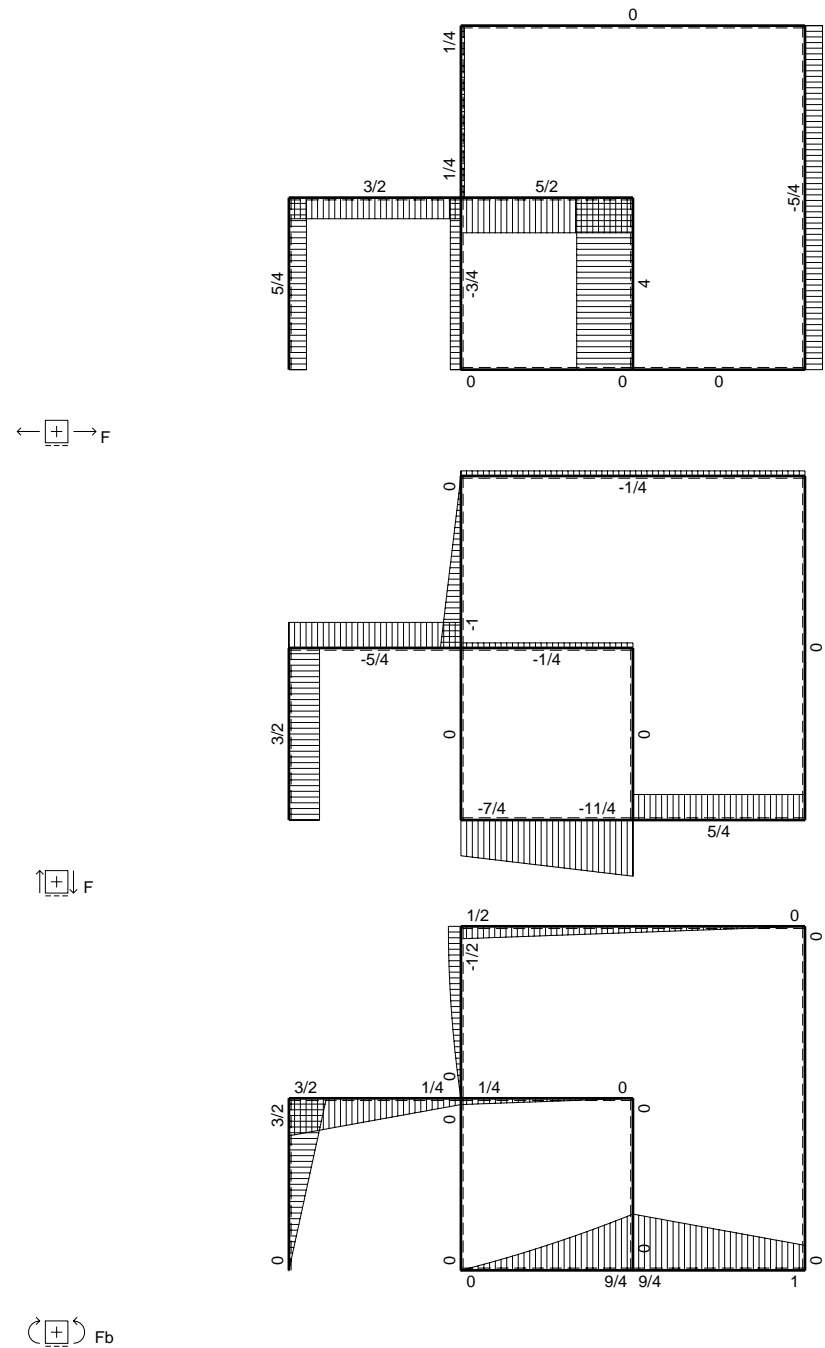
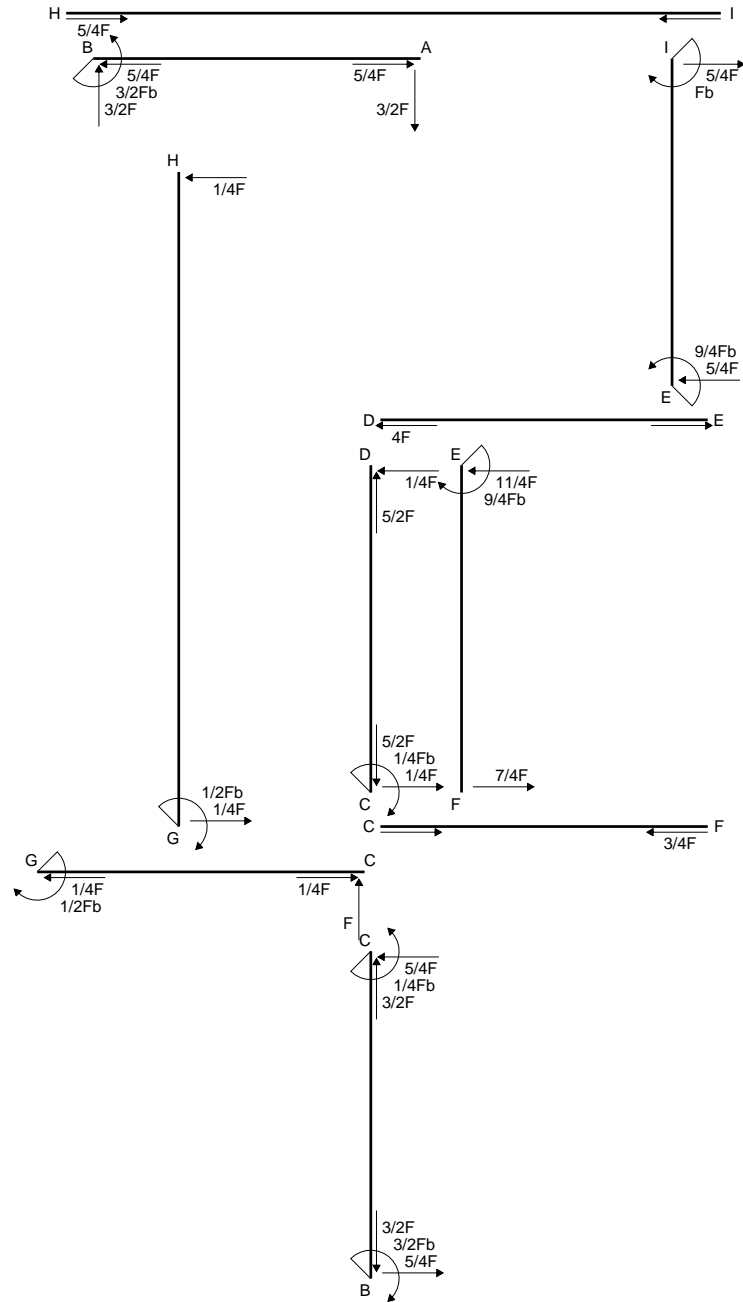
$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

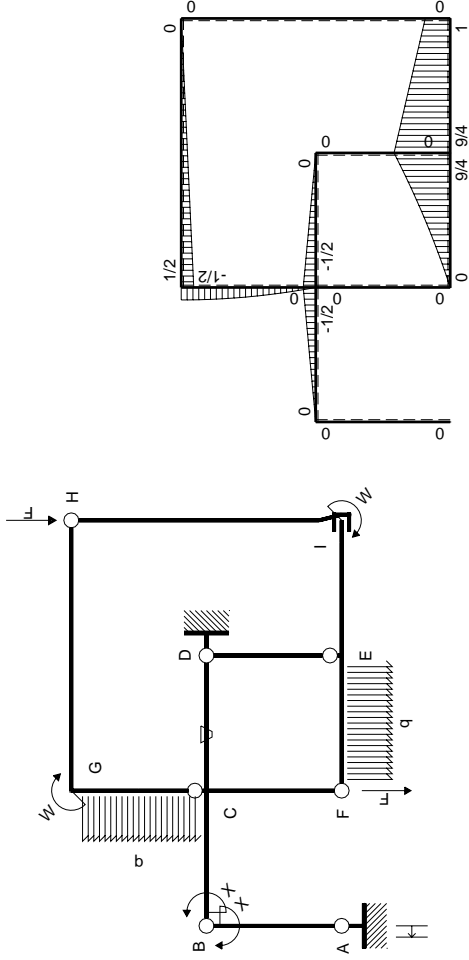
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$3/2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-3/2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

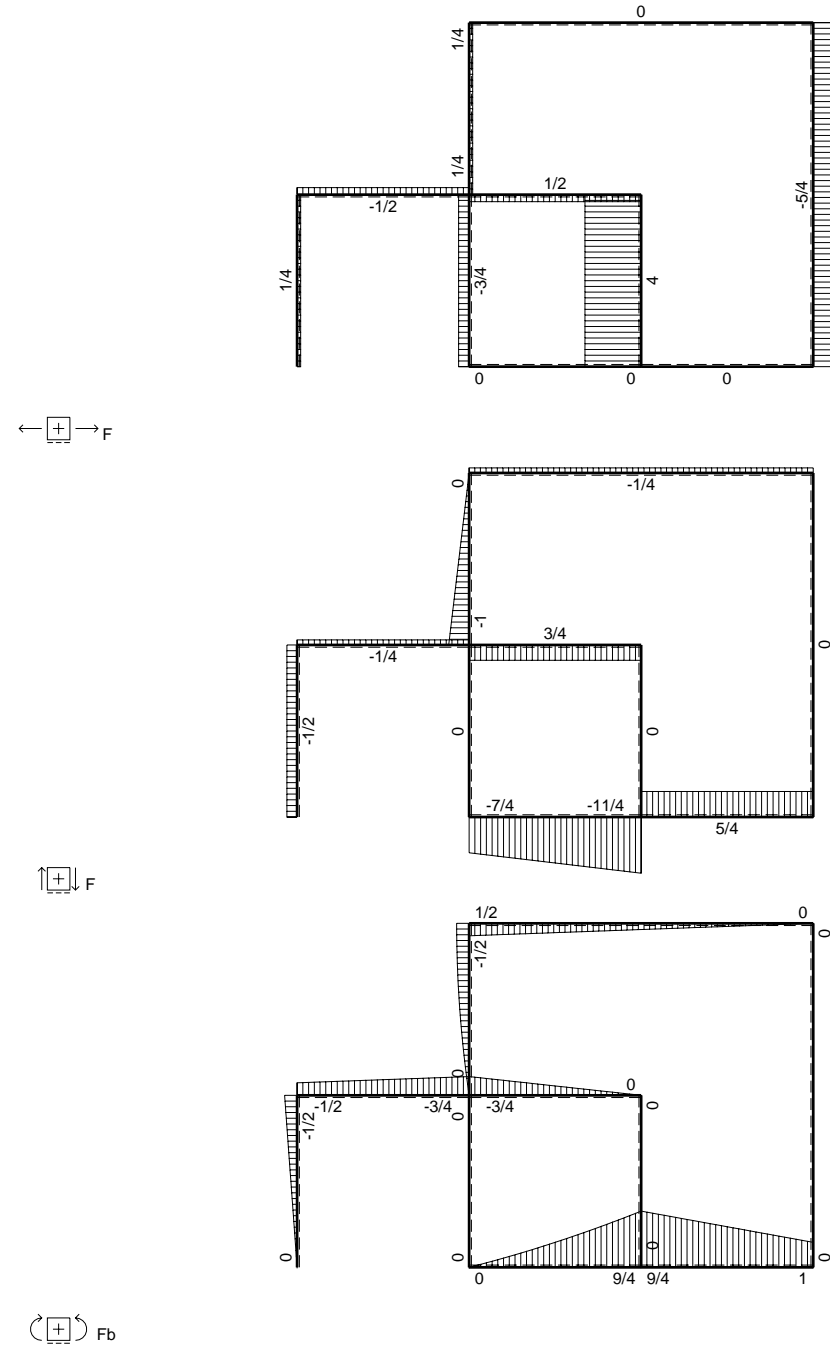
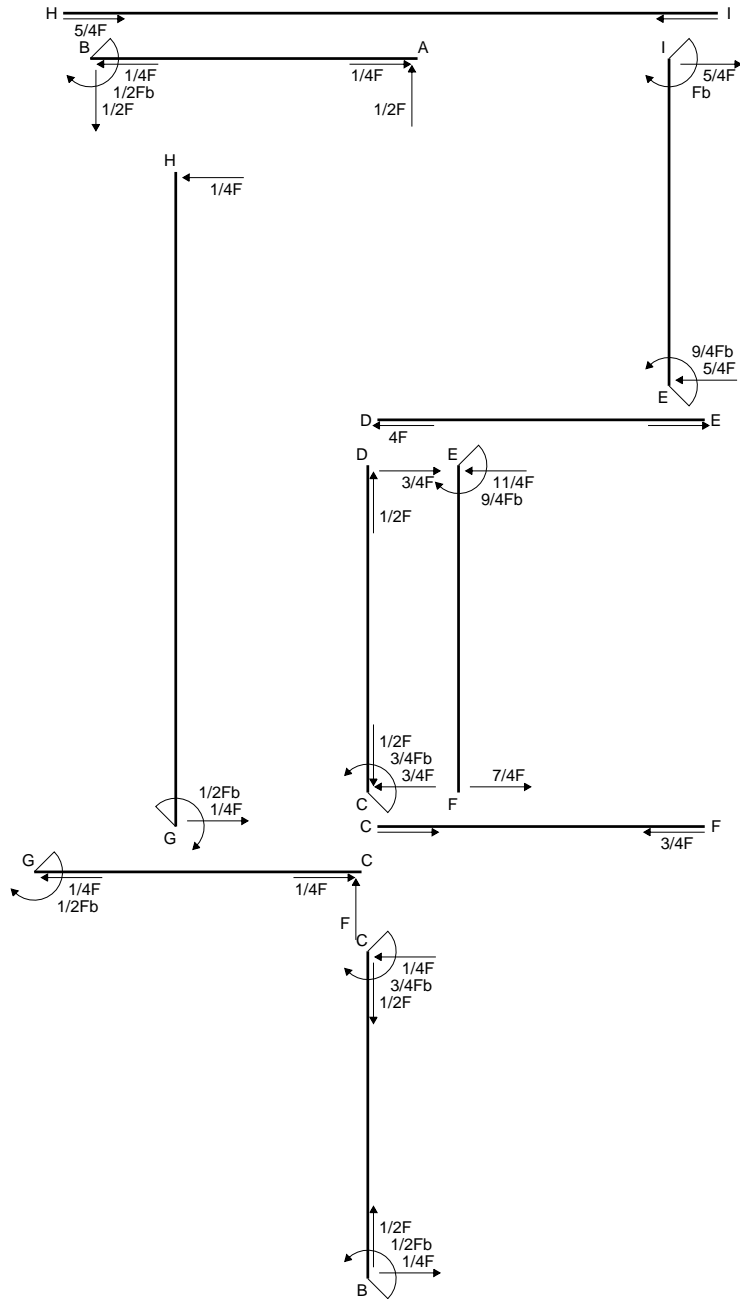
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

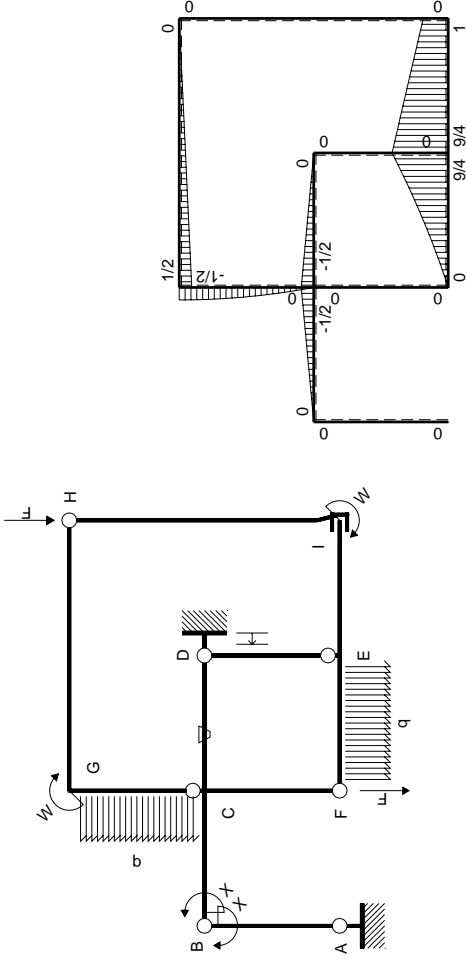
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

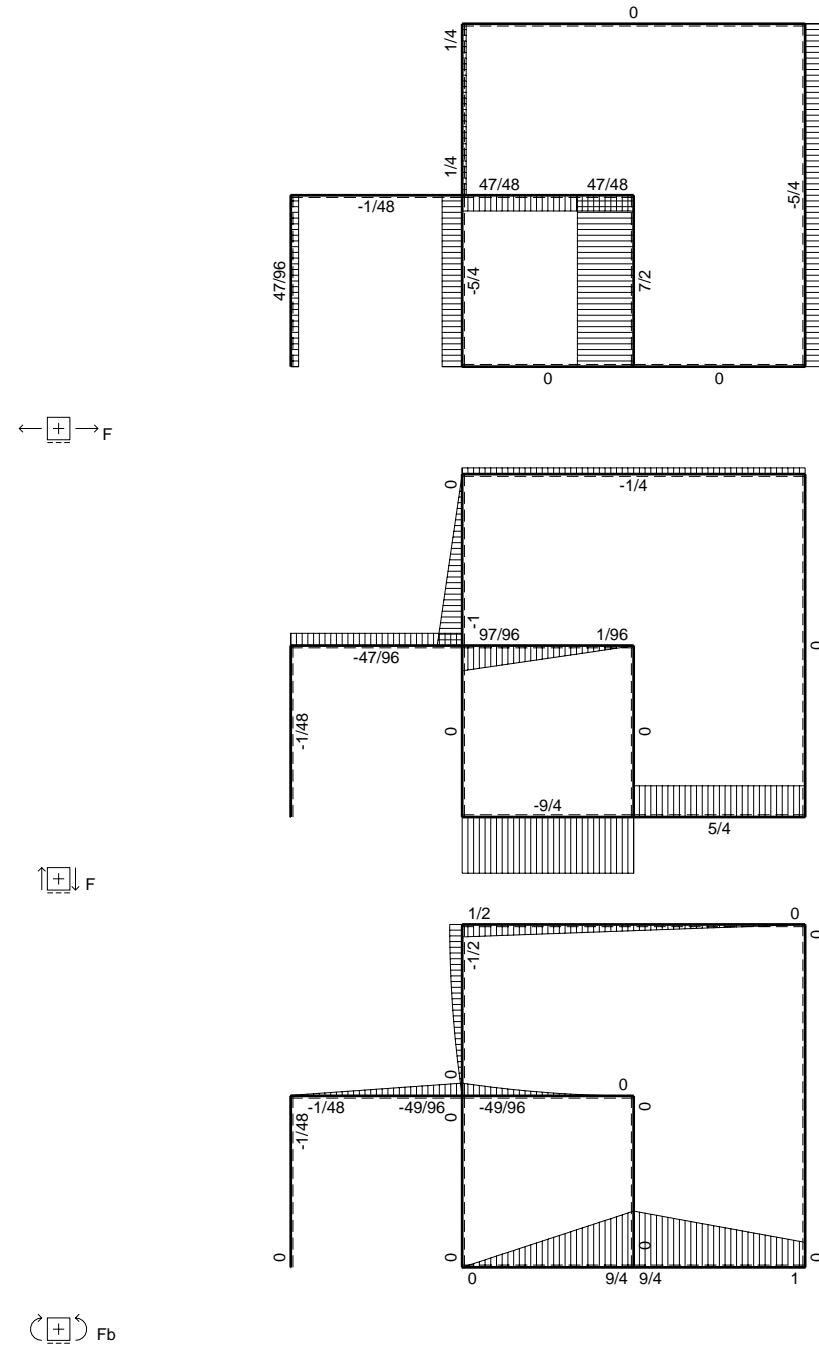
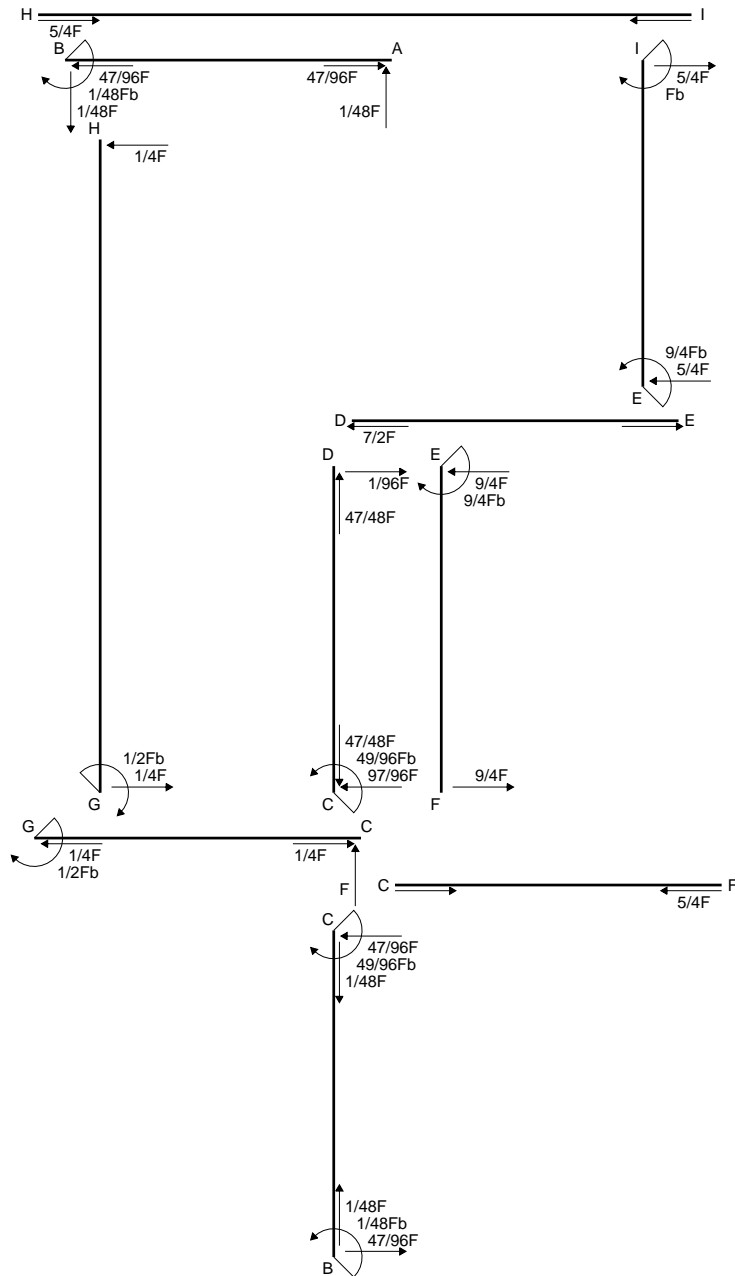
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

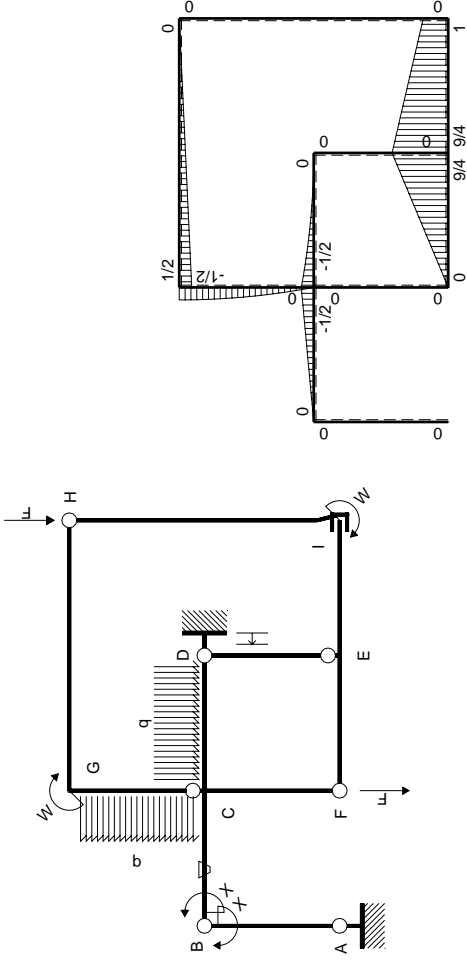
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+Fx-1/2qx^2$	0	$1/4Fb-3/4Fx+3/4Fx^2/b-1/4qx^3/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/16+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2qx^2$	0	$1/4qx^3/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/48Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/48Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

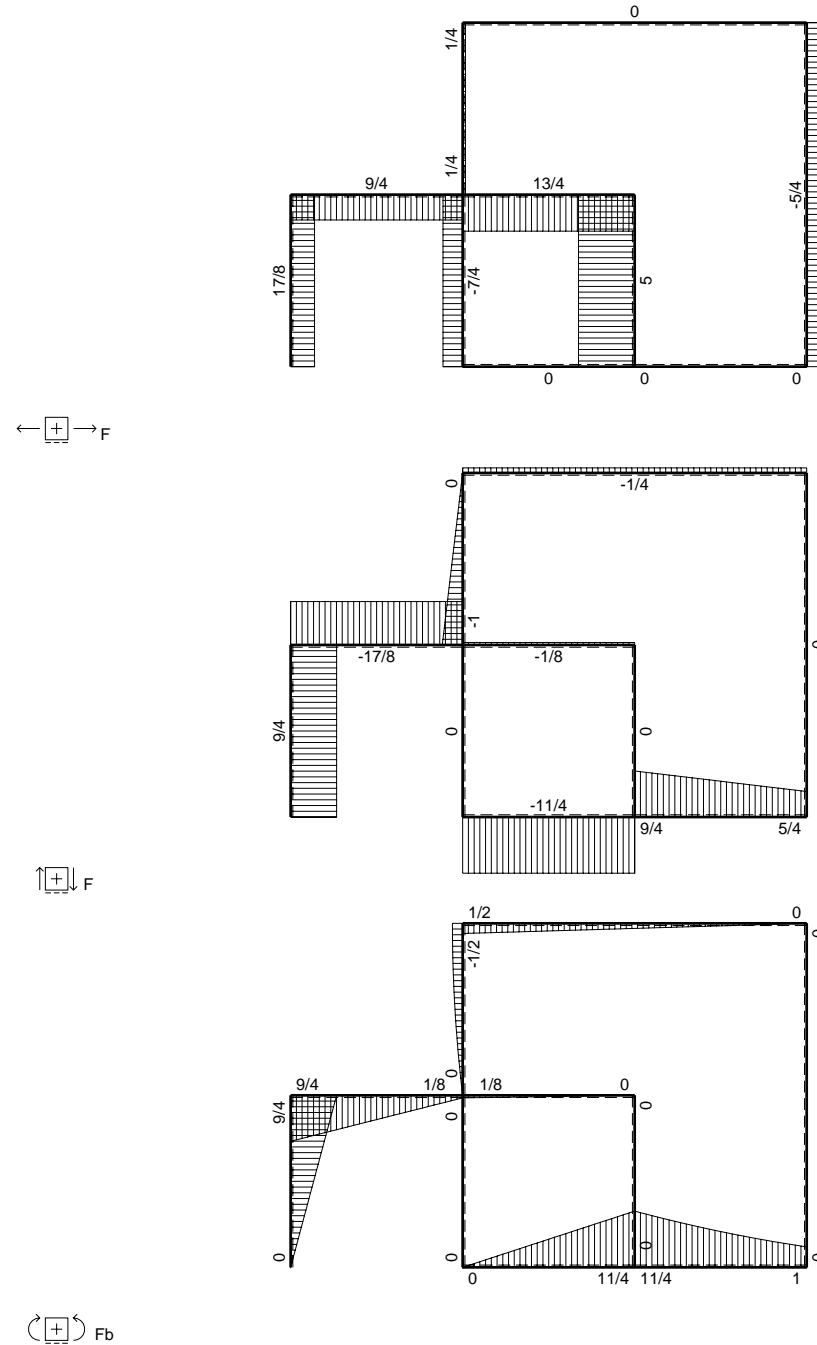
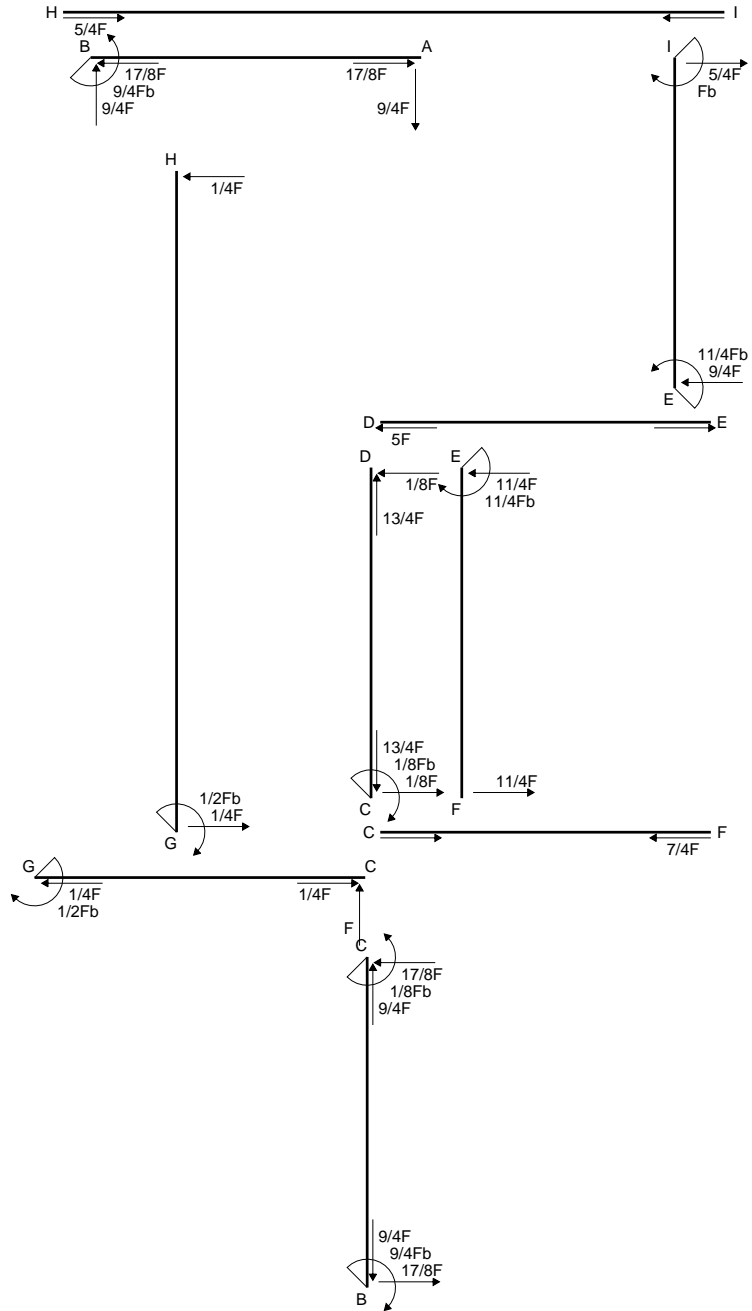
$$L_{CD}^{xo} = \int_0^b (1/4 - 3/4 x/b + 3/4 x^2/b^2 - 1/4 x^3/b^3) Fb 1/EJ dx$$

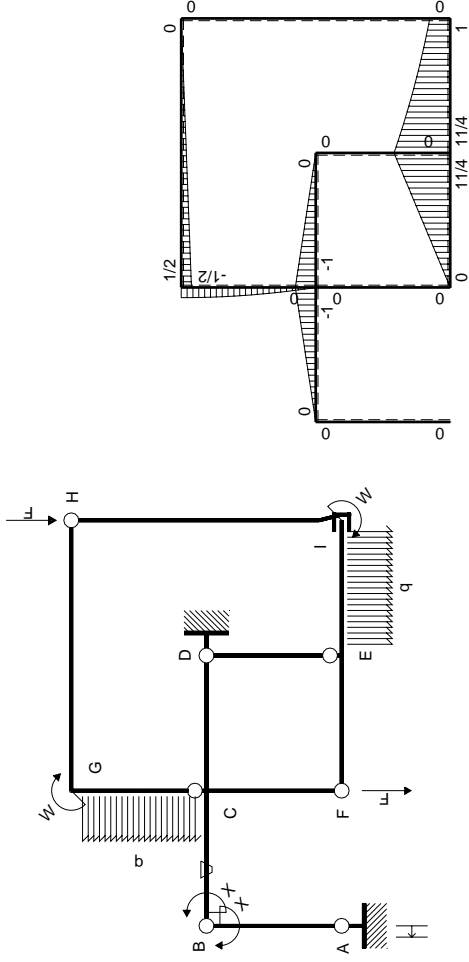
$$= [1/4 x - 3/8 x^2/b + 1/4 x^3/b^2 - 1/16 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 3/8 b + 1/4 b - 1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^3/b^3) Fb 1/EJ dx = [1/16 x^4/b^3]_0^b Fb 1/EJ$$

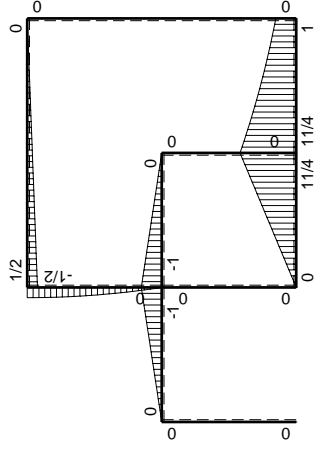
$$= (1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$9/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-9/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

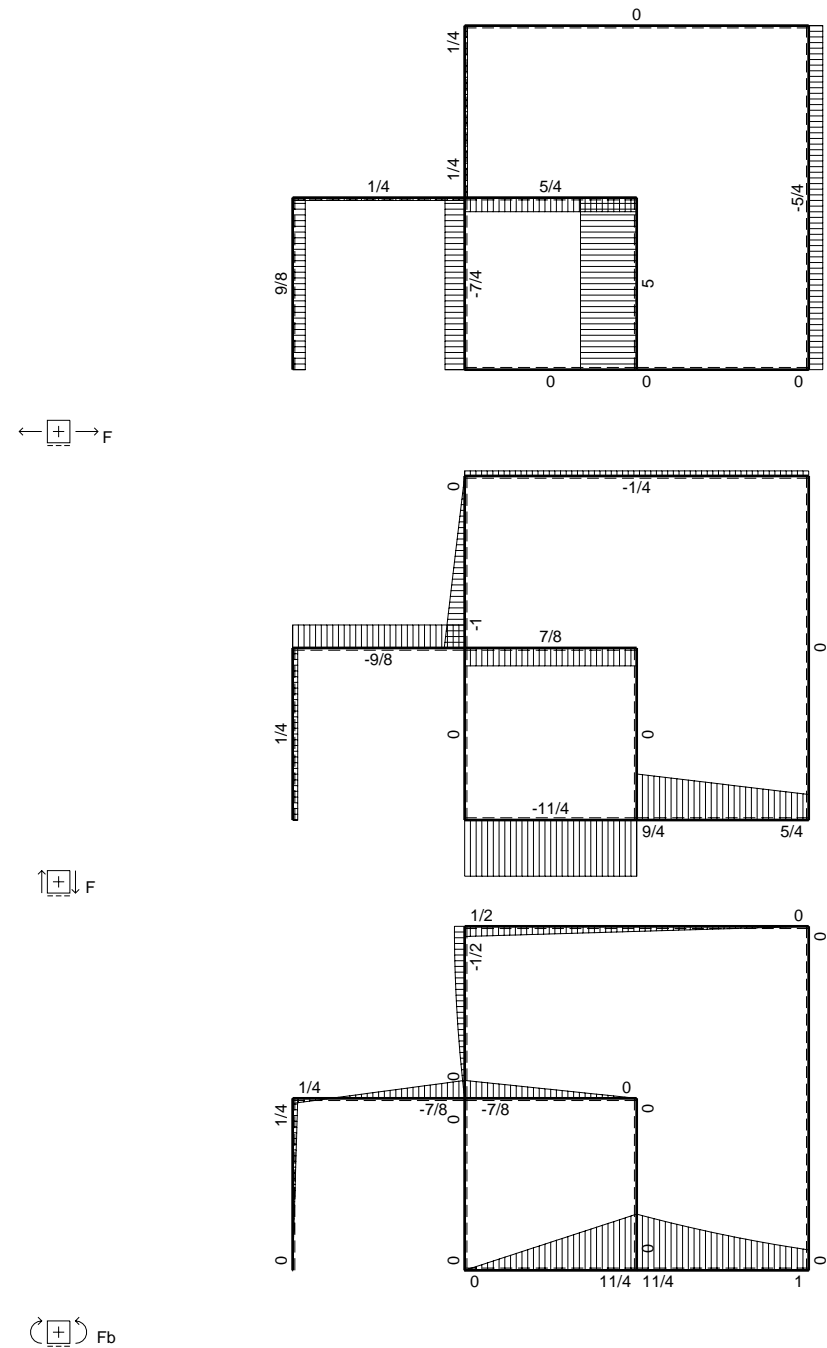
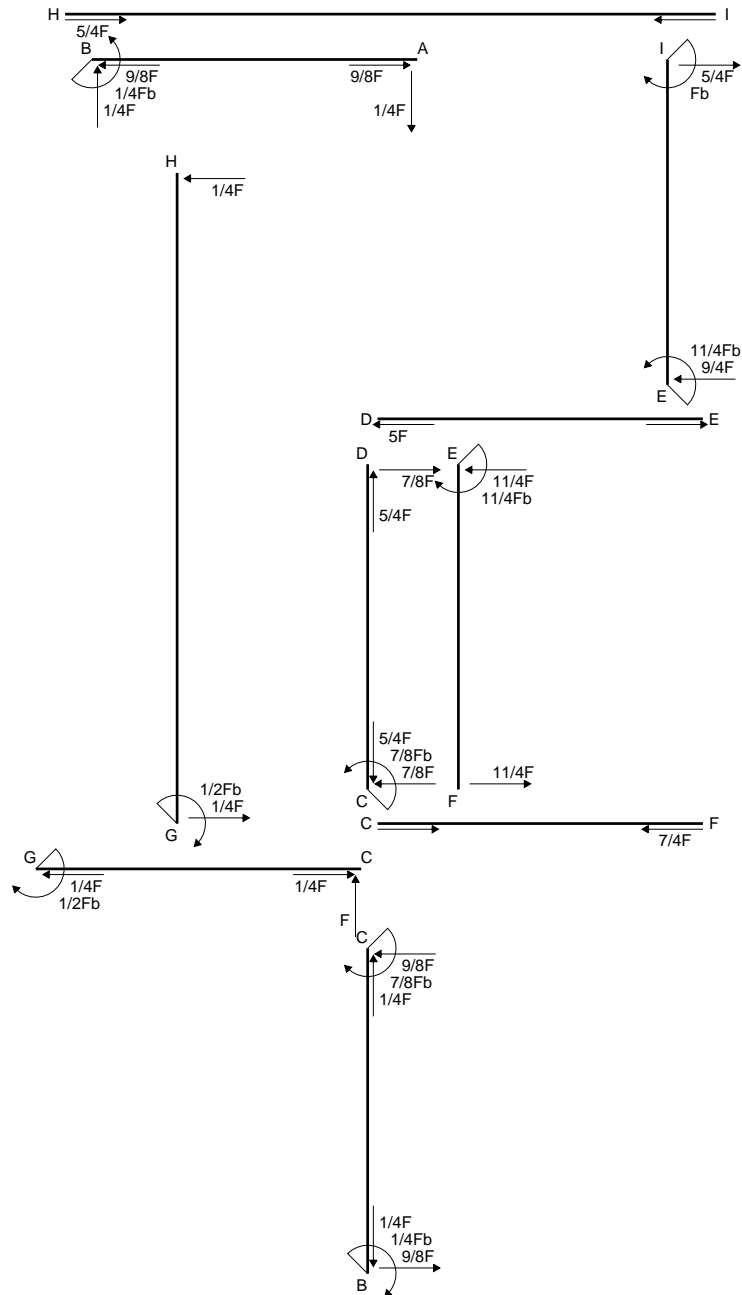
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

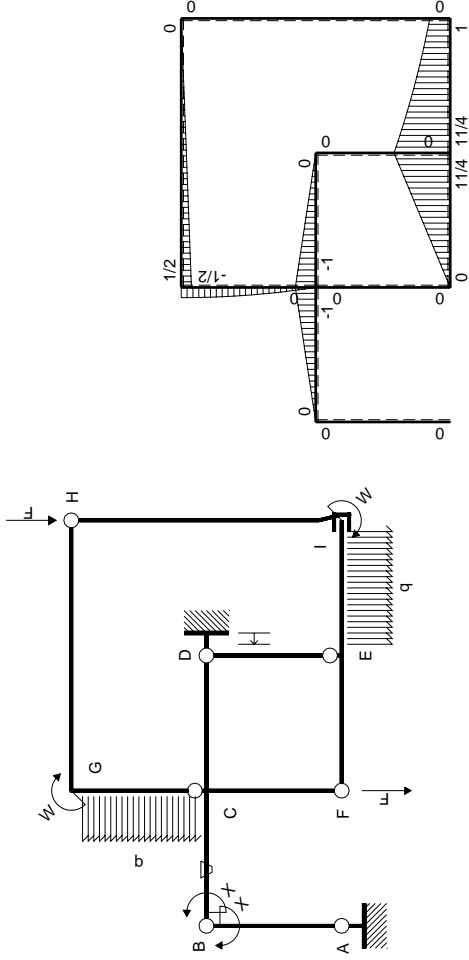
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

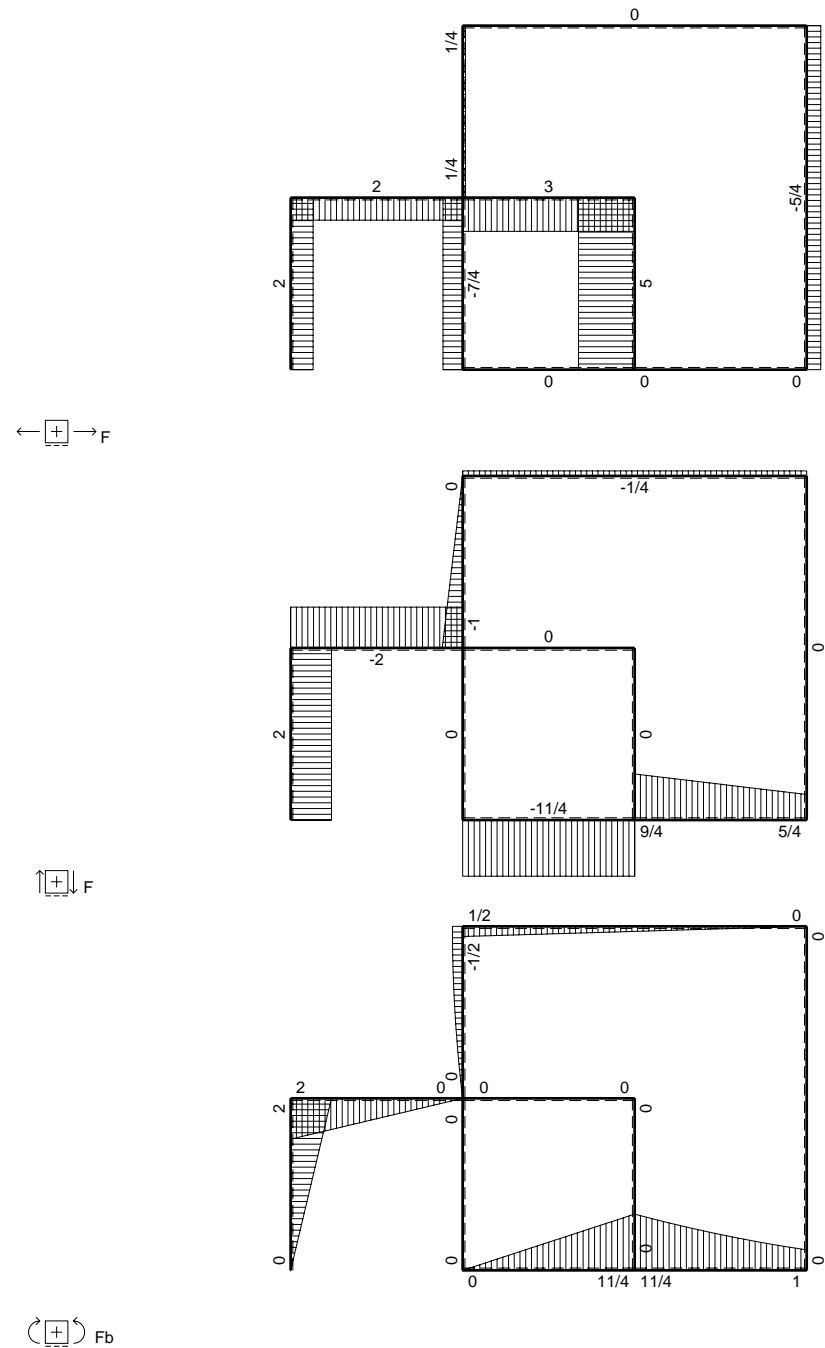
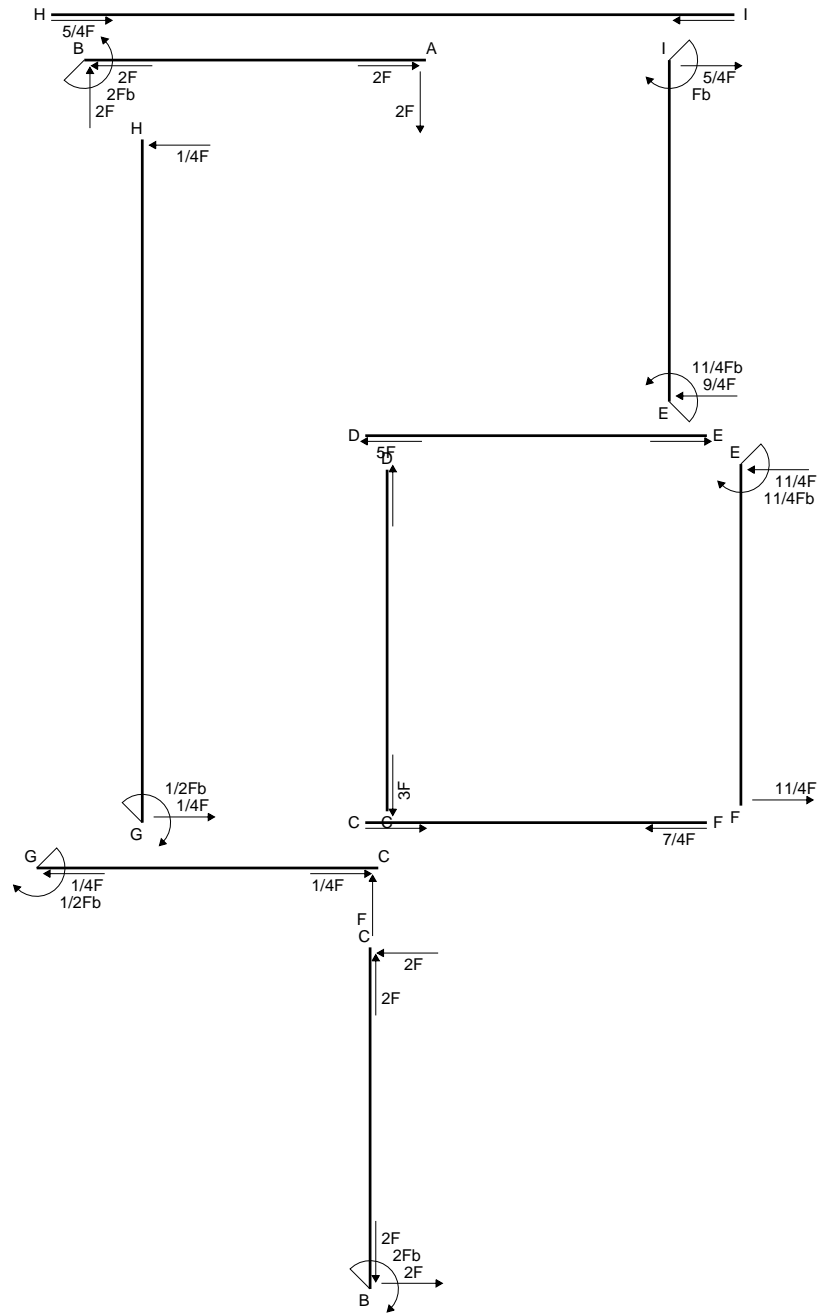
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

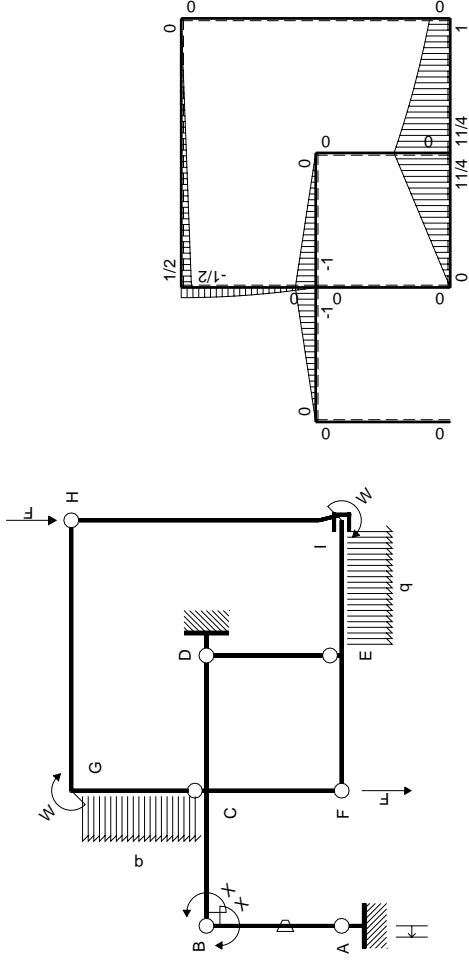
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

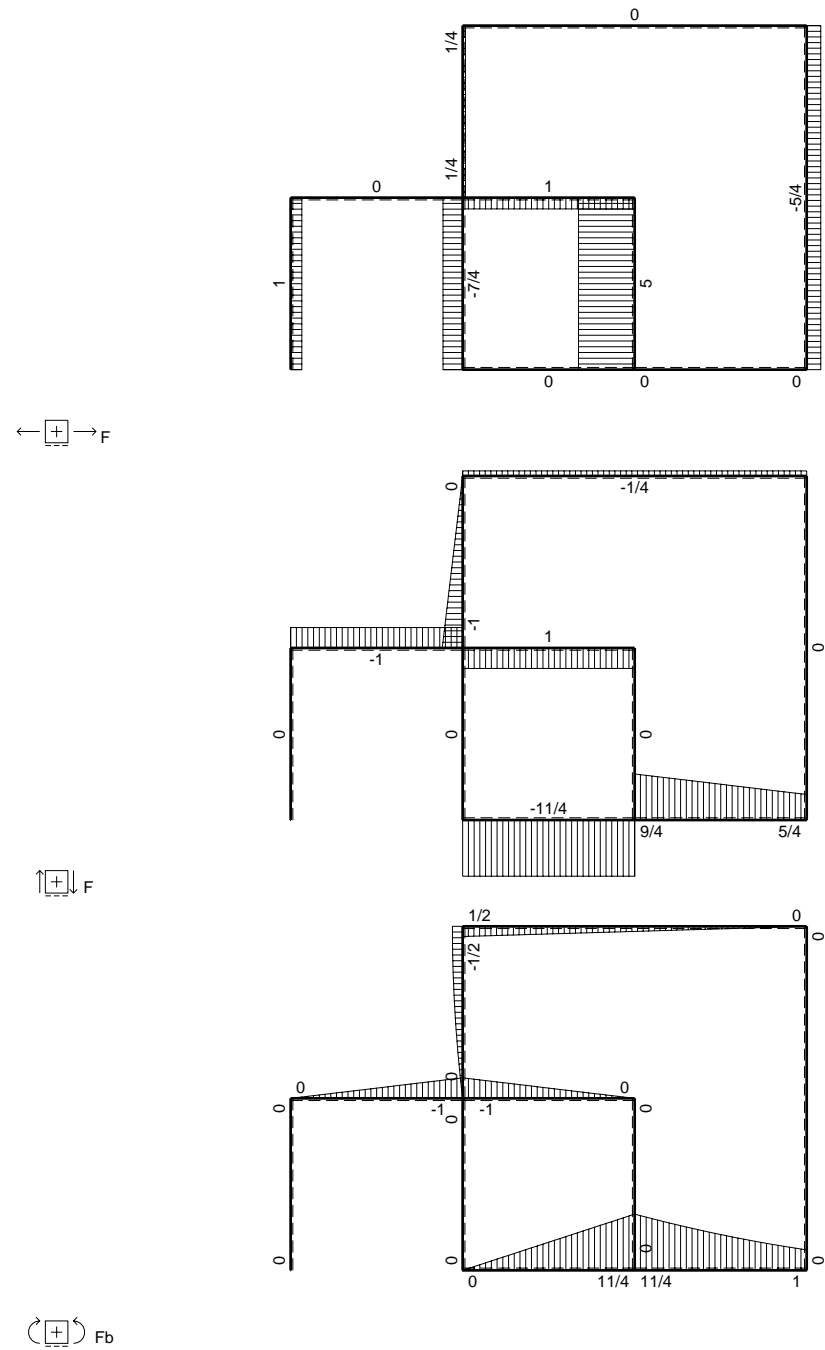
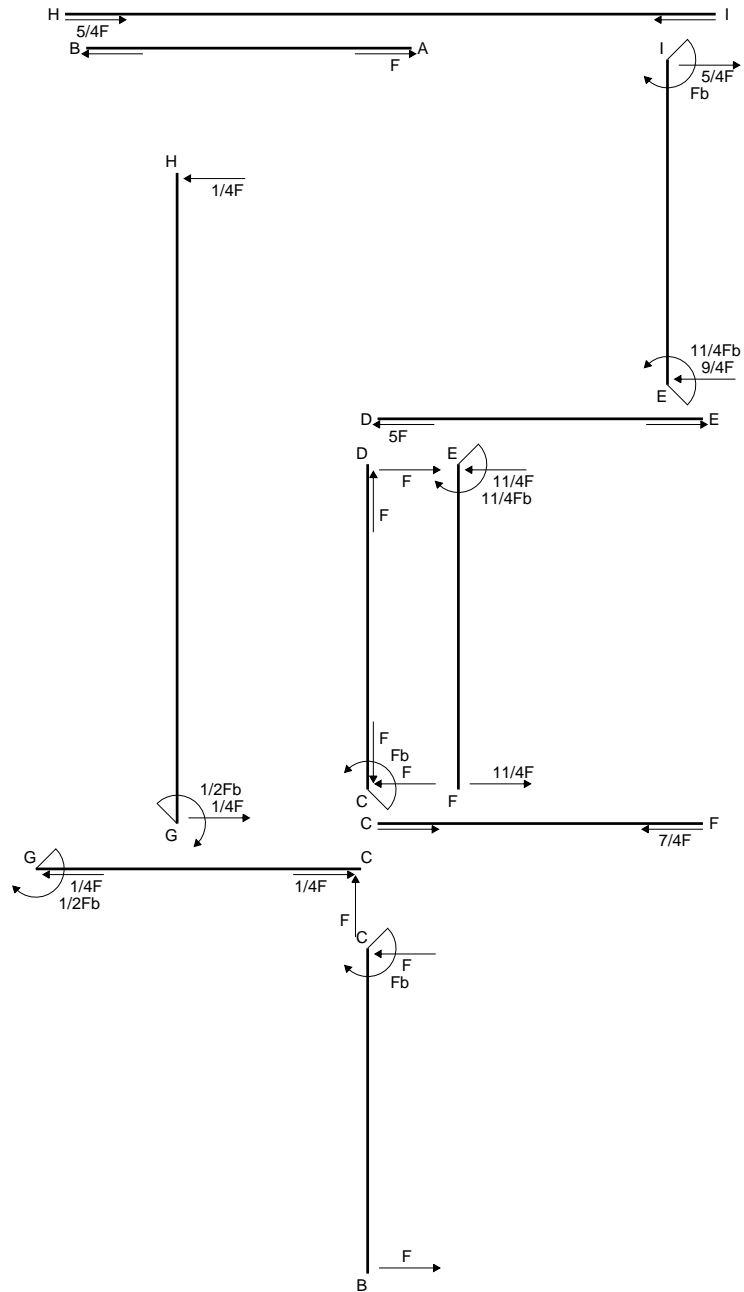
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

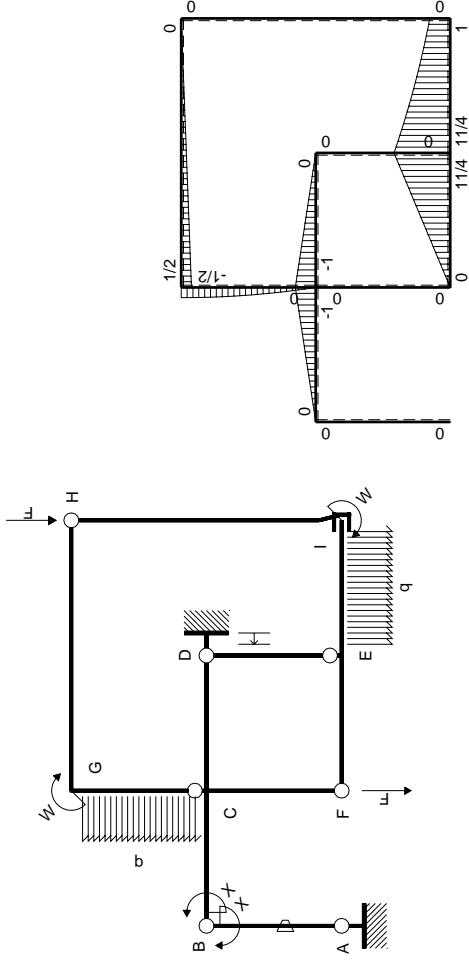
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						0	Xb/EJ
	iperstatica $X=W_{BC}$						0	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

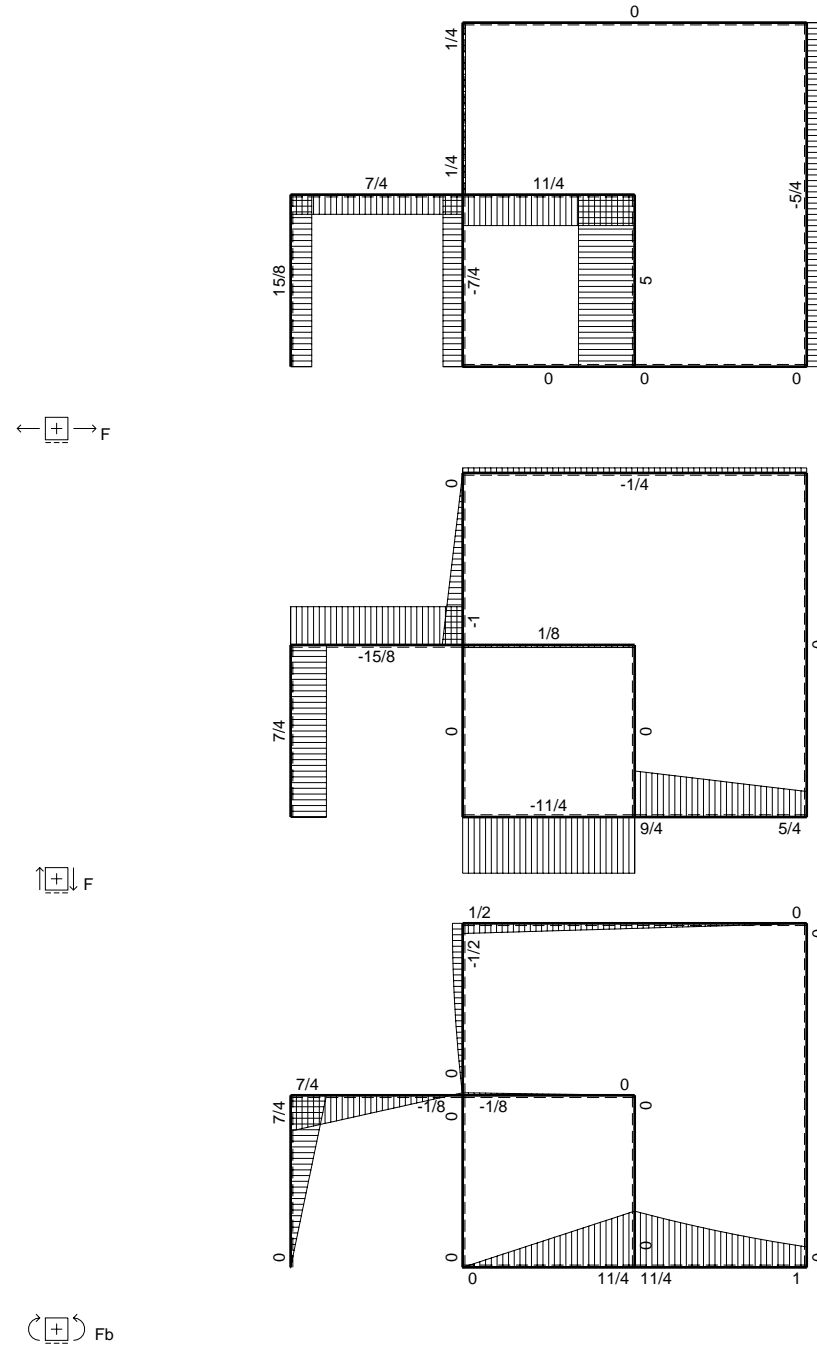
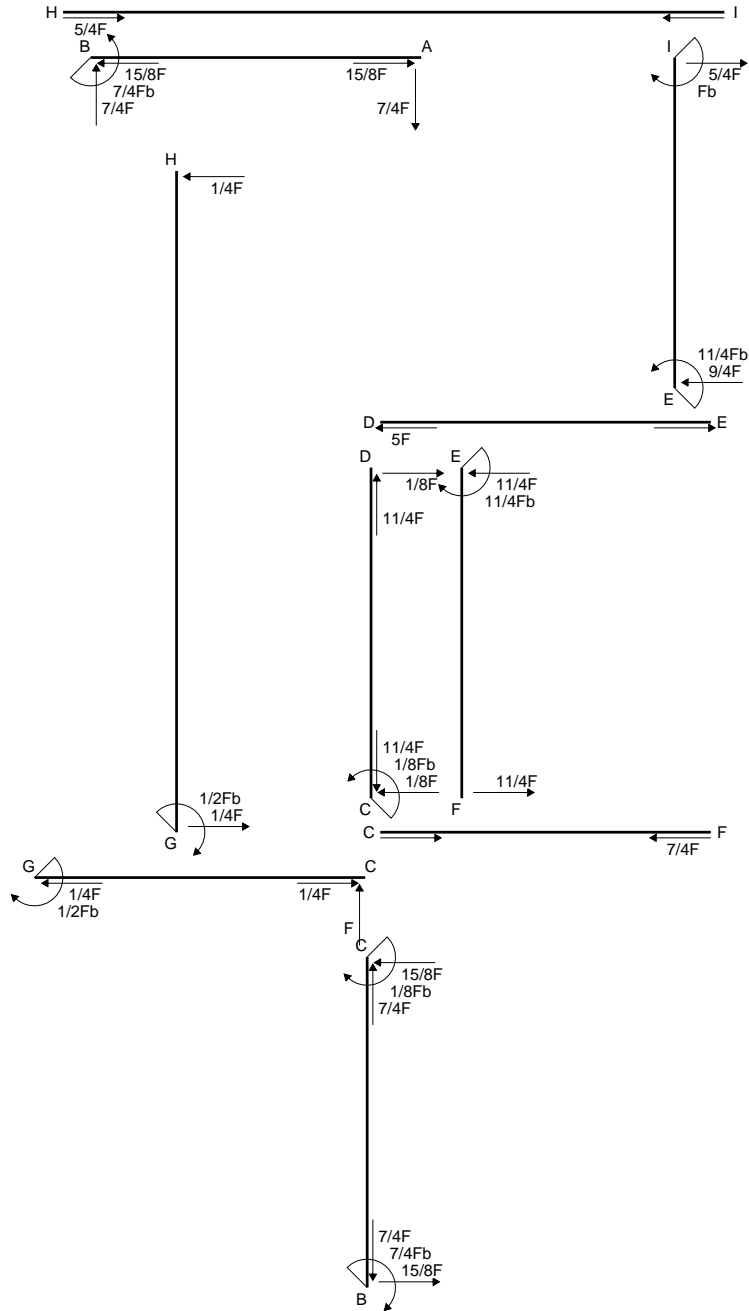
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

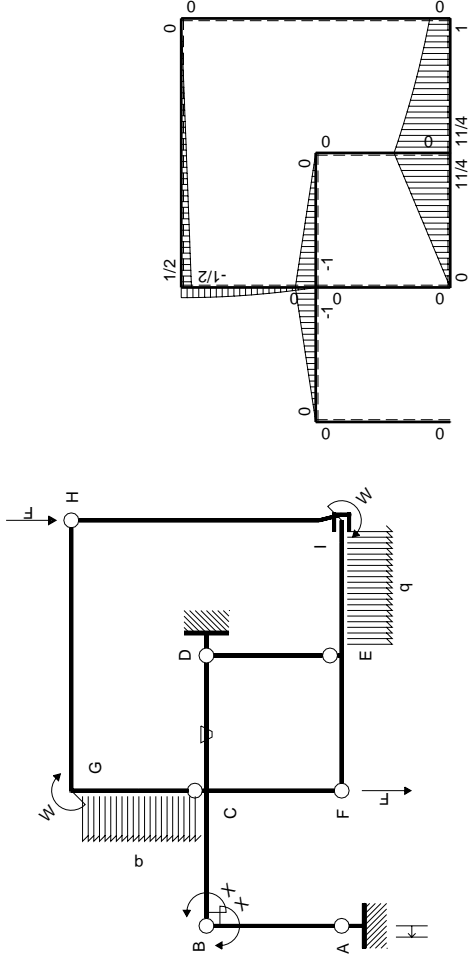
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

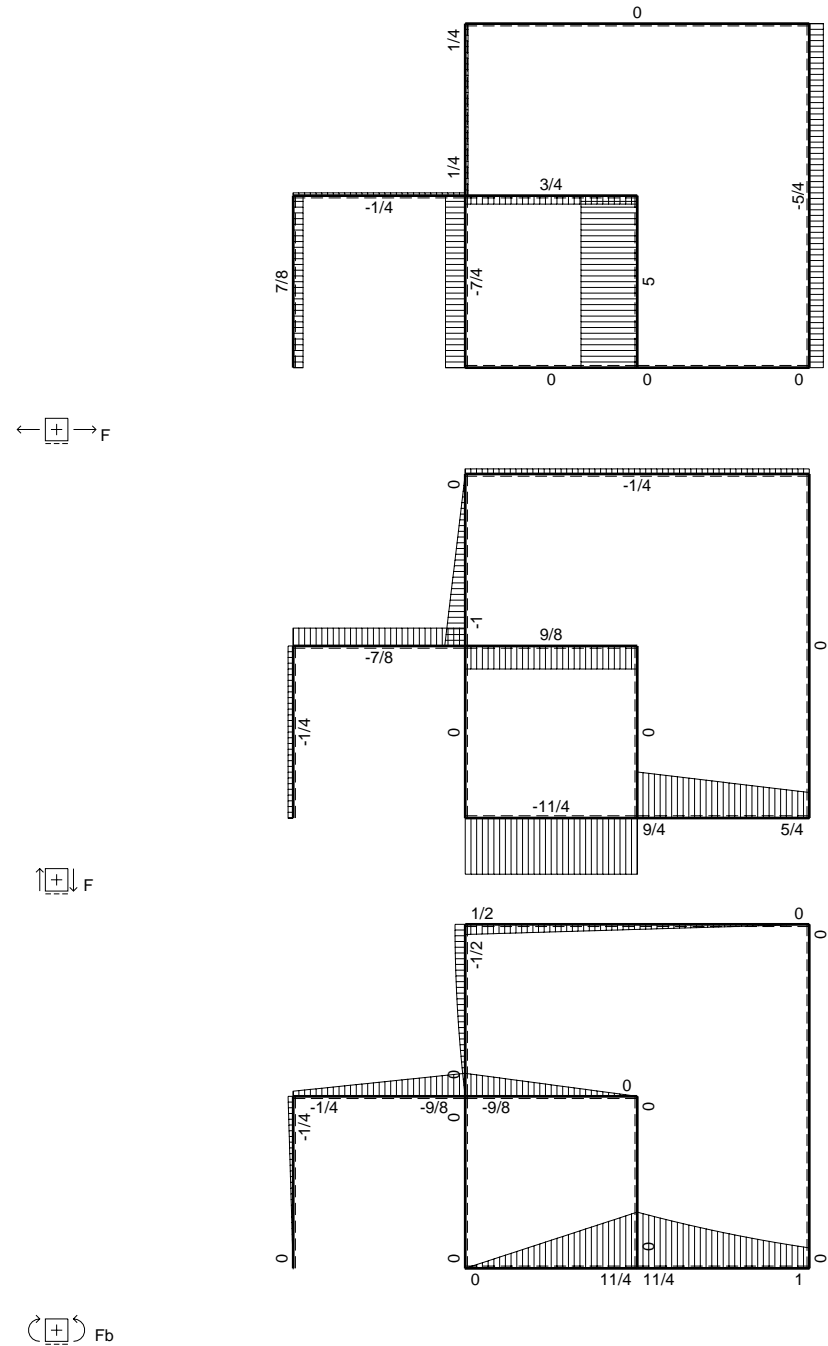
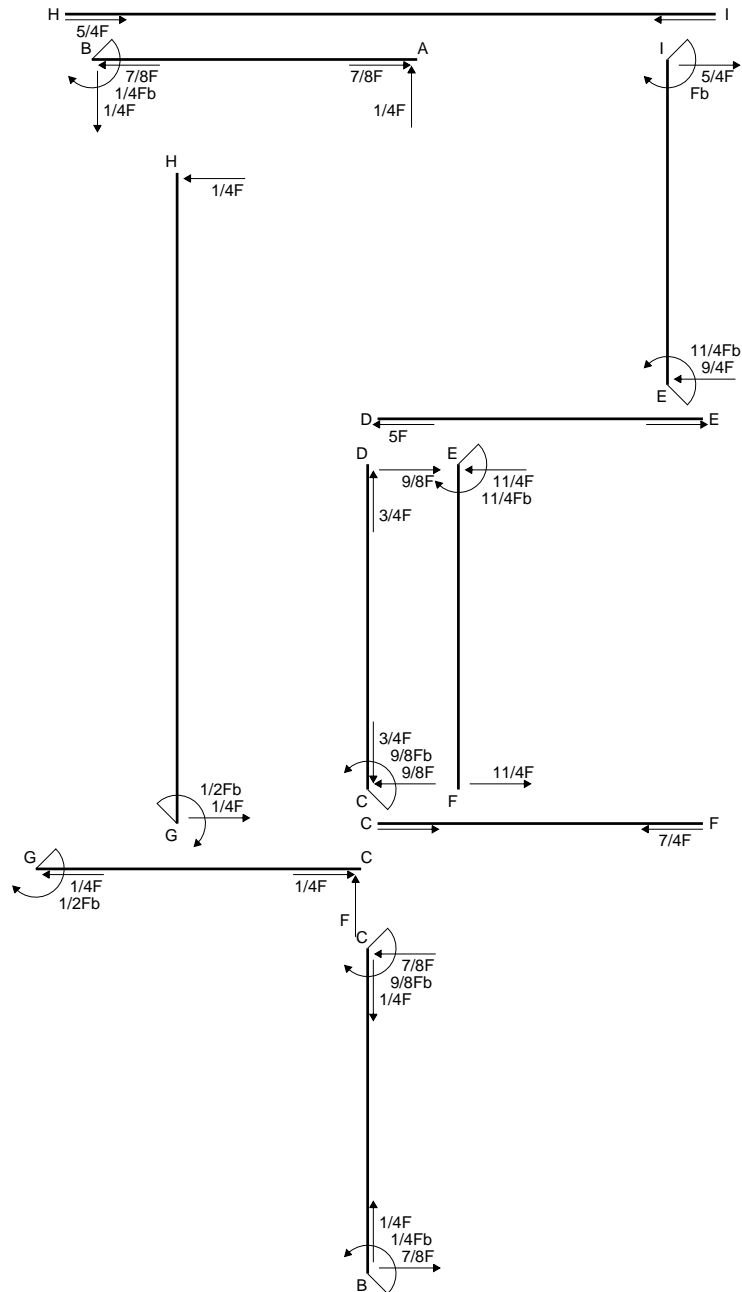
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

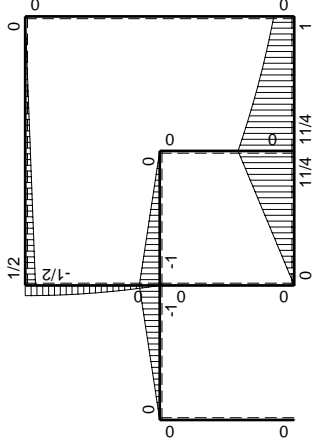
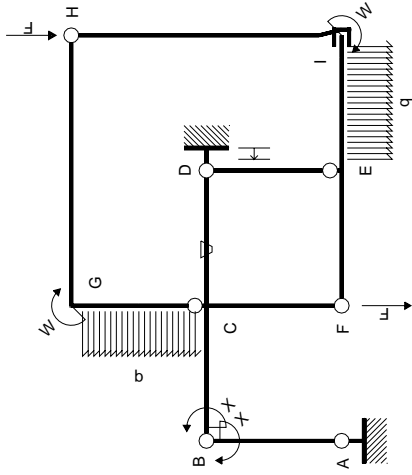
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

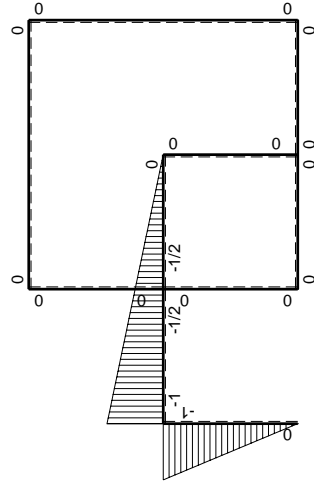
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-11/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

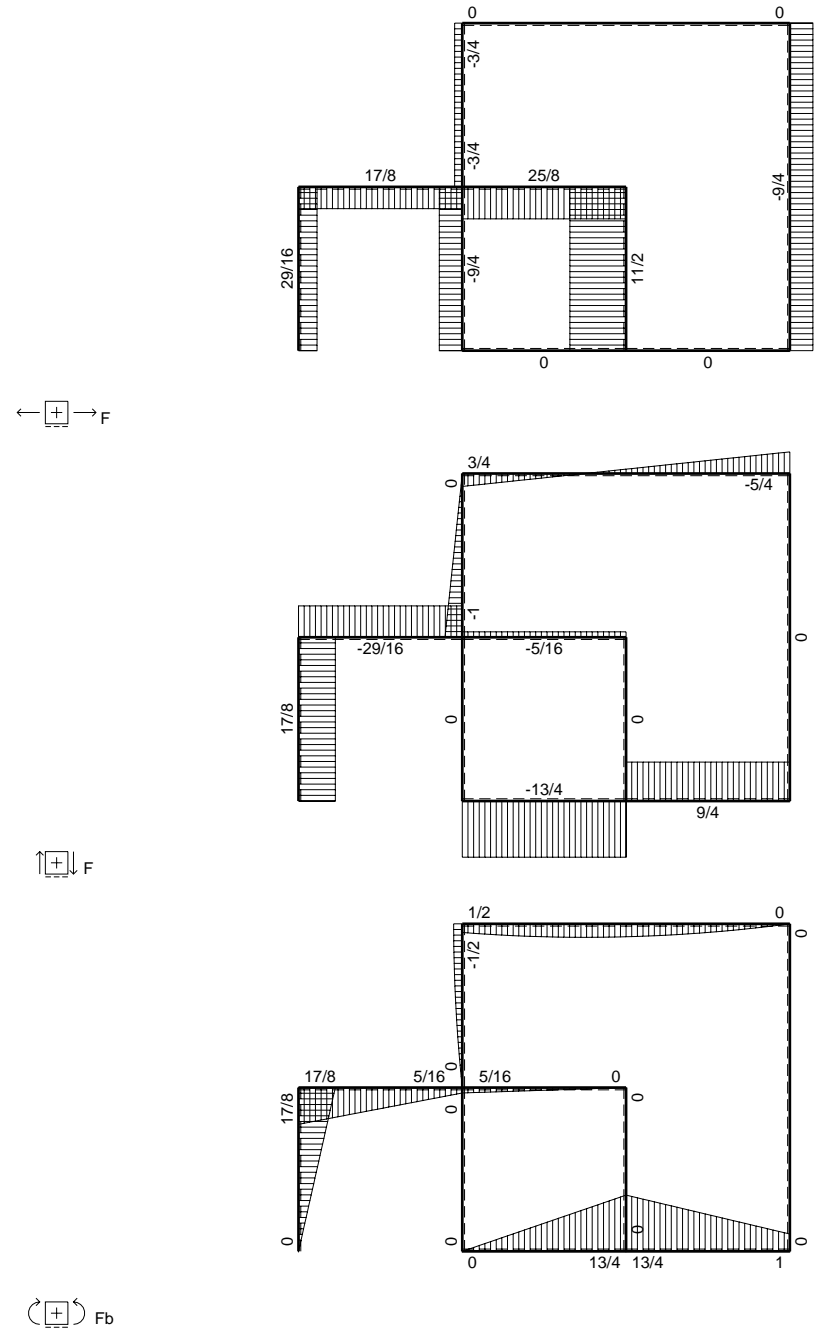
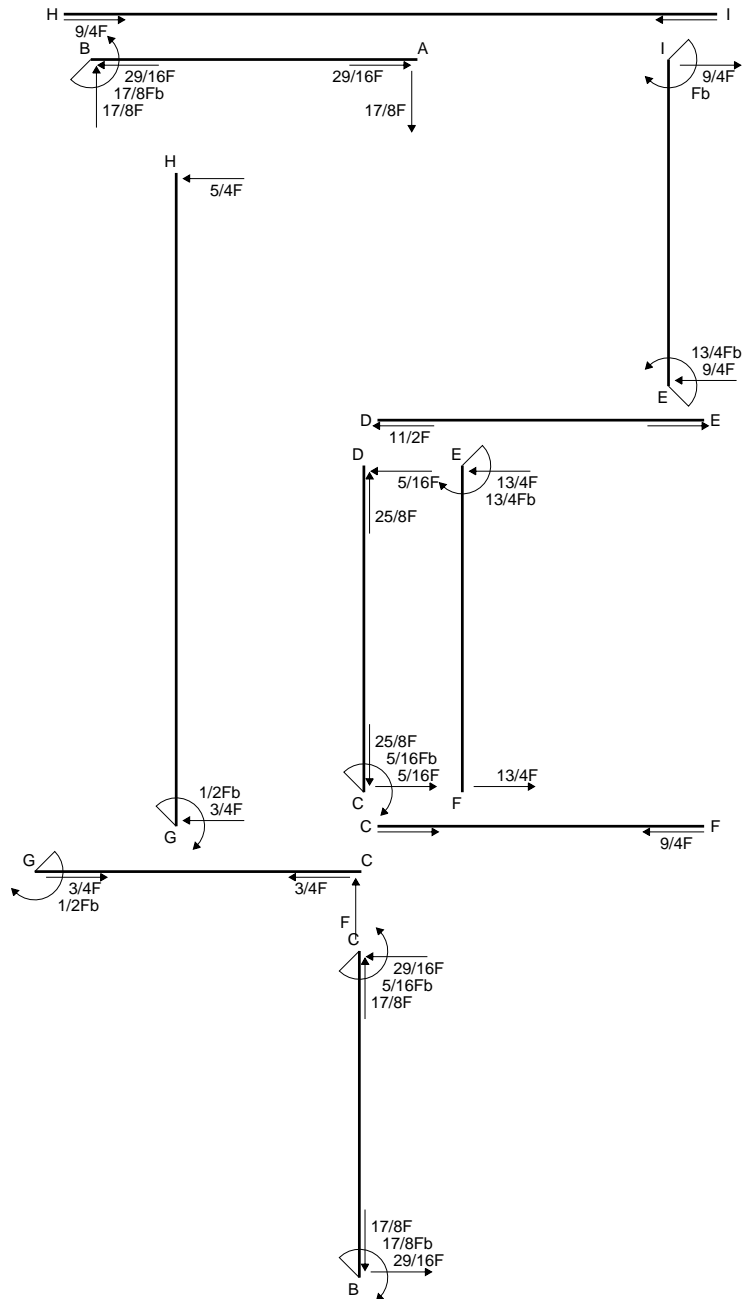
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

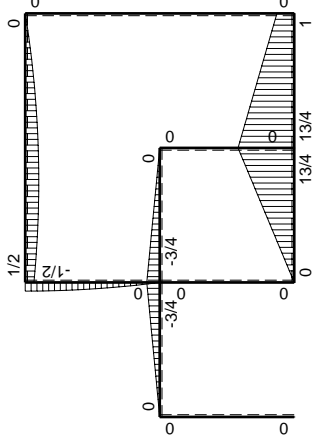
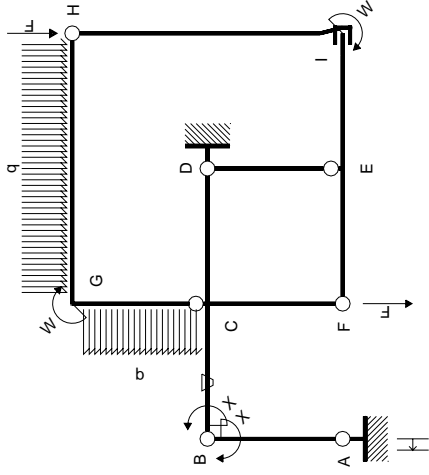
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

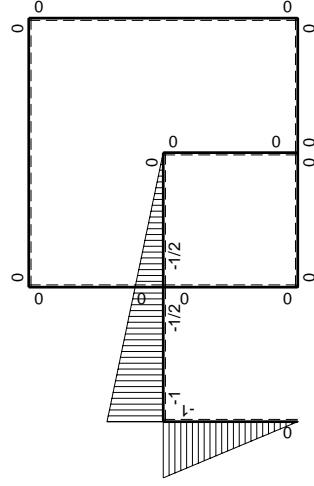
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ		
	totali						$17/8Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-17/8Fb$		

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

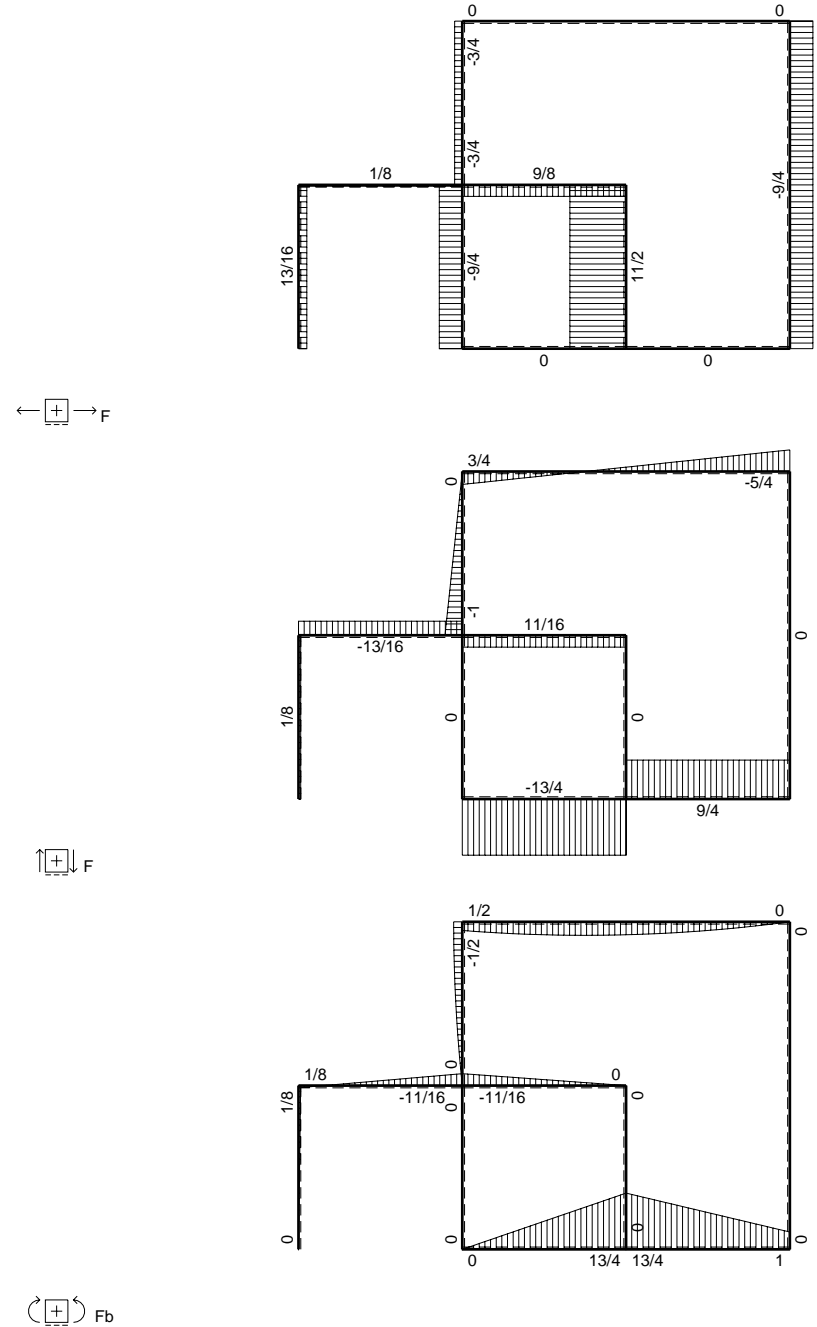
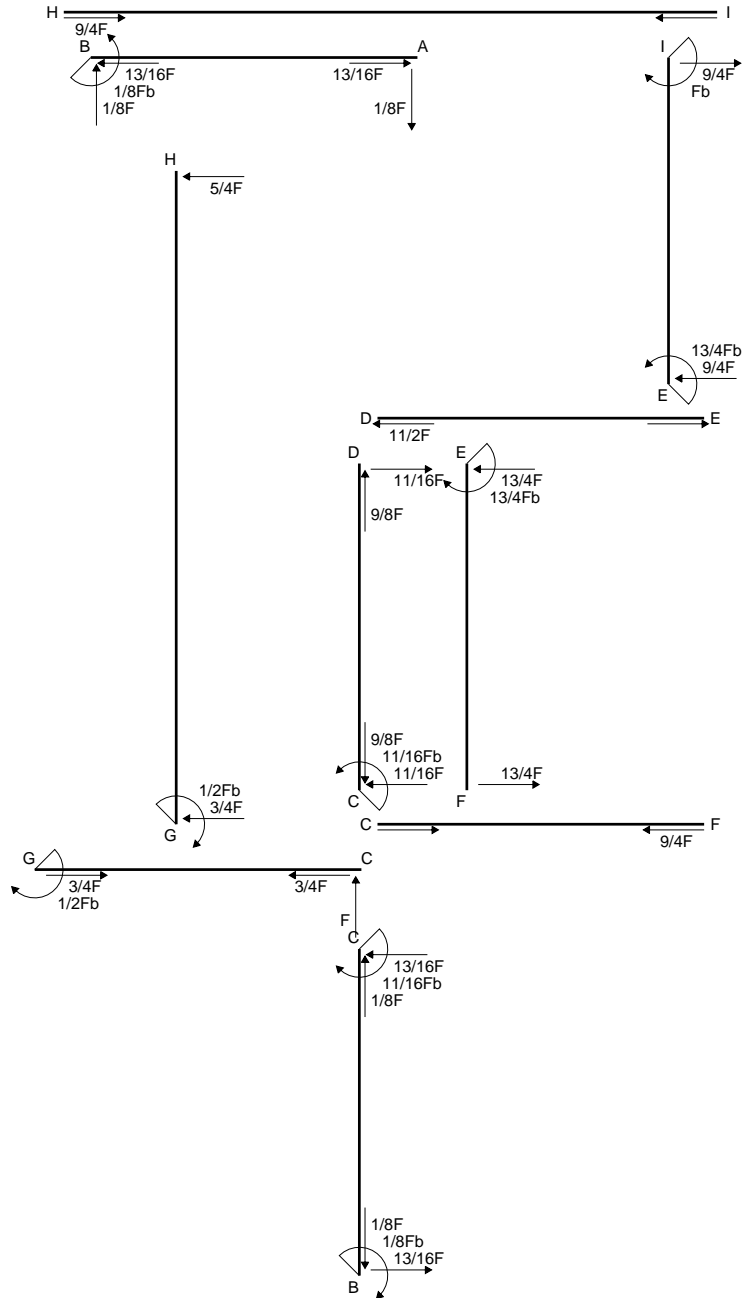
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

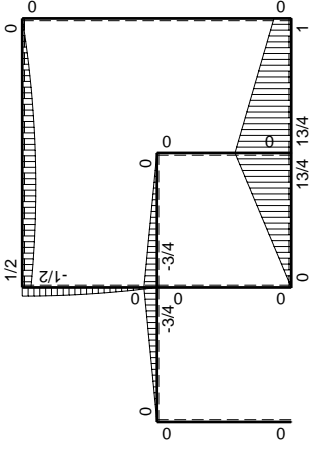
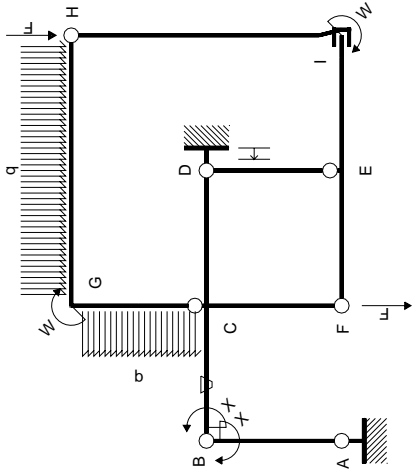
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

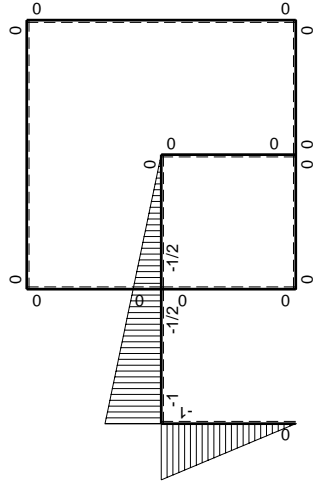
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

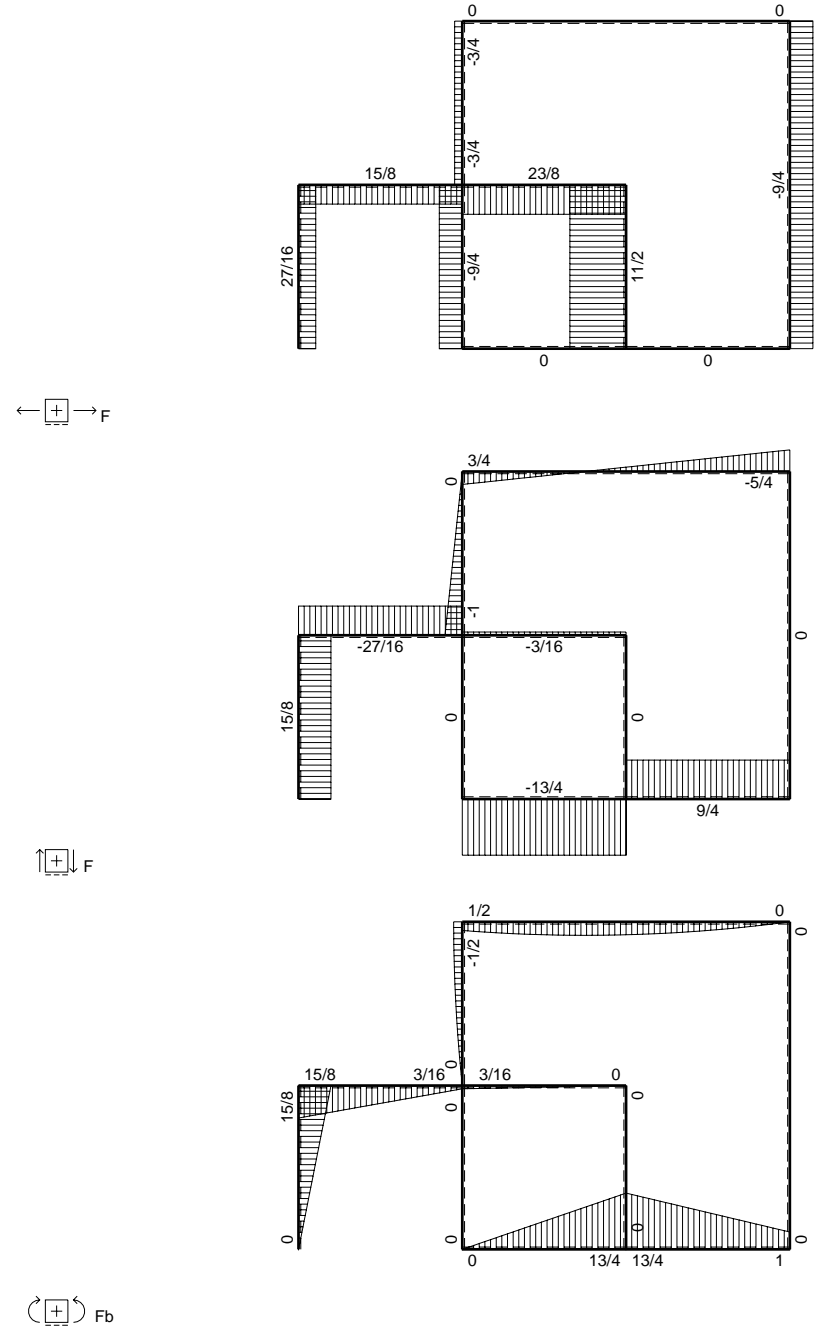
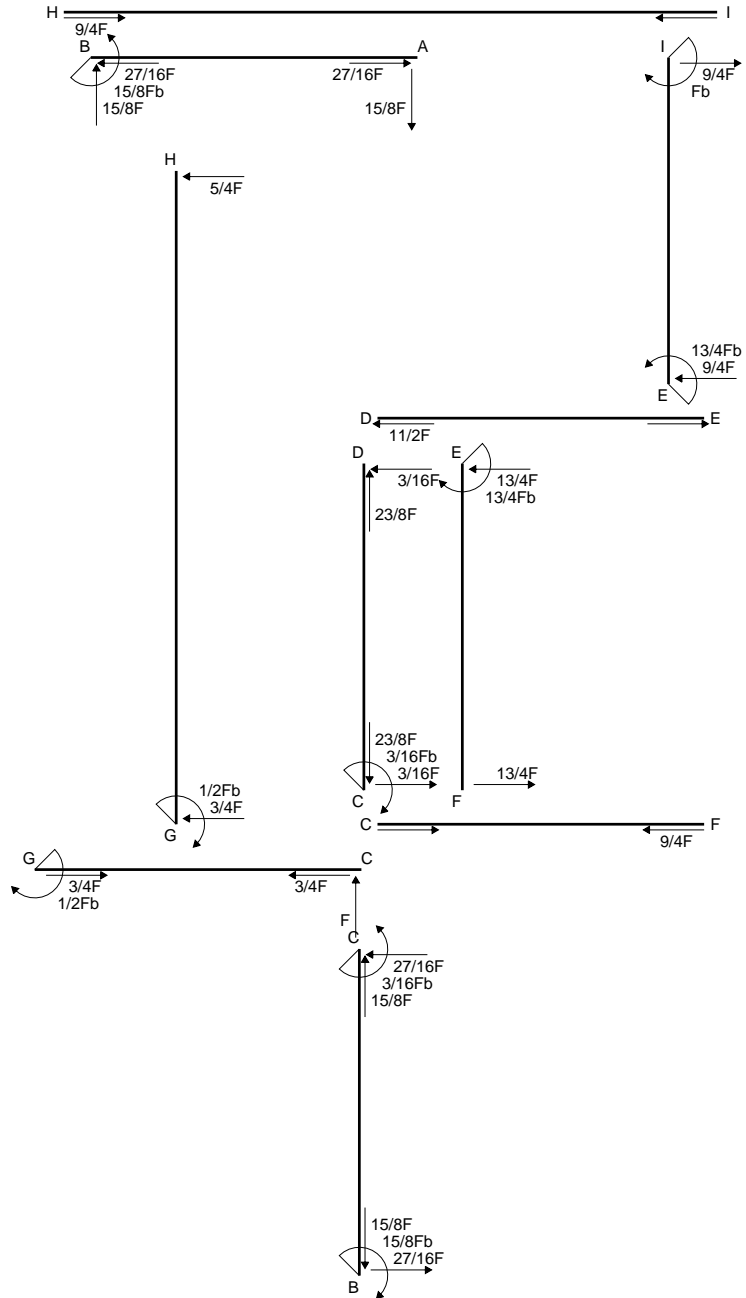
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

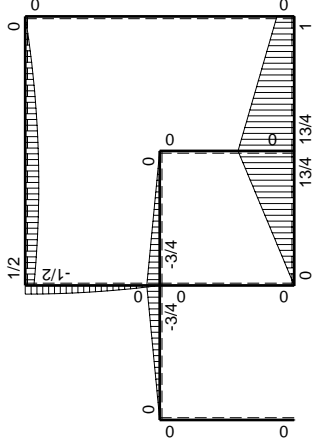
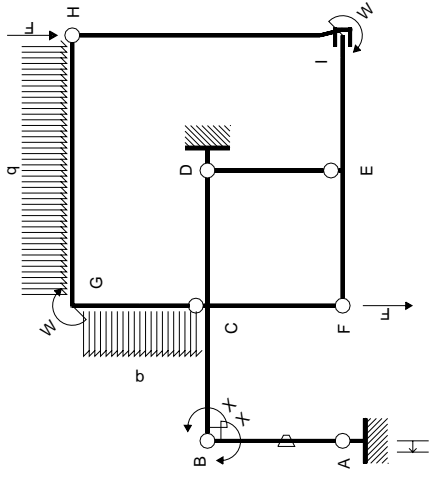
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

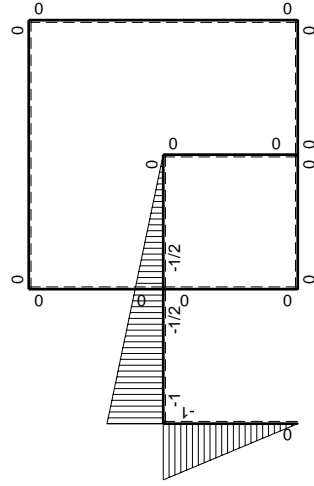
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-15/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

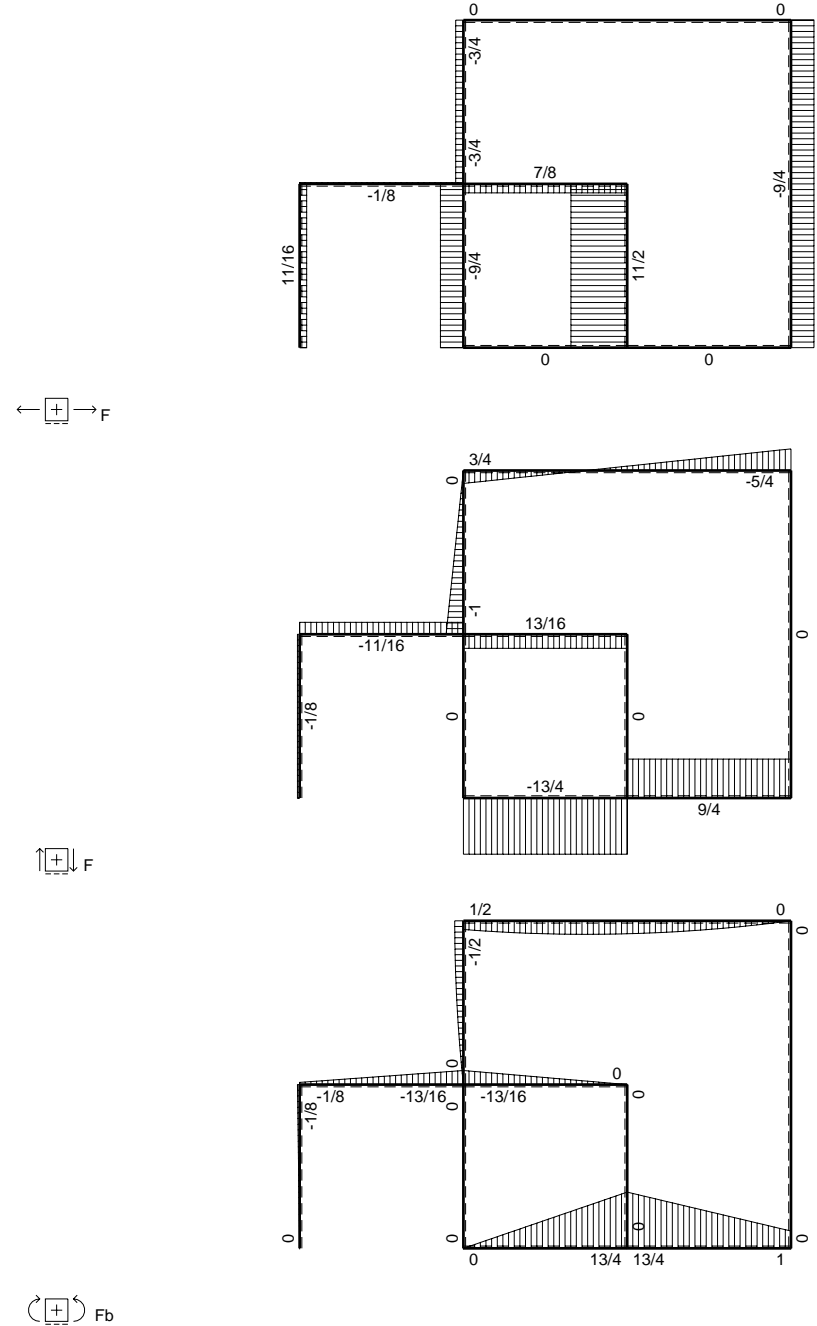
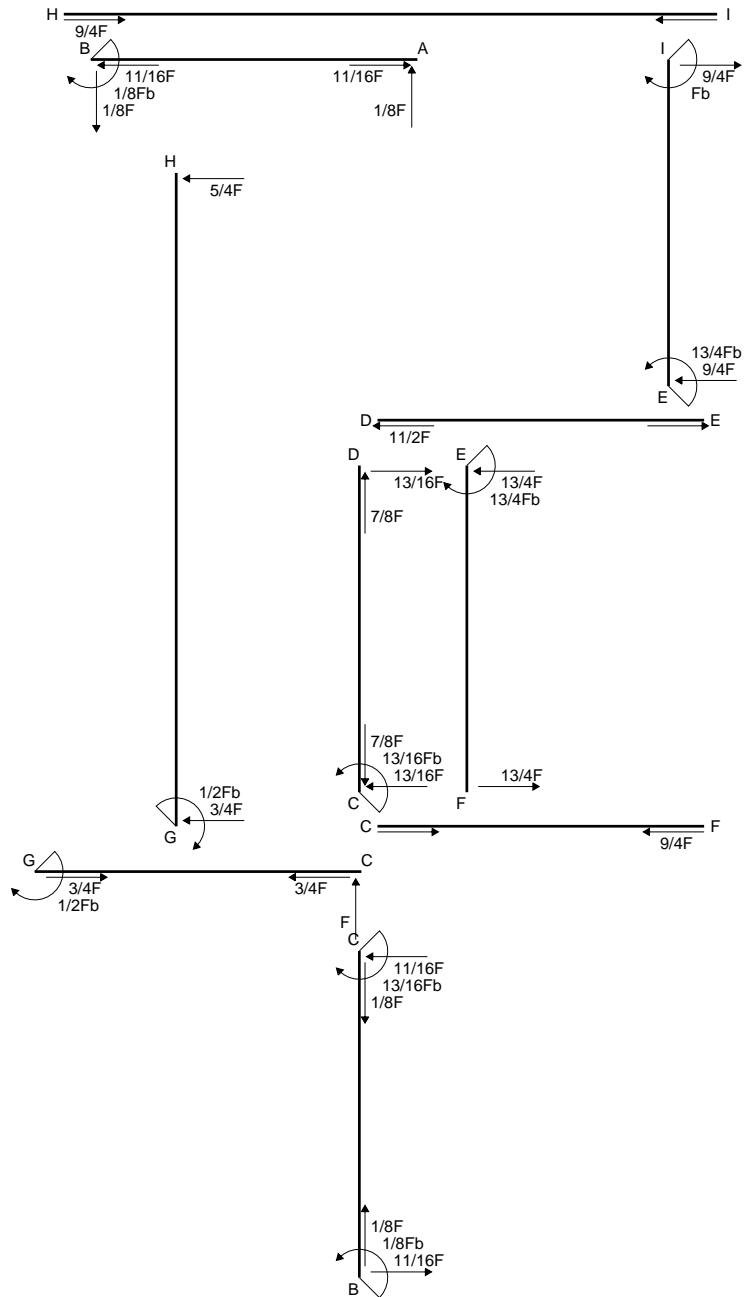
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

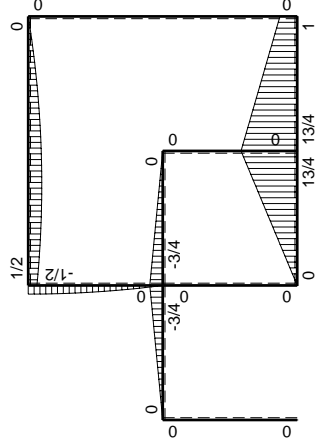
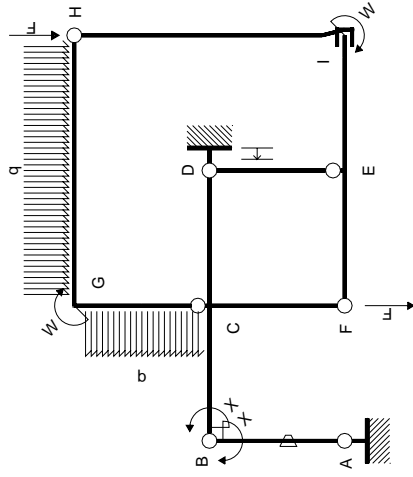
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

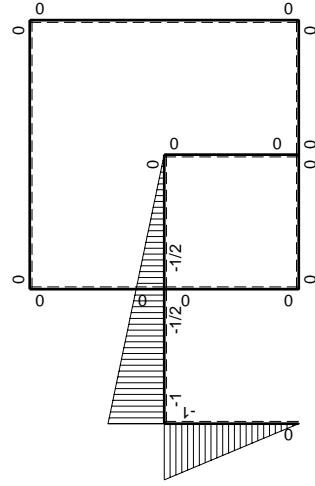
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_1 flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

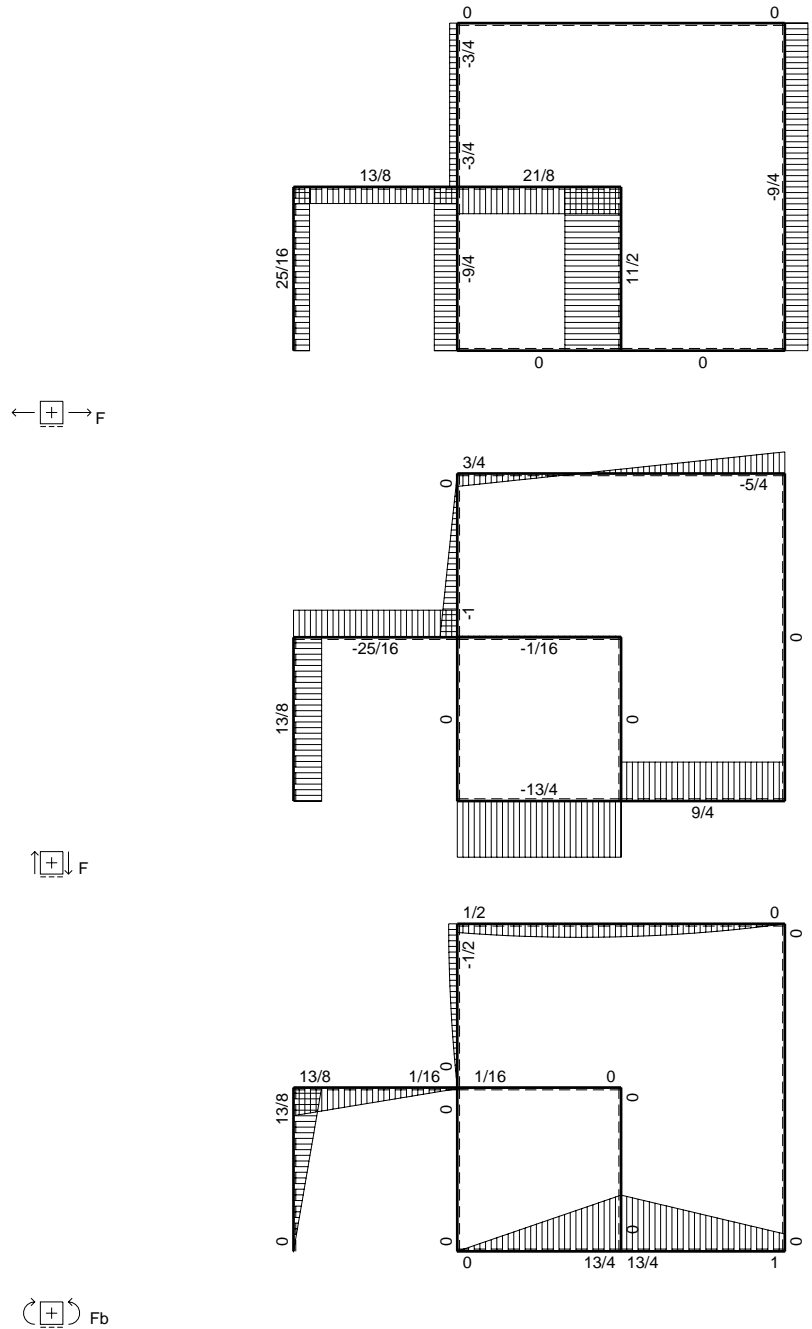
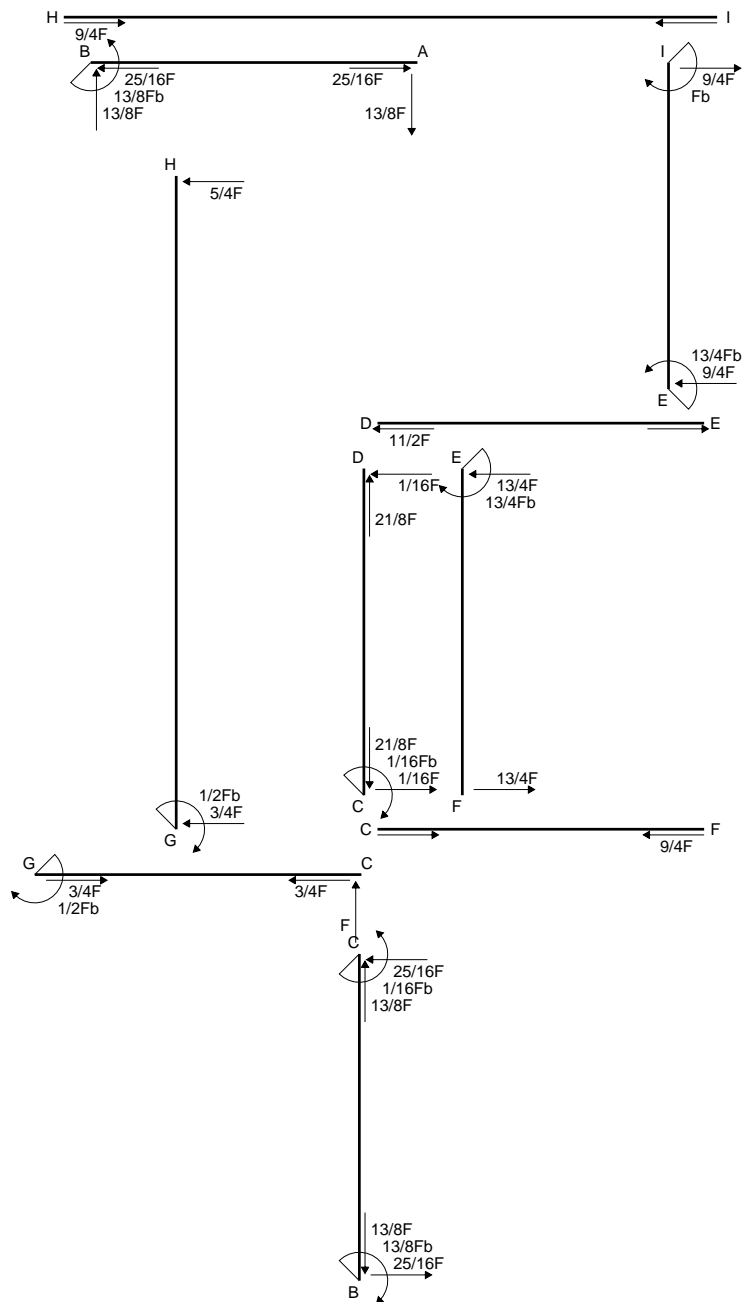
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

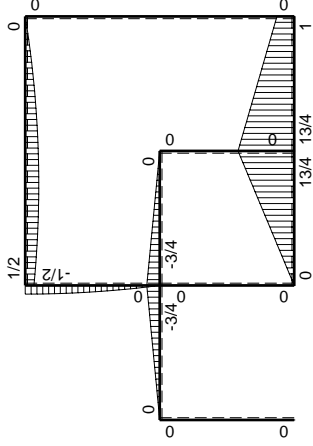
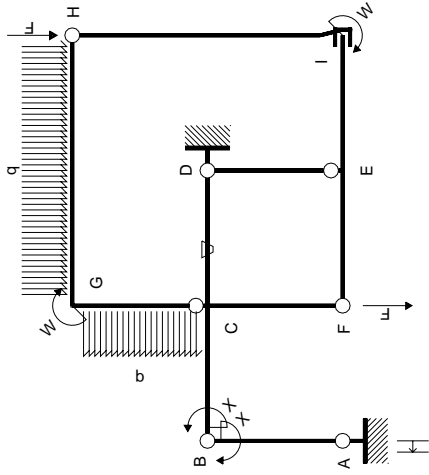
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

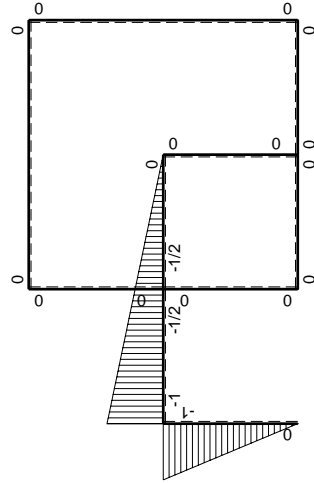
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

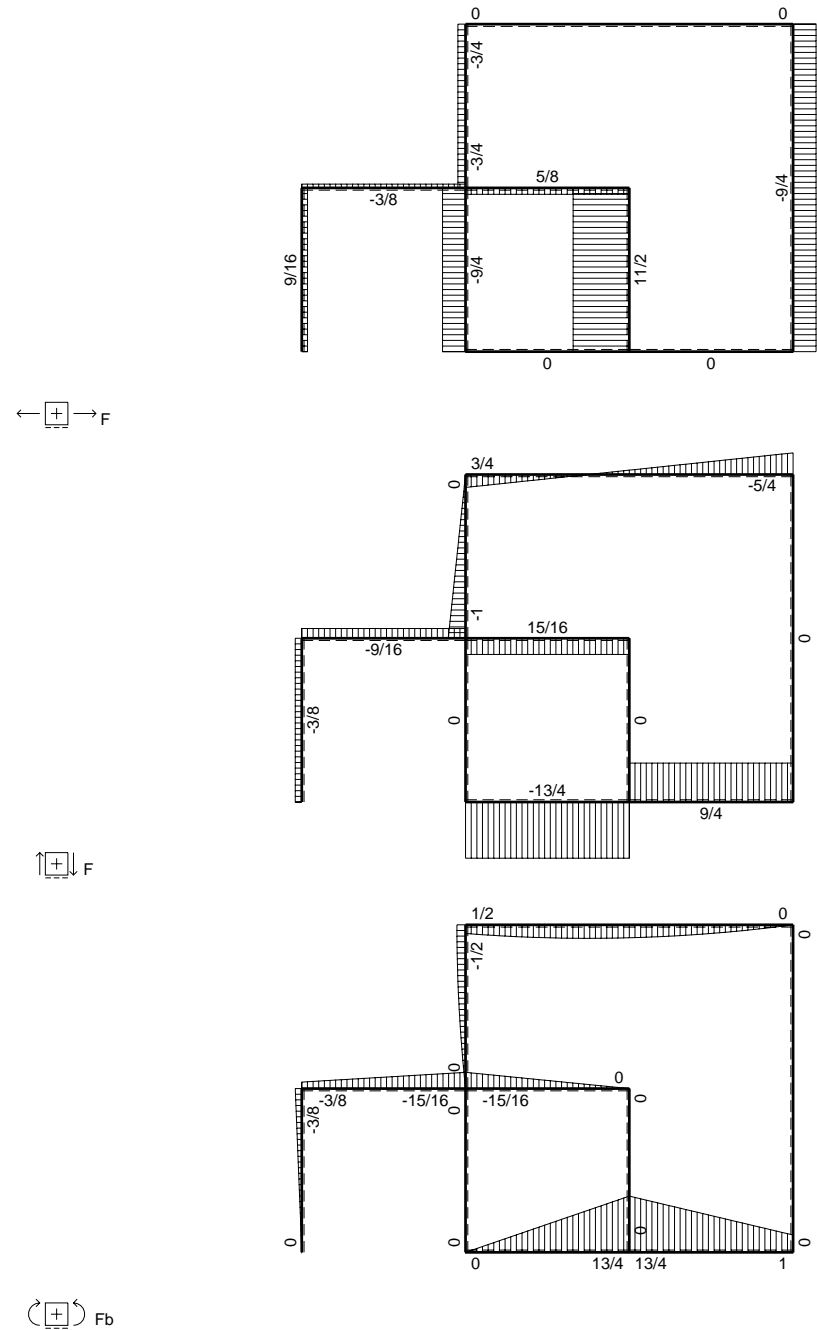
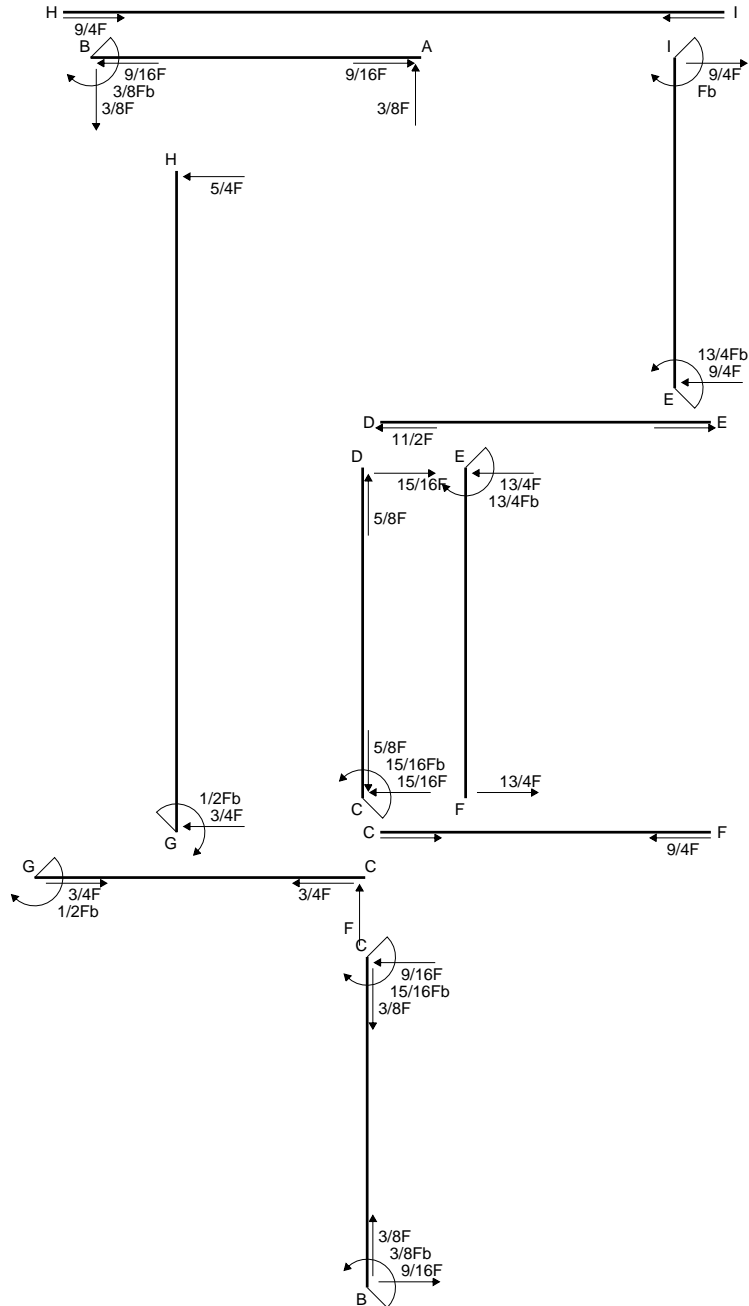
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

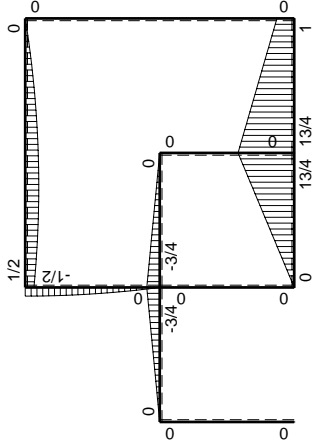
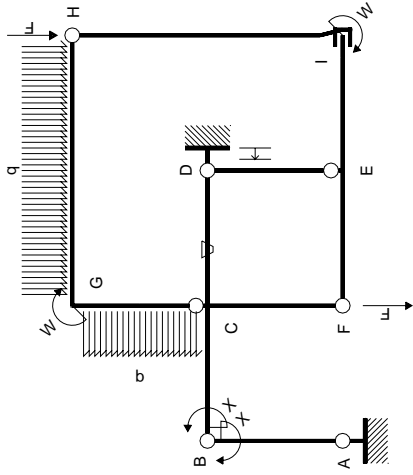
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

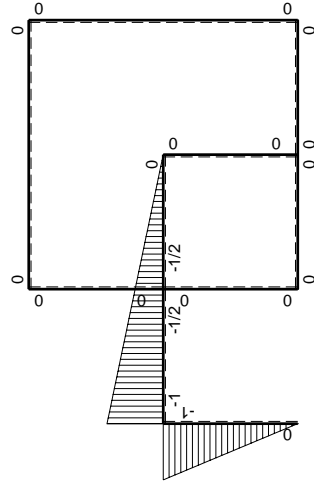
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$3/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

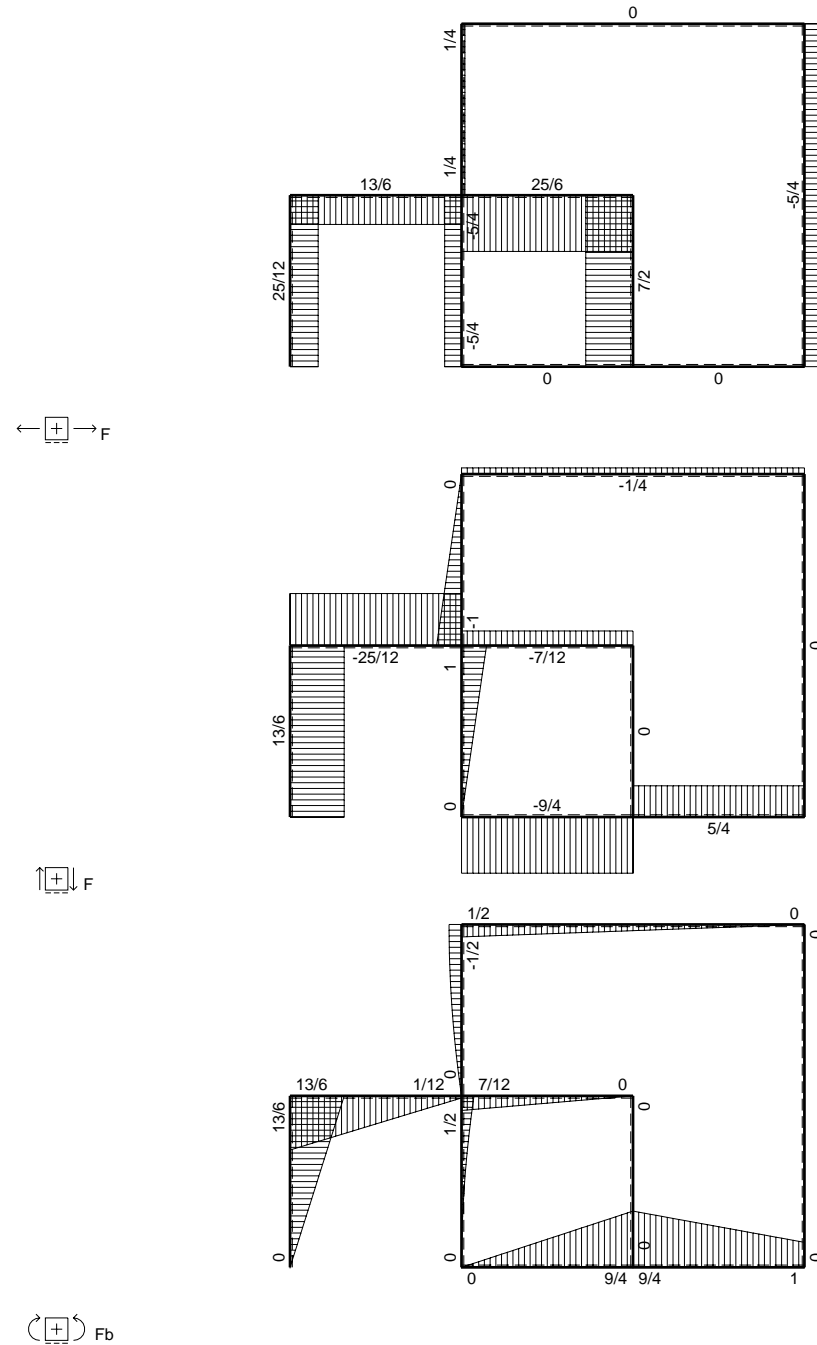
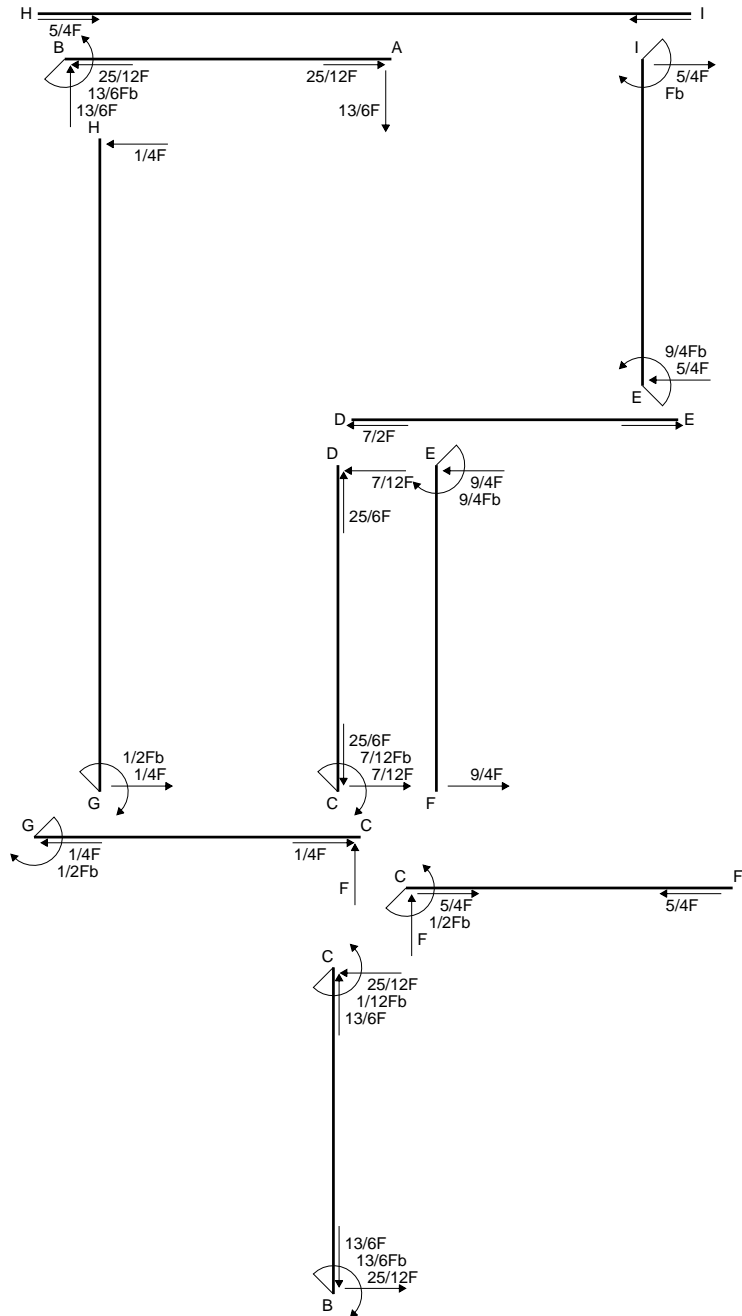
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

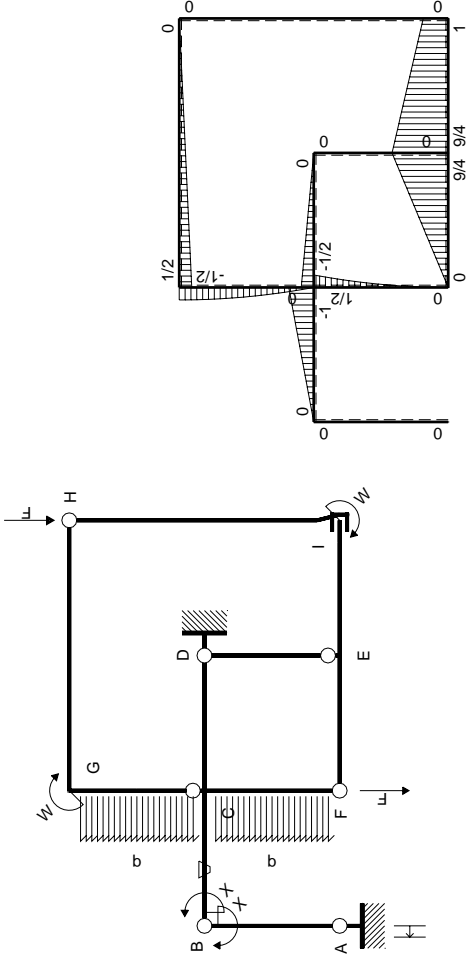
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

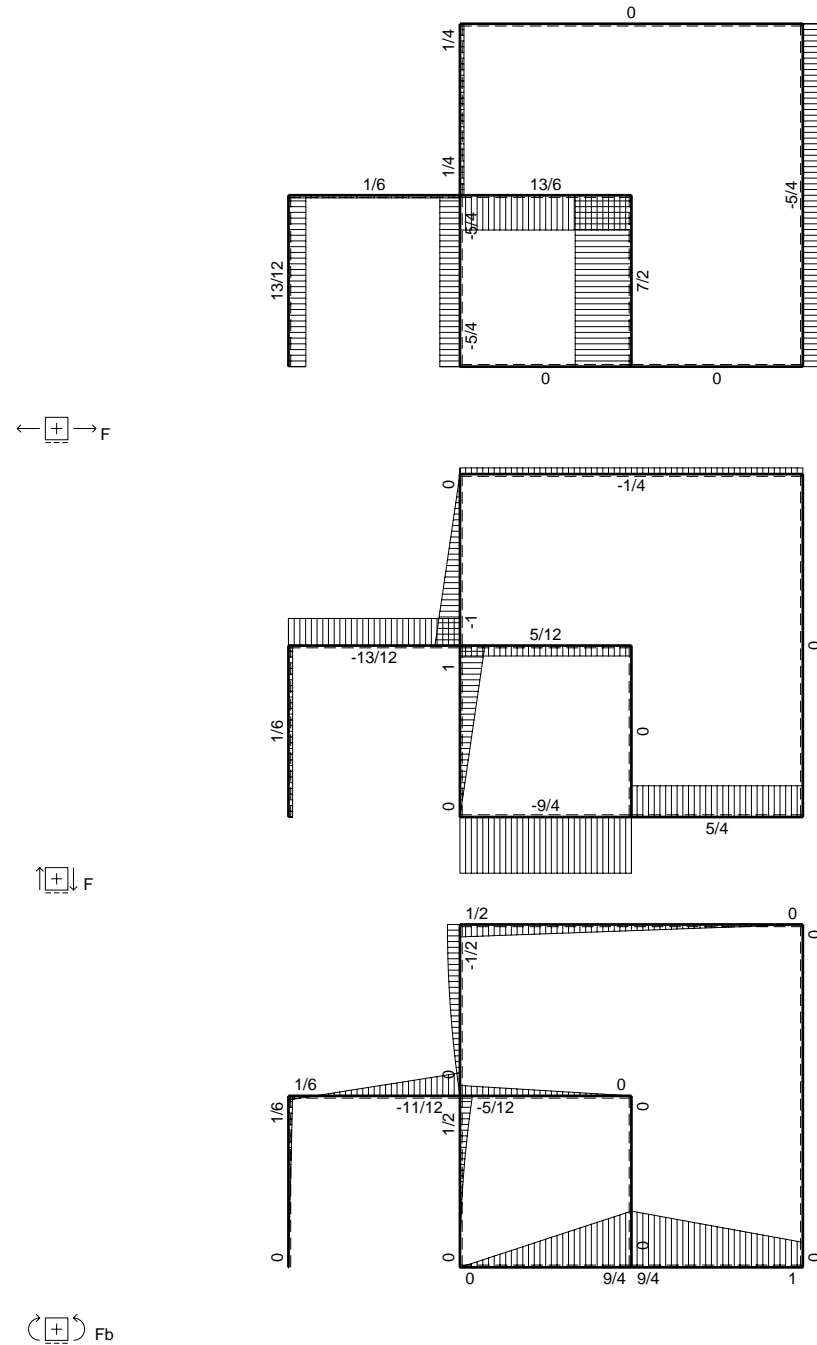
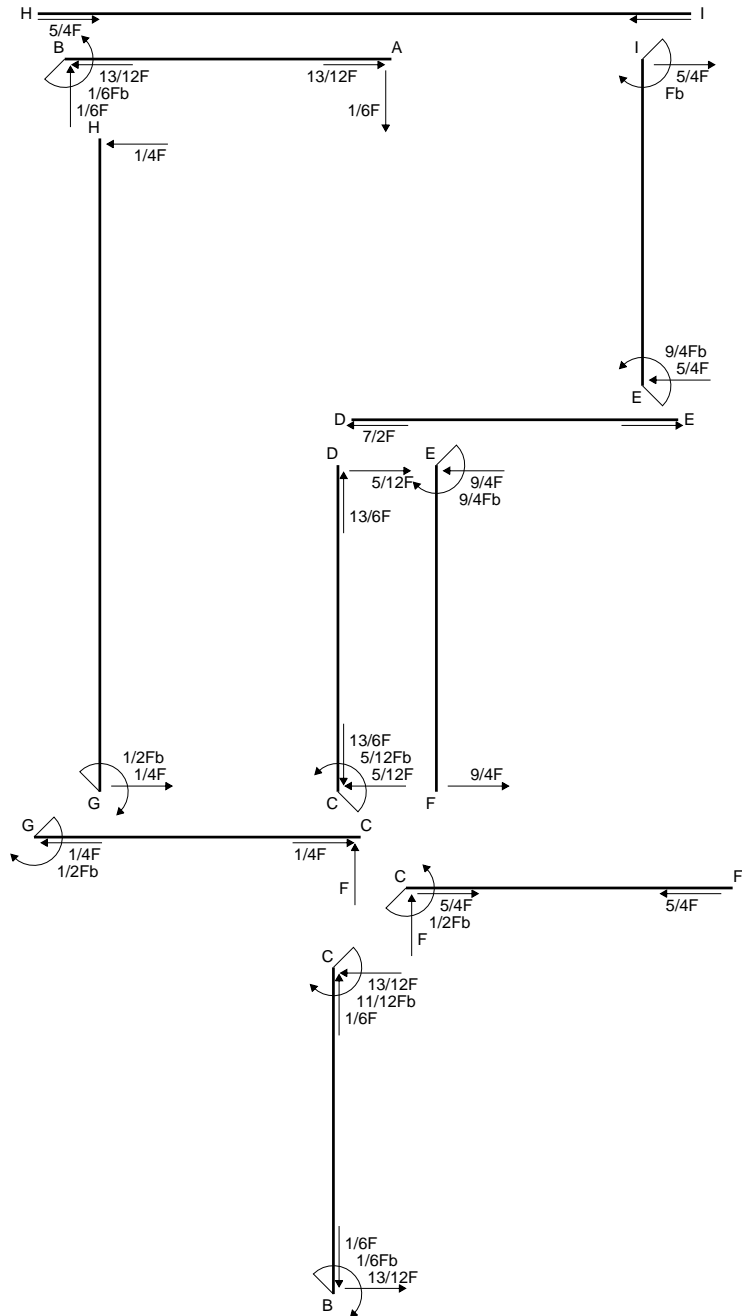
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

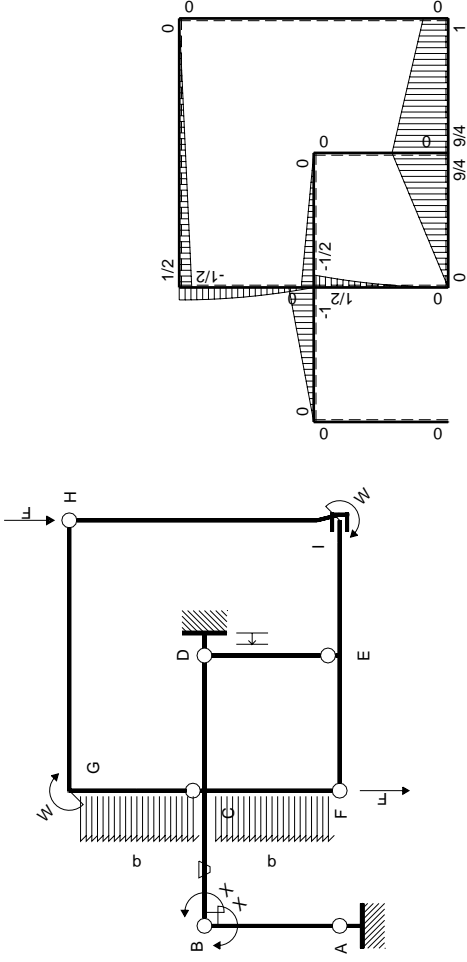
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

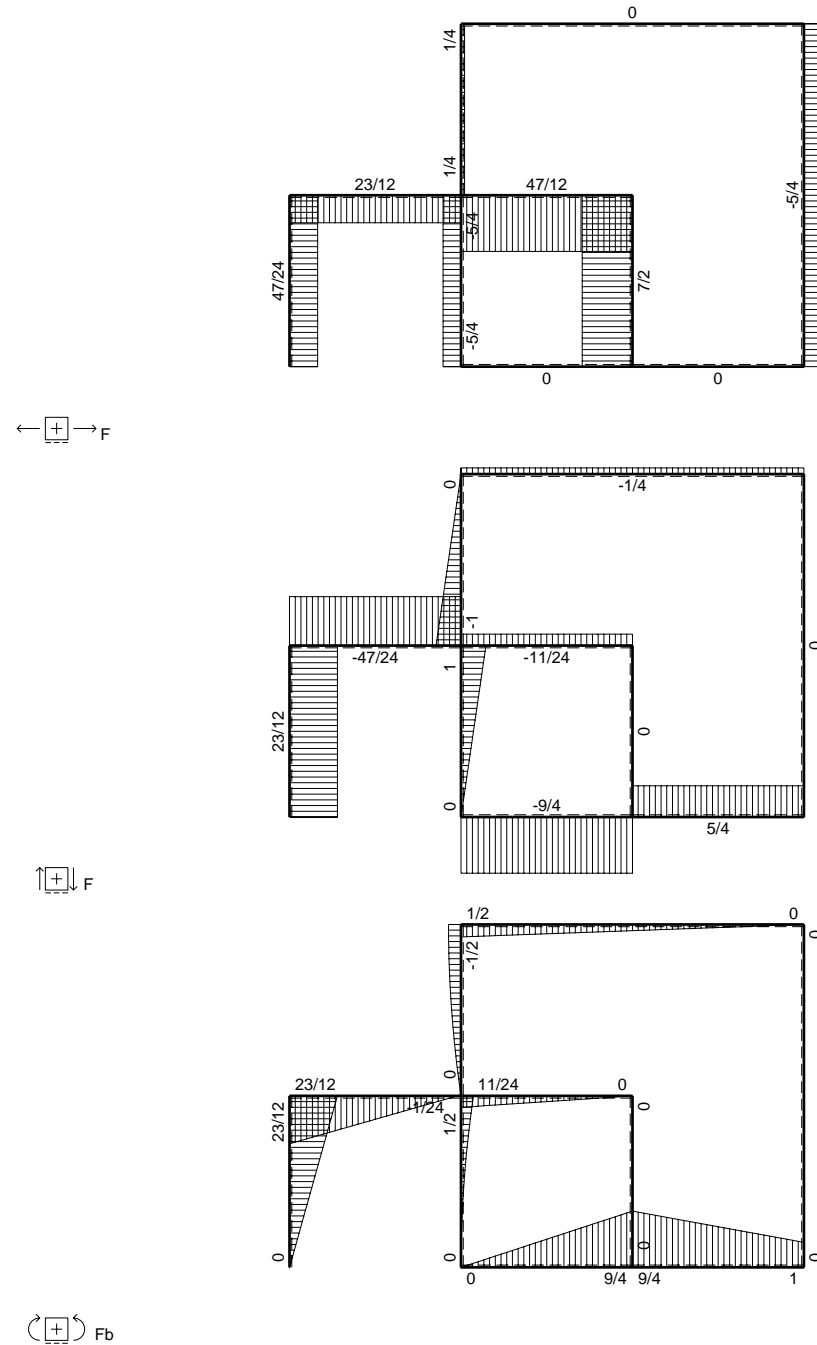
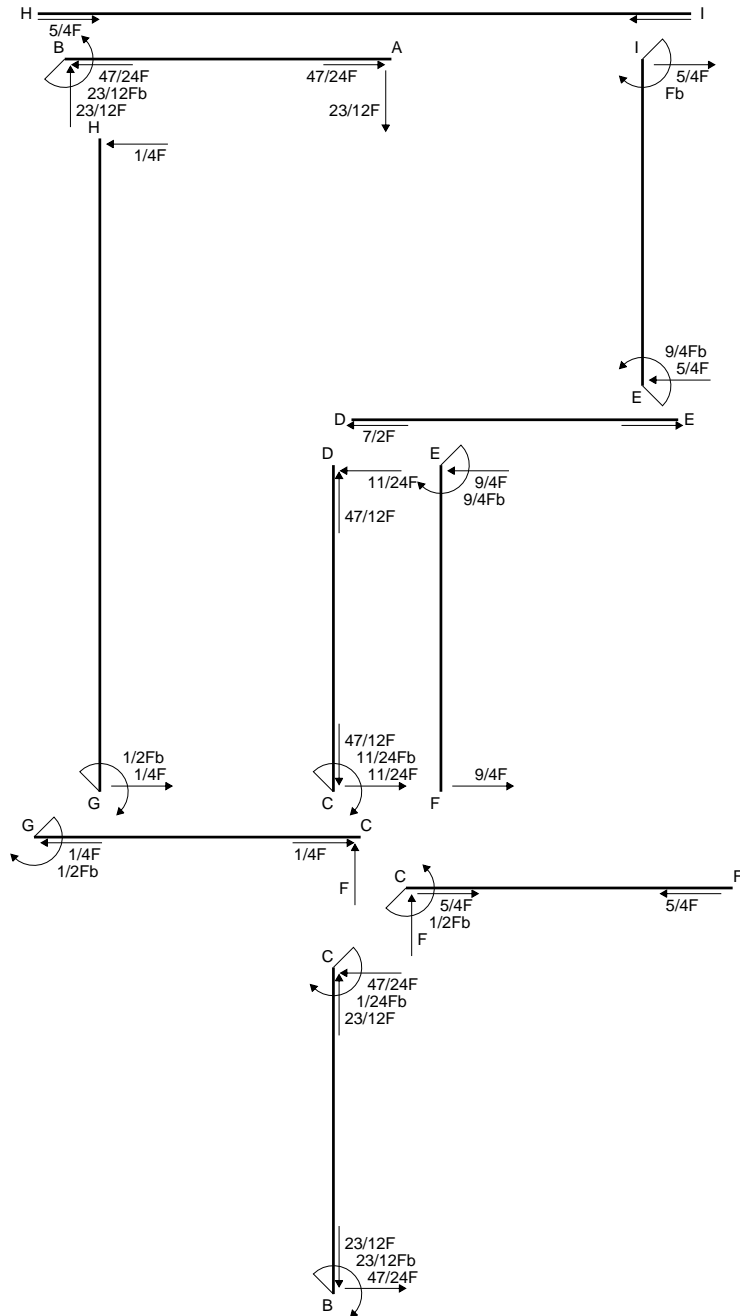
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

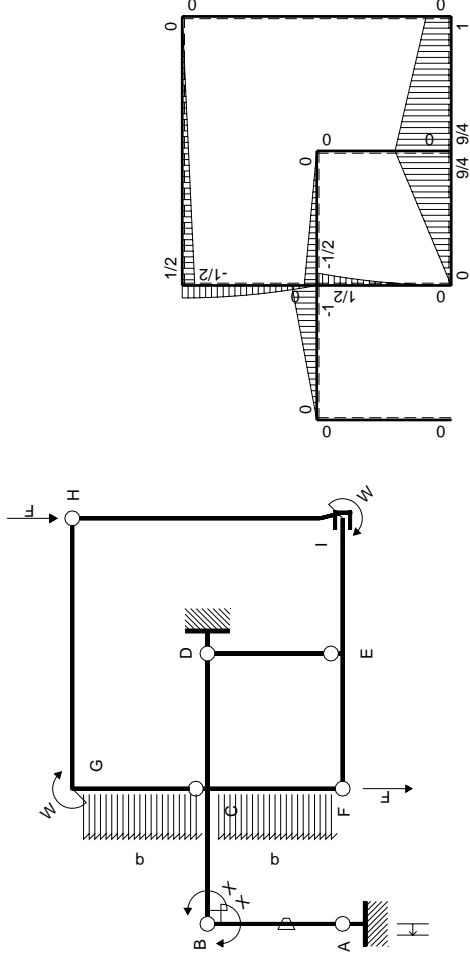
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

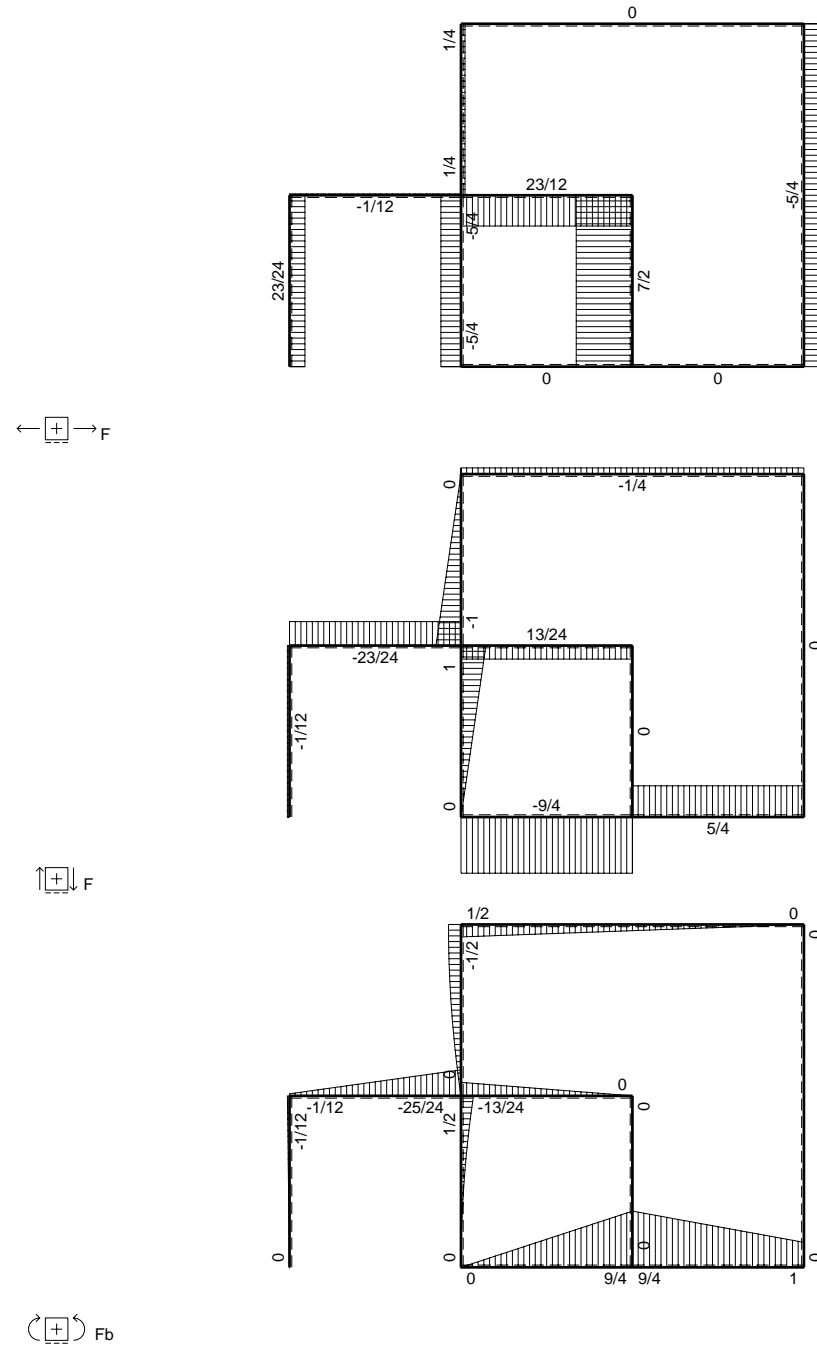
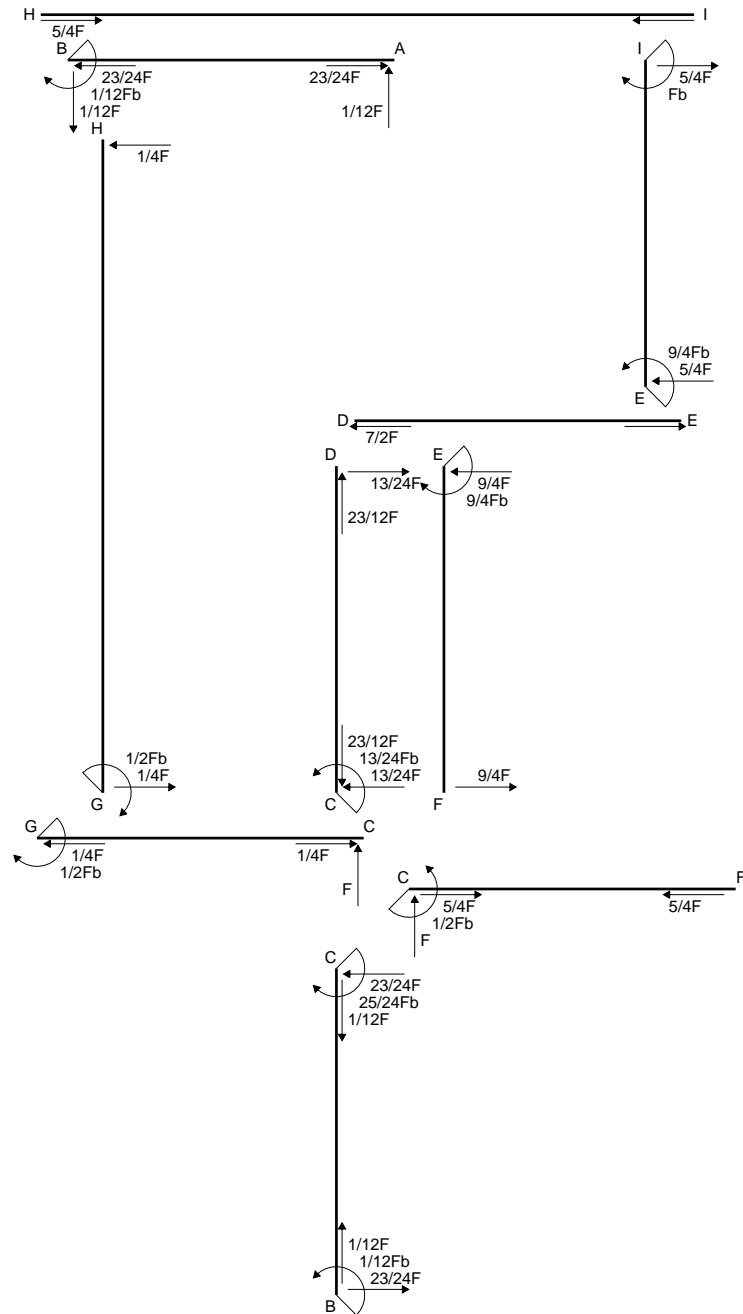
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

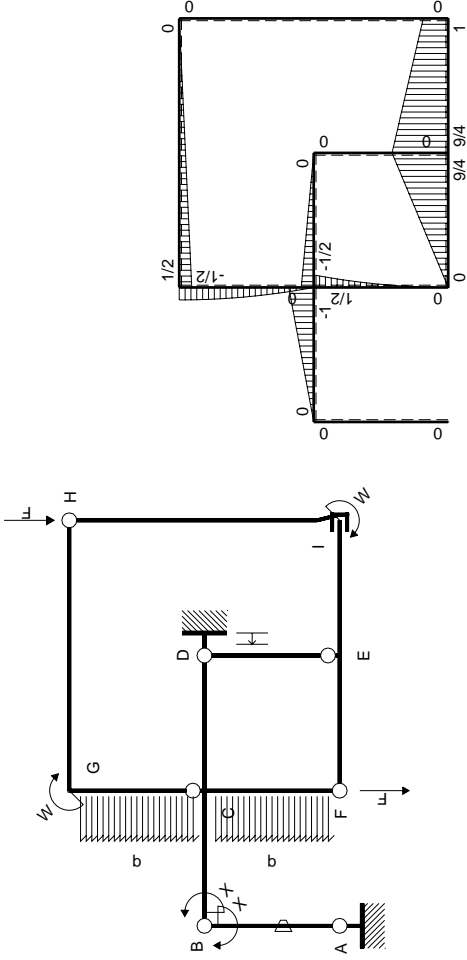
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

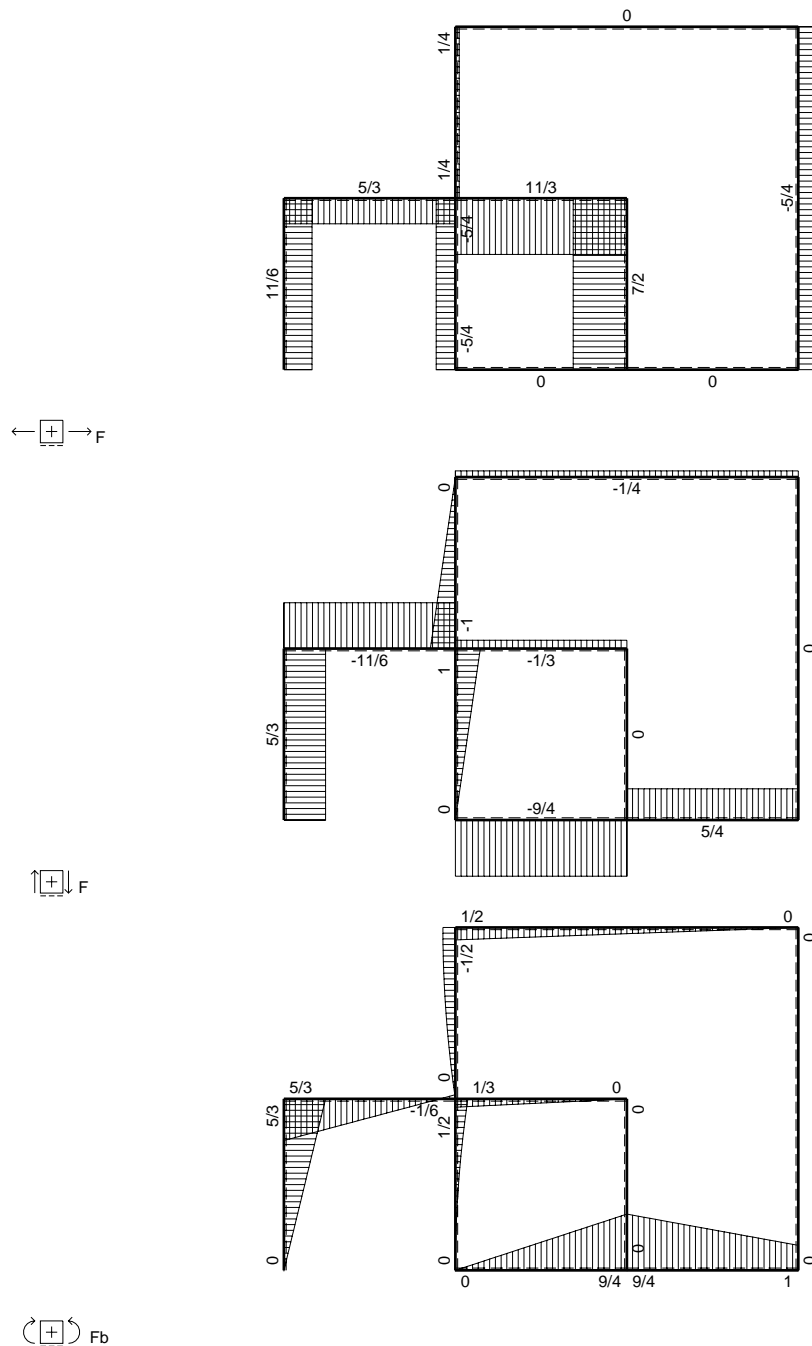
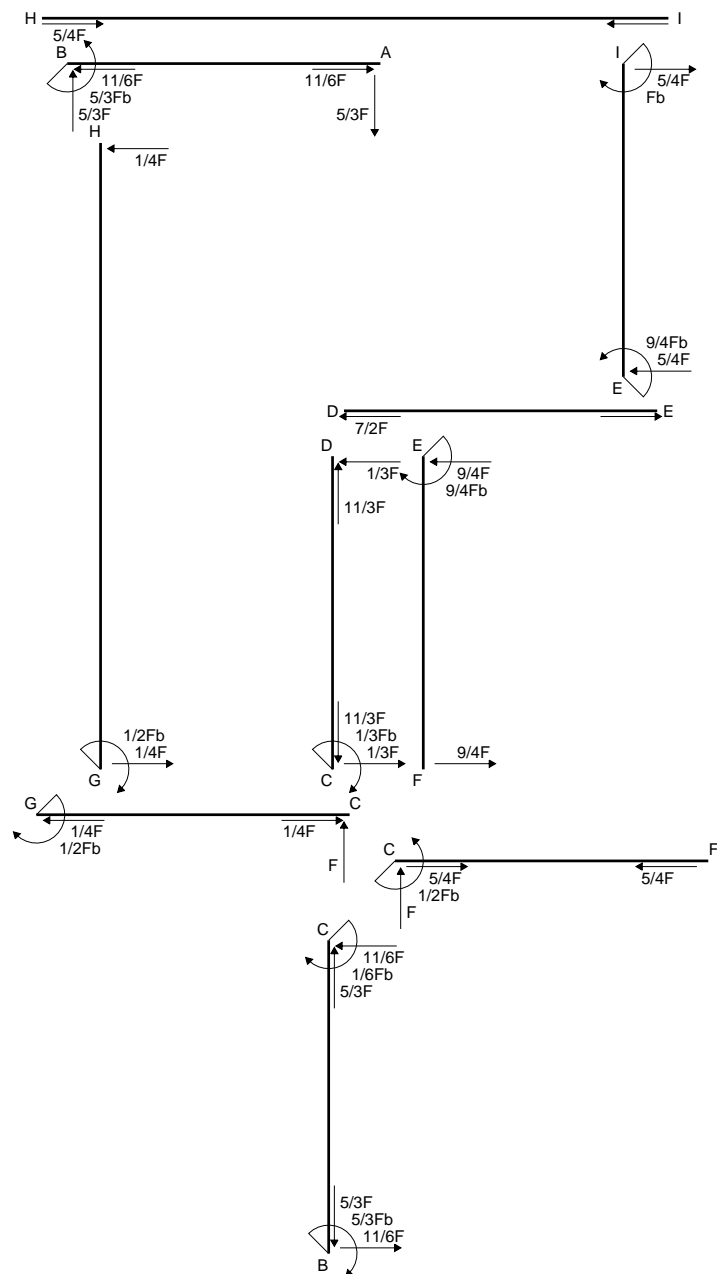
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

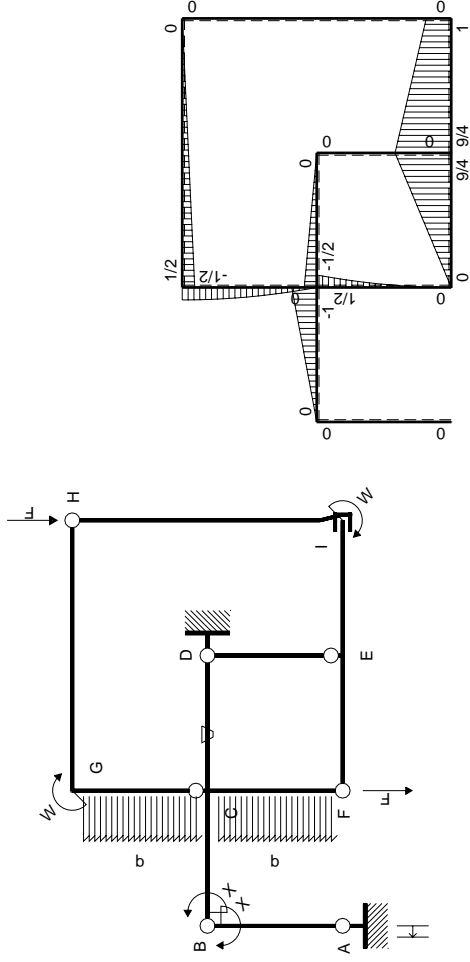
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-5/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

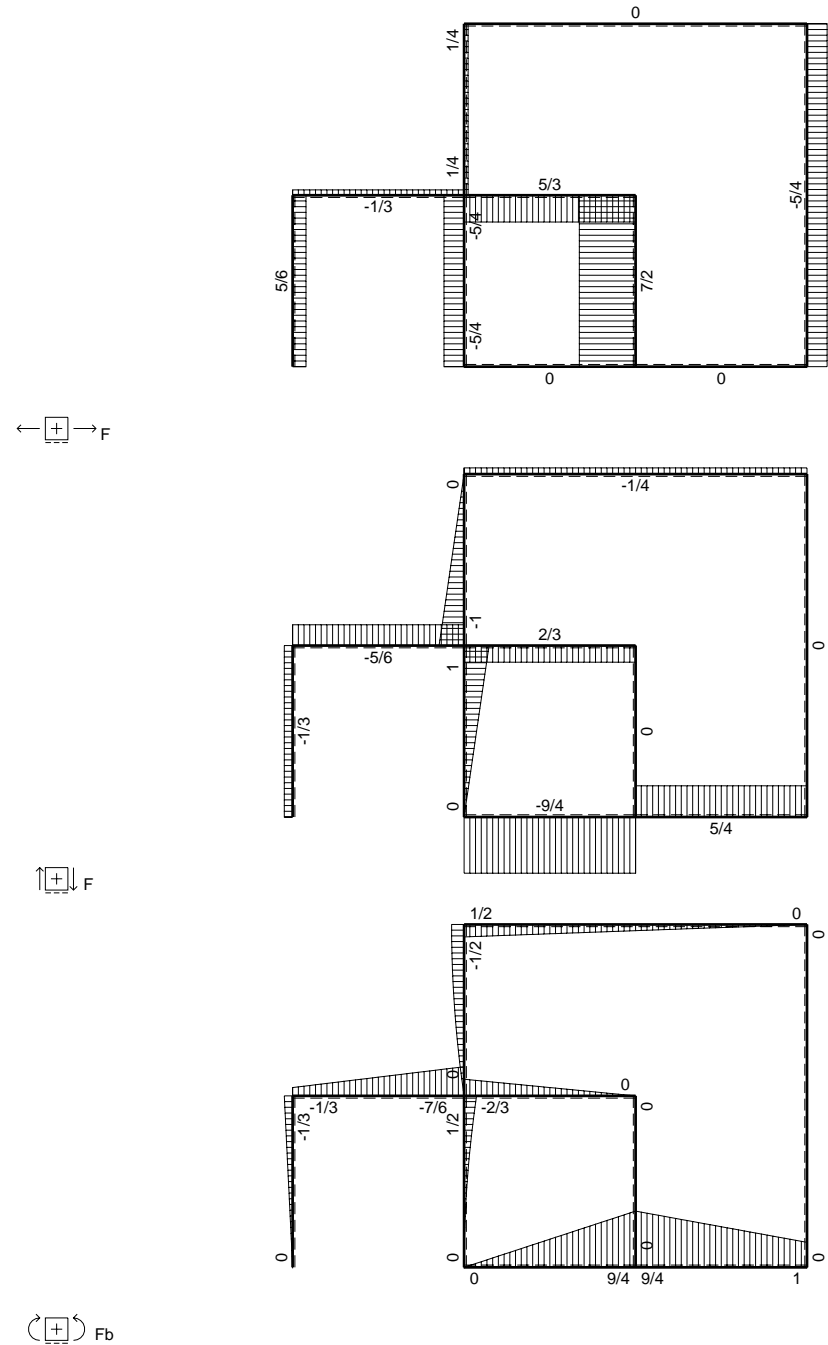
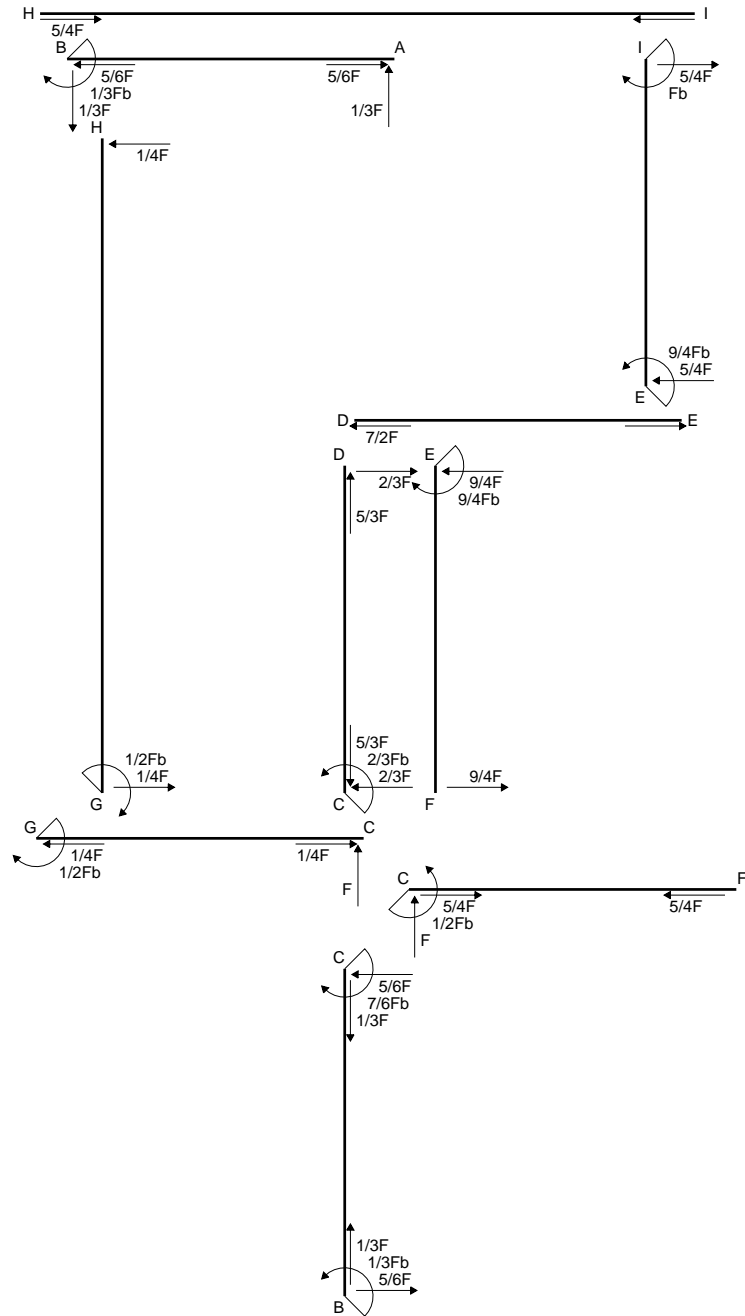
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

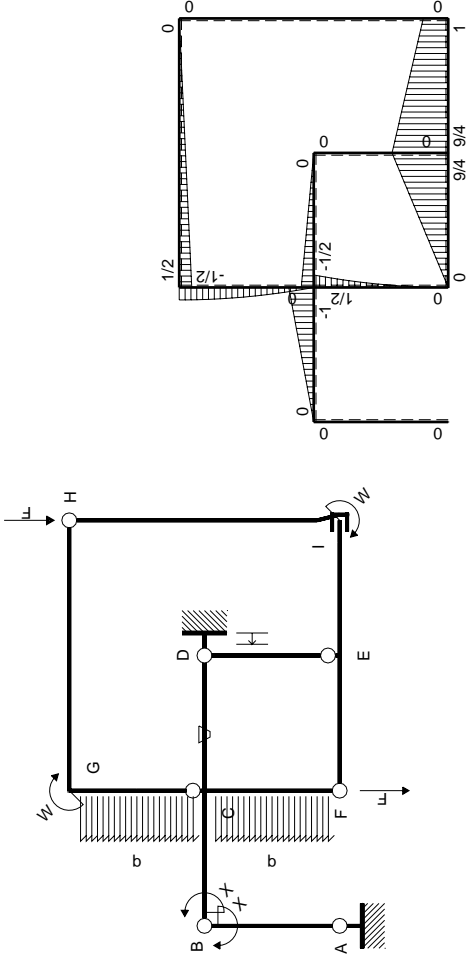
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

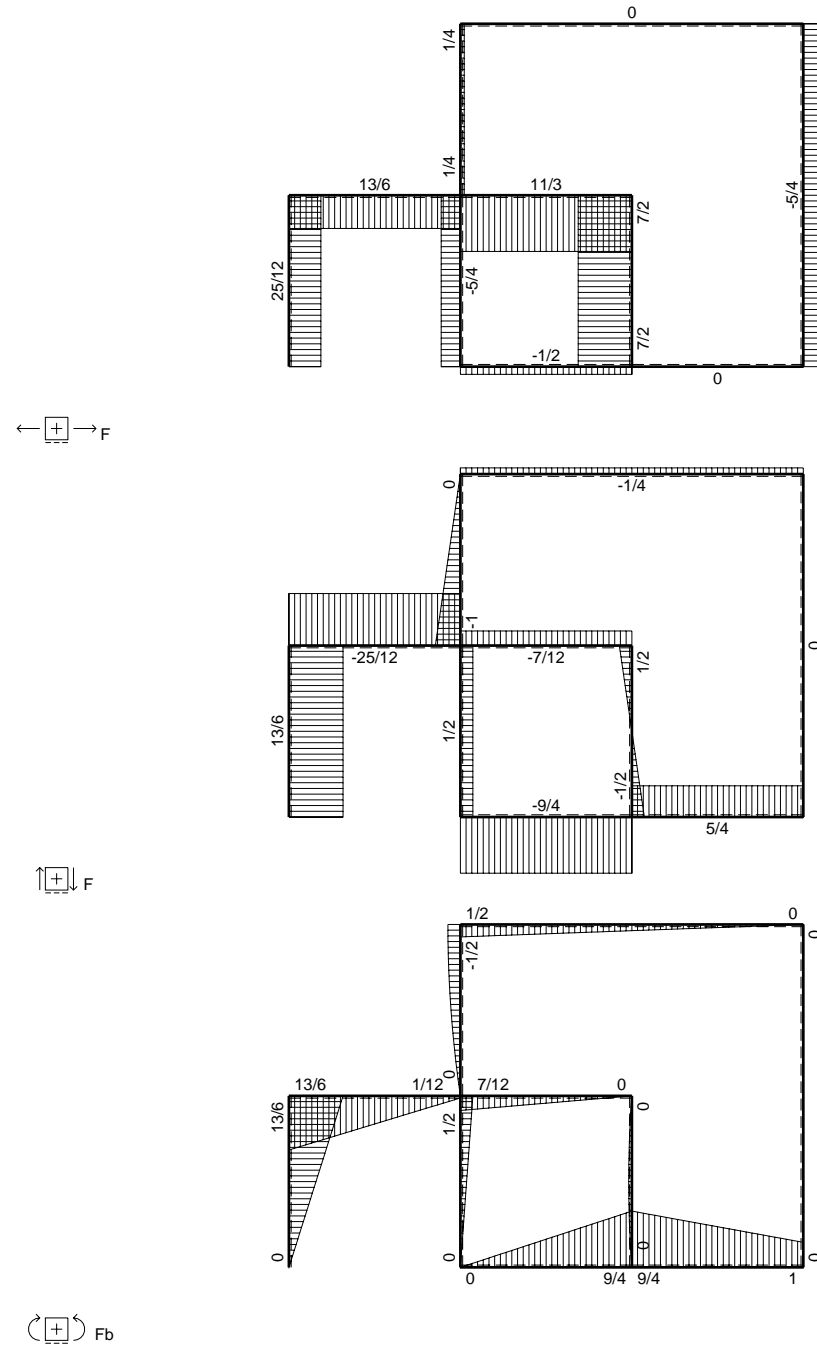
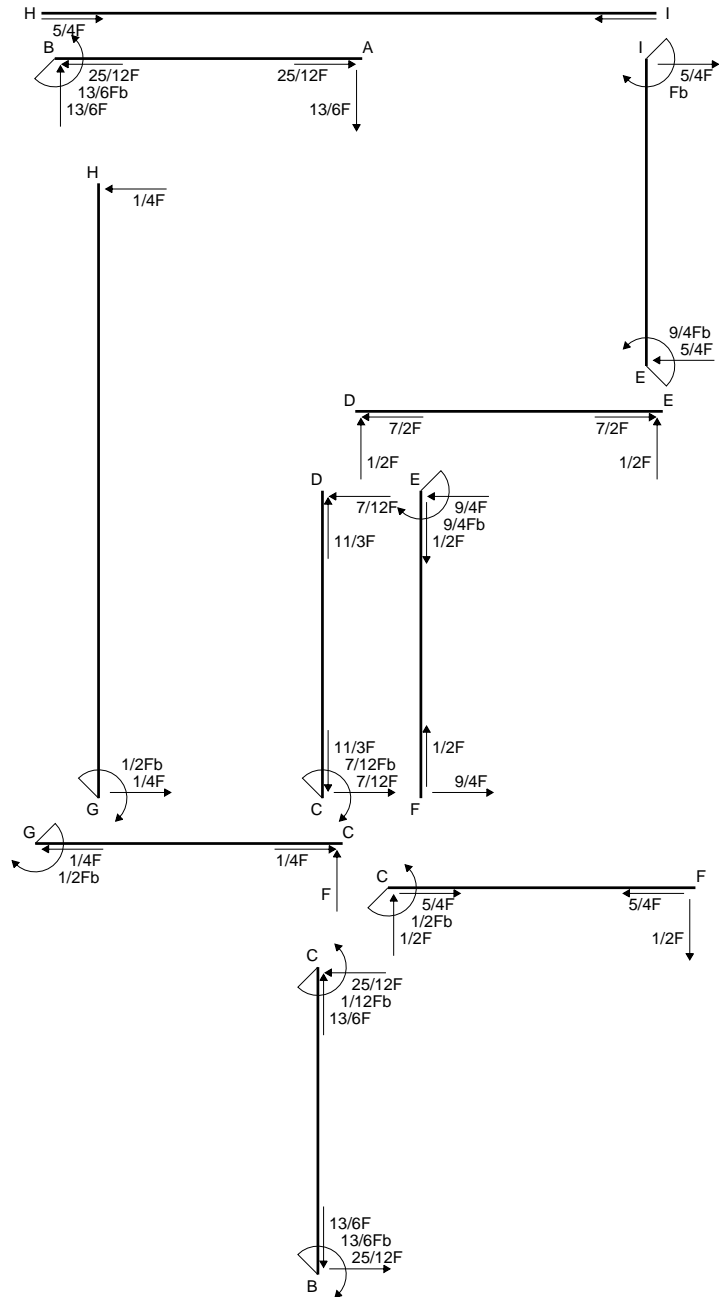
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

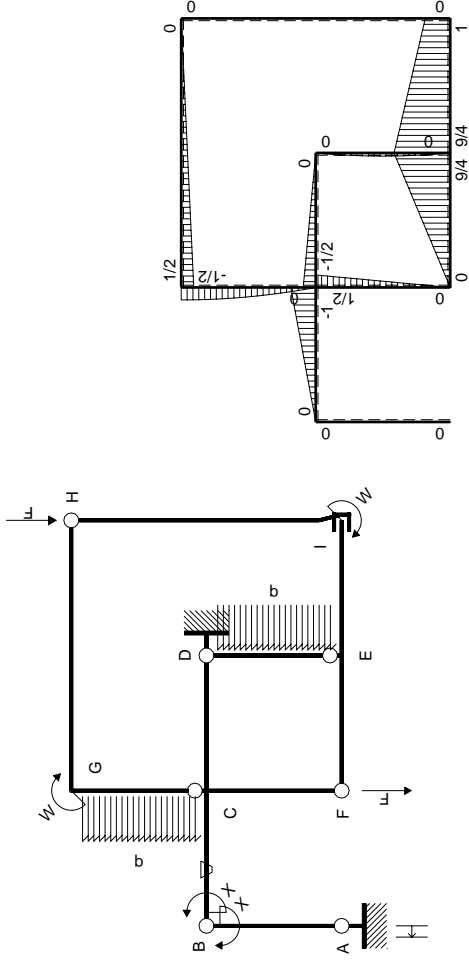
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

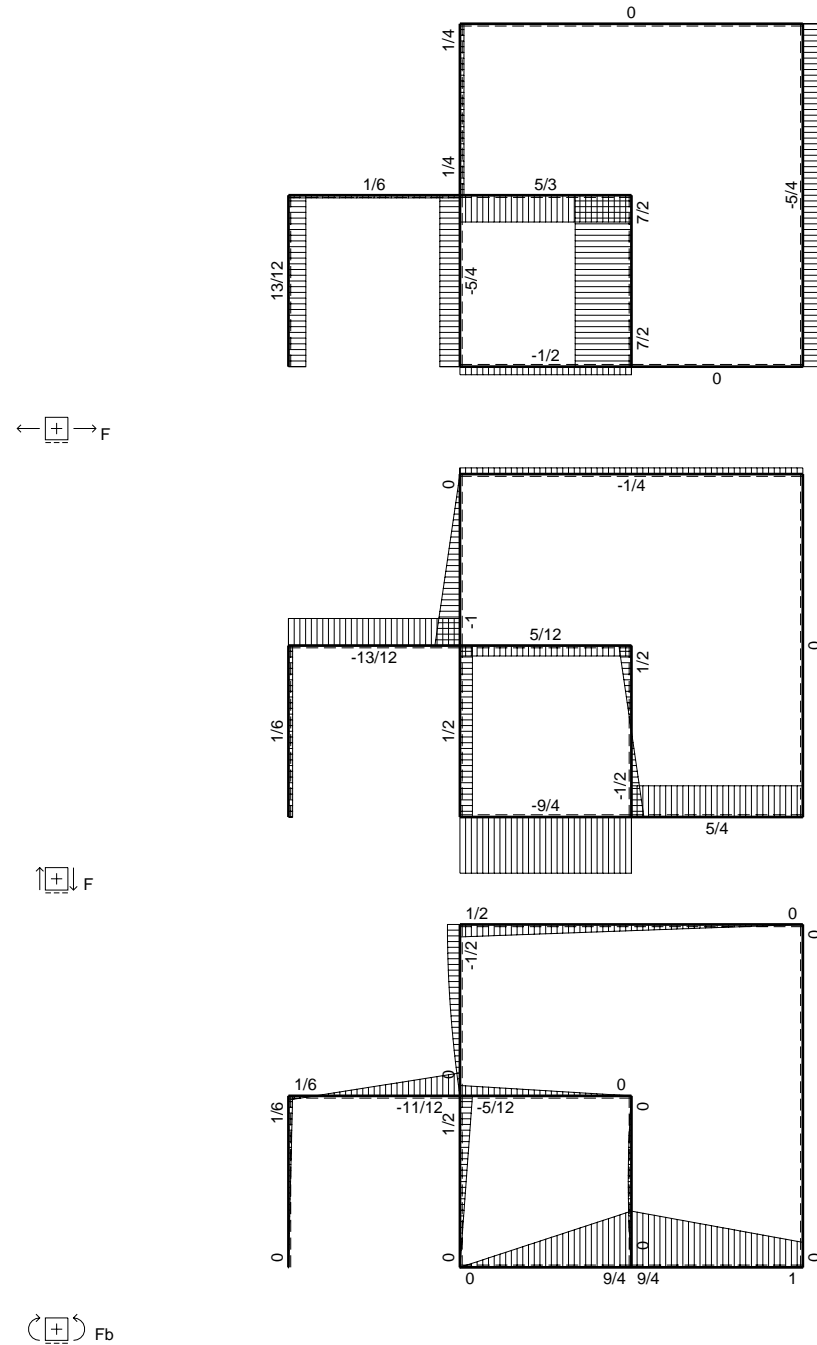
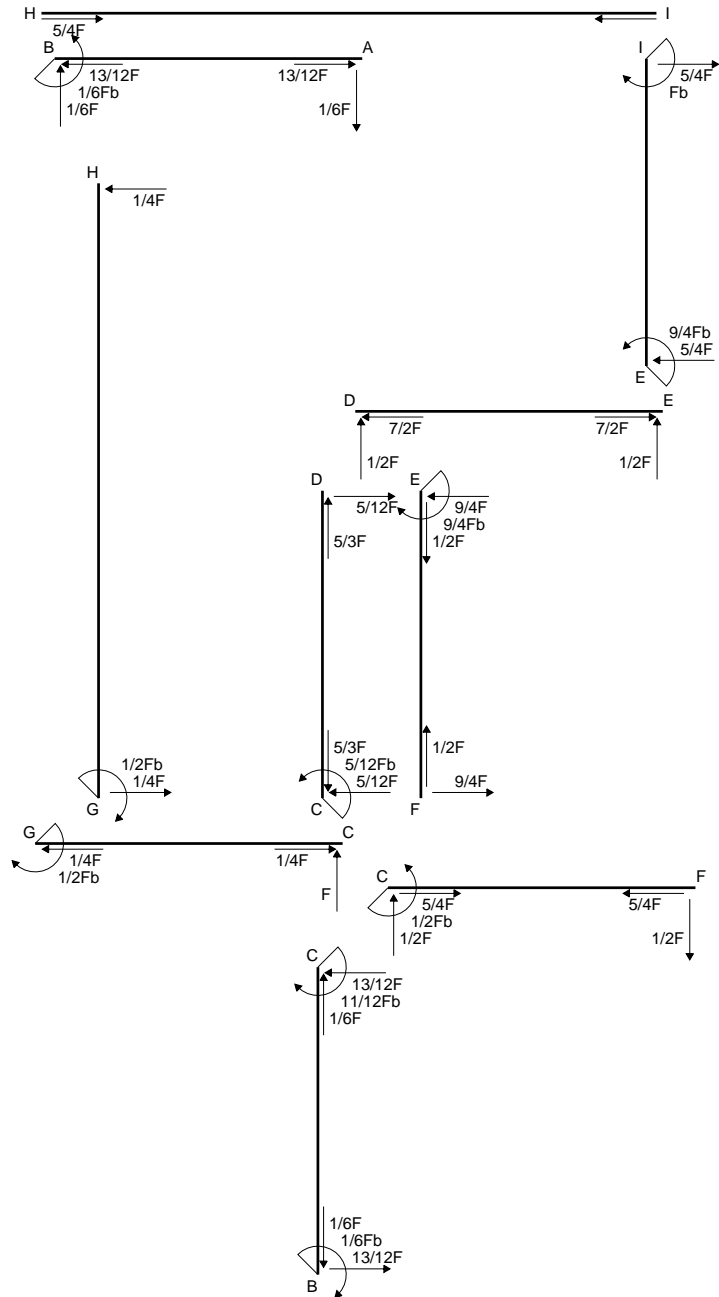
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

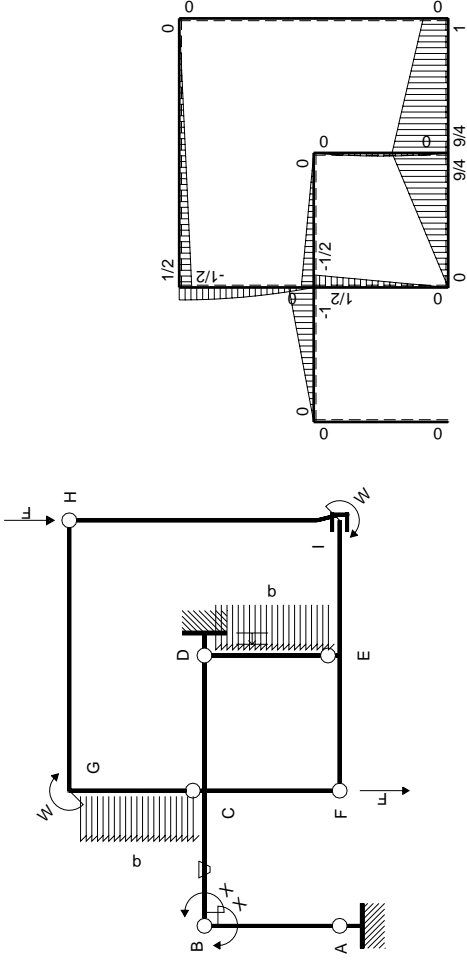
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

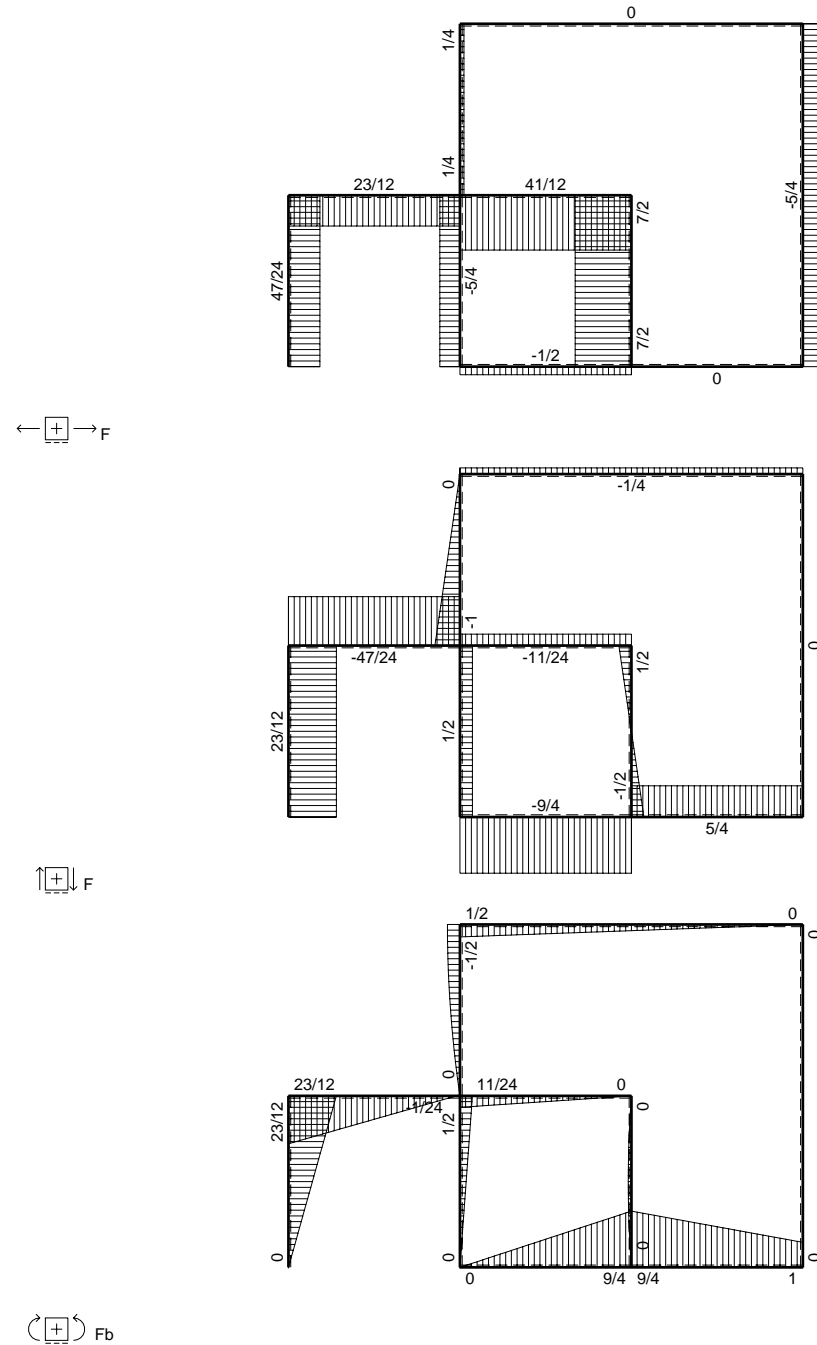
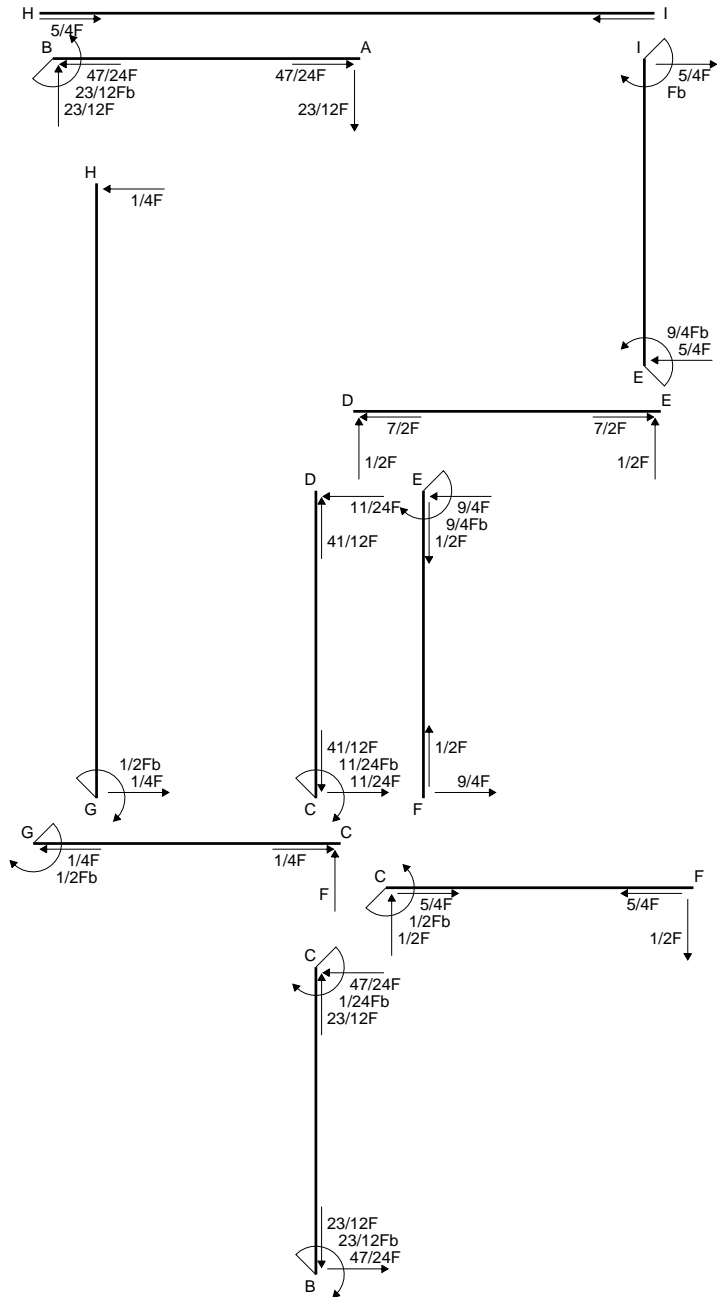
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

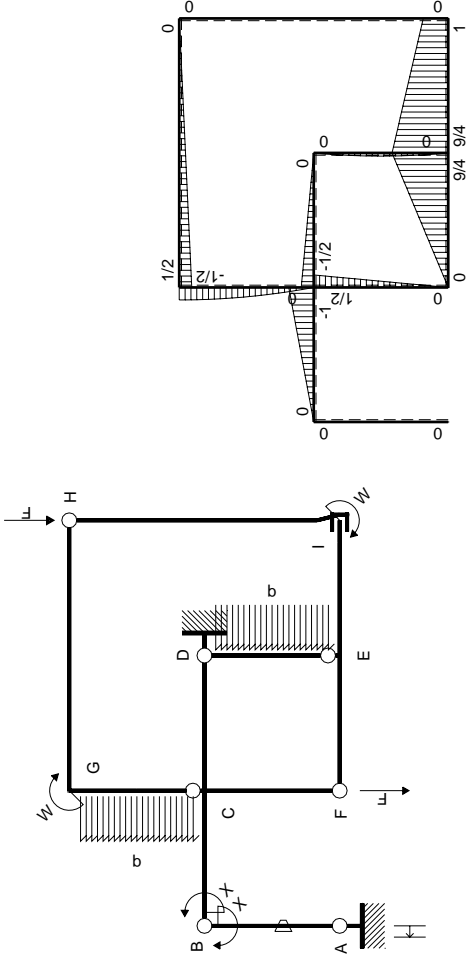
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0
FE b	0	$-9/4Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

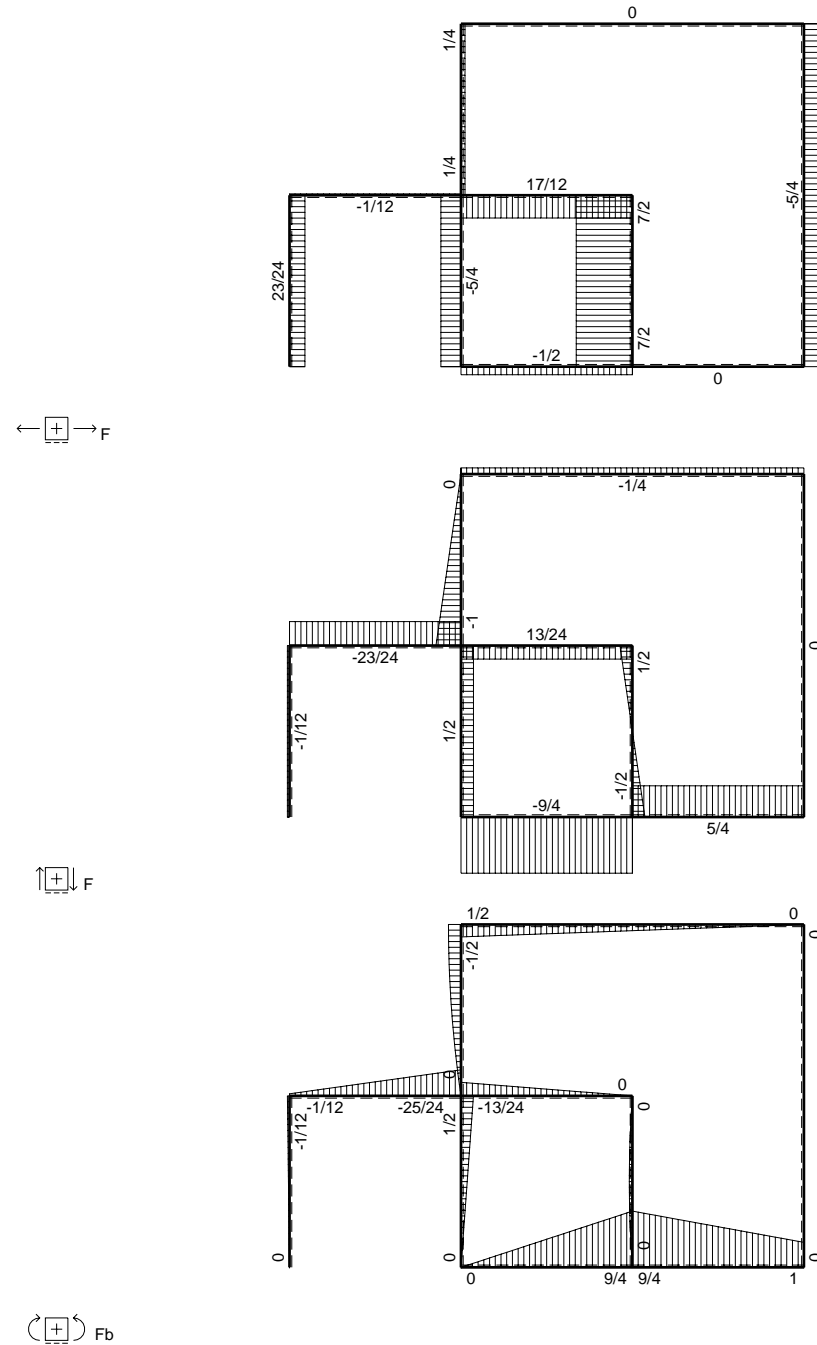
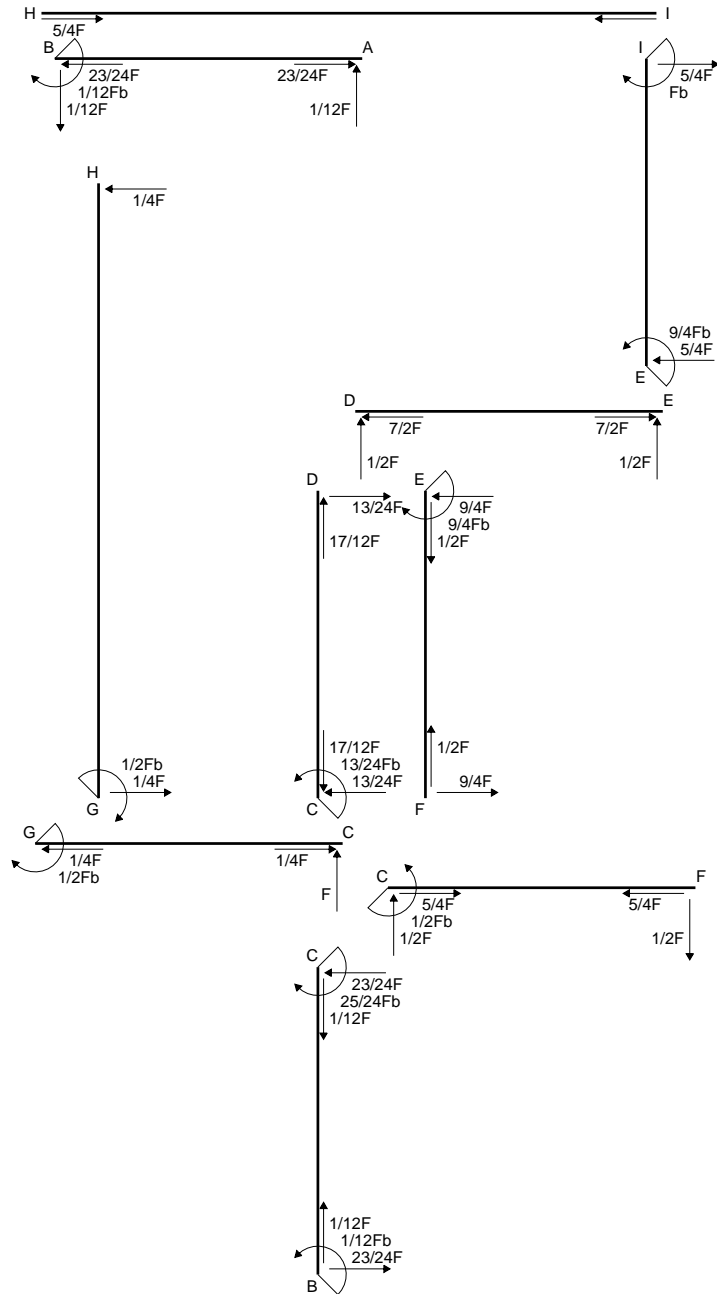
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

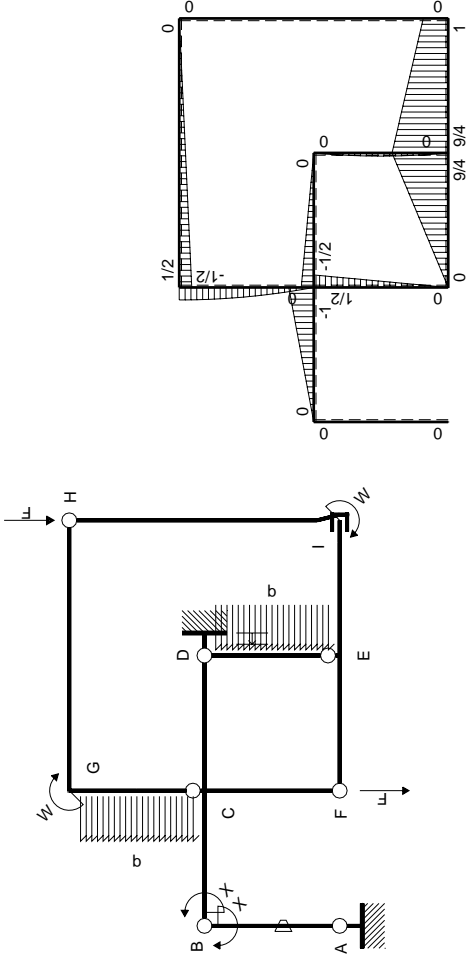
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

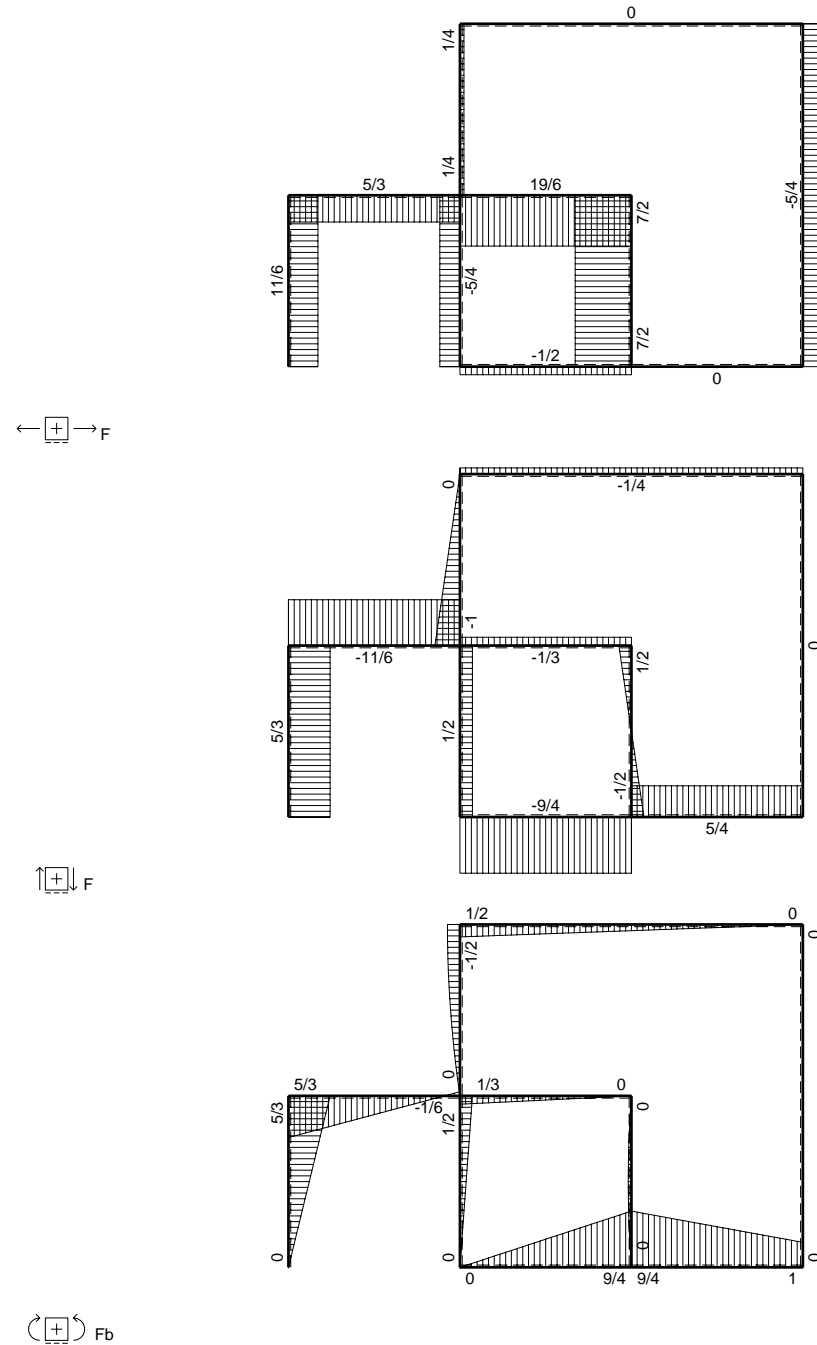
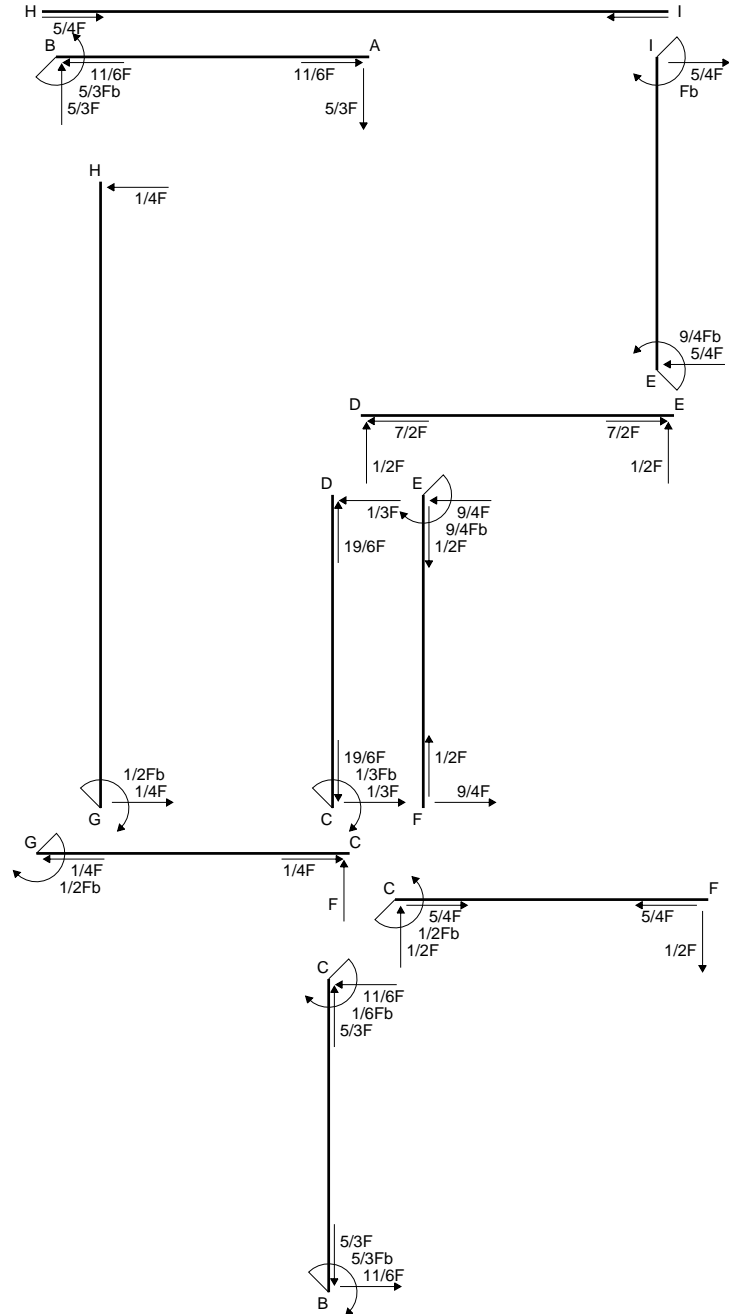
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

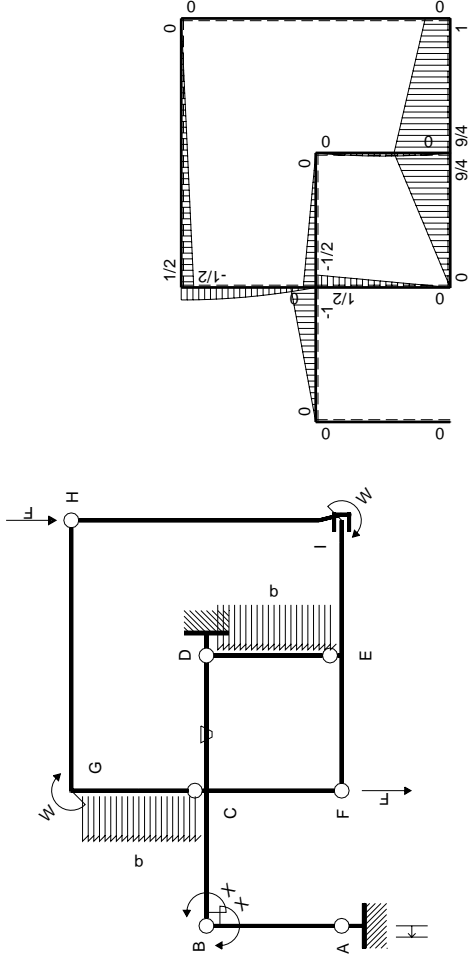
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int x M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	1/3Xb/EJ	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	-Fx	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	7/12Xb/EJ	
CB b	$1/2+1/2x/b$	Fb-Fx	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	-Fb/EJ	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	1/12Xb/EJ	
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-5/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

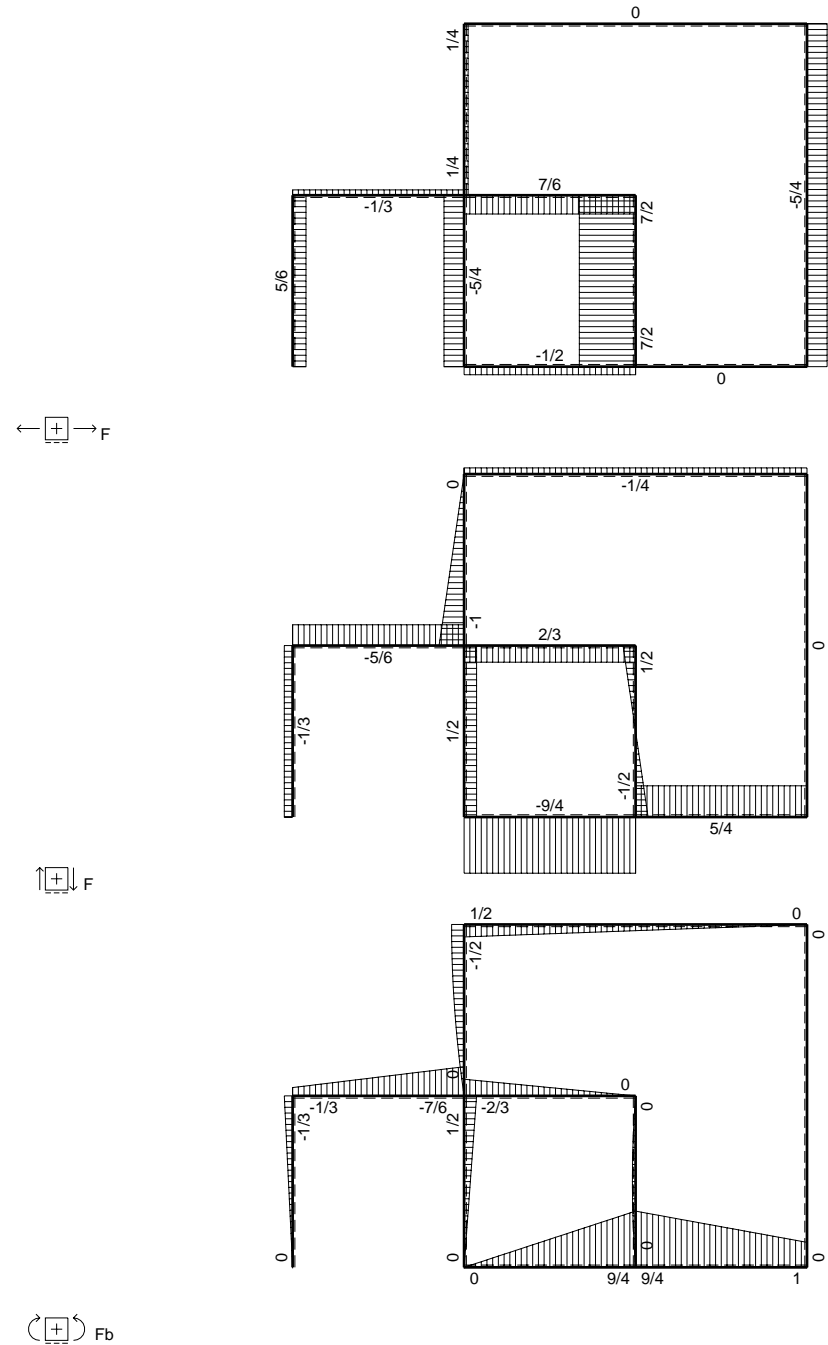
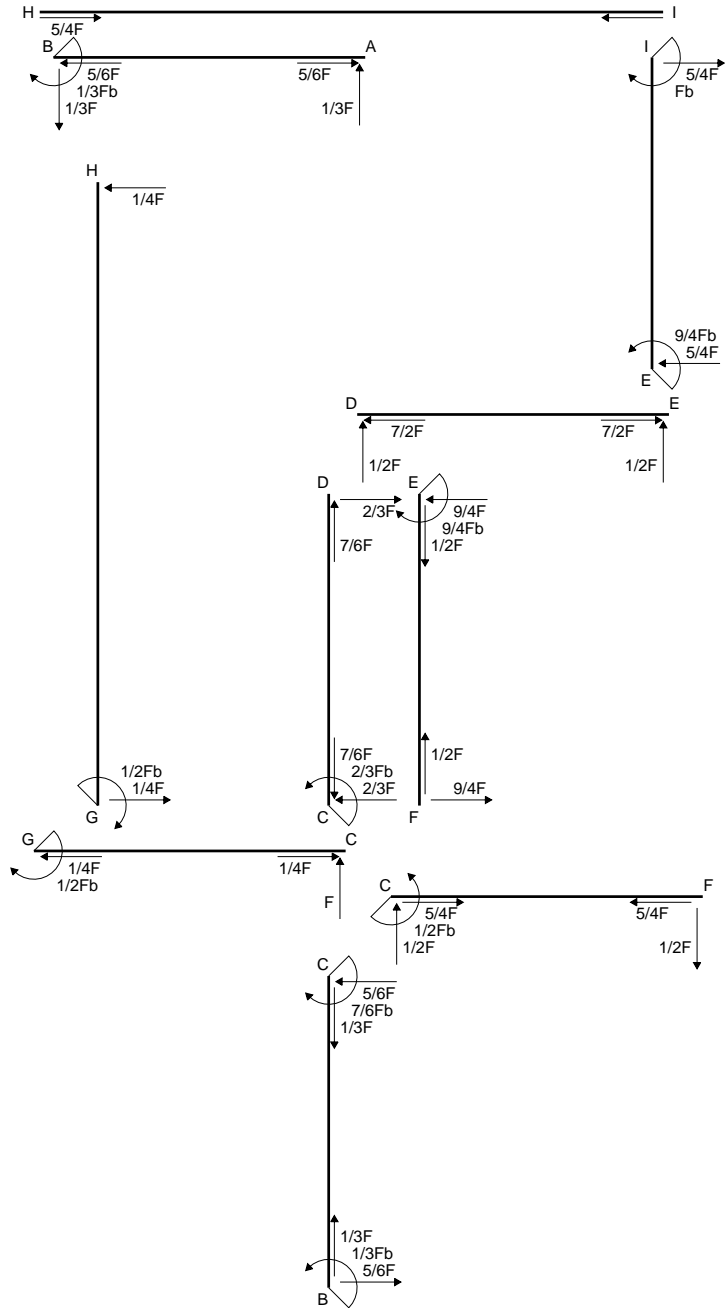
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

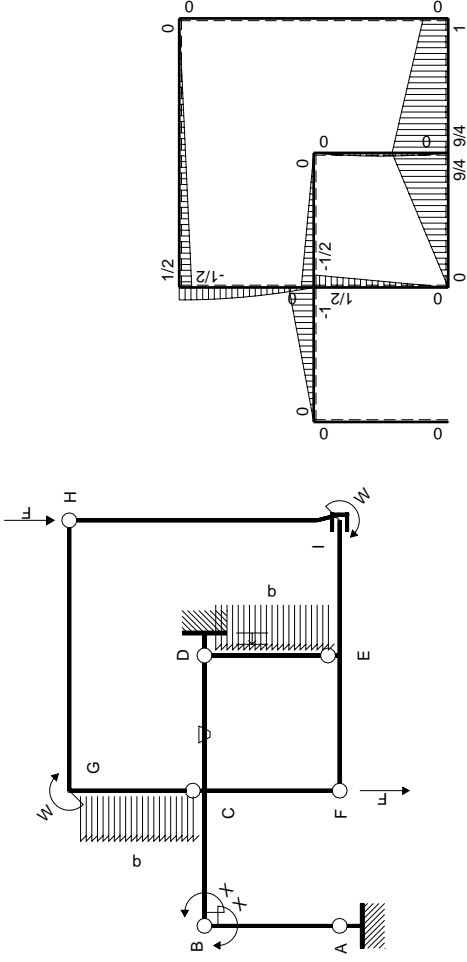
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	1/3Xb/EJ	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	-Fx	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	7/12Xb/EJ	
CB b	$1/2+1/2x/b$	Fb-Fx	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	-Fb/EJ	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	1/12Xb/EJ	
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							1/3Fb	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

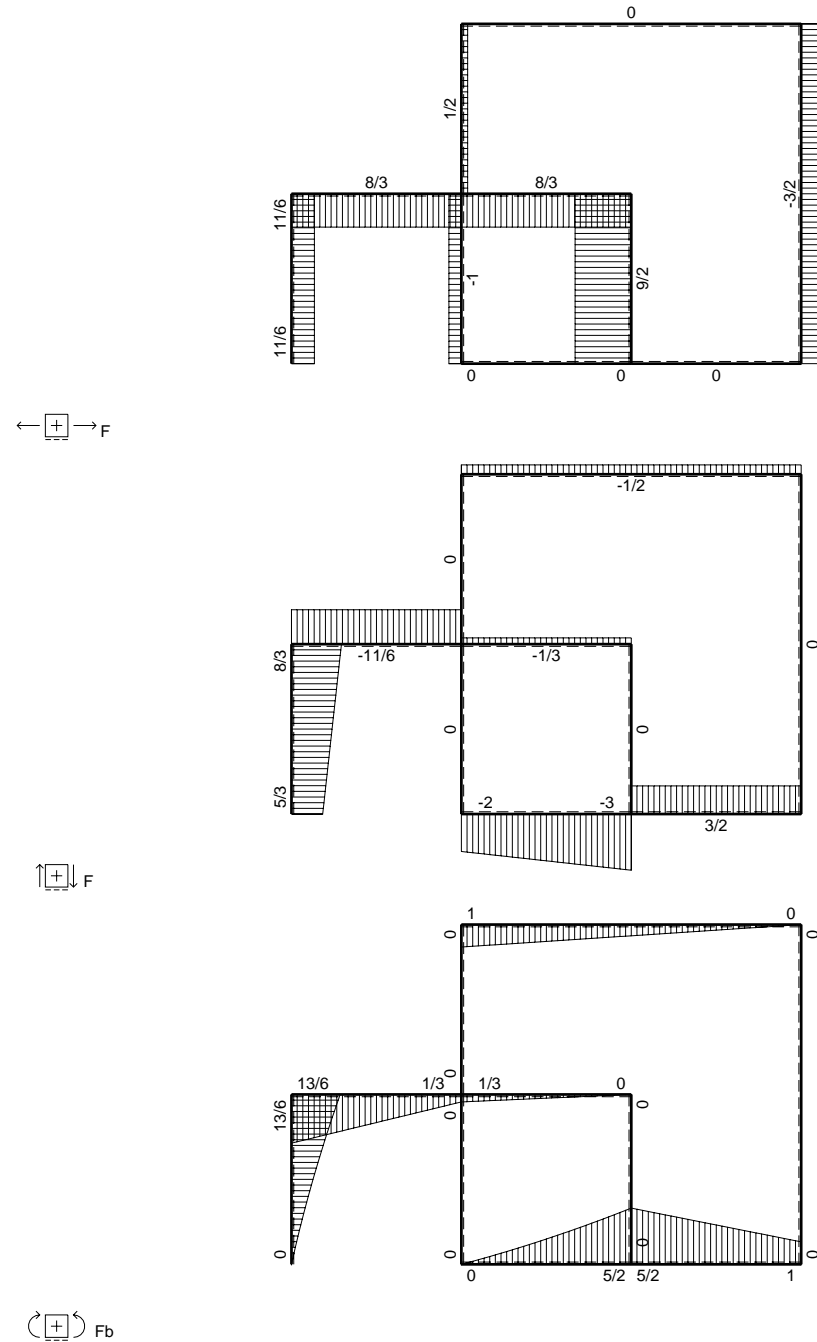
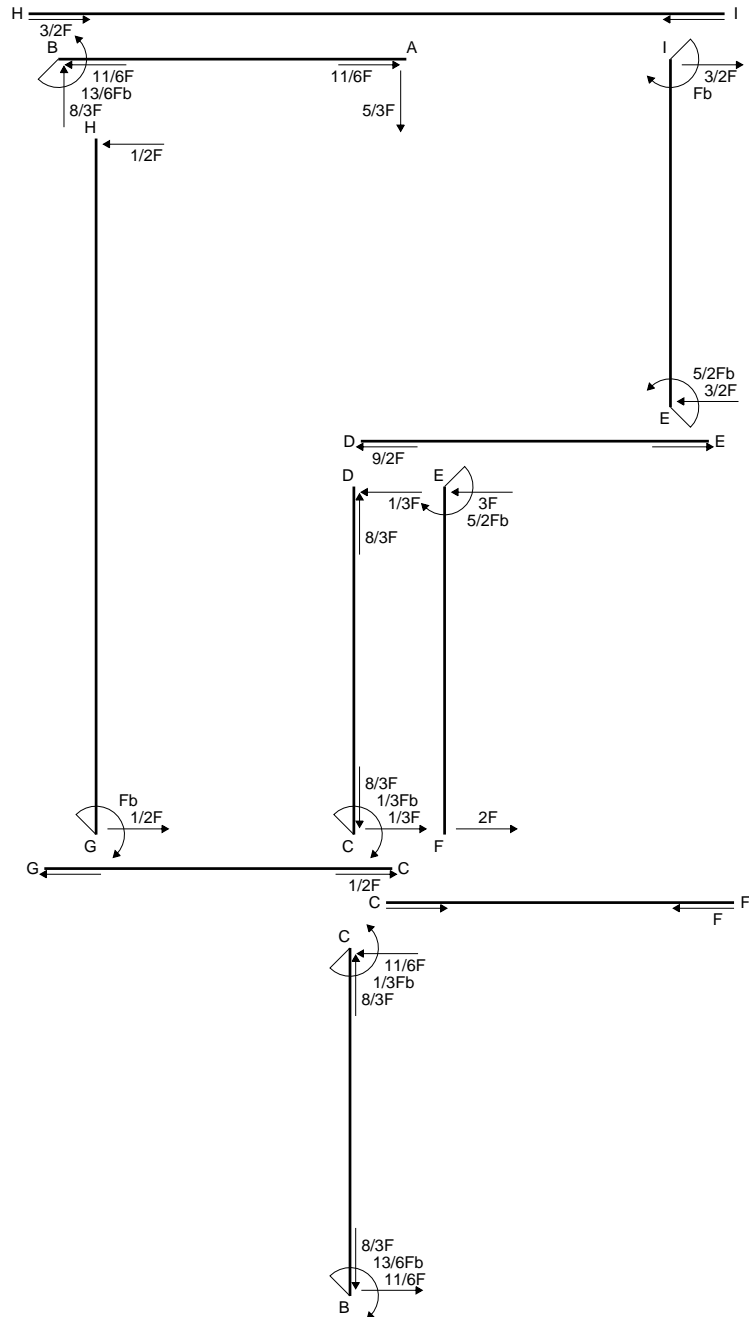
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

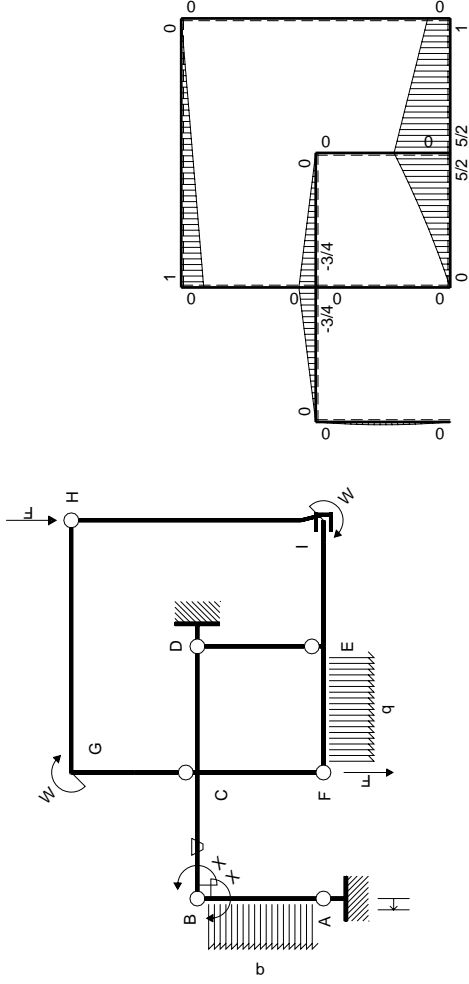
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

 M_0 flessione da carichi assegnati



 M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

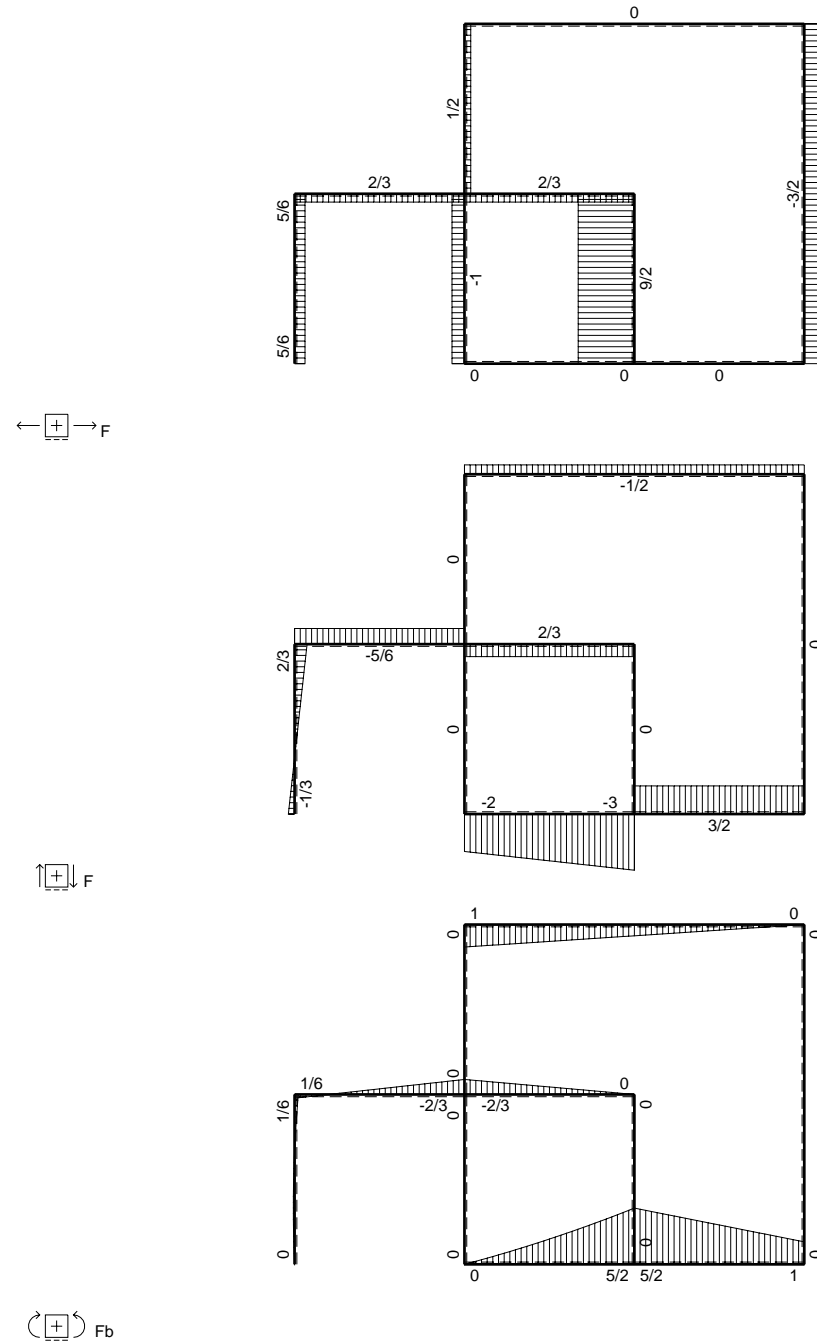
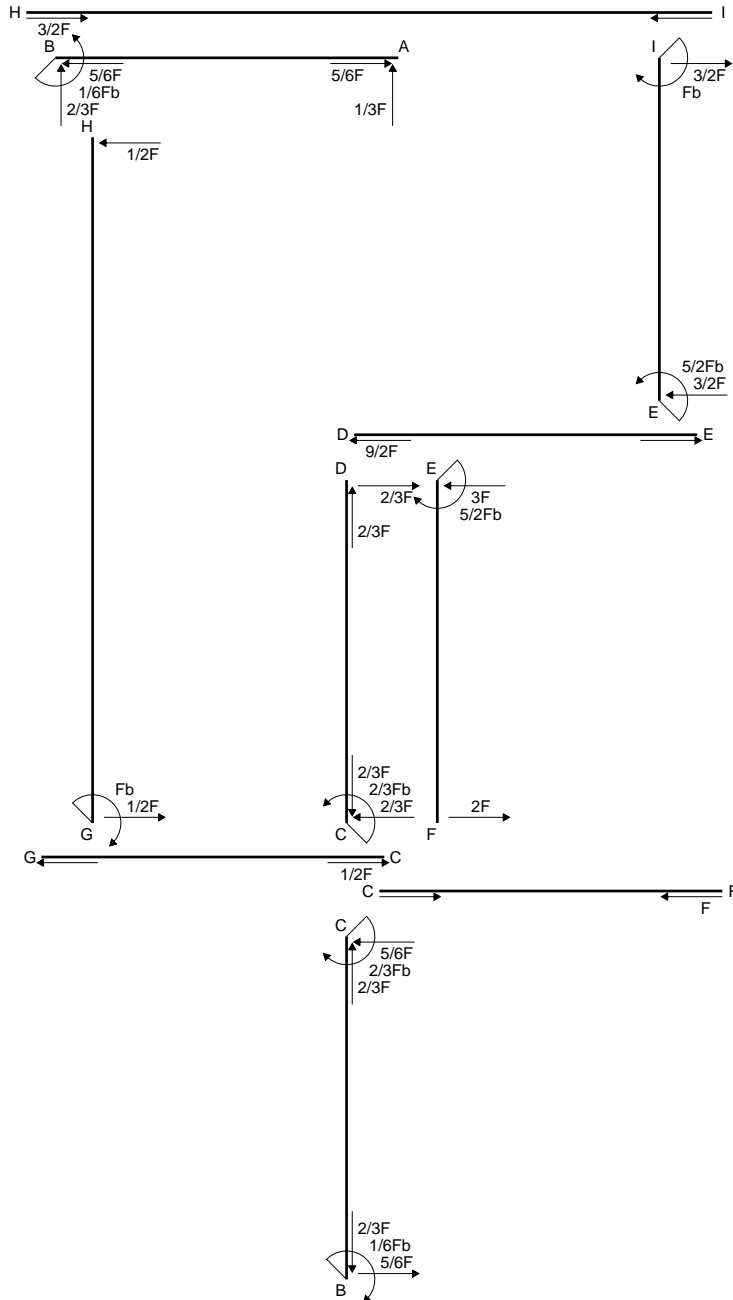
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

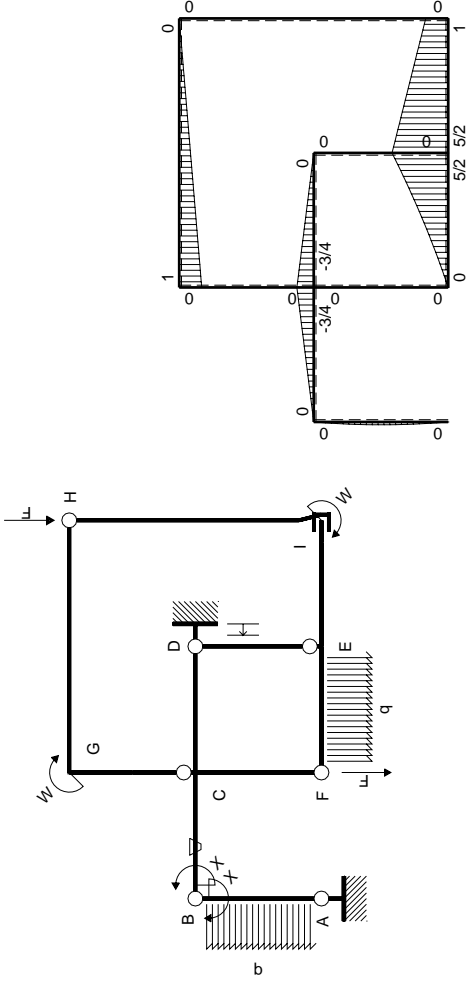
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0			
ED b	0	0	0	0	0	0	0+0	0	
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0			
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0	0+0	0	
FC b	0	0	0	0	0	0			
CF b	0	0	0	0	0	0	0+0	0	
CG b	0	0	0	0	0	0			
GC b	0	0	0	0	0	0	0+0	0	
GH 2b	0	$Fb-1/2Fx$	0	0	0	0			
HG 2b	0	$-1/2Fx$	0	0	0	0	0+0	0	
HI 2b	0	0	0	0	0	0			
IH 2b	0	0	0	0	0	0	0+0	0	
IE b	0	$Fb+3/2Fx$	0	0	0	0			
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0	0+0	0	
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

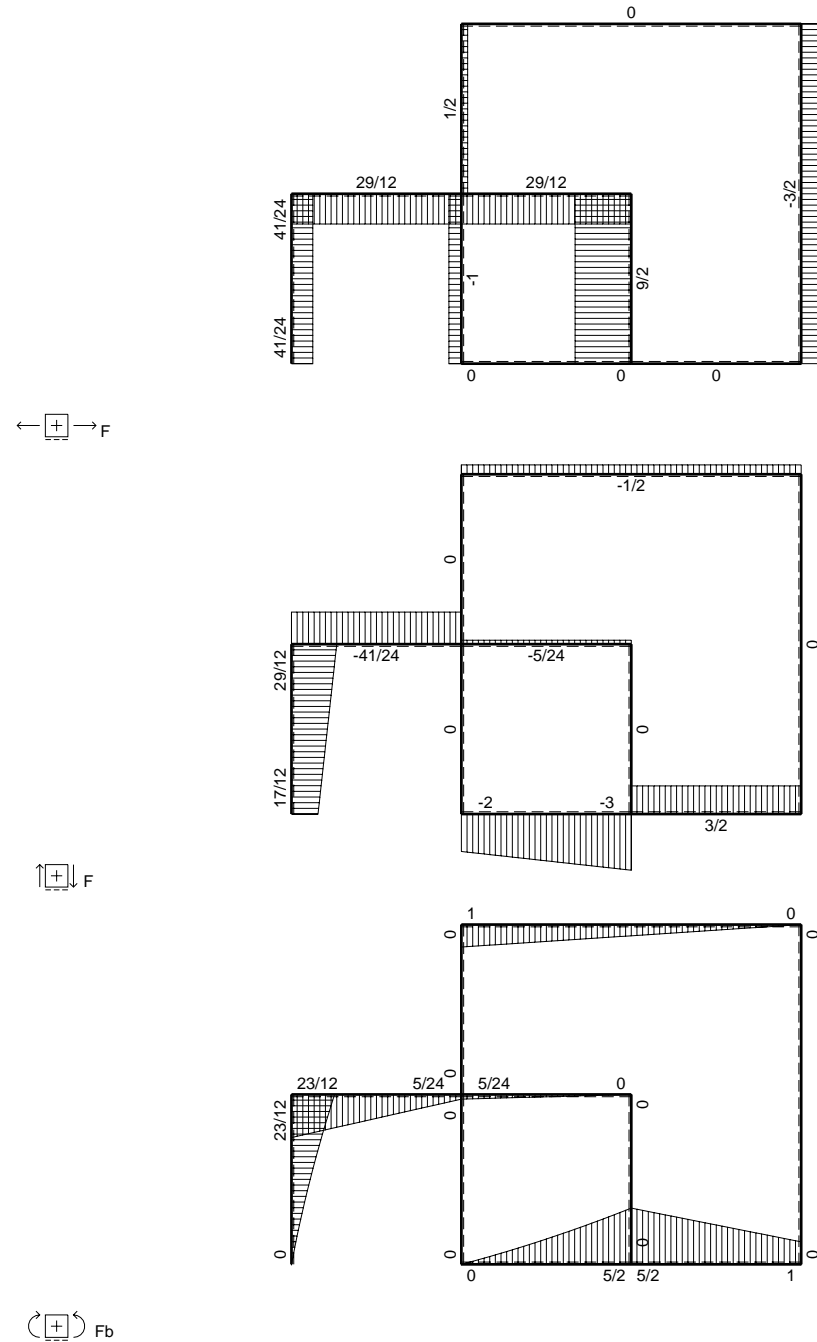
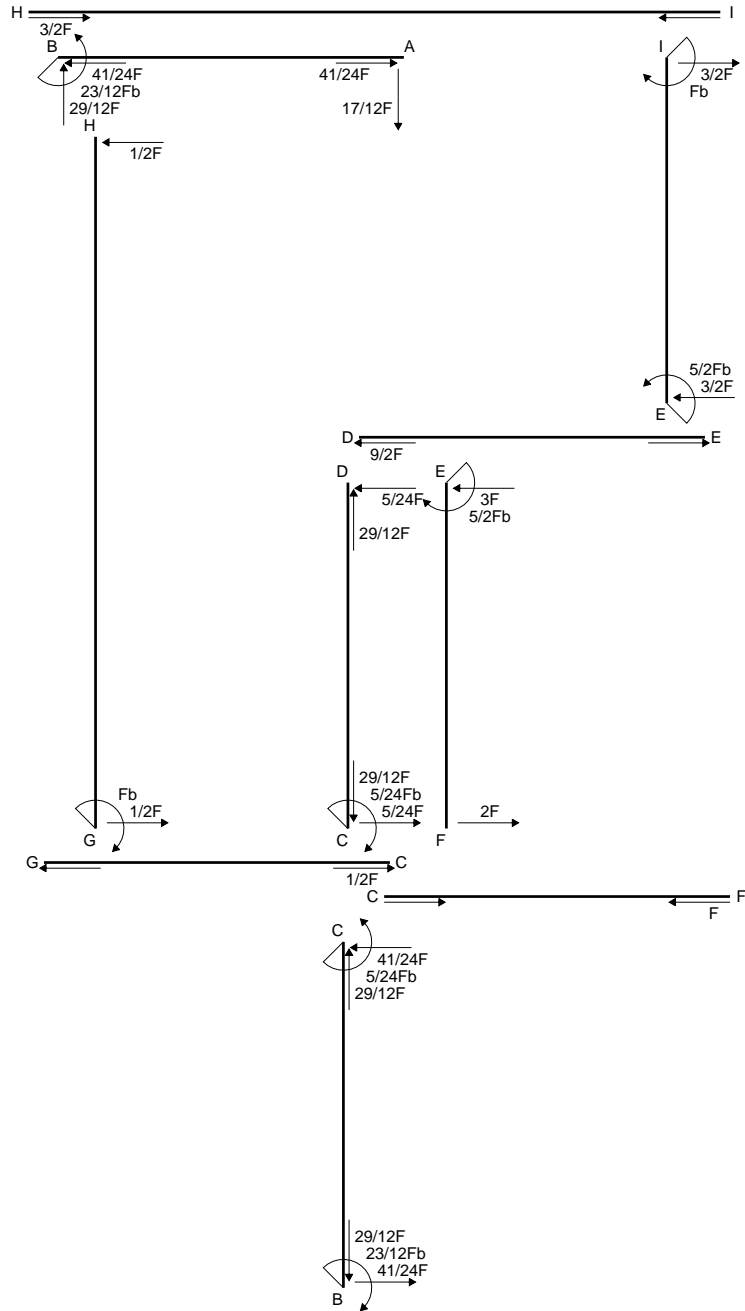
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

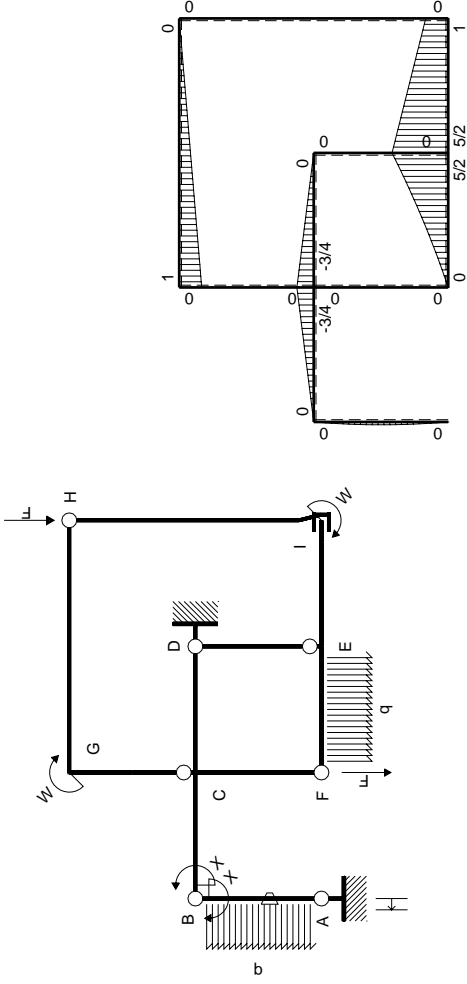
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

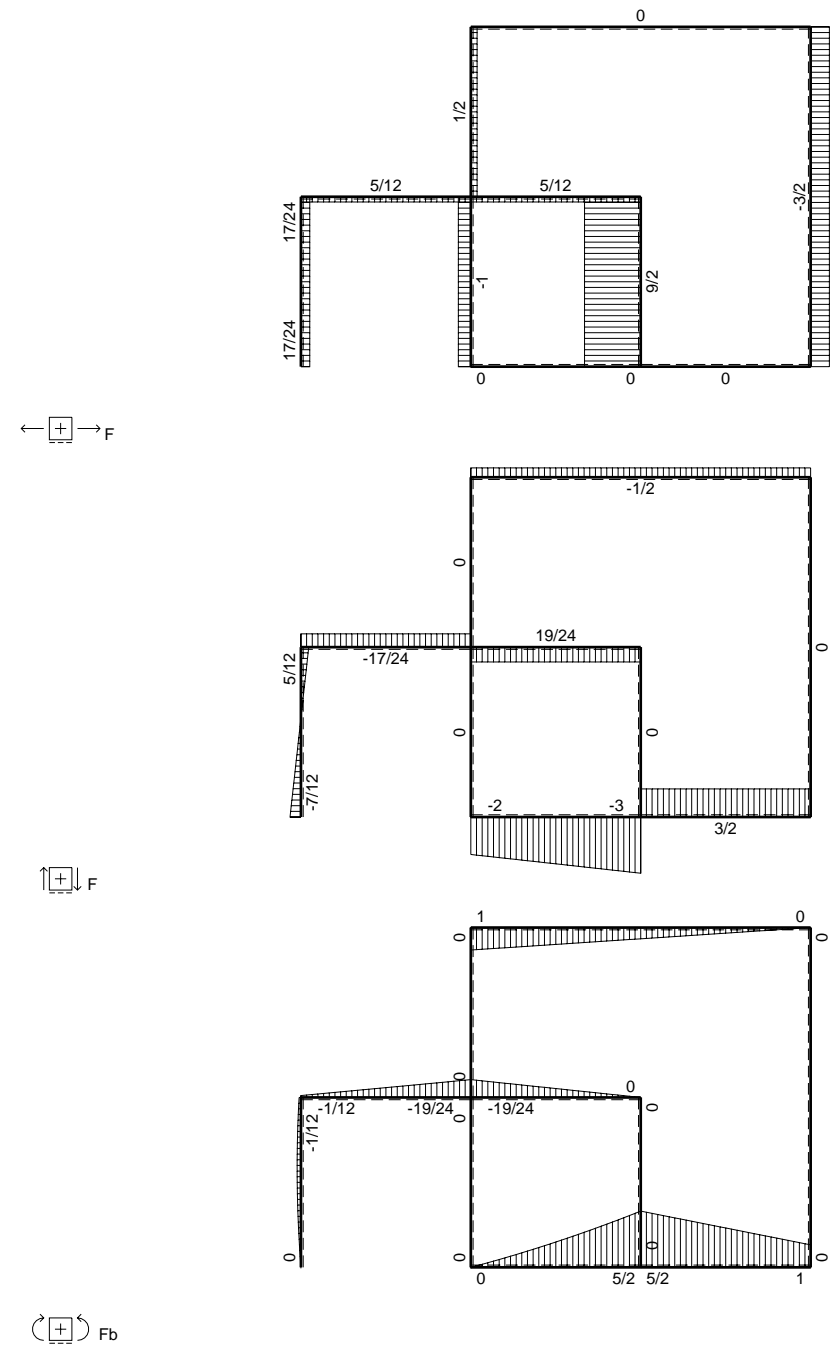
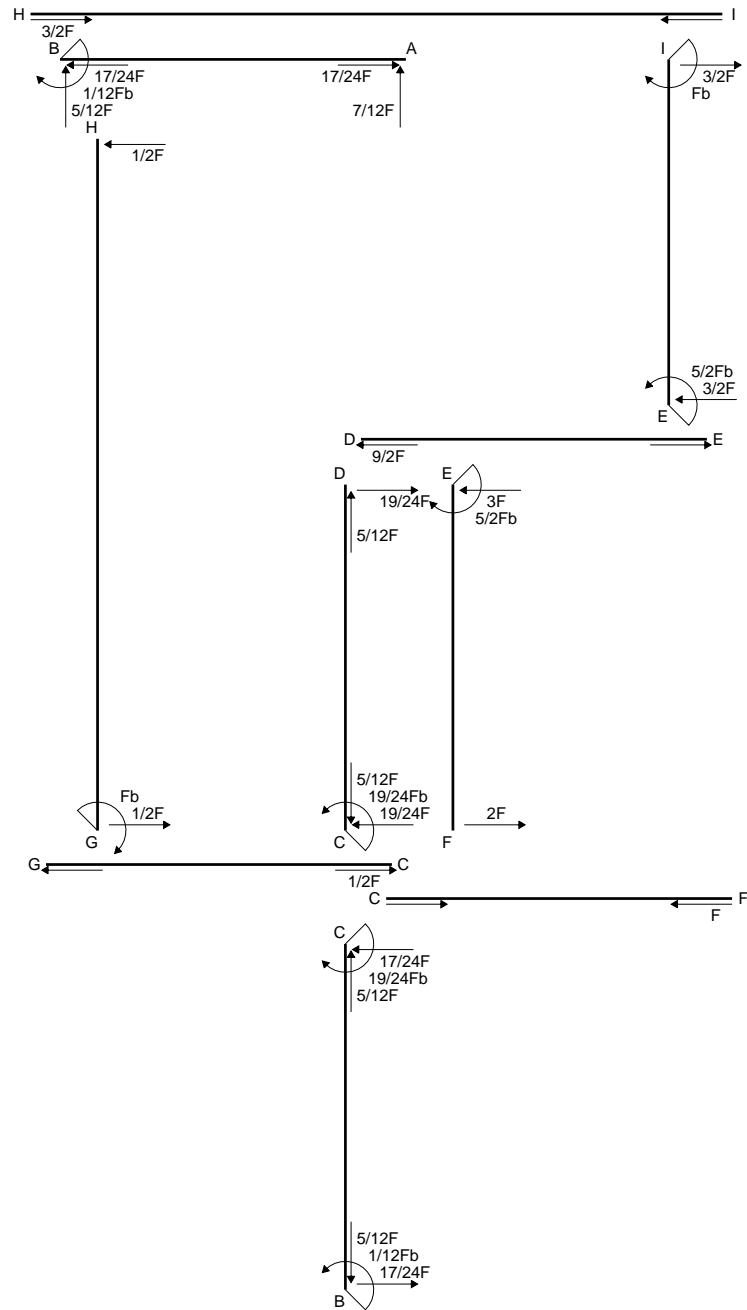
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

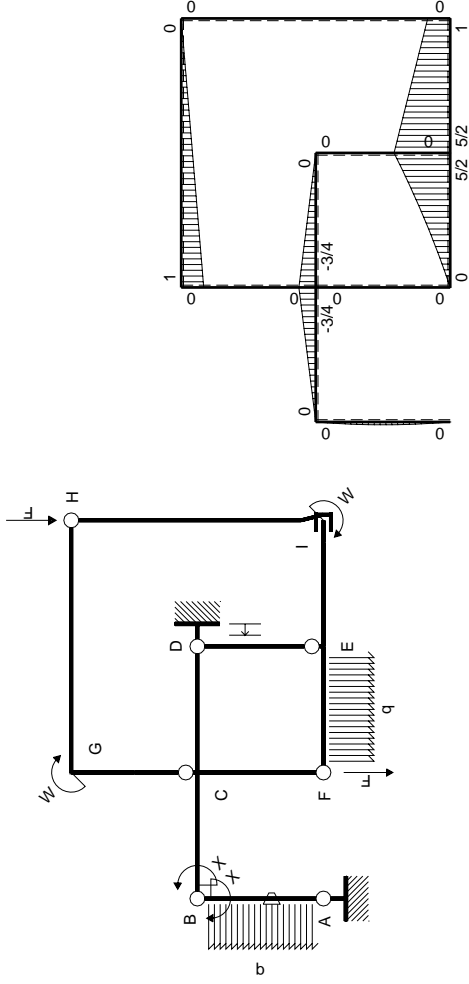
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

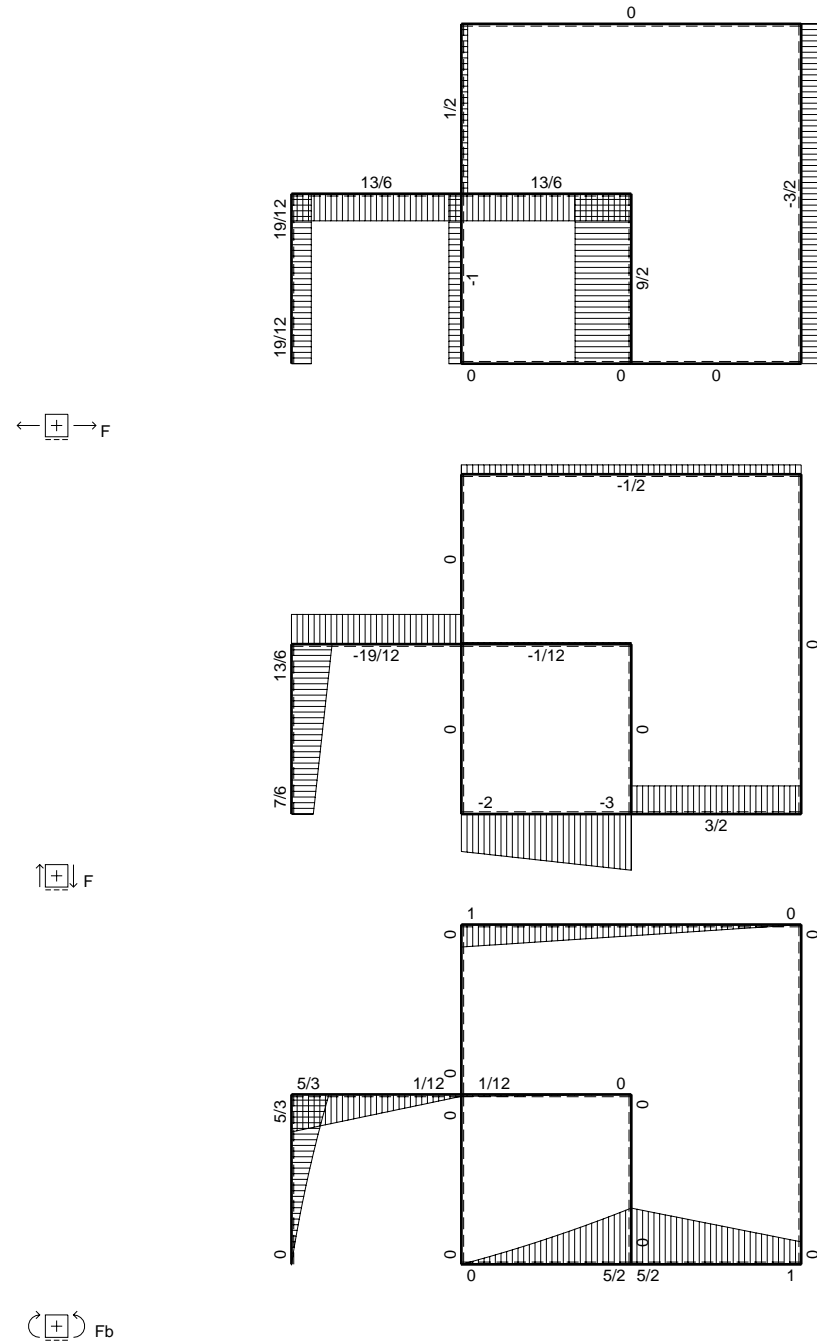
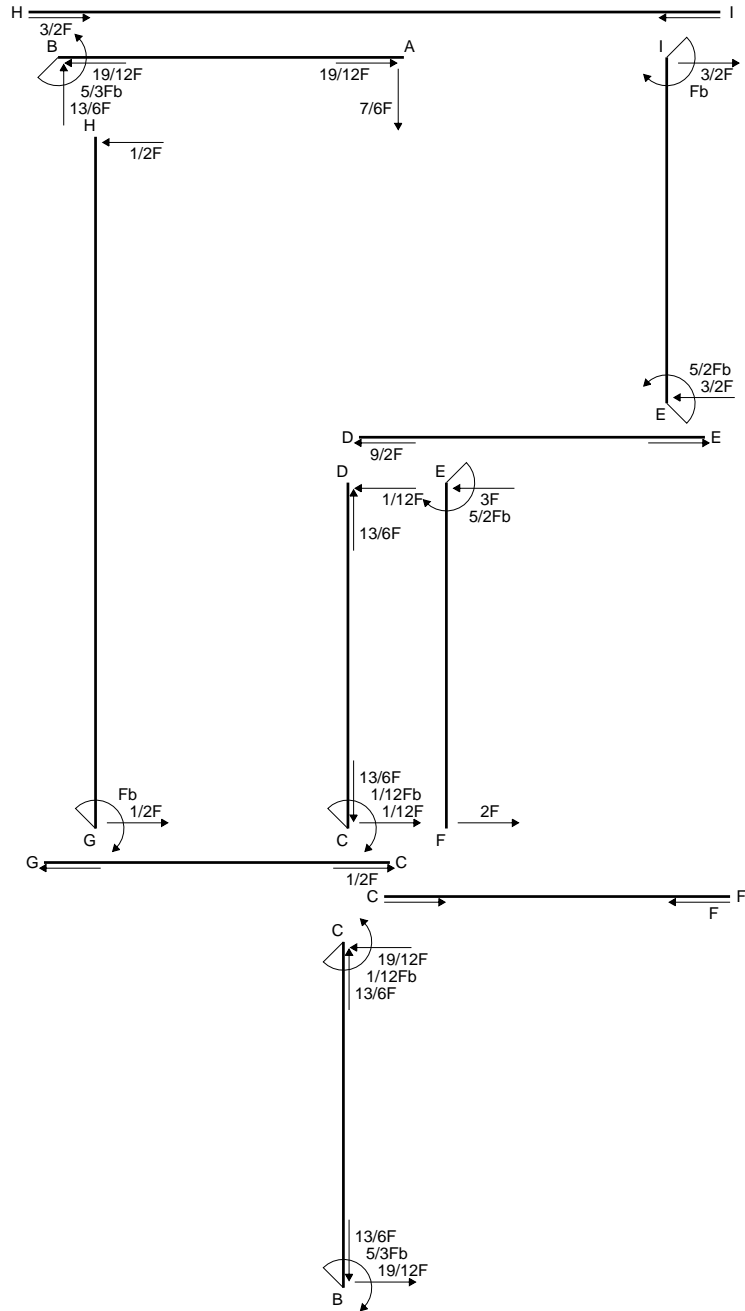
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

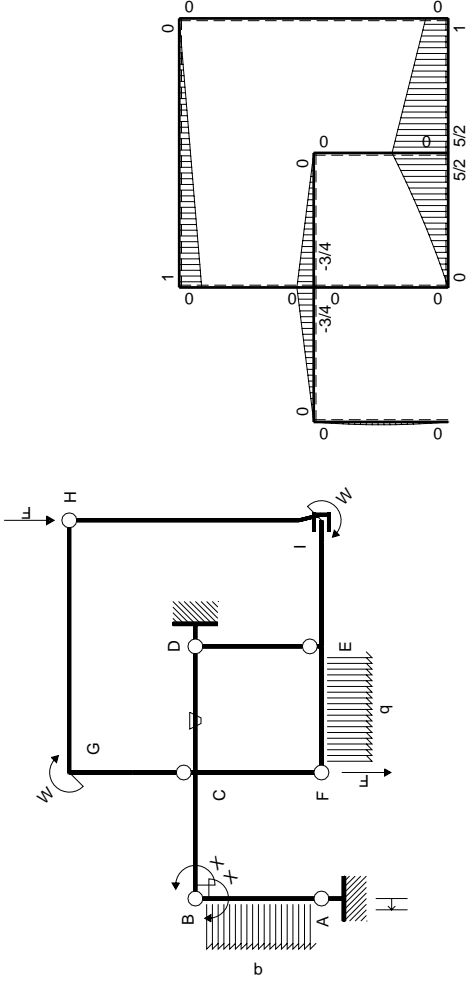
$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

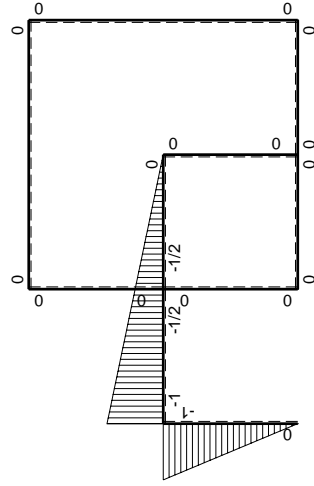


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-5/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

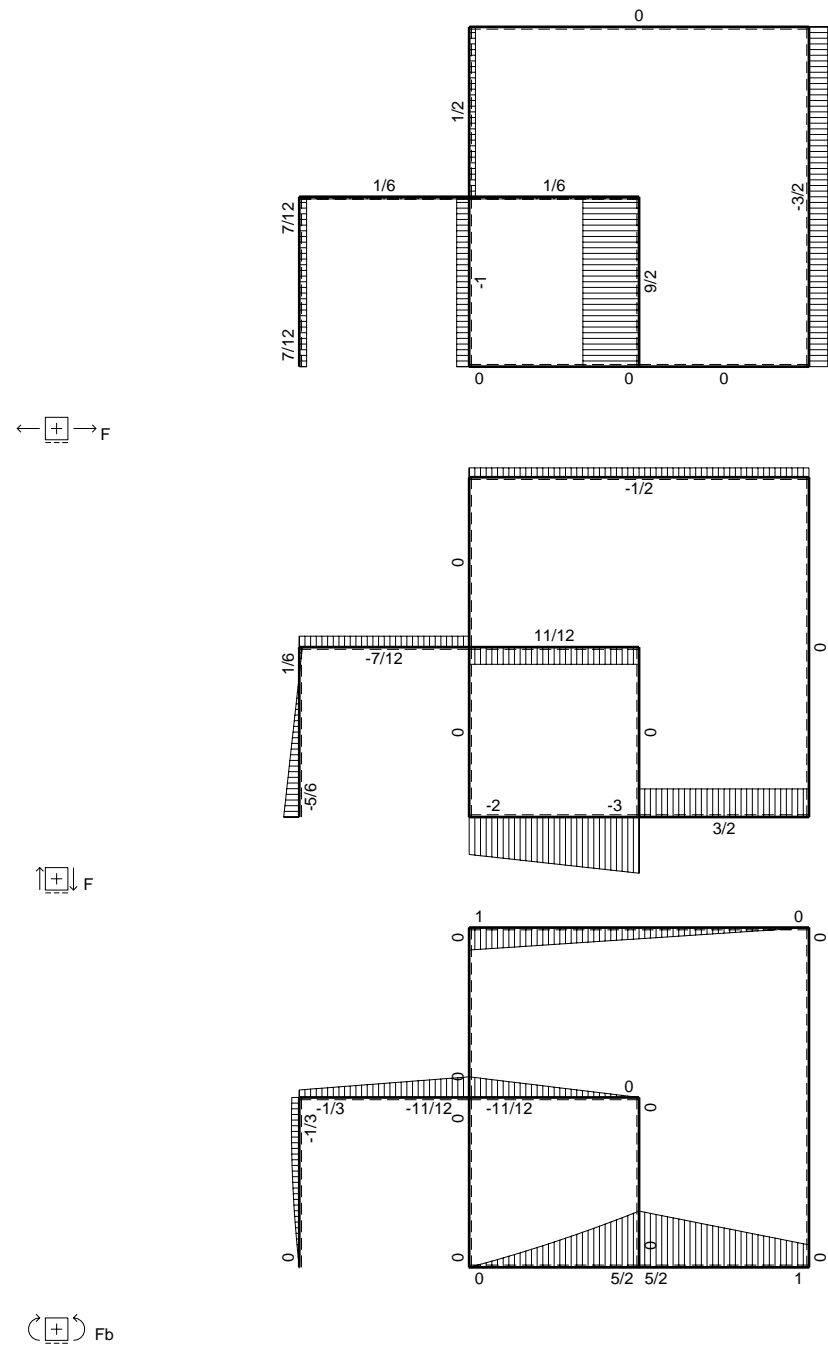
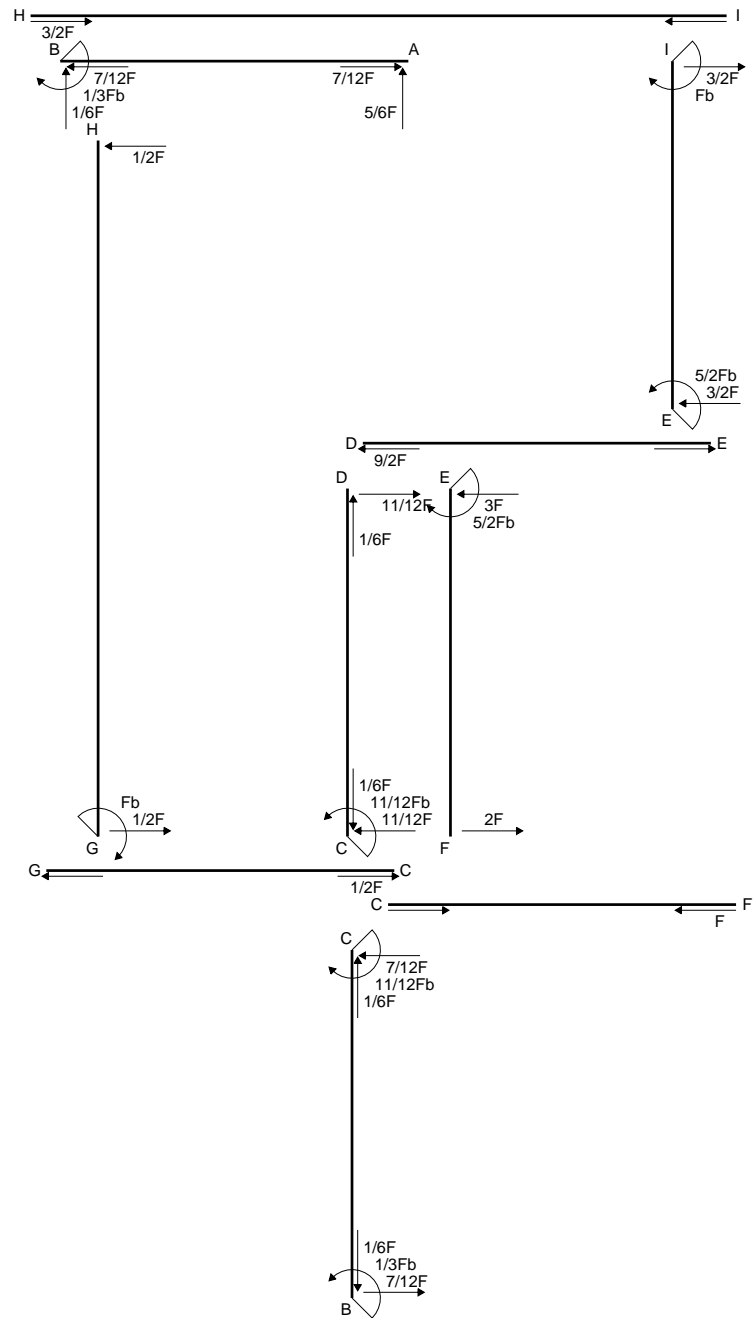
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

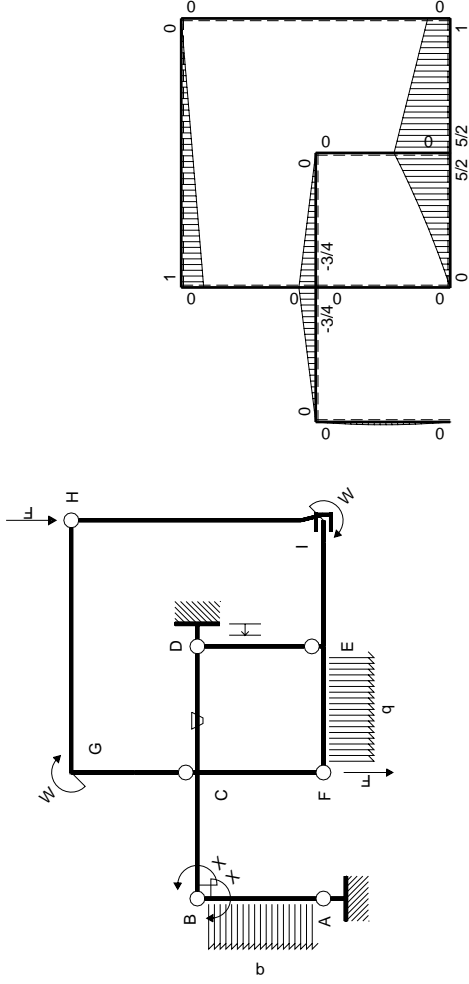
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

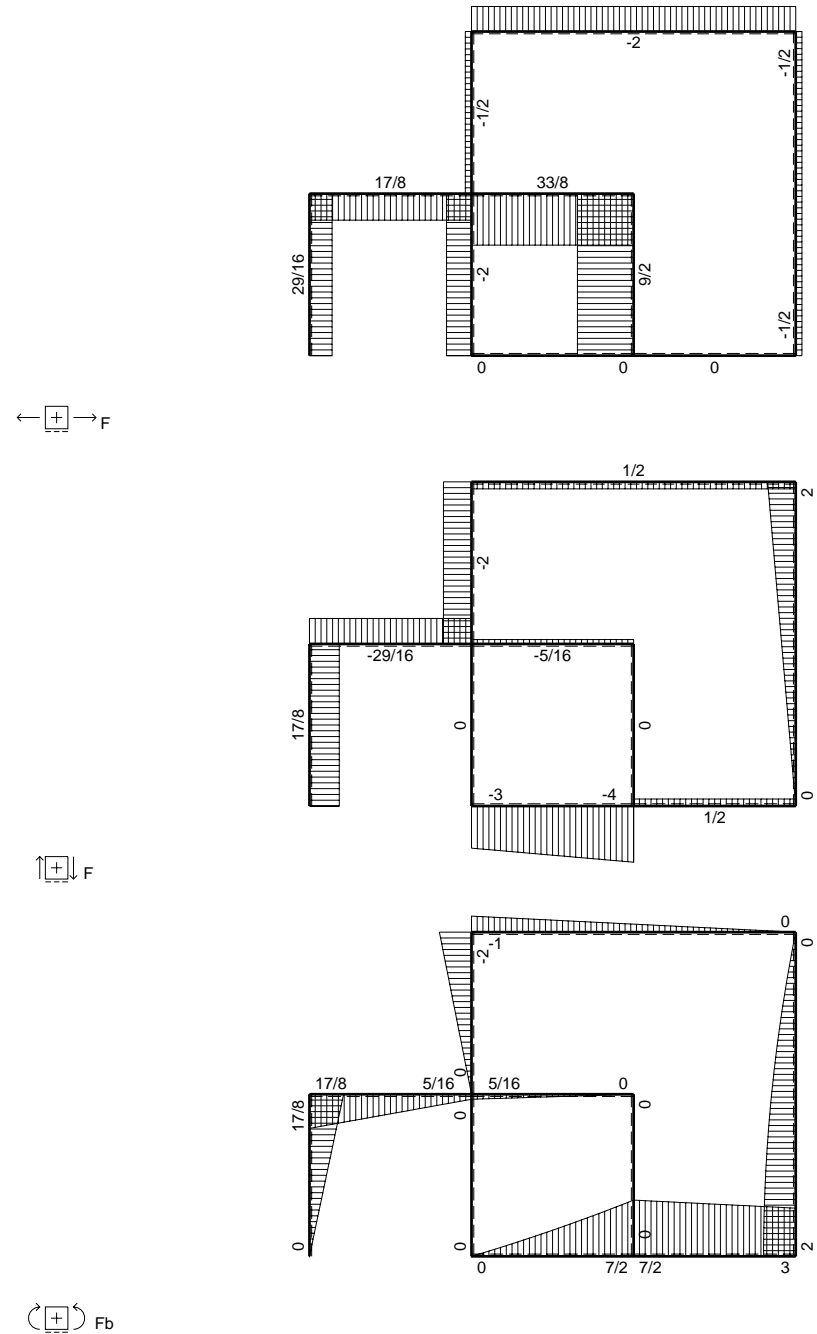
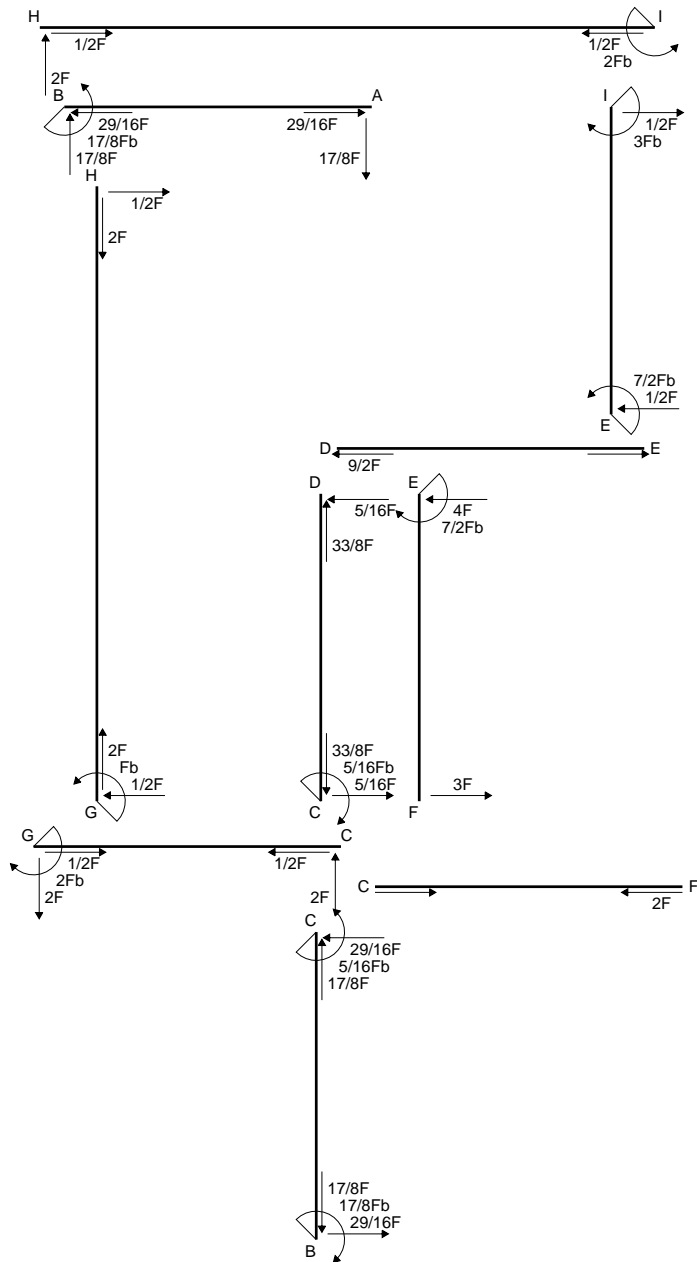
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

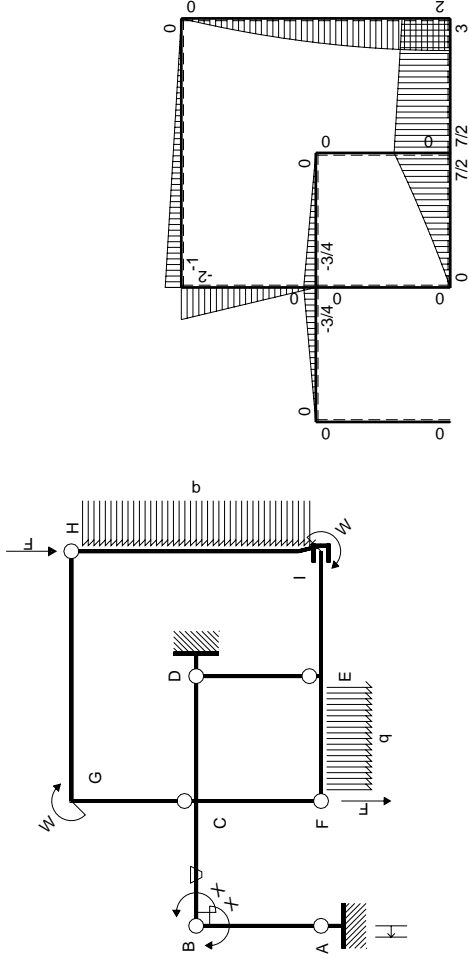
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

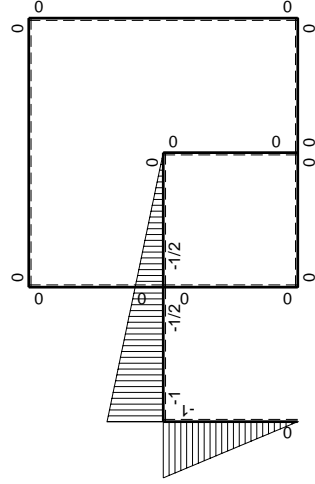
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

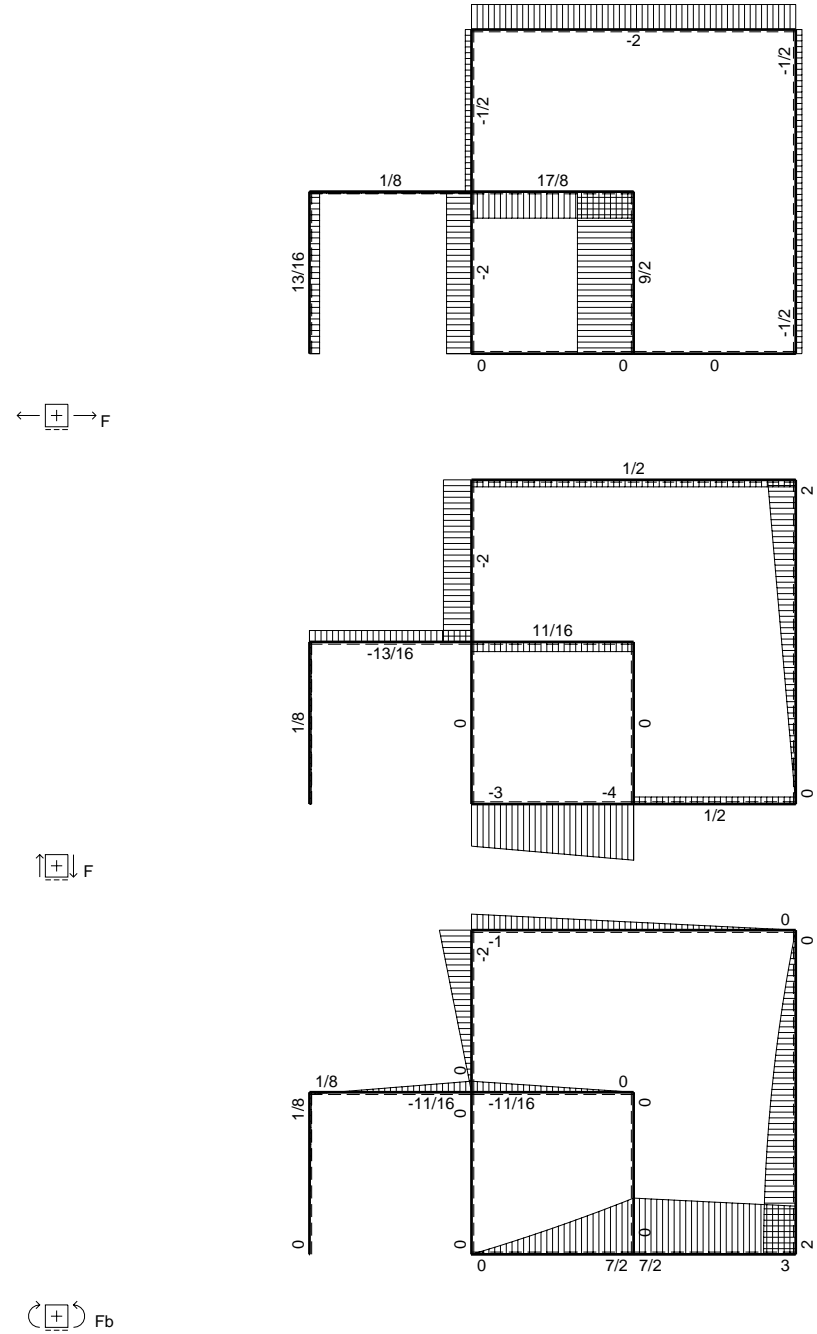
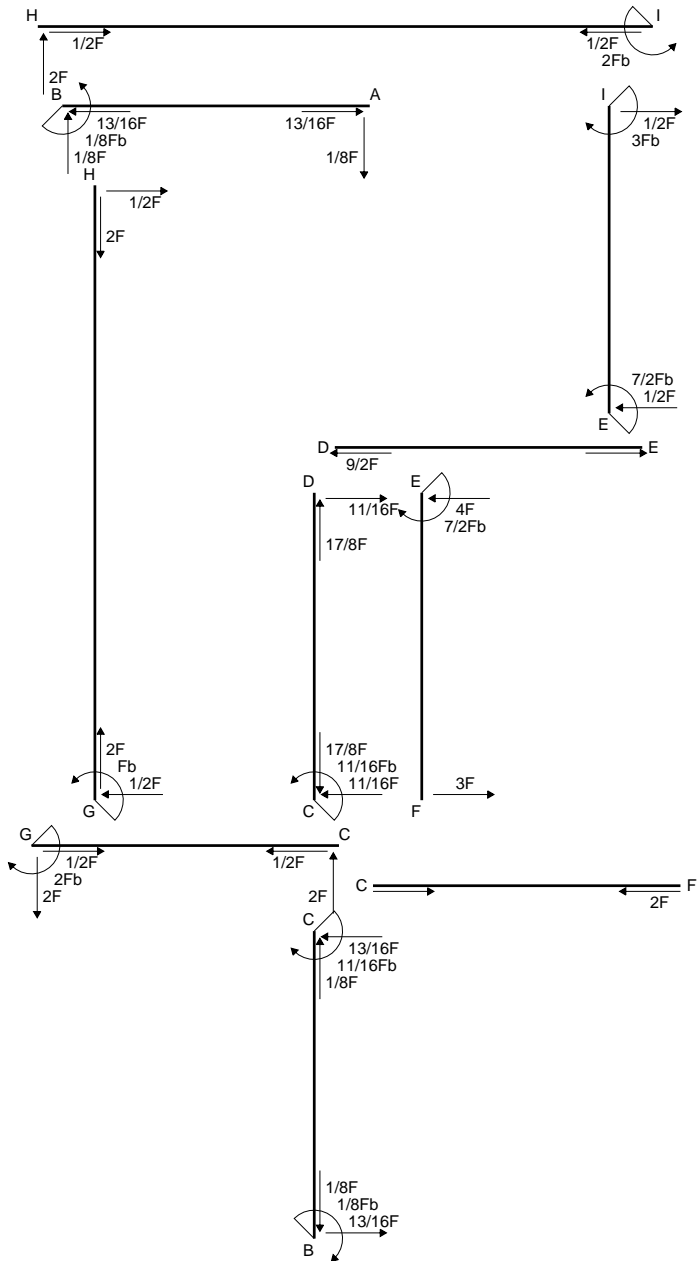
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

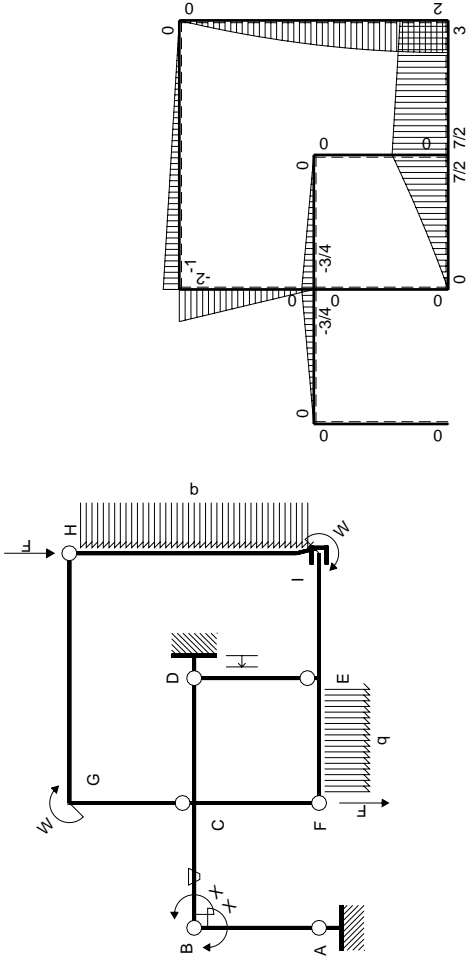
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

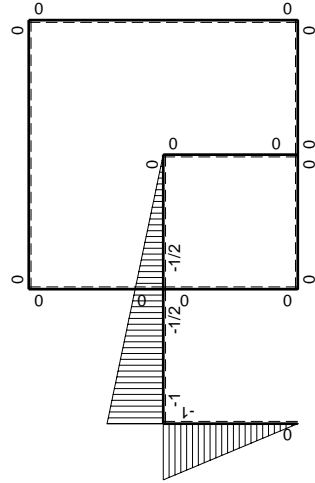
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

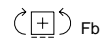
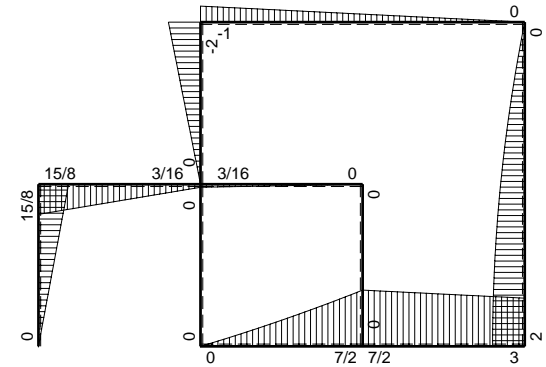
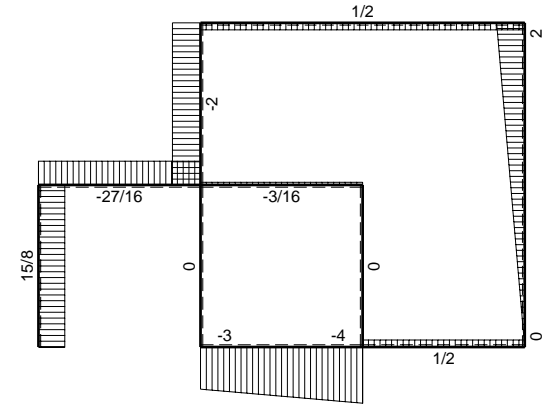
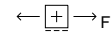
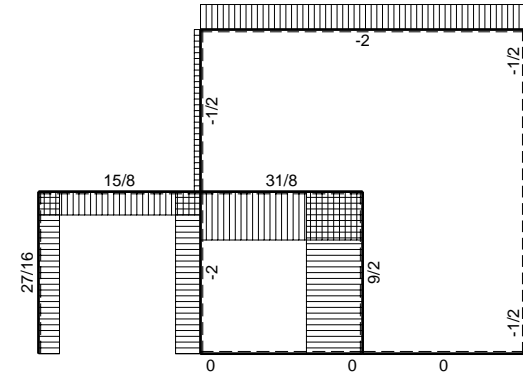
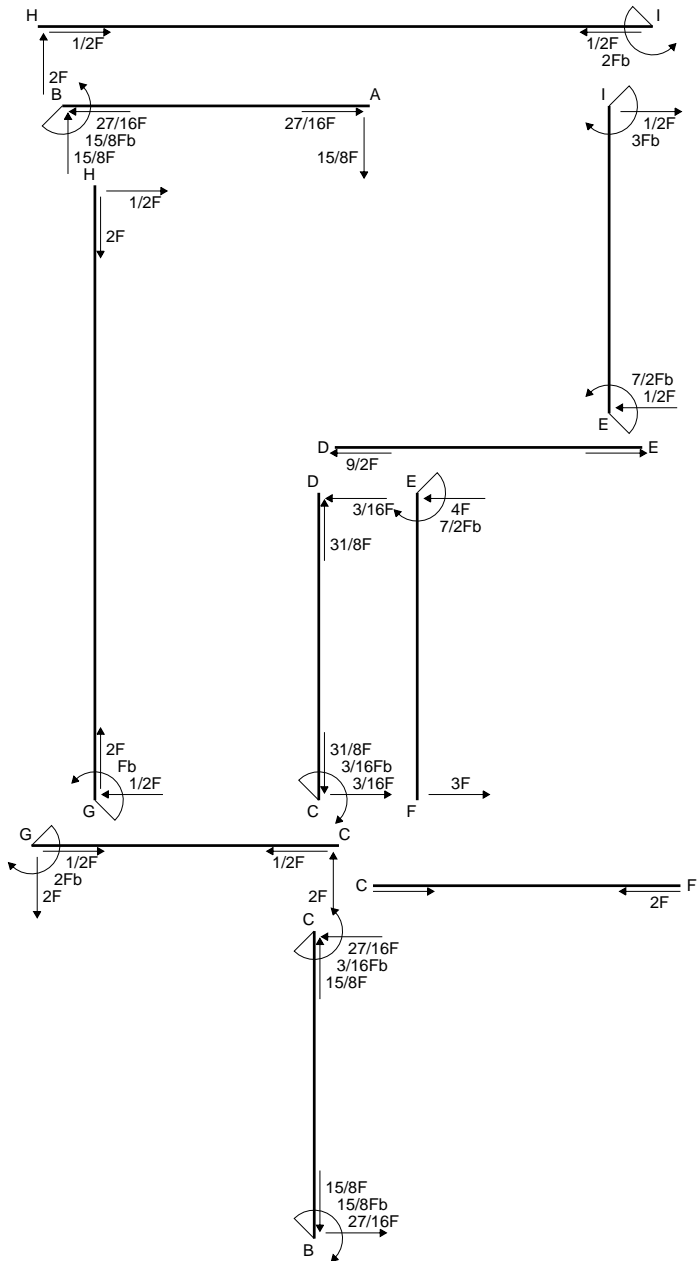
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

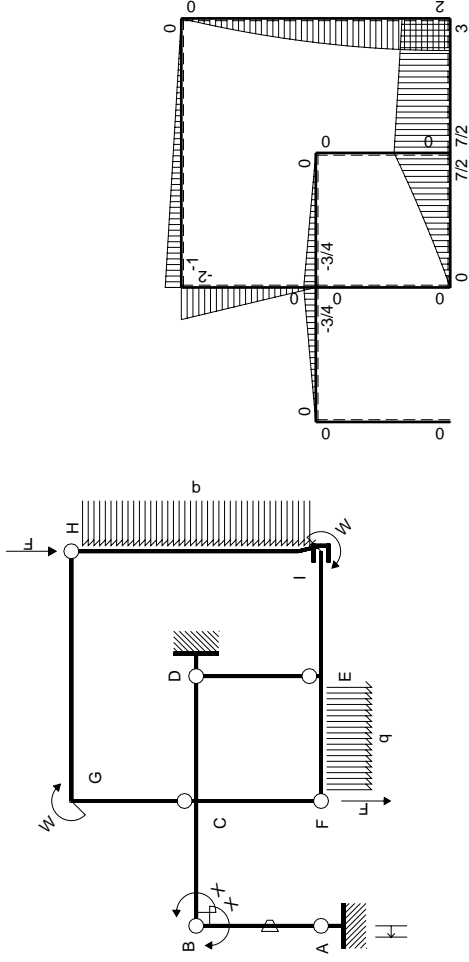
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

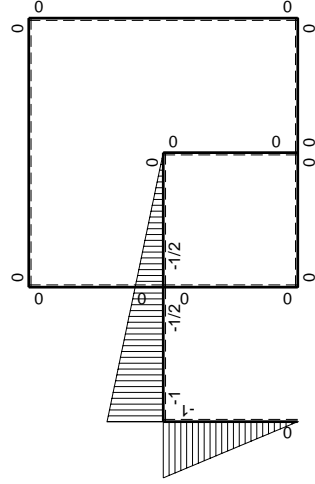
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

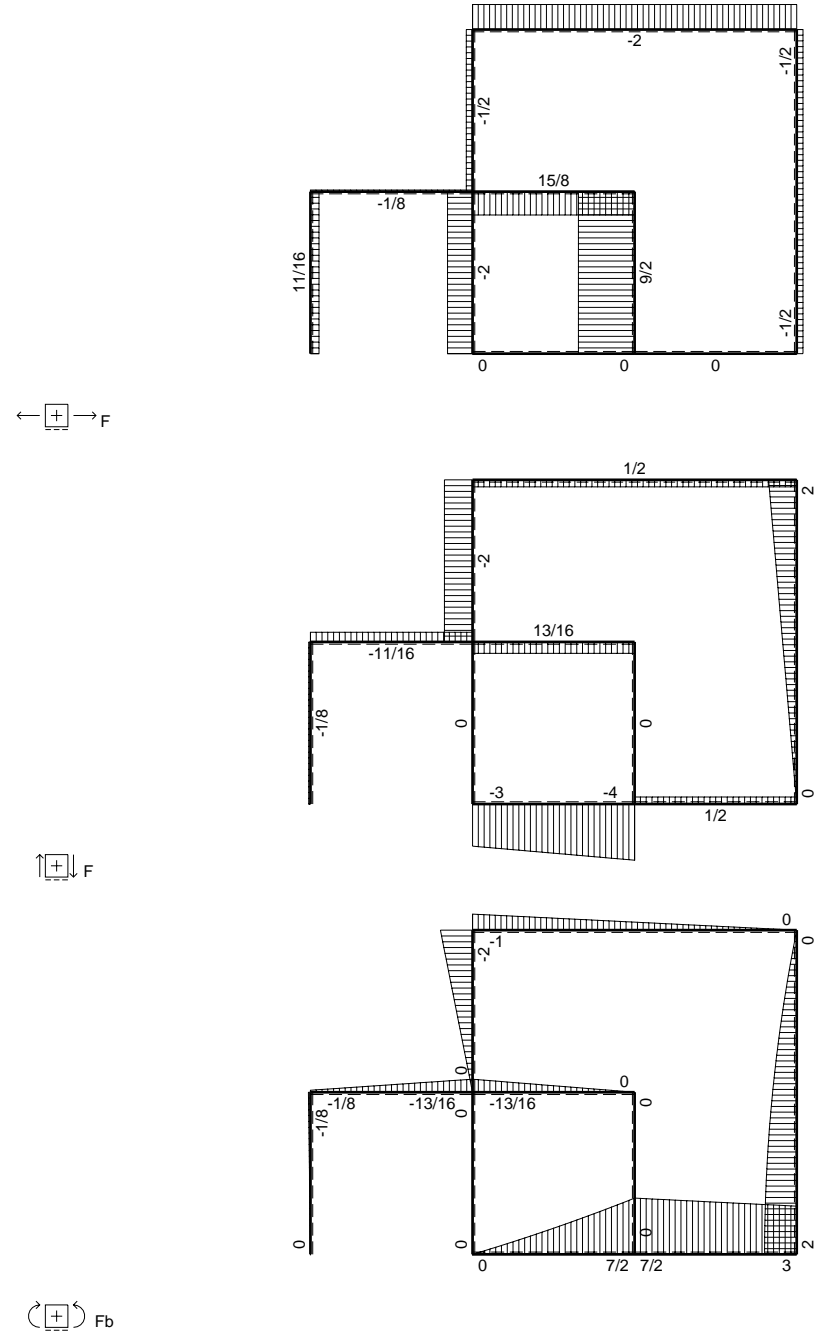
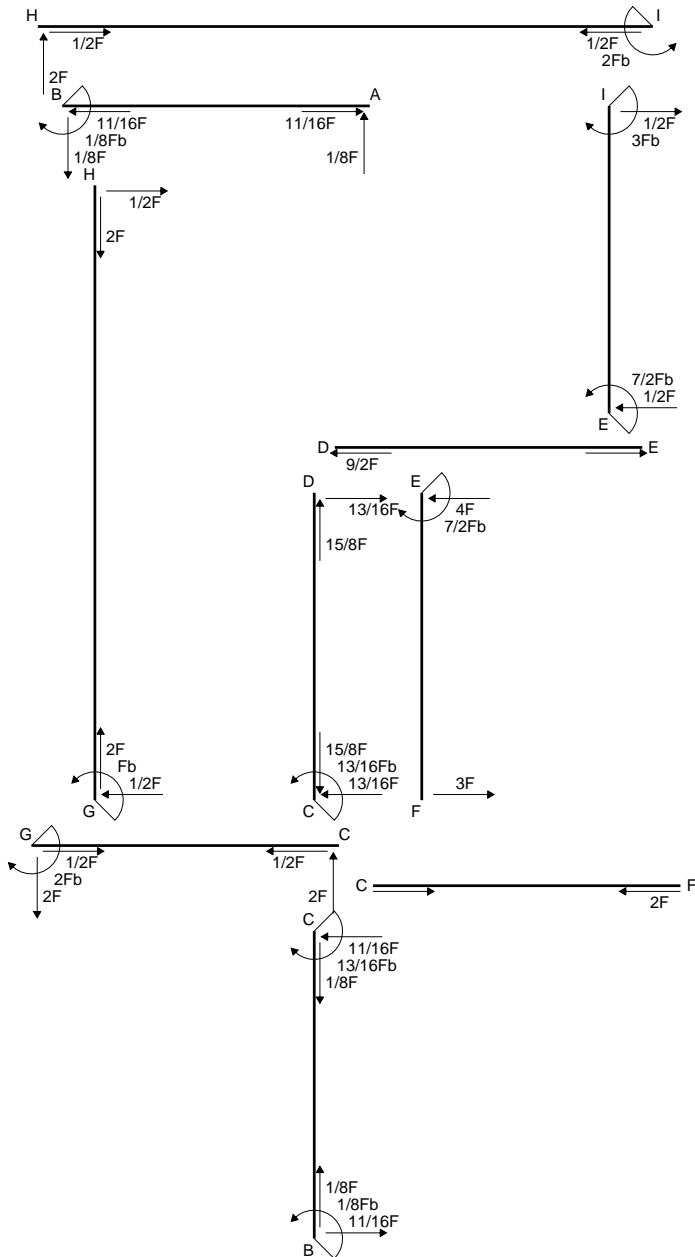
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

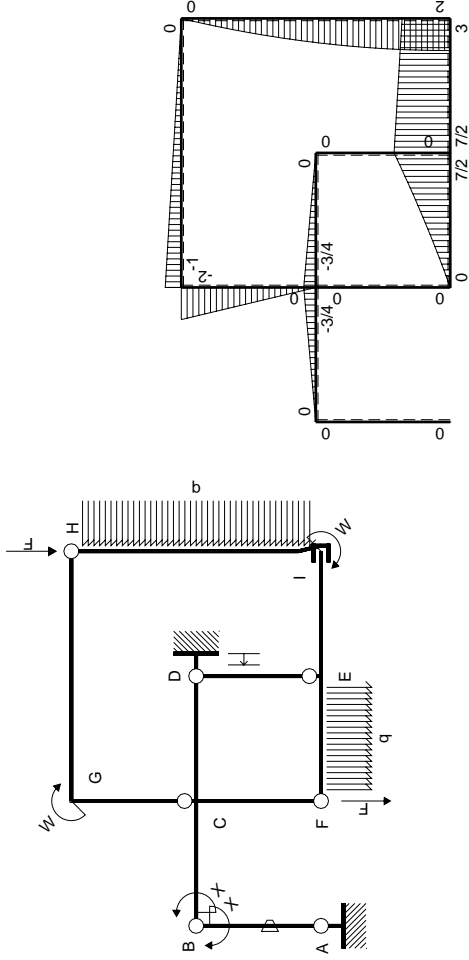
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

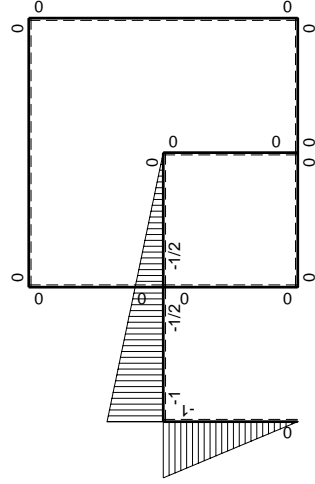
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

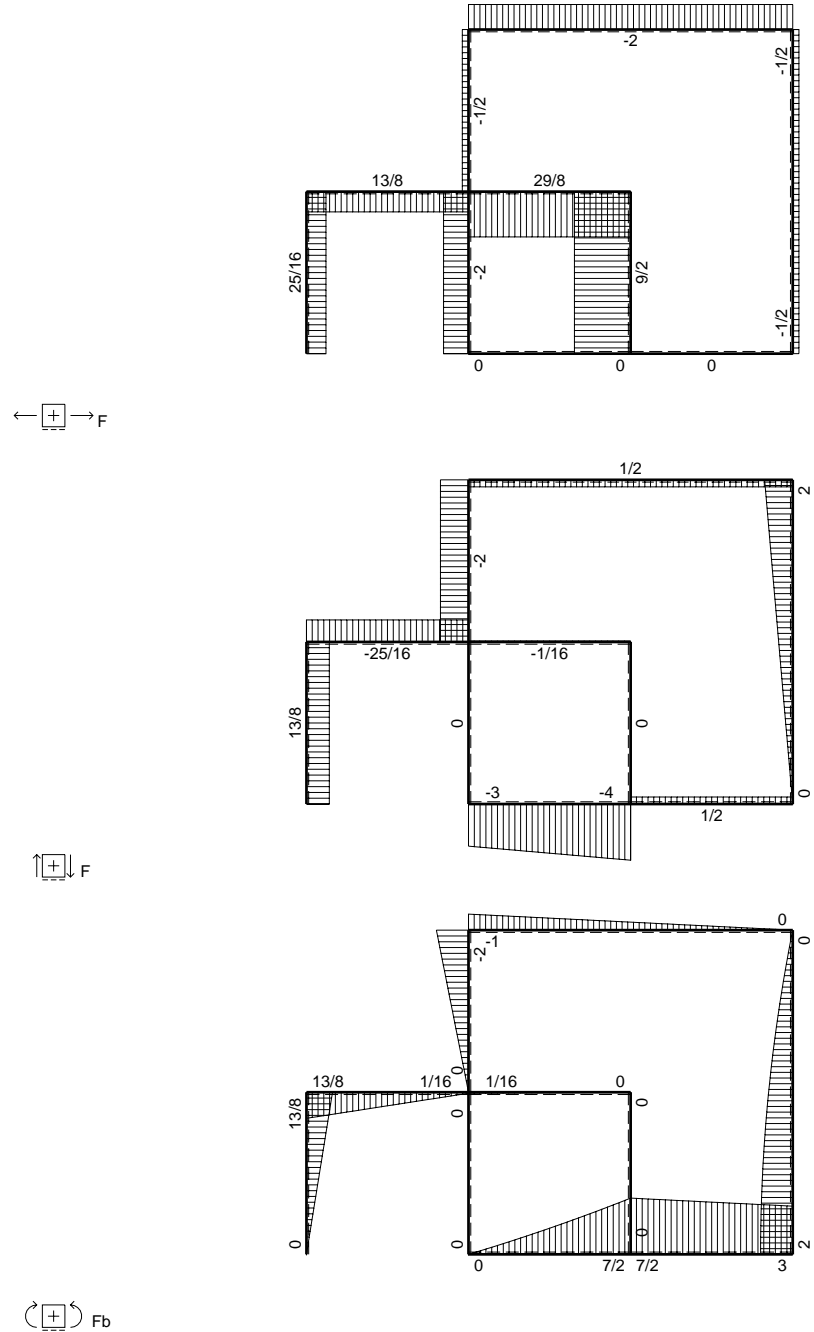
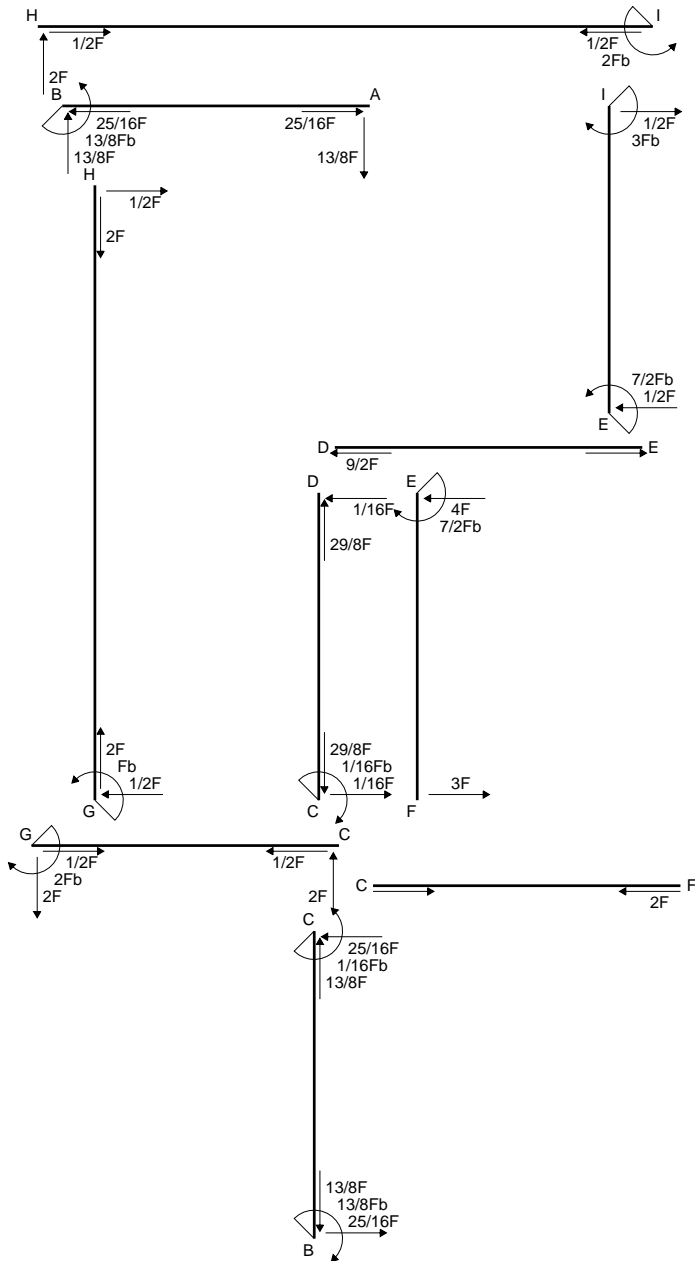
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

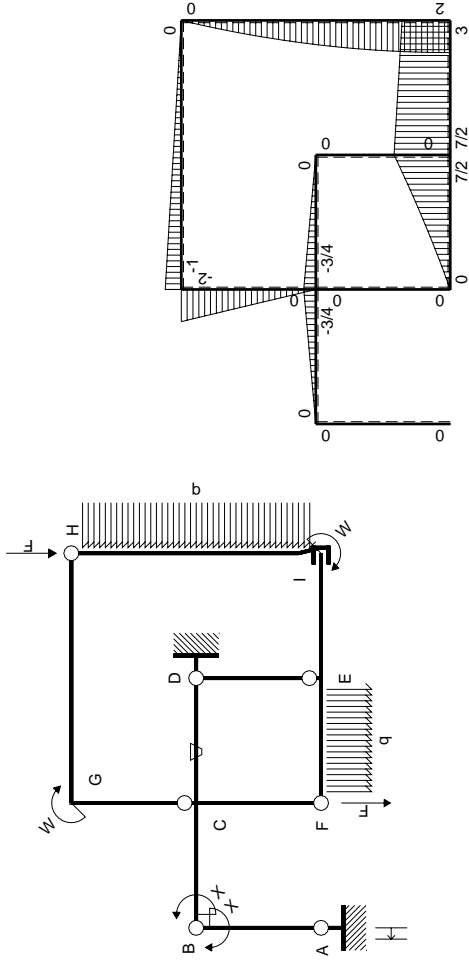
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

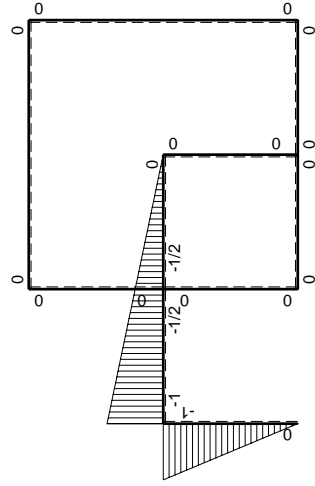
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$13/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-13/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

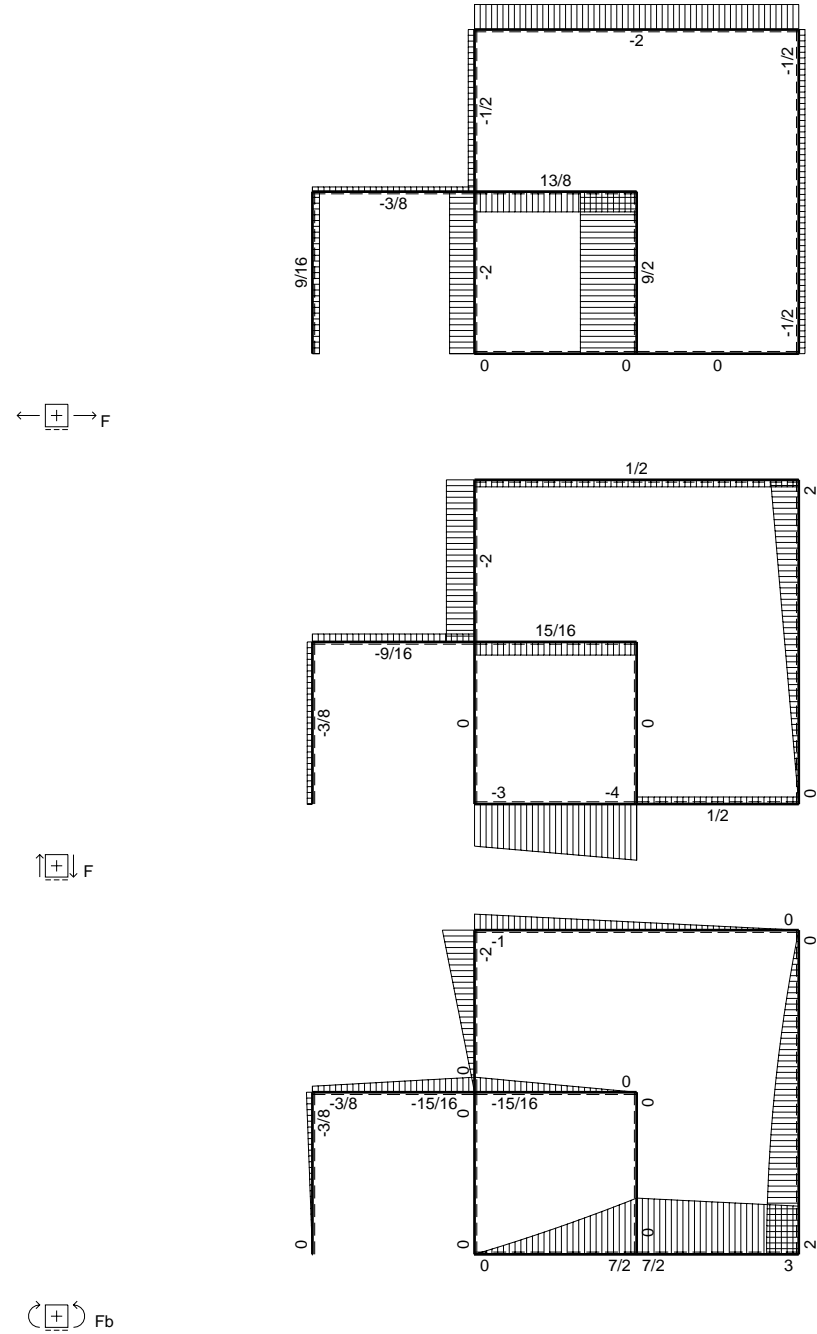
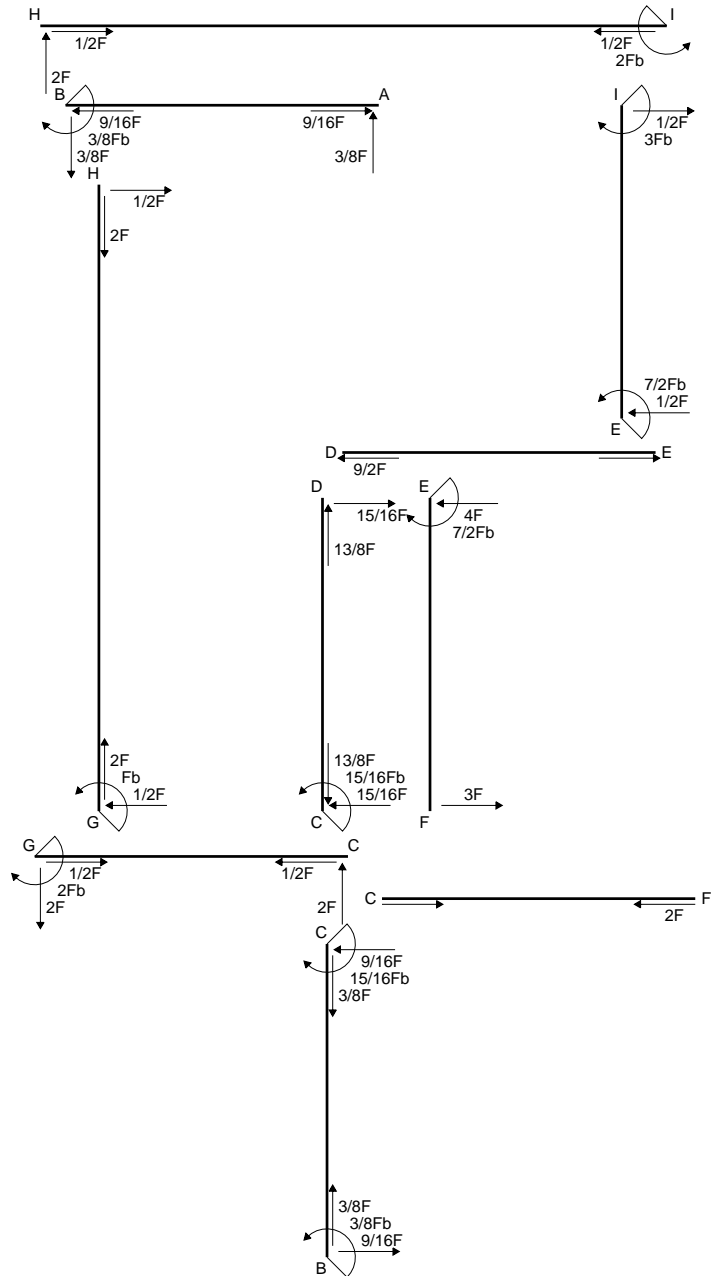
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

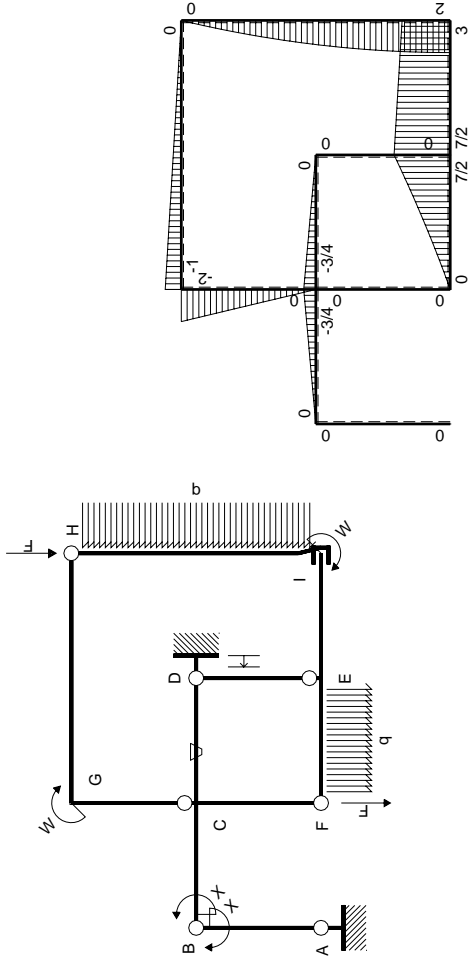
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

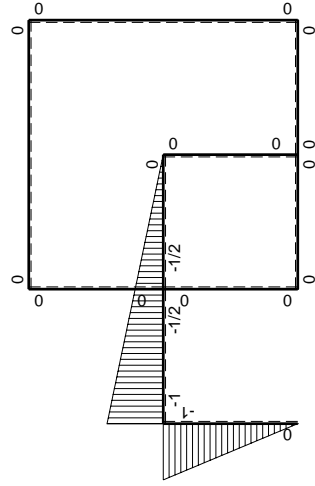
$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+1/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$3/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

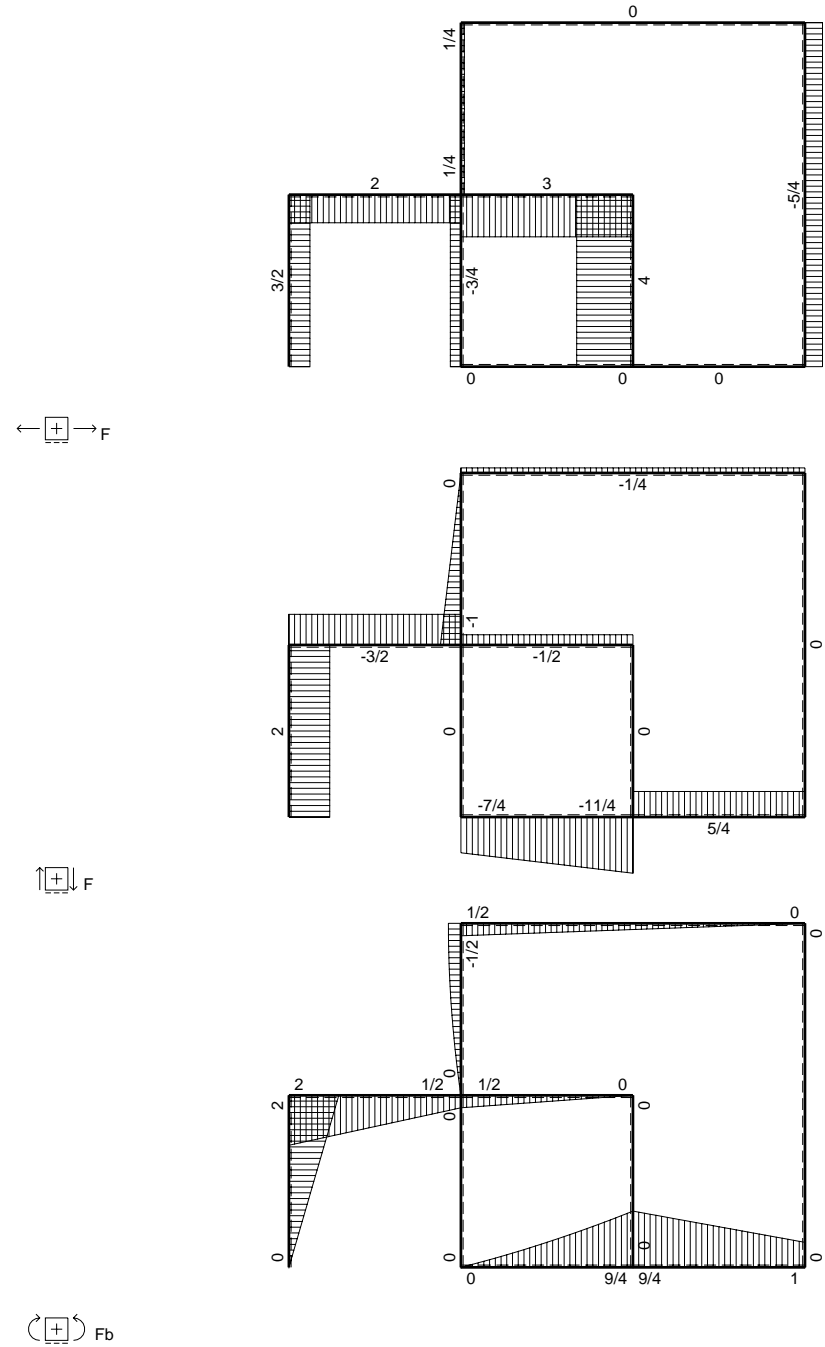
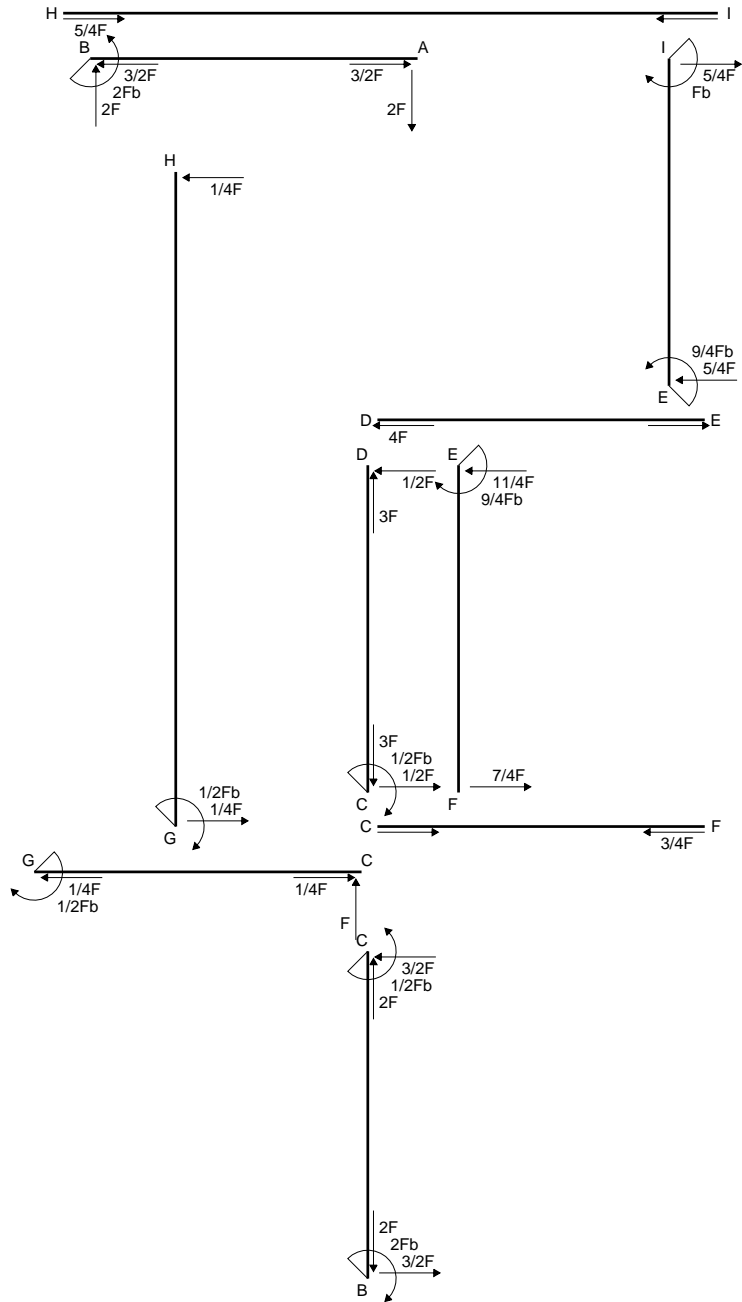
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

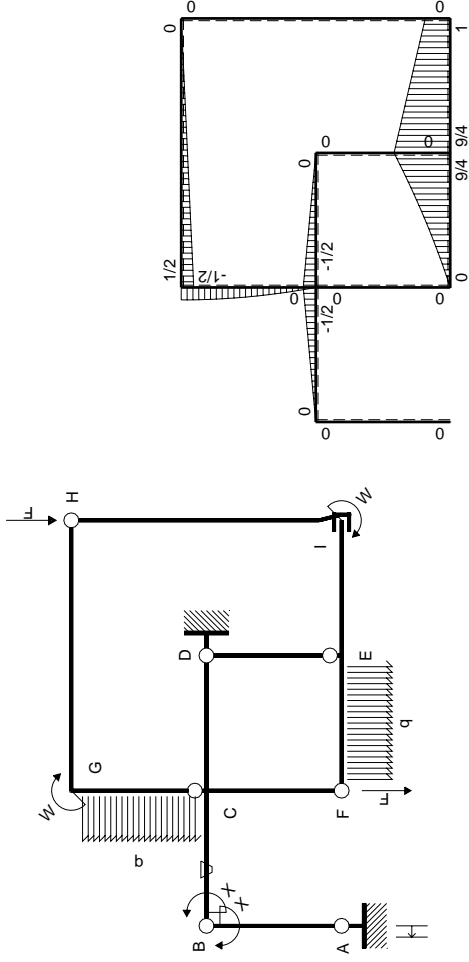
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

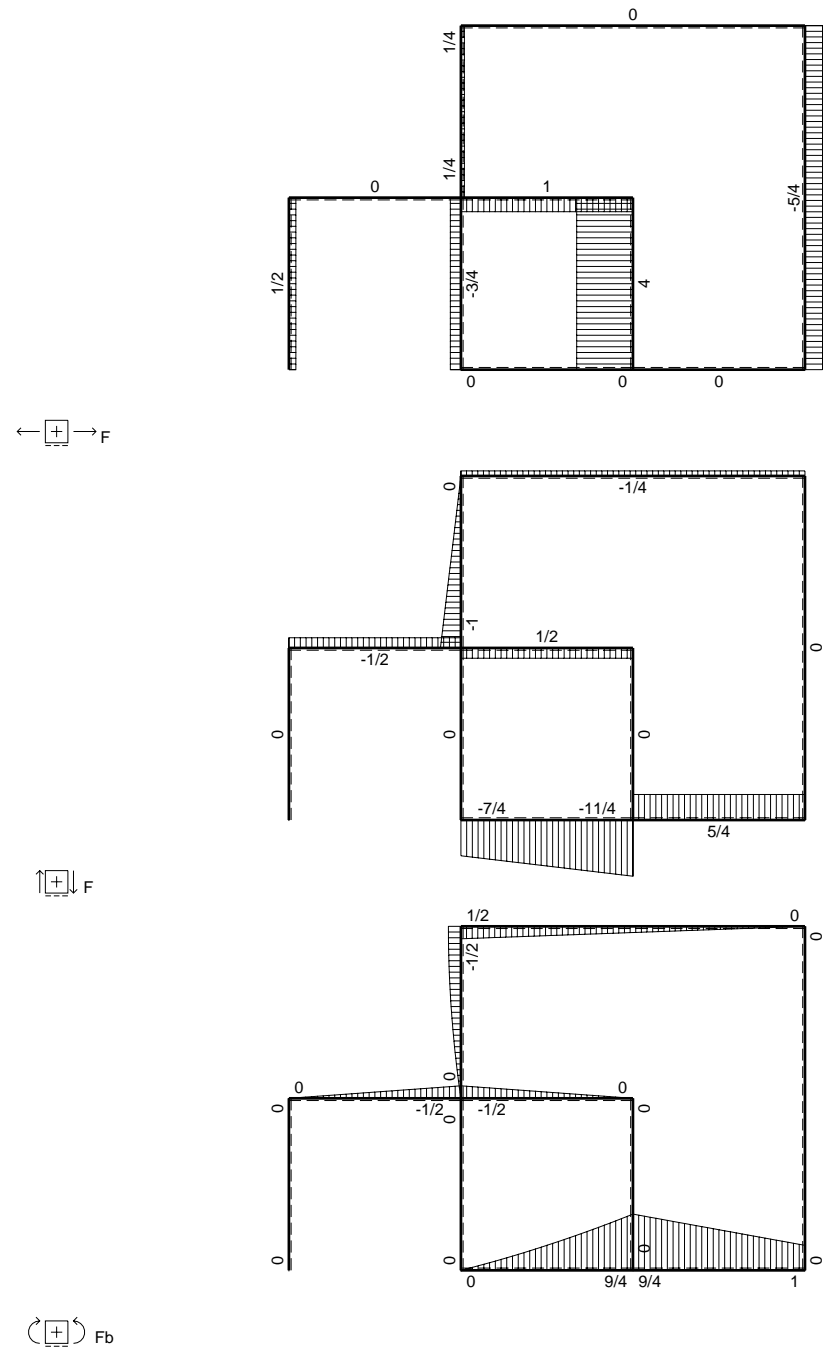
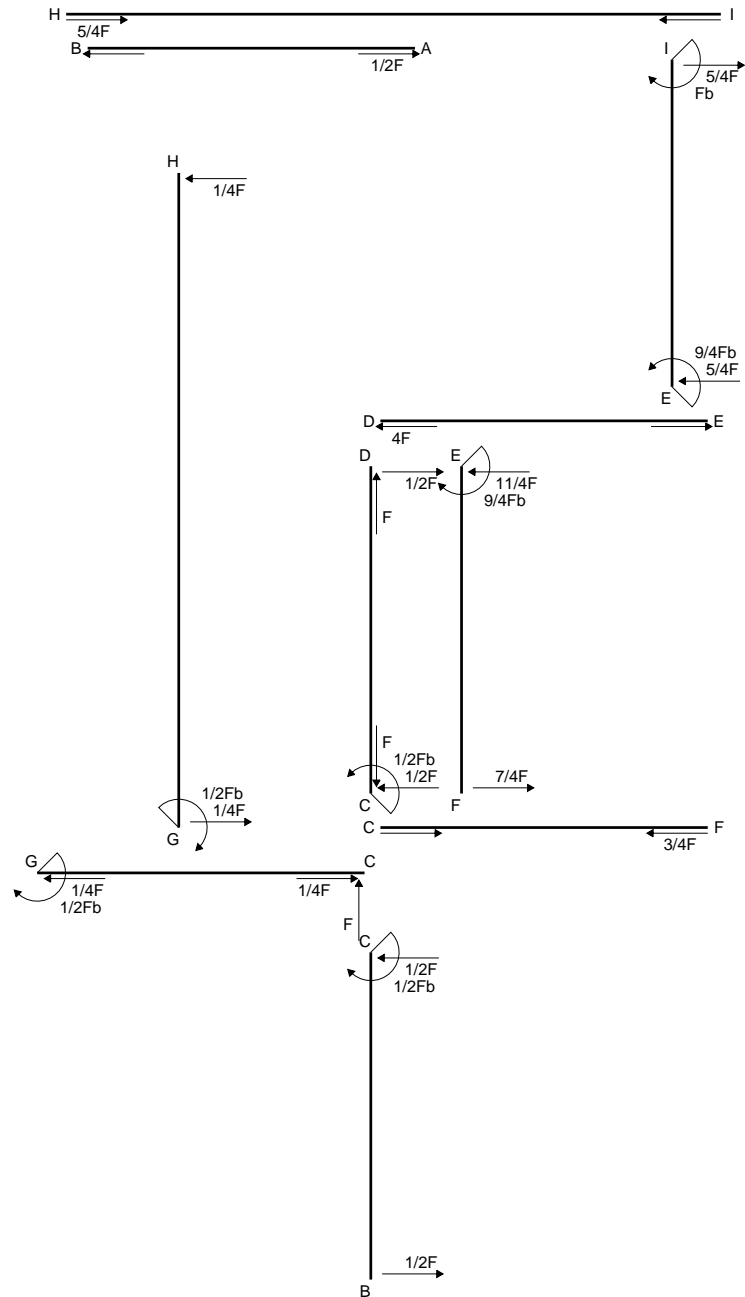
$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

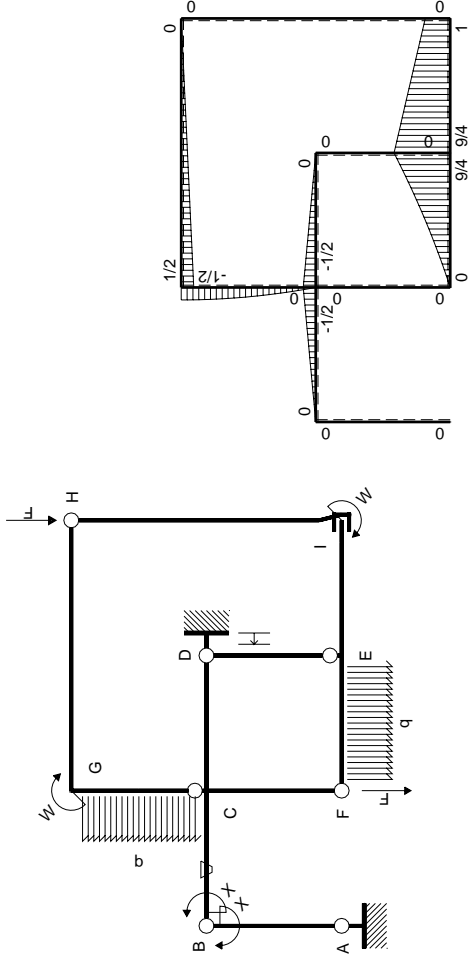
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

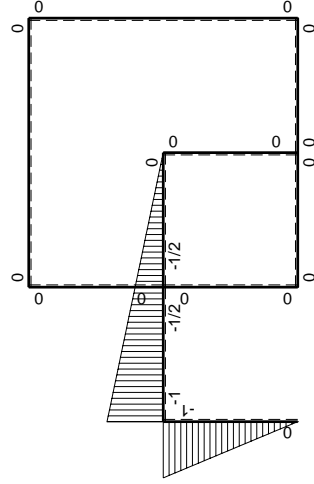
$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						0	Xb/EJ
	iperstatica $X=W_{BC}$						0	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

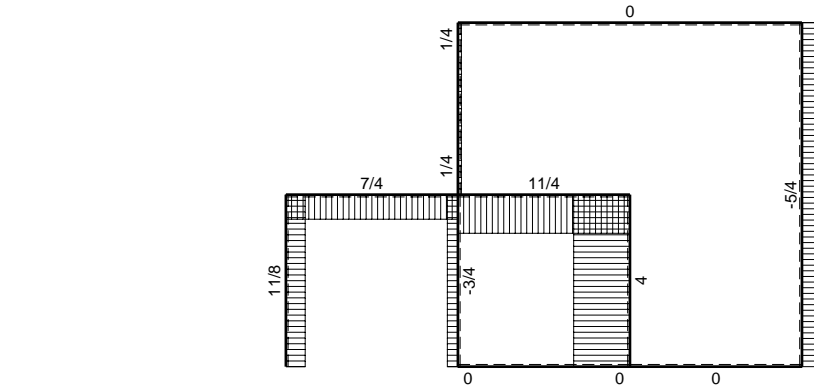
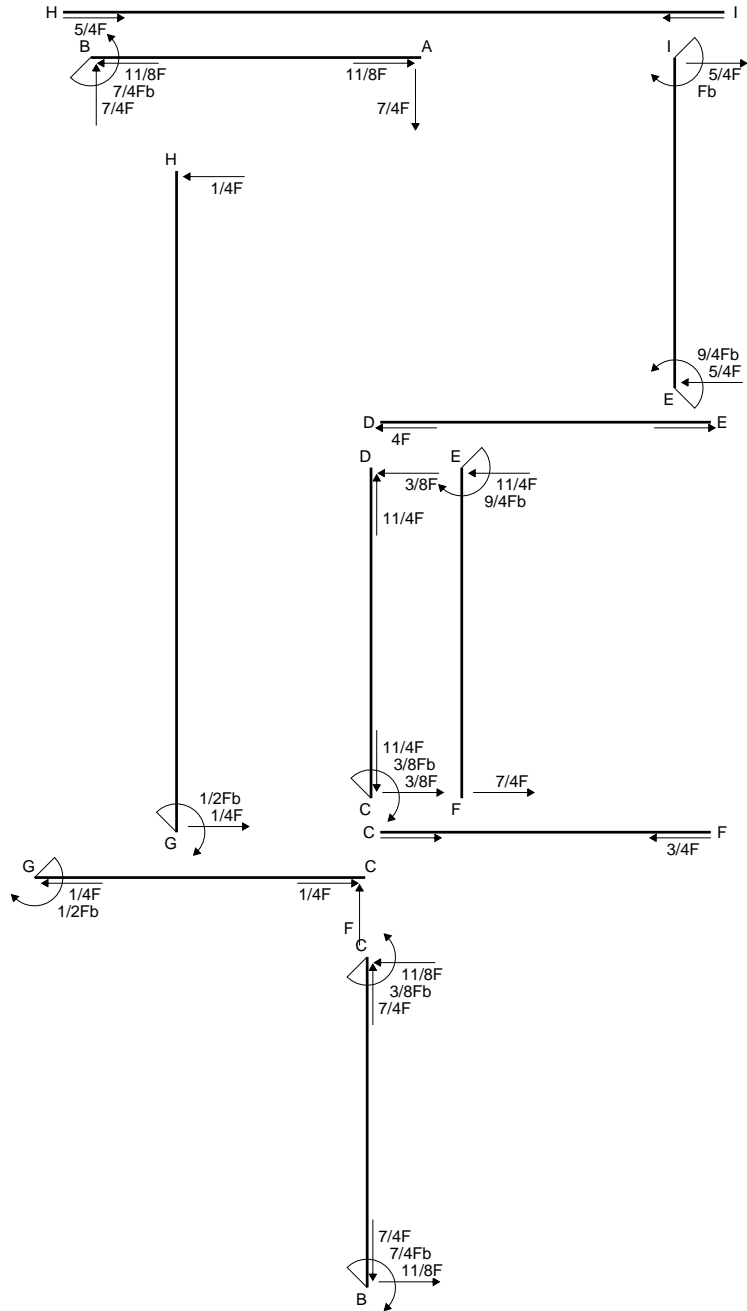
$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

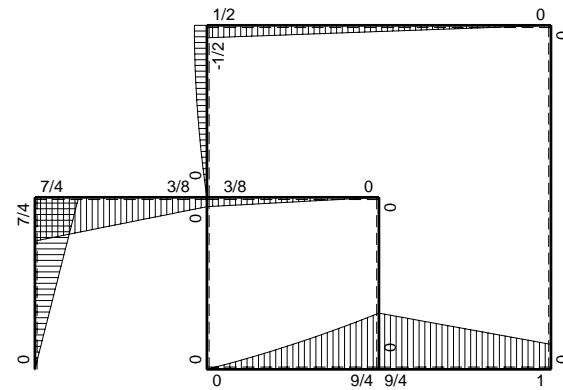
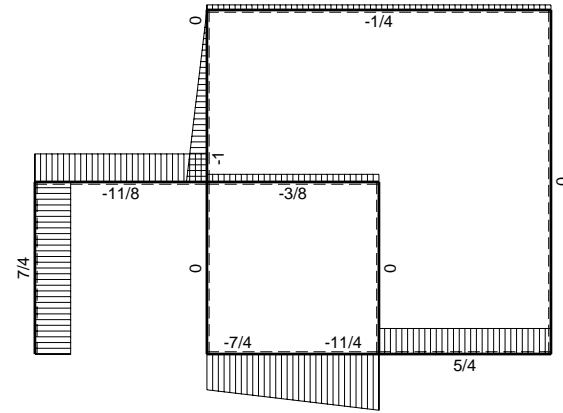
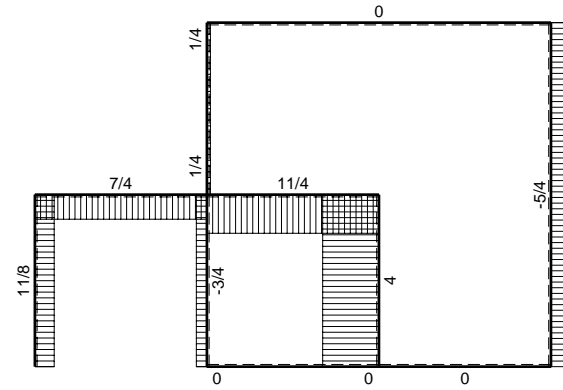
$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

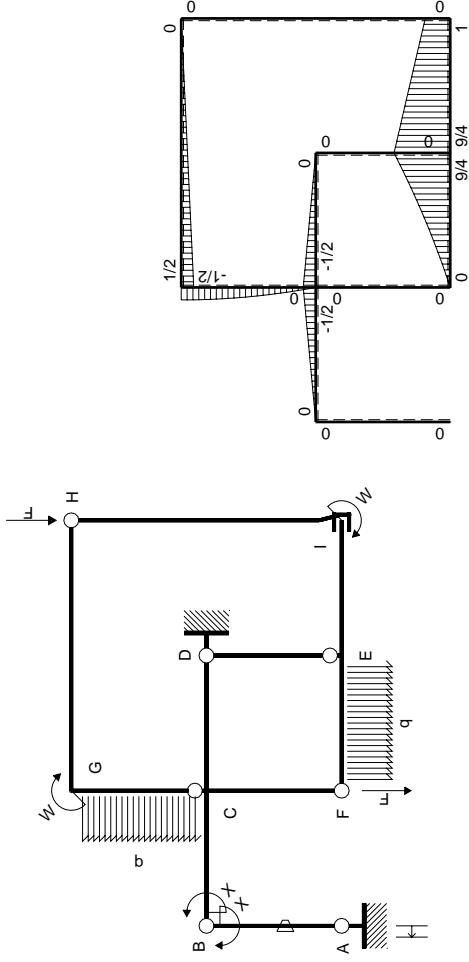


← ⊕ → F

↑ ⊕ ↓ F

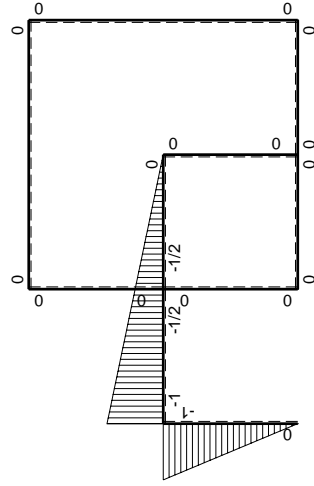
⊕ ⊖ F_b





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

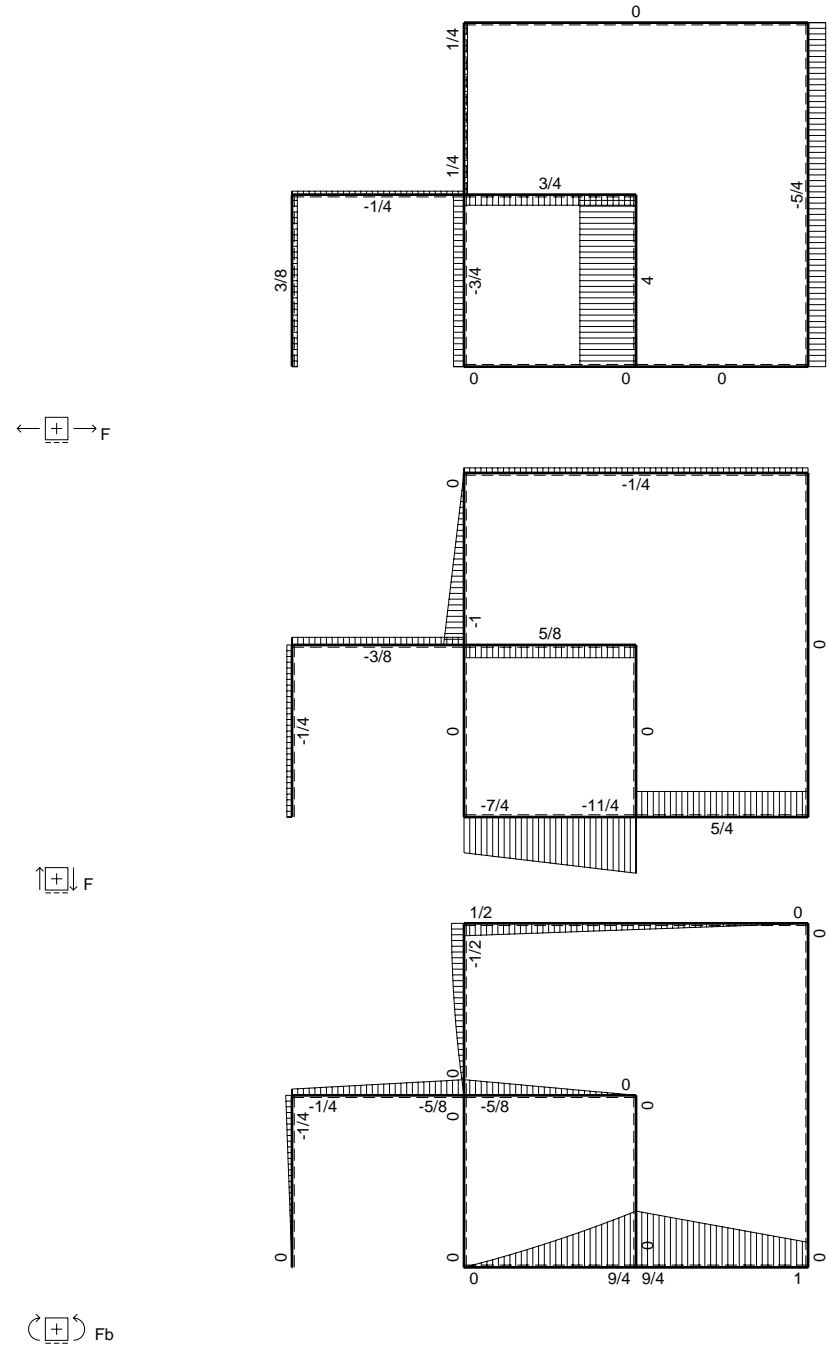
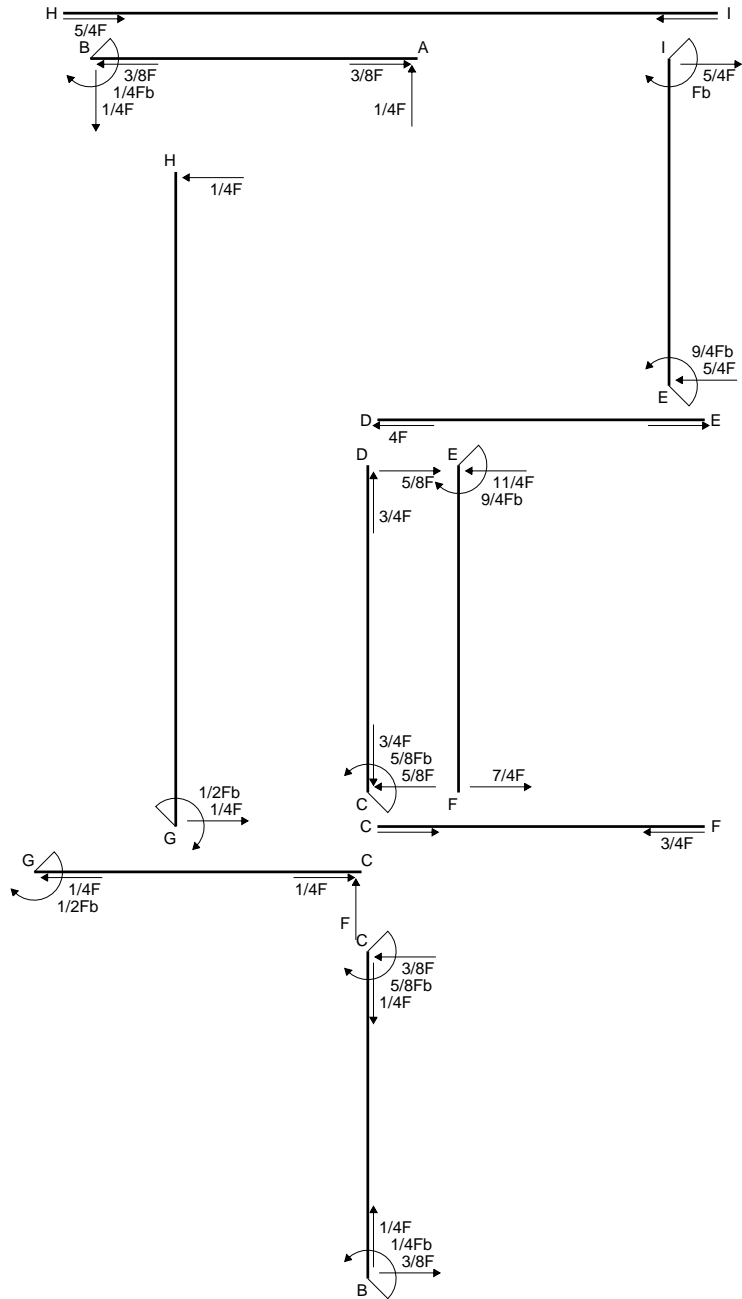
$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

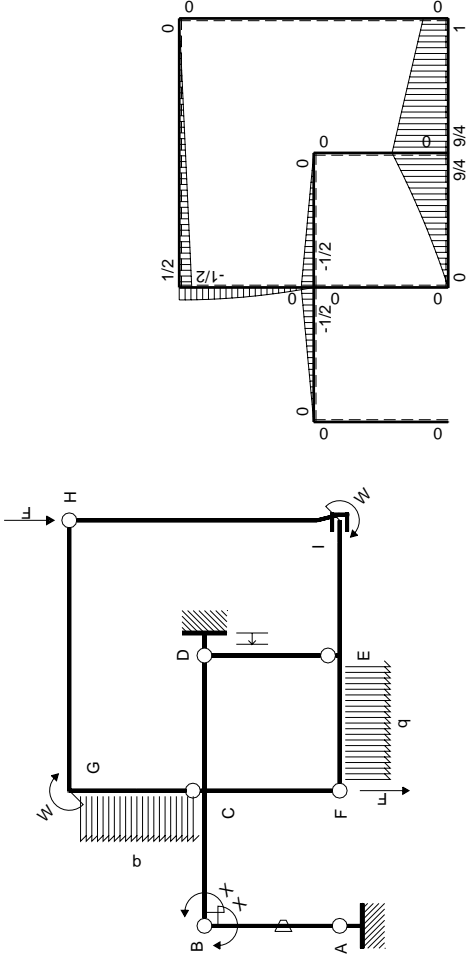
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

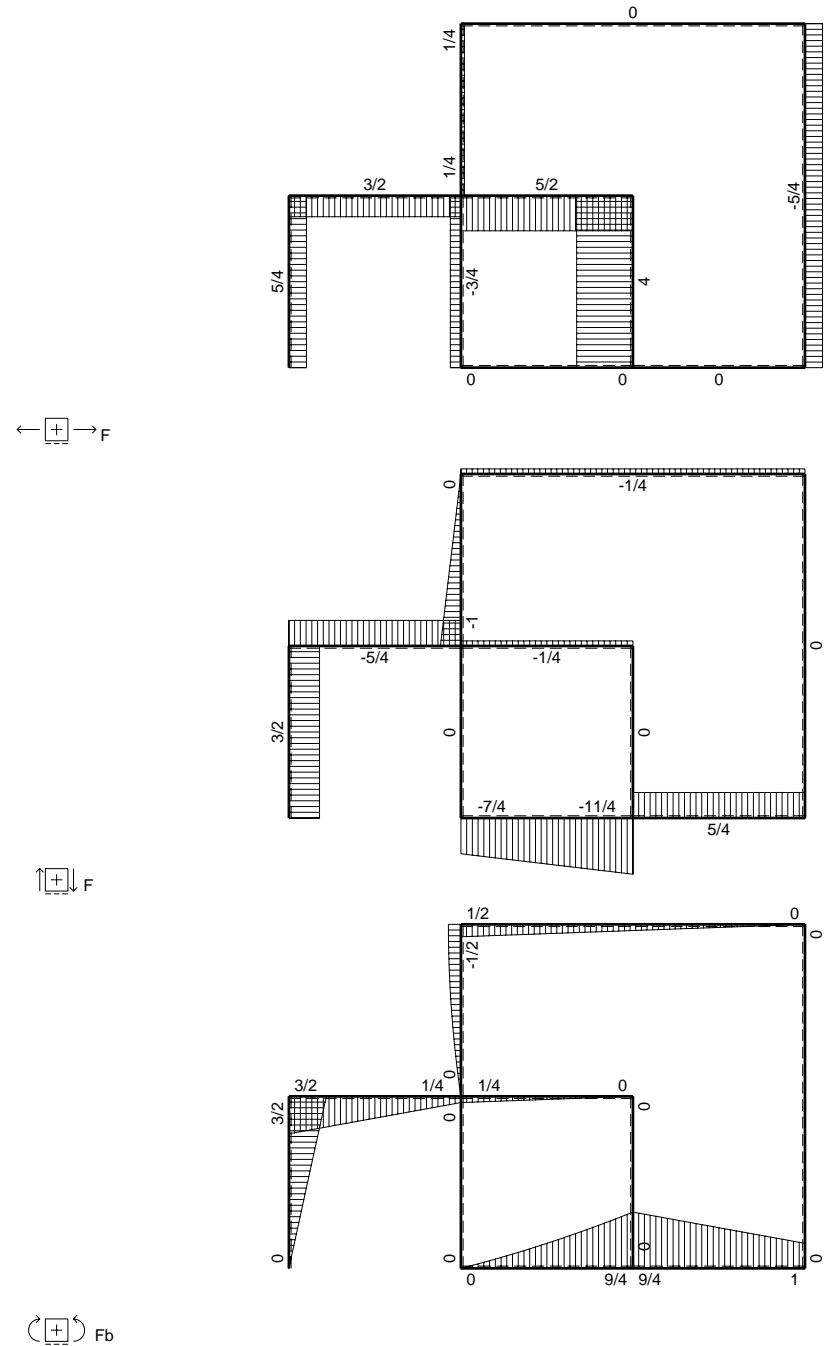
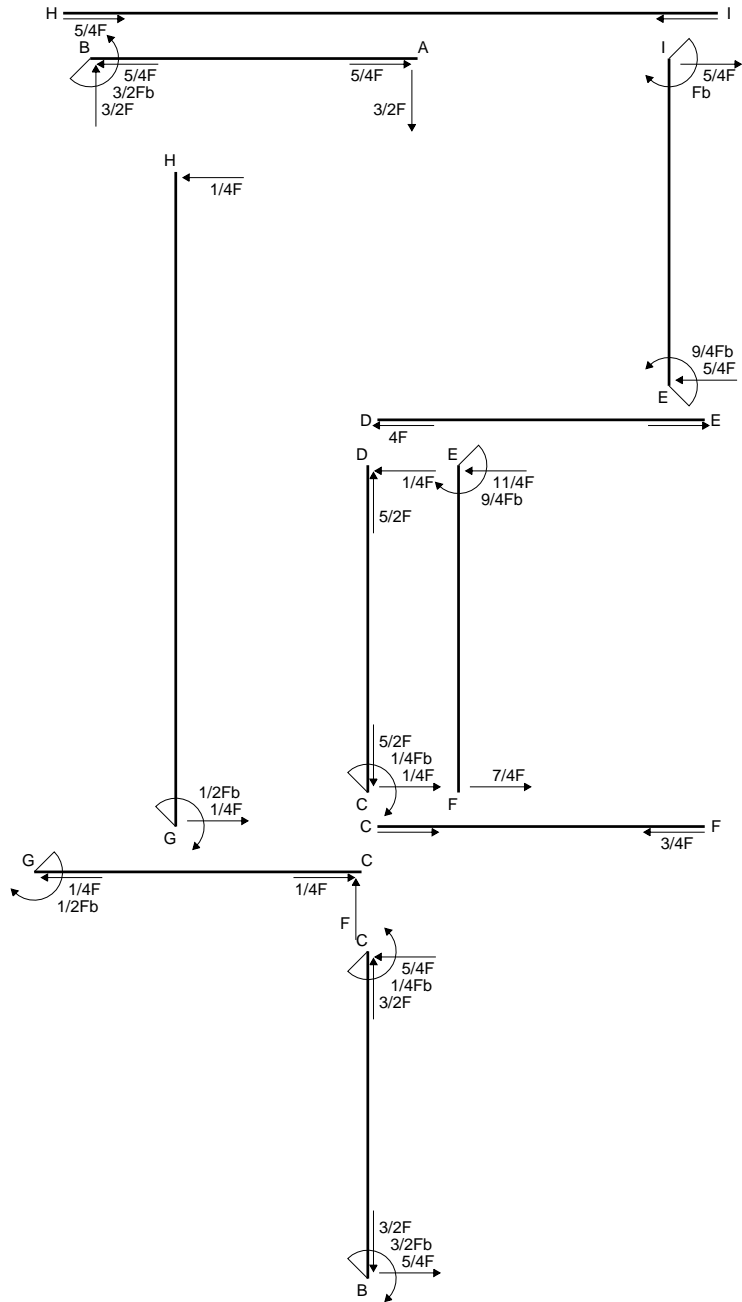
$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

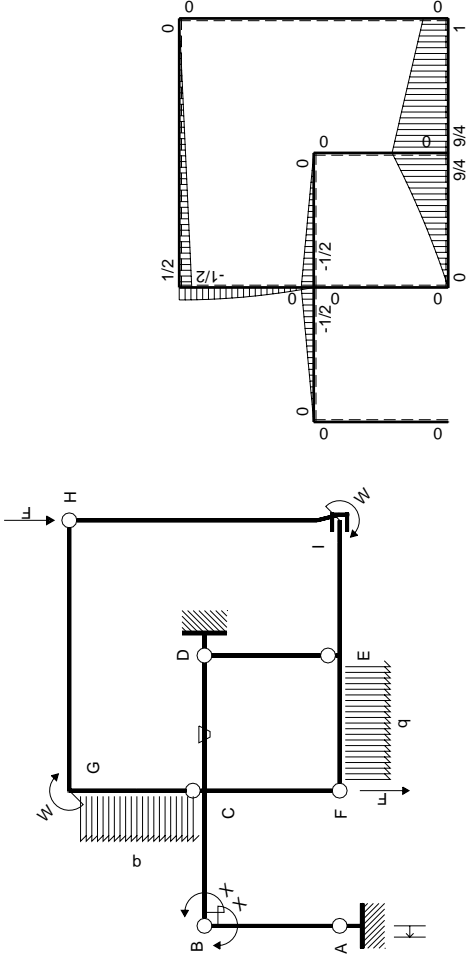
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$3/2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-3/2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

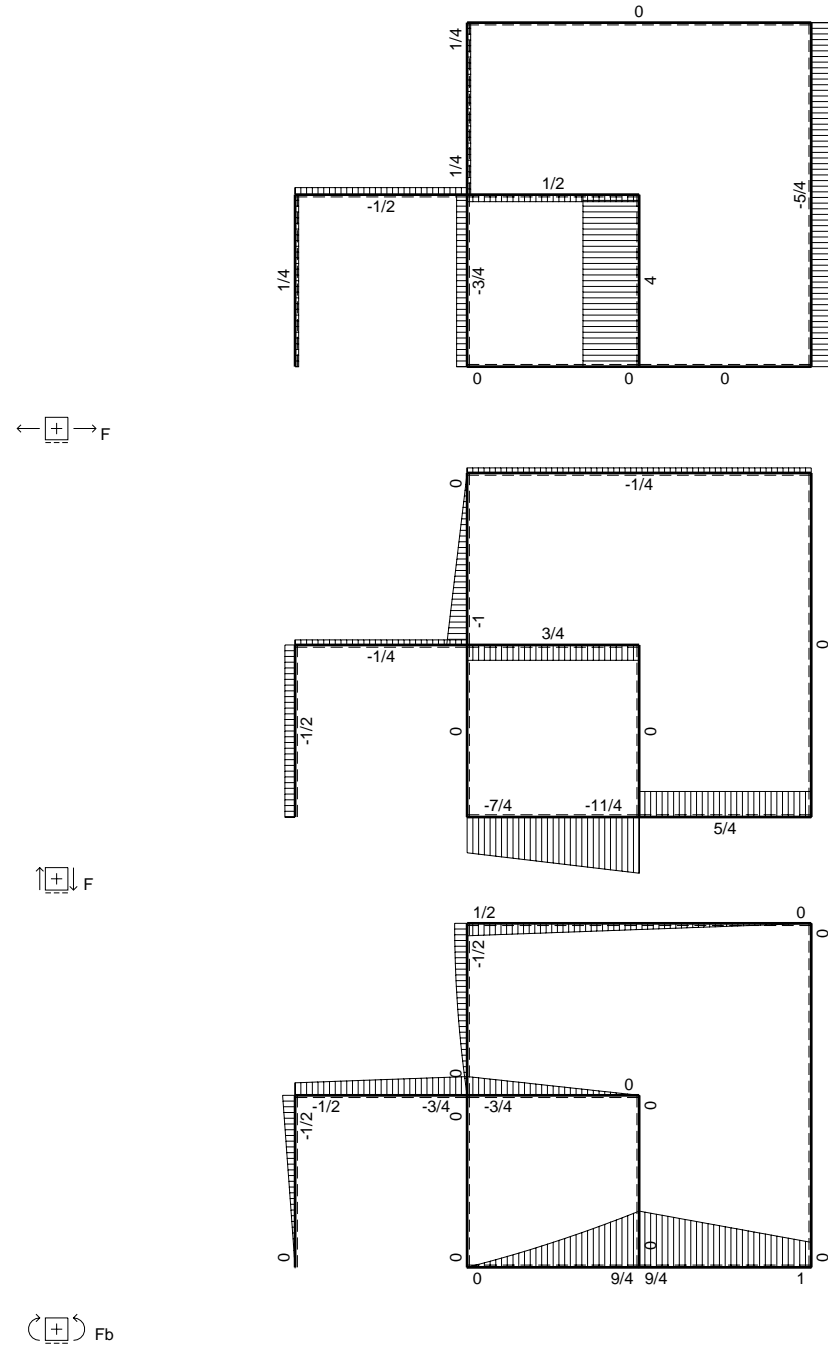
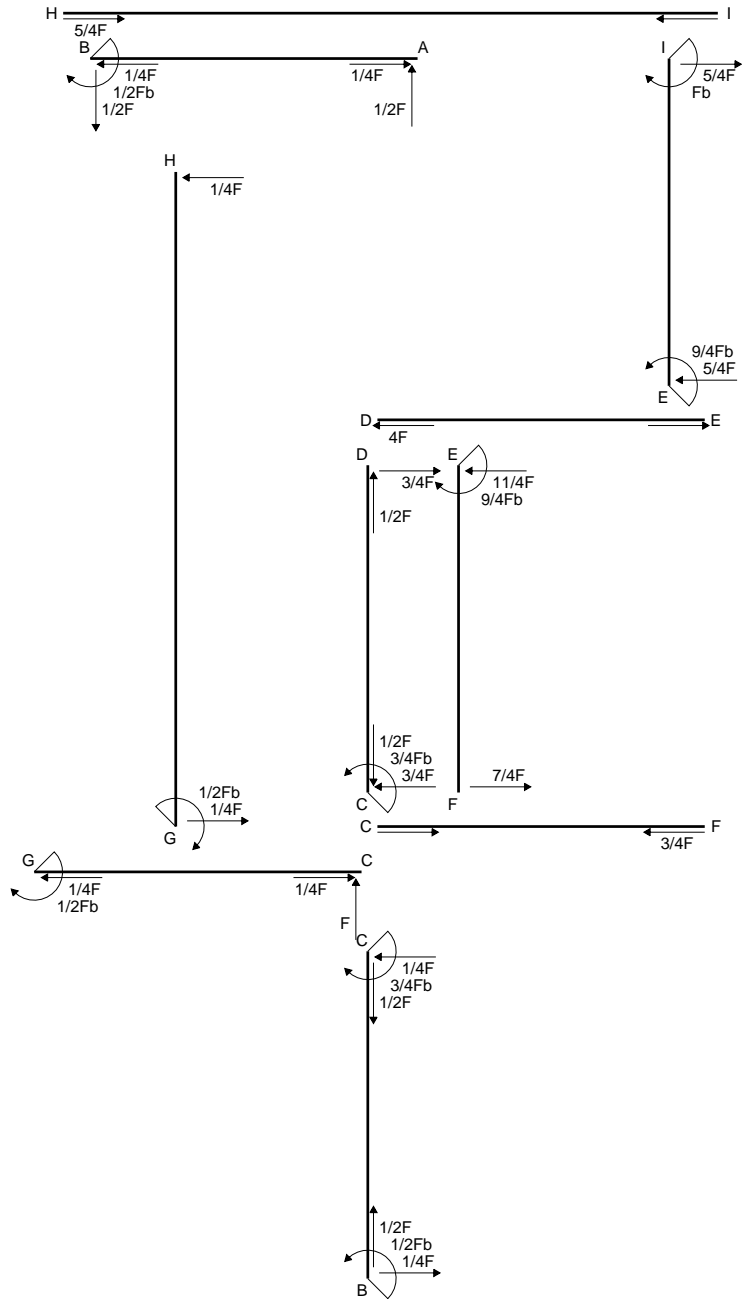
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

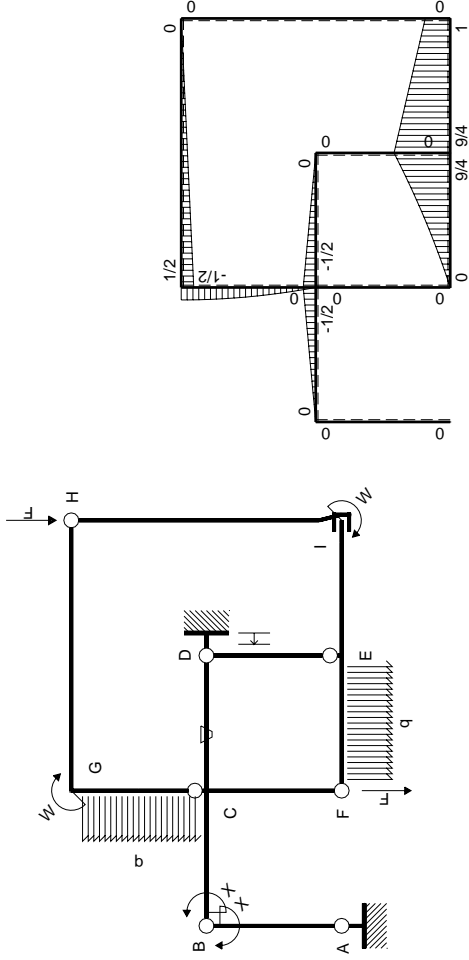
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	0	$1/2Fx-1/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	0	$1/4Fb-1/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/4Fb-11/4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-7/4Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/12 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

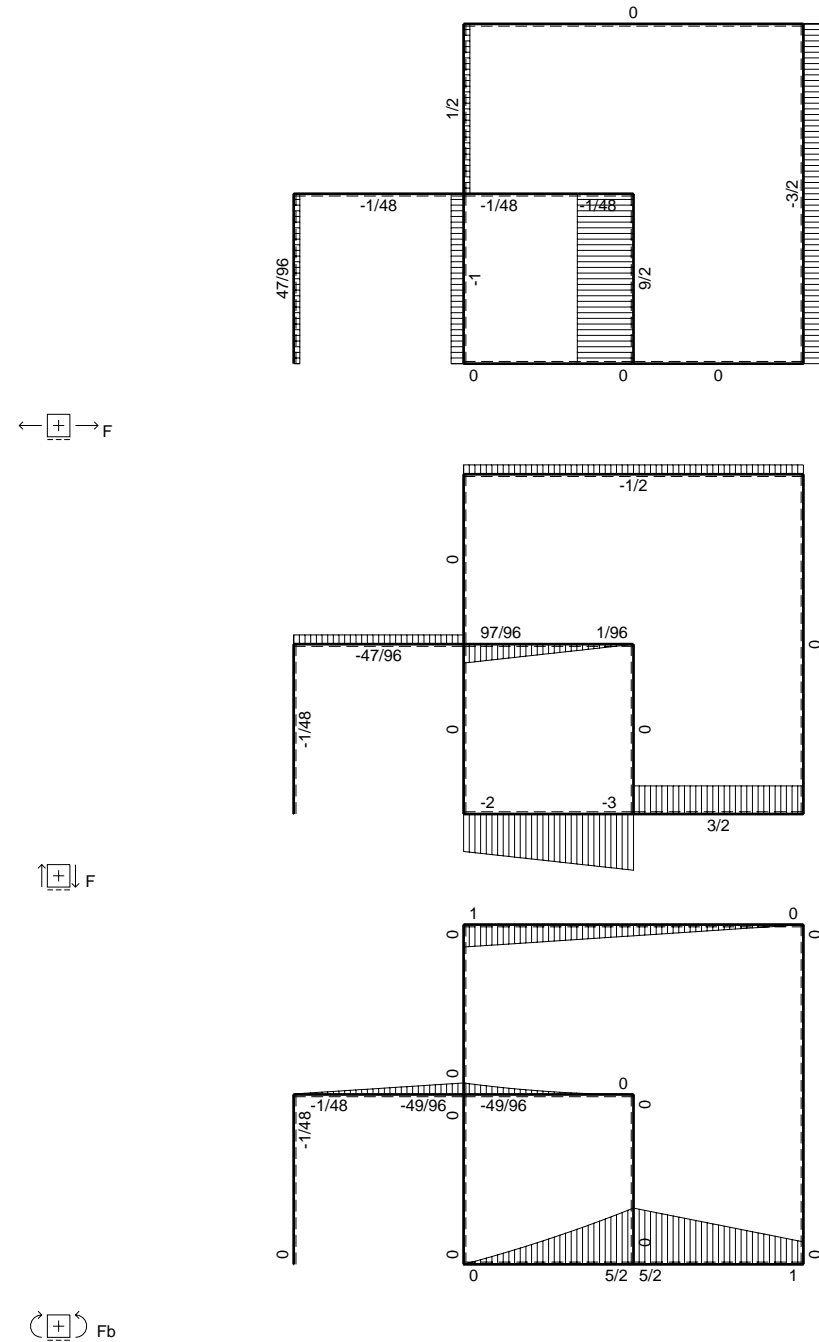
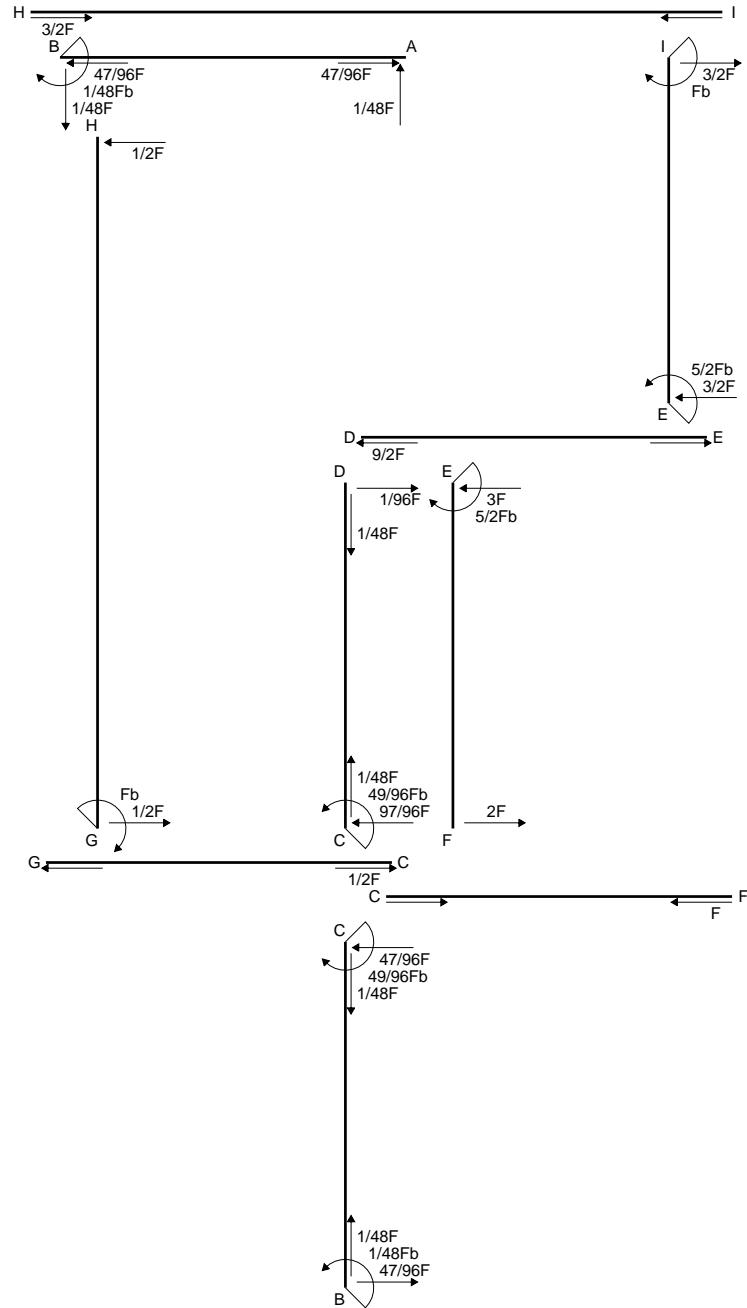
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

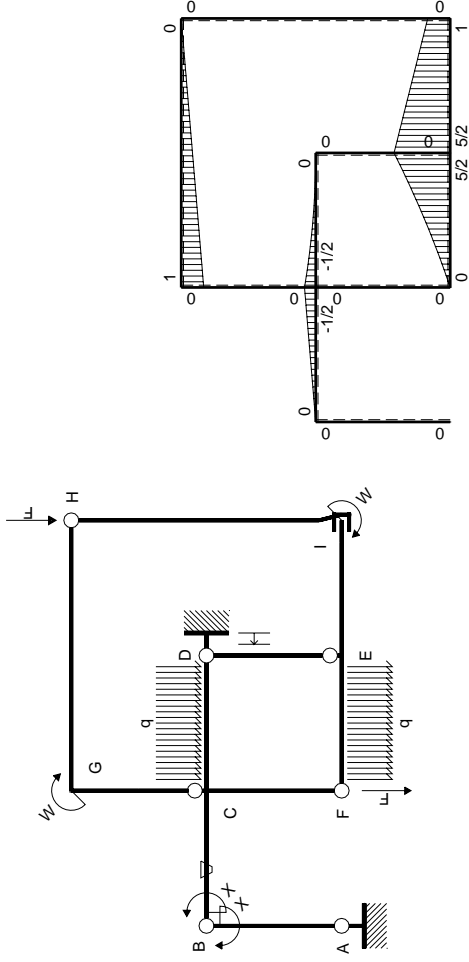
$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$



⊕ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+Fx-1/2qx^2$	0	$1/4Fb-3/4Fx+3/4Fx^2/b-1/4qx^3/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/16+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2qx^2$	0	$1/4qx^3/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/48Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/48Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

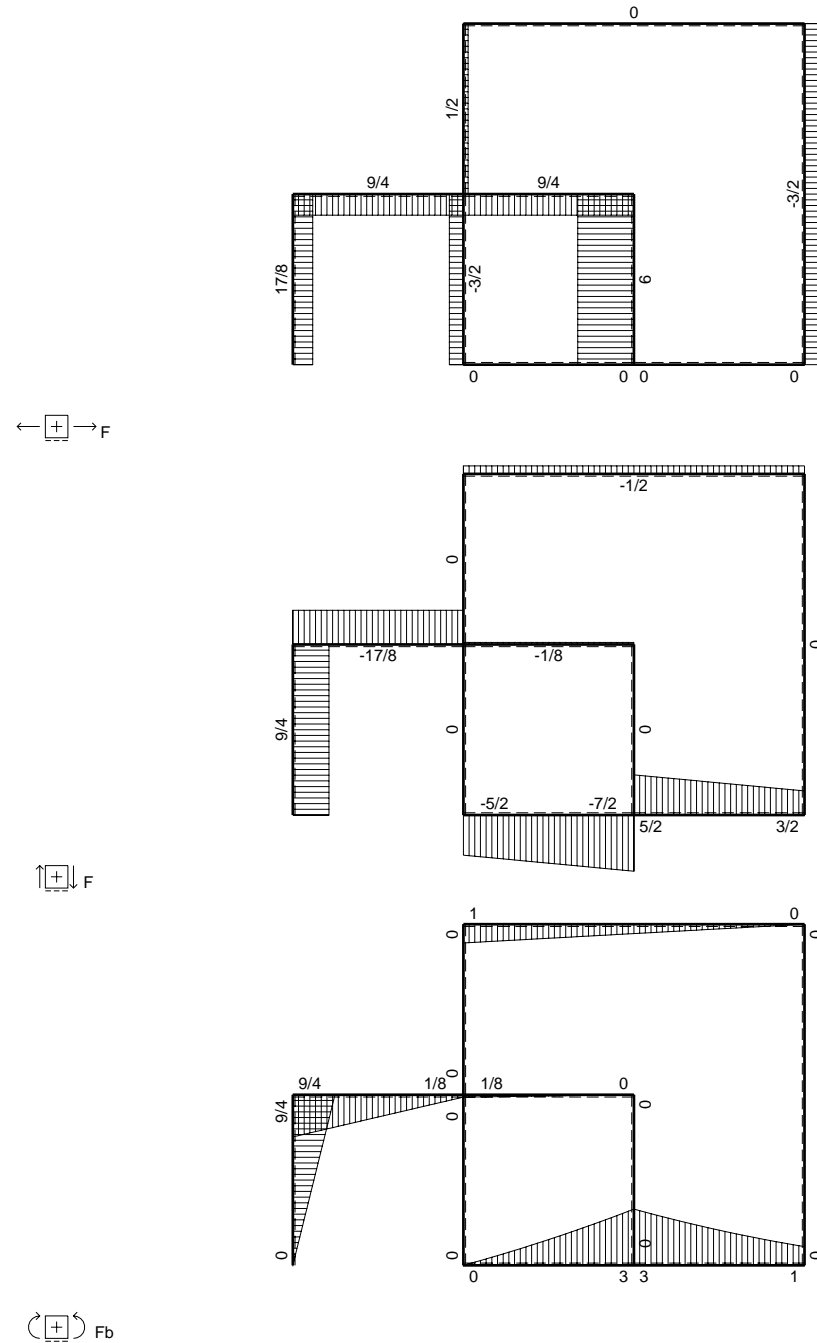
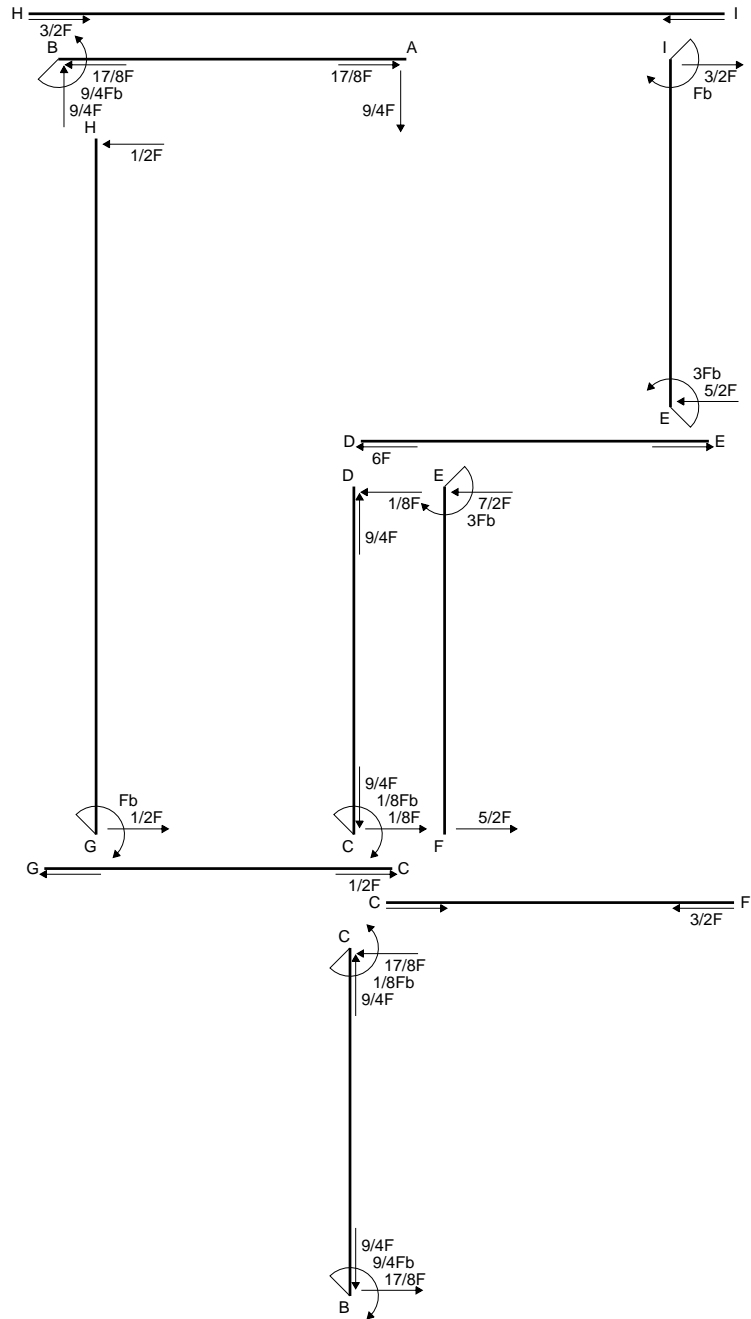
$$L_{CD}^{xo} = \int_0^b (1/4 - 3/4 x/b + 3/4 x^2/b^2 - 1/4 x^3/b^3) Fb 1/EJ dx$$

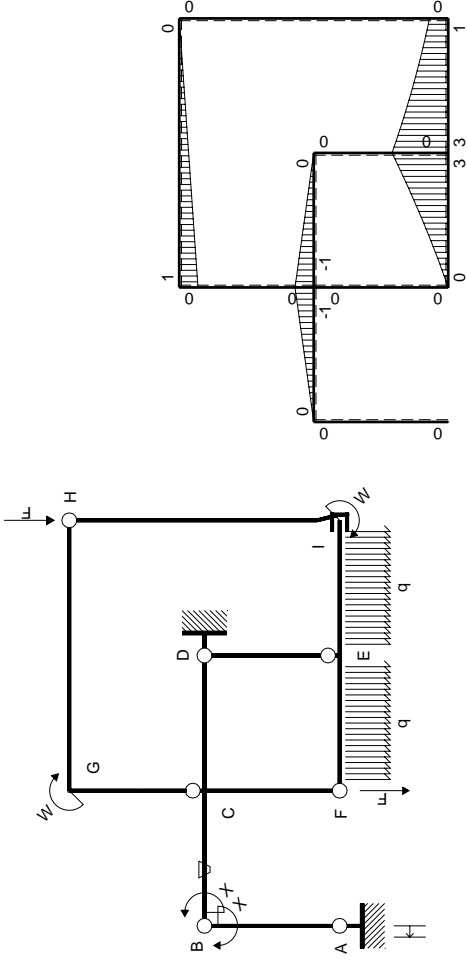
$$= [1/4 x - 3/8 x^2/b + 1/4 x^3/b^2 - 1/16 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 3/8 b + 1/4 b - 1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^3/b^3) Fb 1/EJ dx = [1/16 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$9/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-9/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

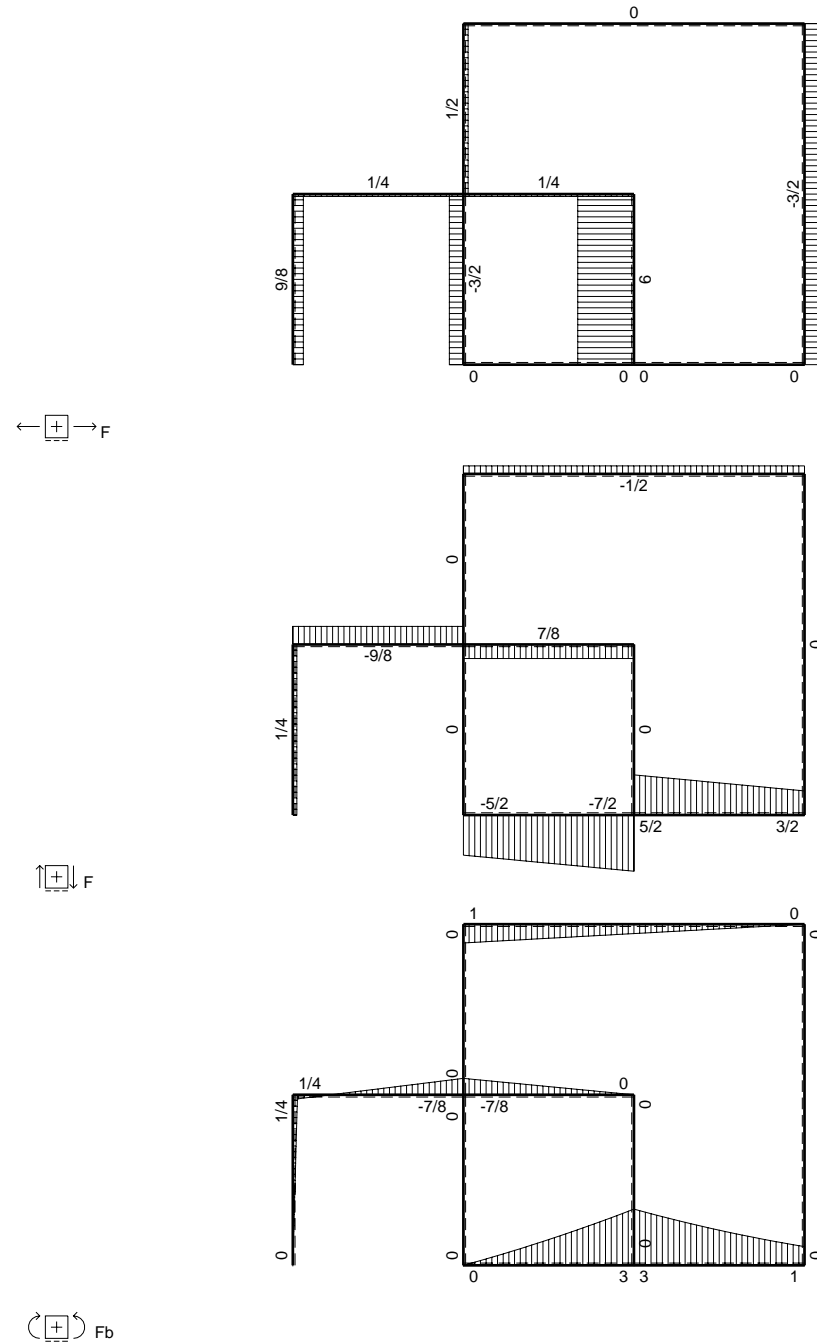
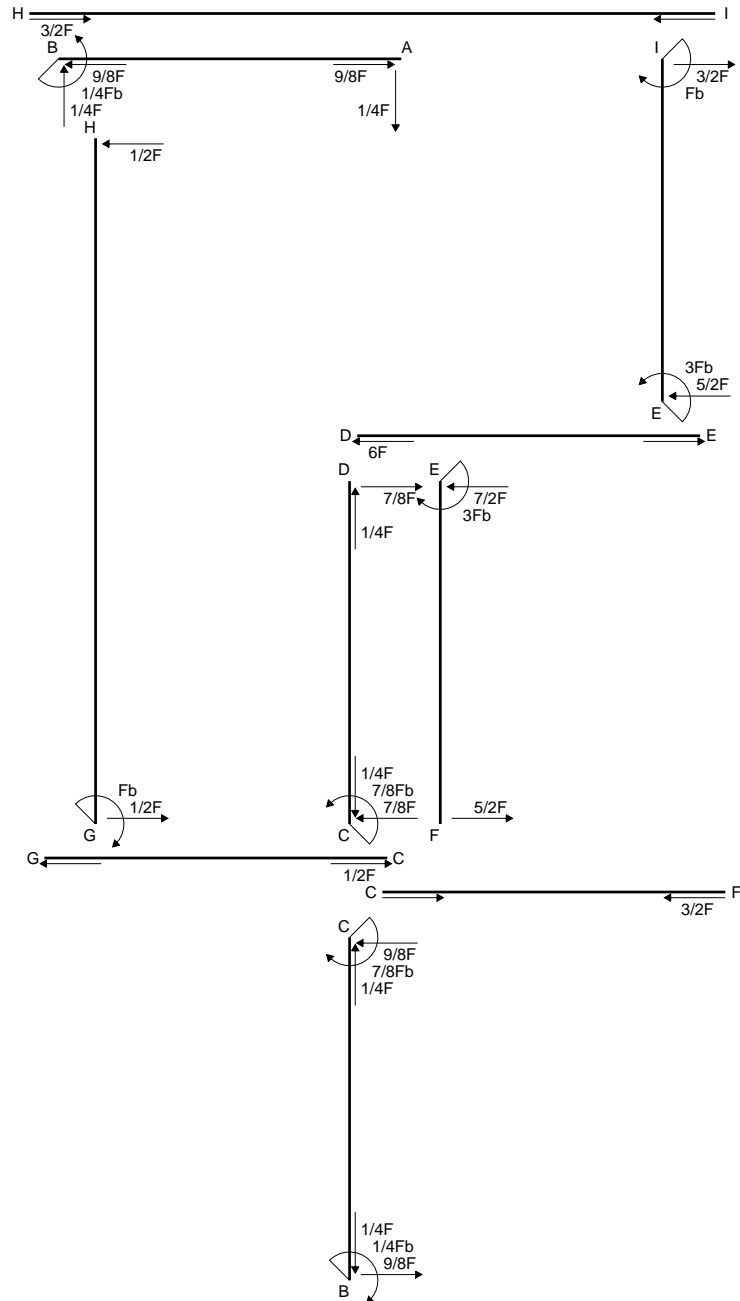
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

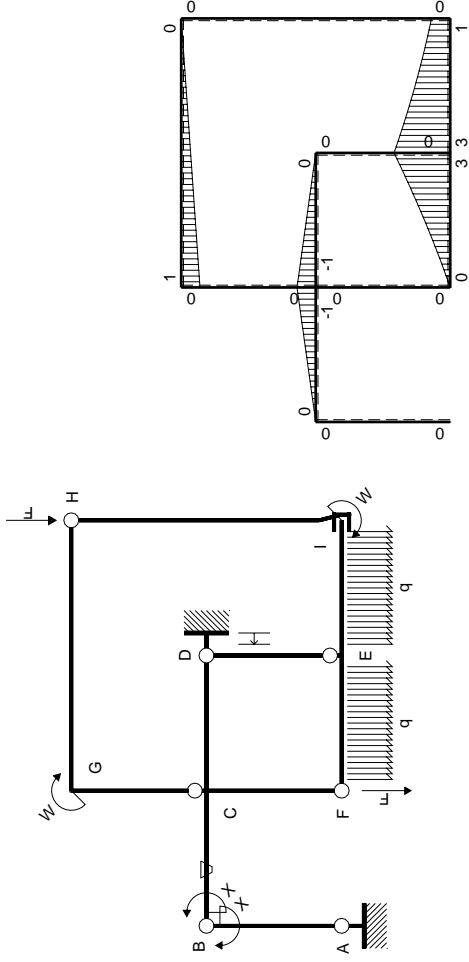
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

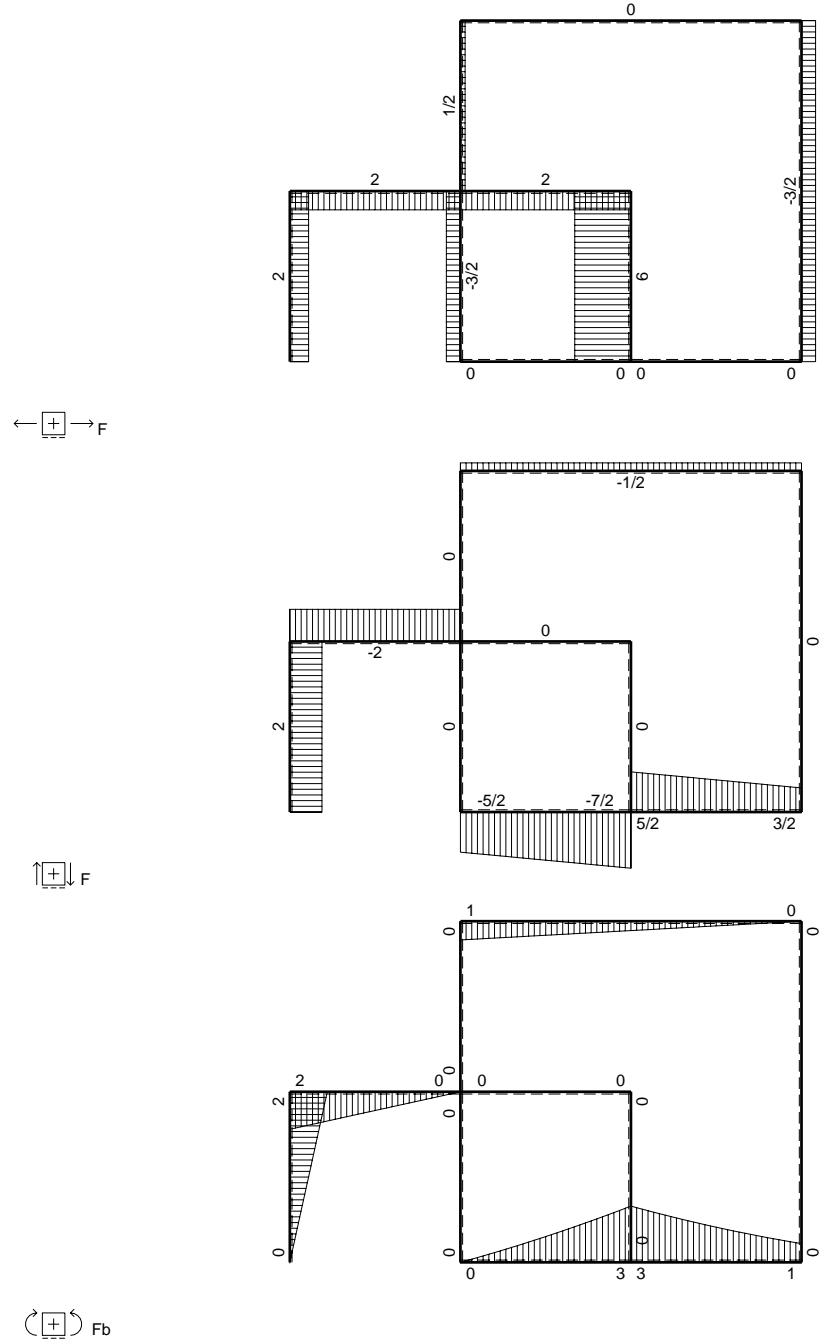
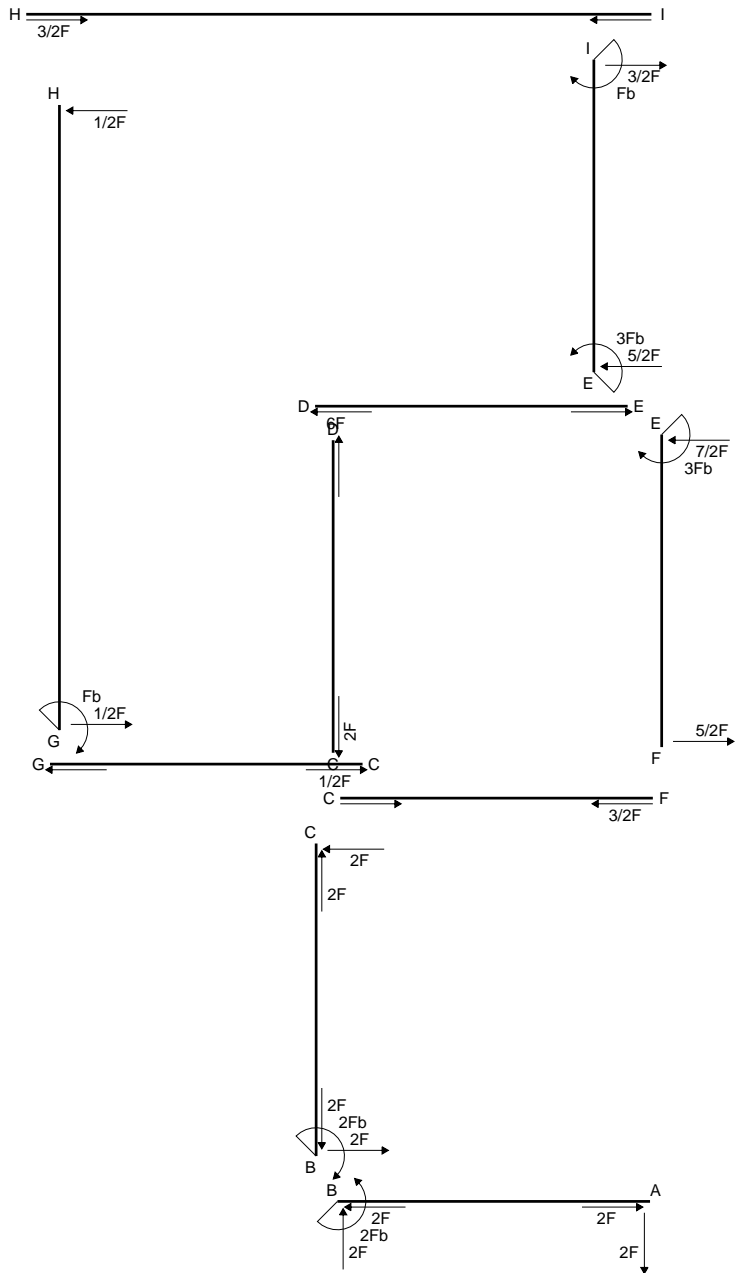
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

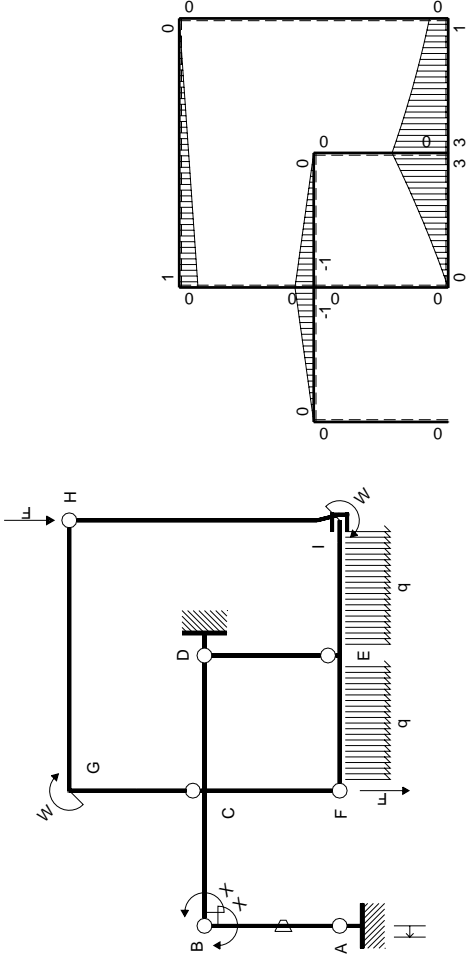
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



↺ (+) ↻ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

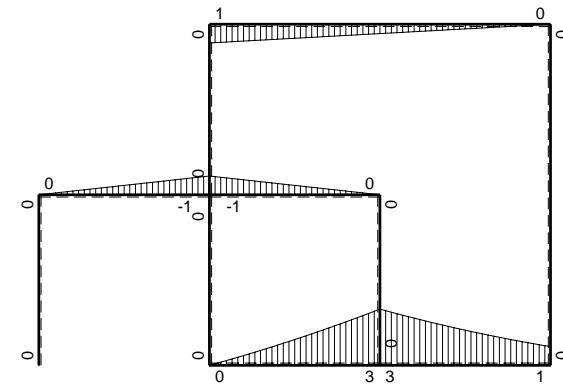
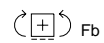
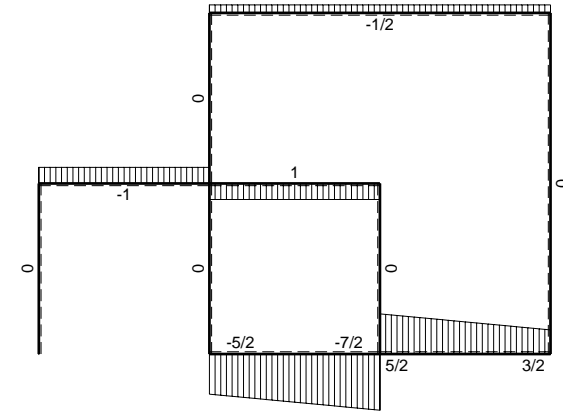
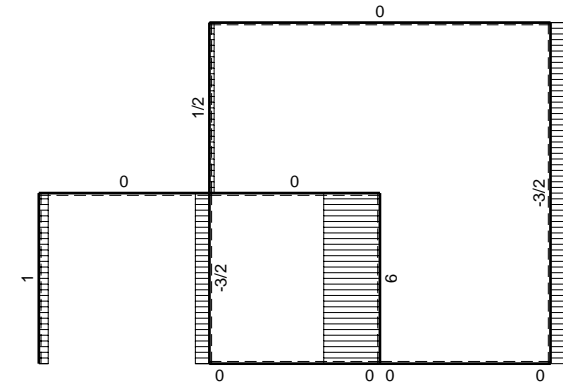
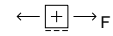
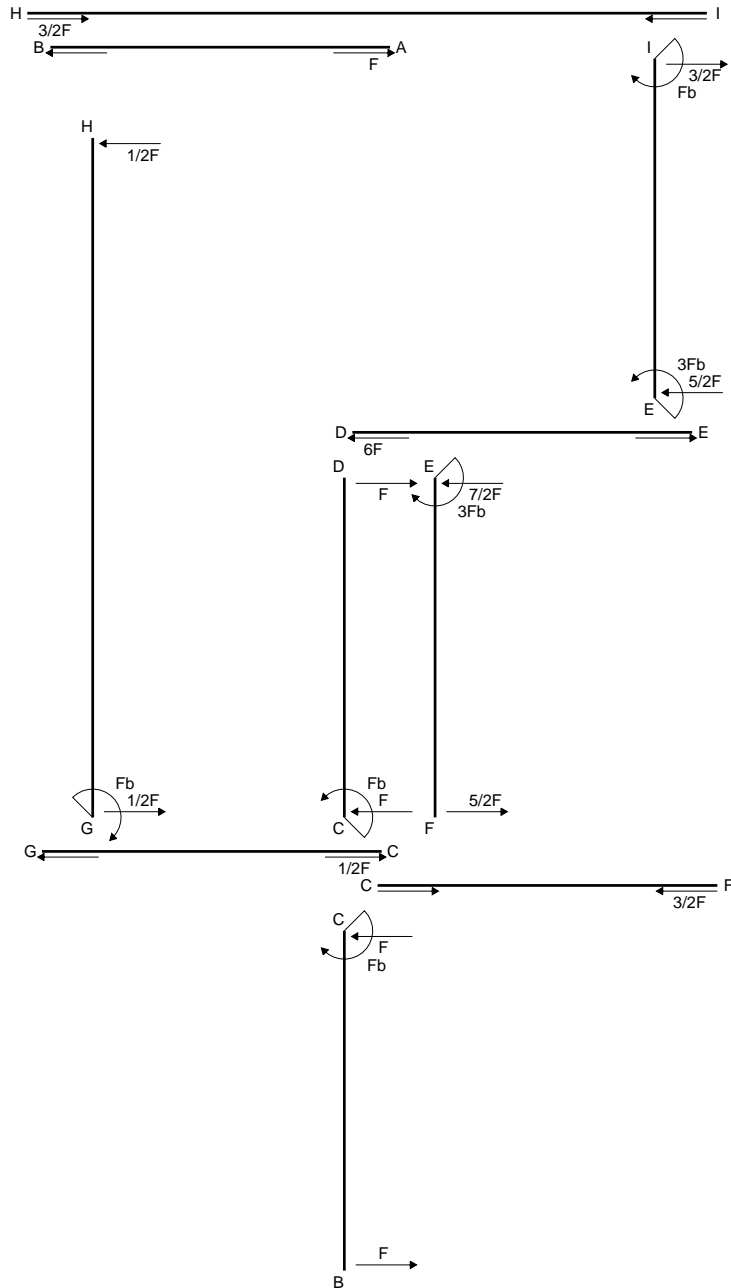
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

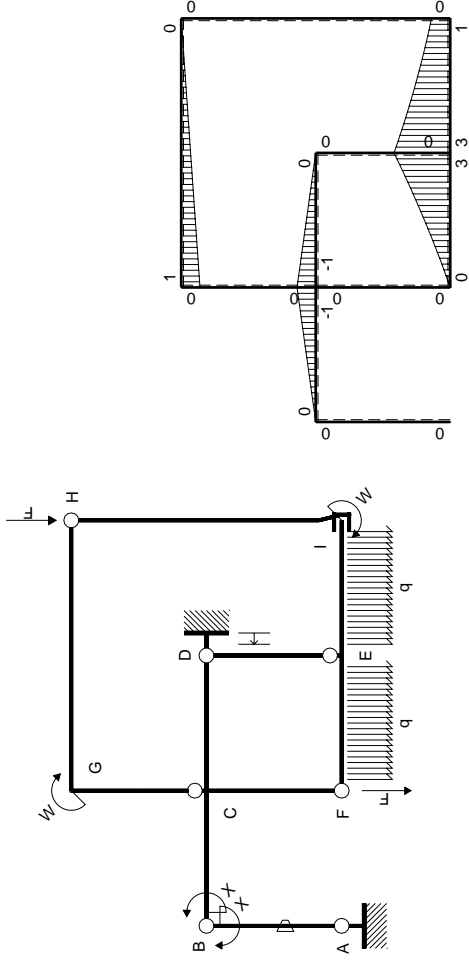
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						0	Xb/EJ
	iperstatica $X=W_{BC}$						0	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

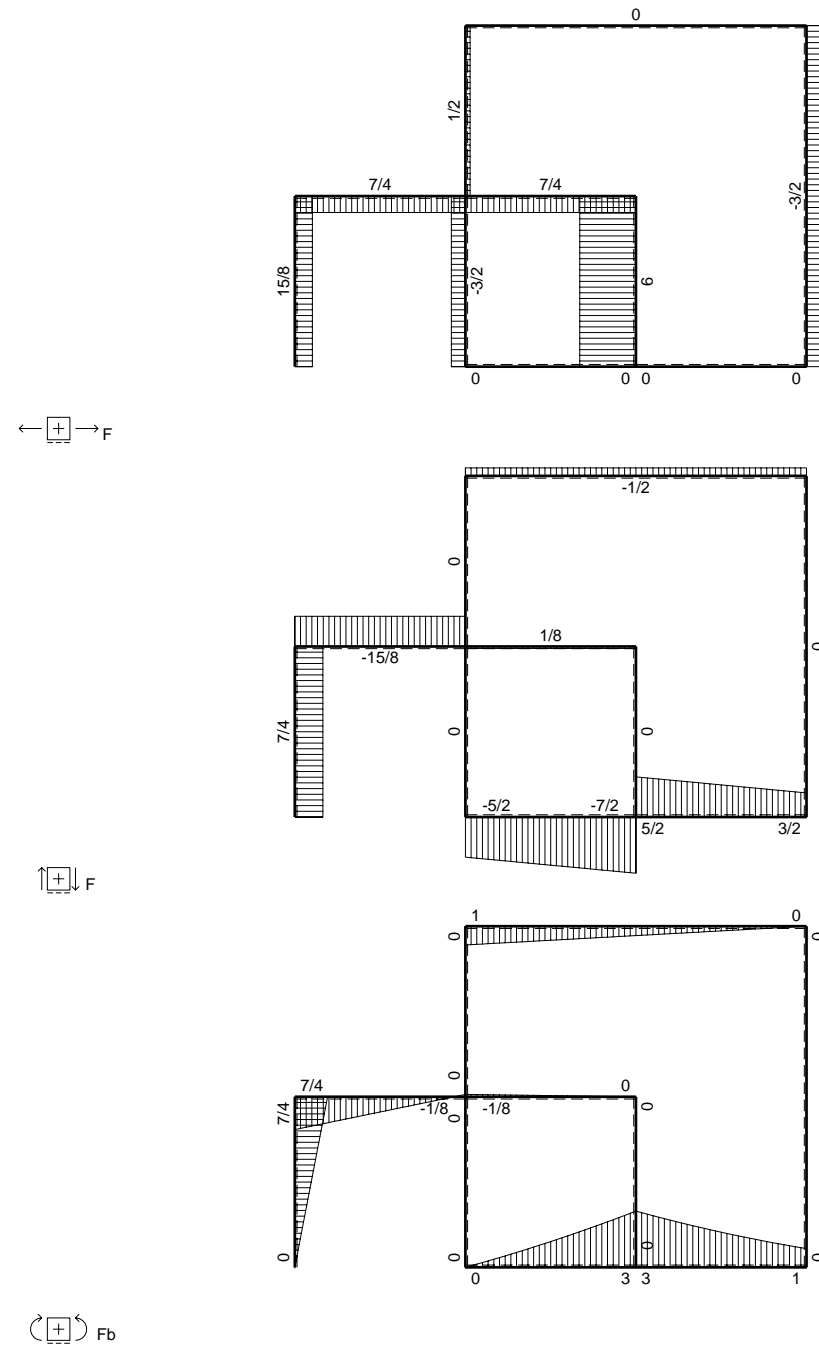
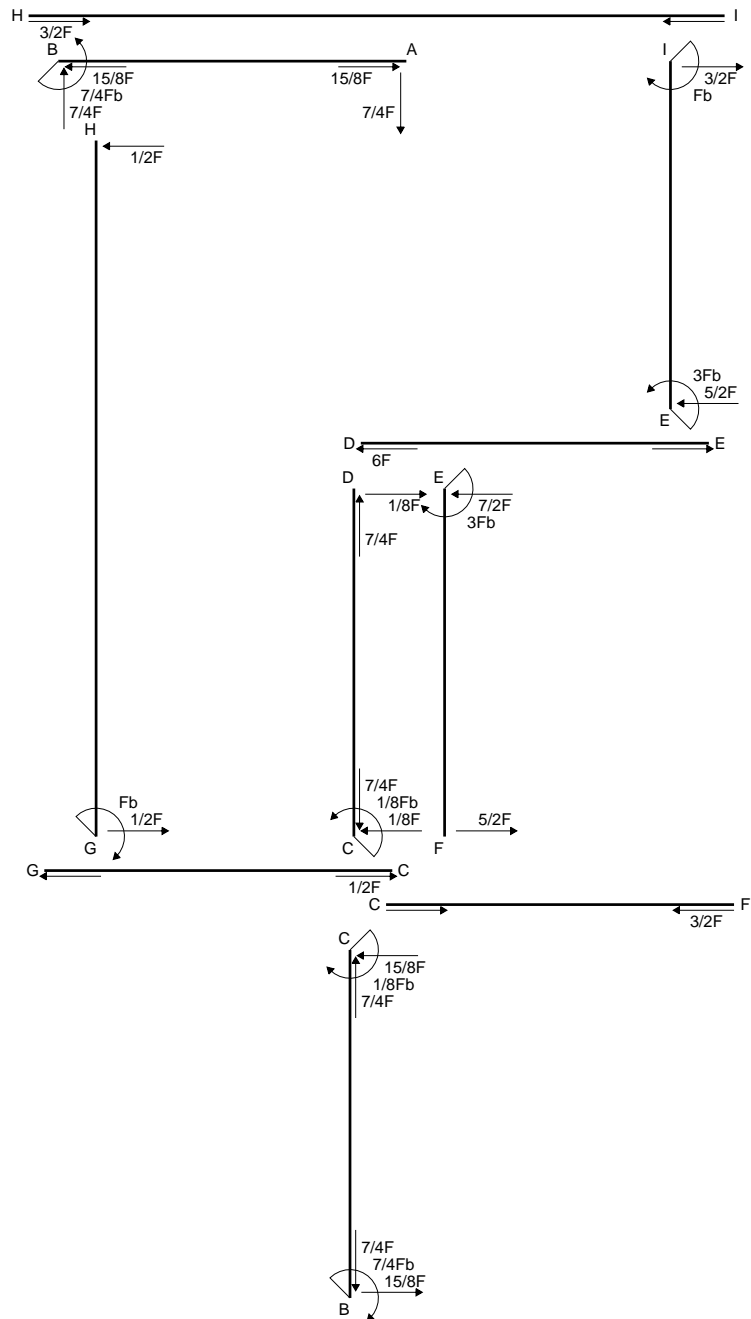
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

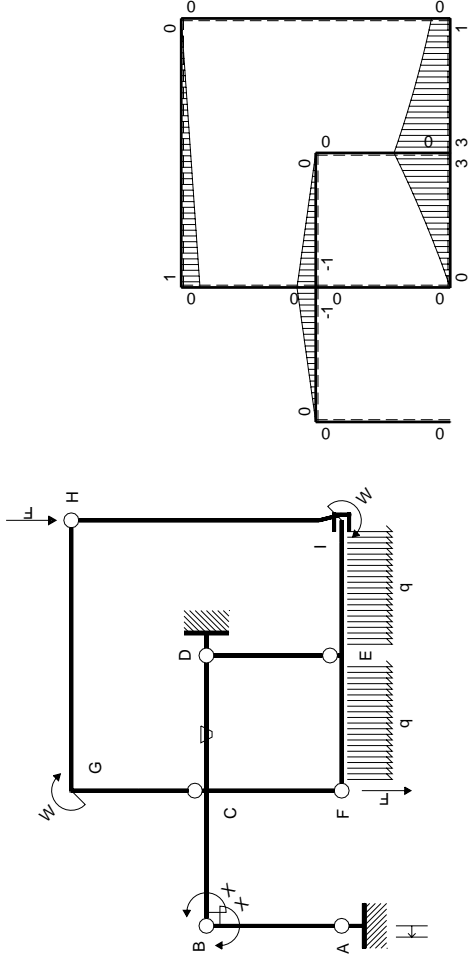
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

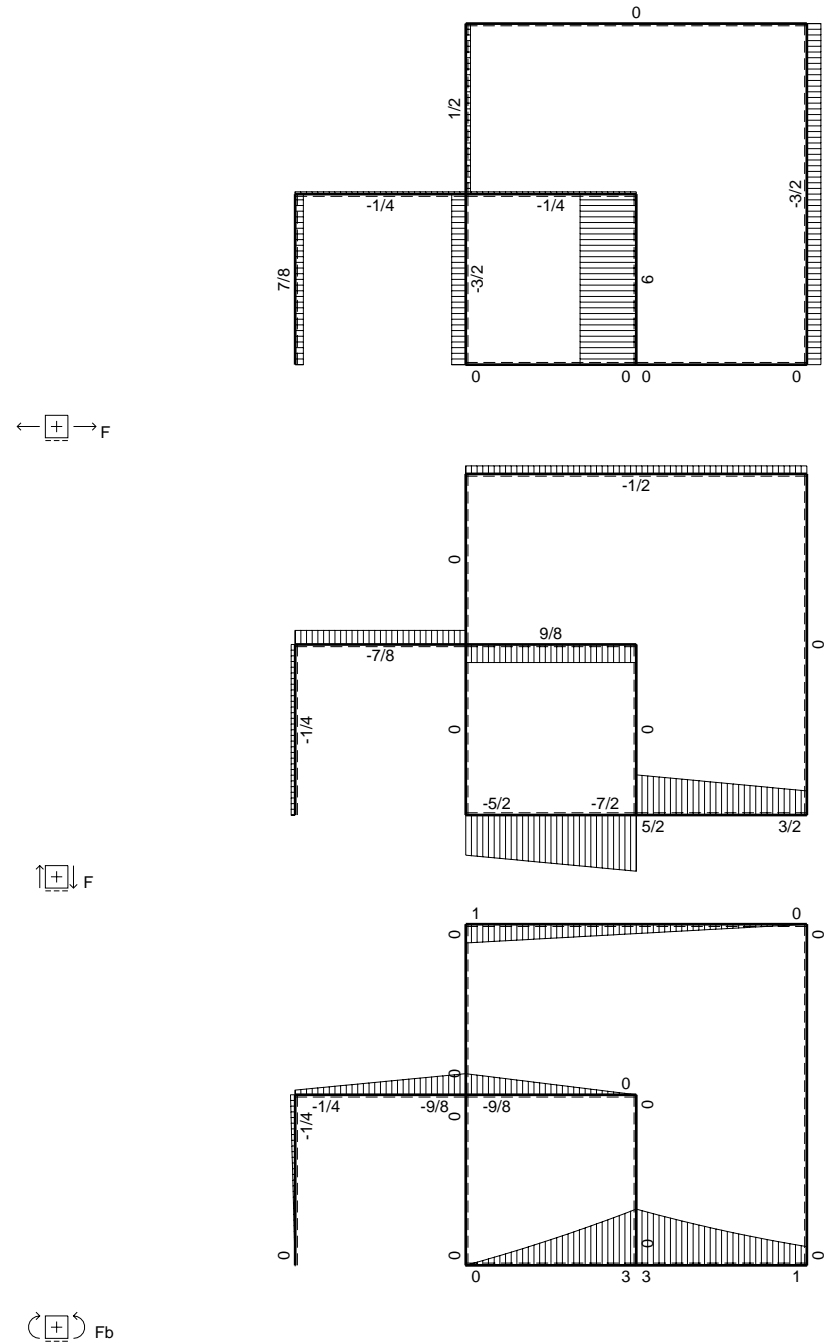
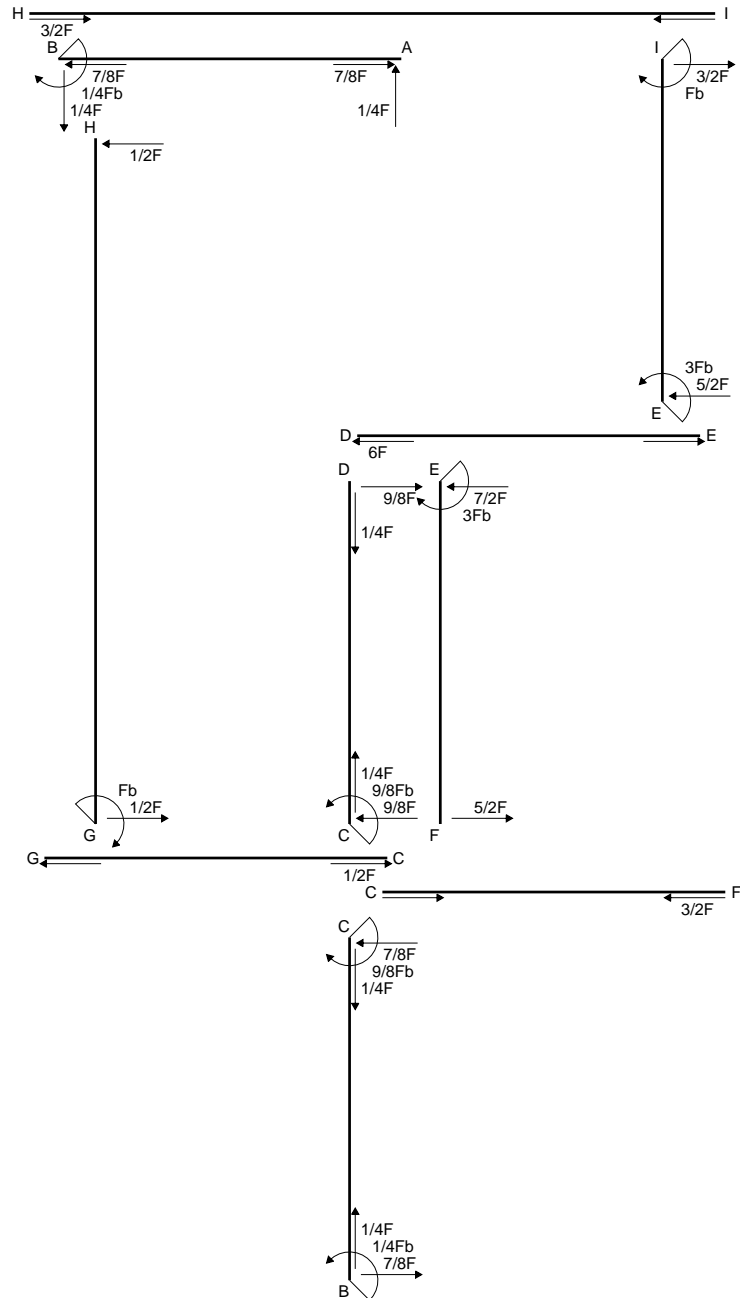
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

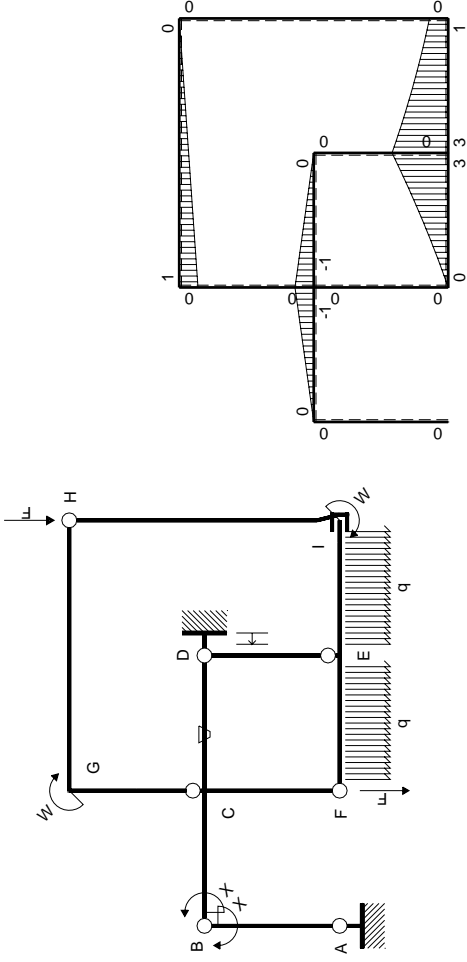
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

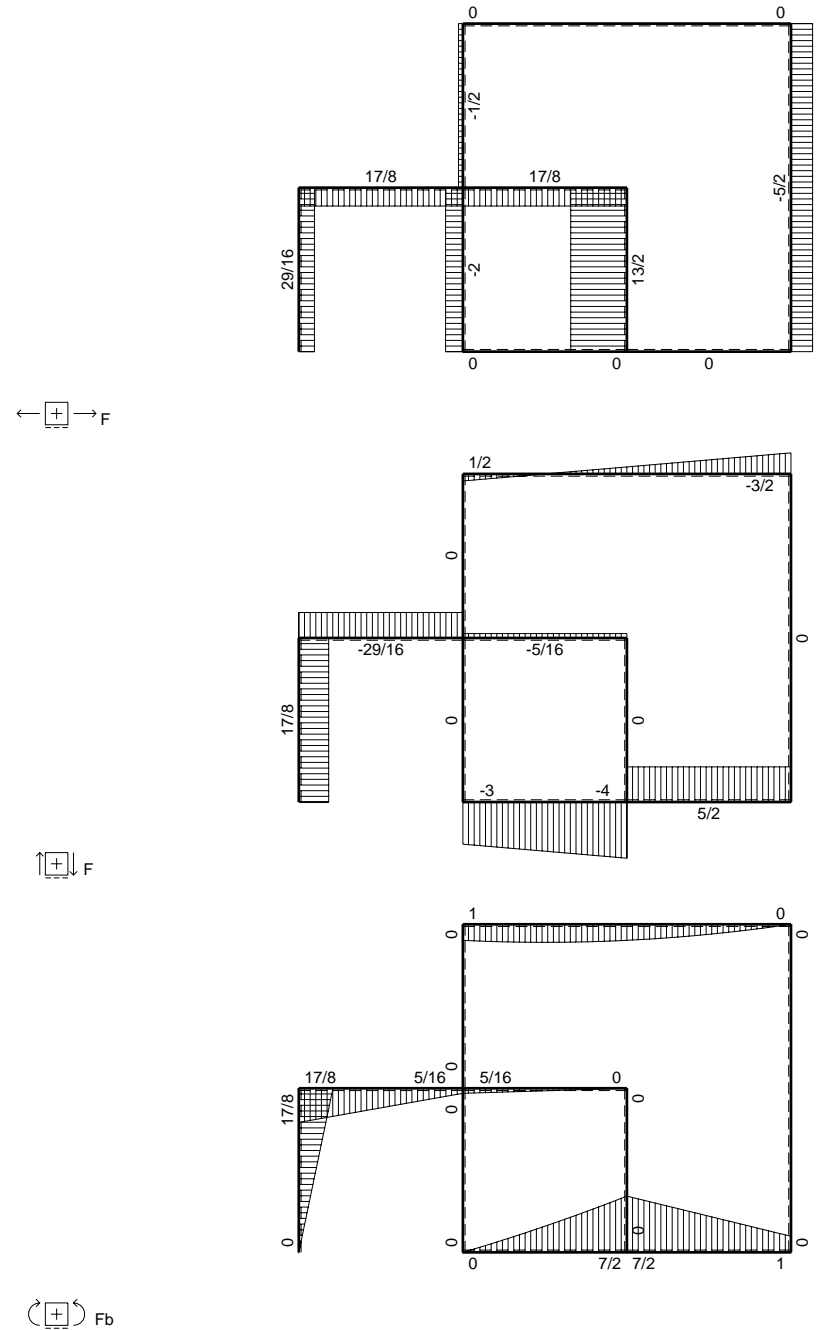
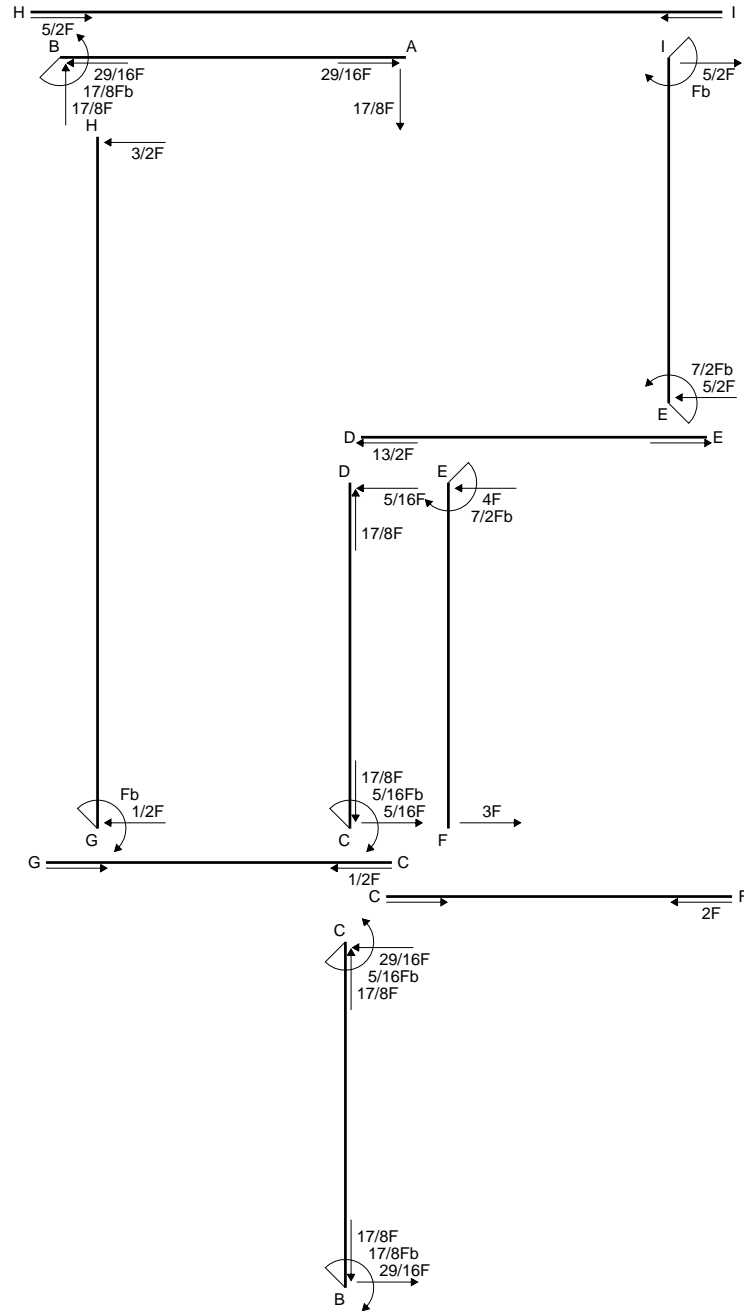
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

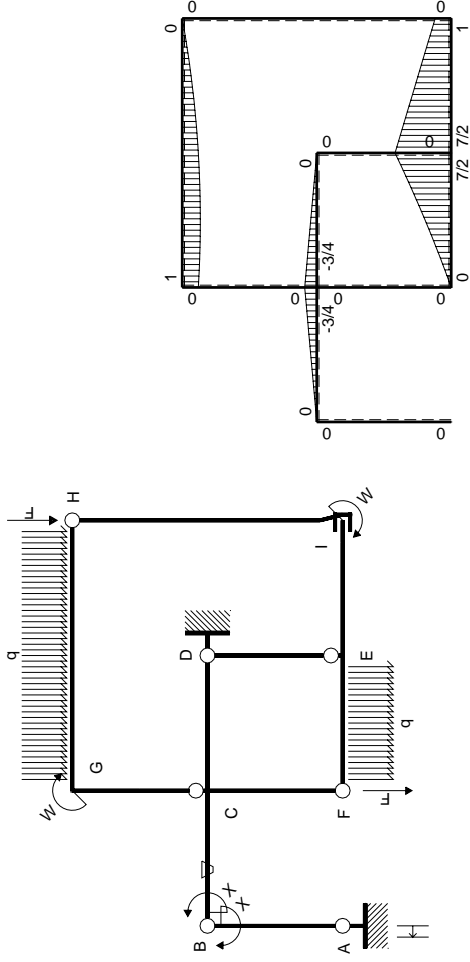
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

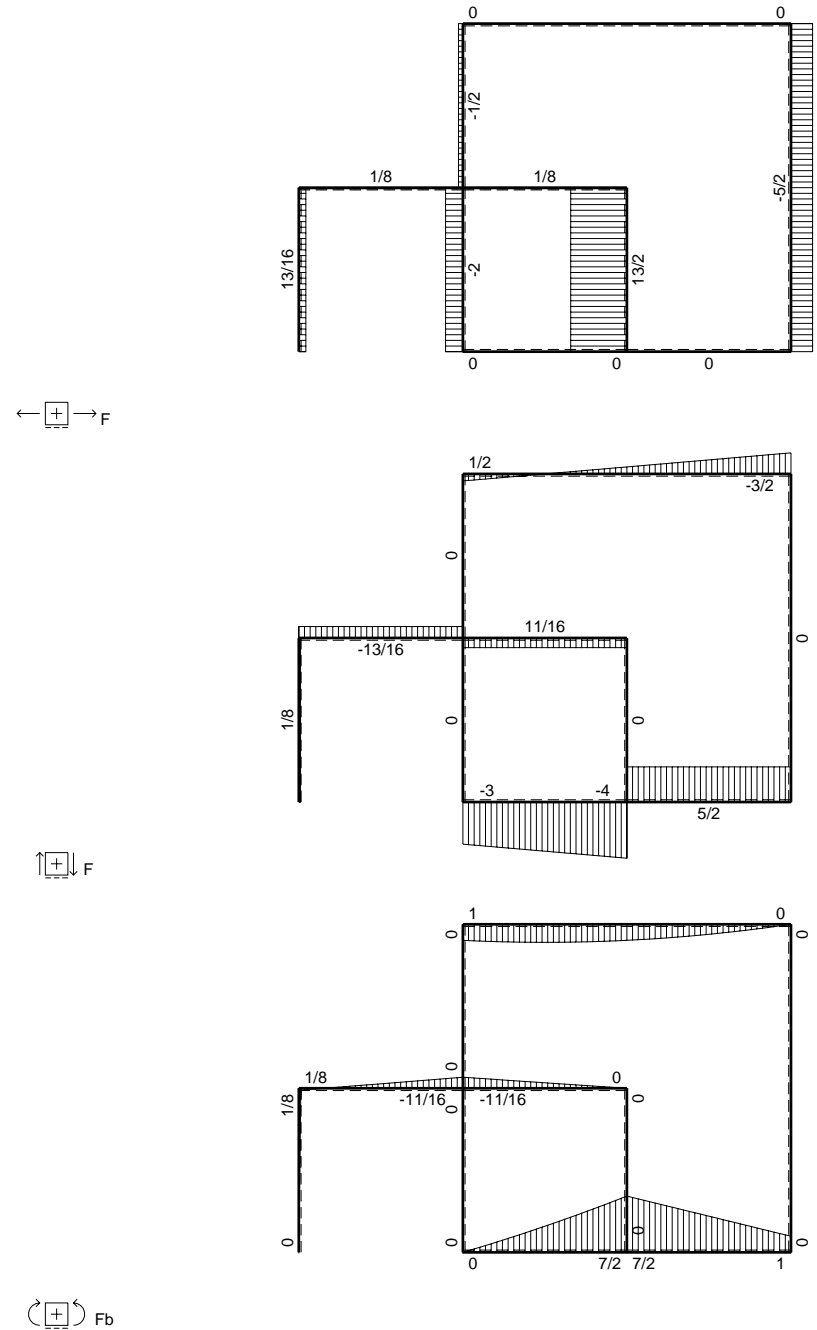
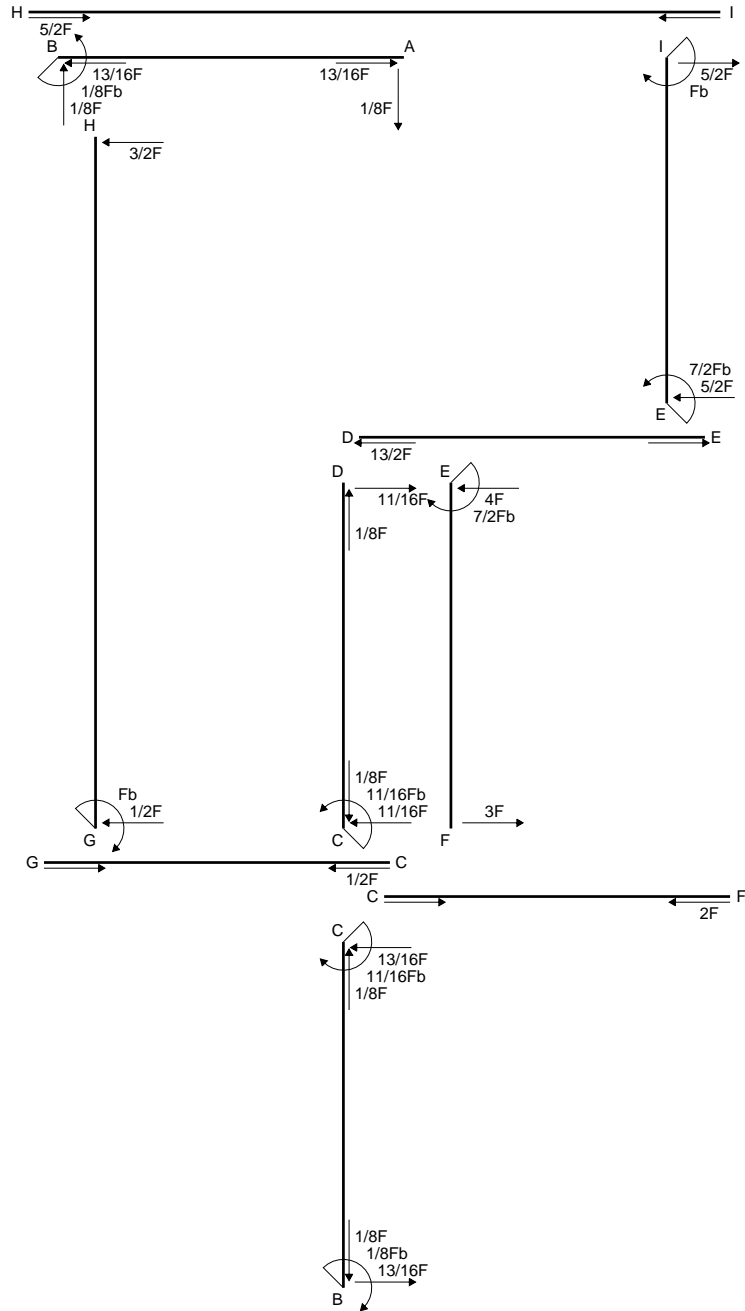
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

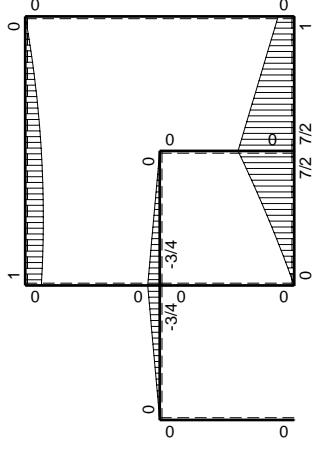
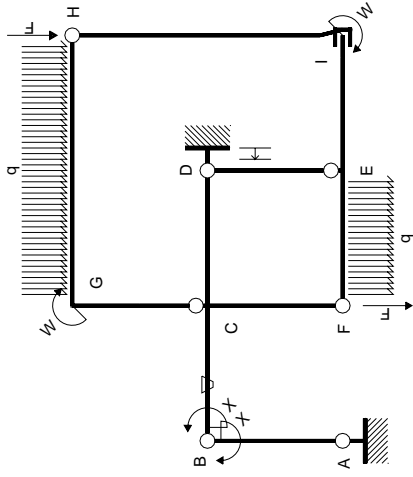
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

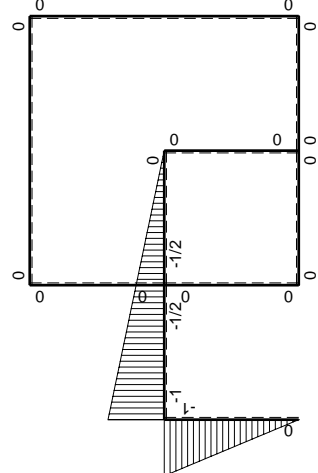
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

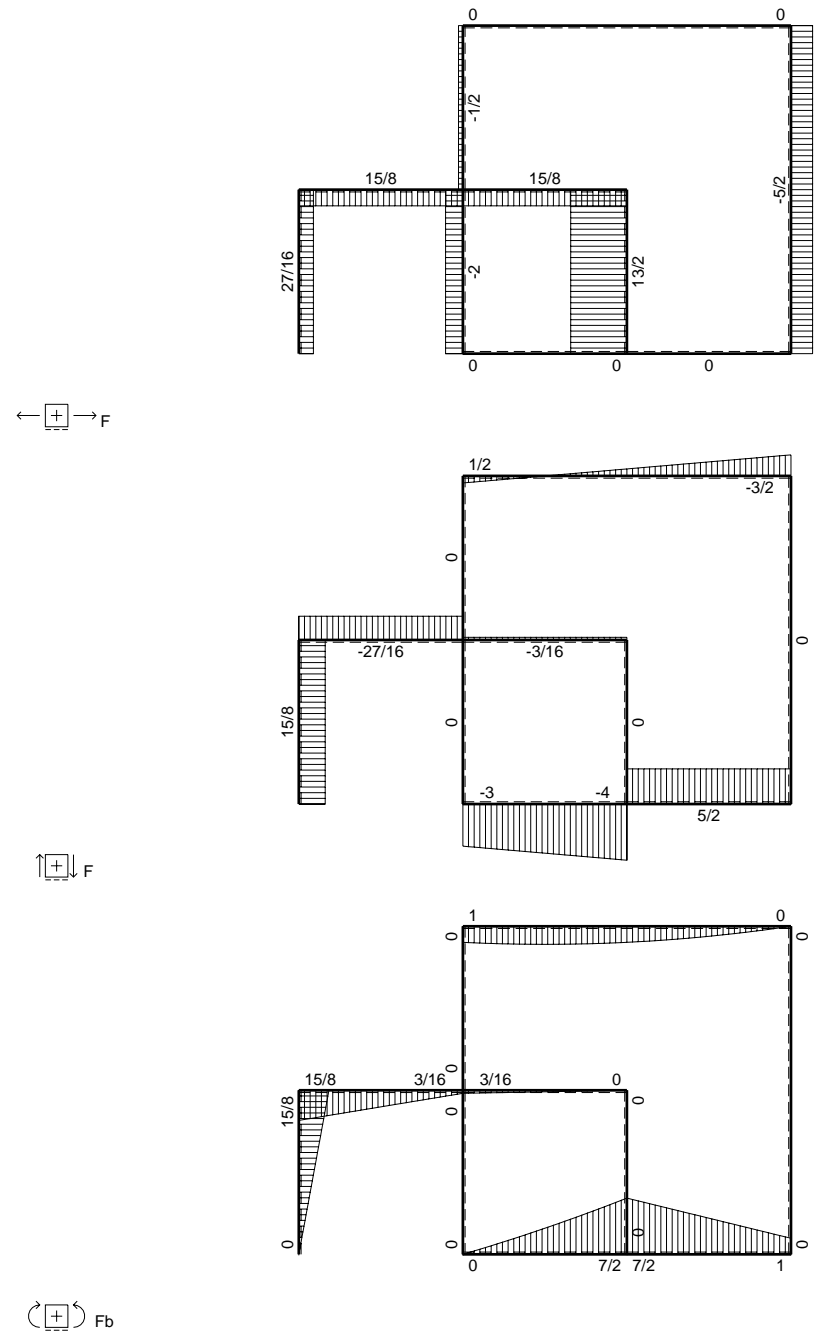
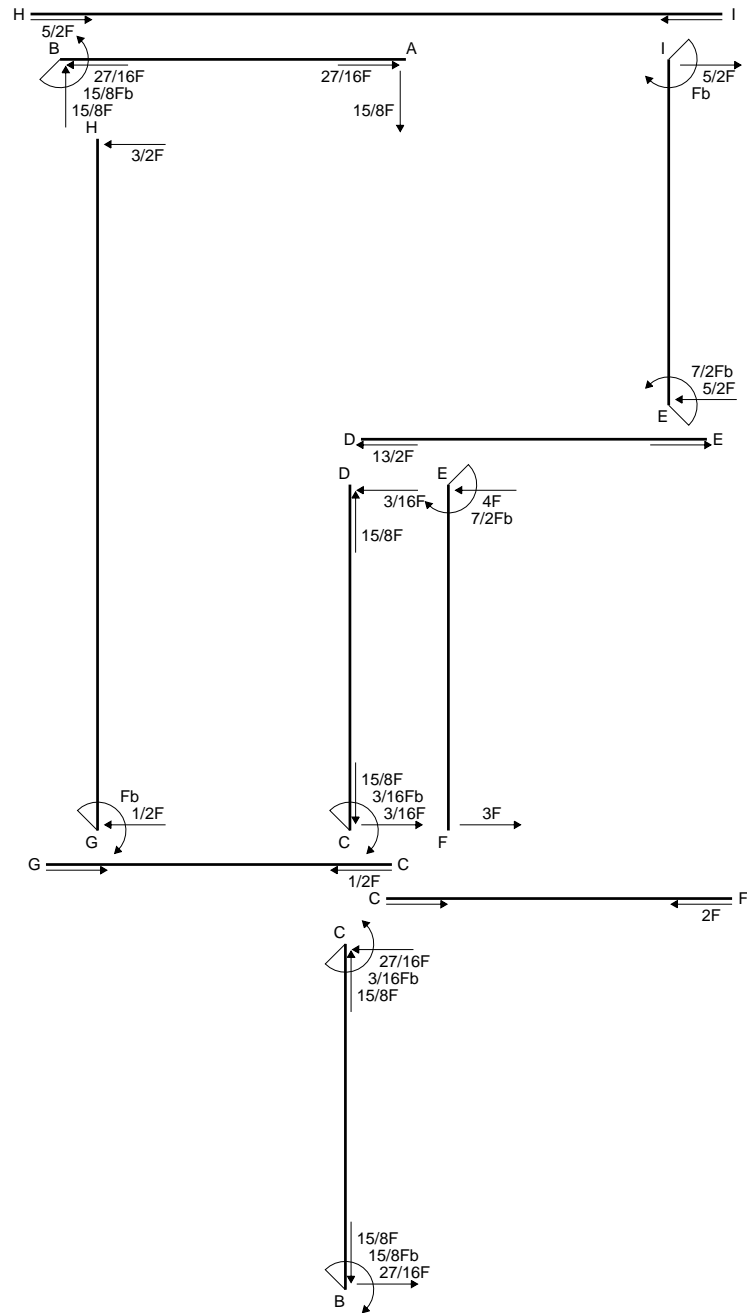
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

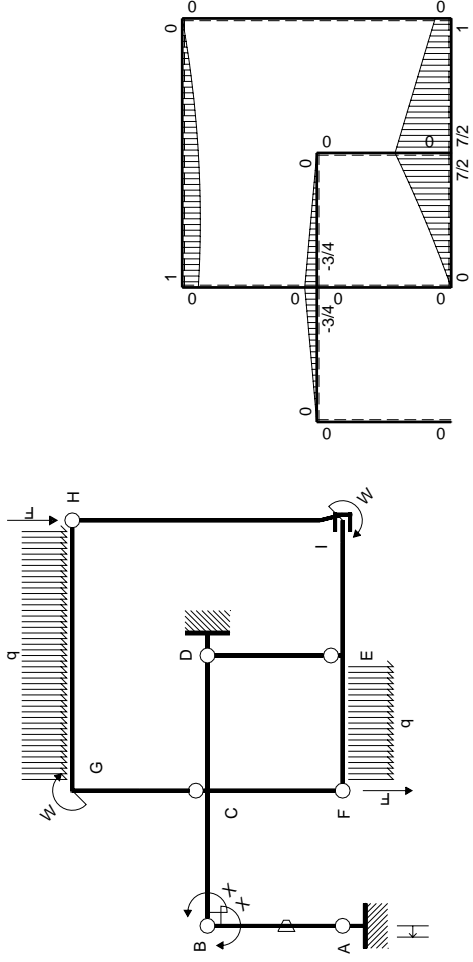
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

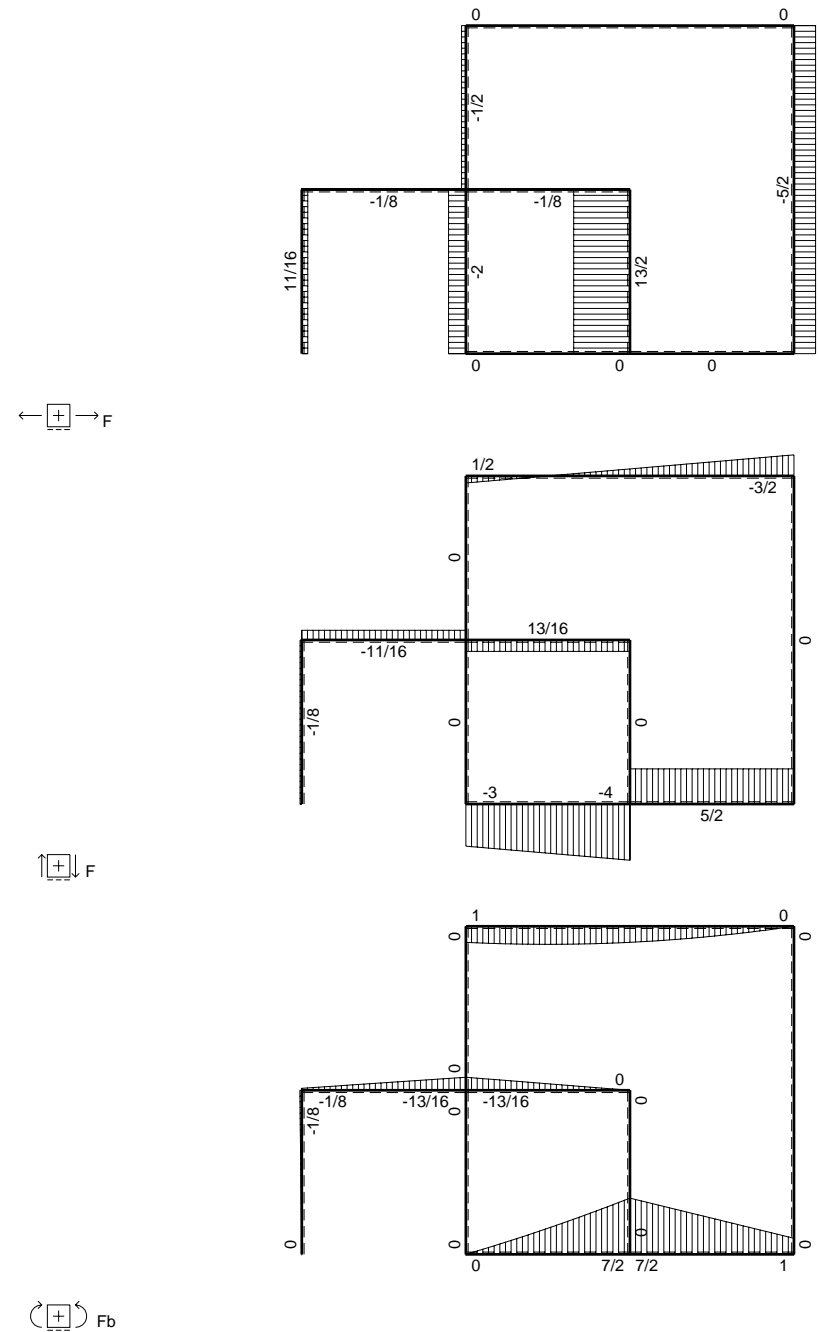
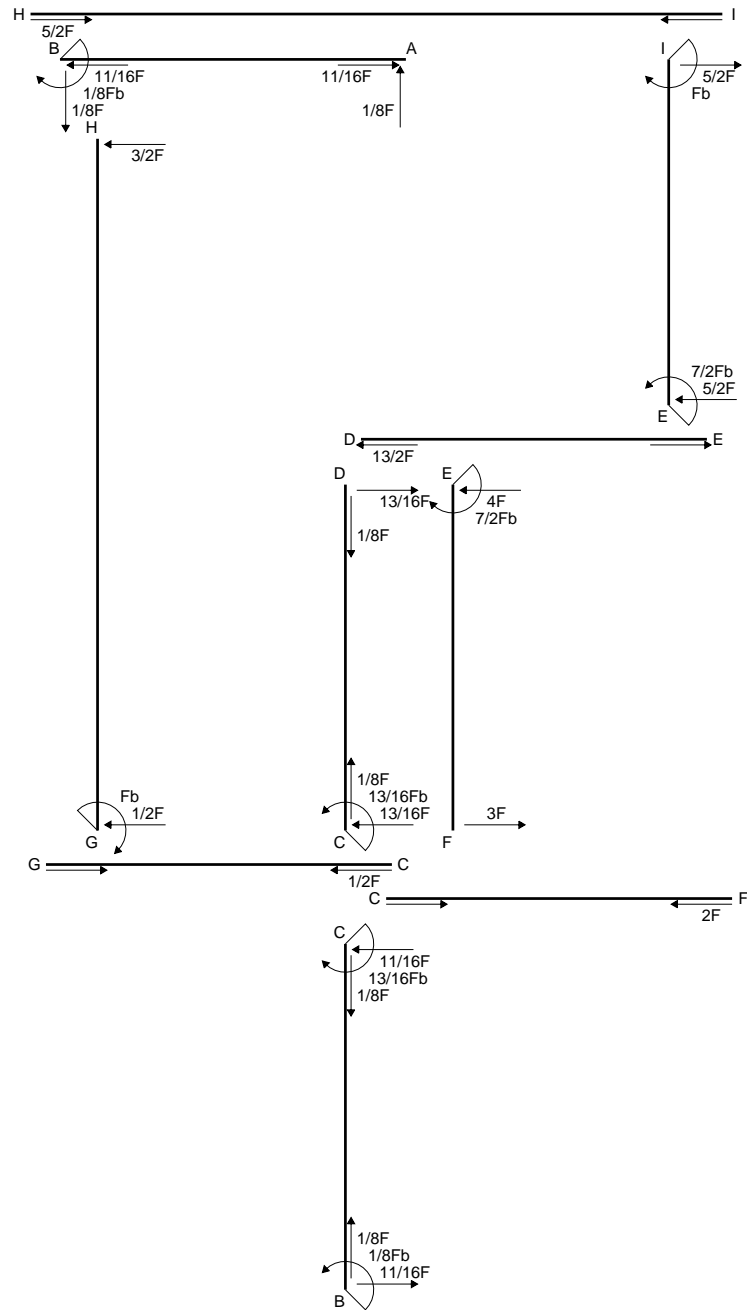
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

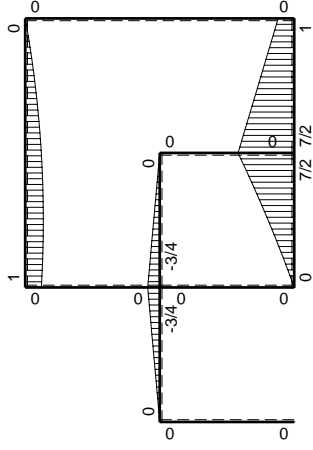
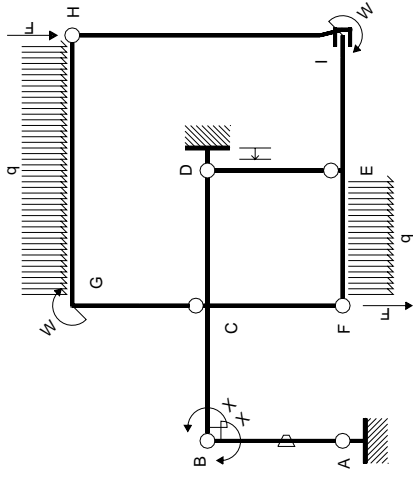
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

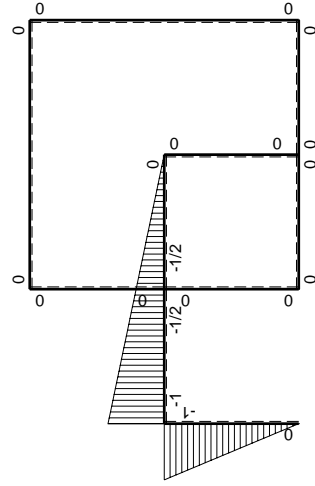
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x / EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

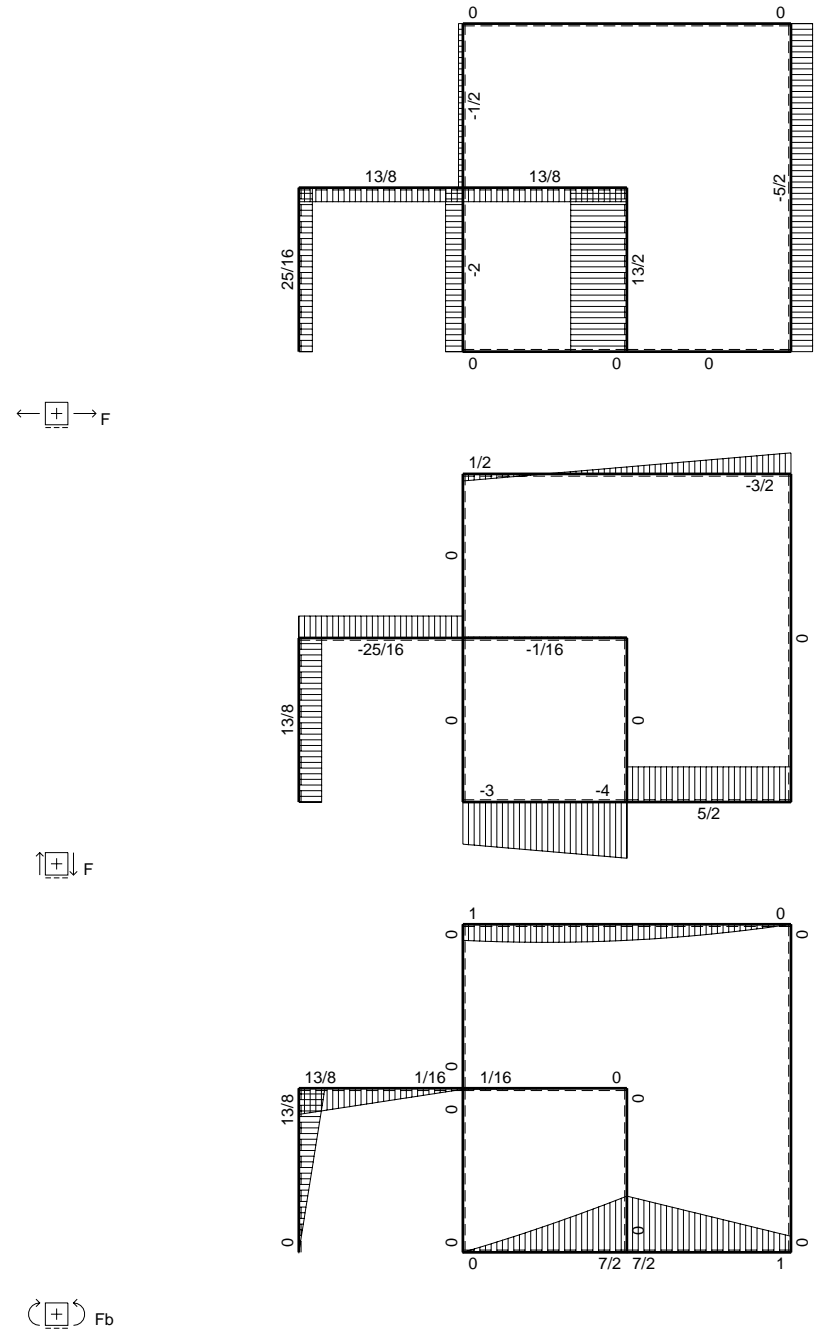
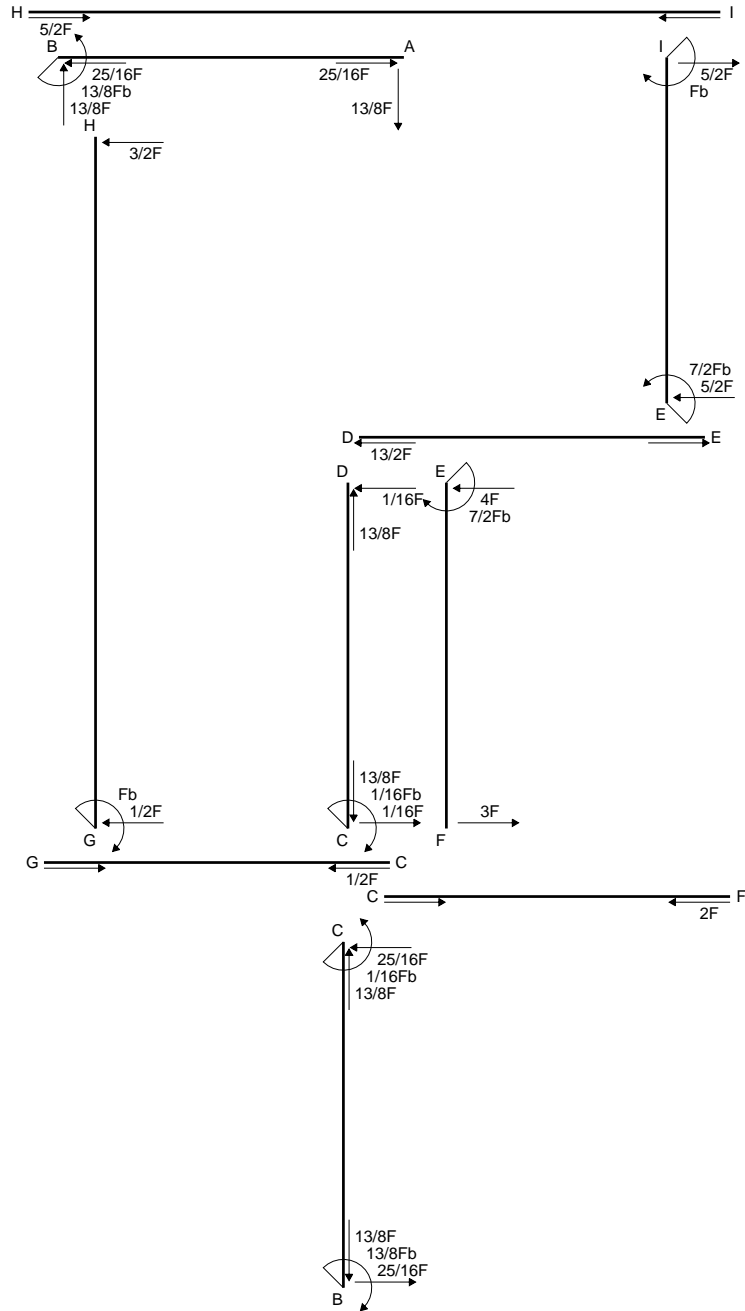
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

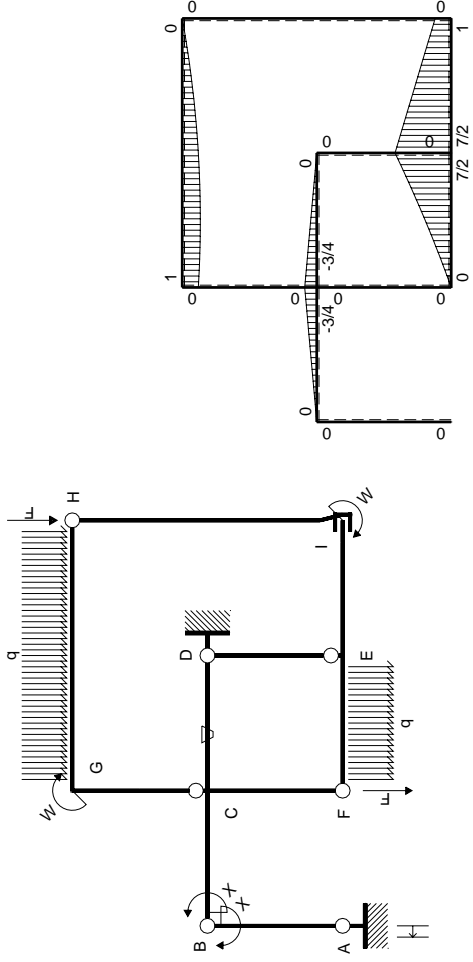
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

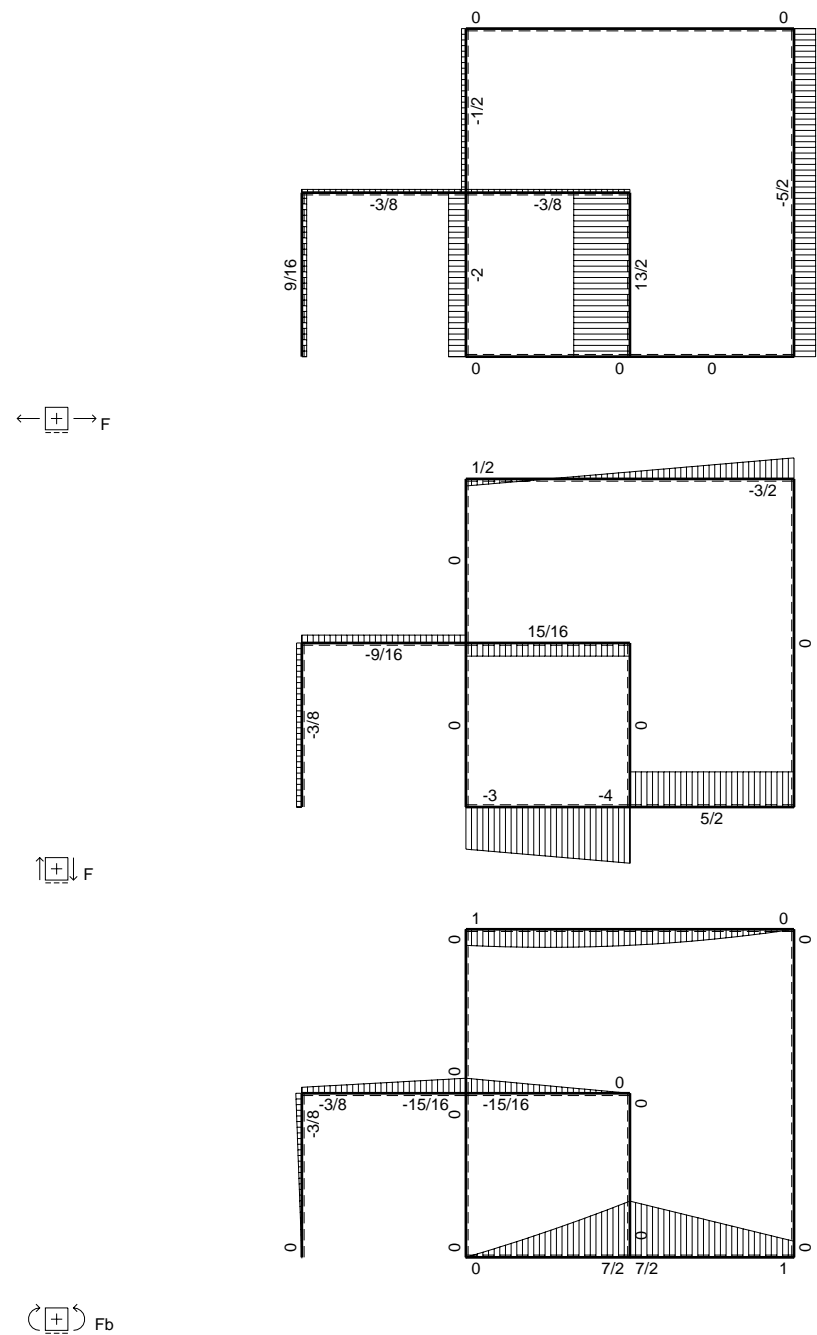
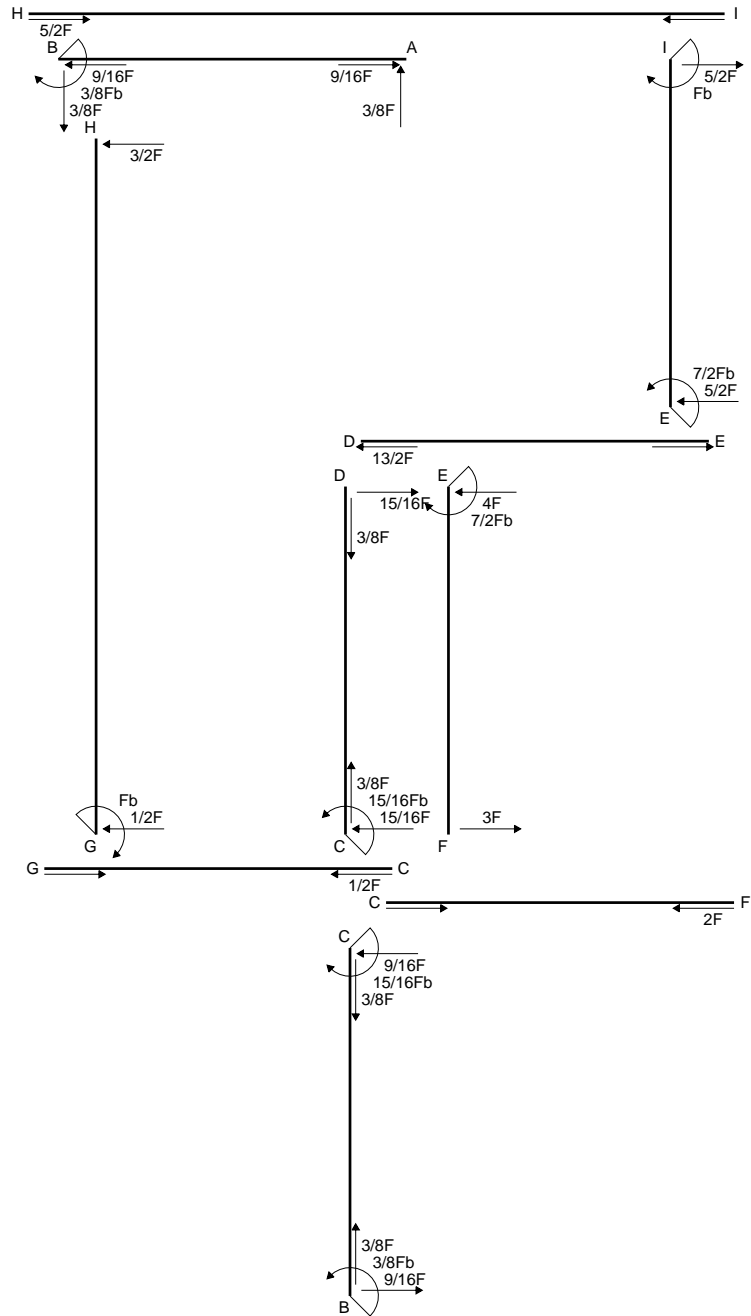
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

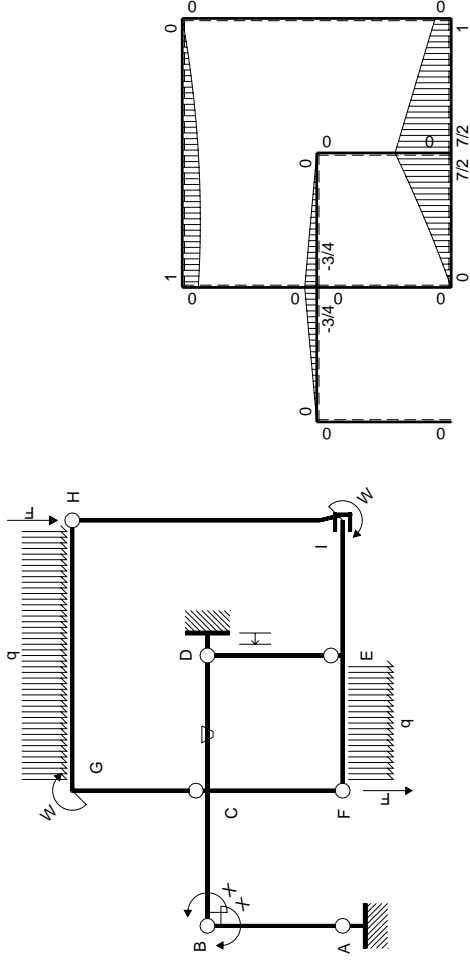
$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-4Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-3Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$3/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

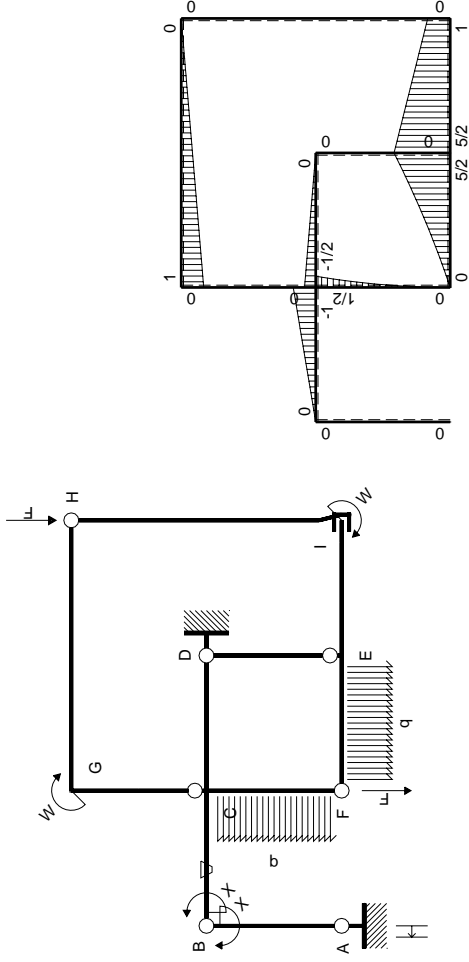
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

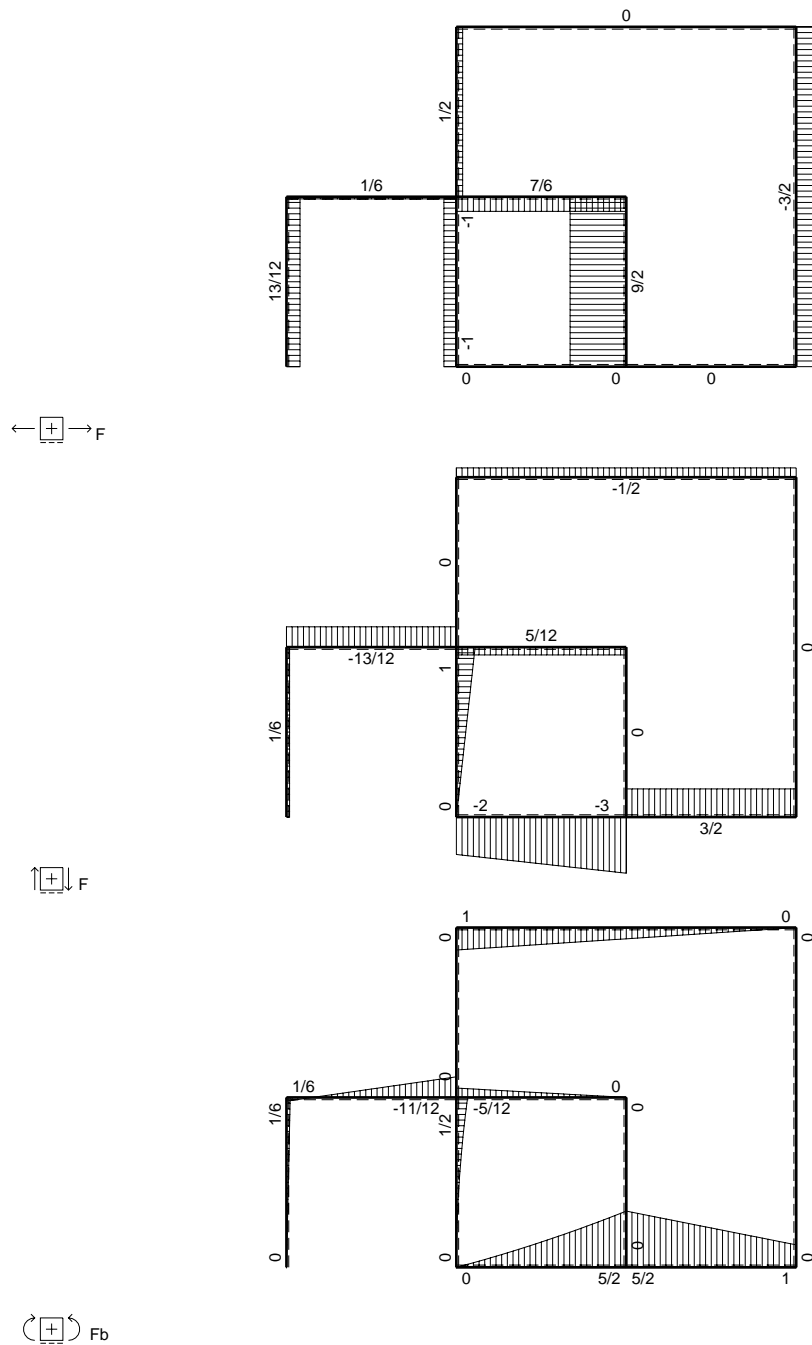
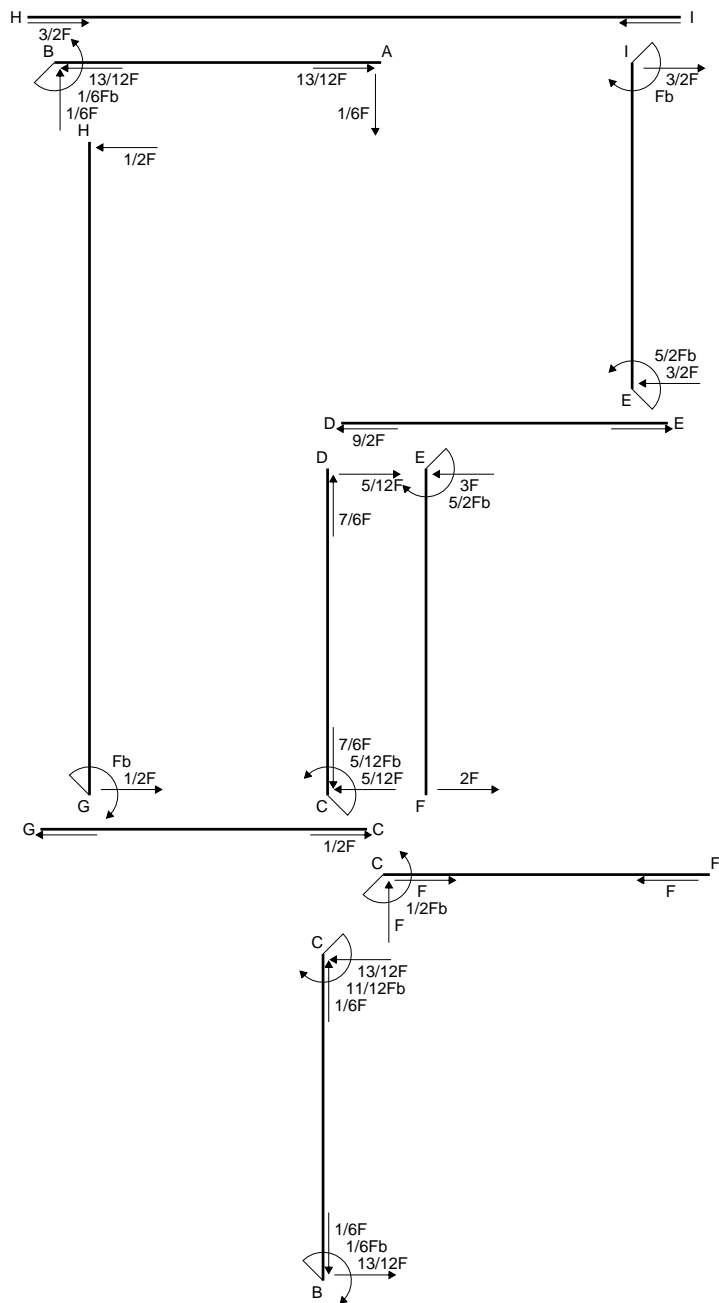
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

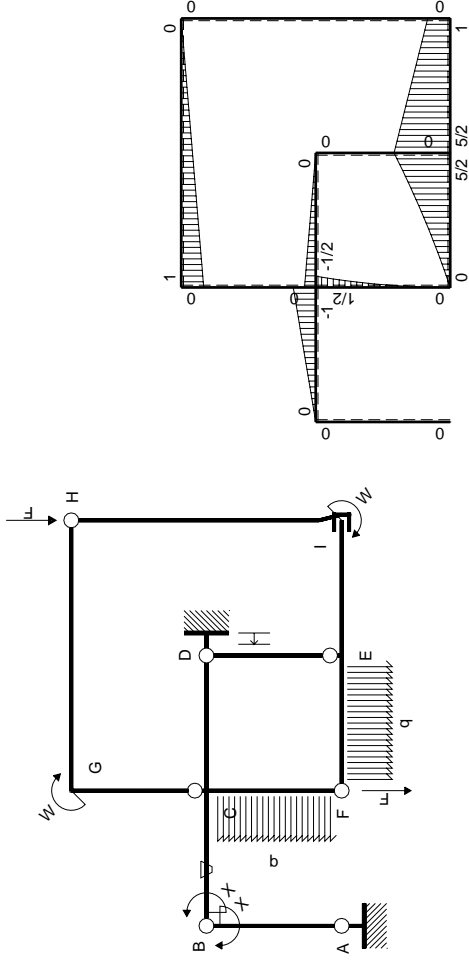
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

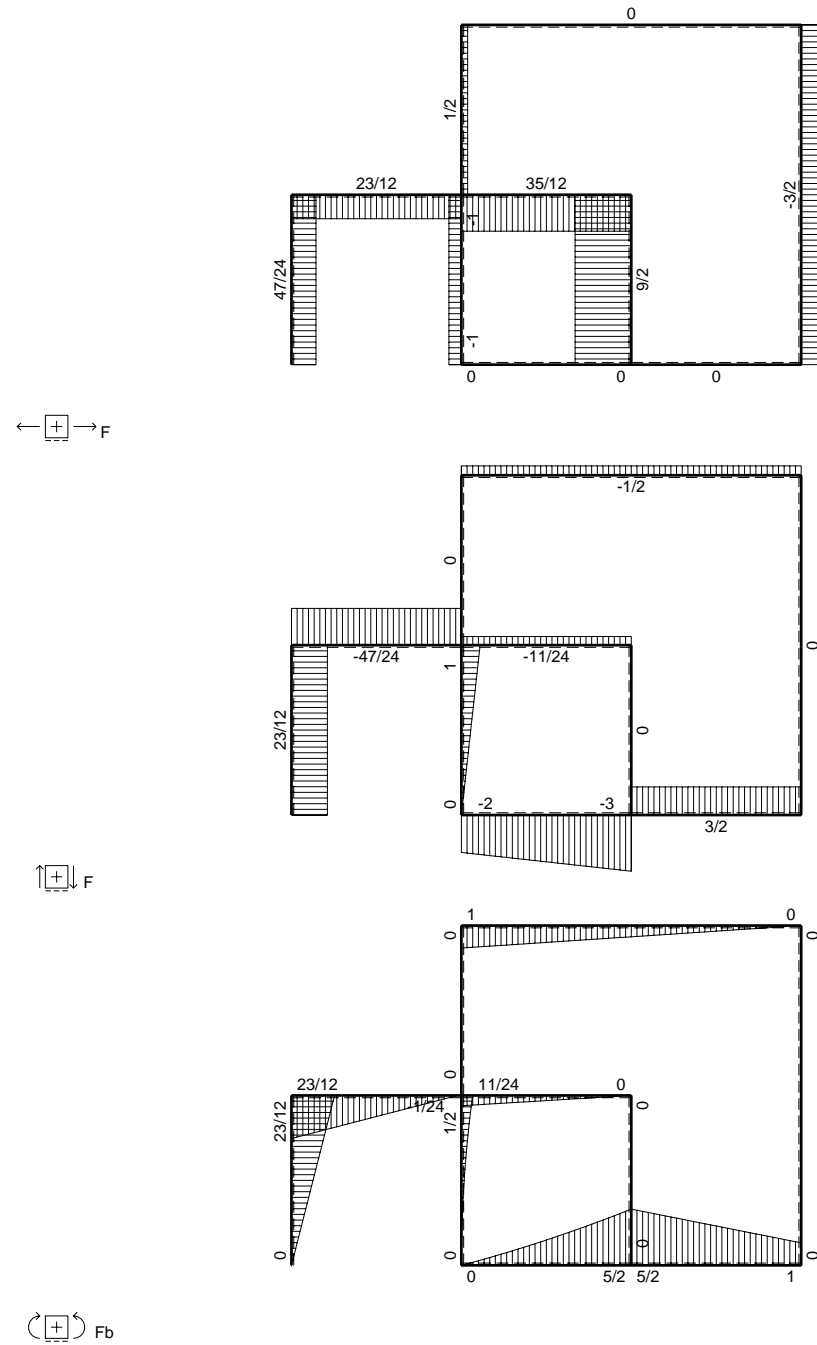
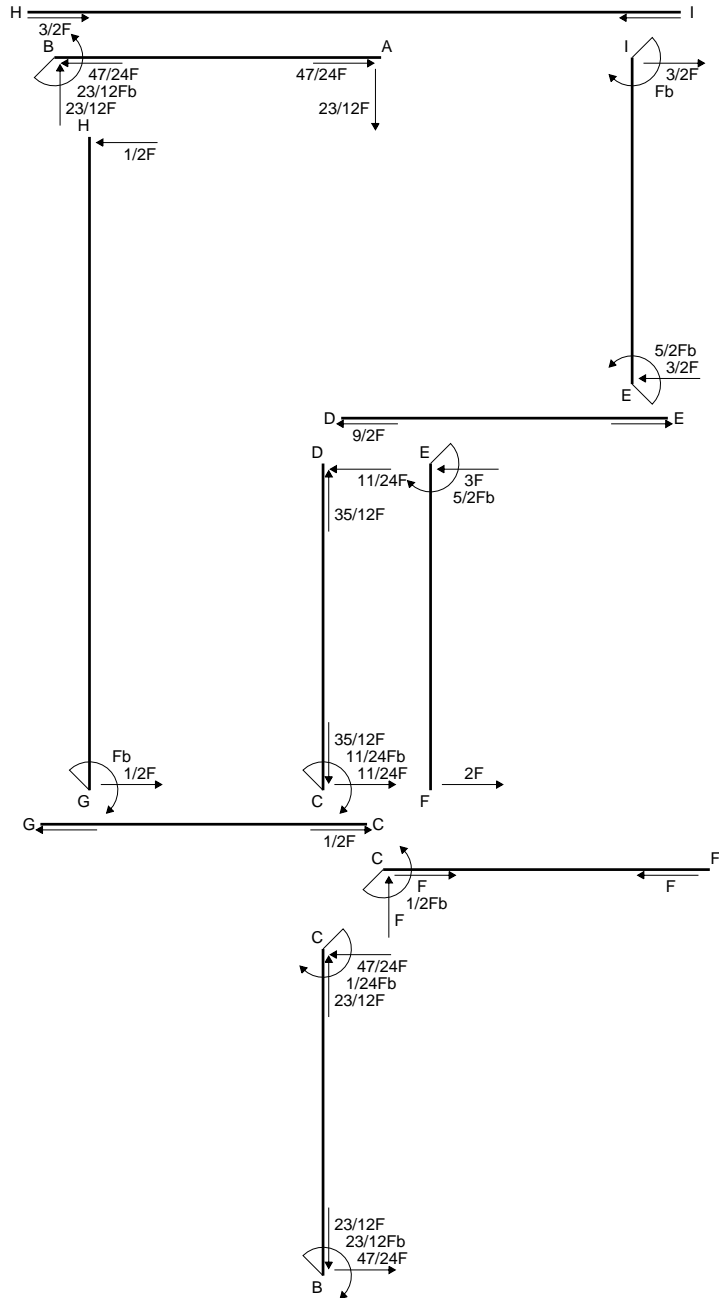
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

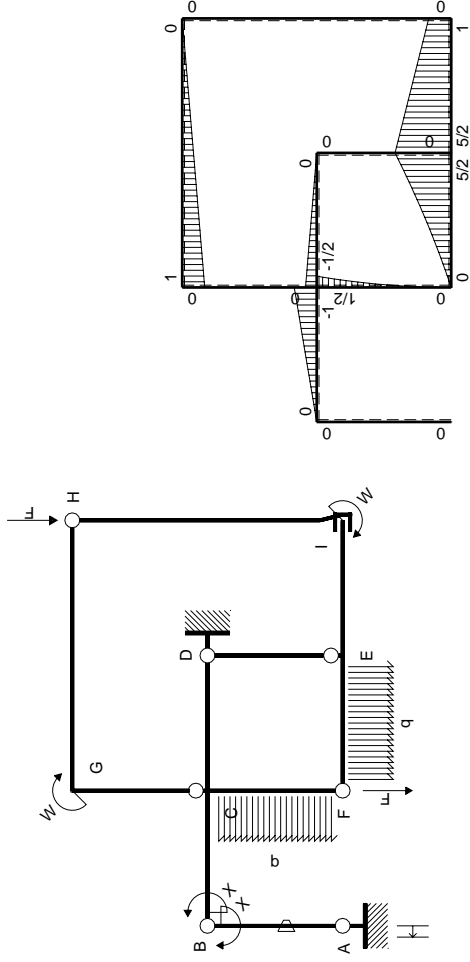
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

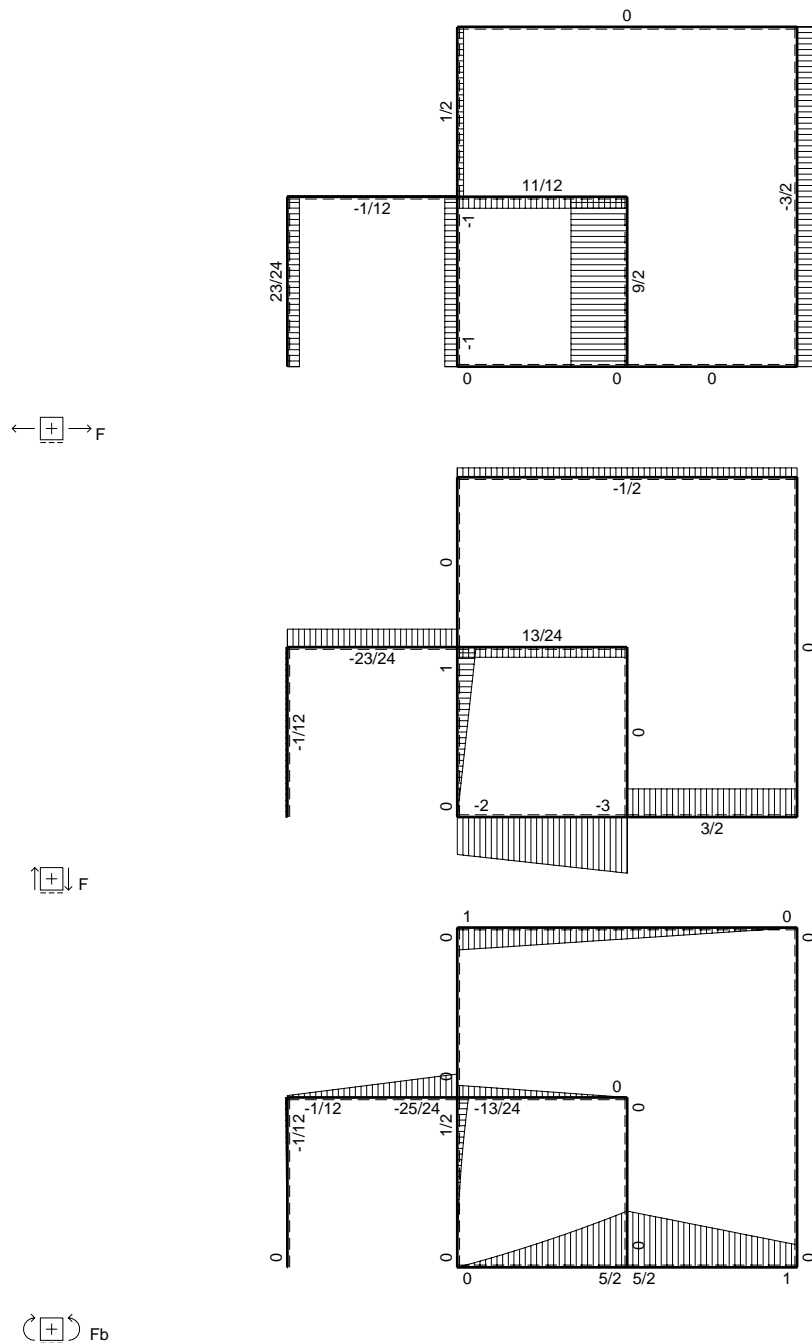
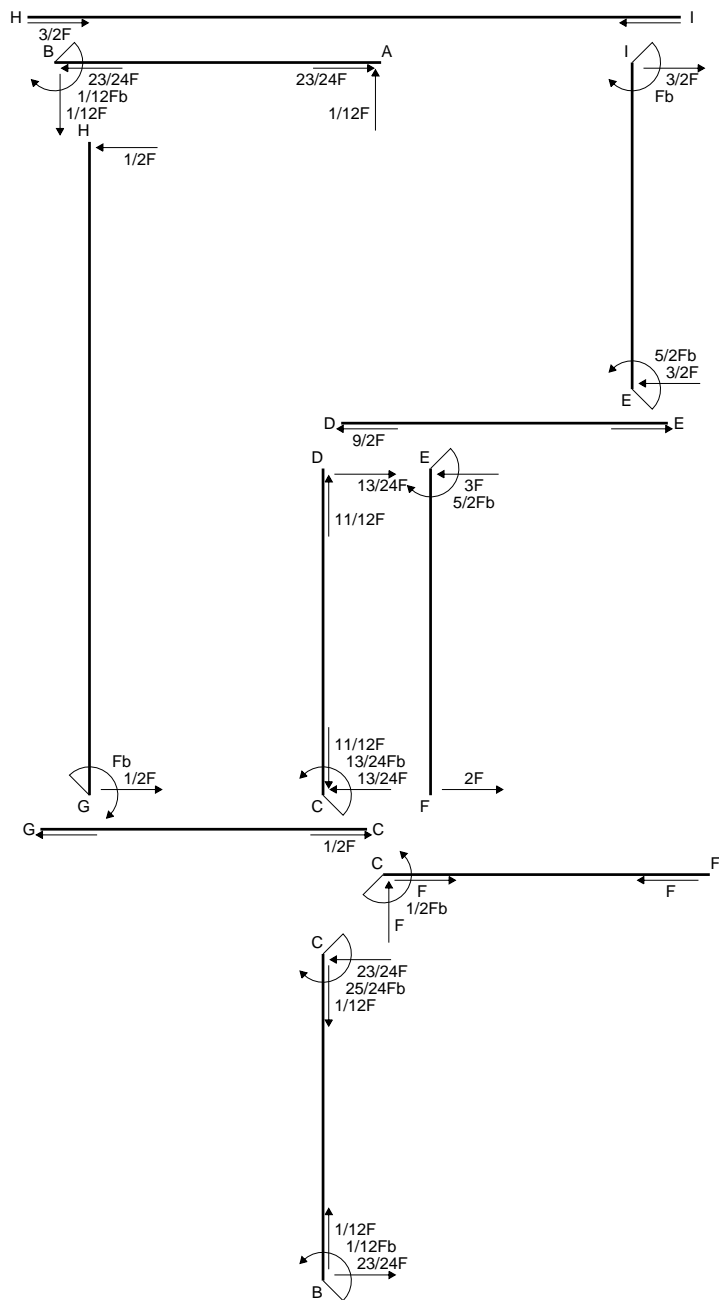
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

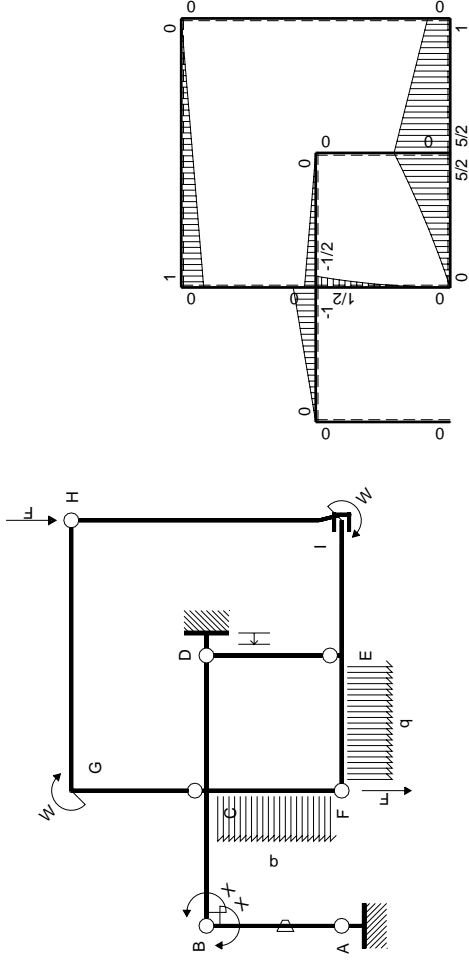
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

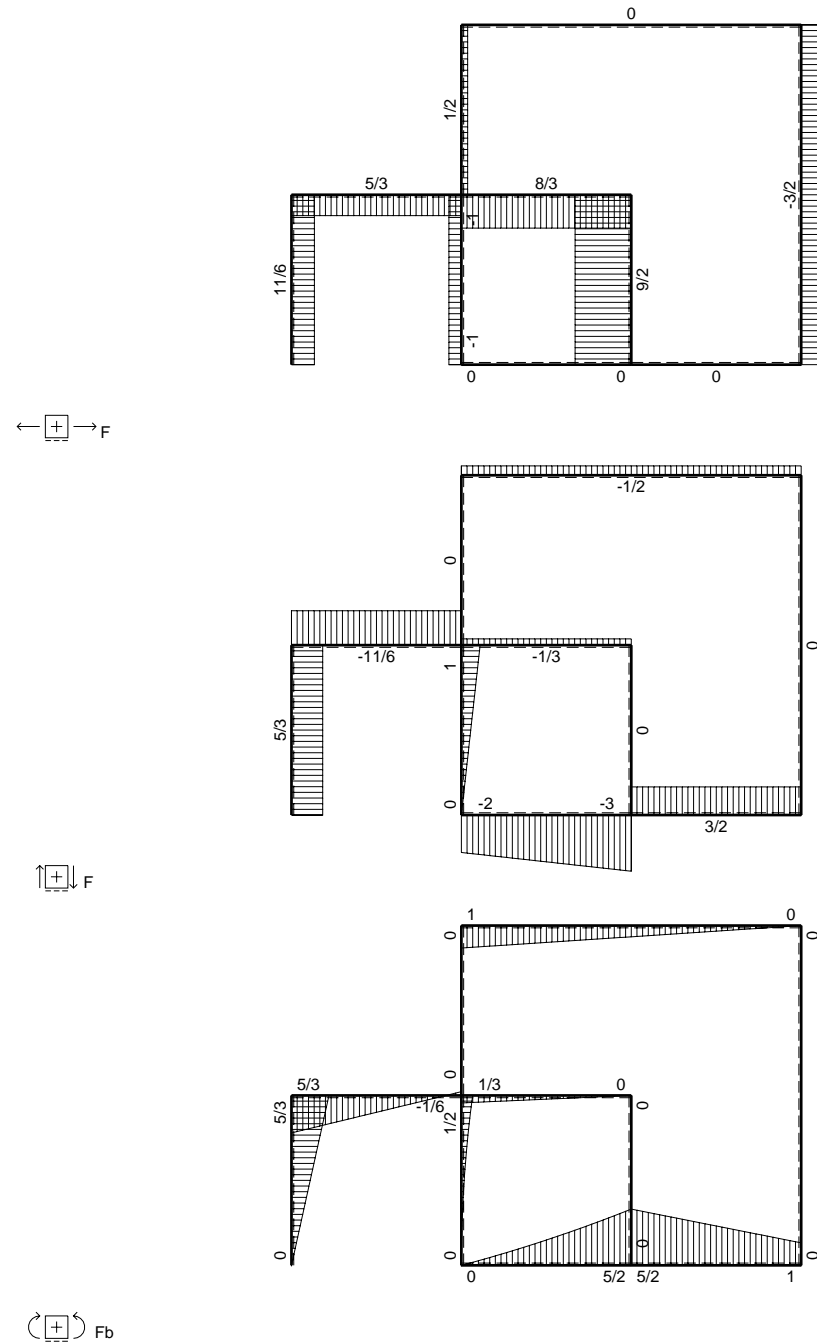
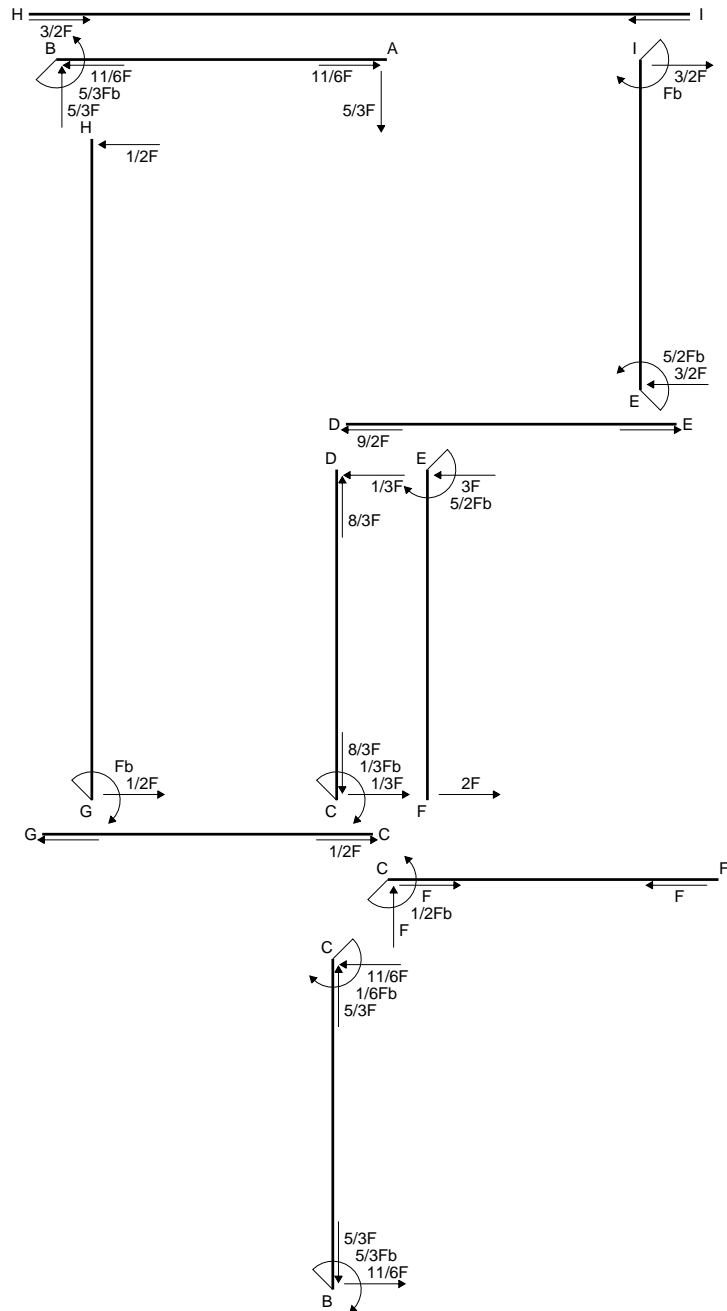
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

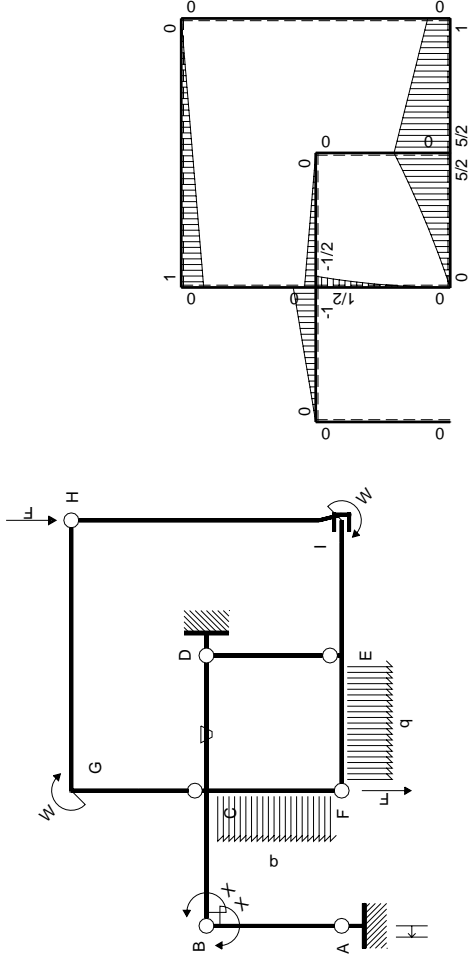
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-5/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

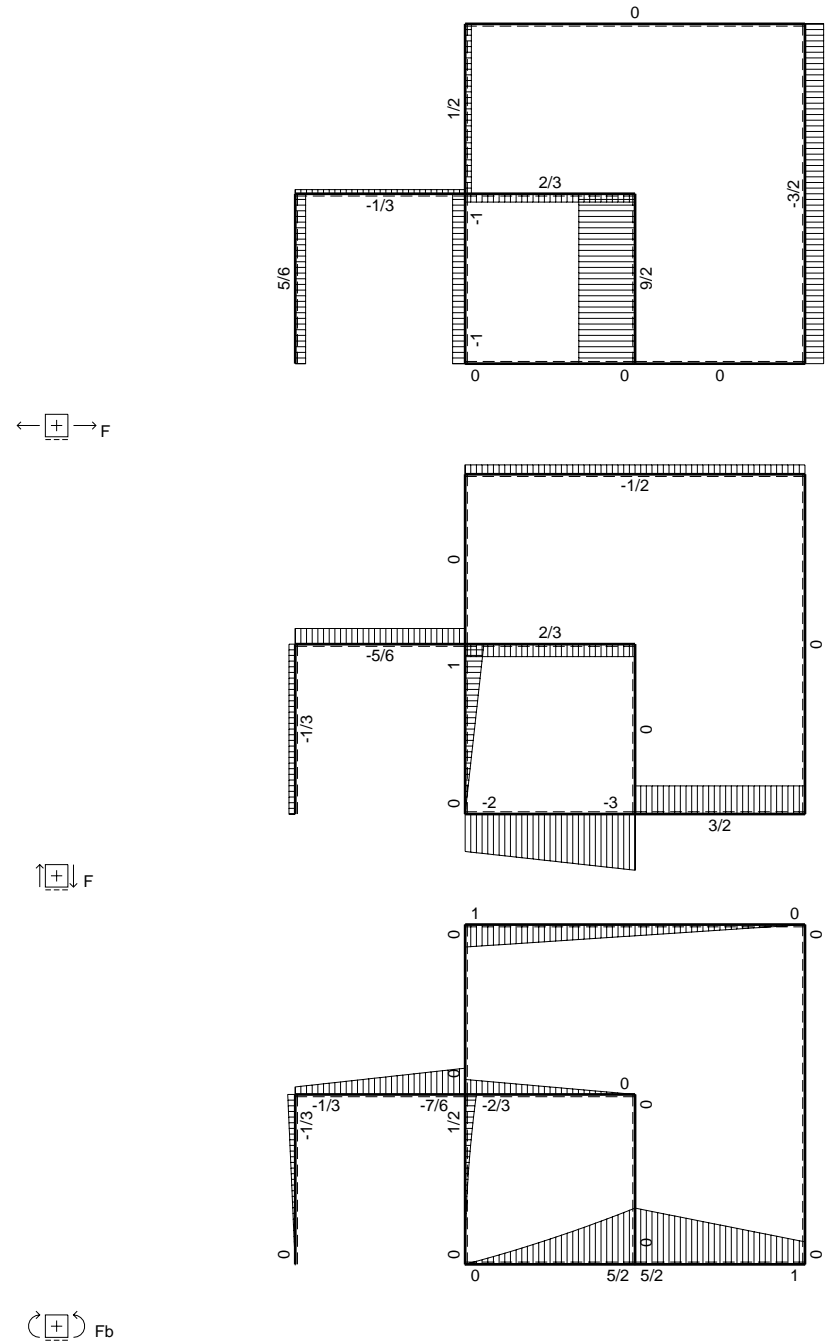
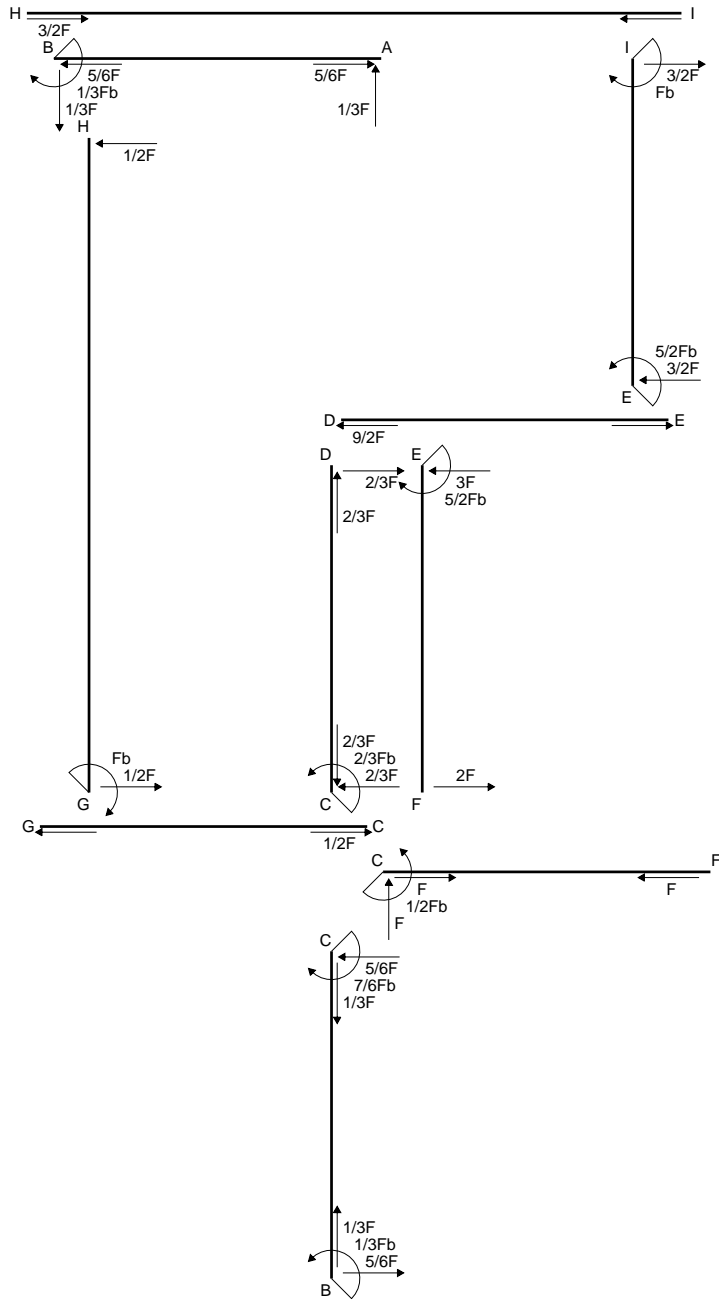
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

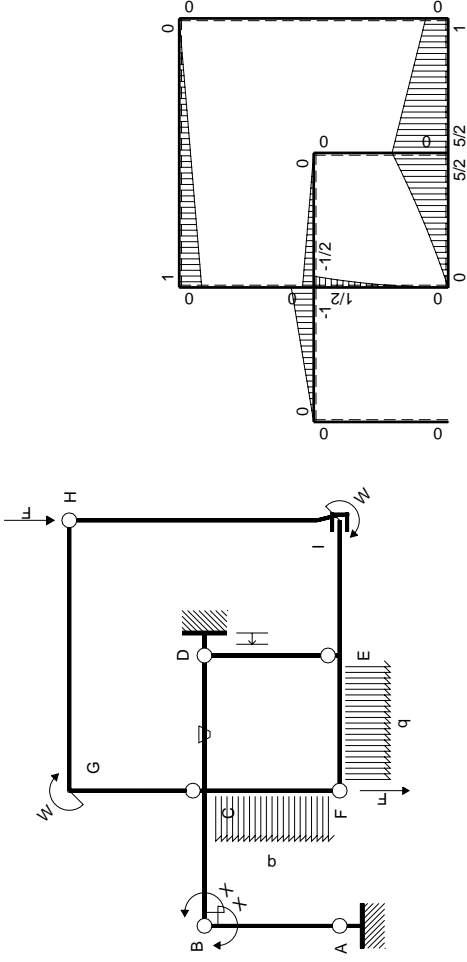
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b \left(x^2/b^2 \right) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b \left(1 - 2x/b + x^2/b^2 \right) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b \left(1 - x/b + 1/4 x^2/b^2 \right) 1/EJ dx = \left[x - 1/2 x^2/b + 1/12 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b \left(1/4 + 1/2 x/b + 1/4 x^2/b^2 \right) 1/EJ dx = \left[1/4 x + 1/4 x^2/b + 1/12 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b \left(1/4 - 1/2 x/b + 1/4 x^2/b^2 \right) 1/EJ dx = \left[1/4 x - 1/4 x^2/b + 1/12 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b \left(1/4 x^2/b^2 \right) 1/EJ dx = \left[1/12 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b \left(x/b - 1/2 x^2/b^2 \right) Fb 1/EJ dx = \left[1/2 x^2/b - 1/6 x^3/b^2 \right]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b \left(1/2 - 1/2 x^2/b^2 \right) Fb 1/EJ dx = \left[1/2 x - 1/6 x^3/b^2 \right]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

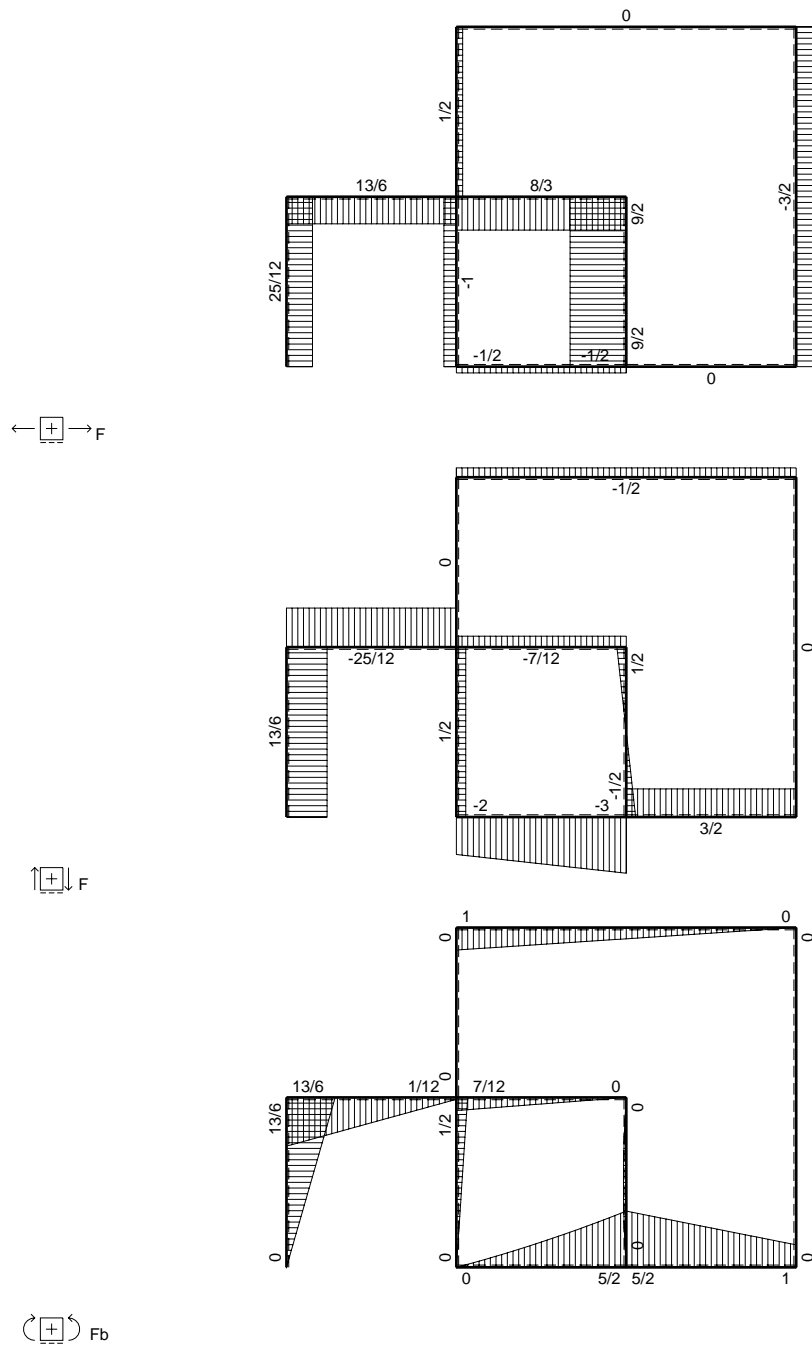
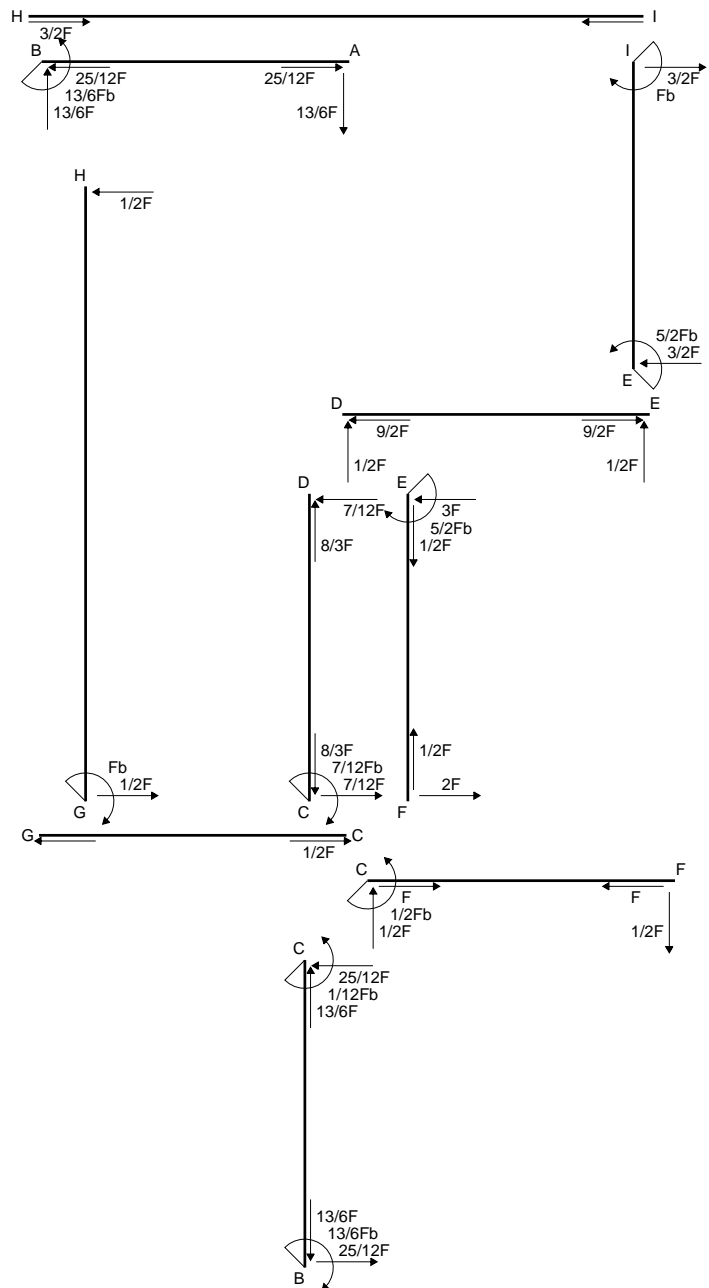
$$L_{CD}^{xo} = \int_0^b \left(1/4 - 1/2 x/b + 1/4 x^2/b^2 \right) Fb 1/EJ dx + \int_0^b \left(1/2 - 1/2 x/b \right) \theta dx$$

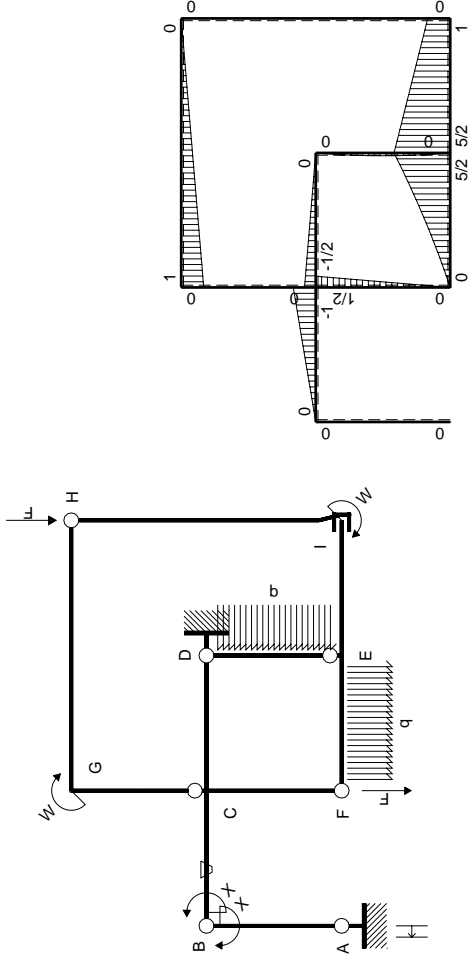
$$= \left[1/4 x - 1/4 x^2/b + 1/12 x^3/b^2 \right]_0^b Fb 1/EJ + \left[1/2 x - 1/4 x^2/b \right]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b \left(1/4 x^2/b^2 \right) Fb 1/EJ dx + \int_0^b \left(-1/2 x/b \right) \theta dx = \left[1/12 x^3/b^2 \right]_0^b Fb 1/EJ + \left[-1/4 x^2/b \right]_0^b \theta$$

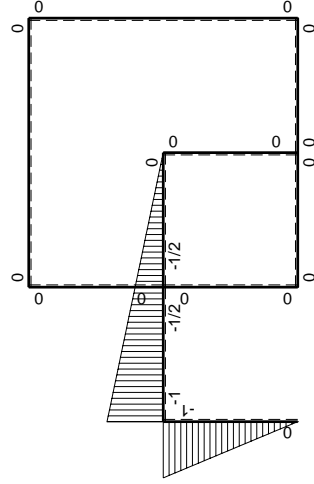
$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	-x/b	0	0	0	0	x^2/b^2	0+0	1/3Xb/EJ
BA b	1-x/b	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	-1+1/2x/b	-Fx	-Fb/EJ	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	7/12Xb/EJ
CB b	1/2+1/2x/b	Fb-Fx	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	-1/2+1/2x/b	-1/2Fb+1/2Fx	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	1/12Xb/EJ
DC b	1/2x/b	1/2Fx	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	1/2Fx	0	0	0	0	0+0	0
CF b	0	-1/2Fb+1/2Fx	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	Fb-1/2Fx	0	0	0	0	0+0	0
HG 2b	0	-1/2Fx	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	Fb+3/2Fx	0	0	0	0	0+0	0
EI b	0	-5/2Fb+3/2Fx	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						-13/6Fb	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

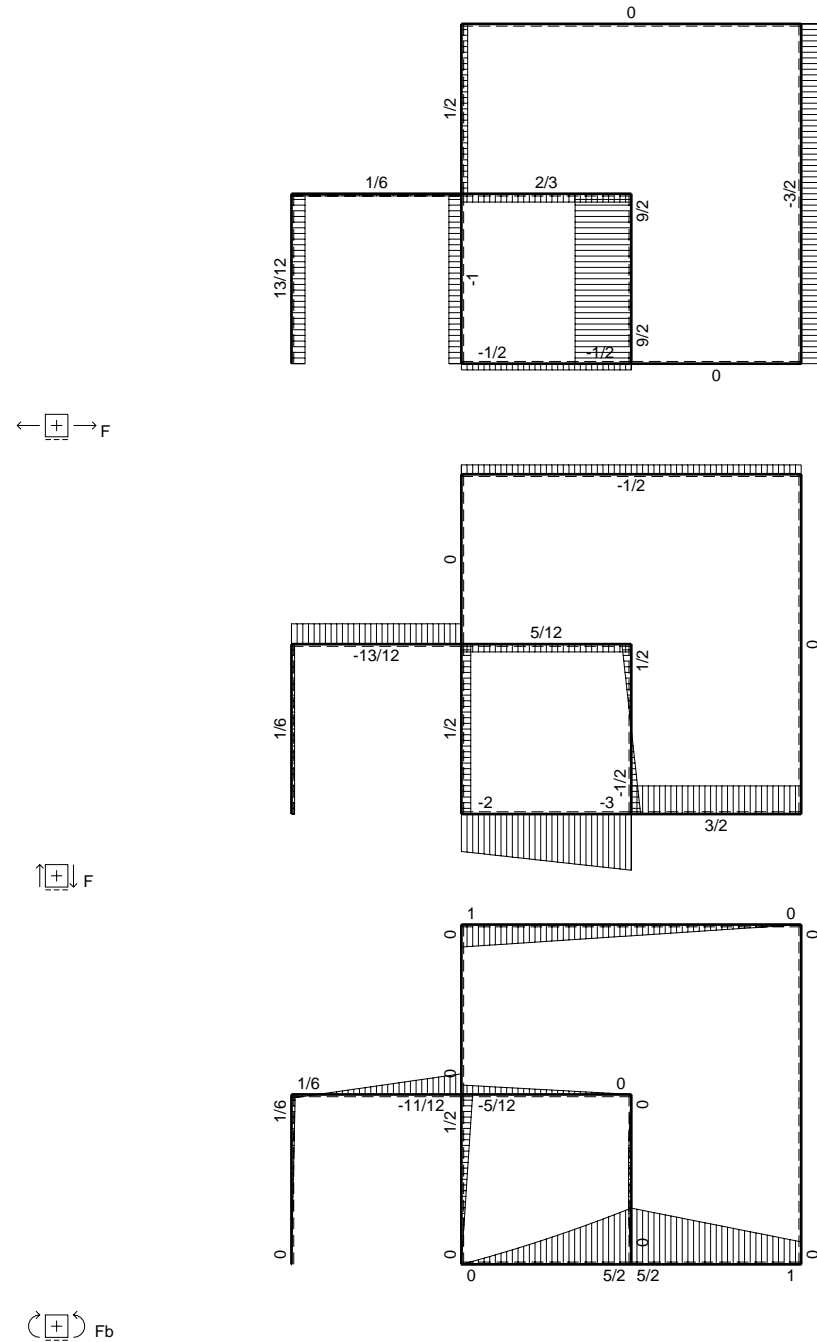
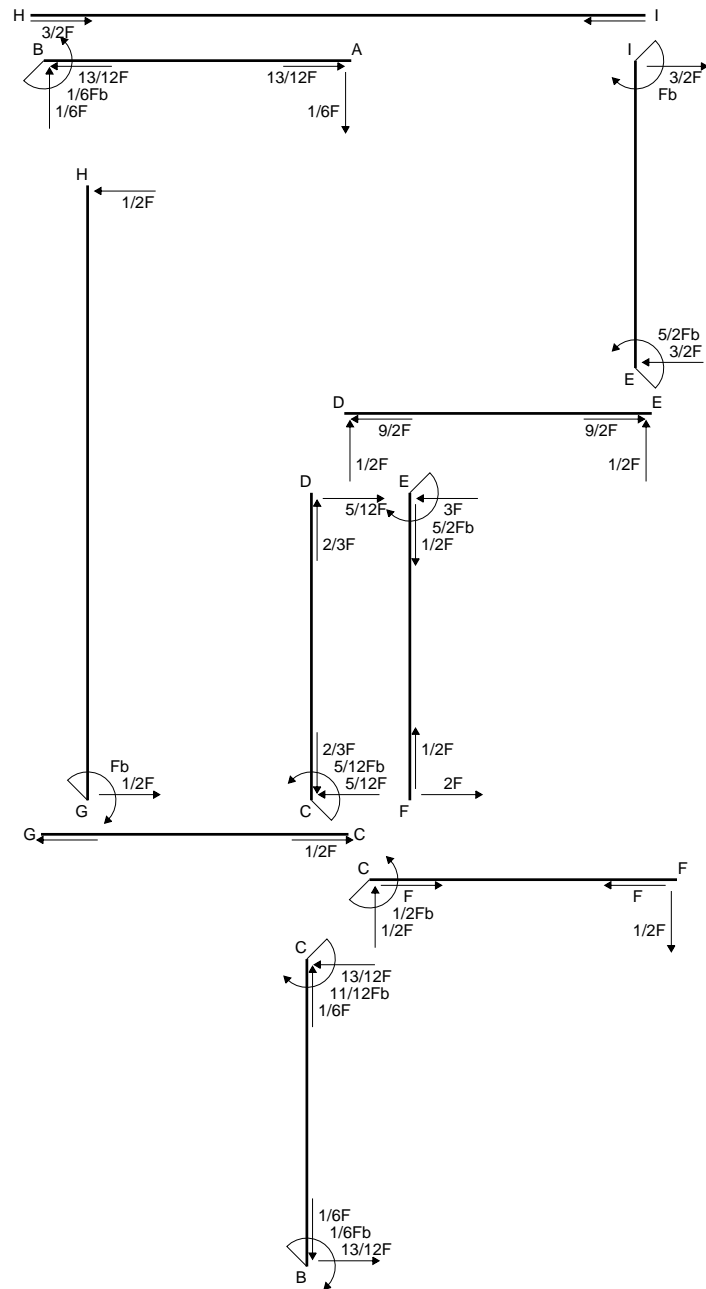
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

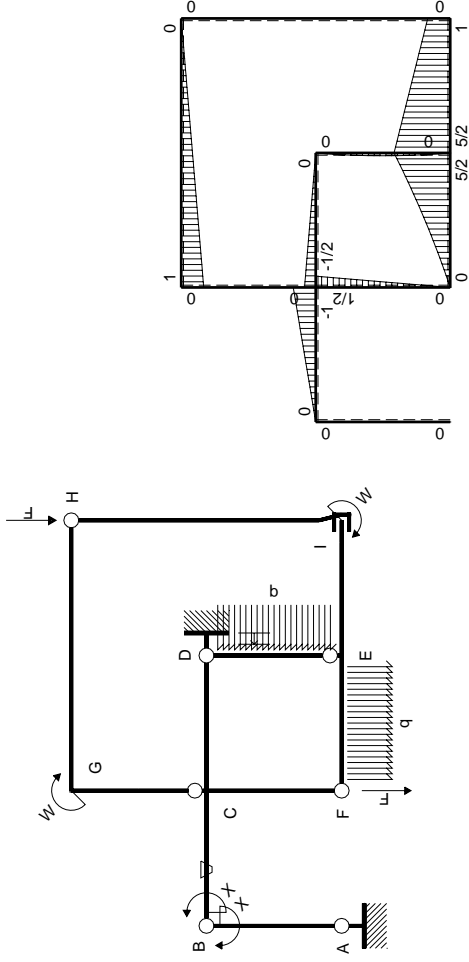
$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$



⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

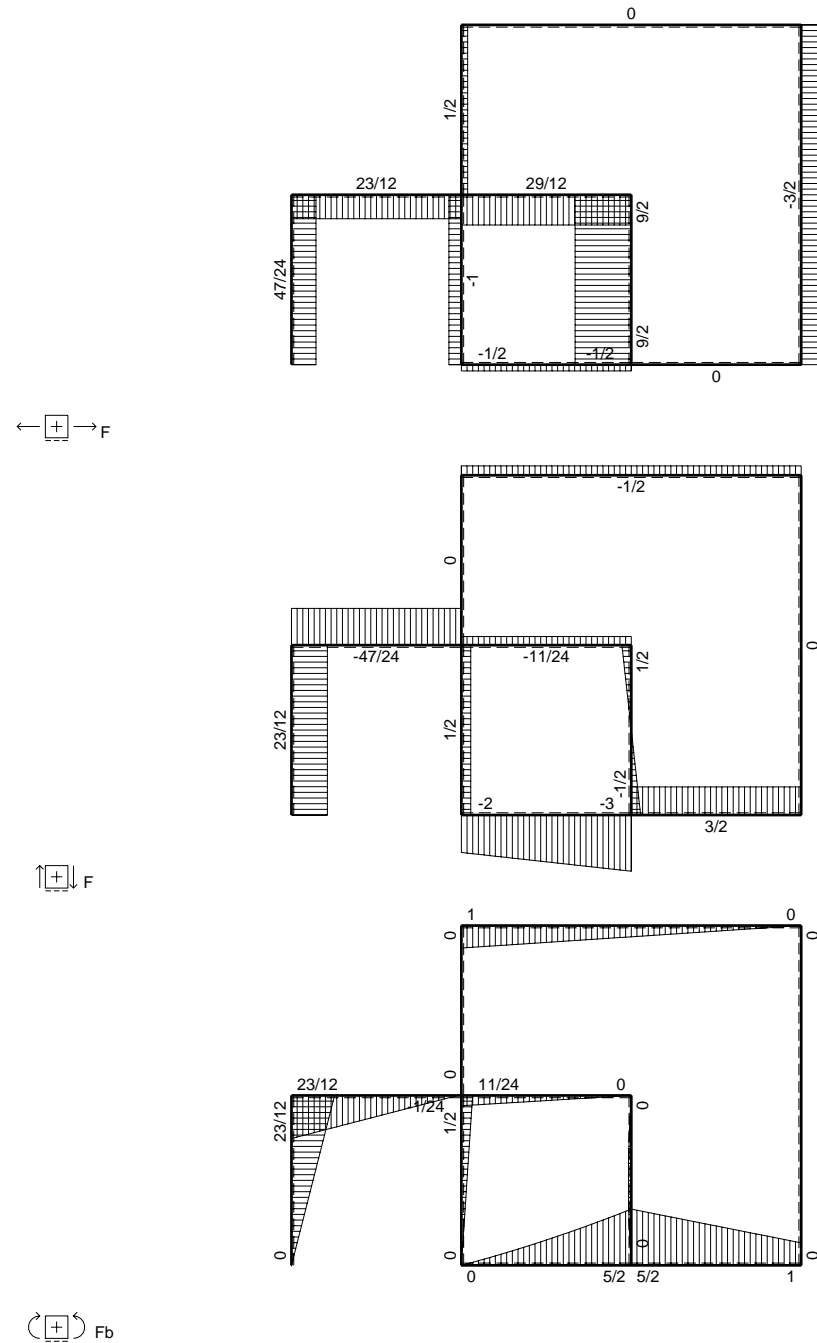
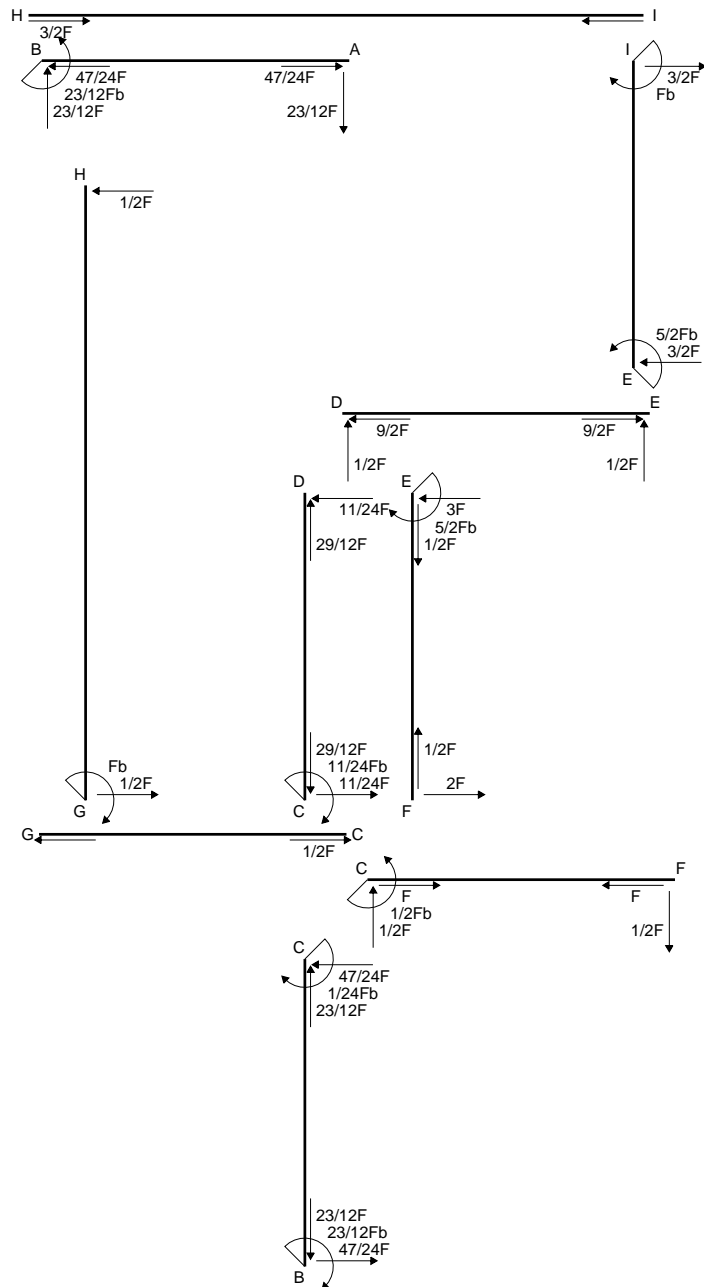
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

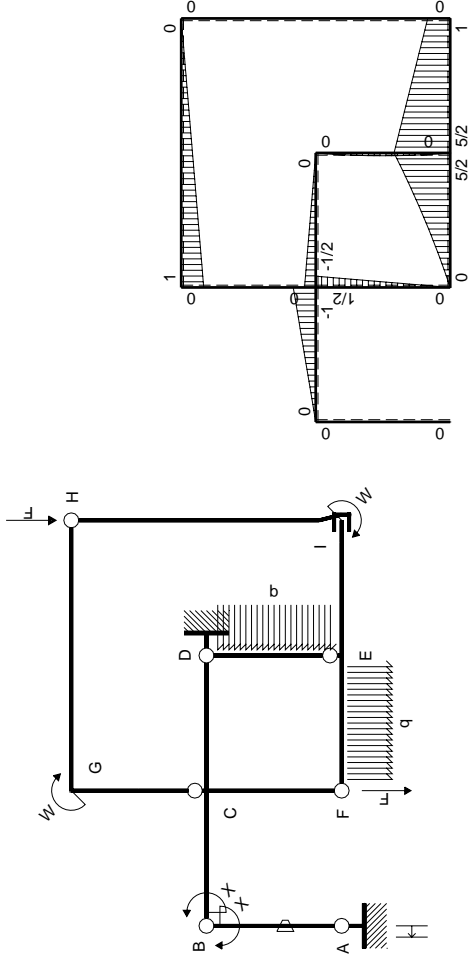
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

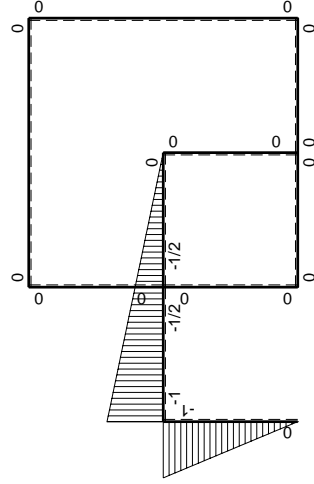
$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

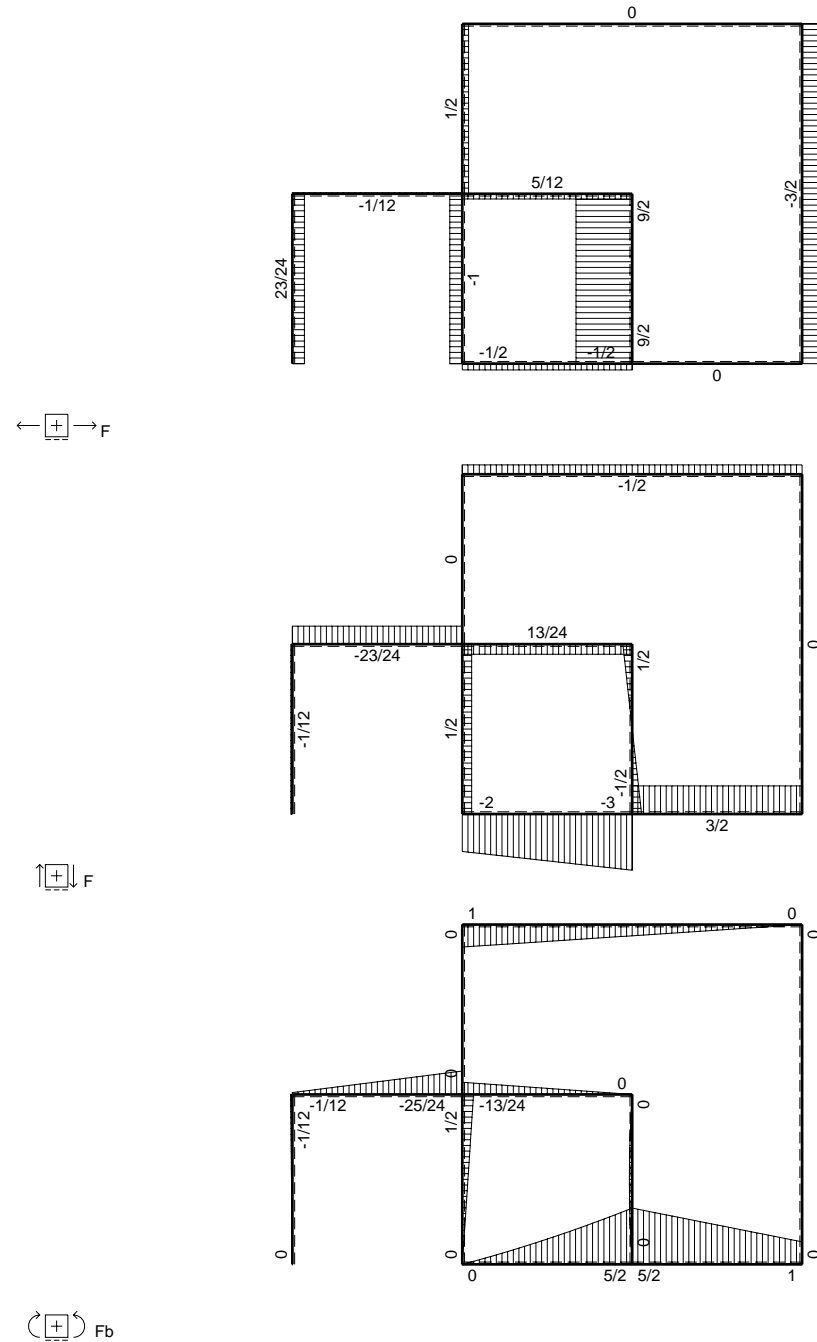
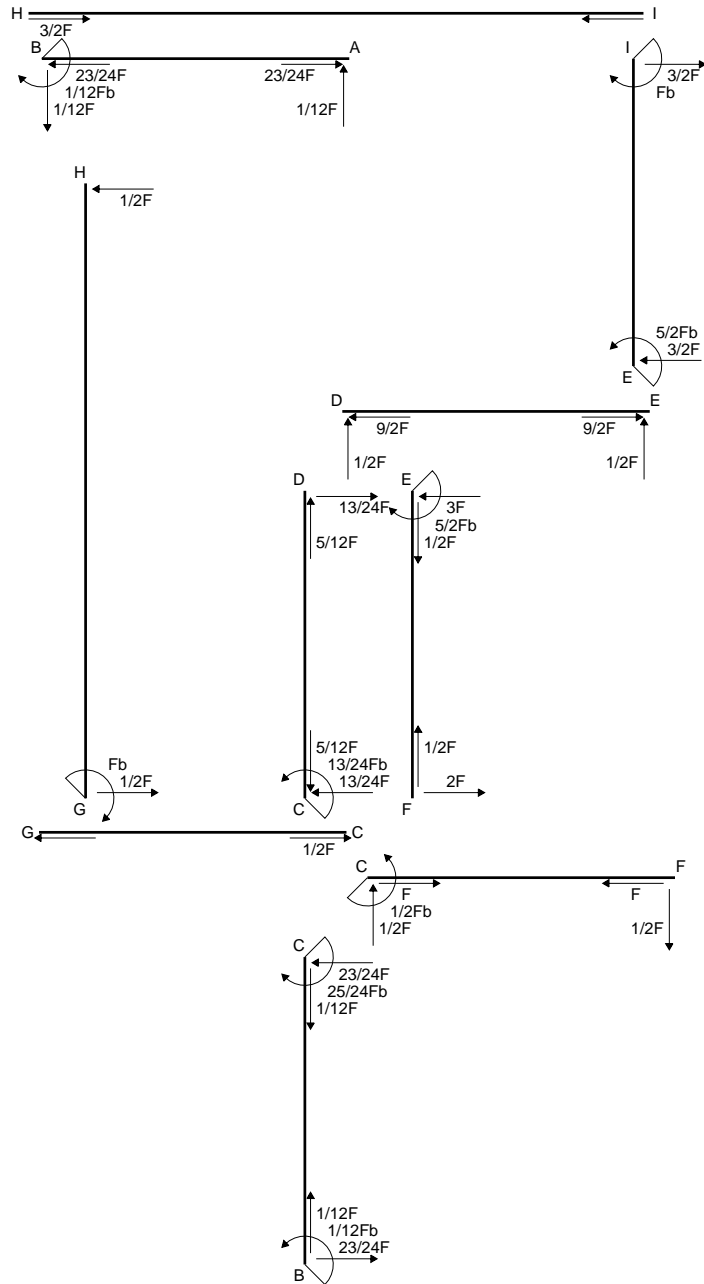
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

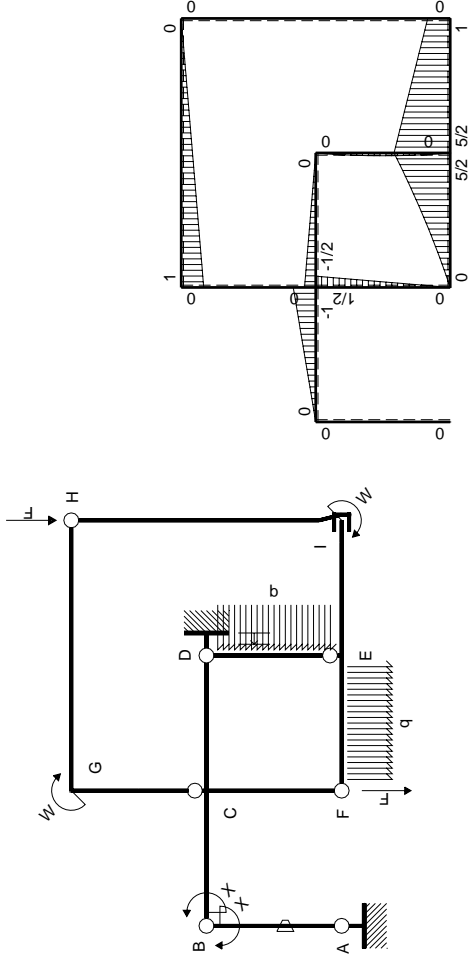
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	0	$1/4Fb-1/2Fx+1/4Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	0	$1/4Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

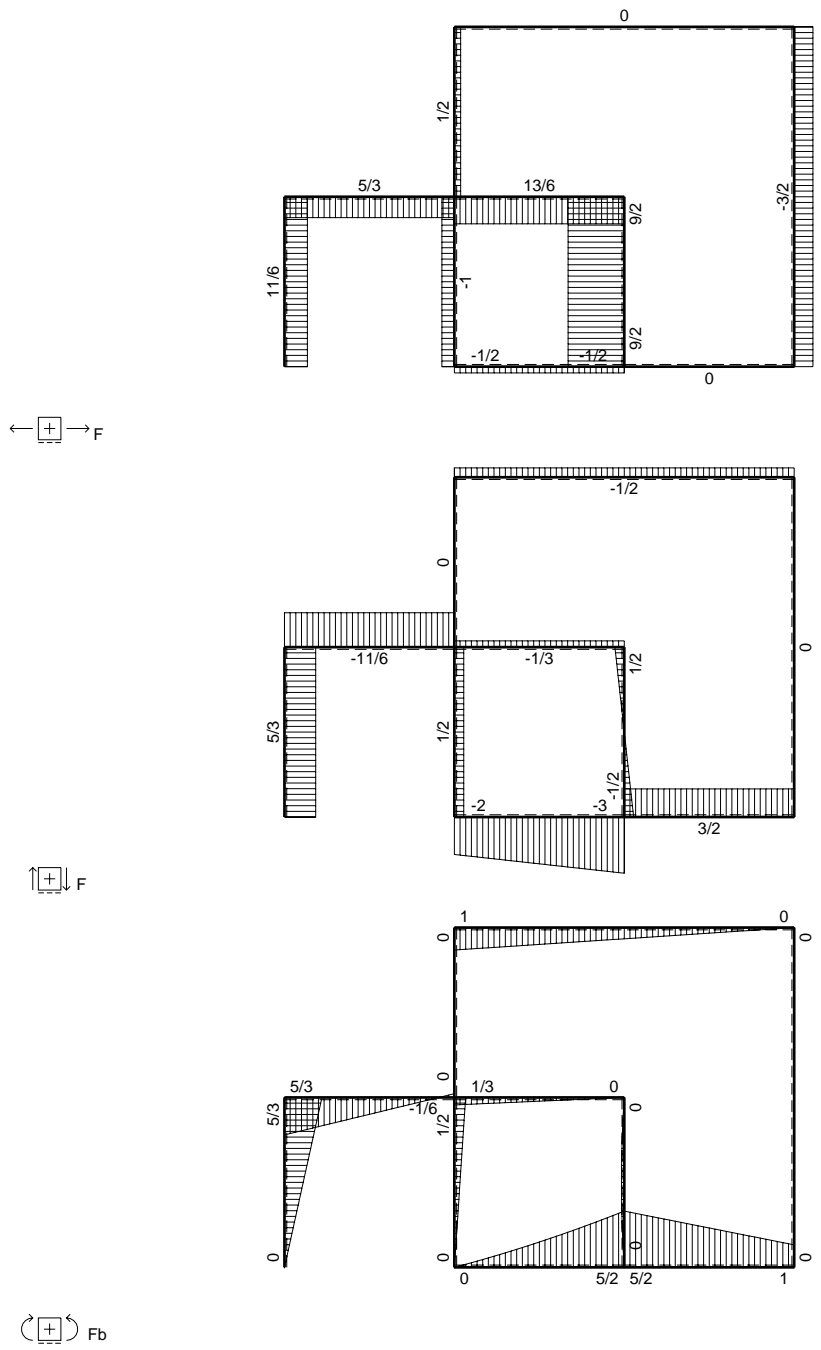
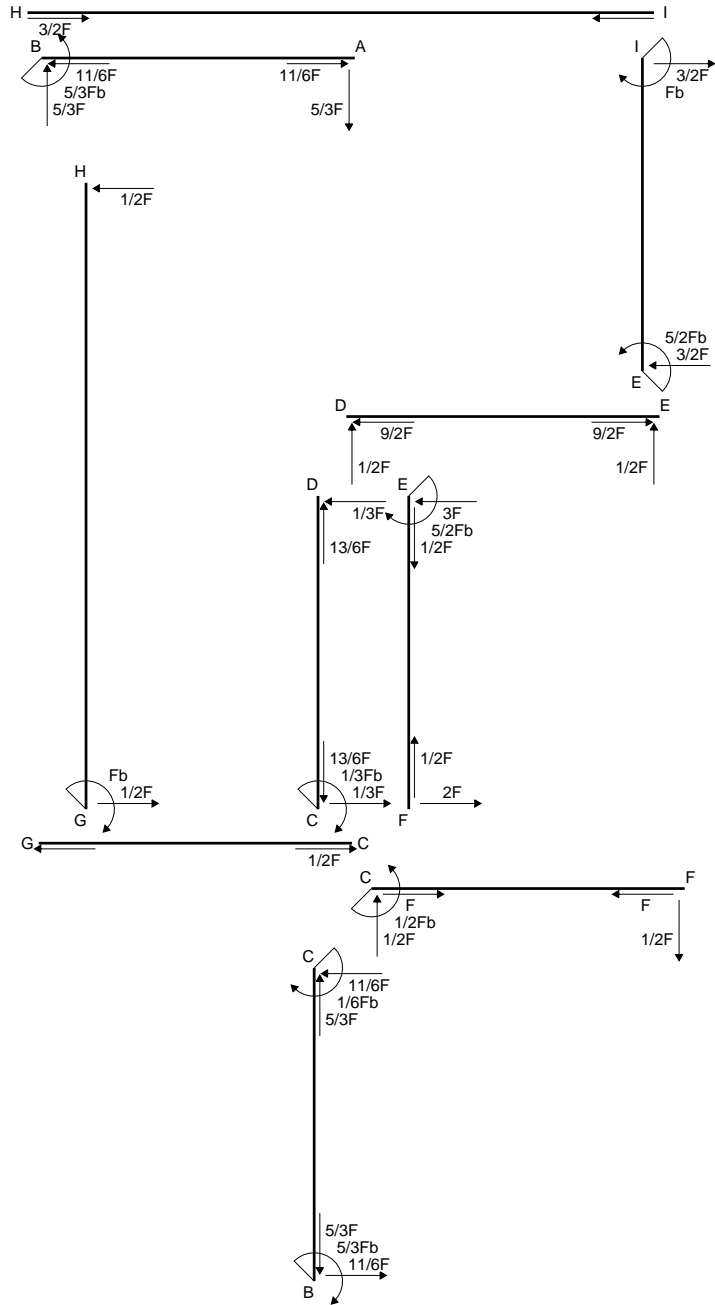
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

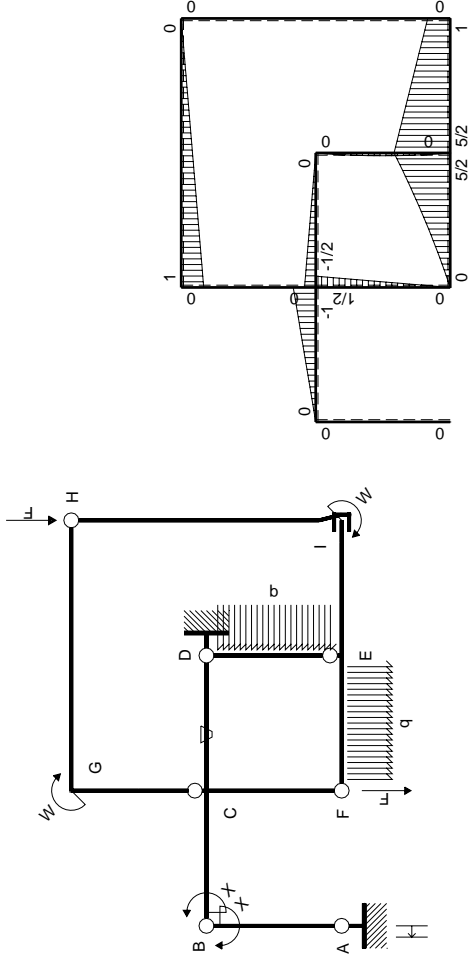
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx = [1/12 x^3/b^2]_0^b Fb 1/EJ$$

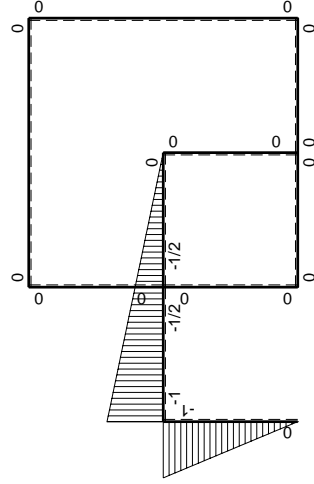
$$= (1/12 b) Fb 1/EJ = 1/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$5/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-5/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

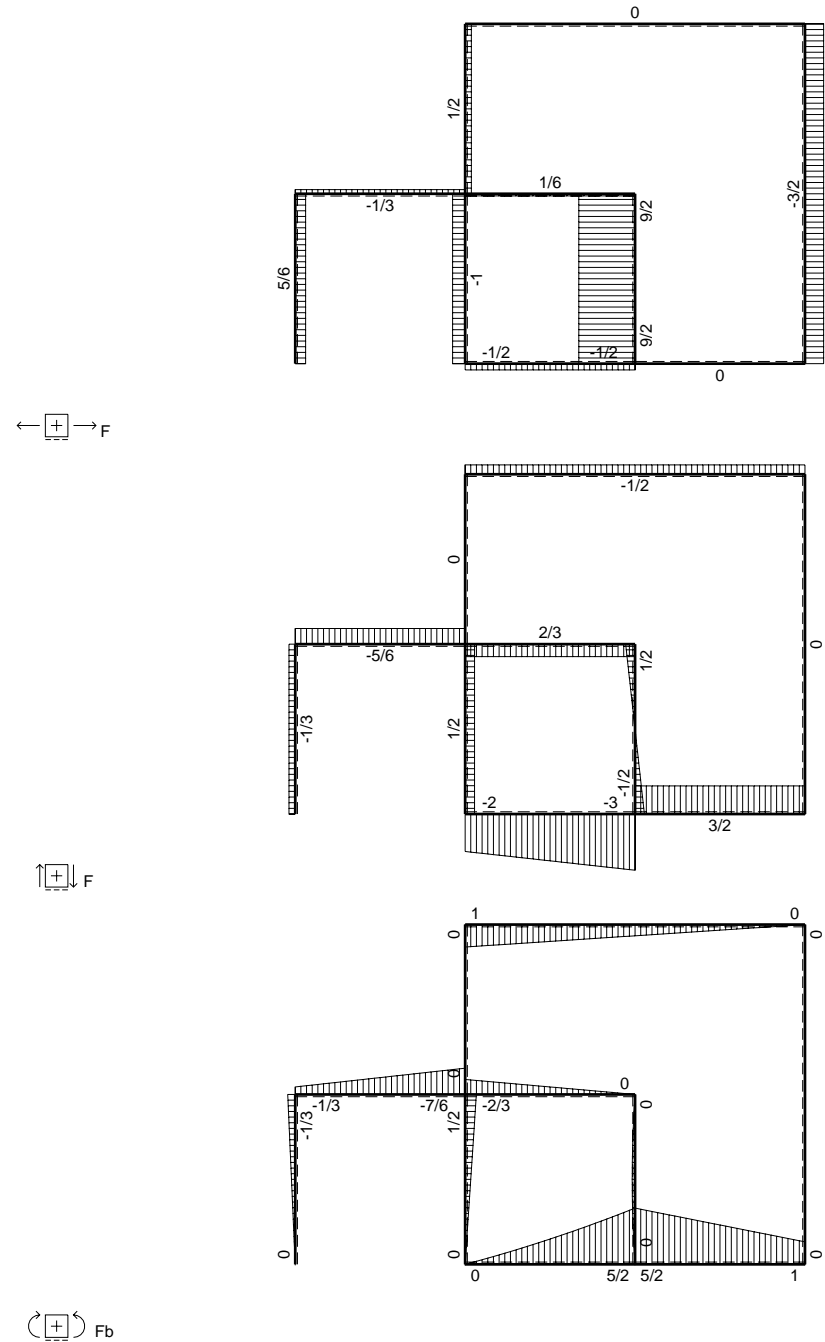
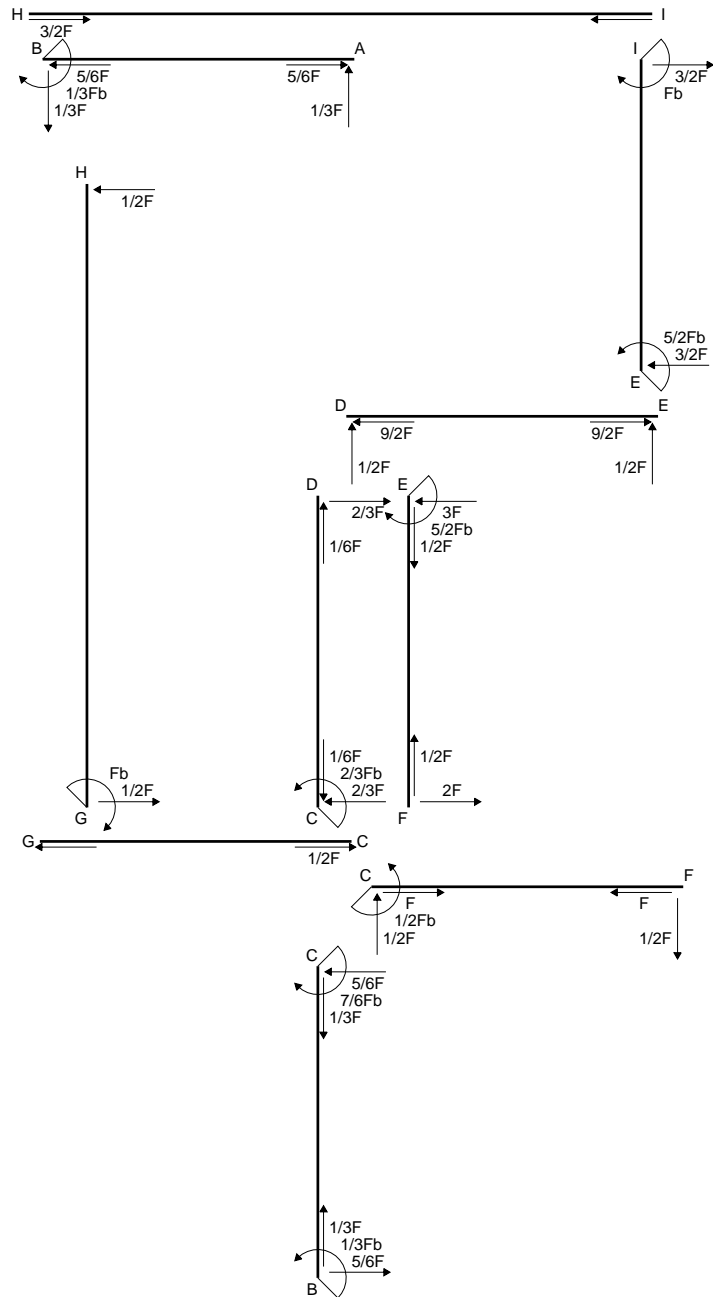
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

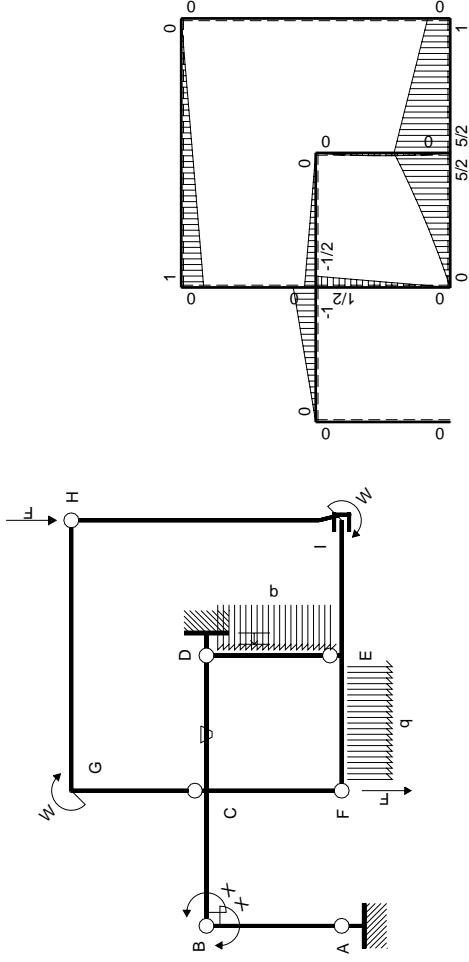
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+1/2Fx$	$-Fb/EJ$	$1/4Fb-1/2Fx+1/4Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/12+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2Fx$	Fb/EJ	$1/4Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/3Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/3Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

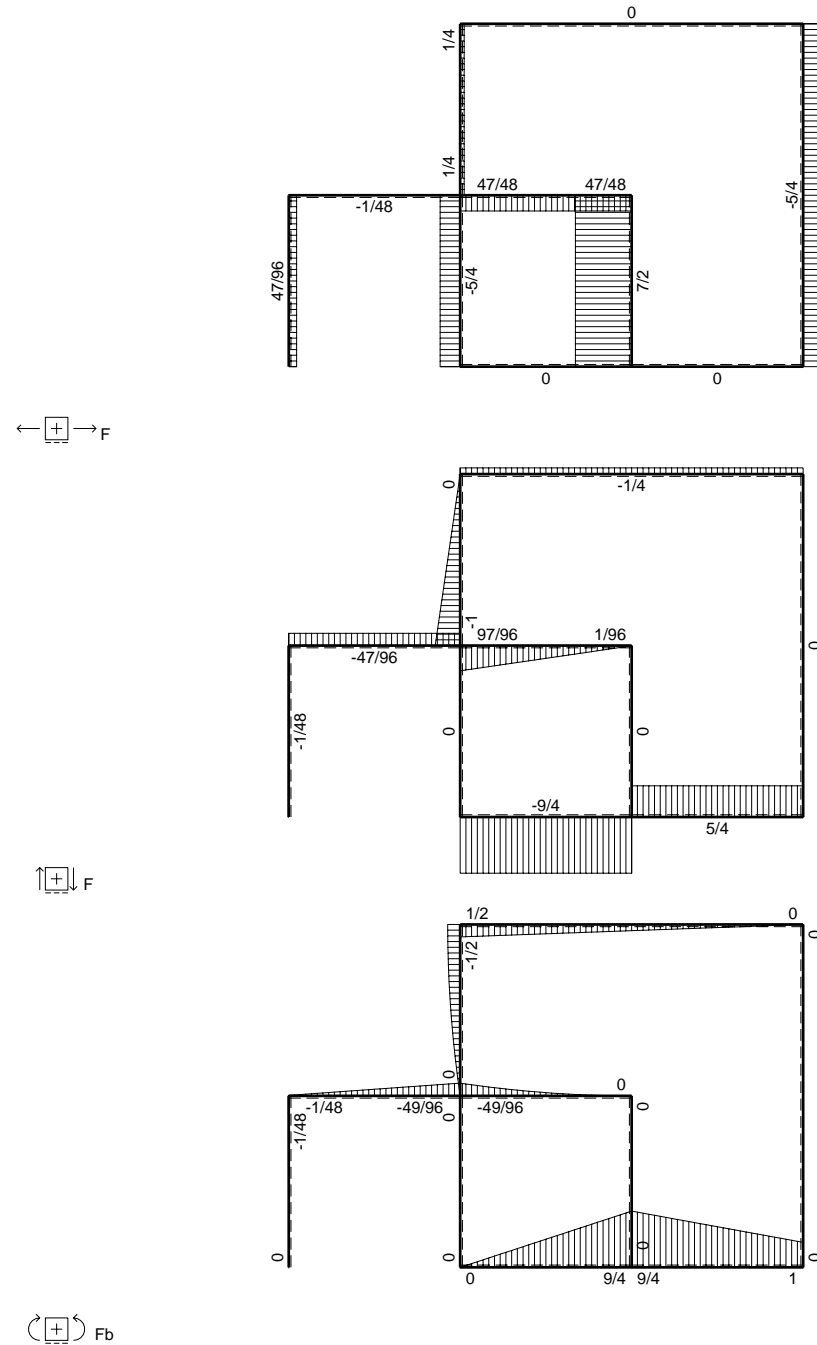
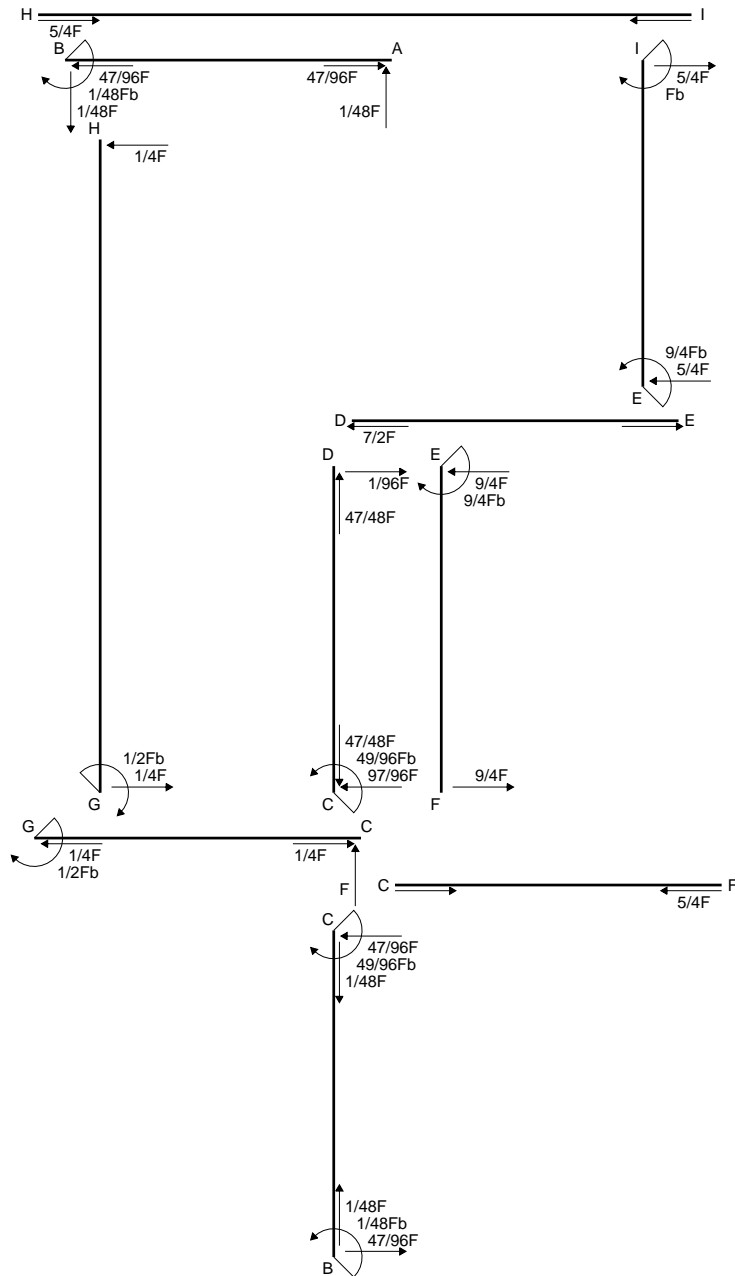
$$L_{CD}^{xo} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

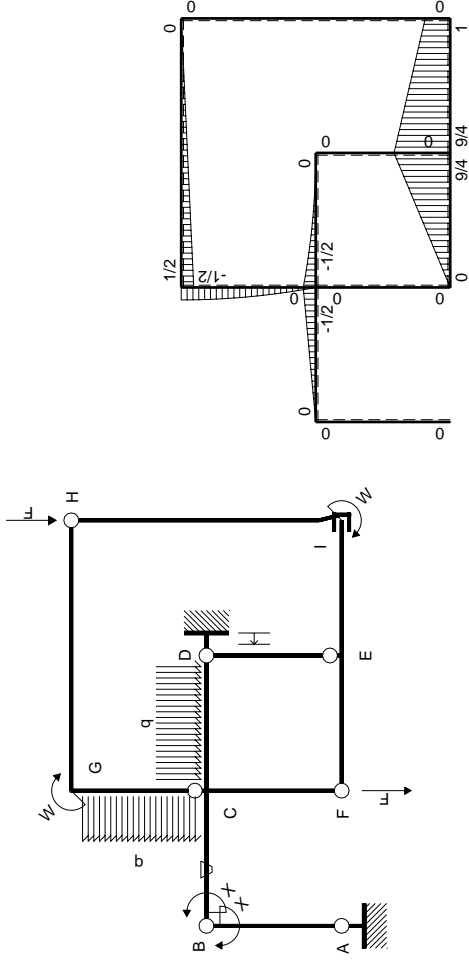
$$= [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/4 b + 1/12 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 1/3 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/12 b) Fb 1/EJ + (-1/4 b) \theta = 1/3 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-1/2Fb+Fx-1/2qx^2$	0	$1/4Fb-3/4Fx+3/4Fx^2/b-1/4qx^3/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/16+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$1/2qx^2$	0	$1/4qx^3/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/4Fb-9/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/4Fb+5/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/48Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/48Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

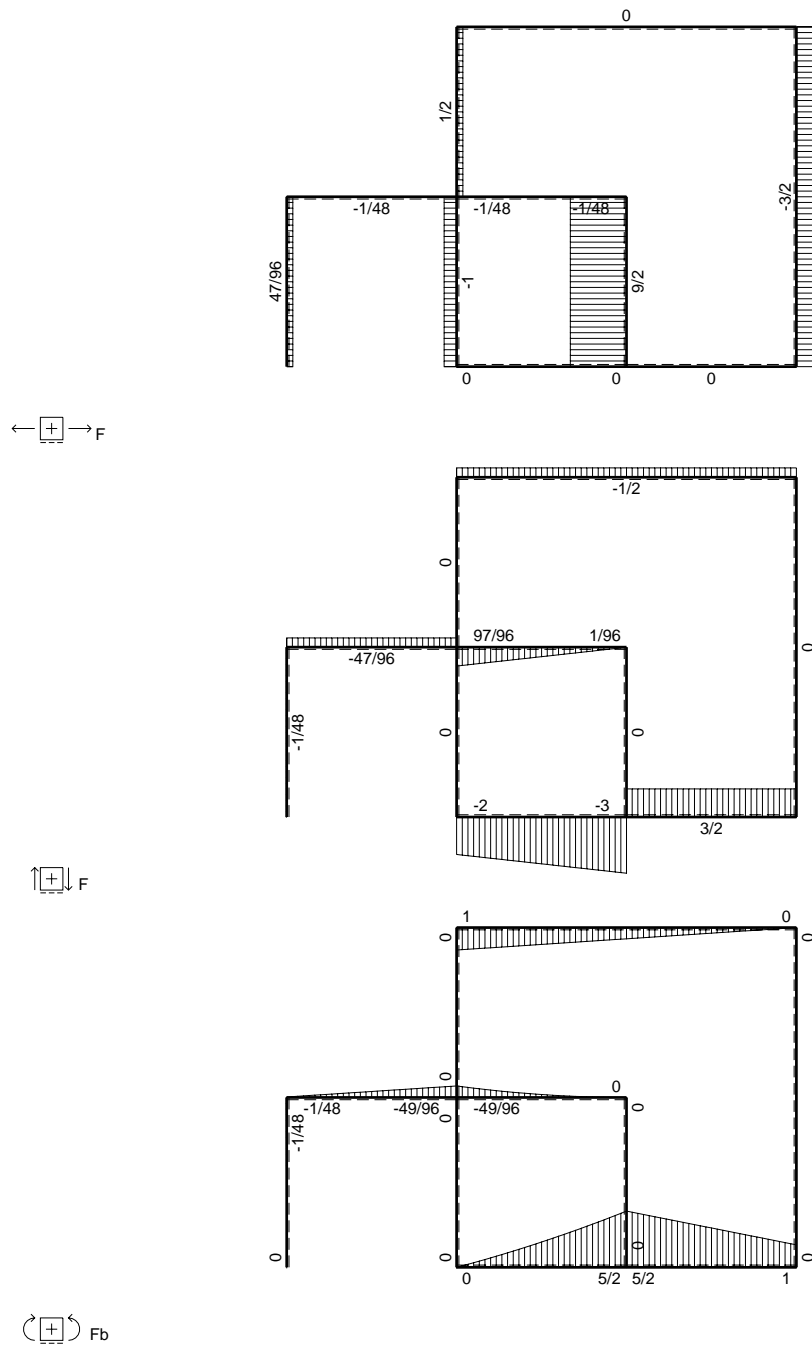
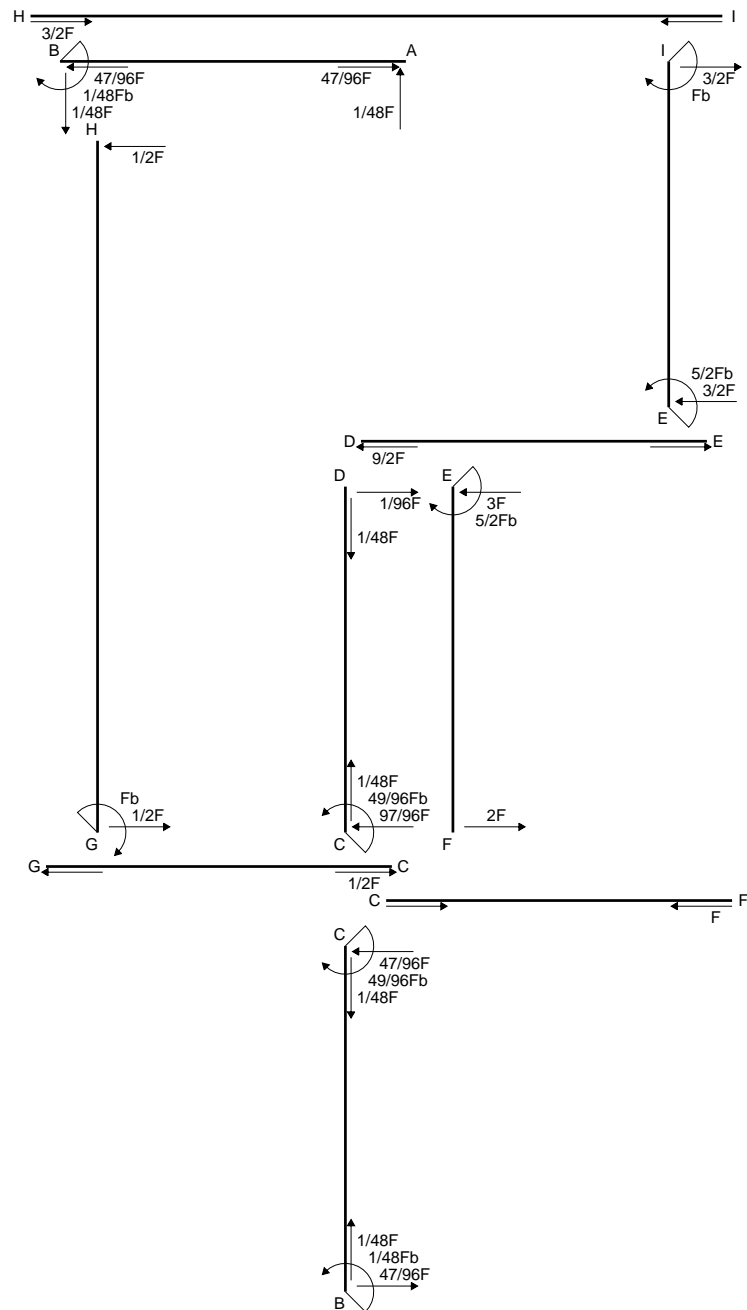
$$L_{CD}^{xo} = \int_0^b (1/4 - 3/4 x/b + 3/4 x^2/b^2 - 1/4 x^3/b^3) Fb 1/EJ dx$$

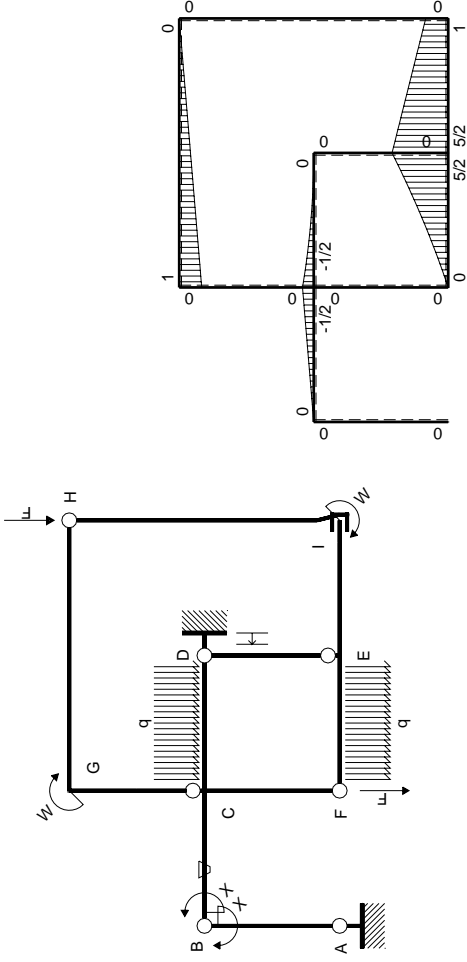
$$= [1/4 x - 3/8 x^2/b + 1/4 x^3/b^2 - 1/16 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 3/8 b + 1/4 b - 1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^3/b^3) Fb 1/EJ dx = [1/16 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-1/2Fx$	$-Fb/EJ$	$1/2Fx-1/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/6+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$1/2Fb-1/2Fx$	Fb/EJ	$1/4Fb-1/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-1/2Fb+Fx-1/2qx^2$	0	$1/4Fb-3/4Fx+3/4Fx^2/b-1/4qx^3/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/16+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$1/2qx^2$	0	$1/4qx^3/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-5/2Fb+3/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/48Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/48Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (1/2 x/b - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/4 x^2/b - 1/12 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/4 - 1/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/4 x - 1/12 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/12 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 11/12 Fb^2/EJ$$

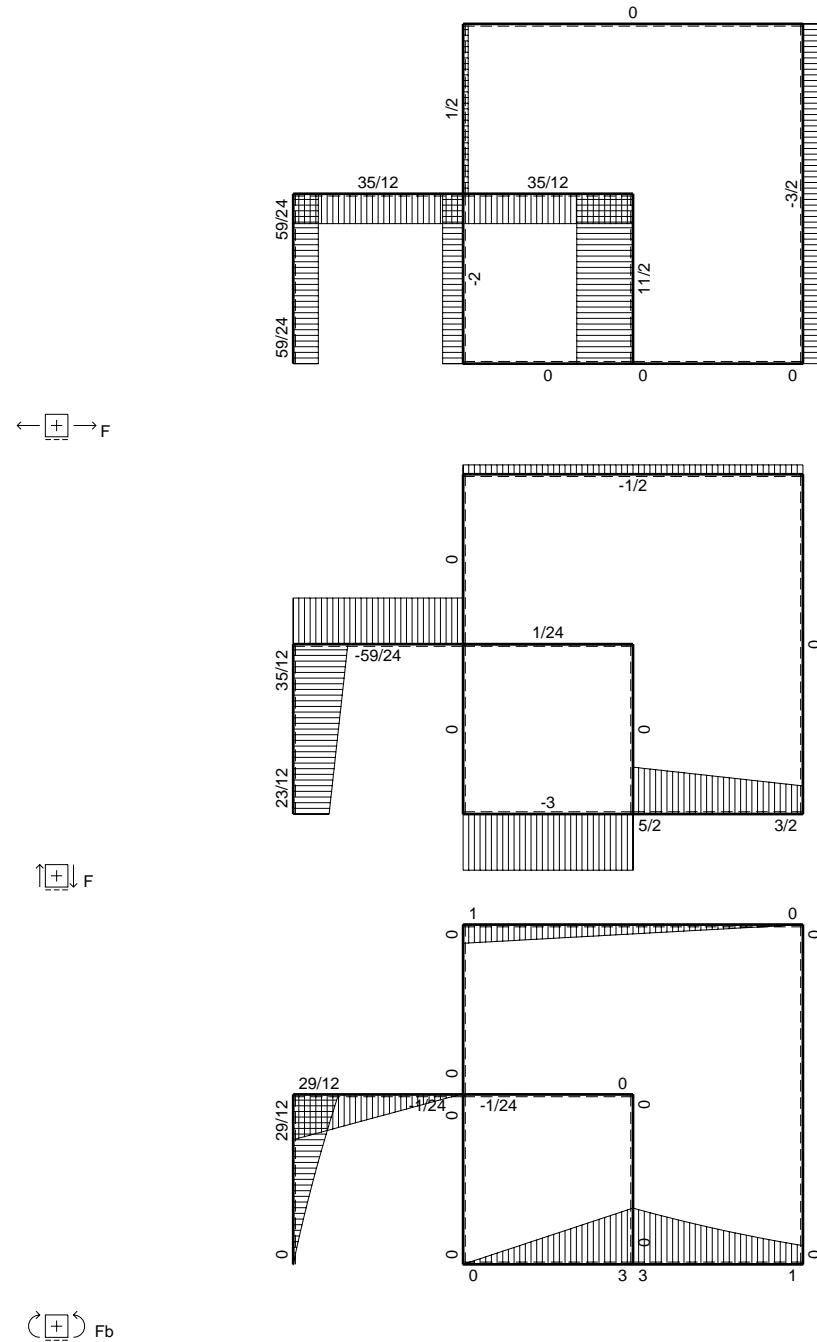
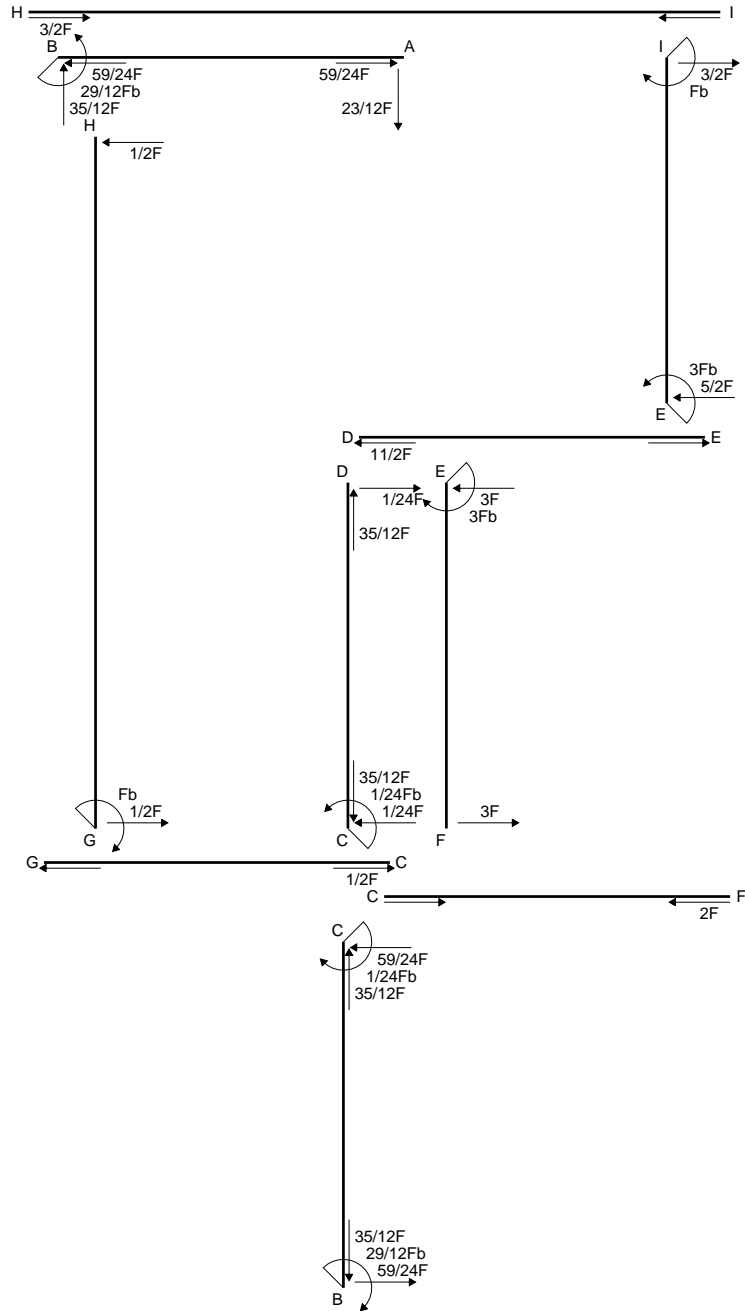
$$L_{CD}^{xo} = \int_0^b (1/4 - 3/4 x/b + 3/4 x^2/b^2 - 1/4 x^3/b^3) Fb 1/EJ dx$$

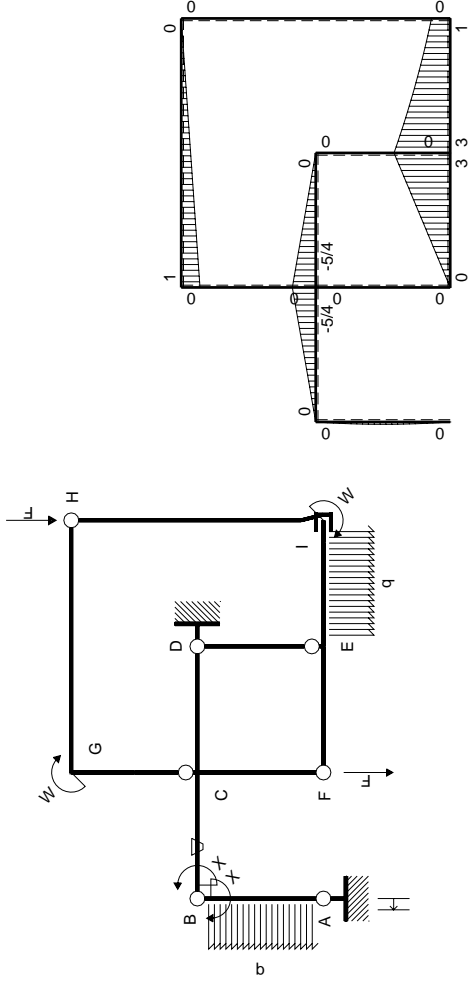
$$= [1/4 x - 3/8 x^2/b + 1/4 x^3/b^2 - 1/16 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 3/8 b + 1/4 b - 1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/4 x^3/b^3) Fb 1/EJ dx = [1/16 x^4/b^3]_0^b Fb 1/EJ$$

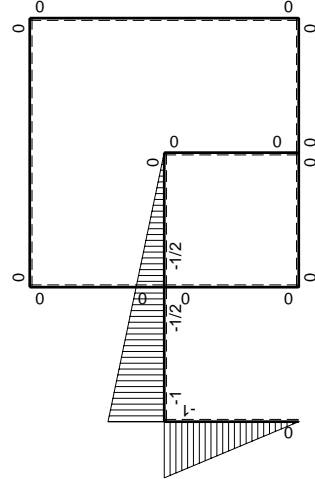
$$= (1/16 b) Fb 1/EJ = 1/16 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$29/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-29/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

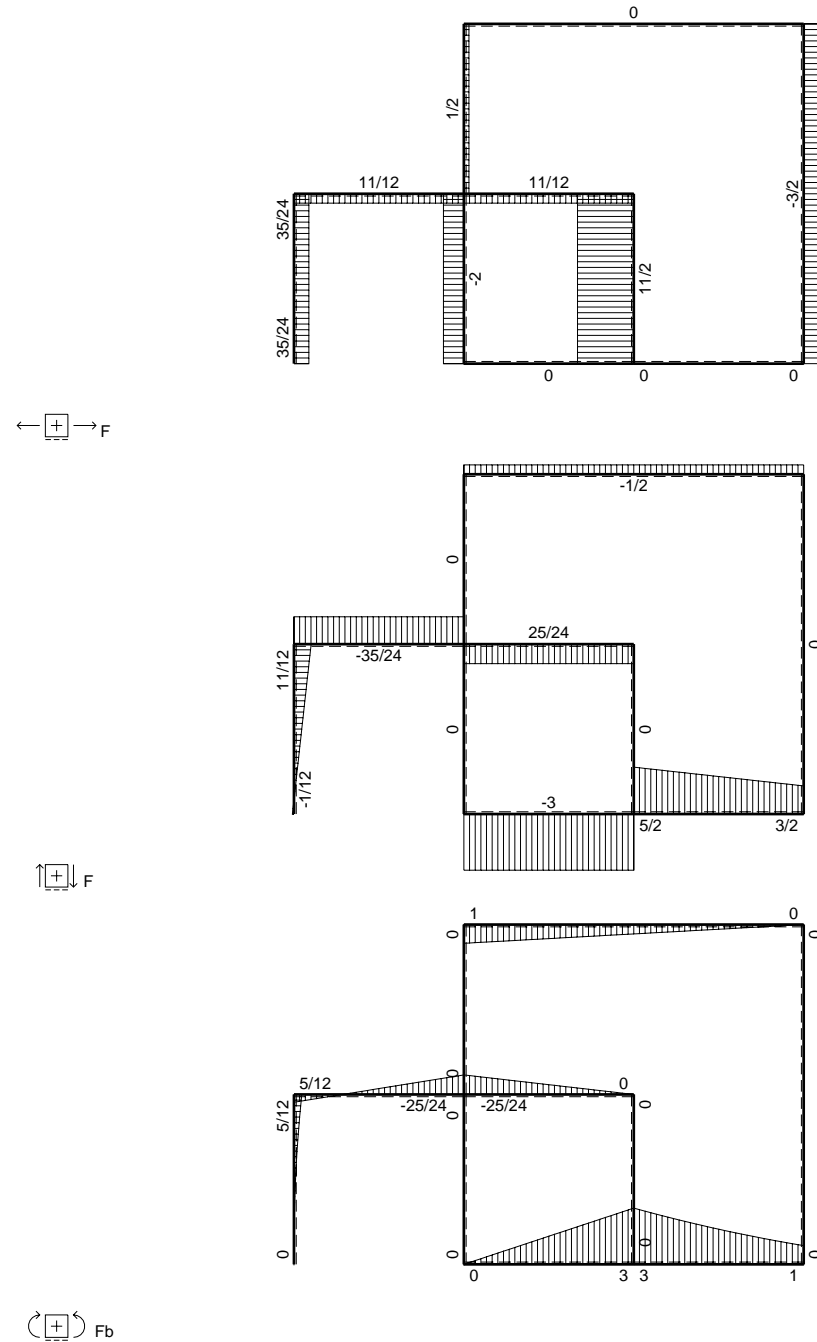
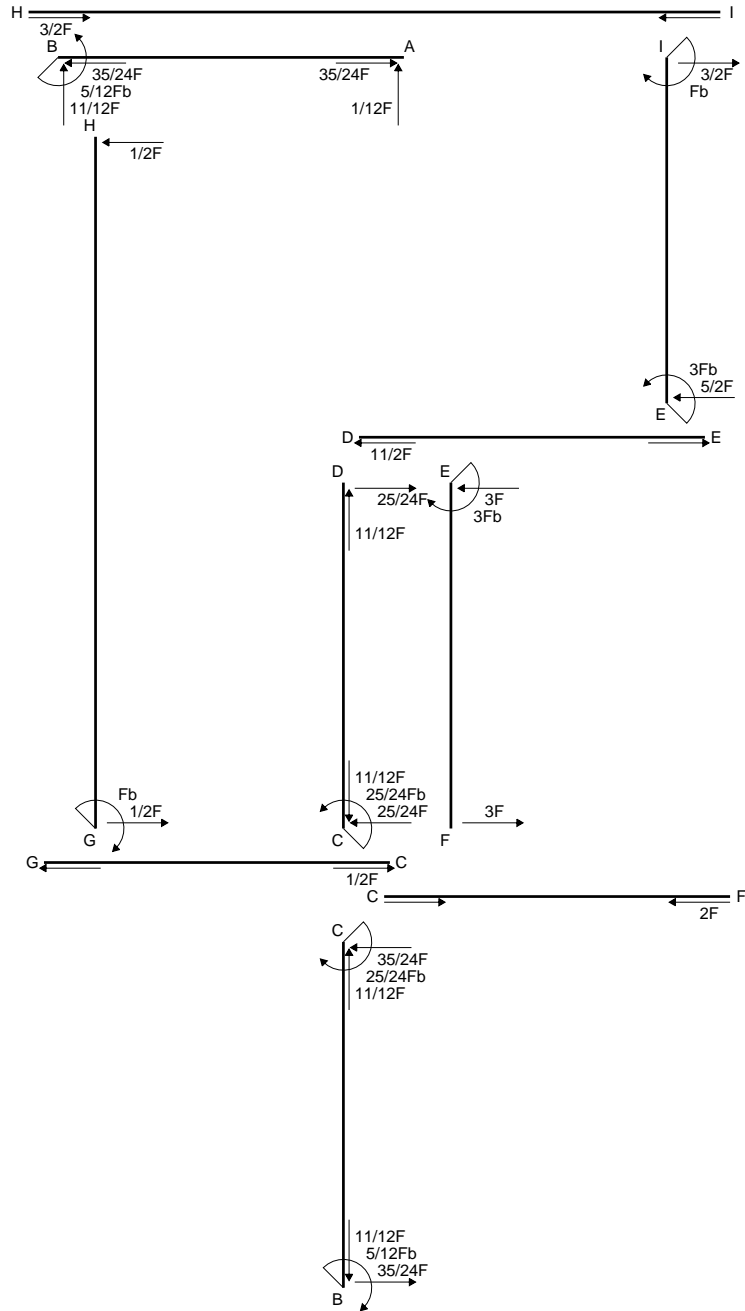
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

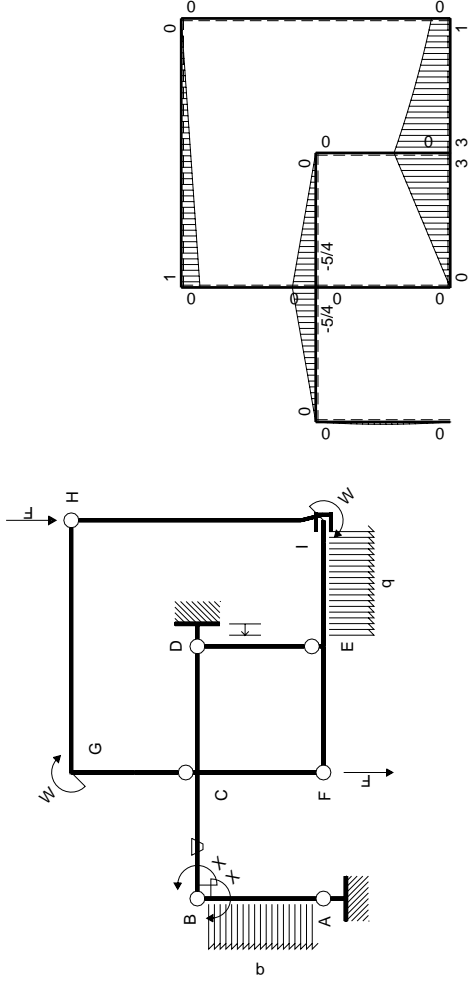
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$5/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-5/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

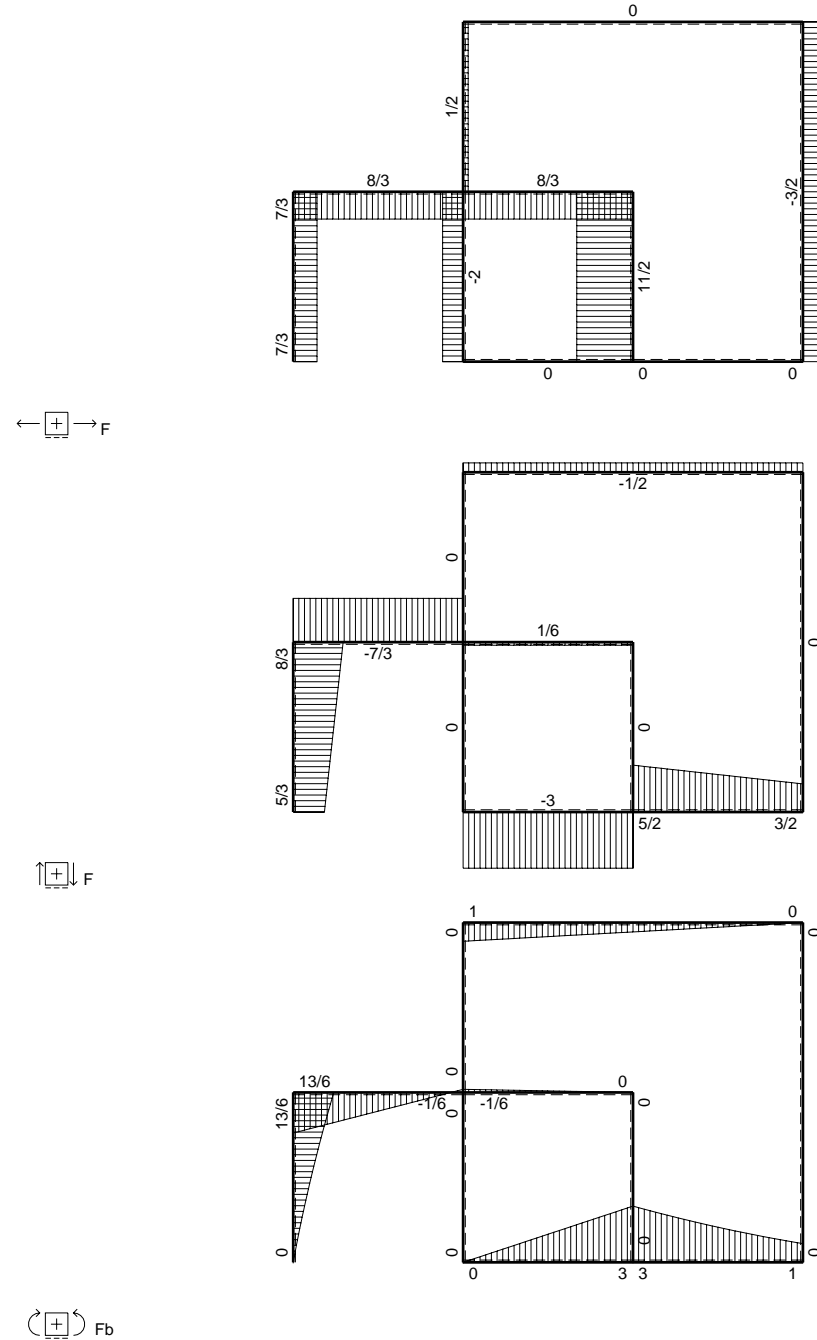
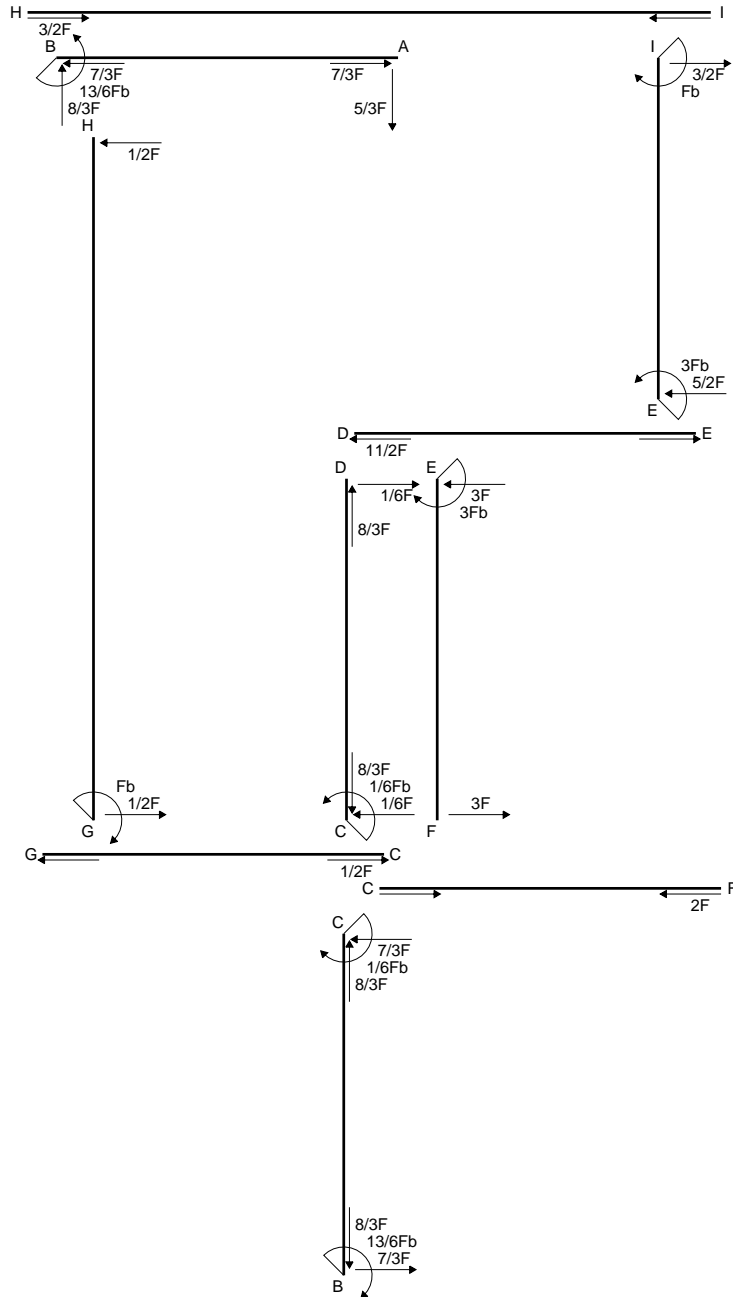
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

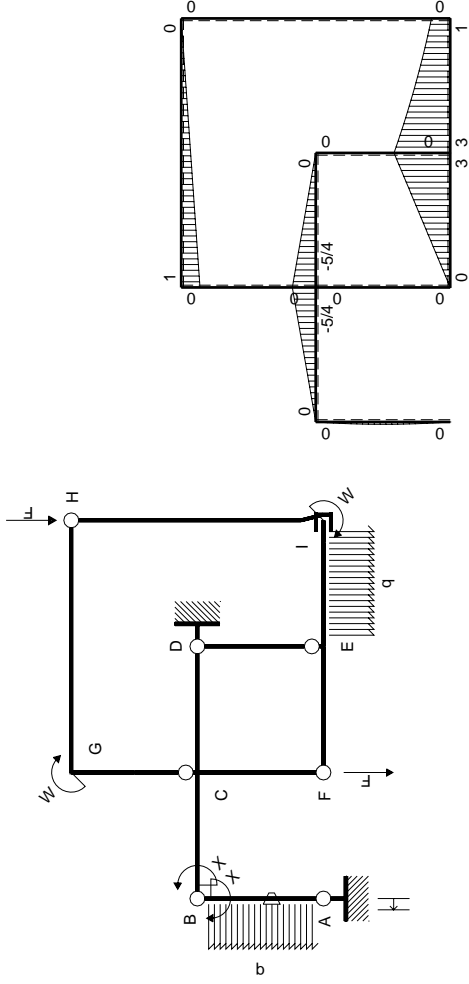
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

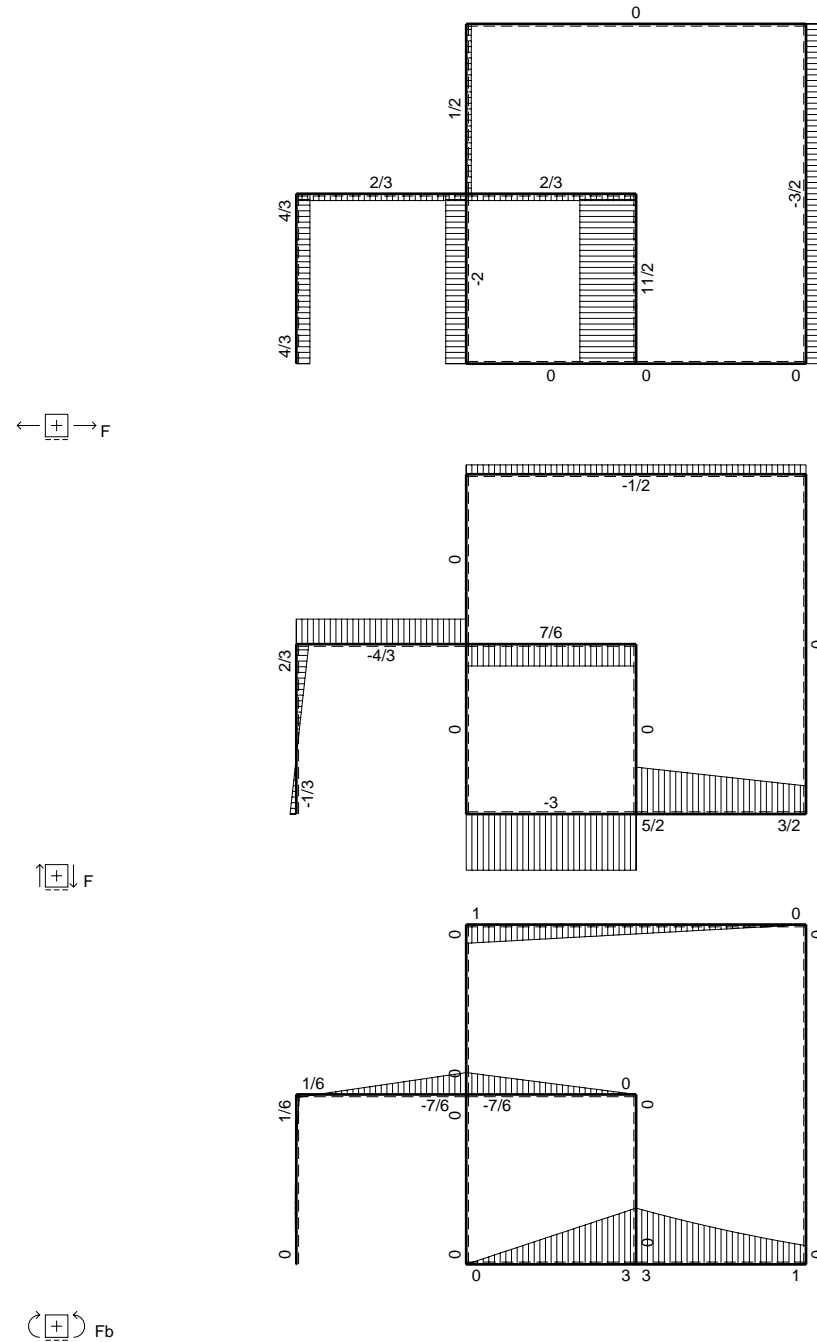
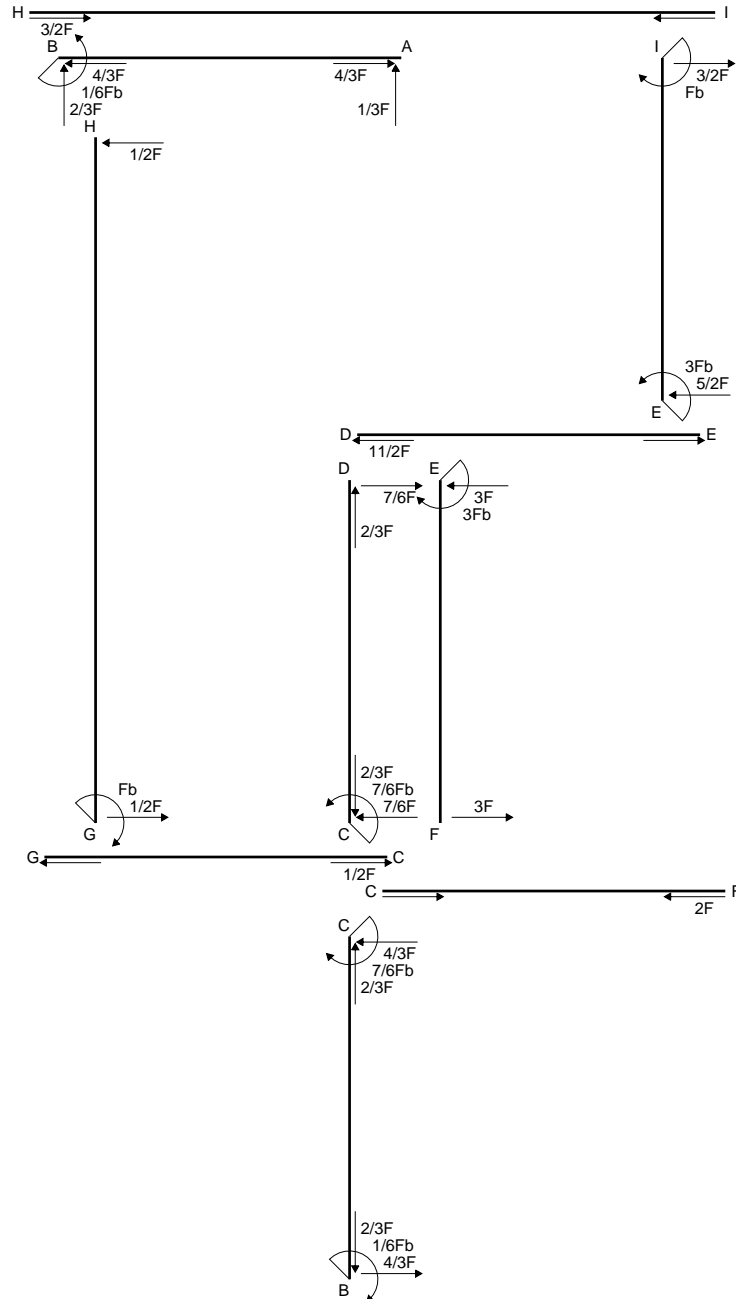
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

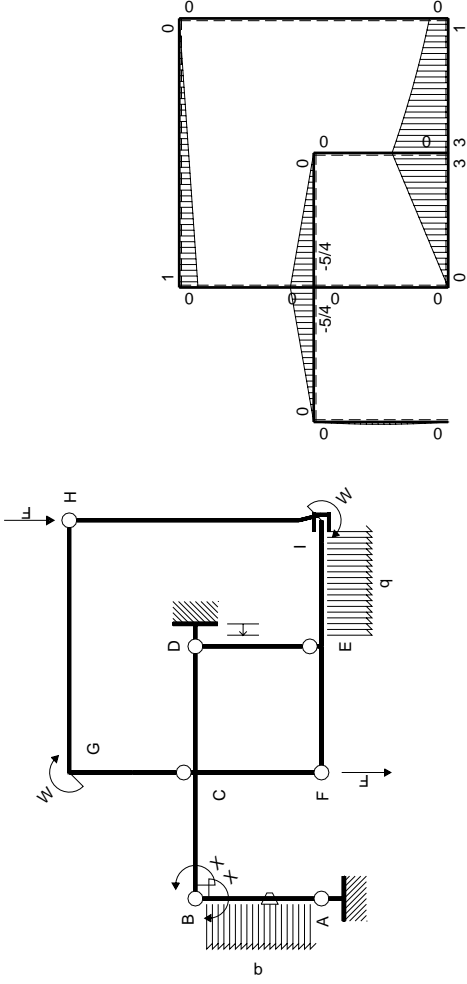
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

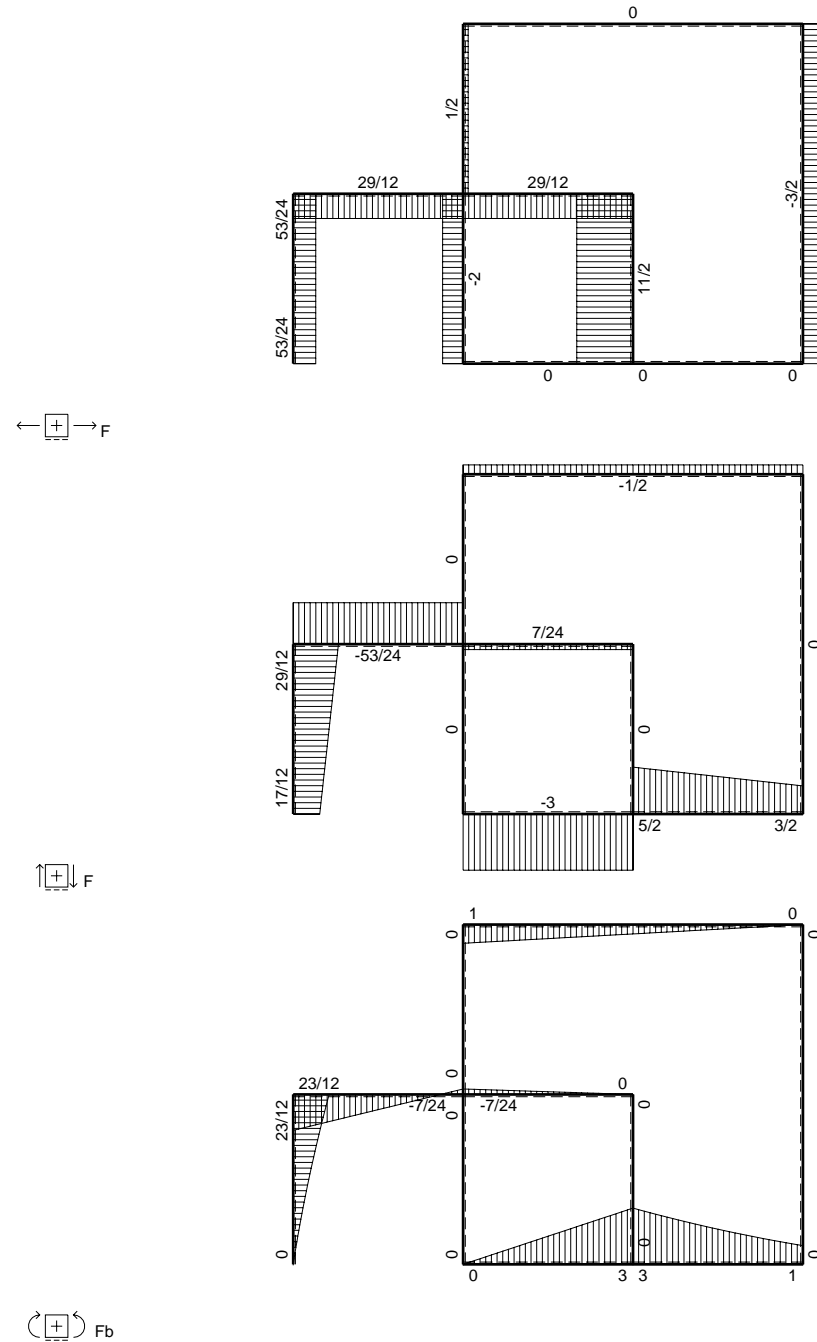
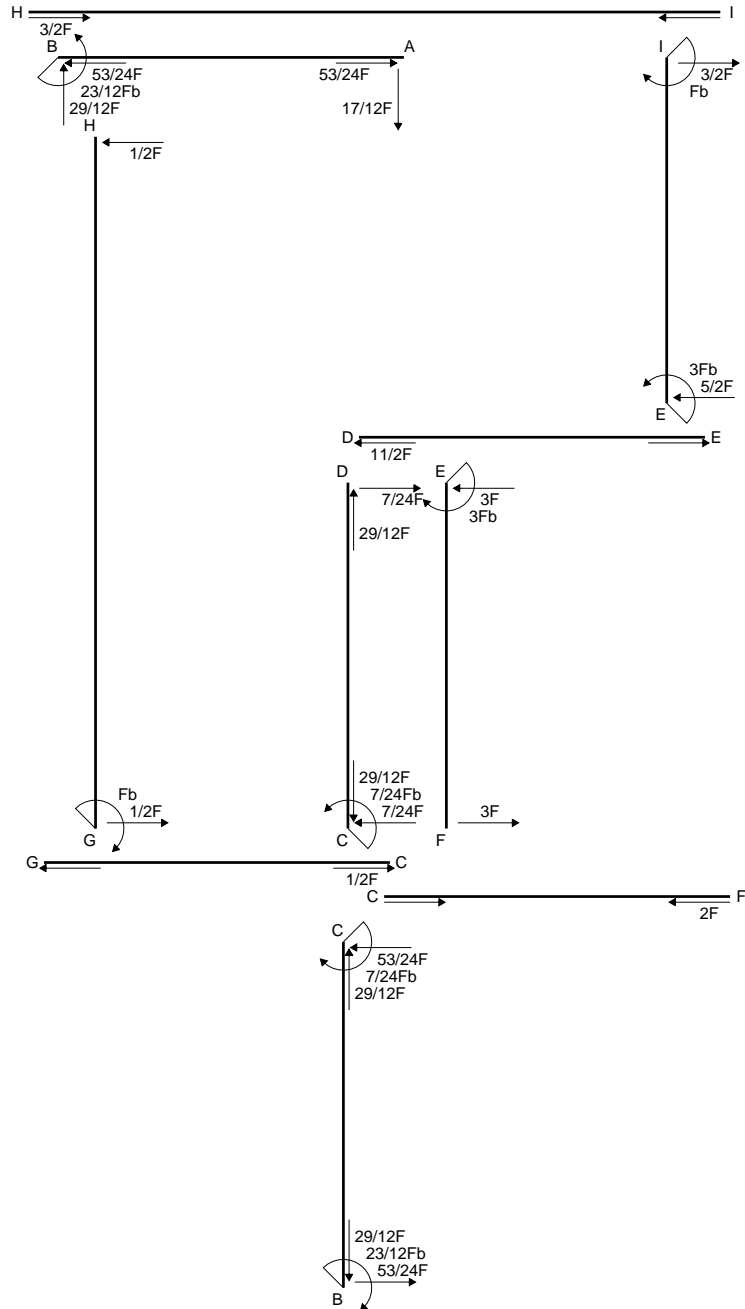
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

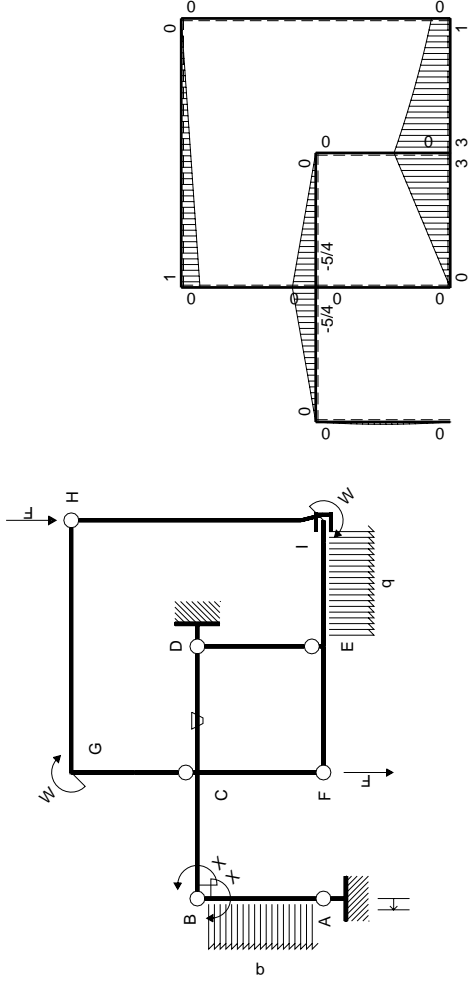
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

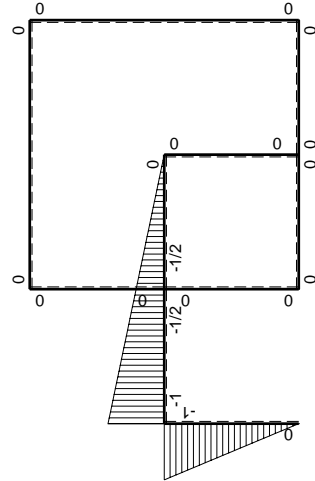
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

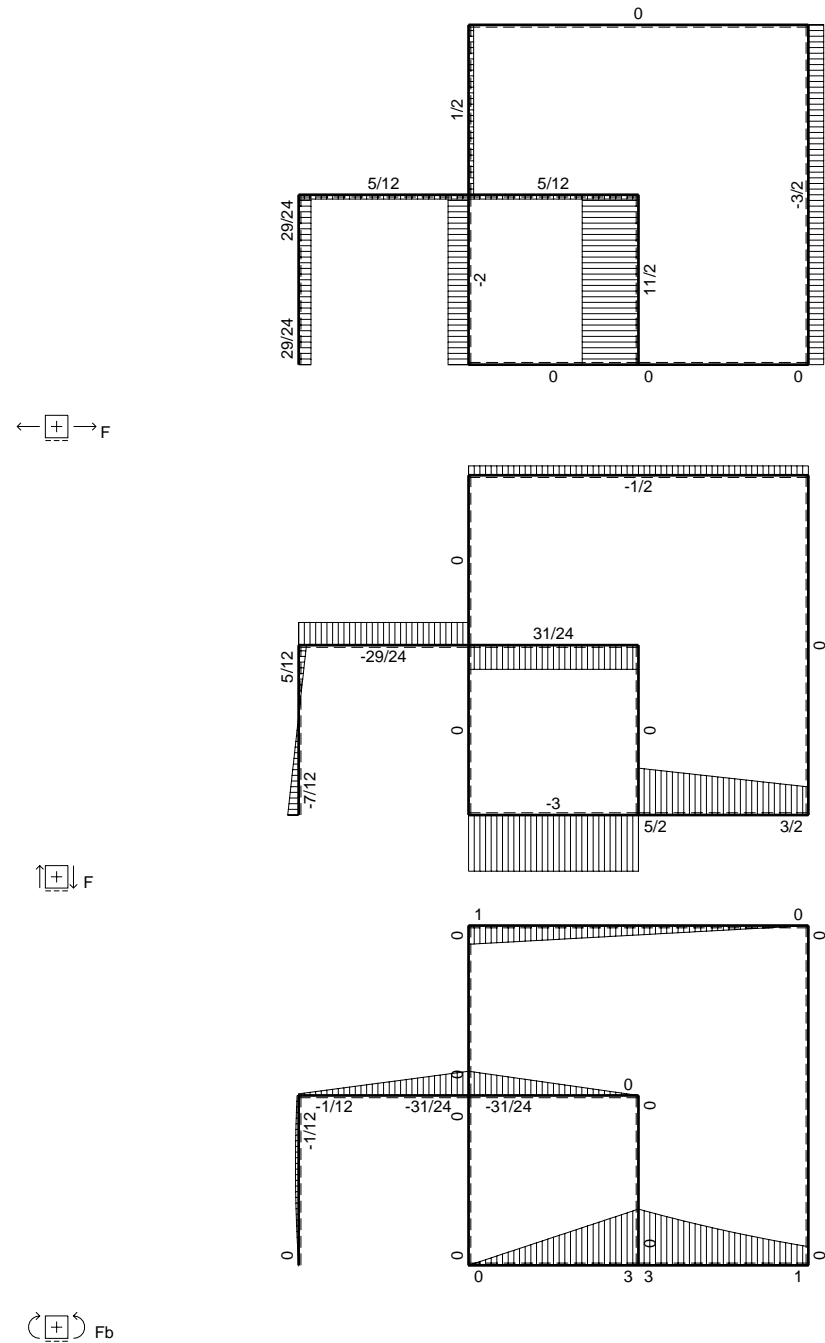
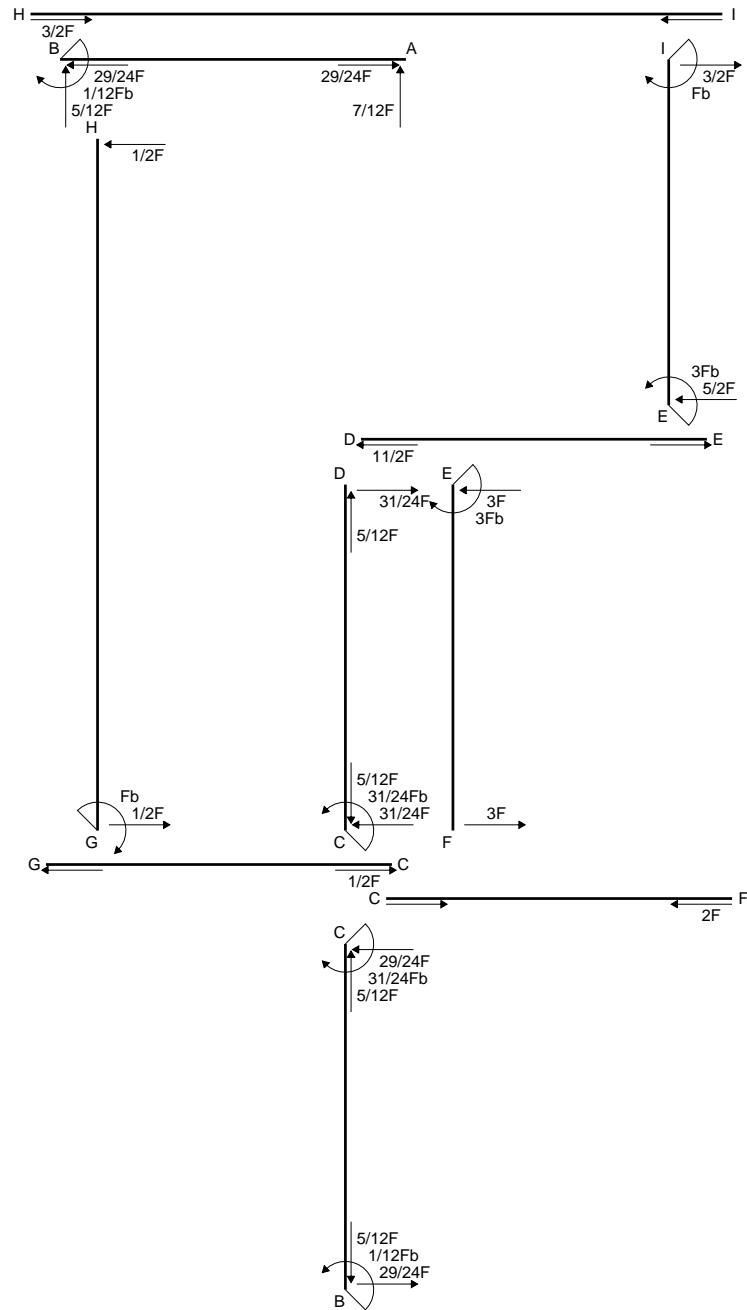
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

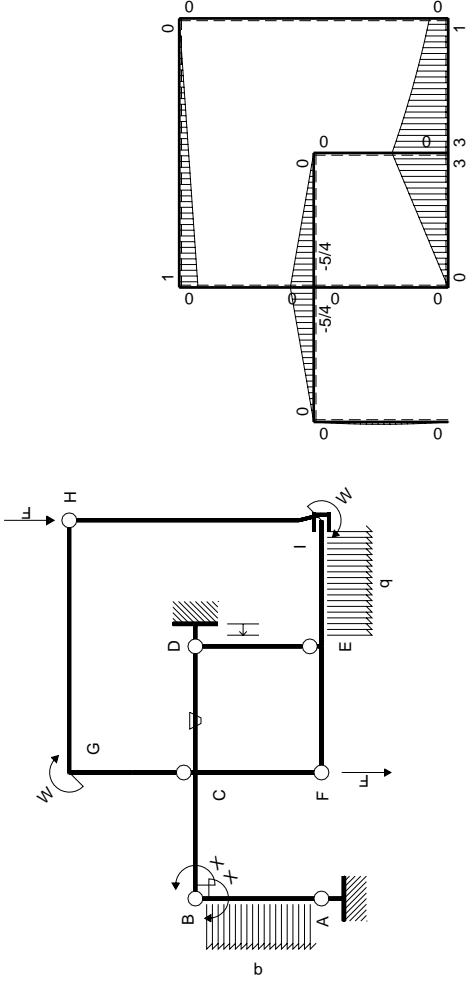
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

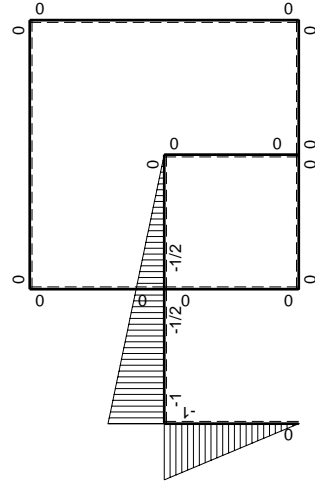
$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

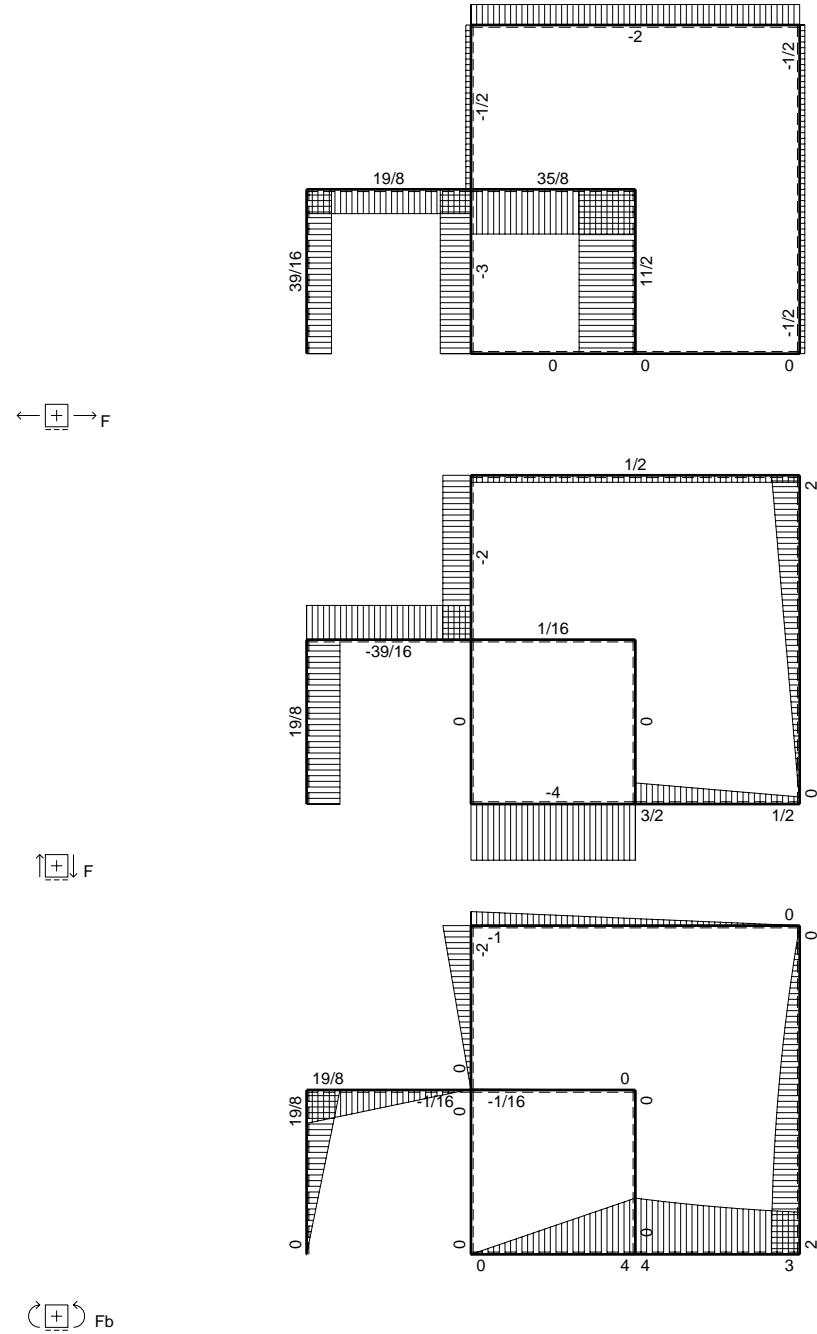
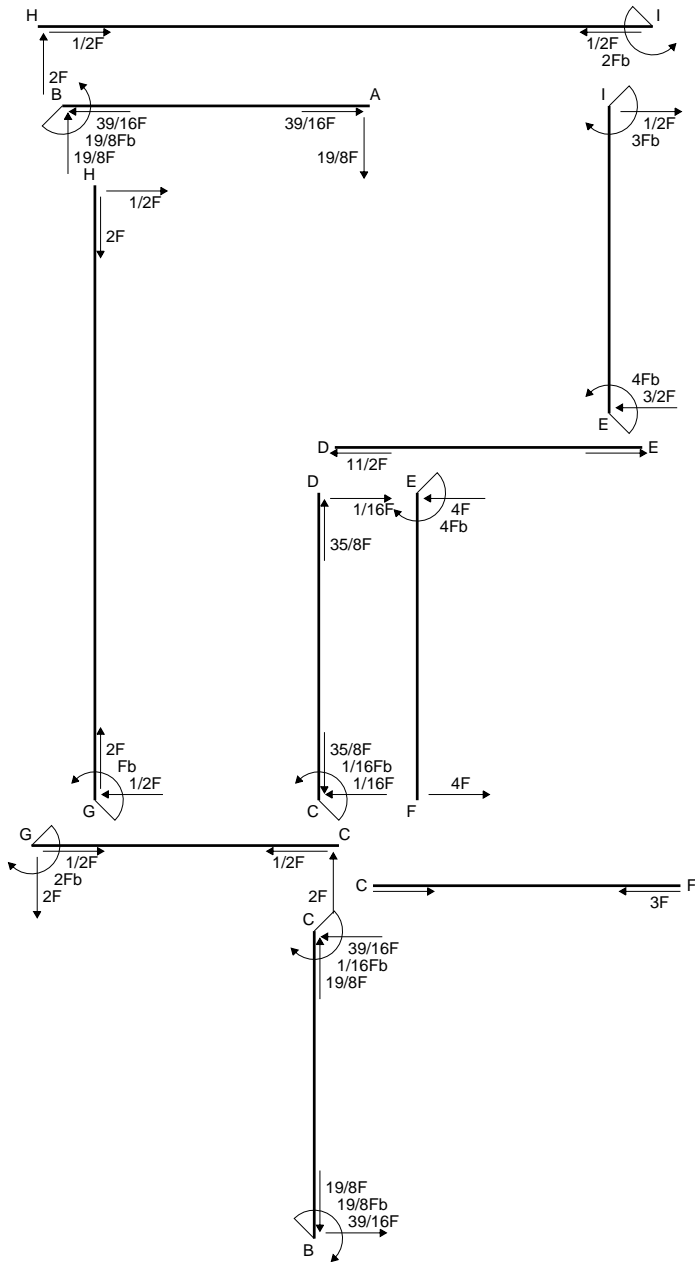
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

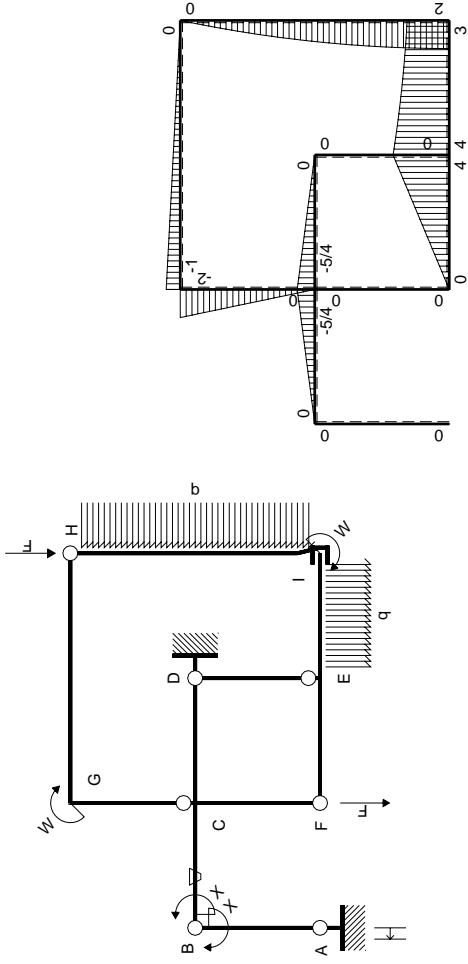
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

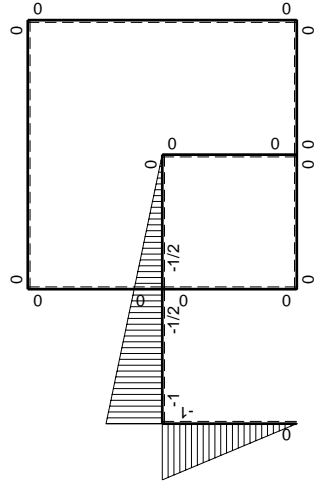
$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$19/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-19/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

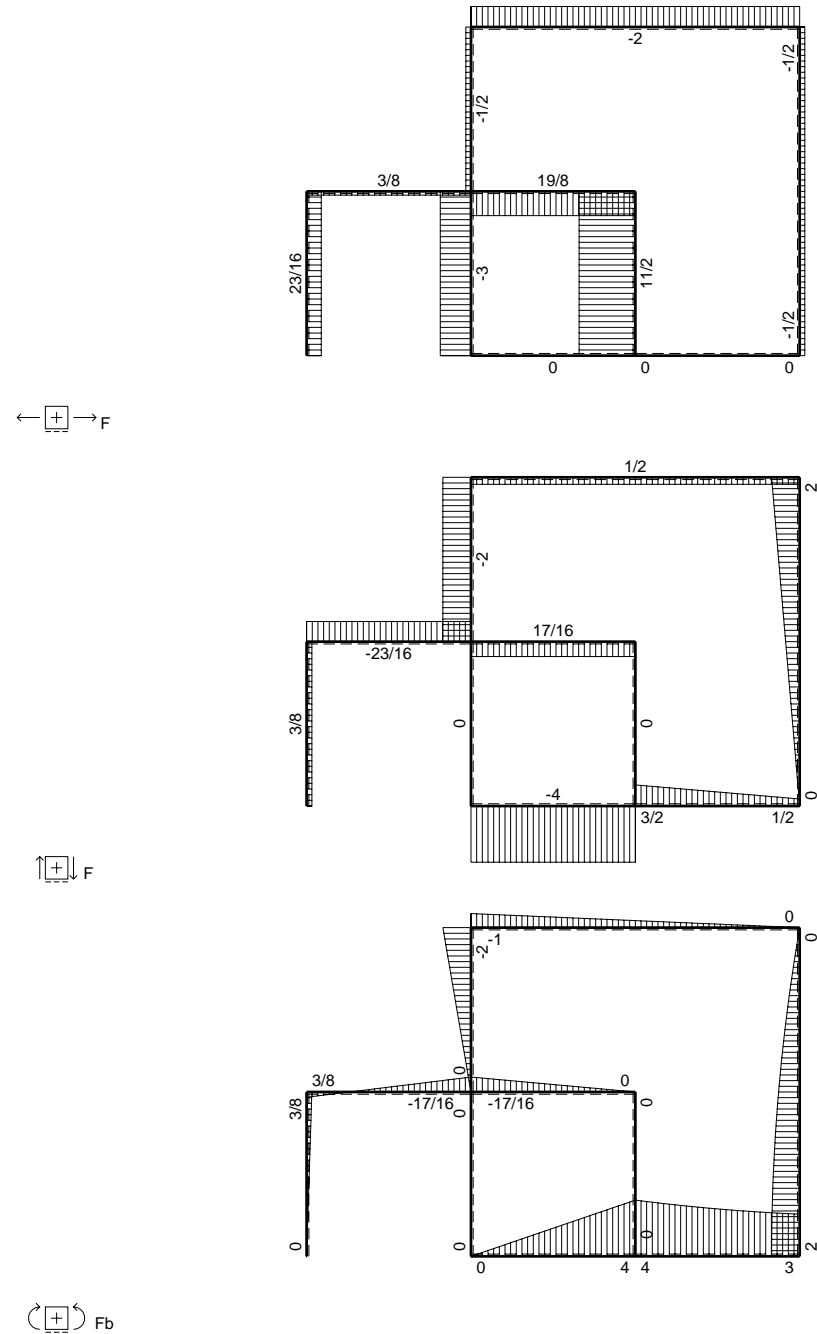
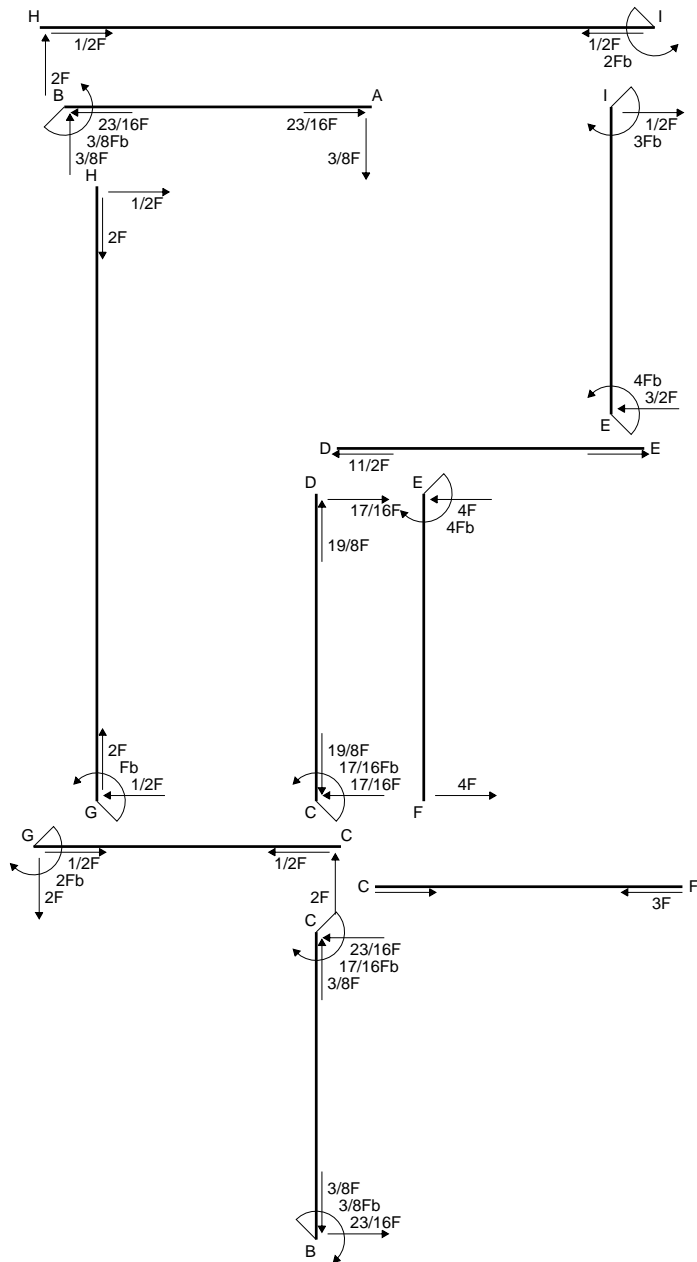
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

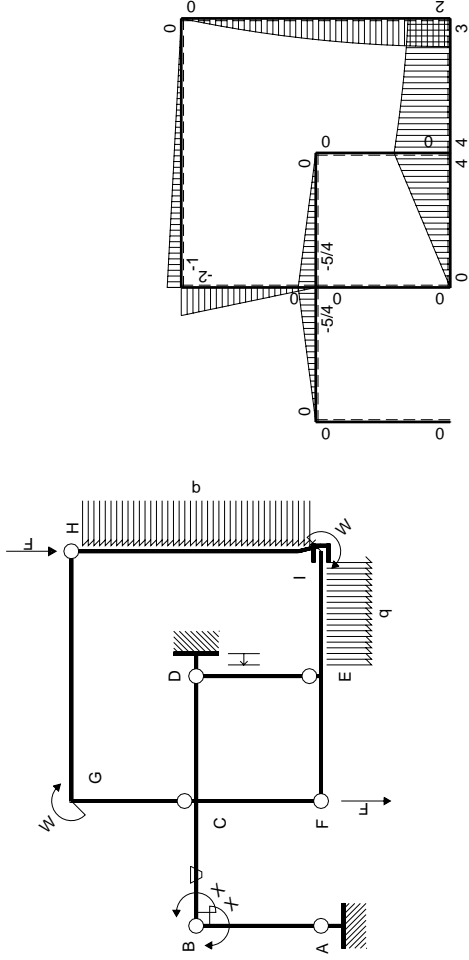
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

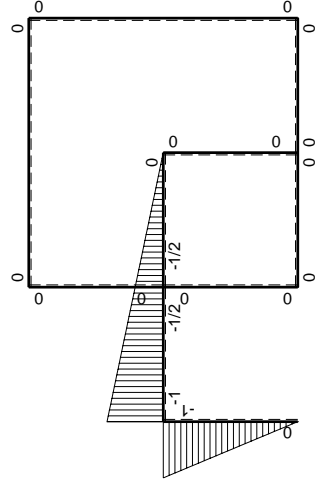
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-3/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

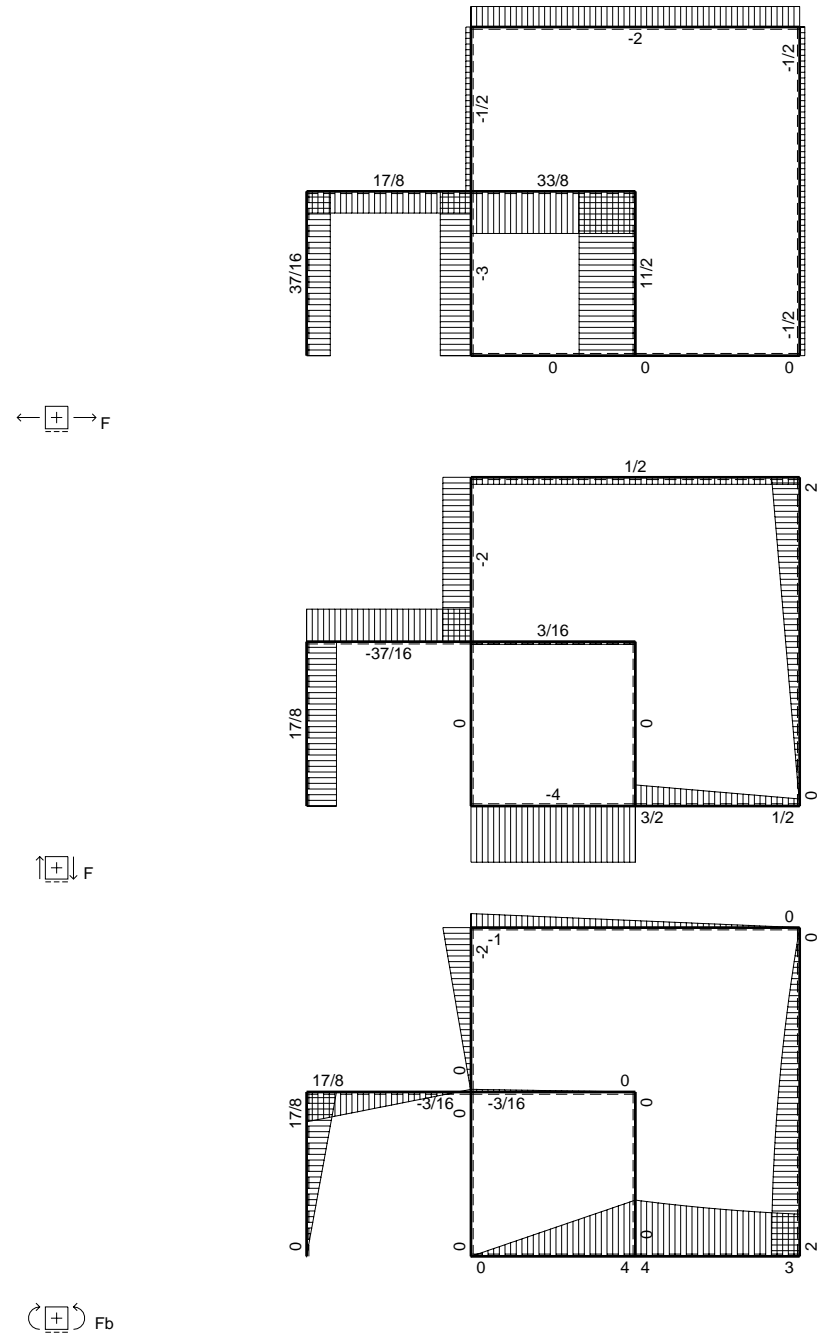
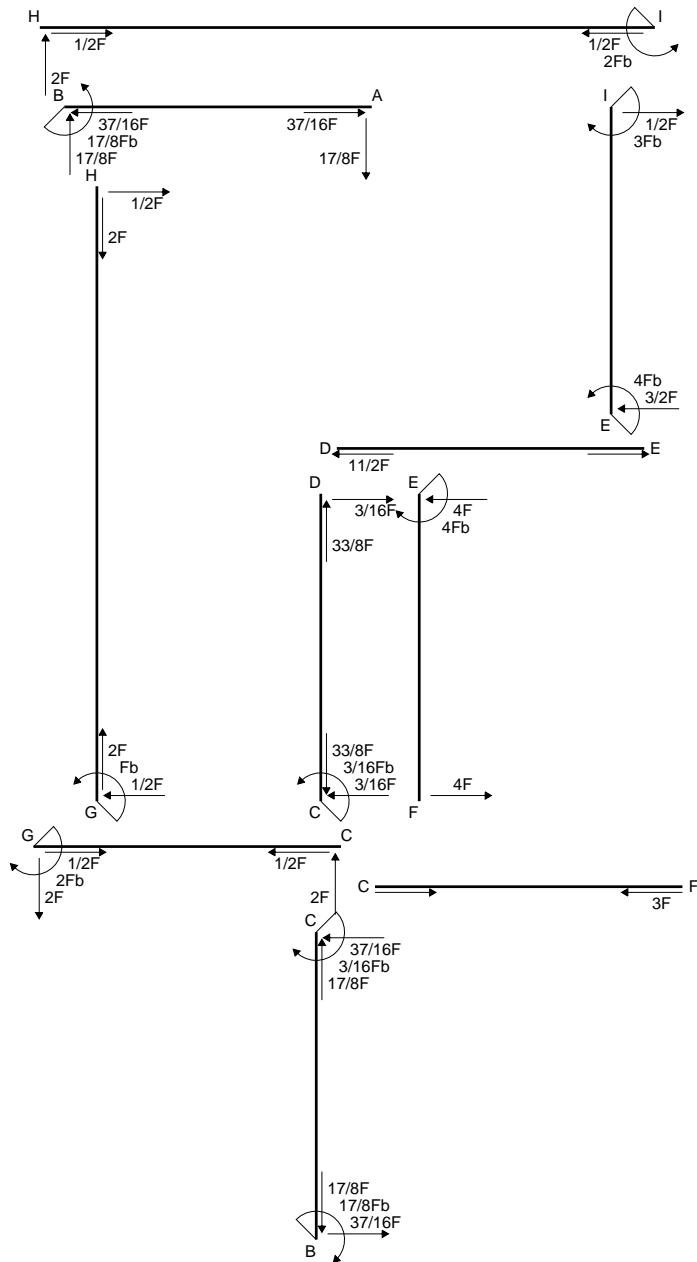
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

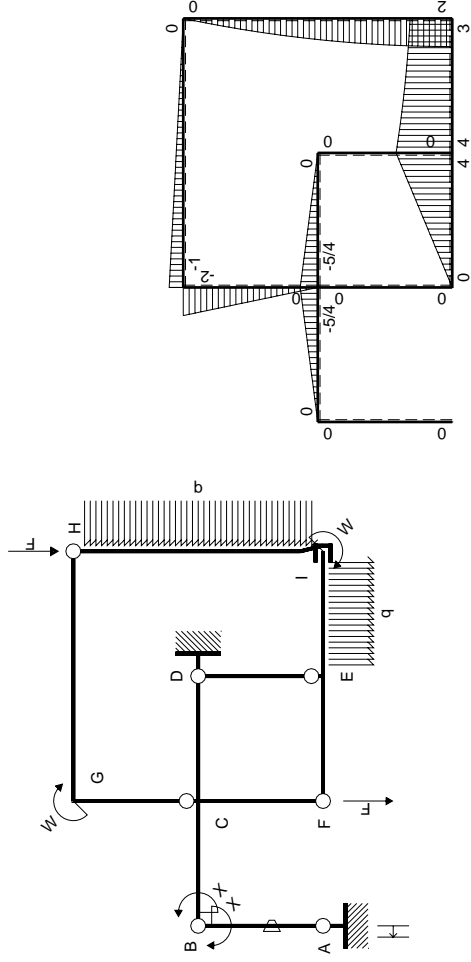
$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

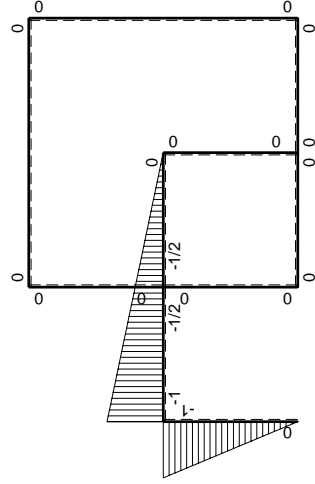


⊕ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$1/2Fx$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

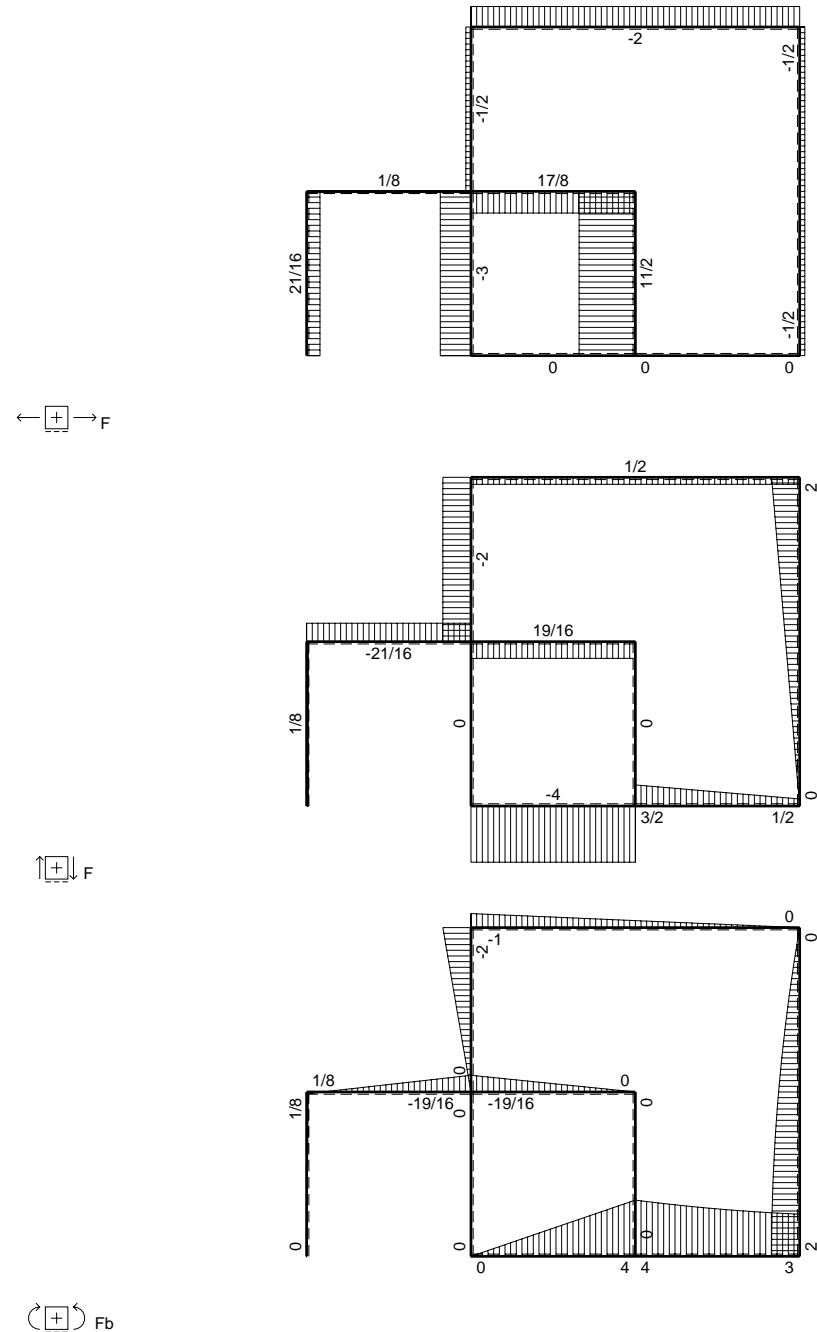
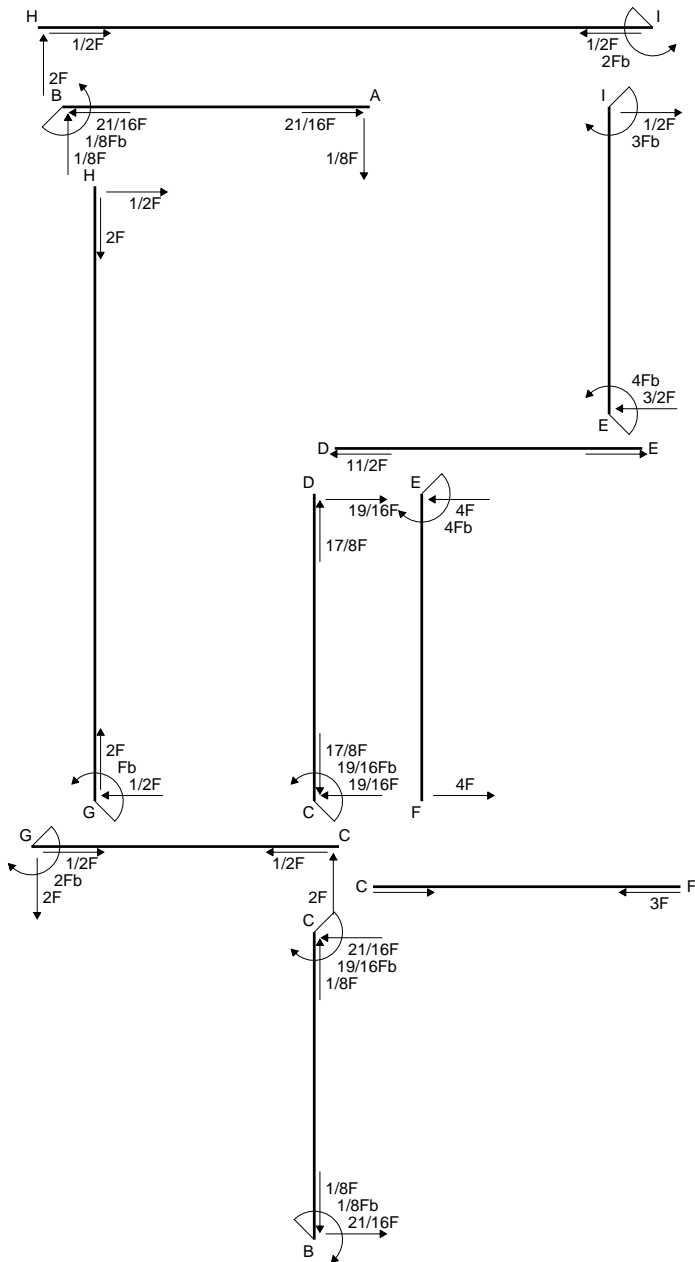
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

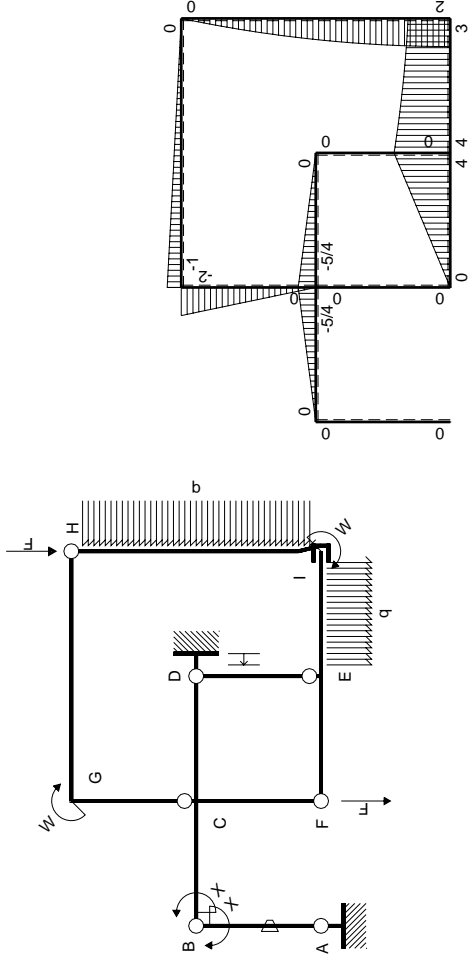
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

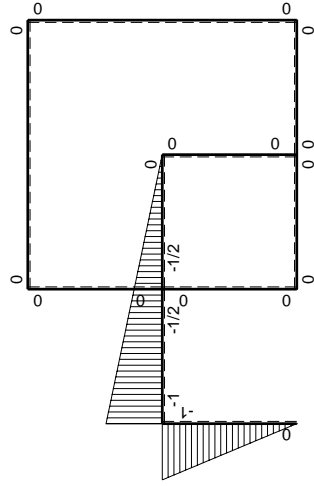
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

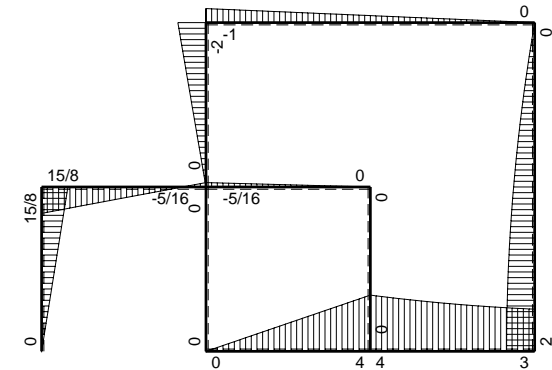
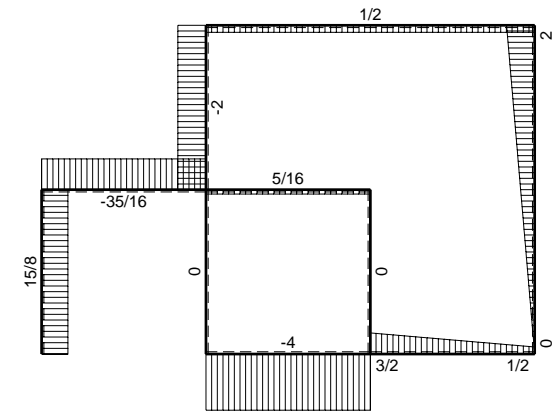
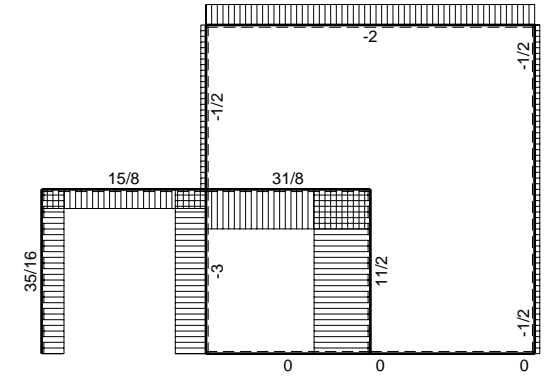
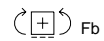
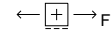
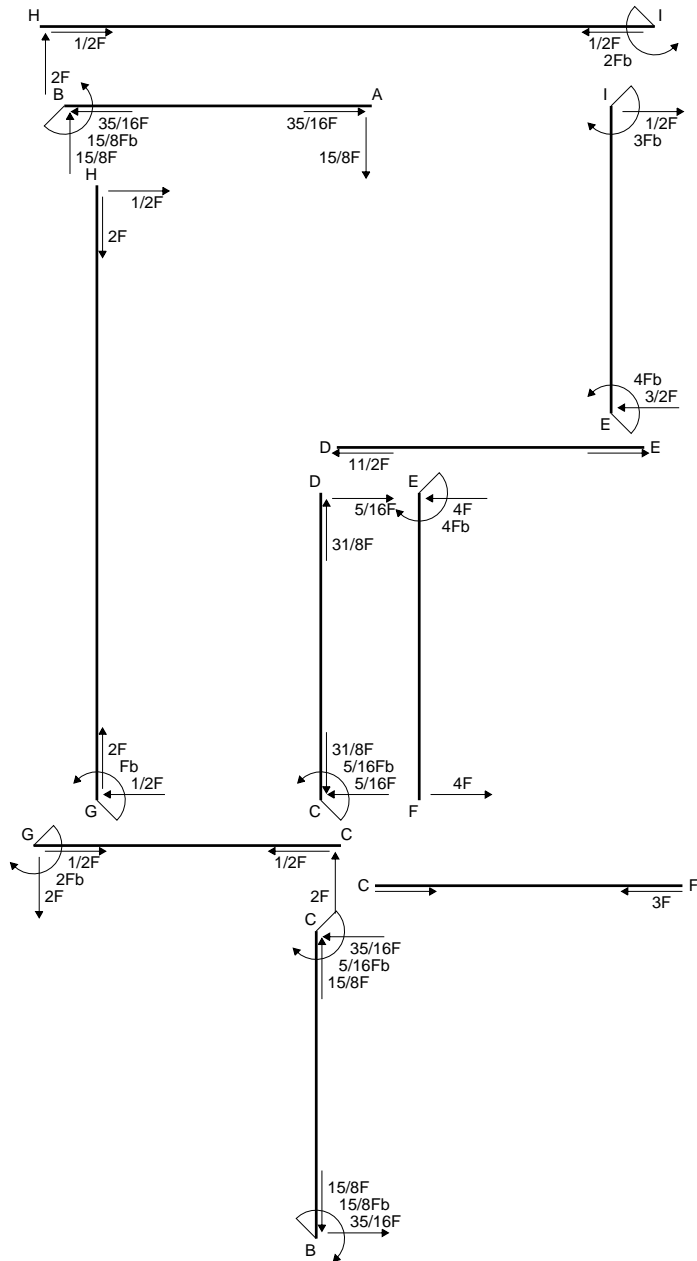
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

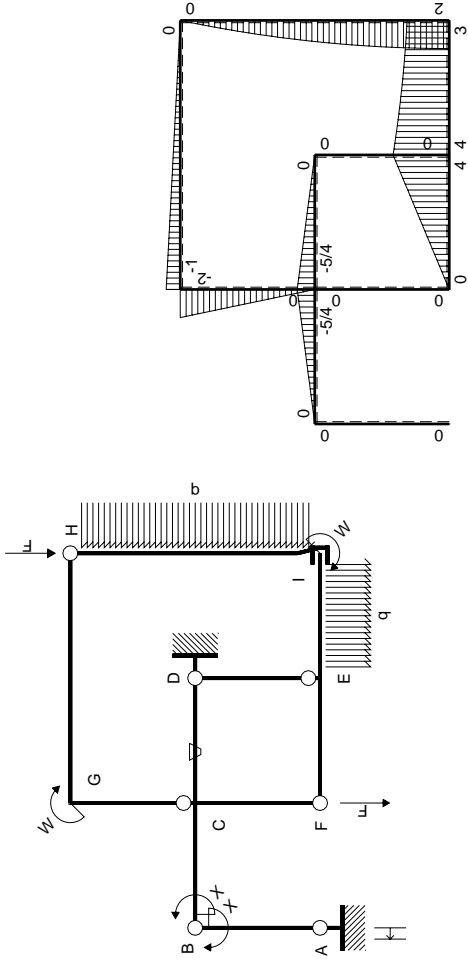
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

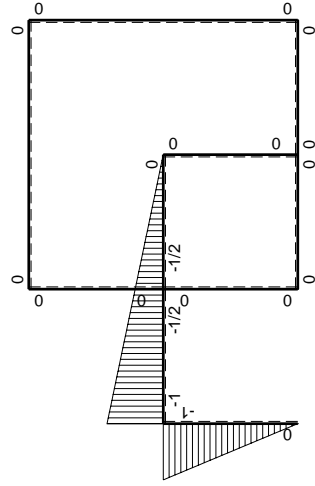
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	-x/b	0	0	0	0	x^2/b^2	0+0	1/3Xb/EJ	
BA b	1-x/b	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	-1+1/2x/b	-5/4Fx	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	7/12Xb/EJ	
CB b	1/2+1/2x/b	5/4Fb-5/4Fx	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	-1/2+1/2x/b	-5/4Fb+5/4Fx	-Fb/EJ	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	1/12Xb/EJ	
DC b	1/2x/b	5/4Fx	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	4Fb-4Fx	0	0	0	0	0+0	0	
FE b	0	-4Fx	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	-2Fx	0	0	0	0	0+0	0	
GC b	0	2Fb-2Fx	0	0	0	0			
GH 2b	0	-Fb+1/2Fx	0	0	0	0	0+0	0	
HG 2b	0	1/2Fx	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$							Fb^2/EJ	
	totali							$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-15/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

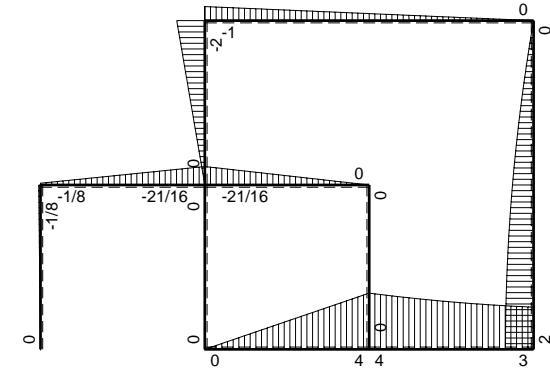
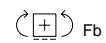
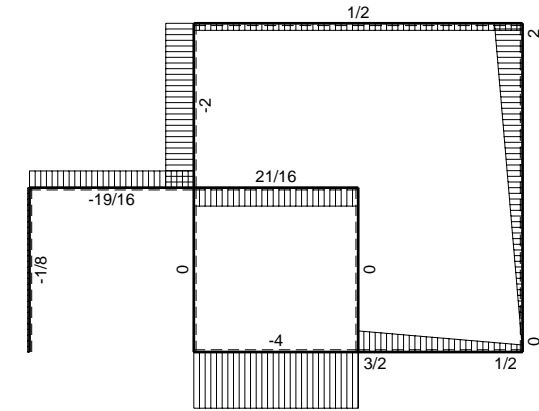
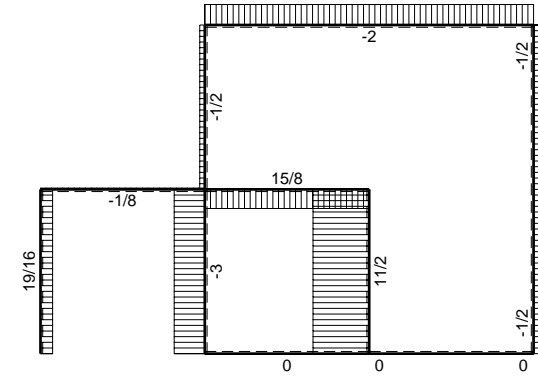
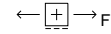
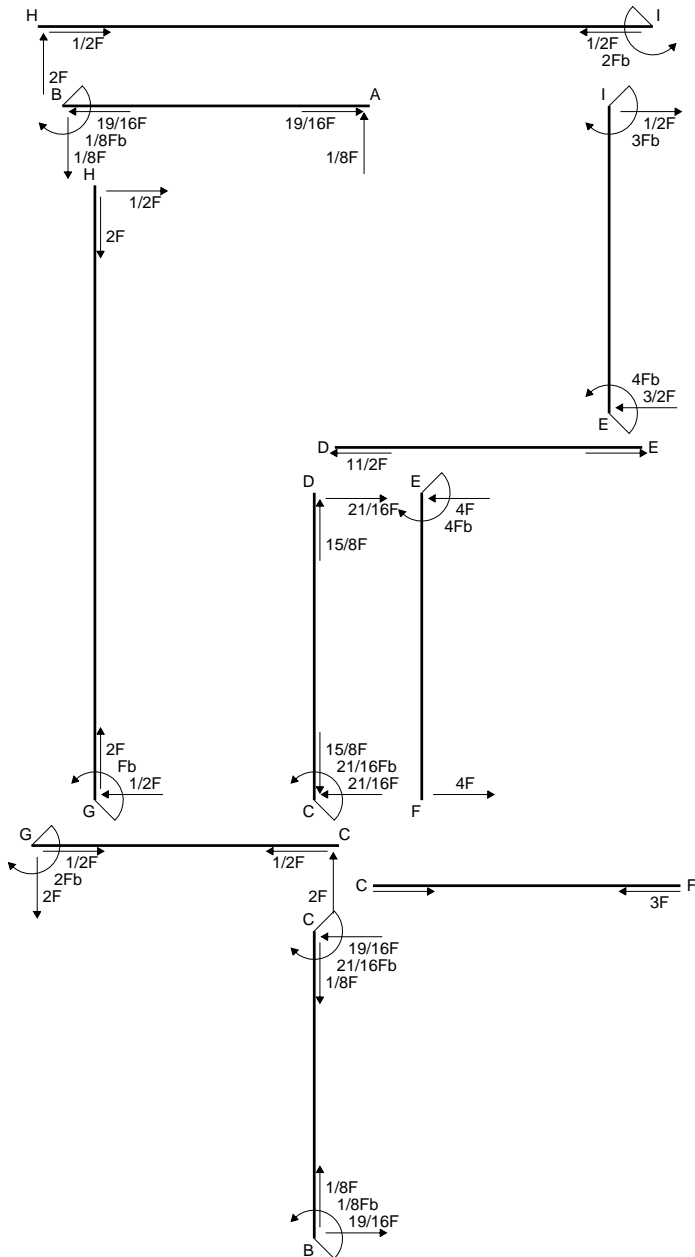
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

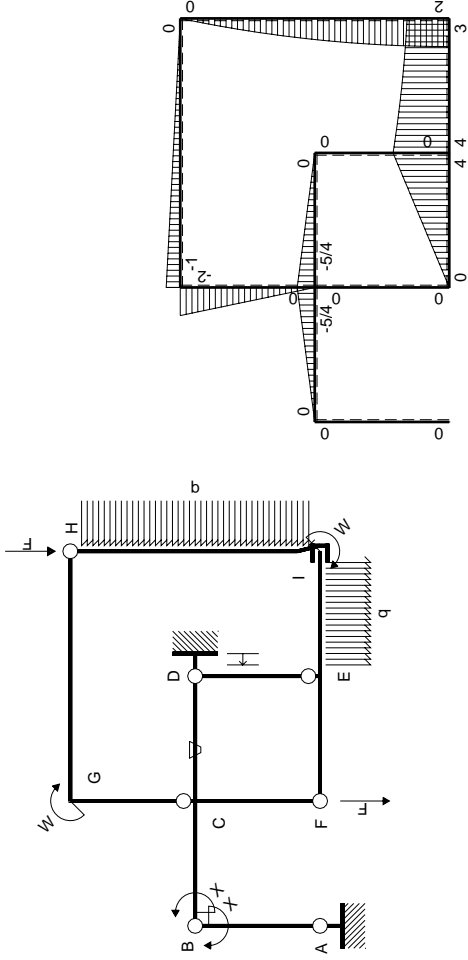
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

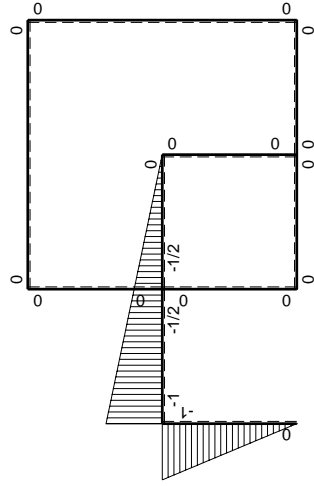
$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$1/2Fx$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+1/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+3/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

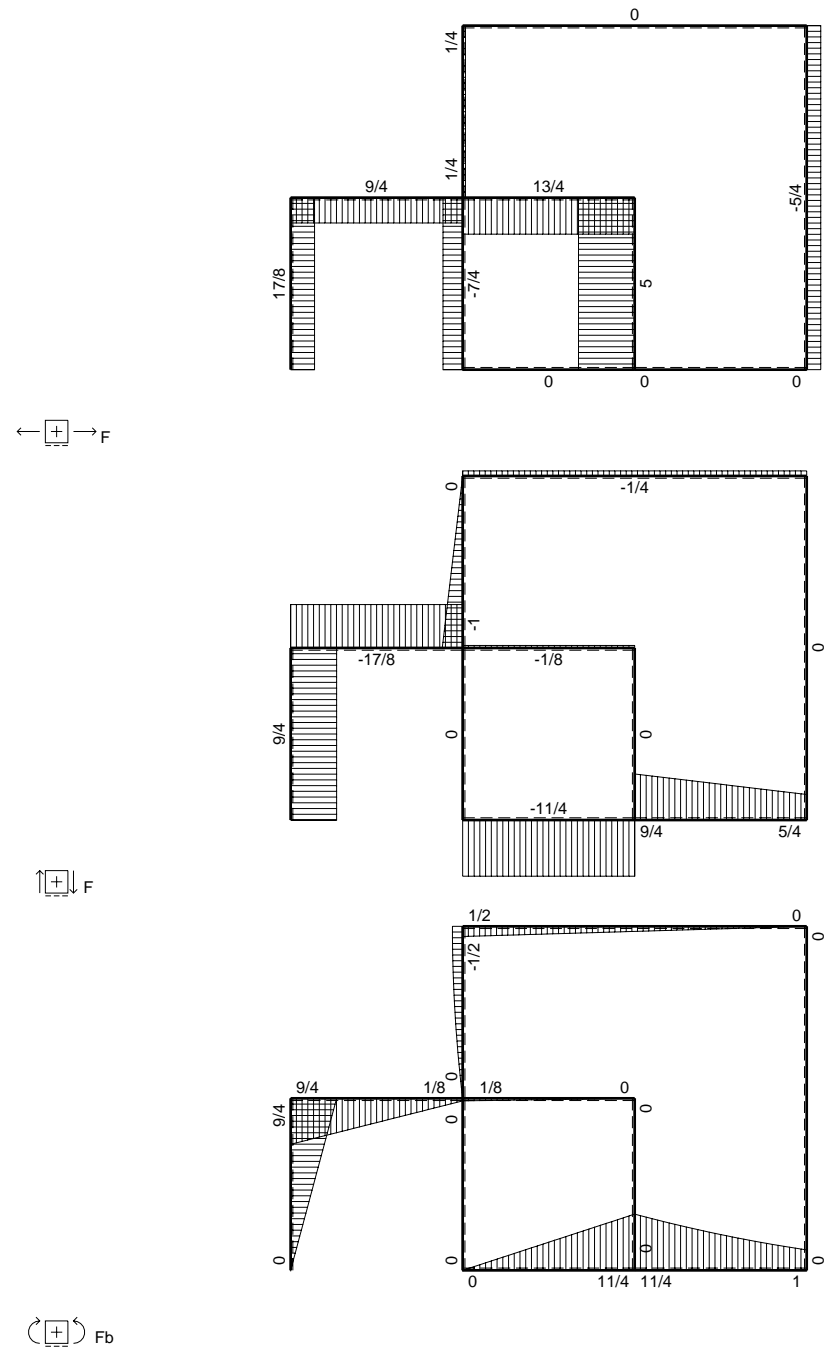
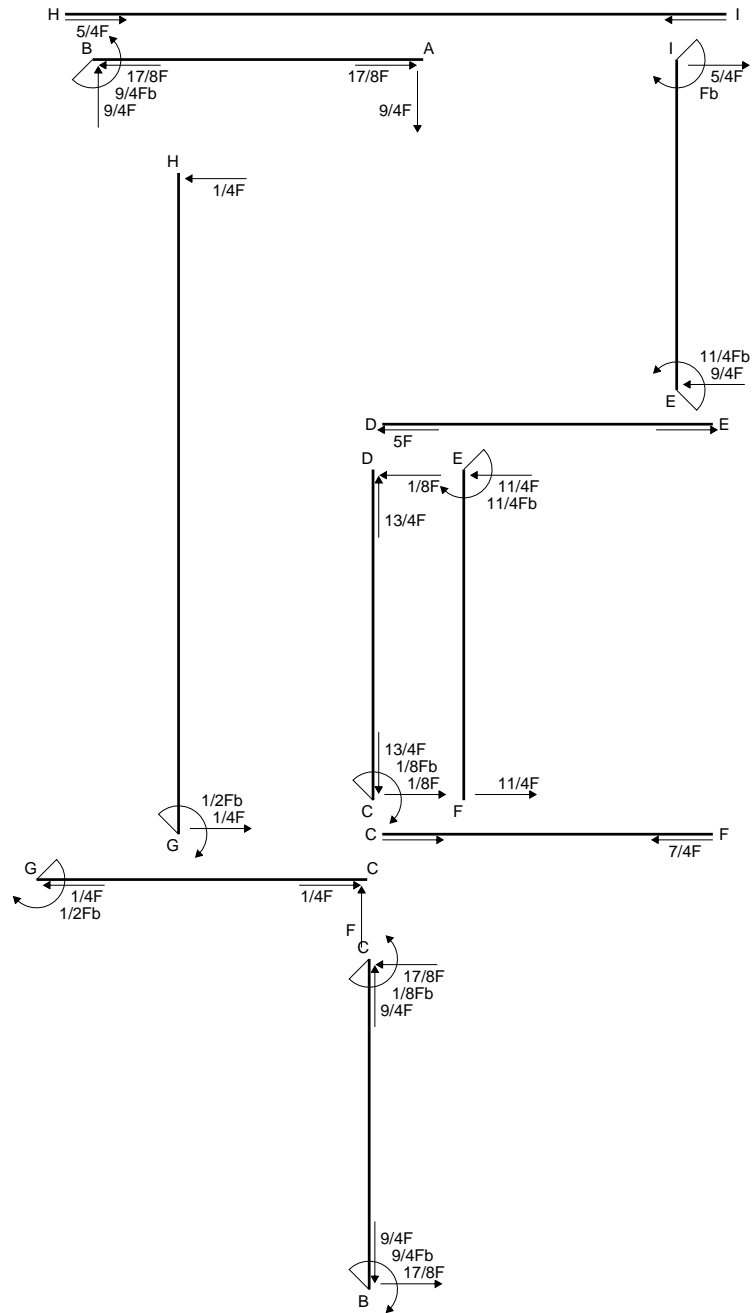
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

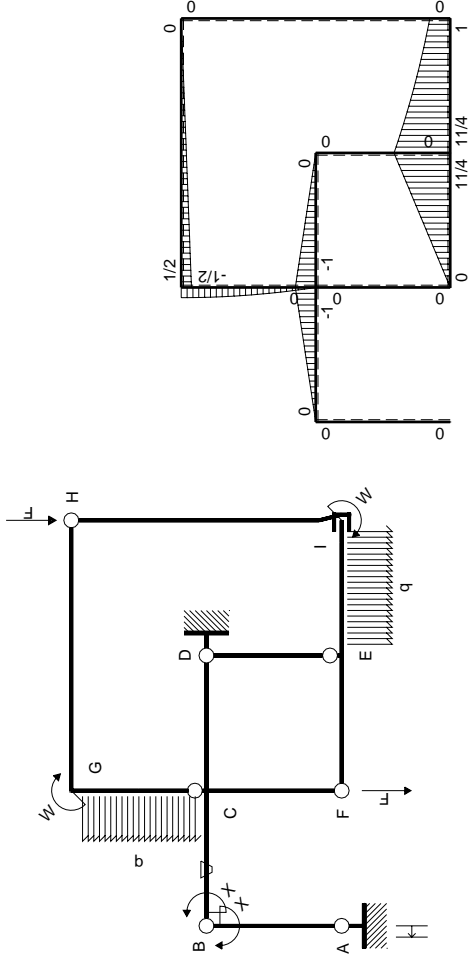
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$9/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-9/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

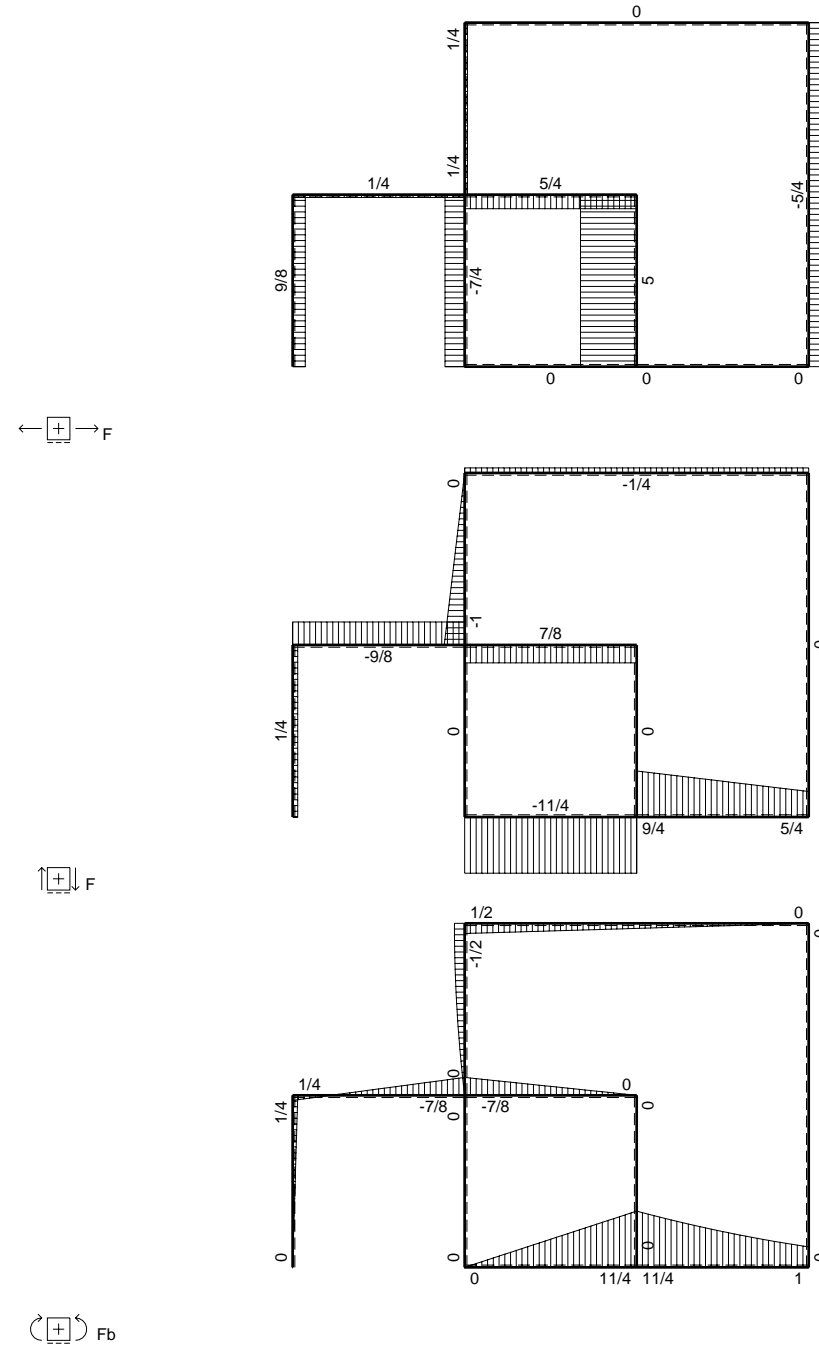
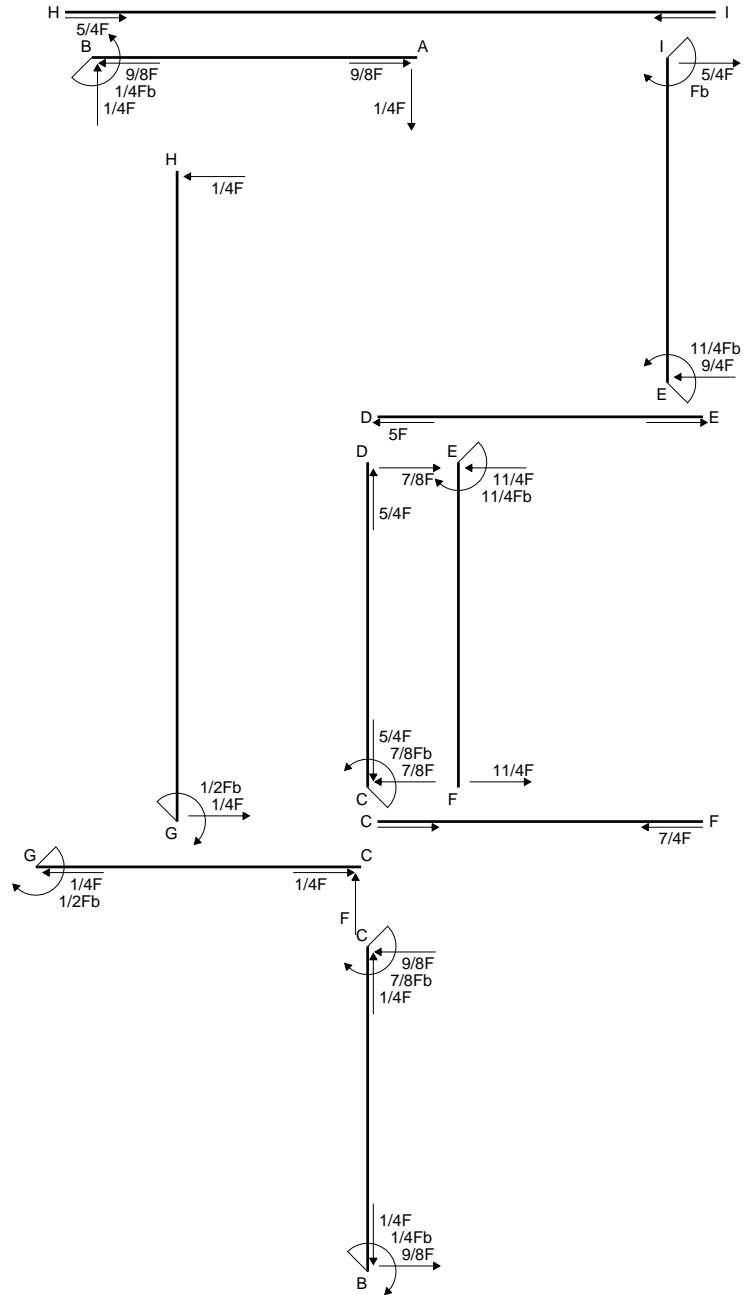
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

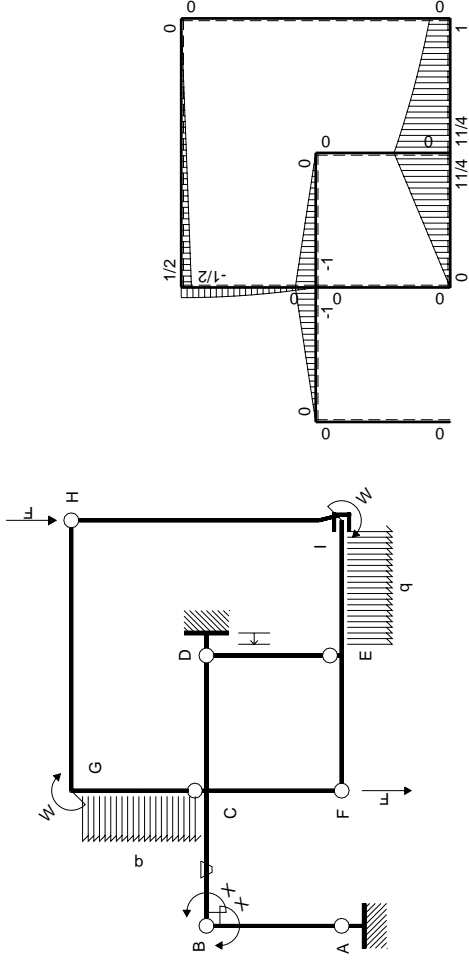
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	-Fx	-Fb/EJ	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	Fb-Fx	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	-Fb+Fx	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-11/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

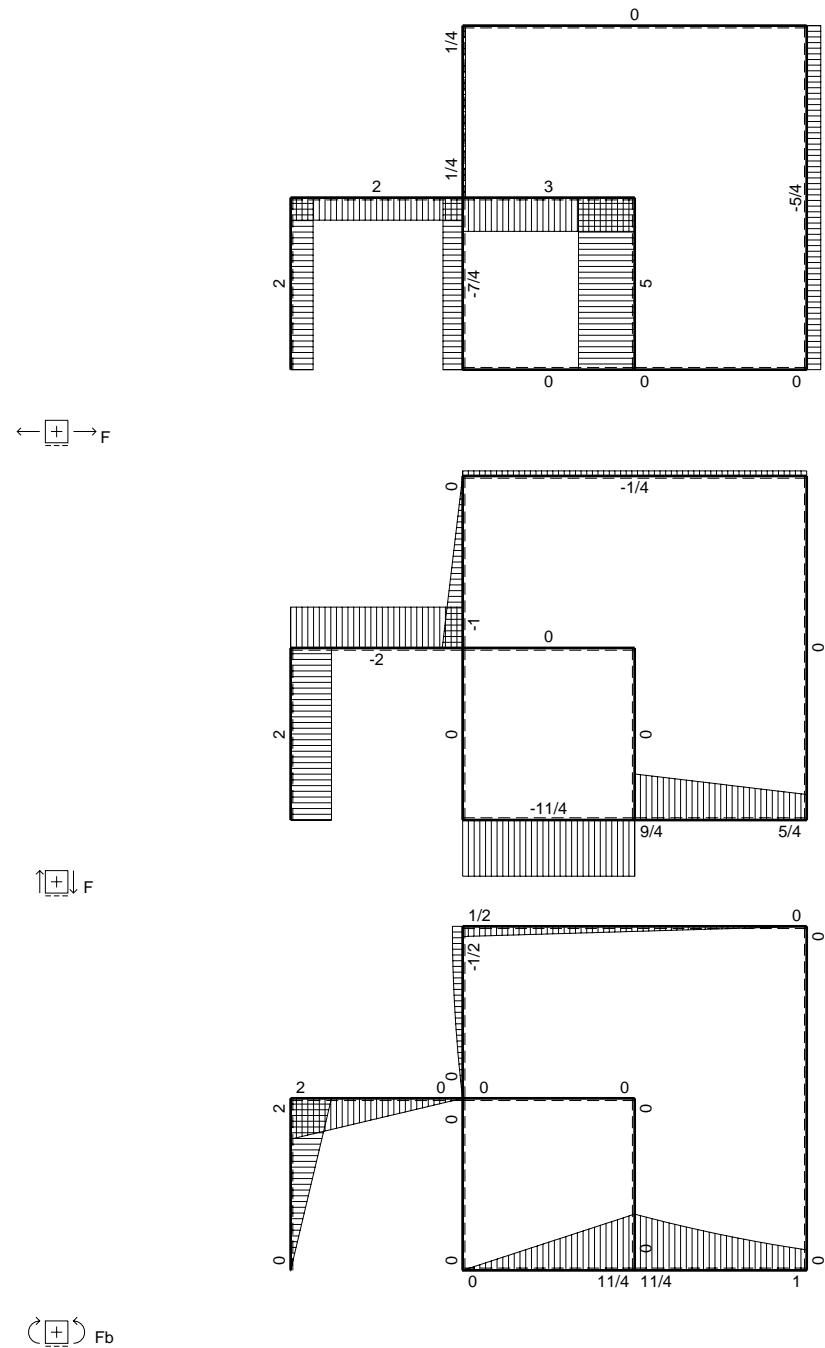
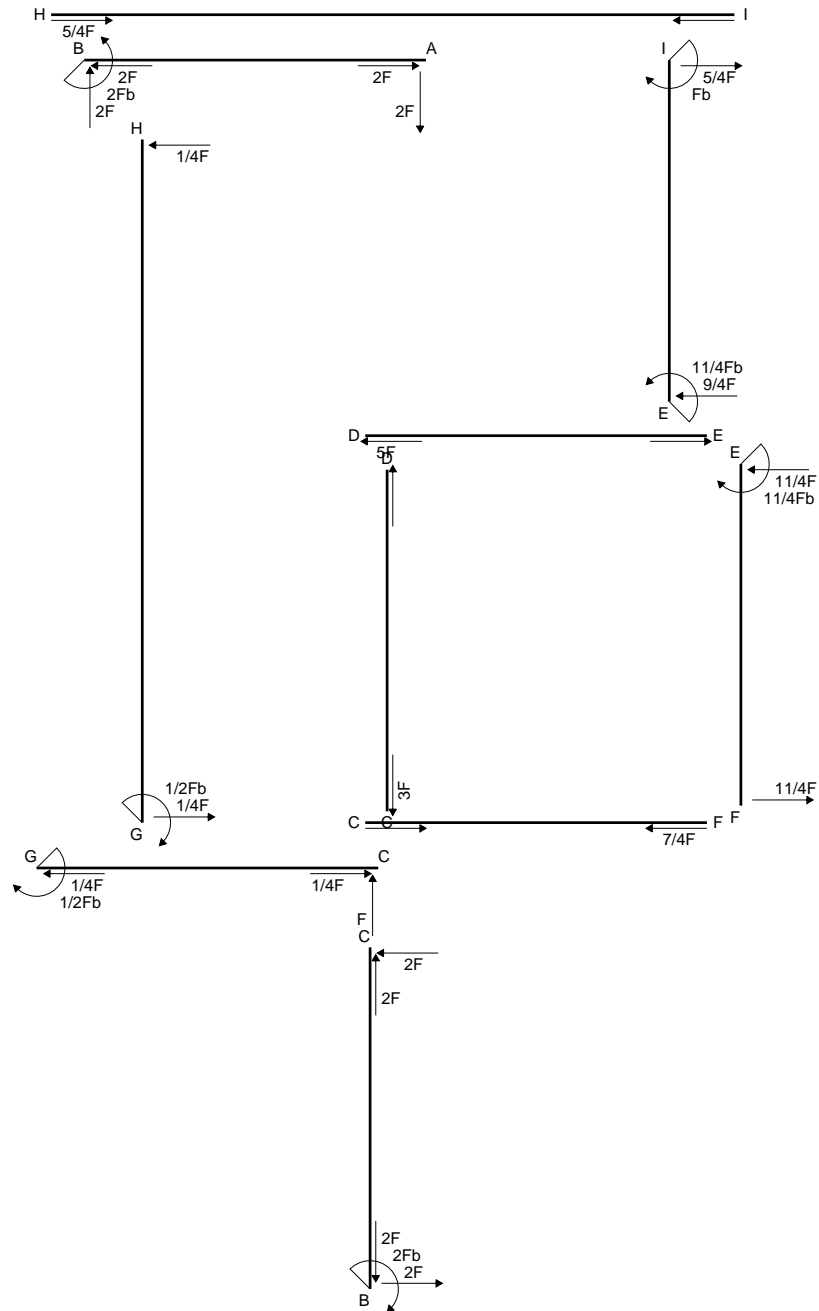
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

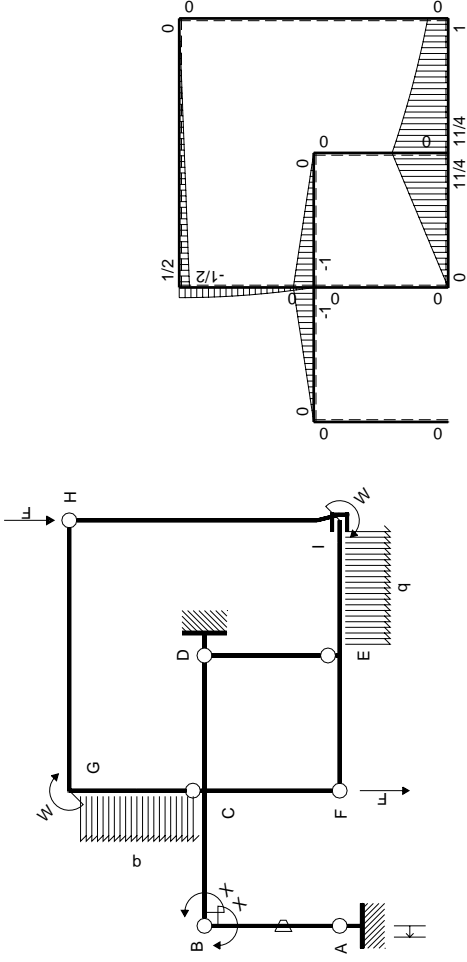
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



← ⊕ → N
 ↑ ⊕ ↓ V
 ⊕ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

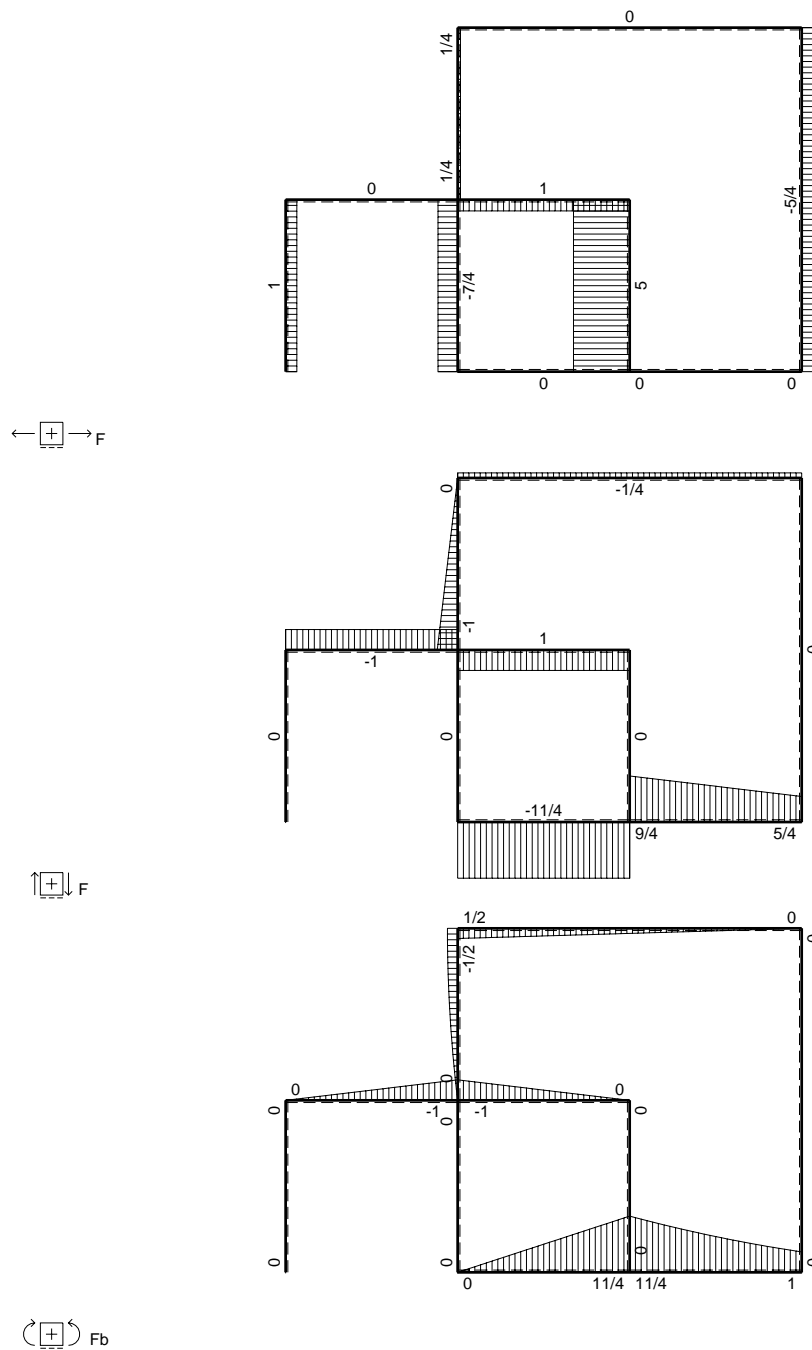
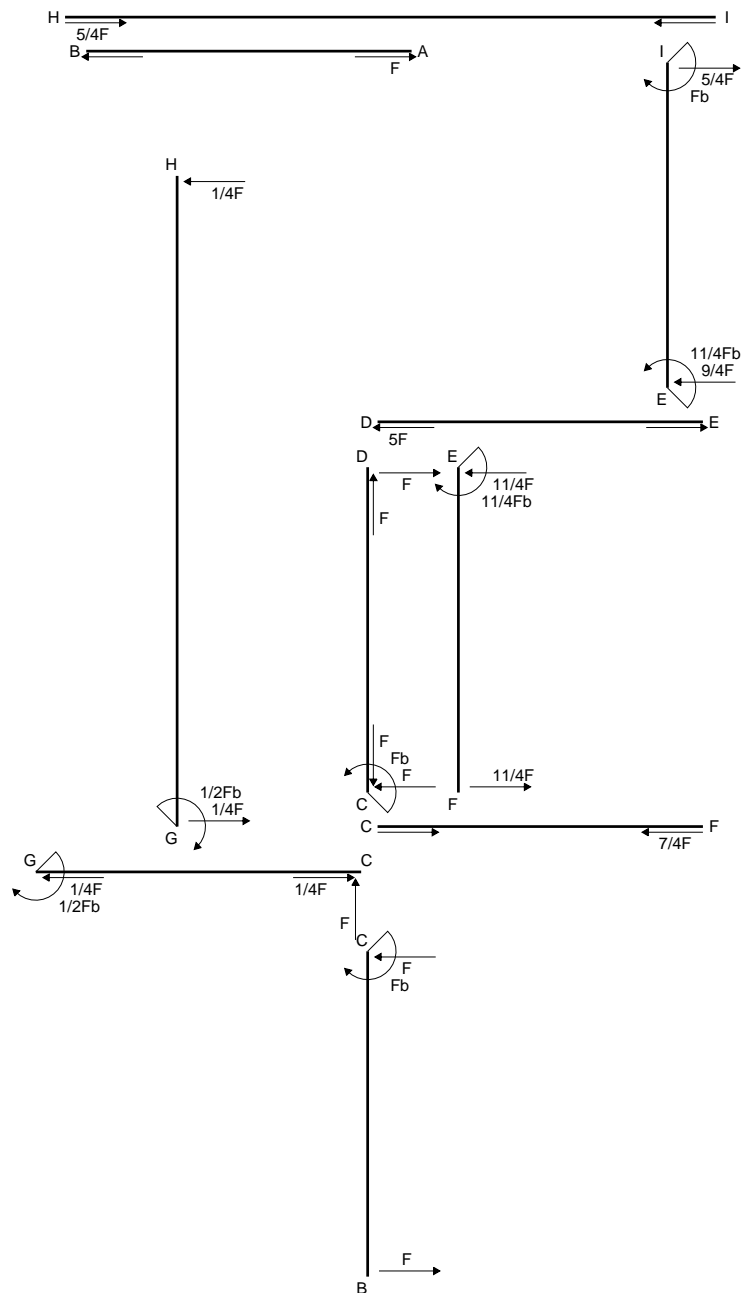
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

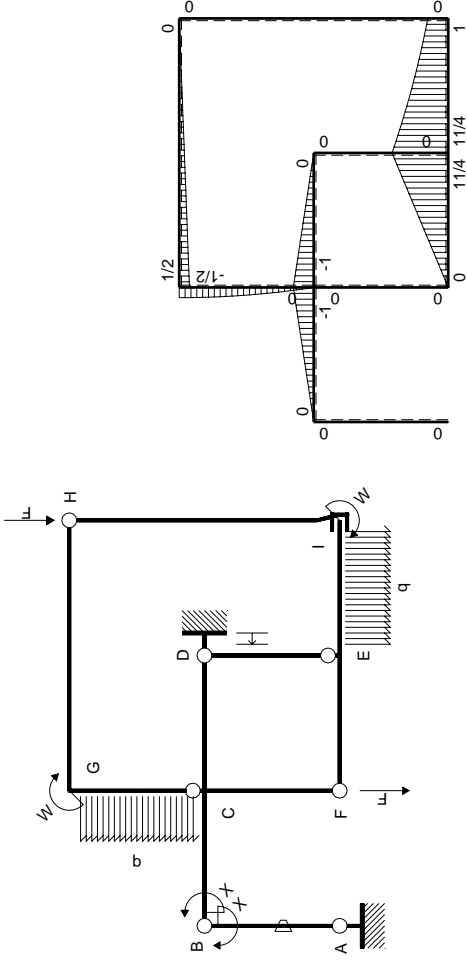
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-11/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							0	Xb/EJ
	iperstatica $X=W_{BC}$							0	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

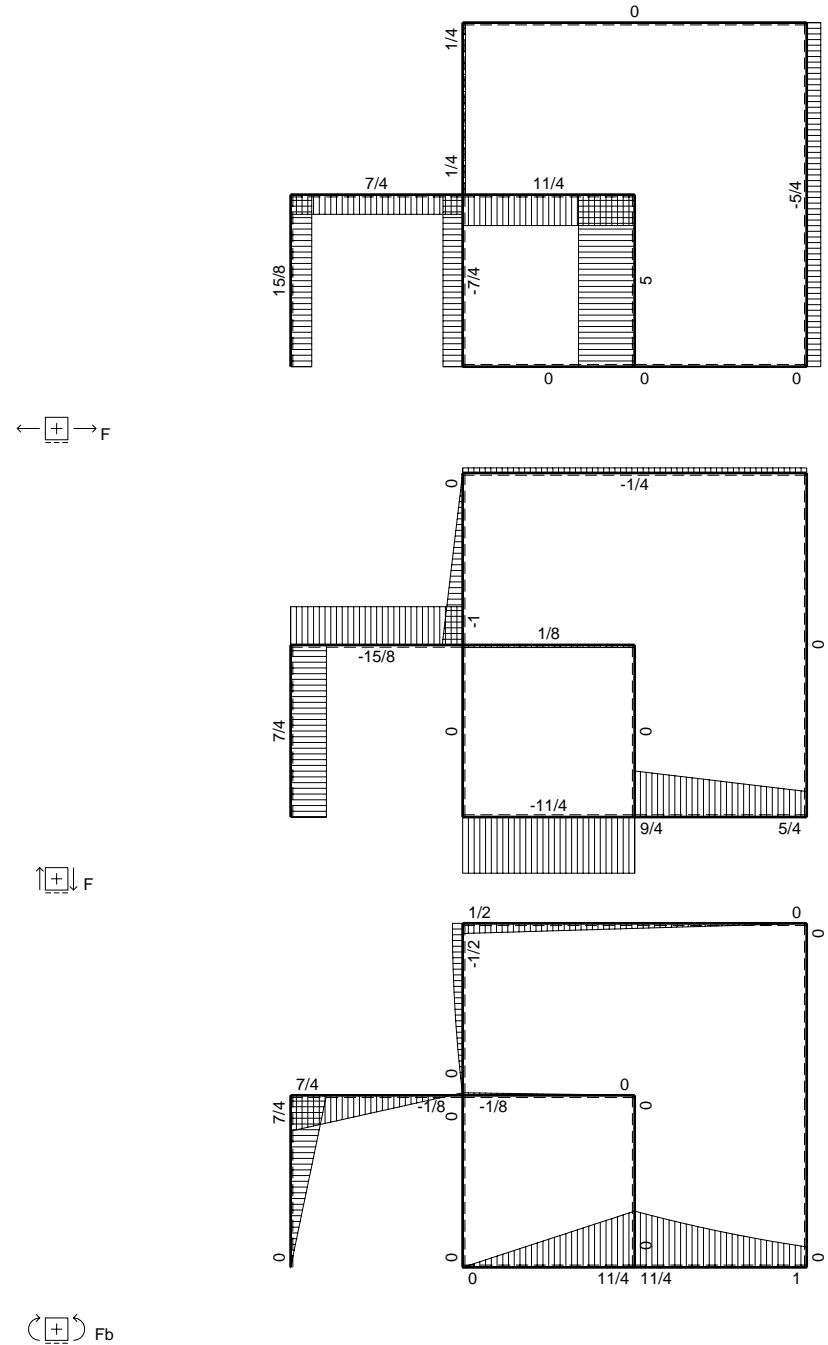
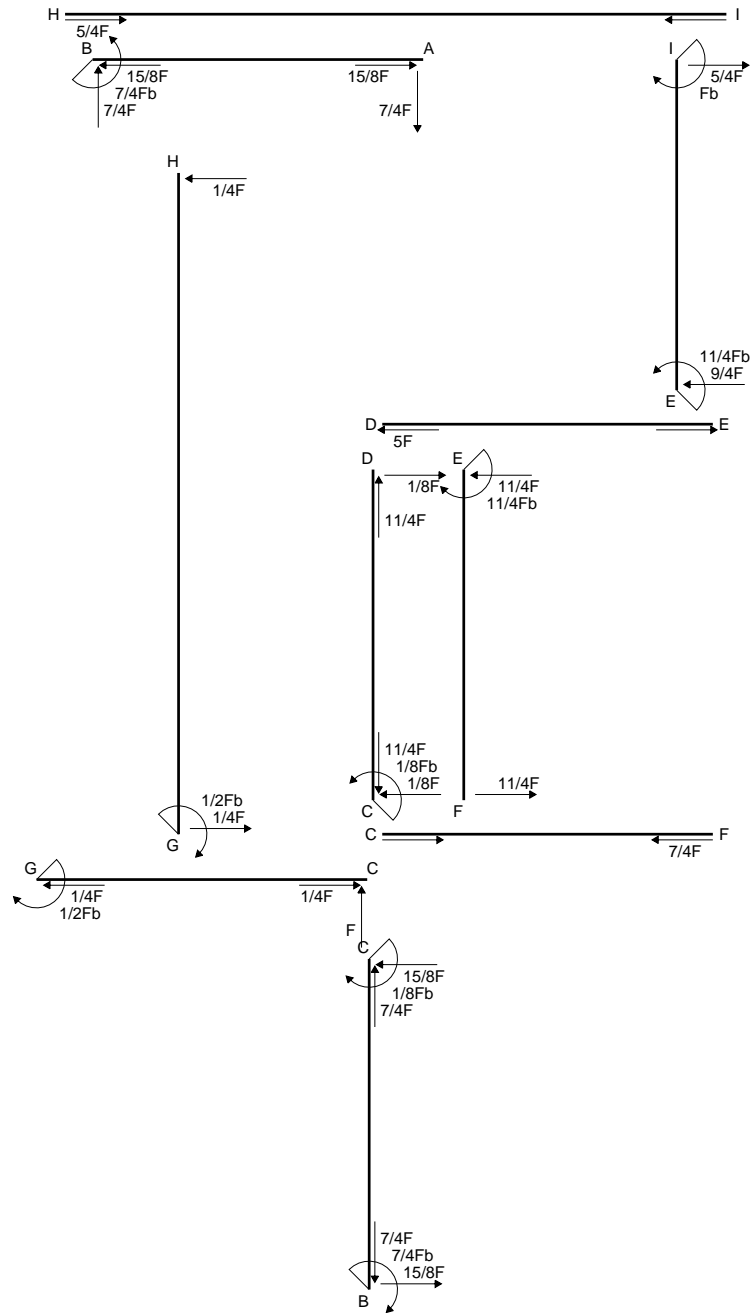
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

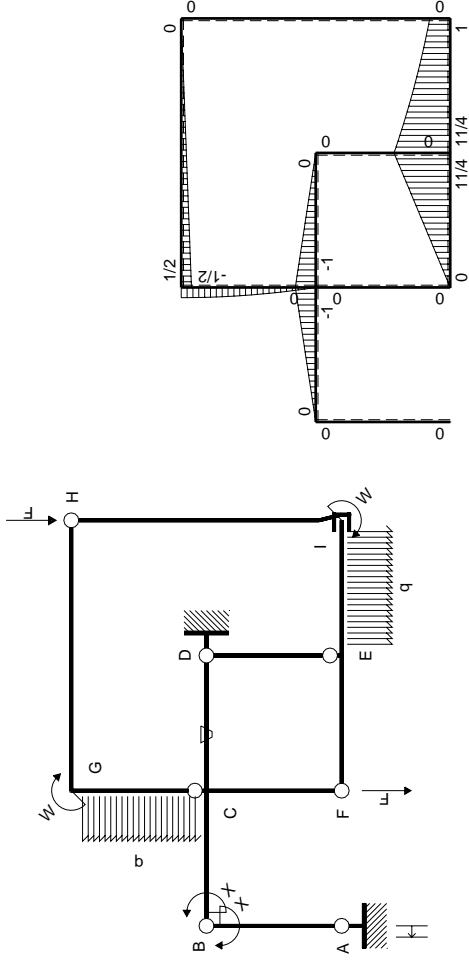
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0
FE b	0	$-11/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/4Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

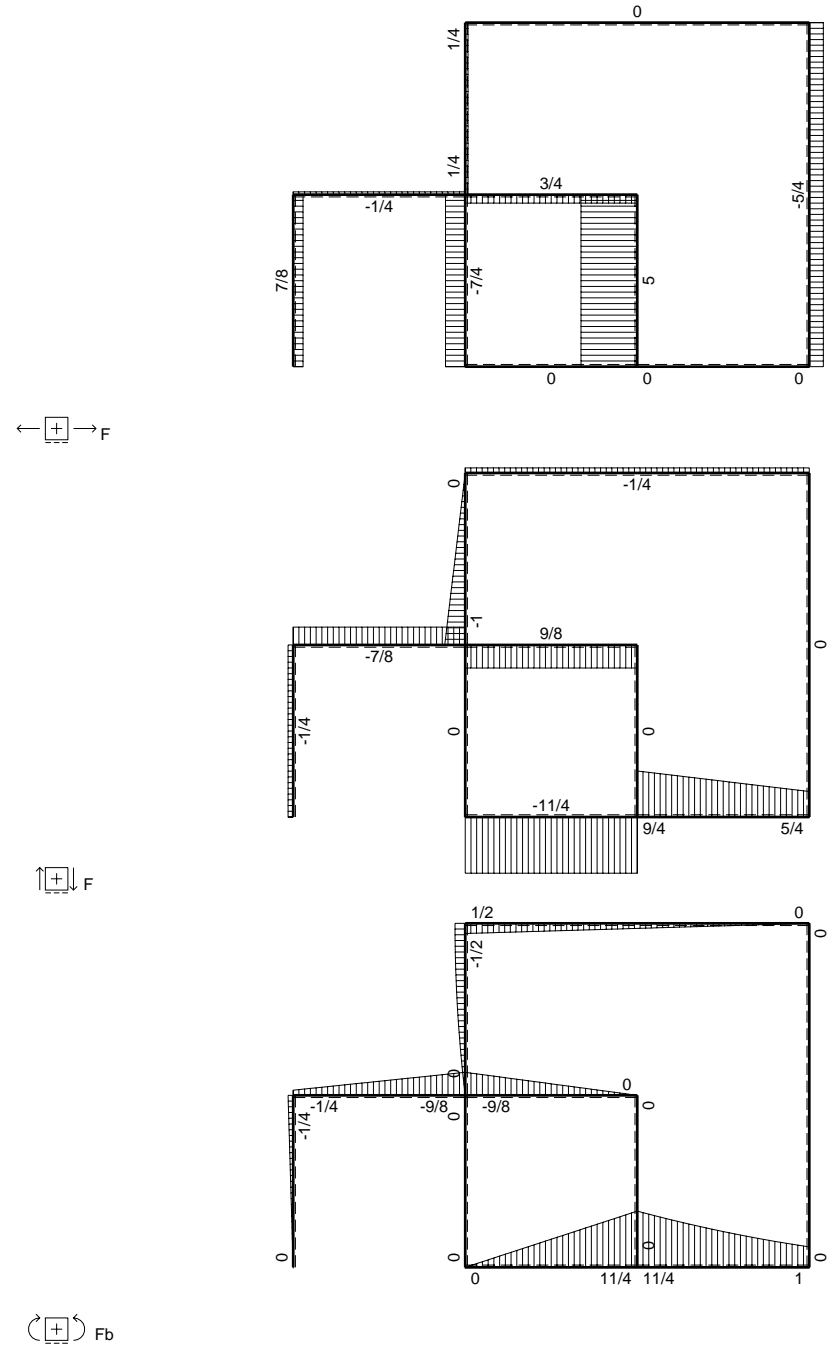
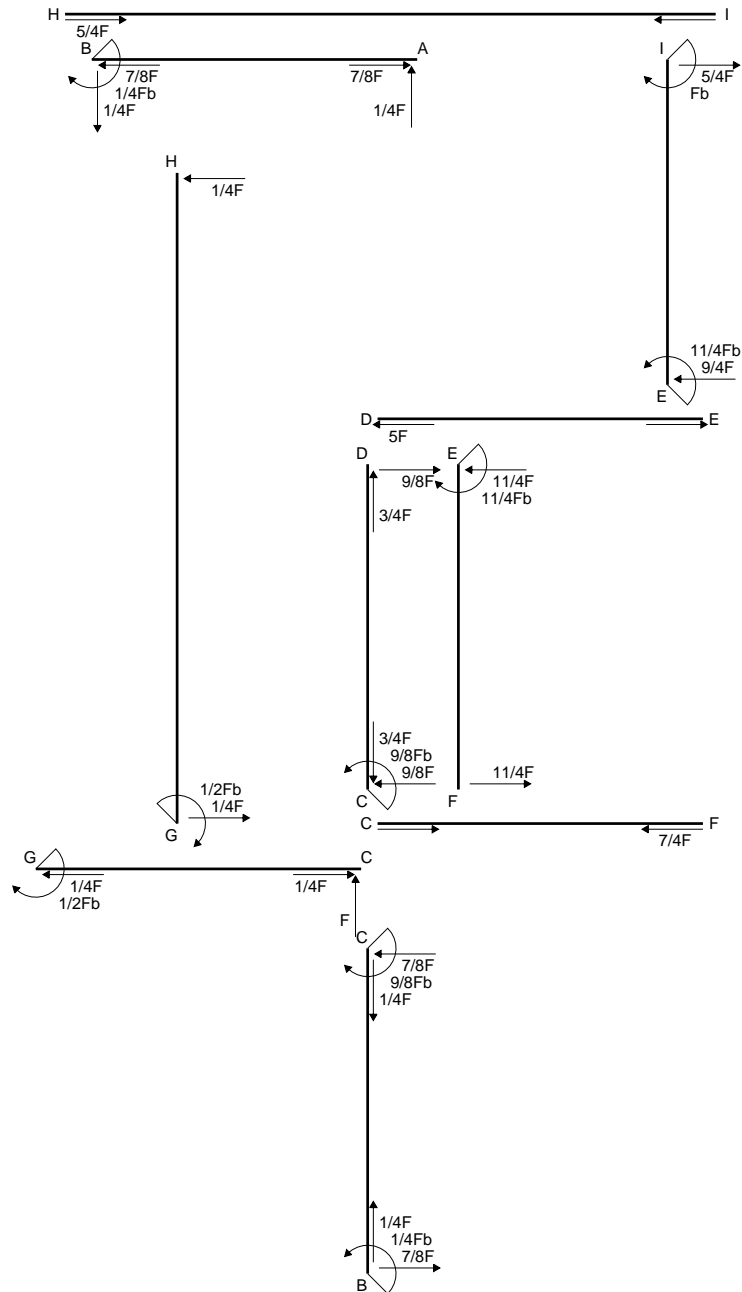
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

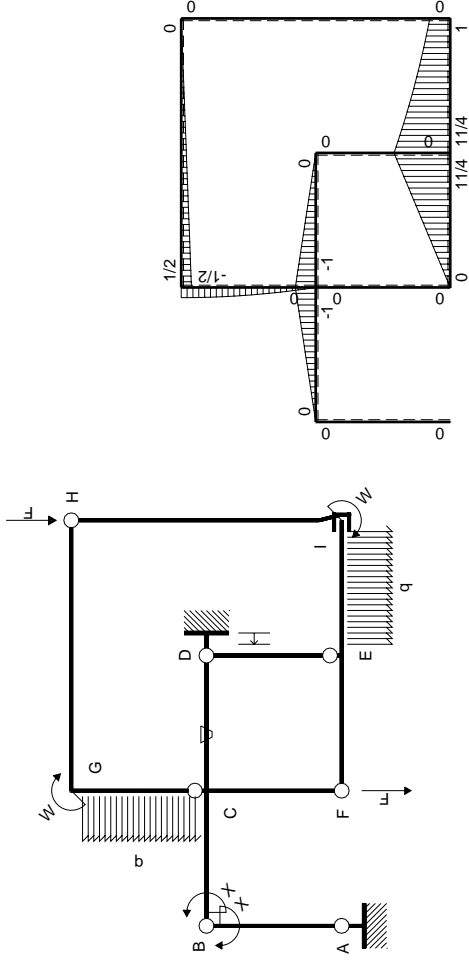
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

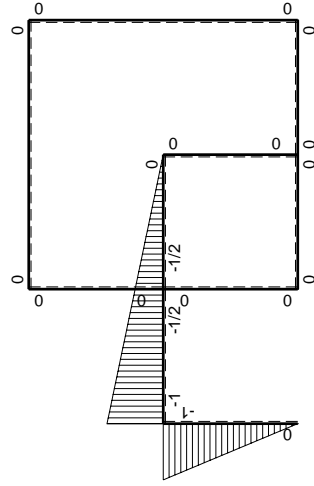
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$11/4Fb-11/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-11/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb-1/4Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/4Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/4Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-11/4Fb+9/4Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

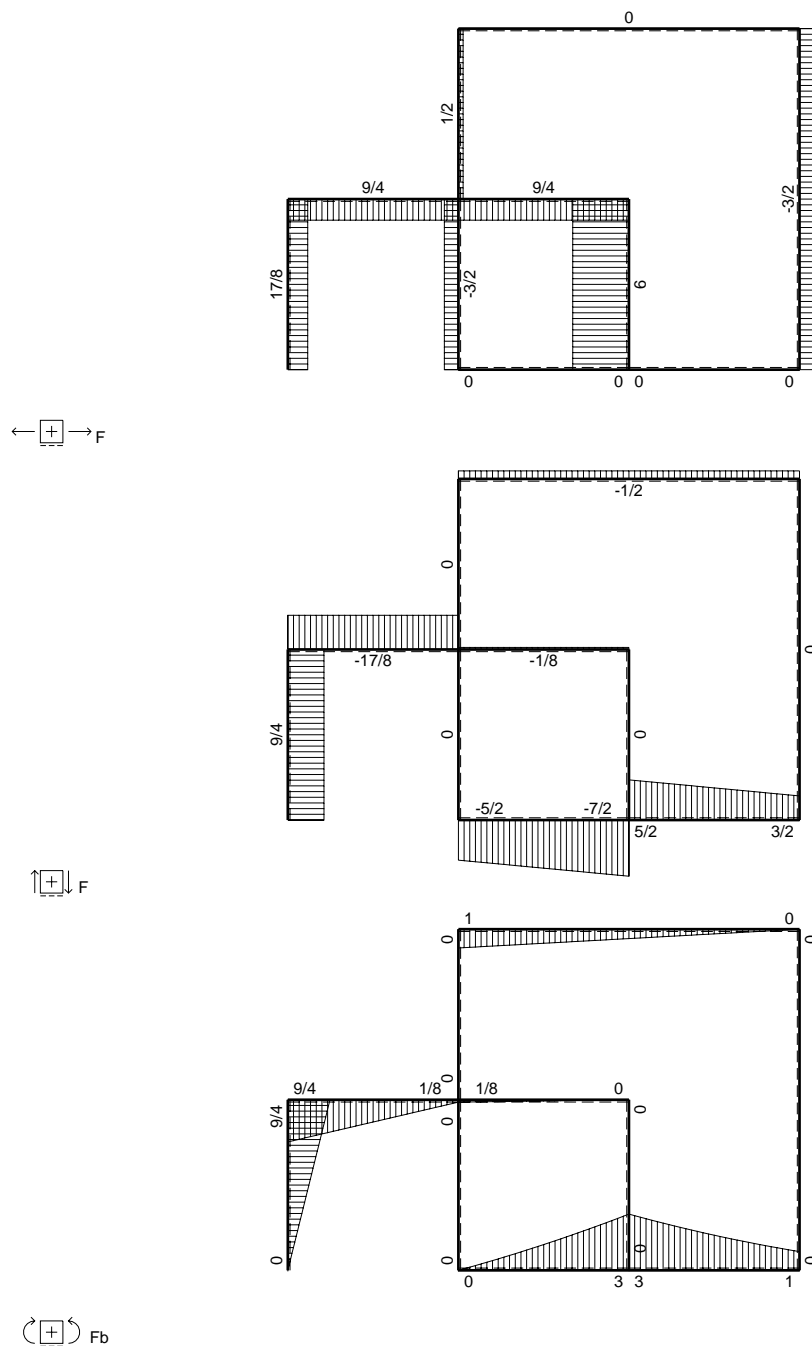
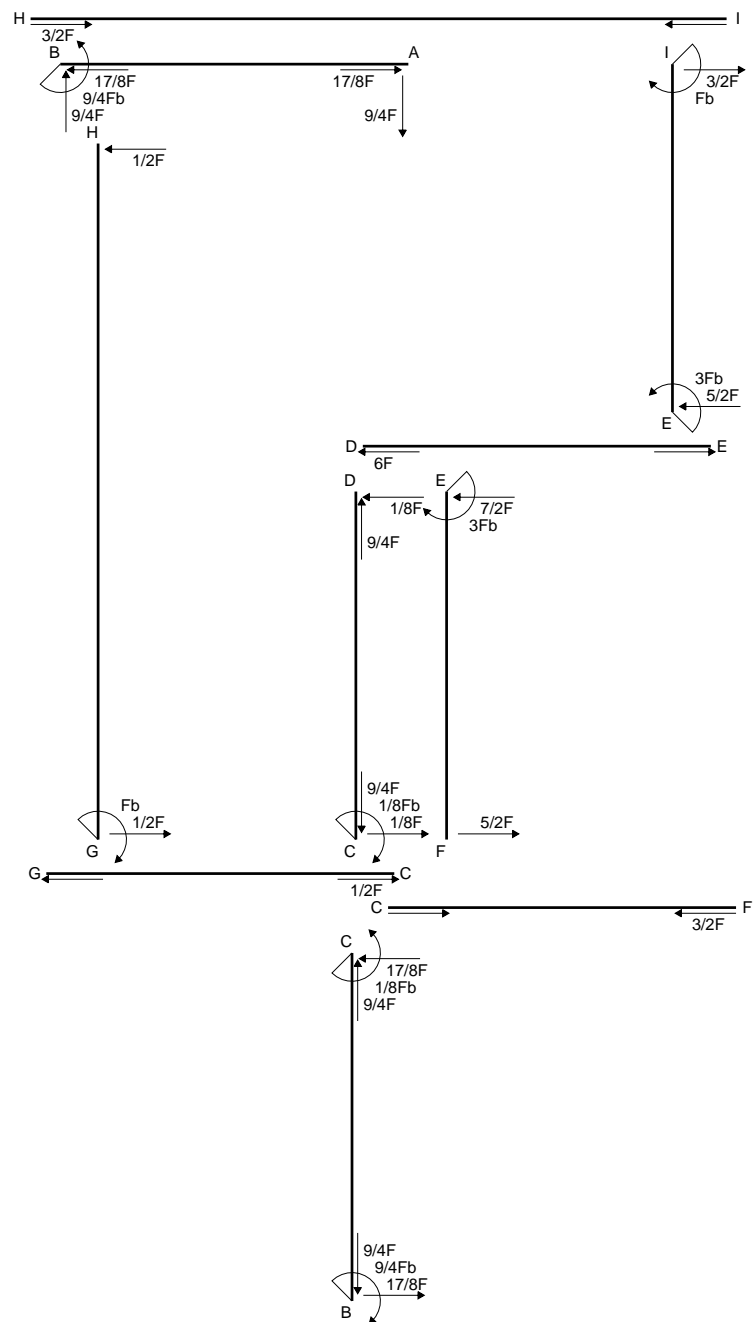
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

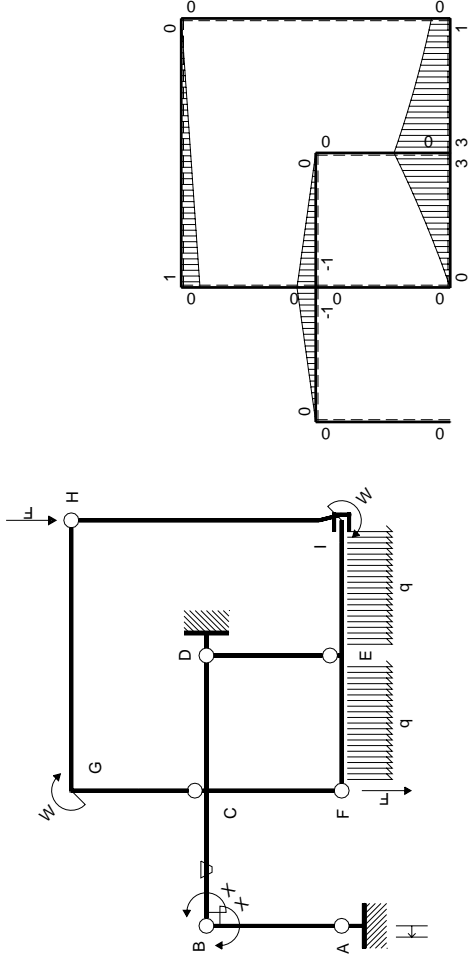
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$9/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-9/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

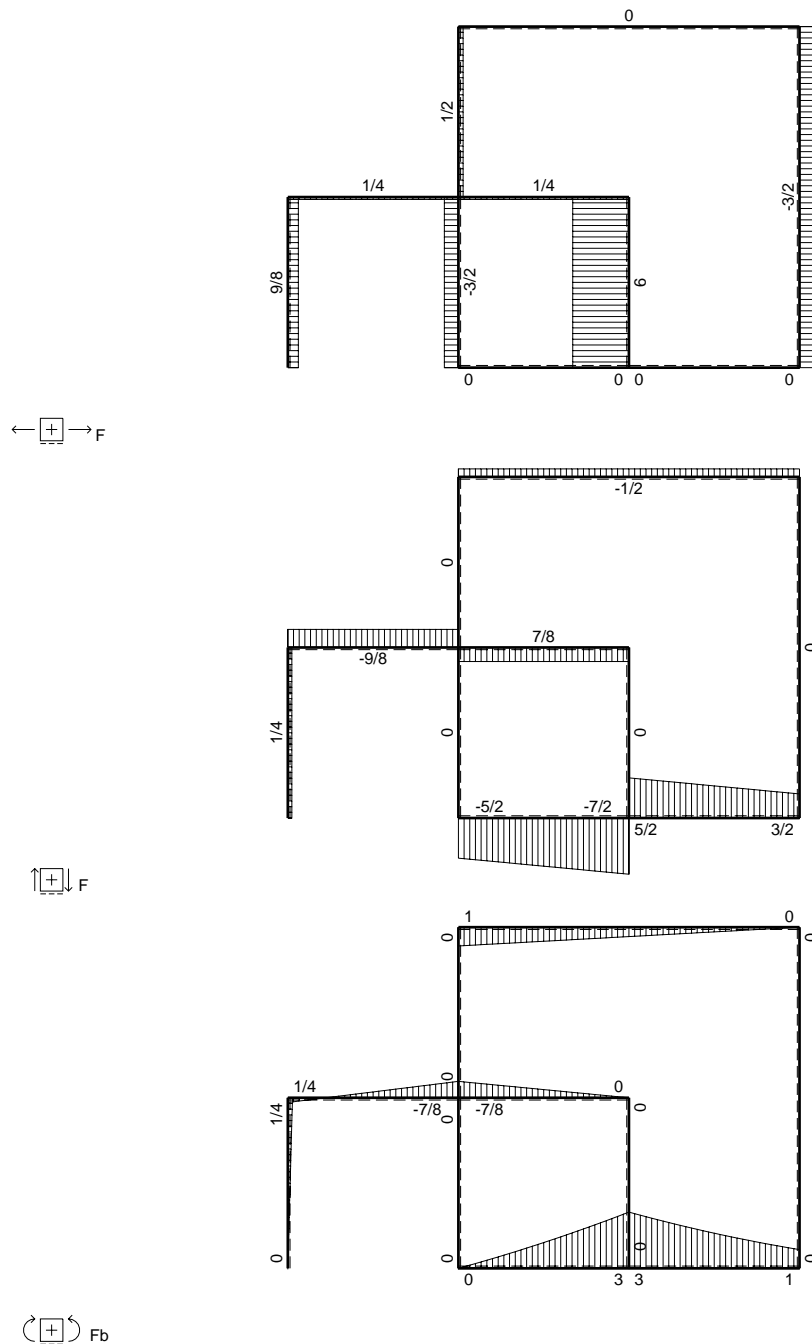
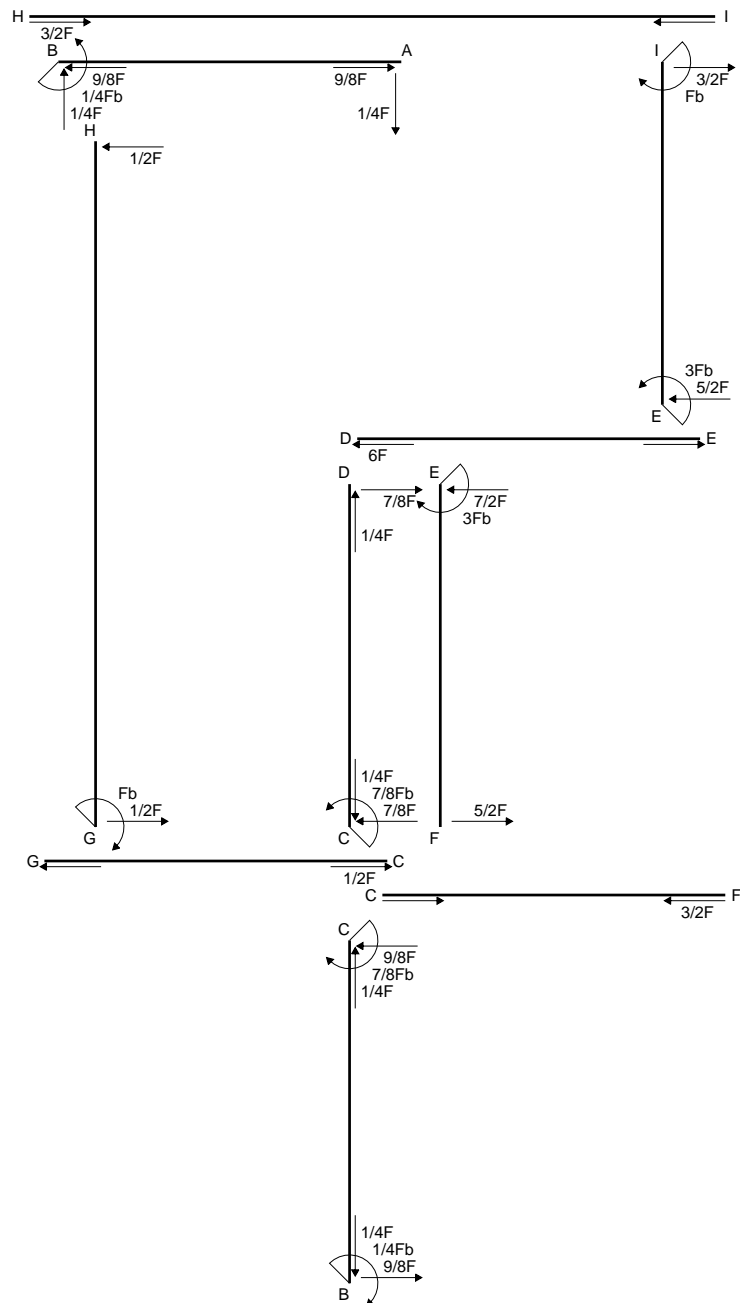
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

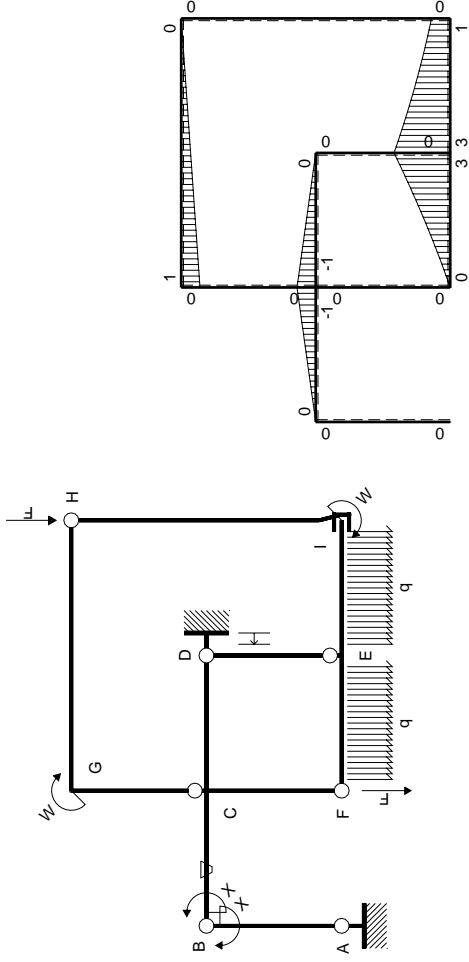
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

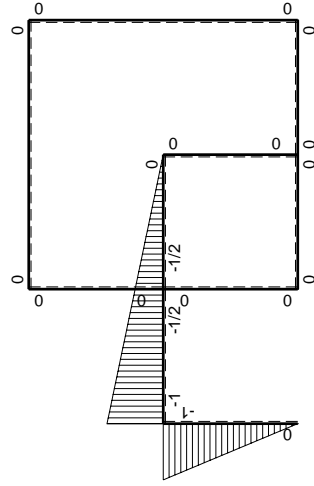


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

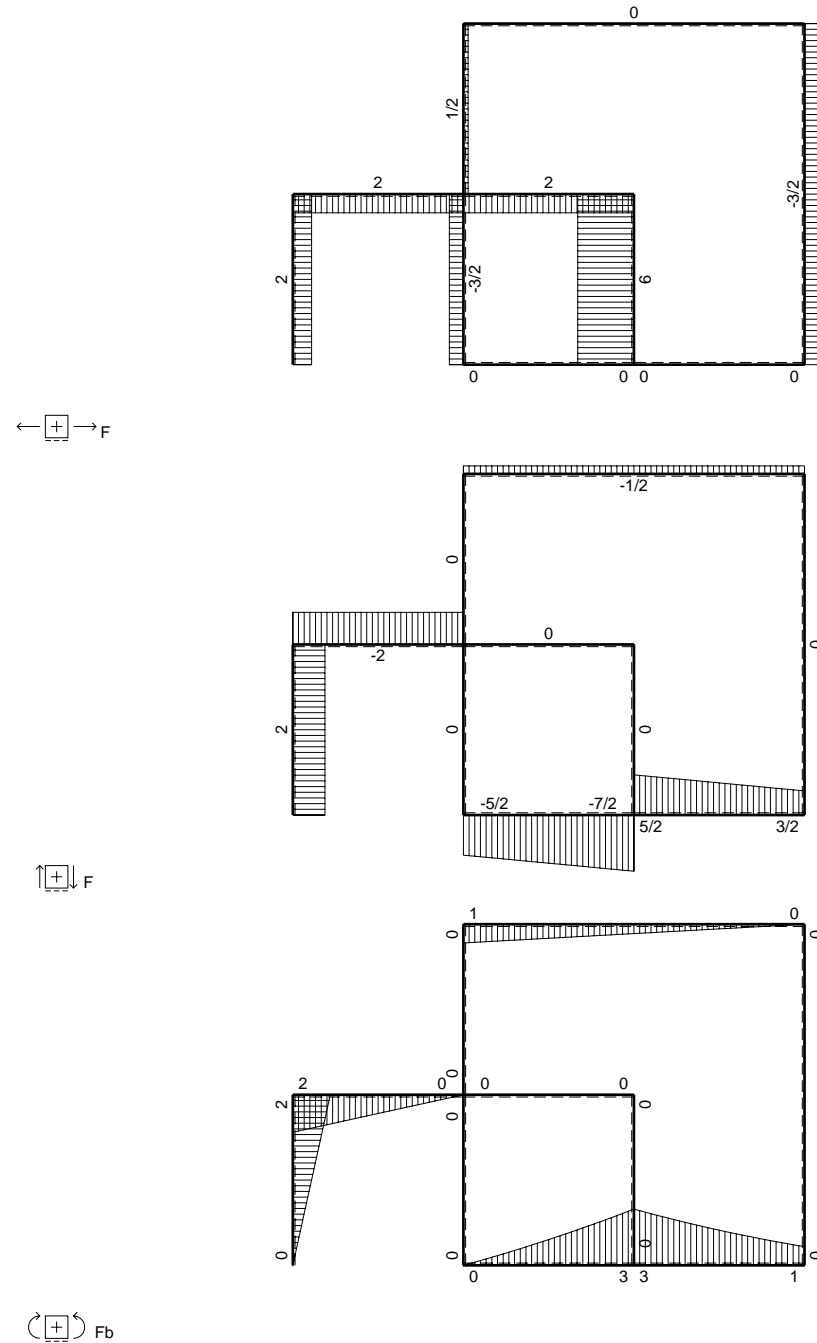
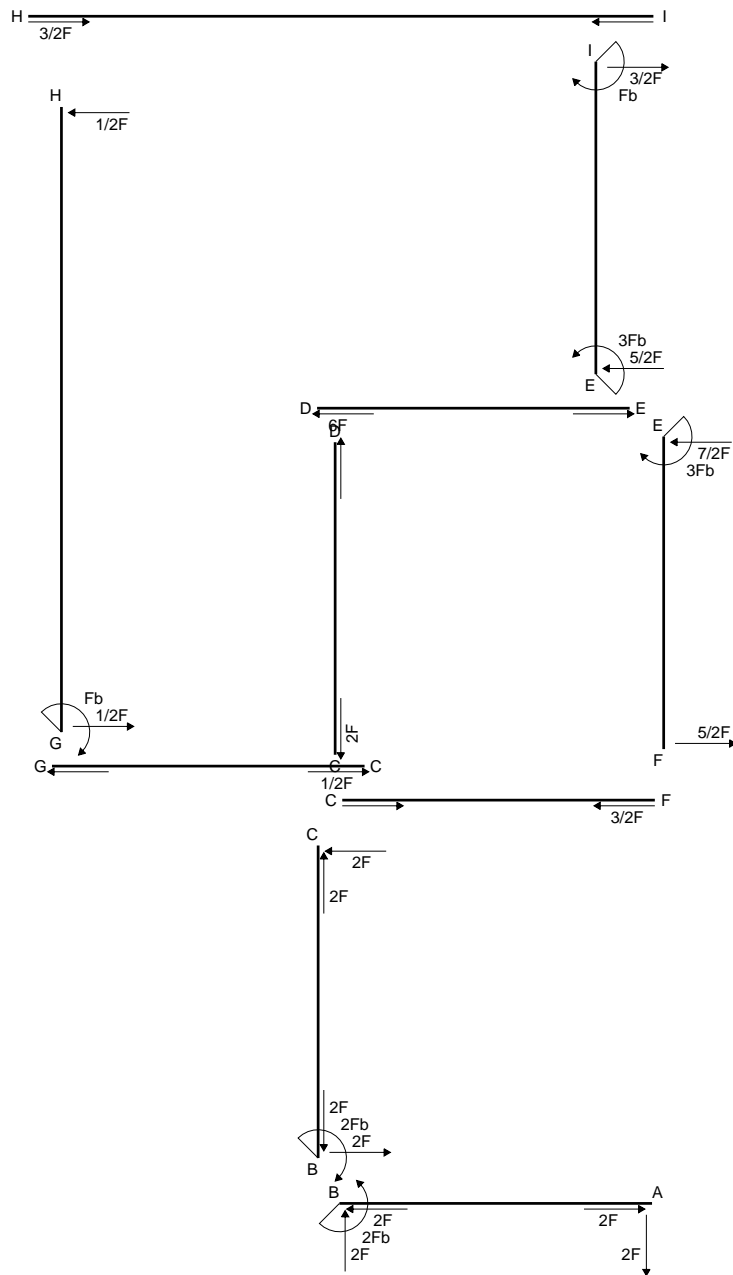
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

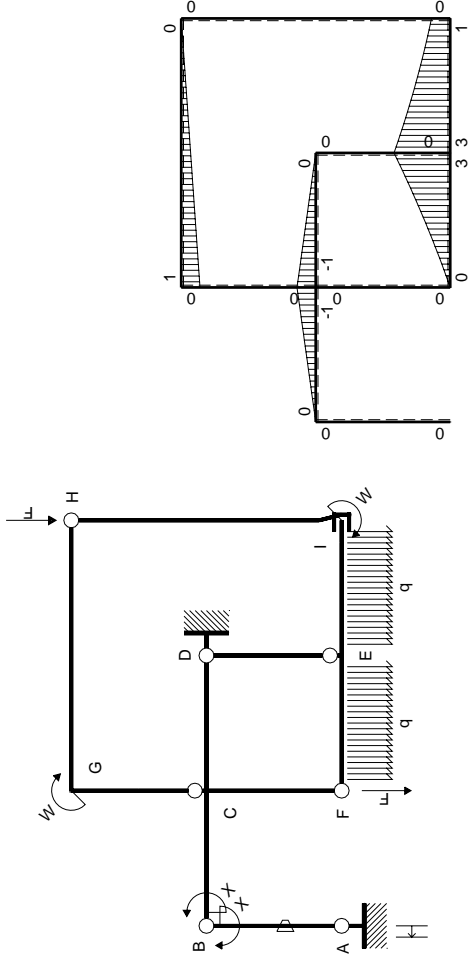
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

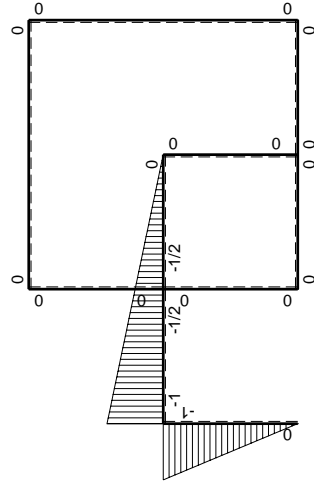
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

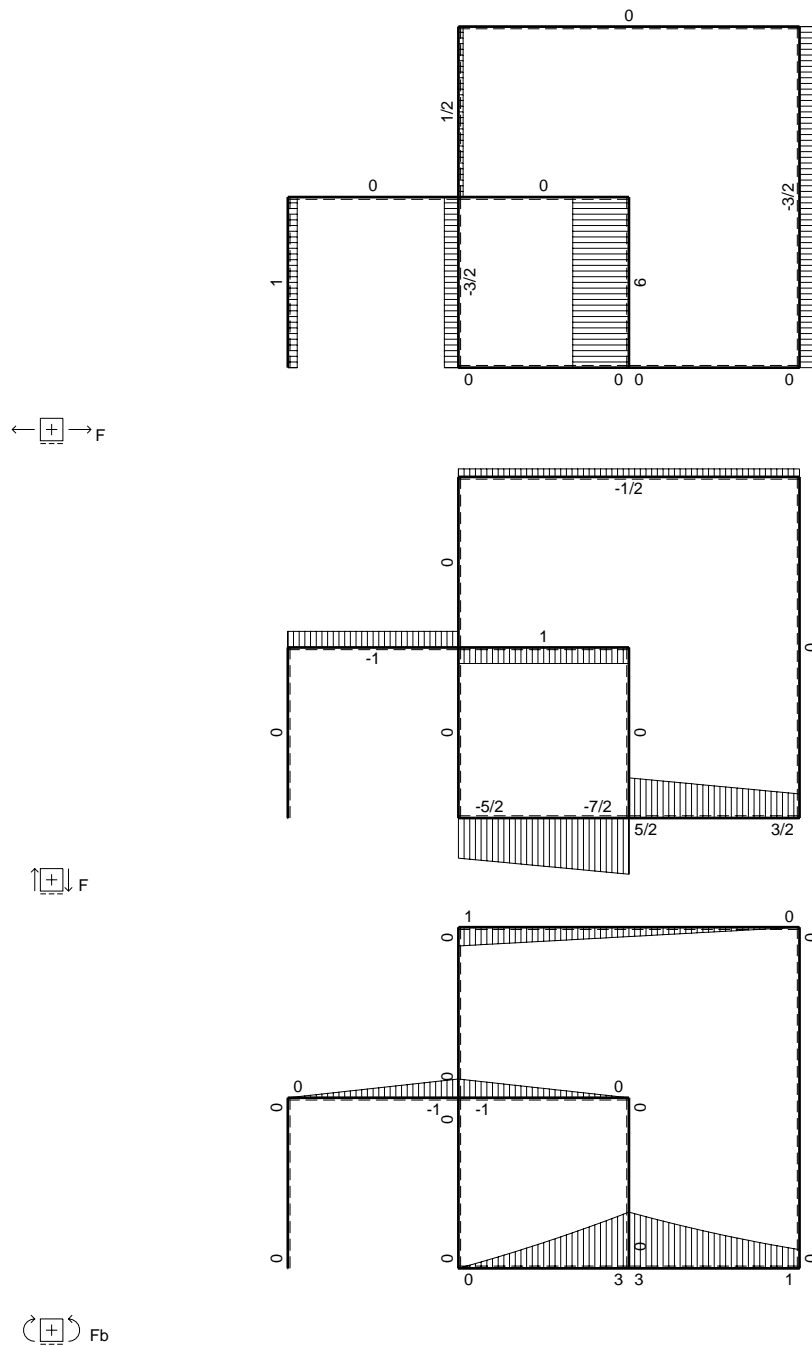
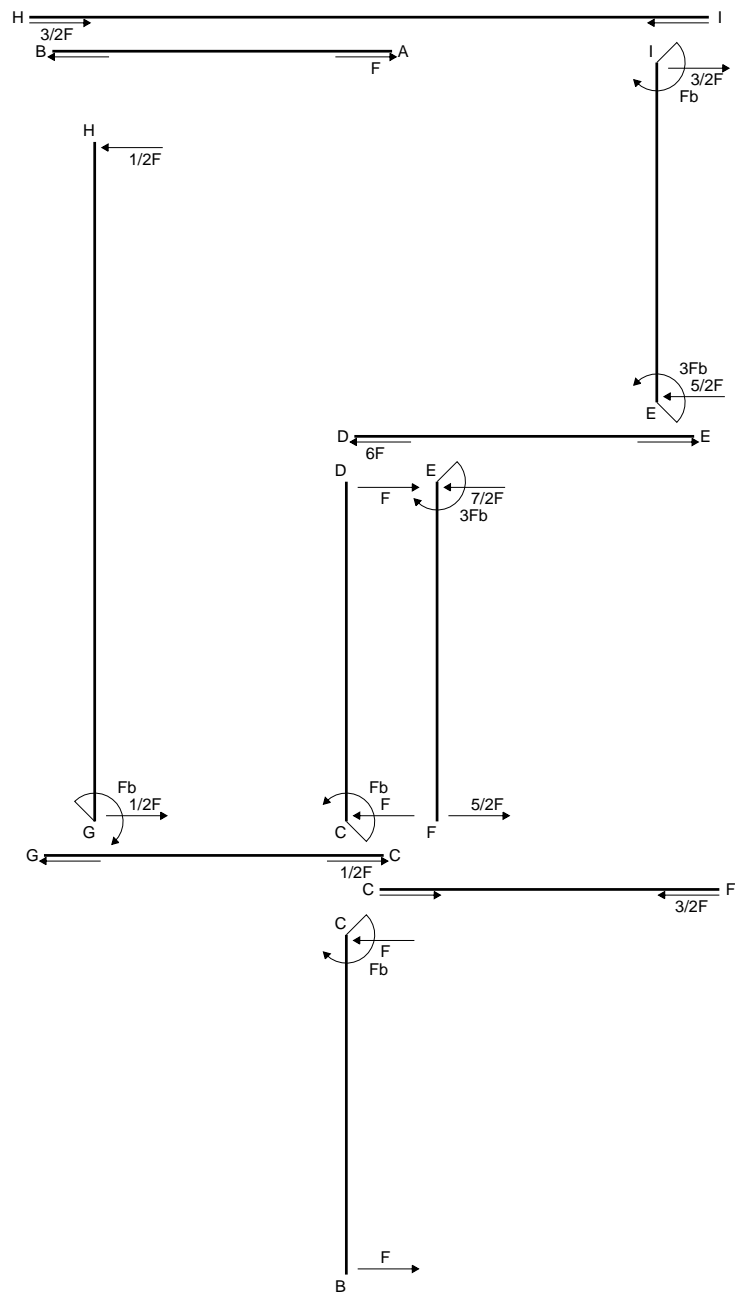
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

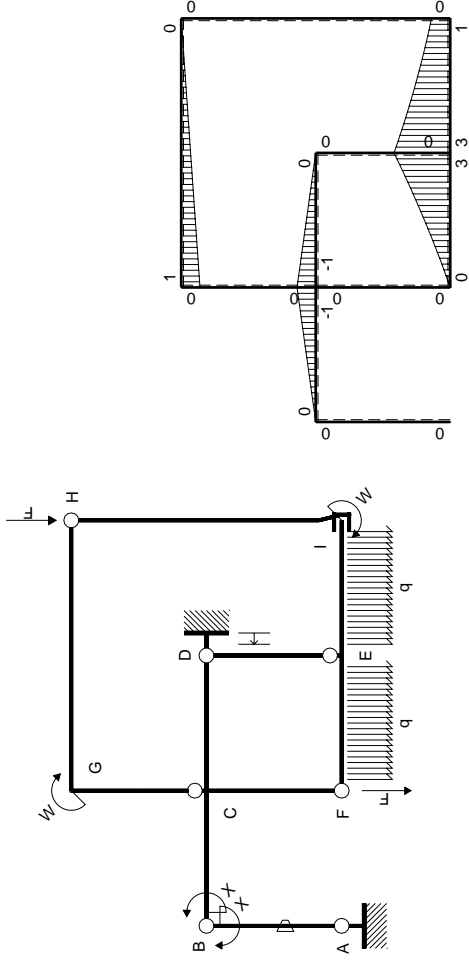
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						0	Xb/EJ
	iperstatica $X=W_{BC}$						0	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

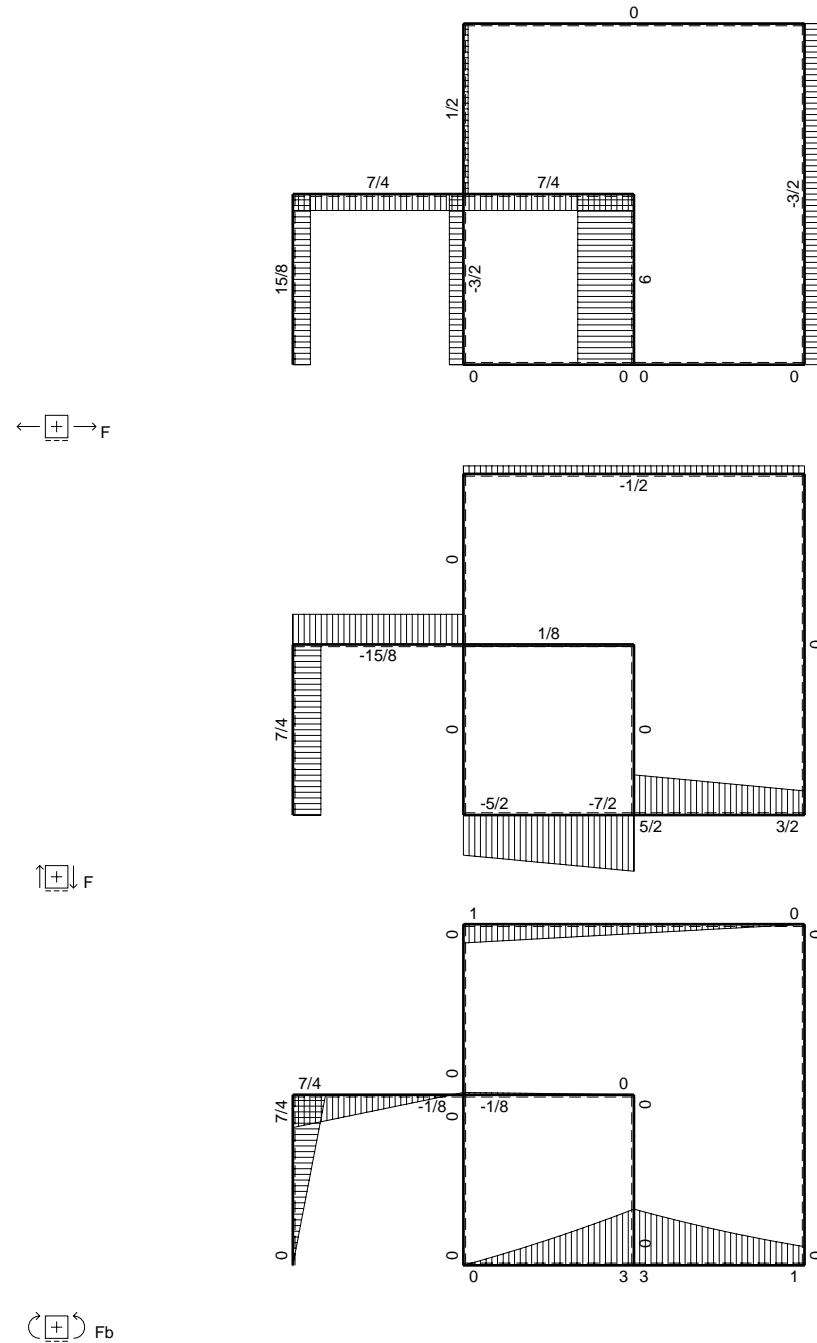
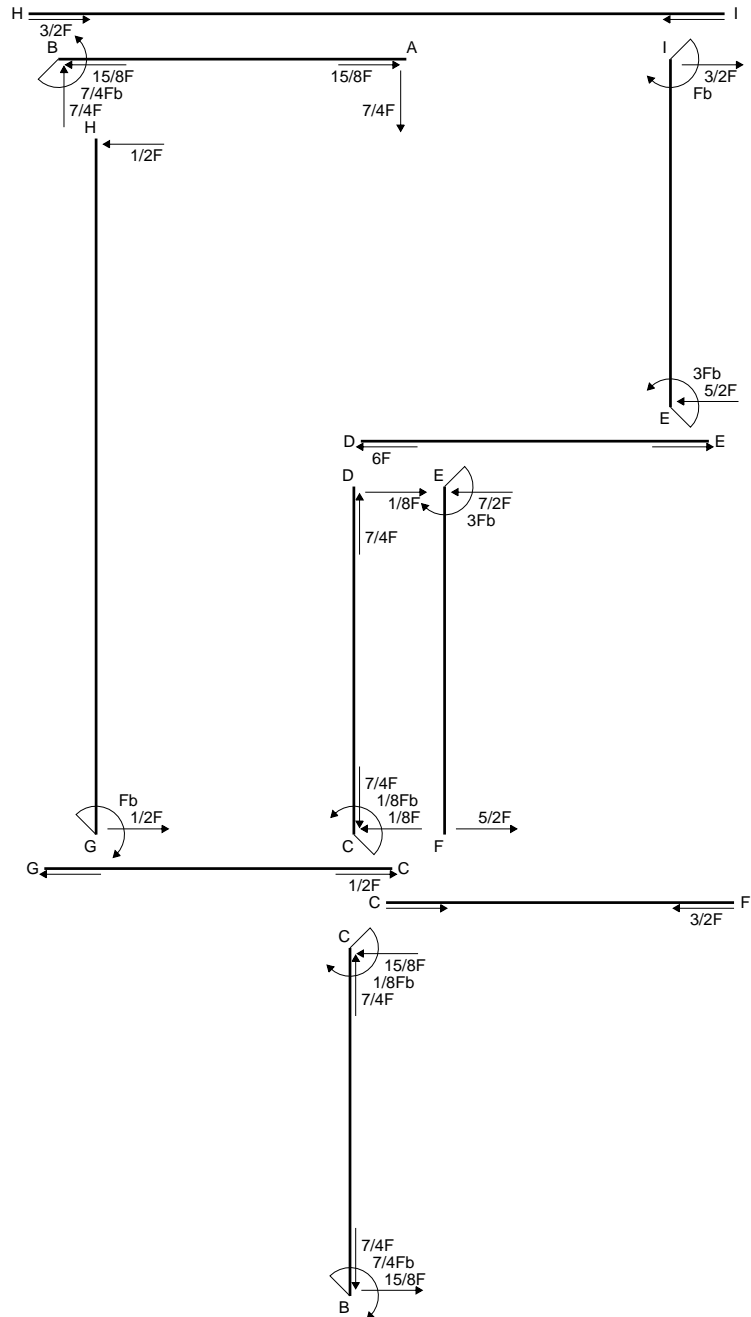
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

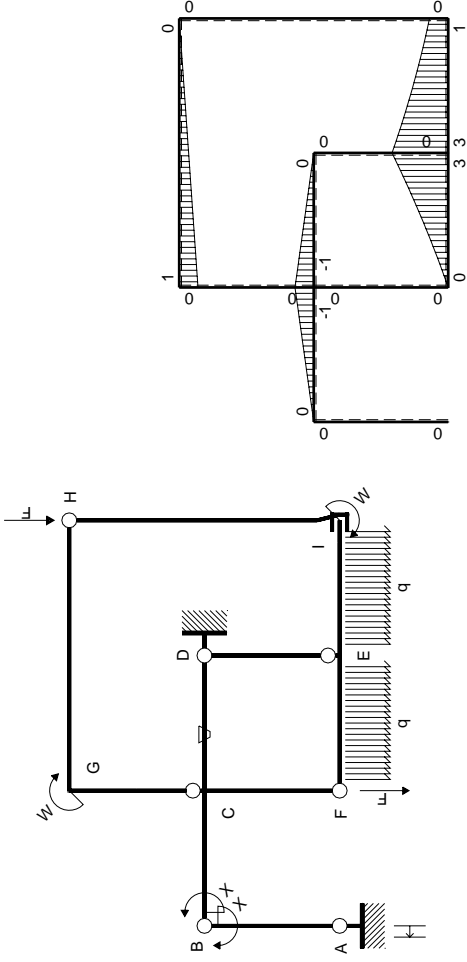
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

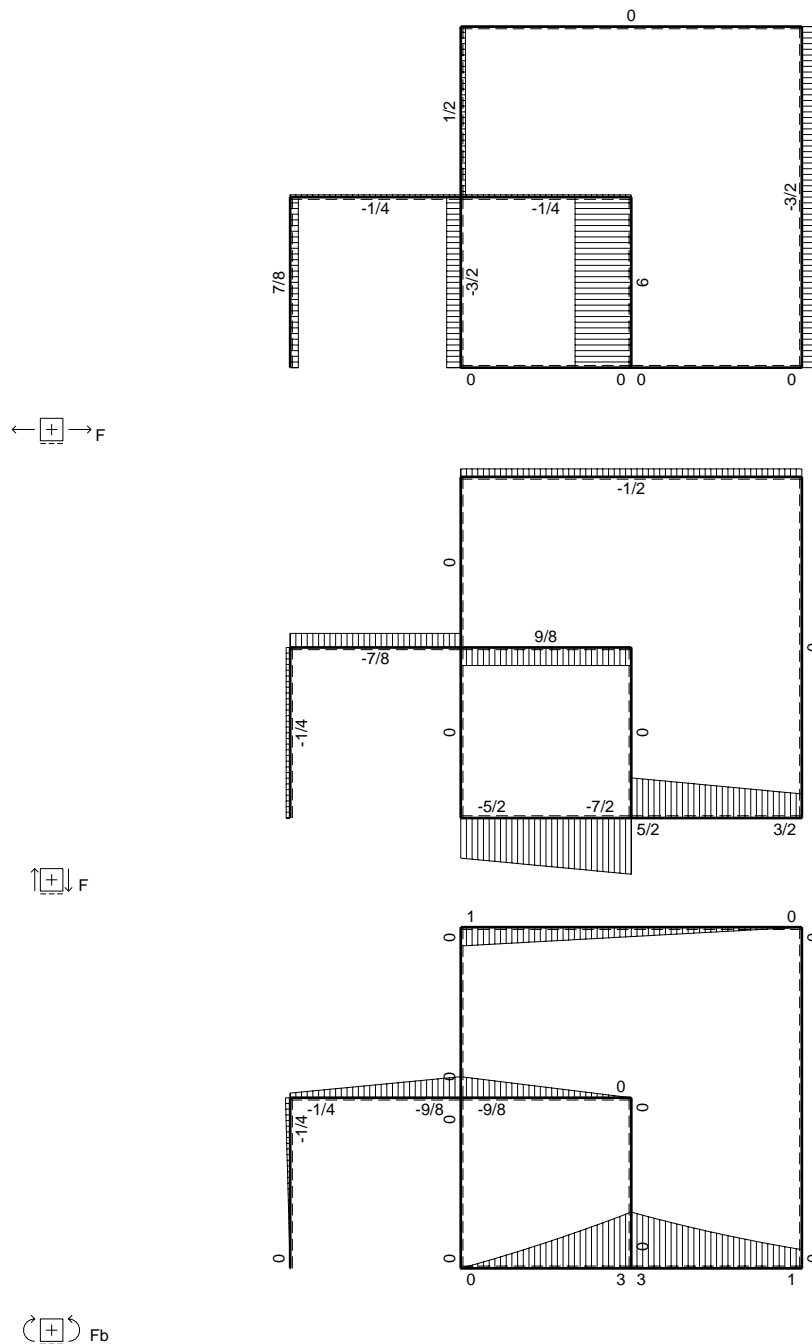
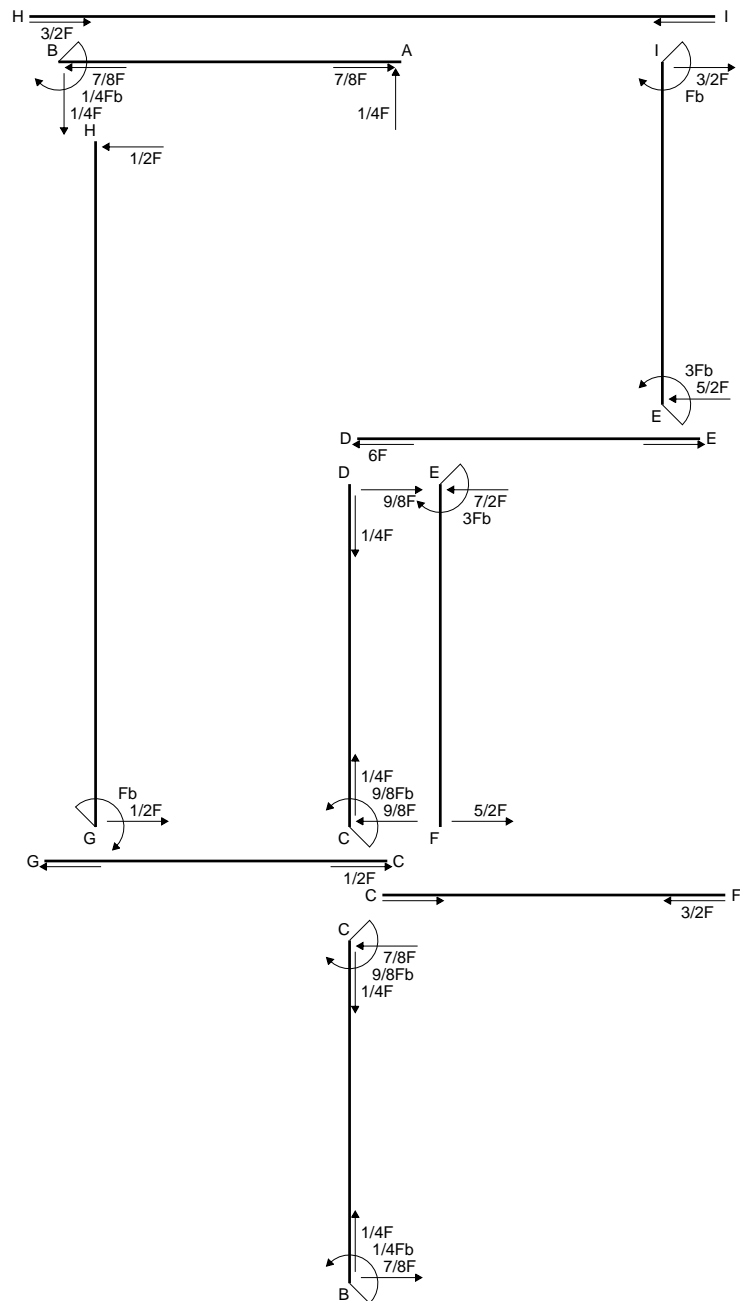
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

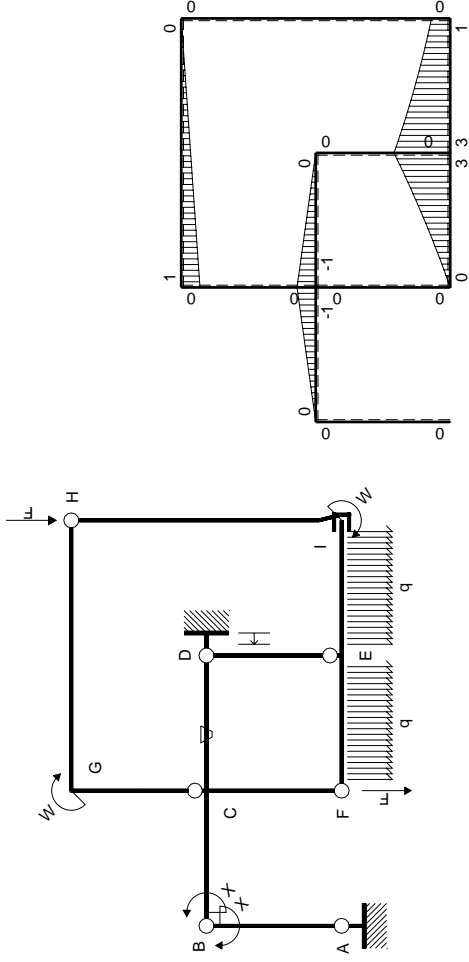
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-7/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
FE b	0	$-5/2Fx-1/2qx^2$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

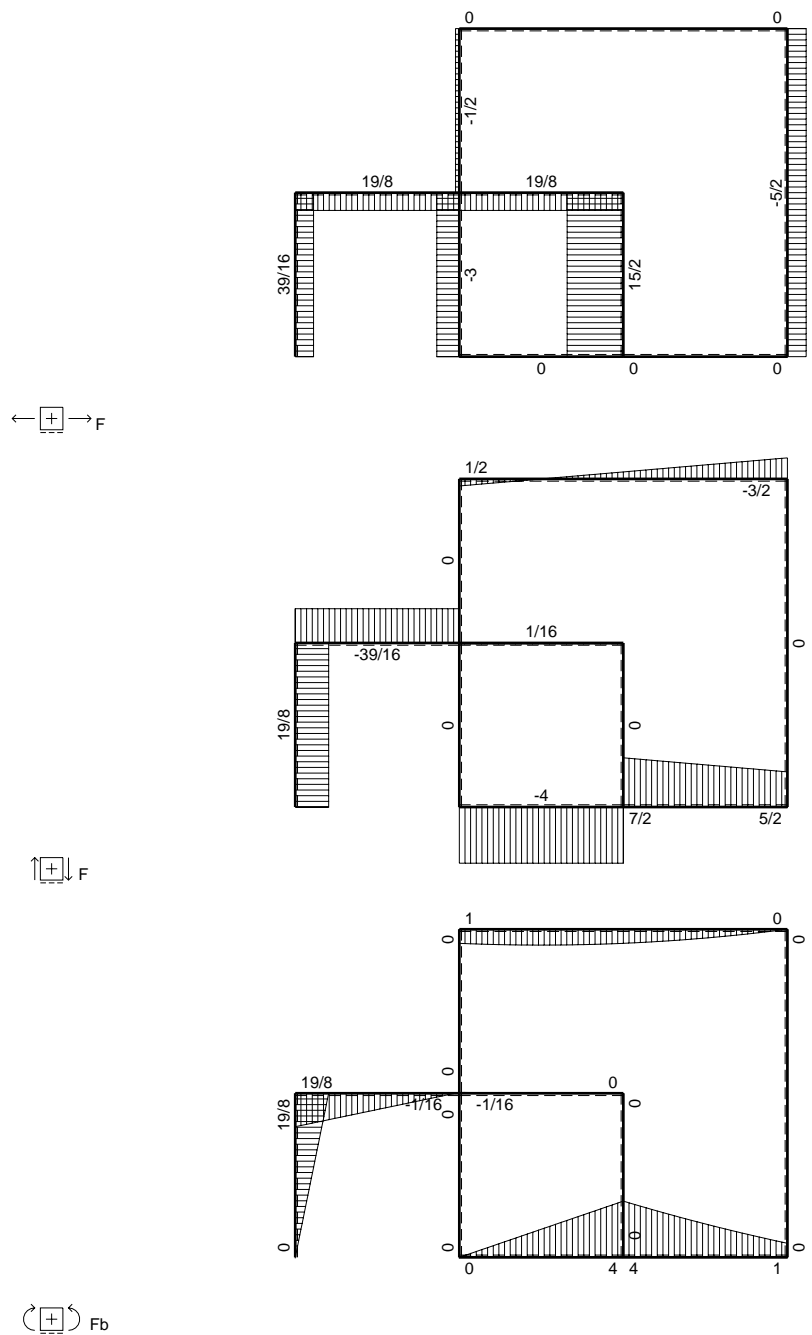
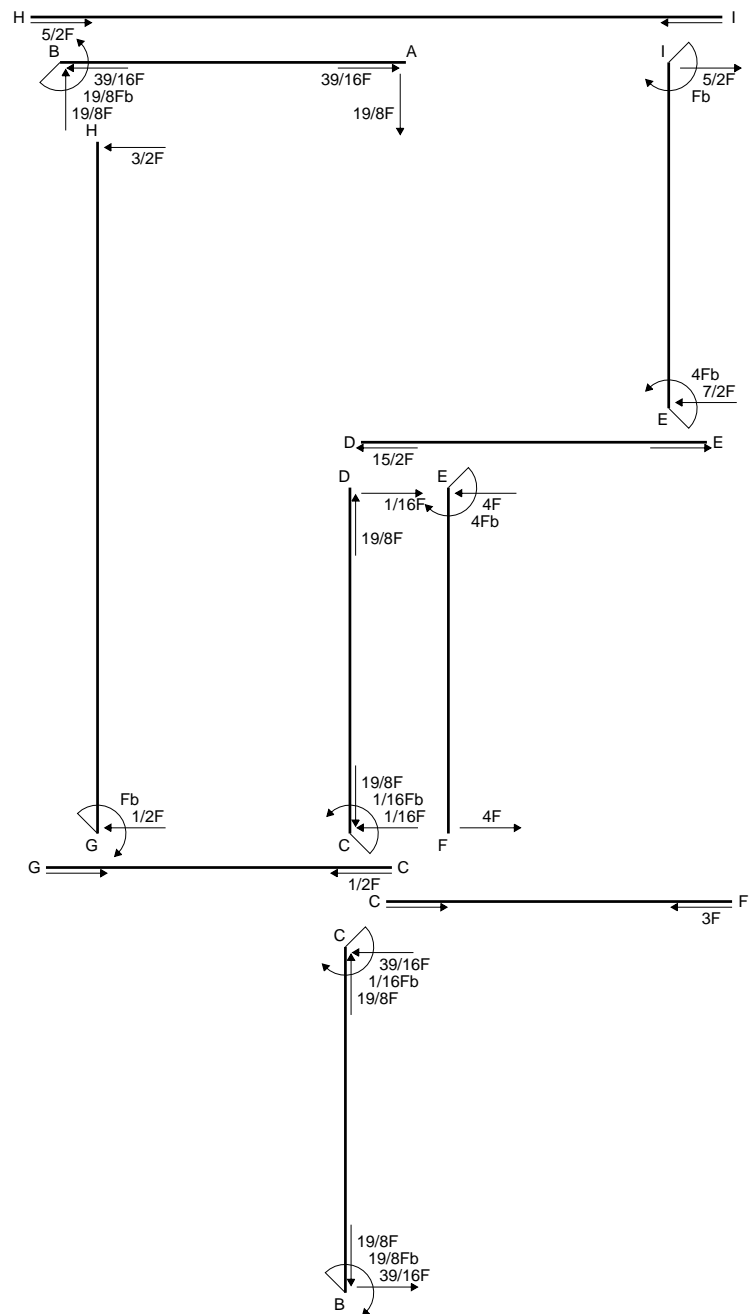
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

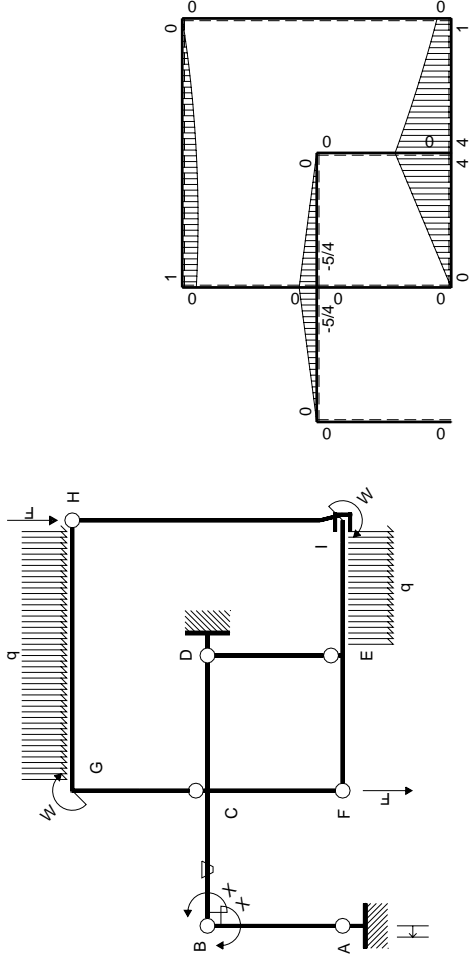
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+7/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$19/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-19/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

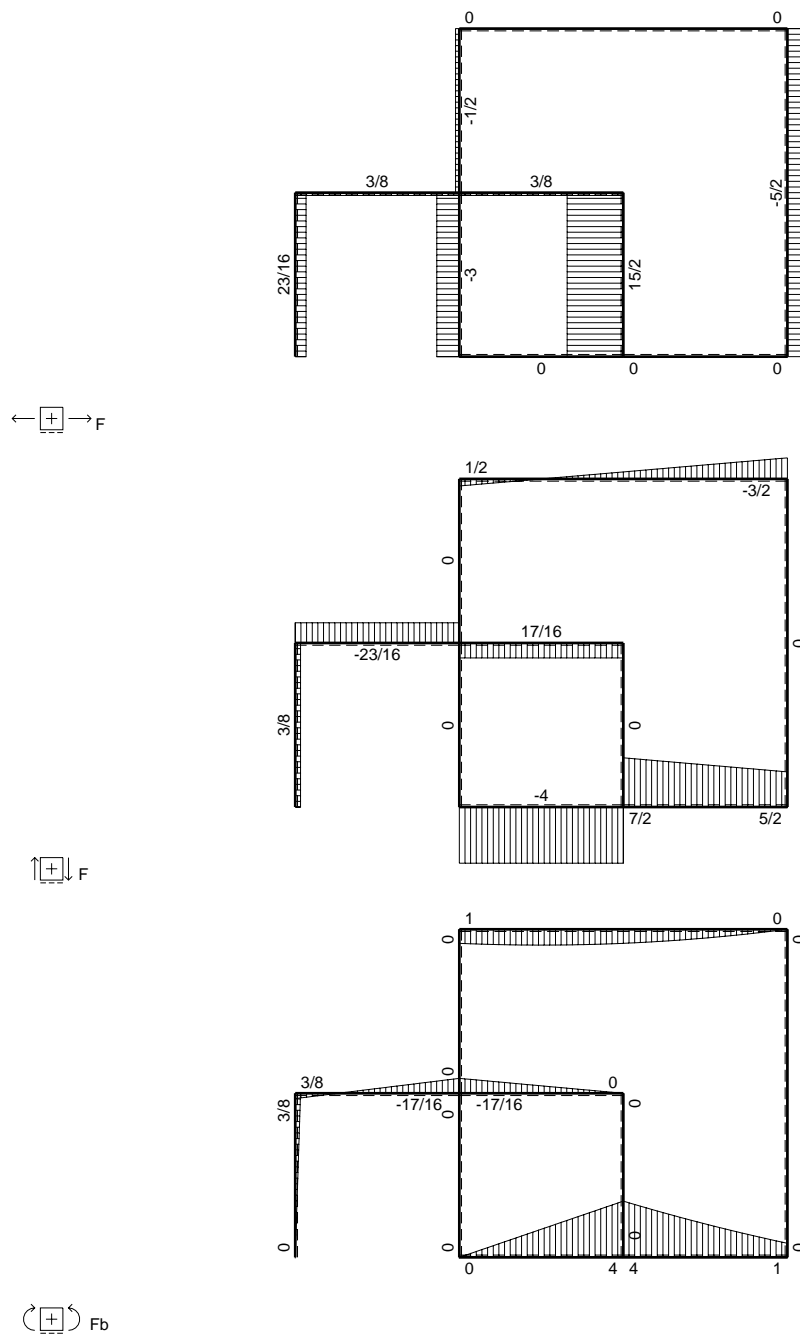
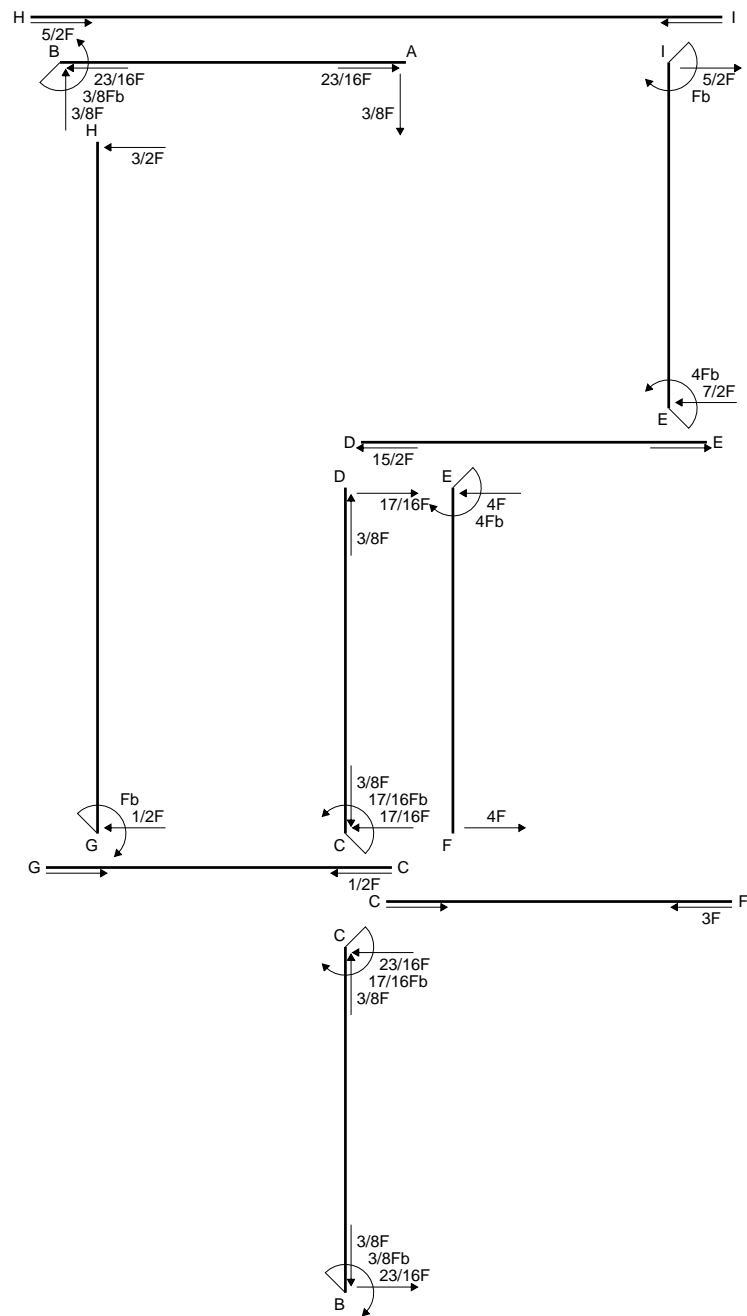
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

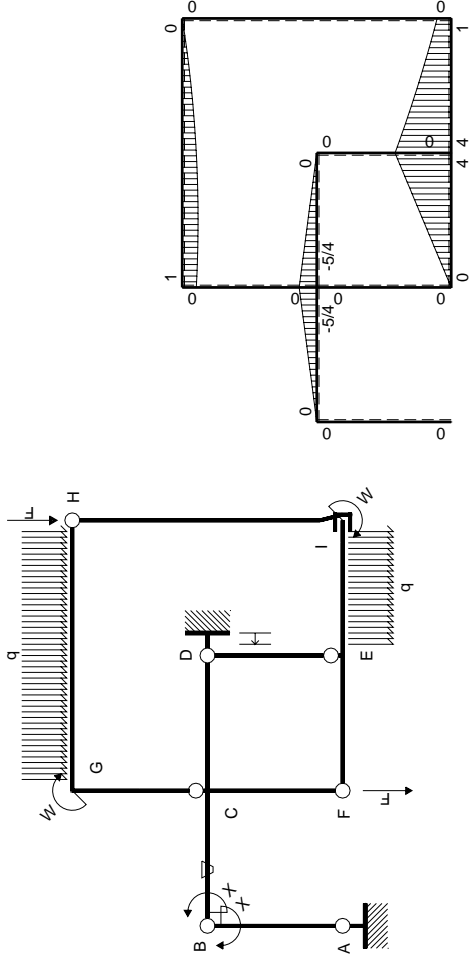
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	1/3Xb/EJ	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	$-Fb/EJ$	$5/4Fx-5/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(5/12+3/4)Fb^2/EJ$	7/12Xb/EJ	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	Fb/EJ	$5/8Fb-5/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	1/12Xb/EJ	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+7/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$3/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-3/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/24 b) Fb 1/EJ + (b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

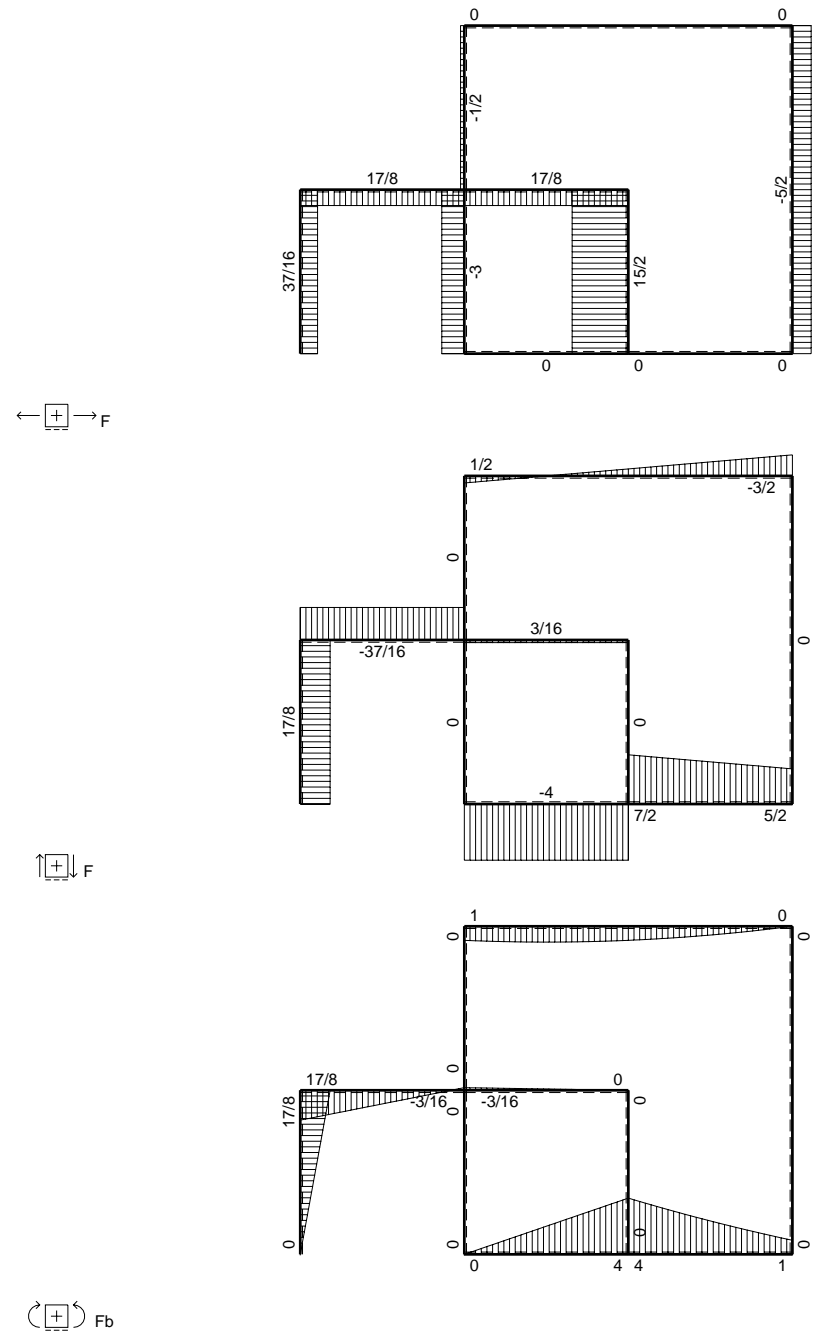
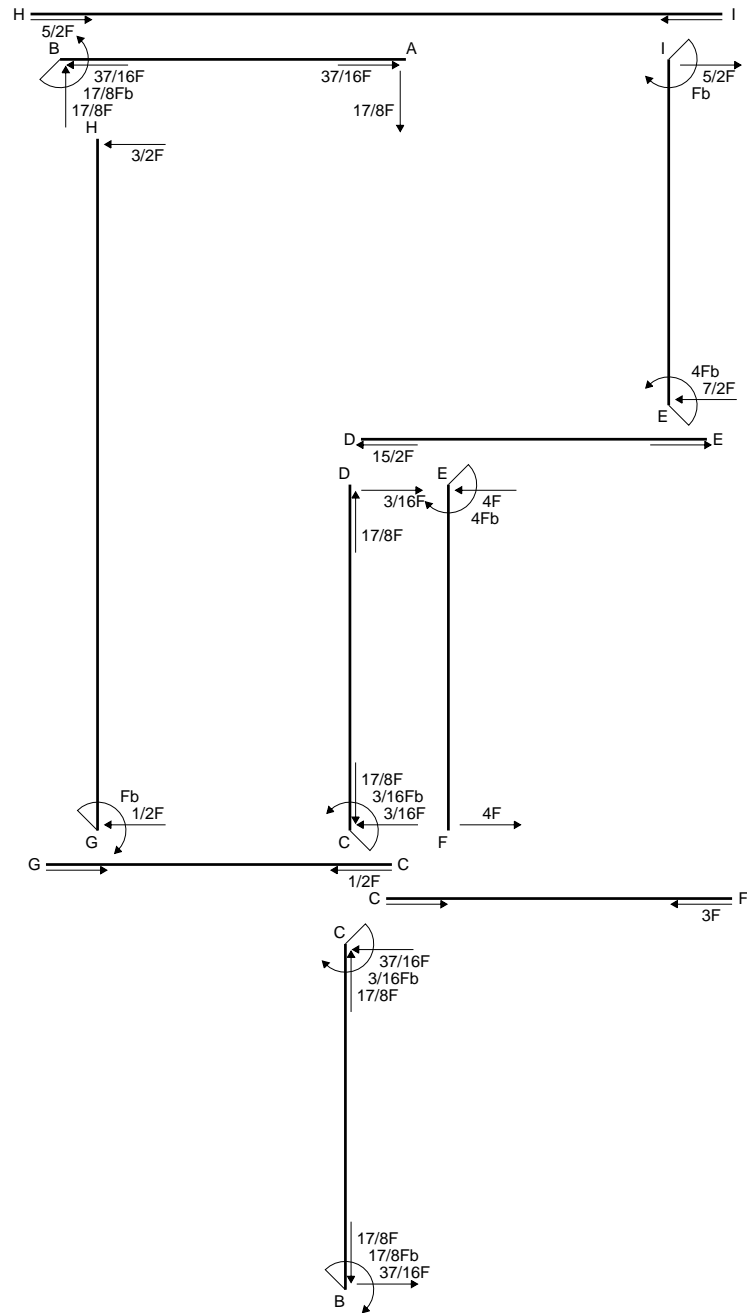
$$= (5/8 b - 5/24 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 7/6 Fb^2/EJ$$

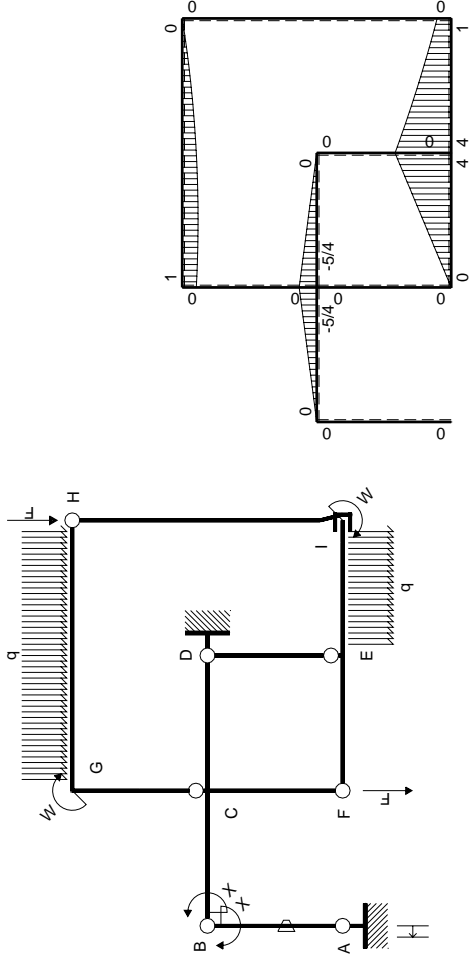
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

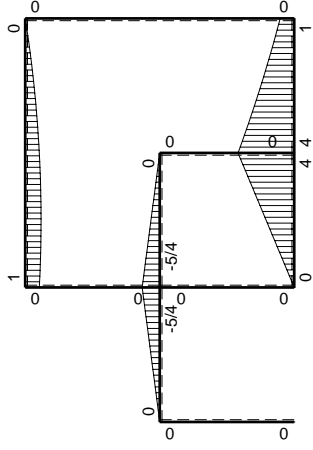
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+7/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$17/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-17/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

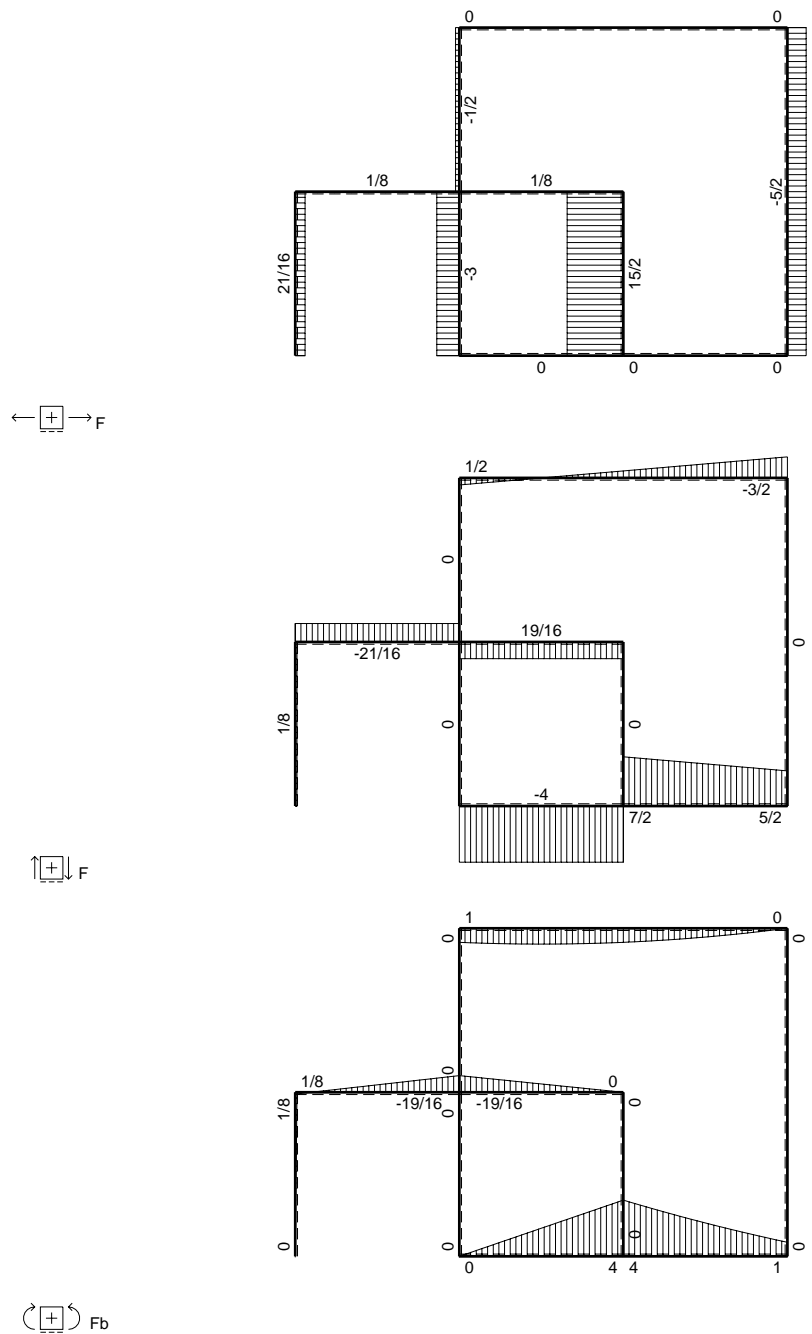
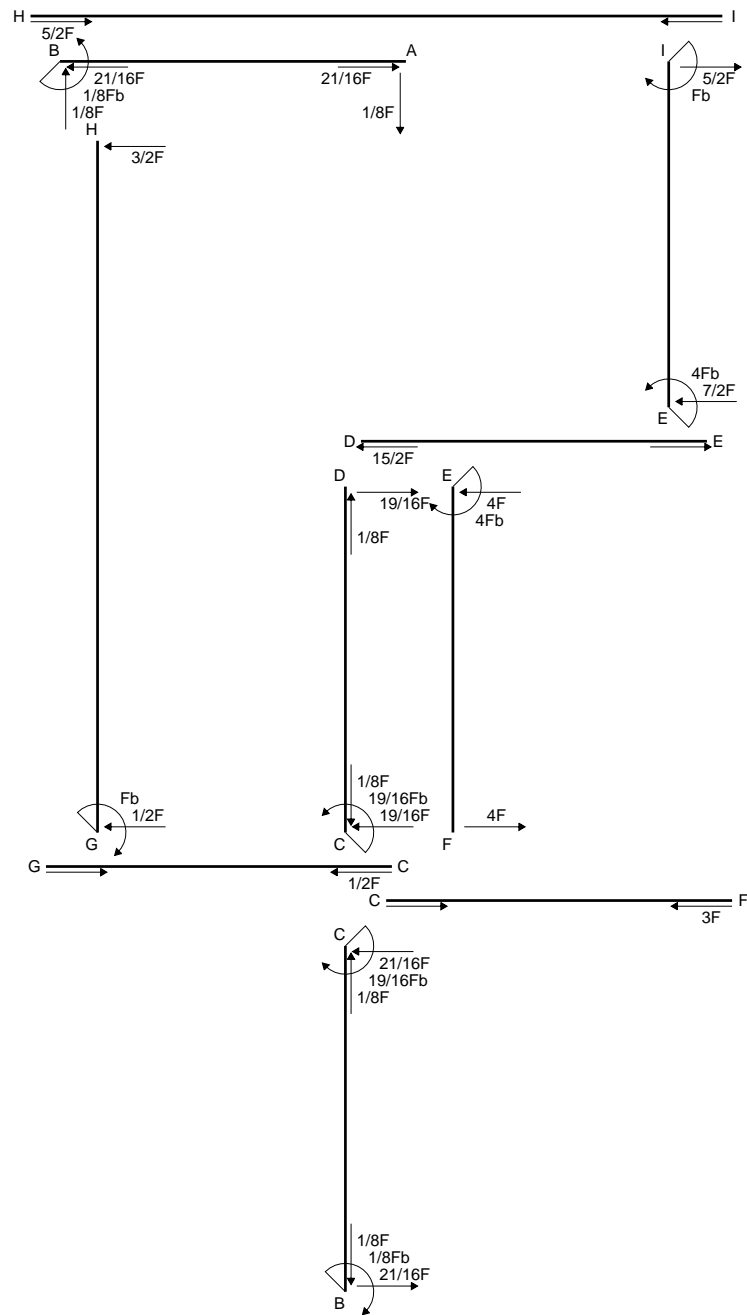
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

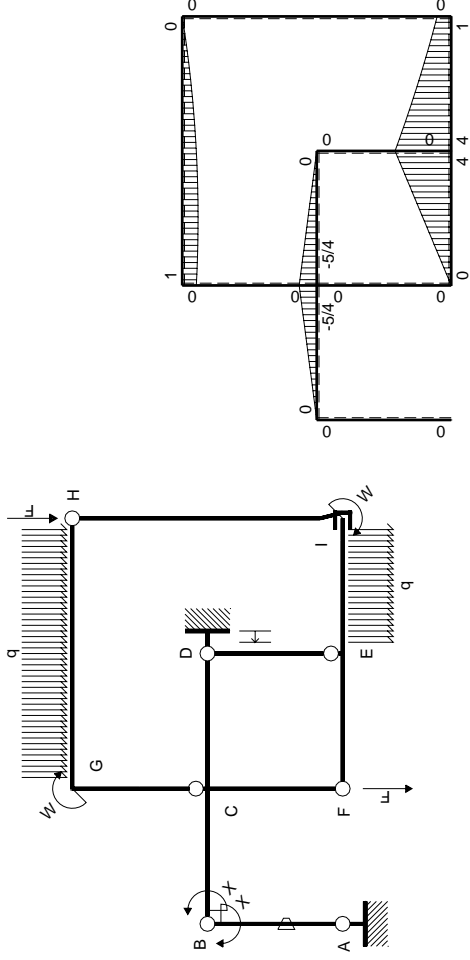
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

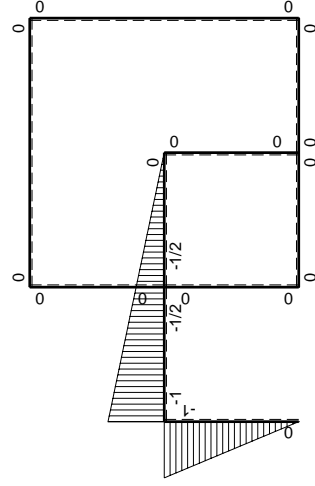
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	0	$5/8Fb-5/4Fx+5/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	0	$5/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+7/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

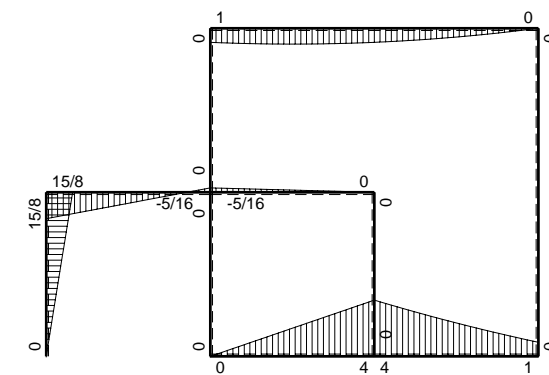
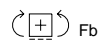
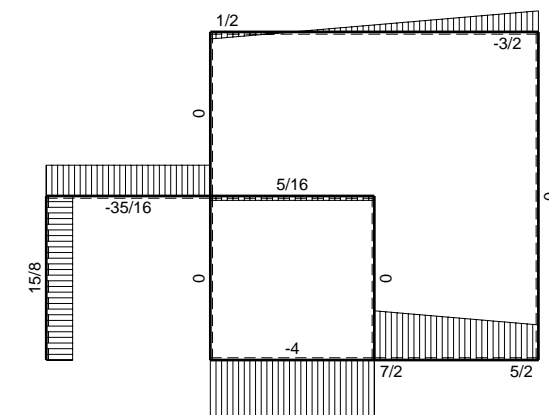
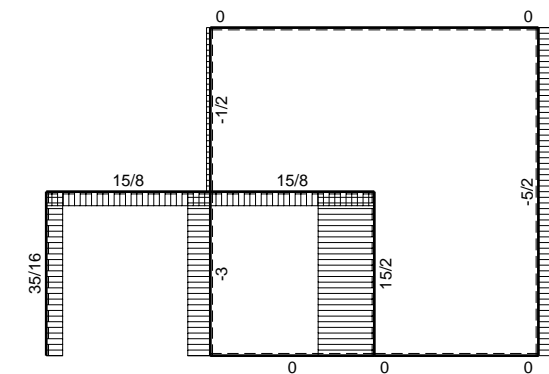
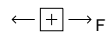
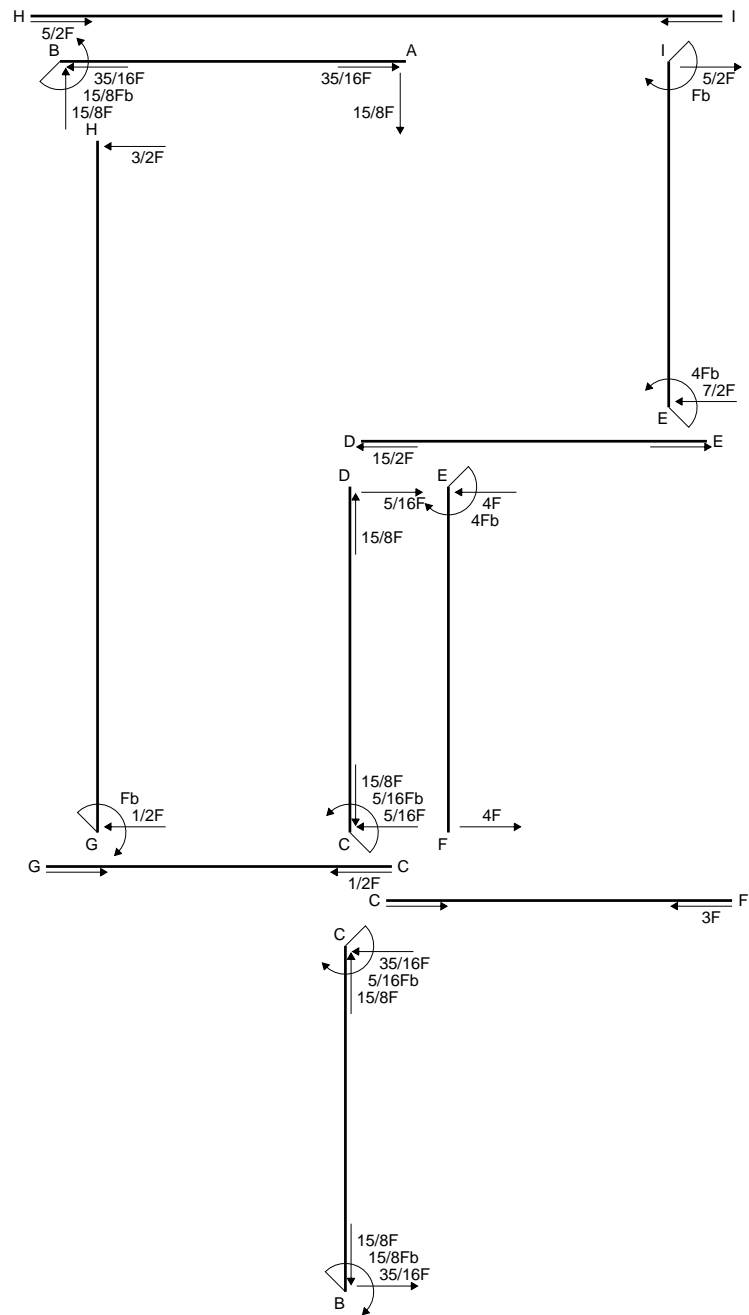
$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

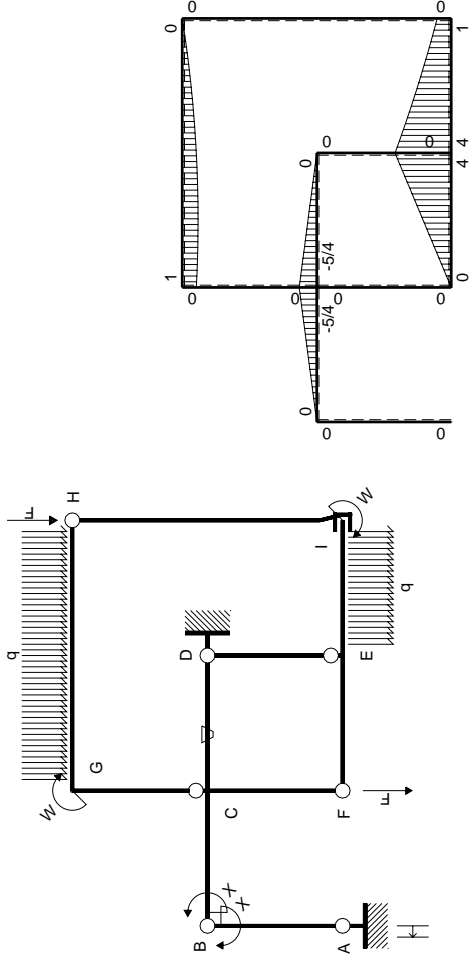
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx = [5/24 x^3/b^2]_0^b Fb 1/EJ$$

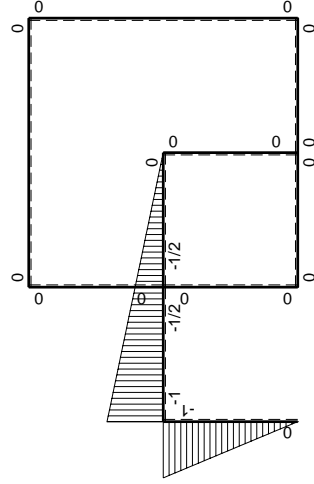
$$= (5/24 b) Fb 1/EJ = 5/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0
FE b	0	$-4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-4Fb+7/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

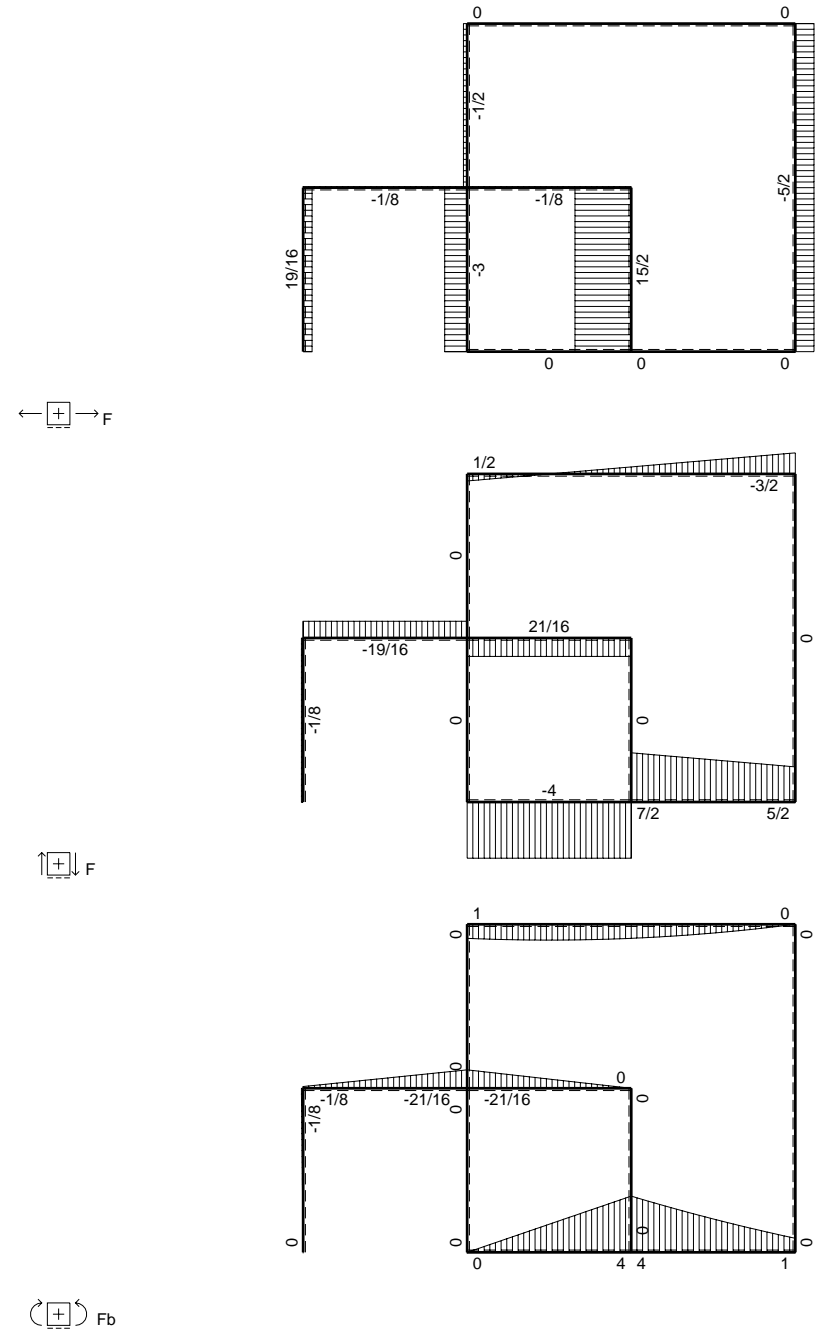
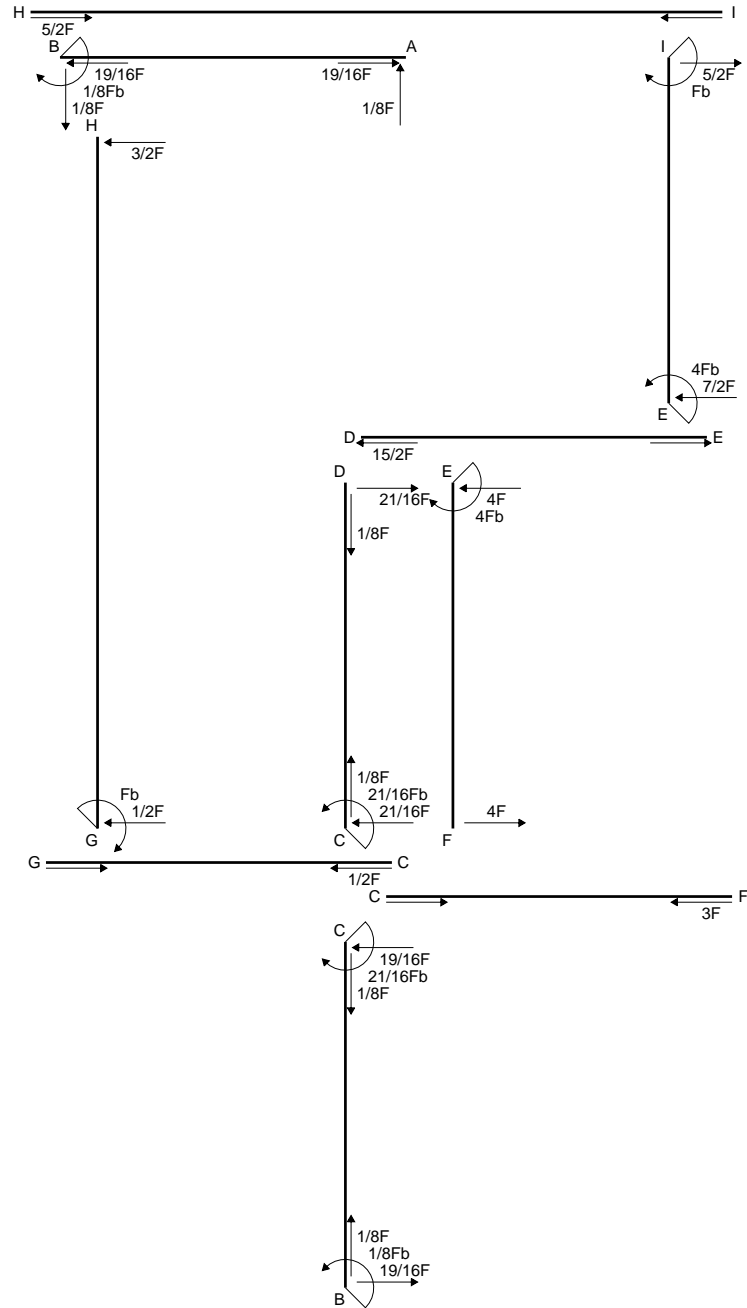
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

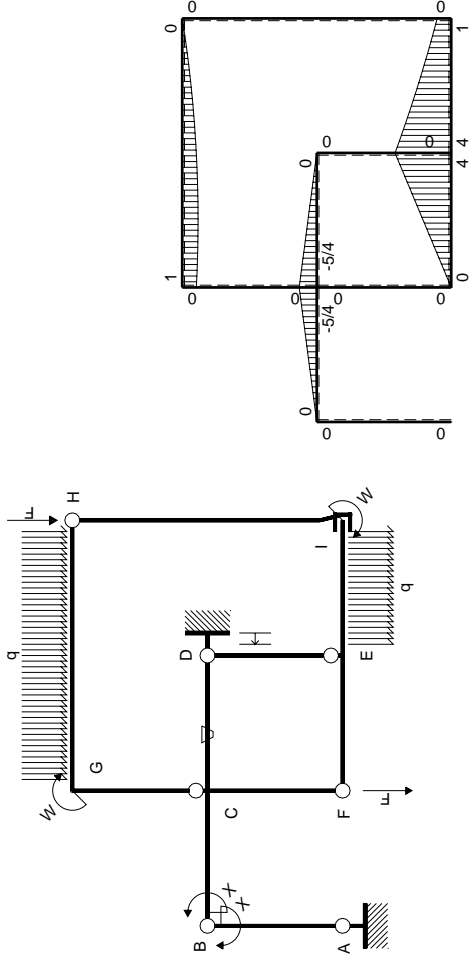
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

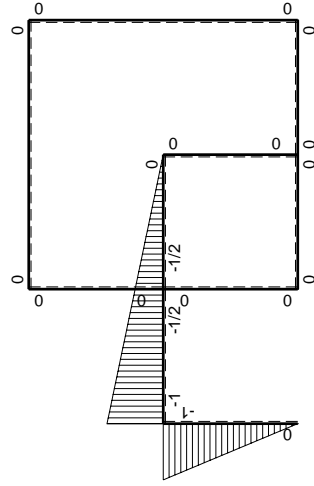
$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-5/4Fx$	0	$5/4Fx-5/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(5/12+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$5/4Fb-5/4Fx$	0	$5/8Fb-5/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-5/4Fb+5/4Fx$	$-Fb/EJ$	$5/8Fb-5/4Fx+5/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(5/24+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$5/4Fx$	Fb/EJ	$5/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$4Fb-4Fx$	0	0	0	0	0+0	0	
FE b	0	$-4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-4Fb+7/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (5/4 x/b - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x^2/b - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (5/8 - 5/8 x^2/b^2) Fb 1/EJ dx = [5/8 x - 5/24 x^3/b^2]_0^b Fb 1/EJ$$

$$= (5/8 b - 5/24 b) Fb 1/EJ = 5/12 Fb^2/EJ$$

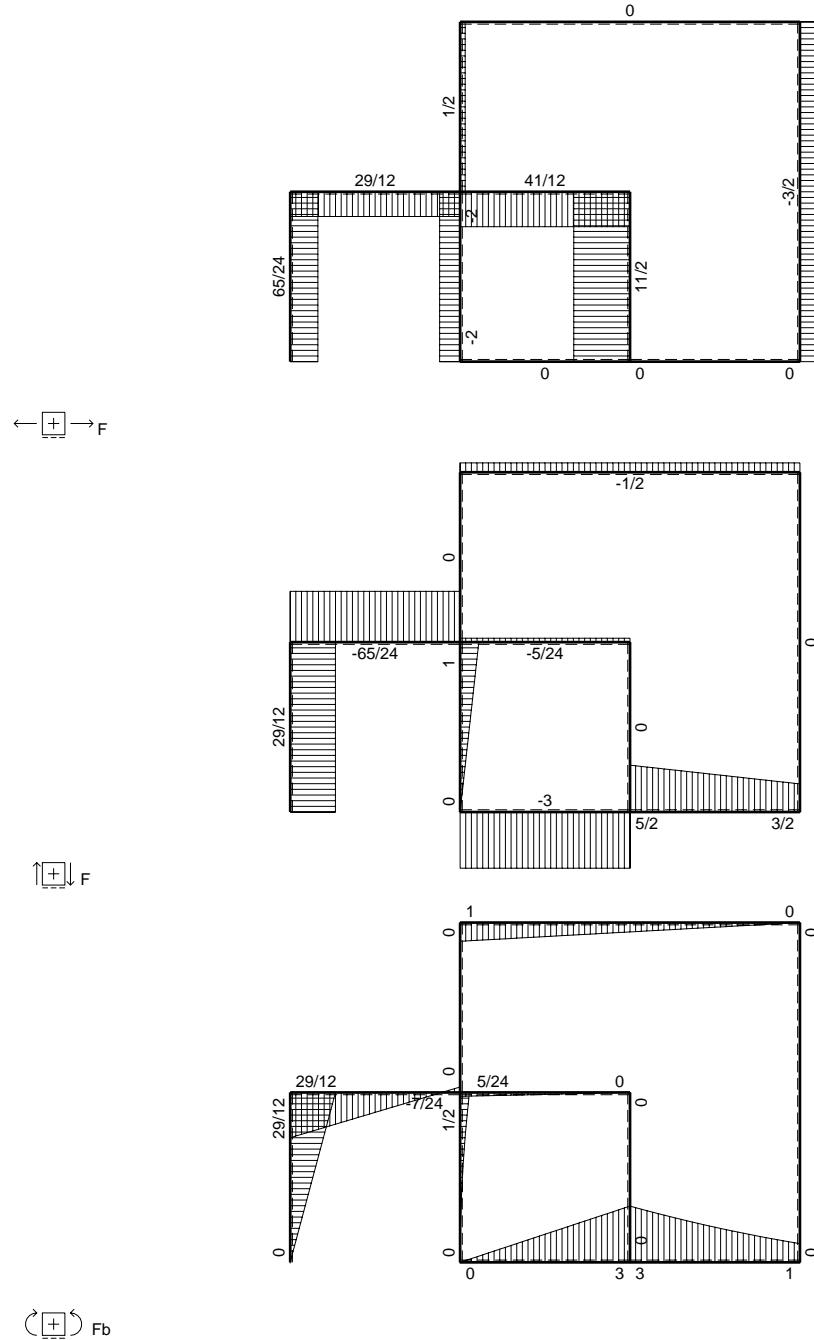
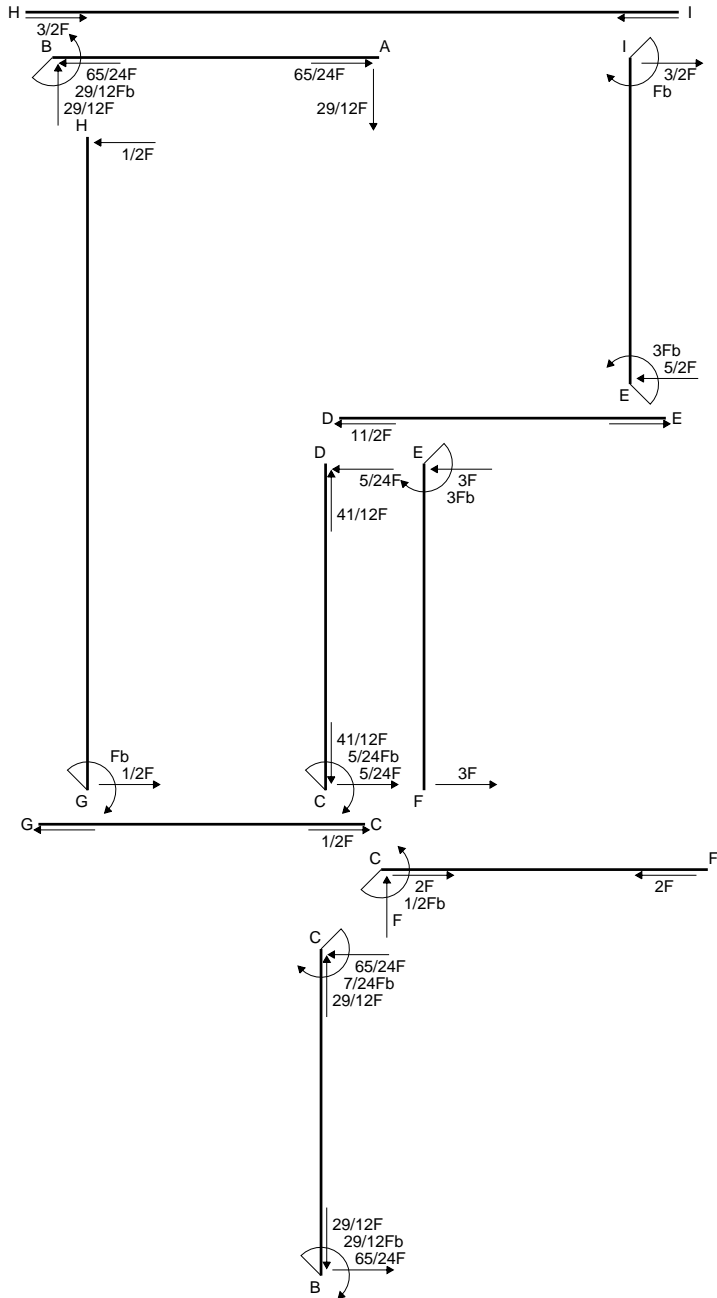
$$L_{CD}^{xo} = \int_0^b (5/8 - 5/4 x/b + 5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

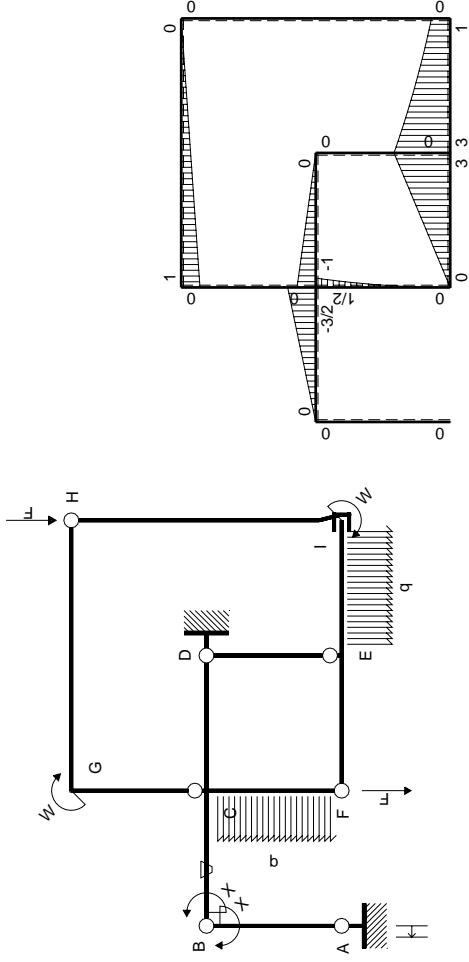
$$= [5/8 x - 5/8 x^2/b + 5/24 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (5/8 b - 5/8 b + 5/24 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 11/24 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (5/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [5/24 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (5/24 b) Fb 1/EJ + (-1/4 b) \theta = 11/24 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	$-Fb/EJ$	$3/2Fx-3/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/2+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	Fb/EJ	$3/4Fb-3/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$29/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-29/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/4 b - 1/4 b) Fb 1/EJ + (b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

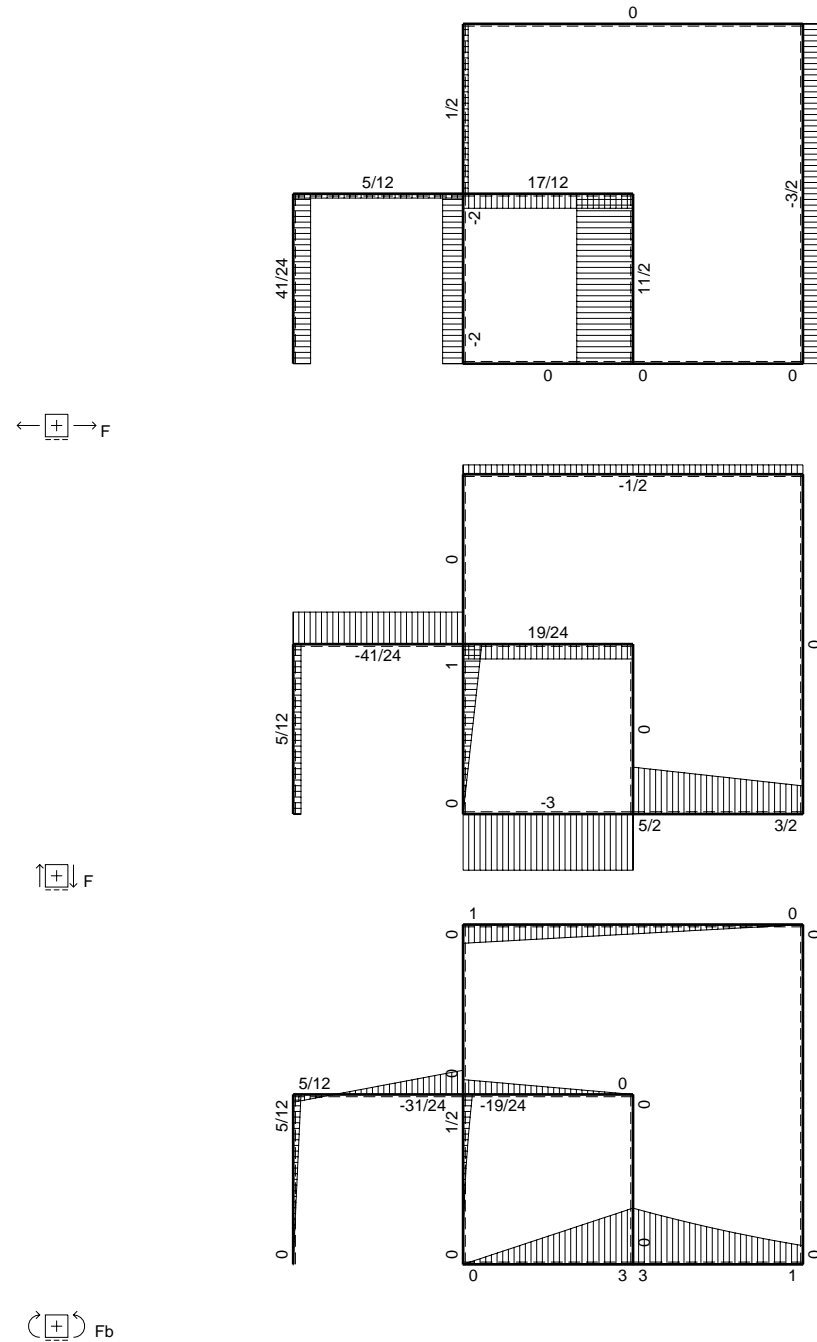
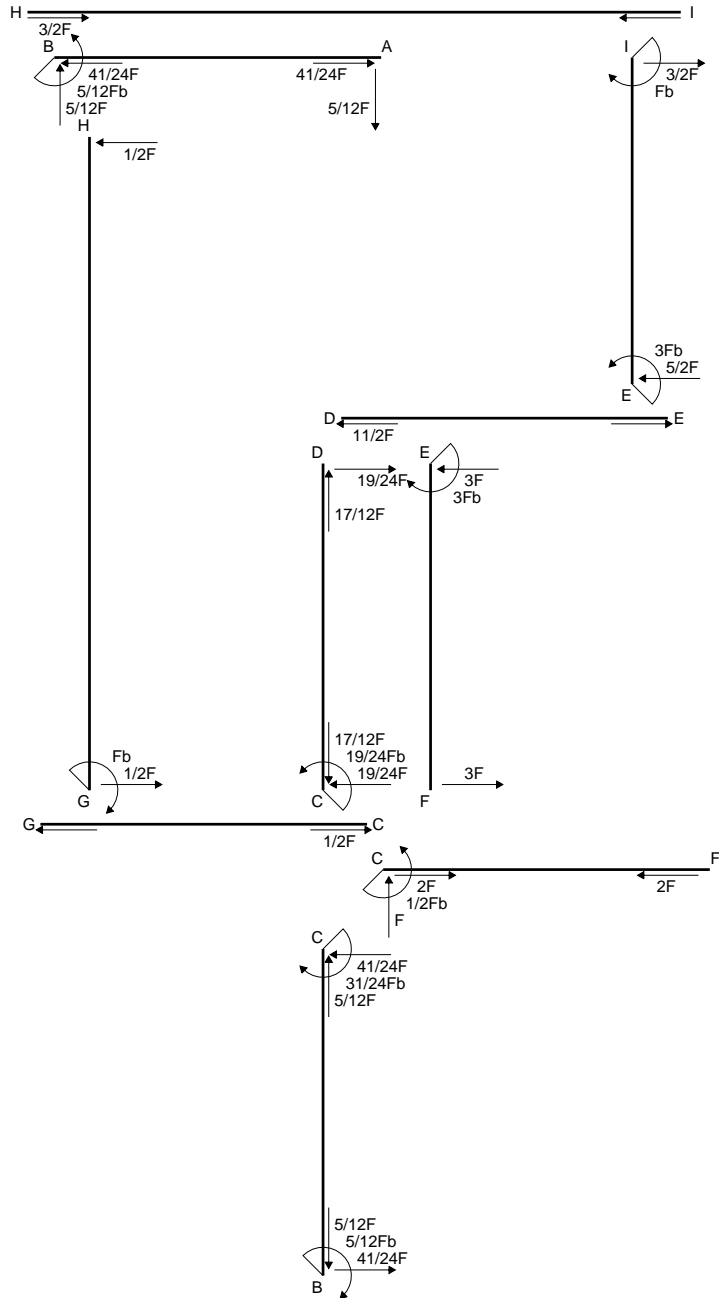
$$= (3/4 b - 1/4 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

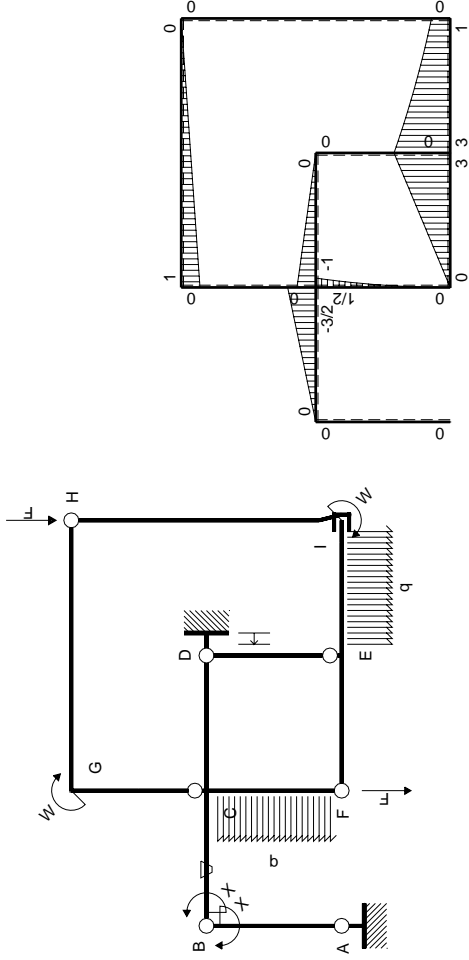
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

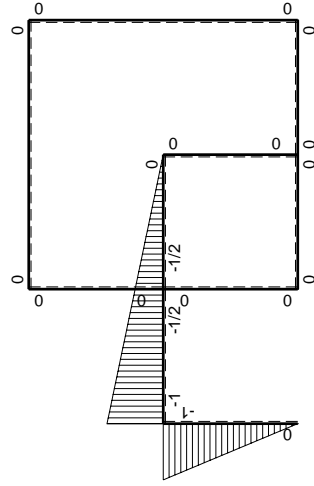
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/2Fx$	$-Fb/EJ$	$3/2Fx-3/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/2+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	Fb/EJ	$3/4Fb-3/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$5/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-5/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/4 b - 1/4 b) Fb 1/EJ + (b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

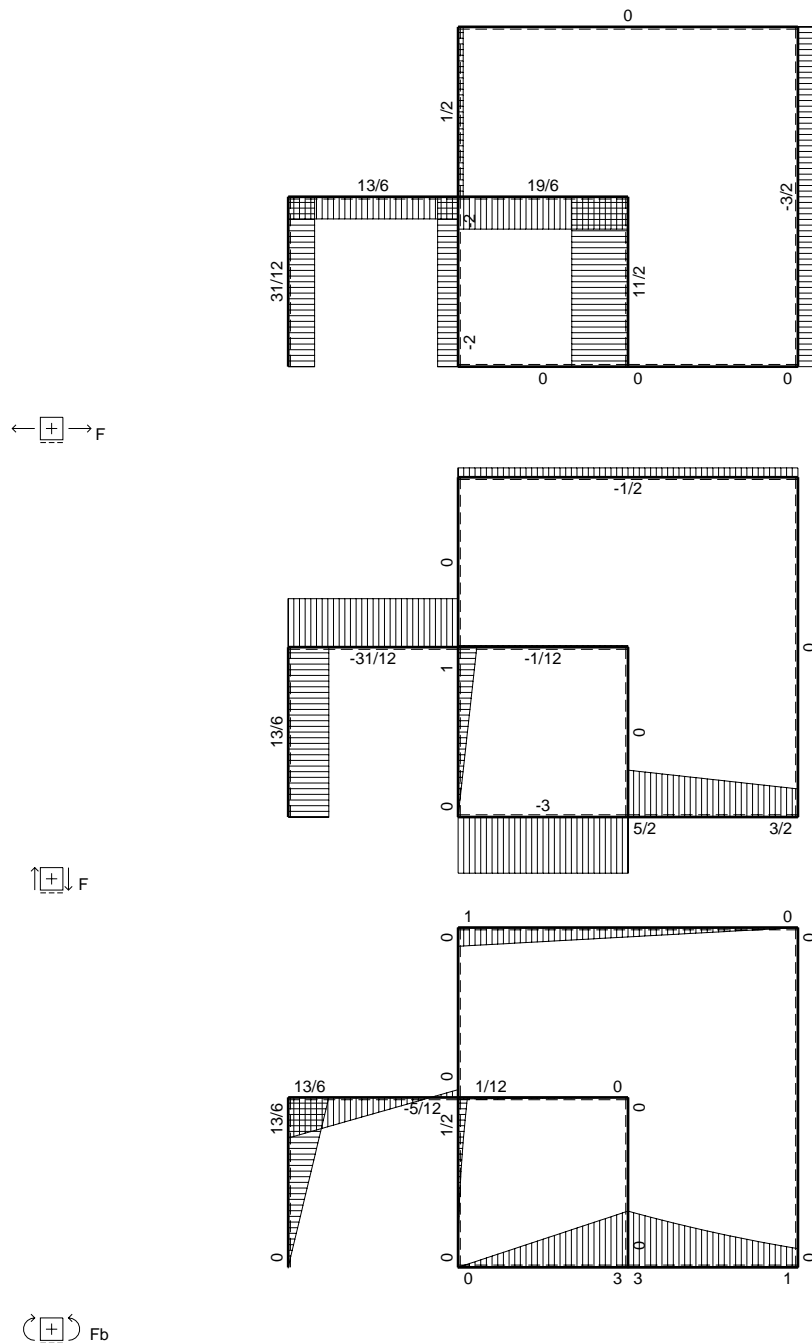
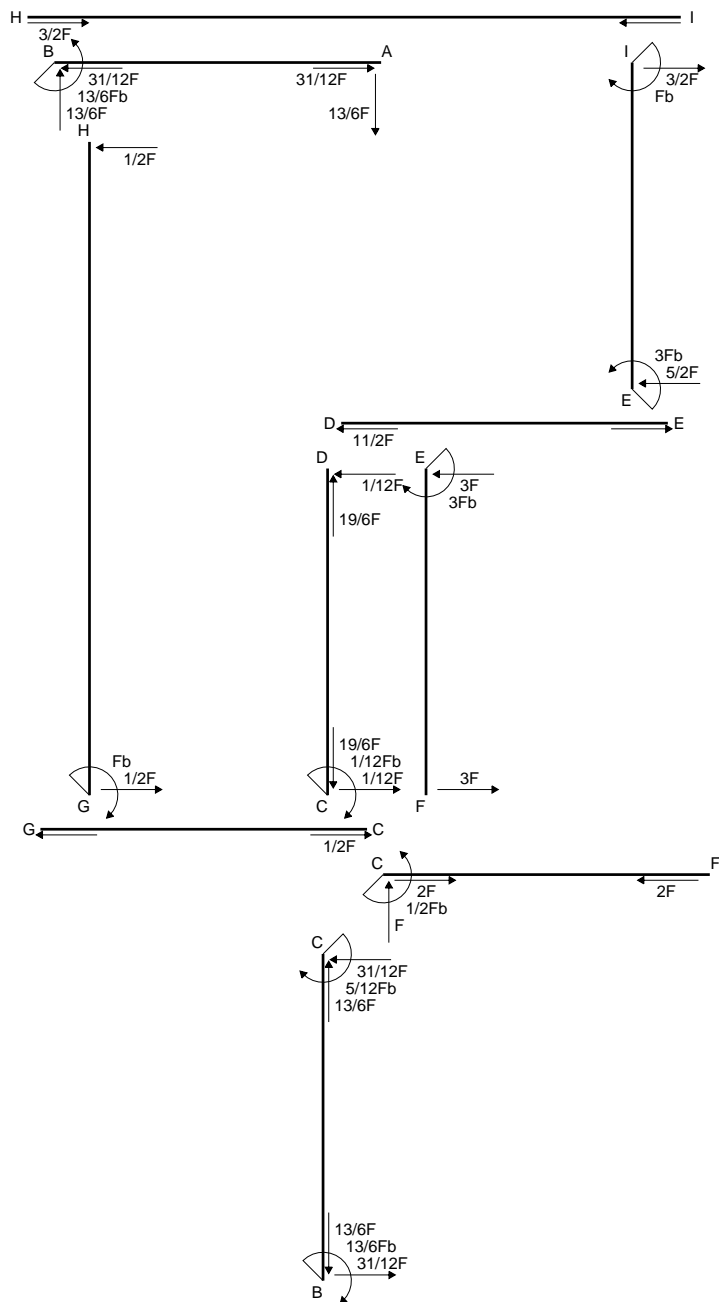
$$= (3/4 b - 1/4 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

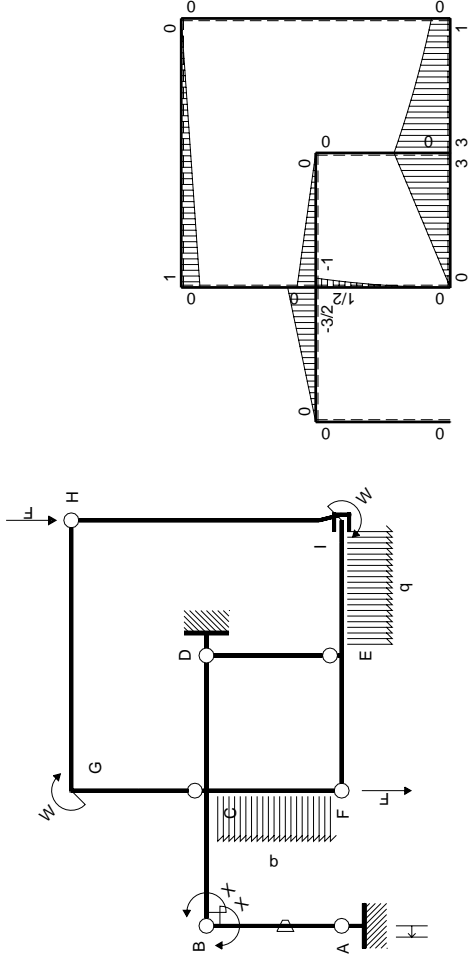
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

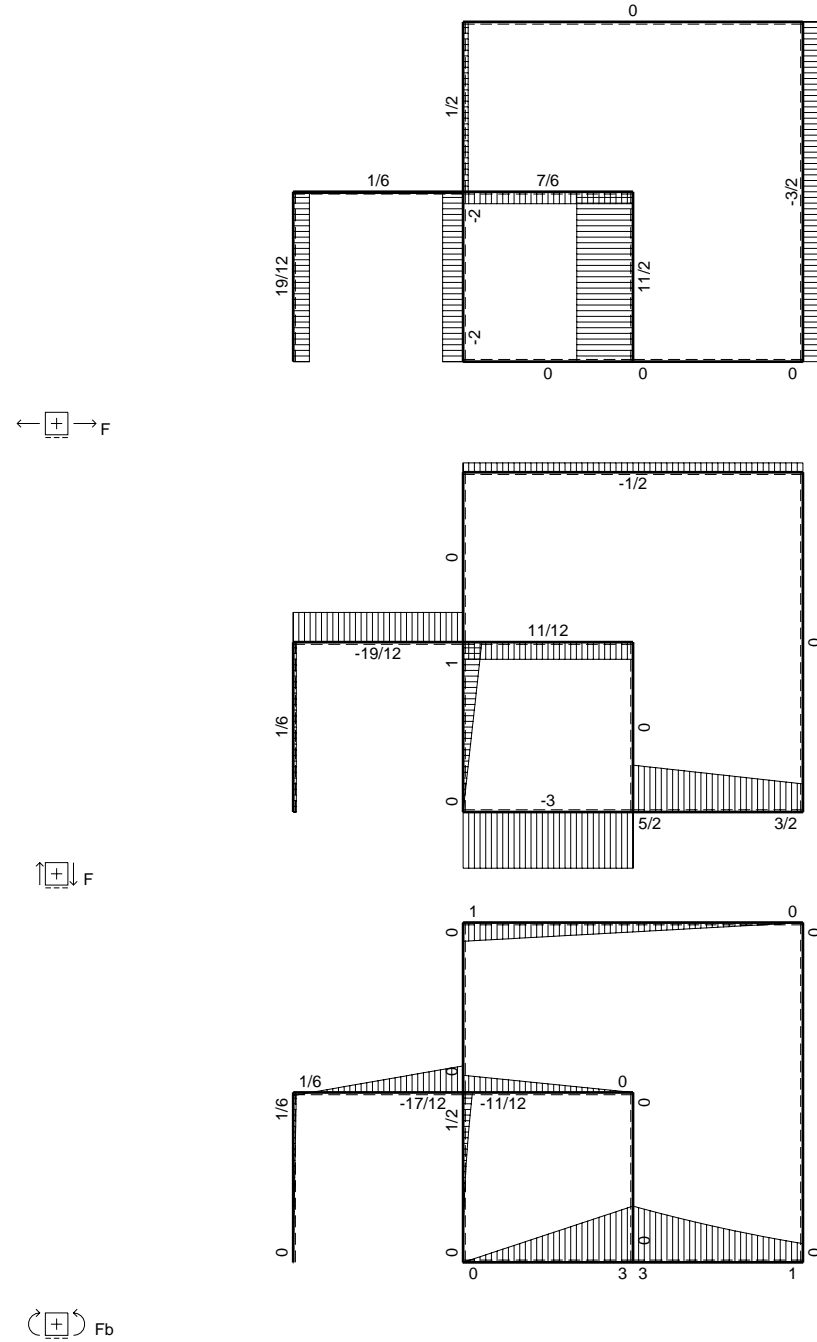
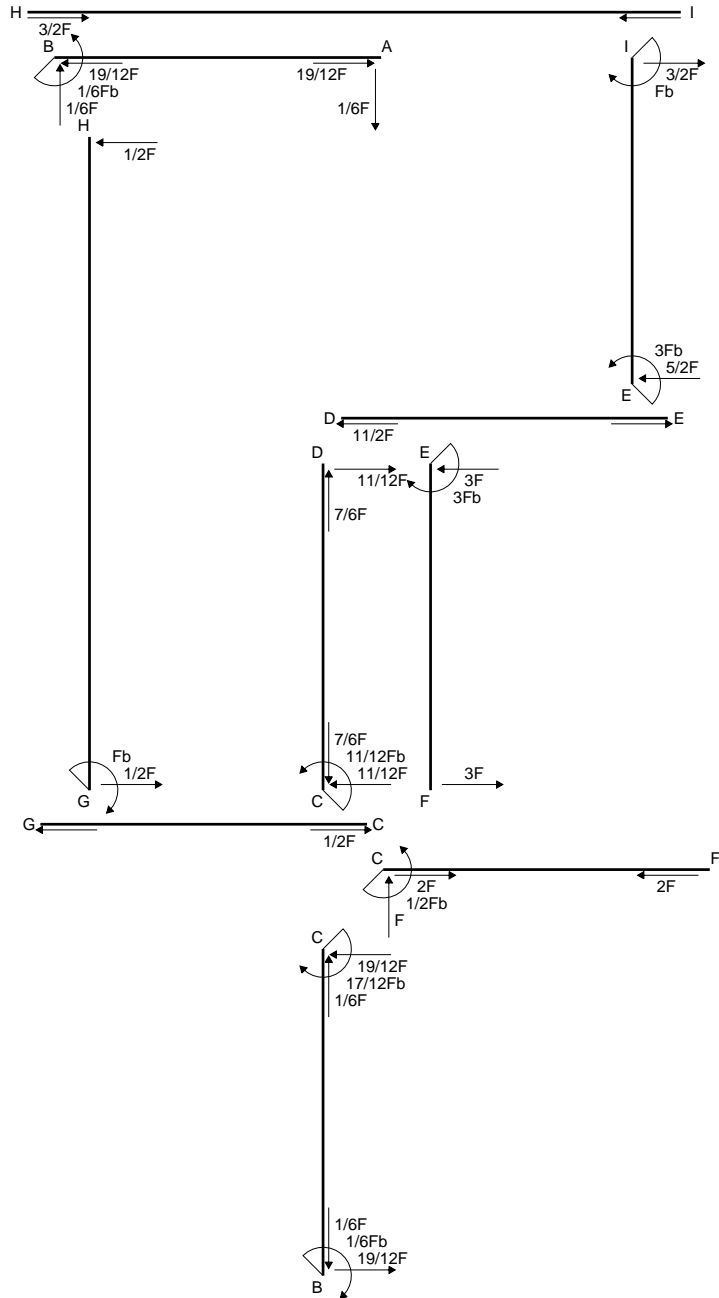
$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

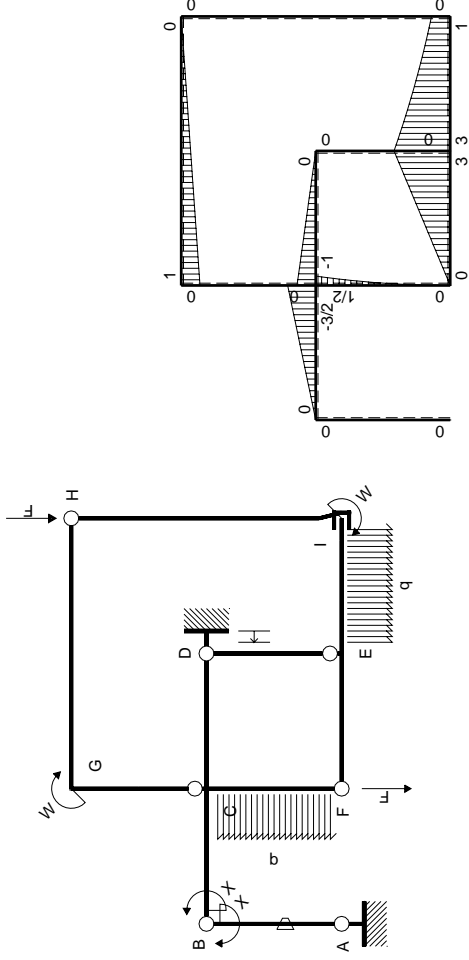
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

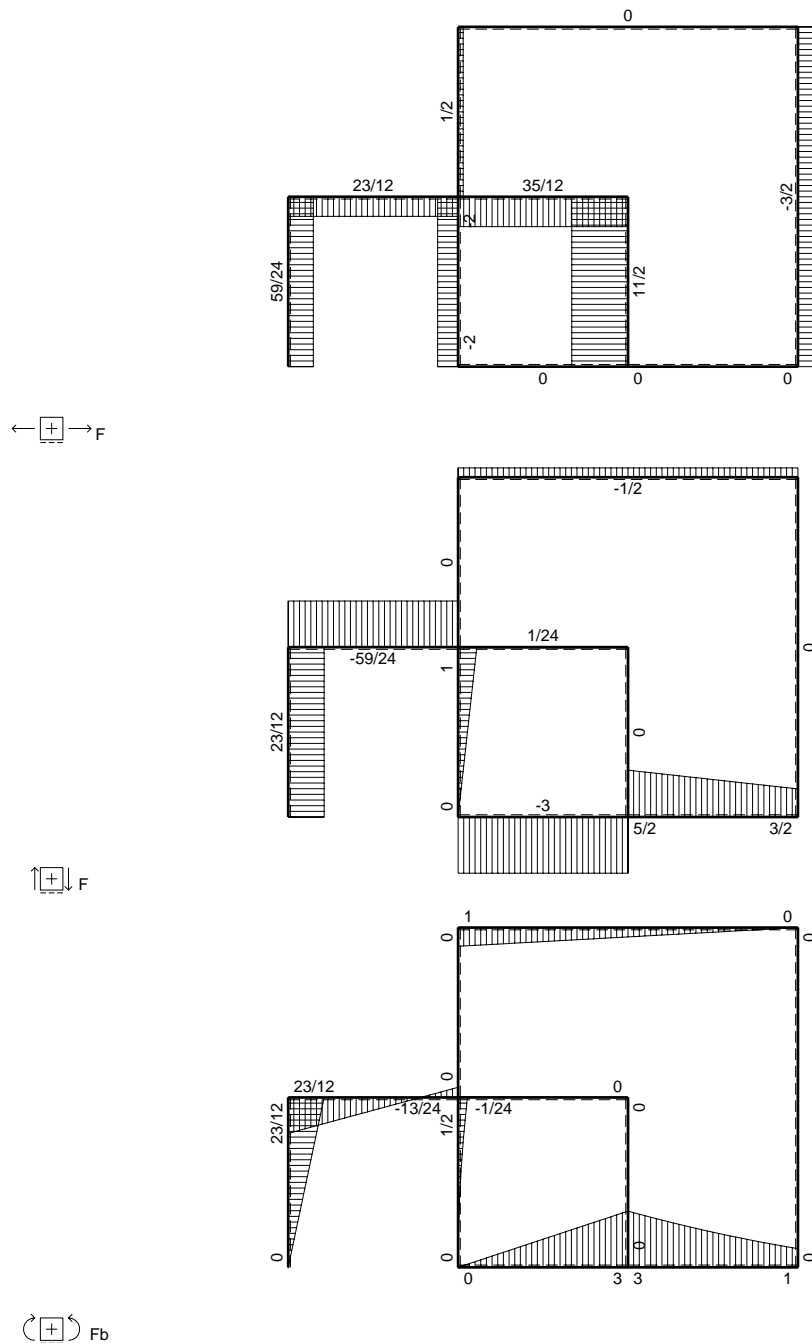
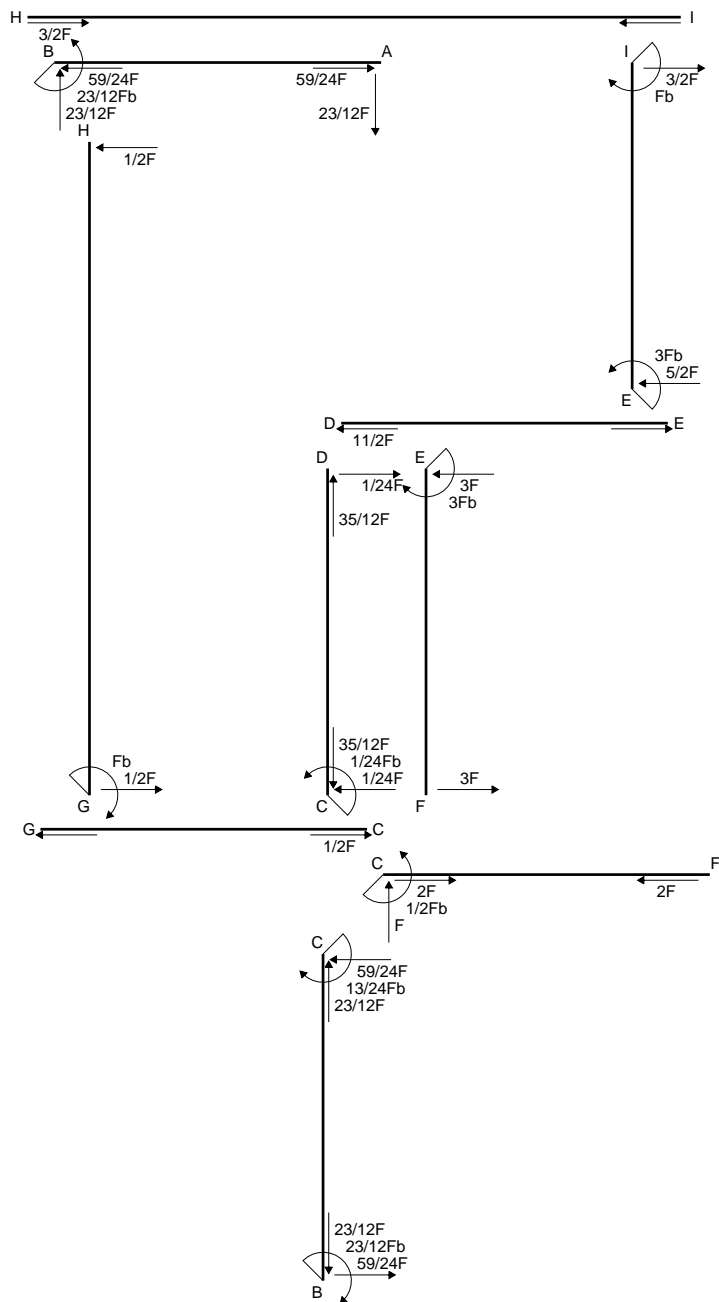
$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

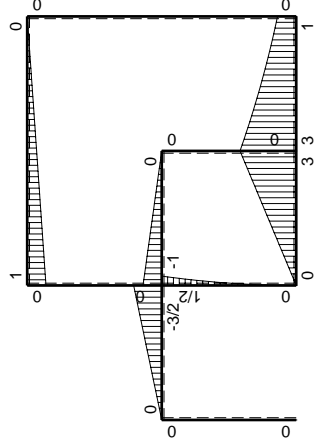
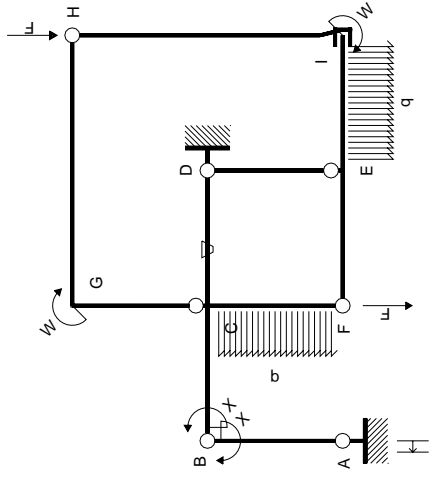
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

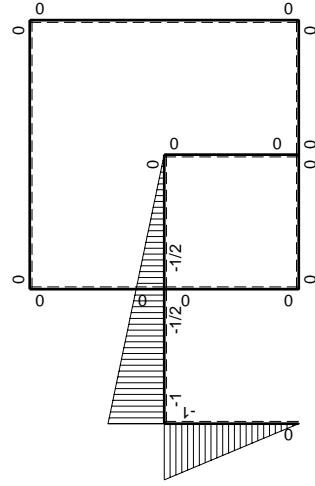


\oplus \ominus F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

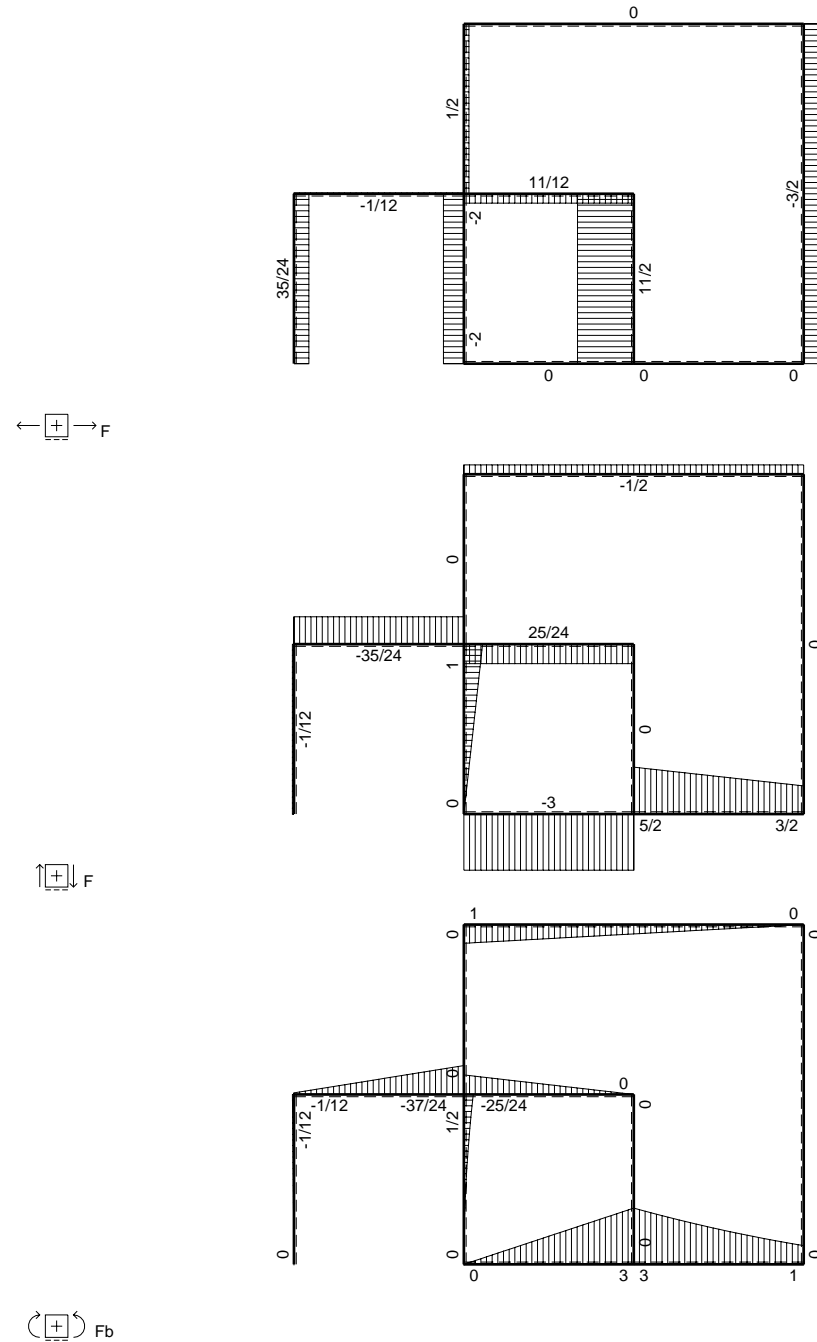
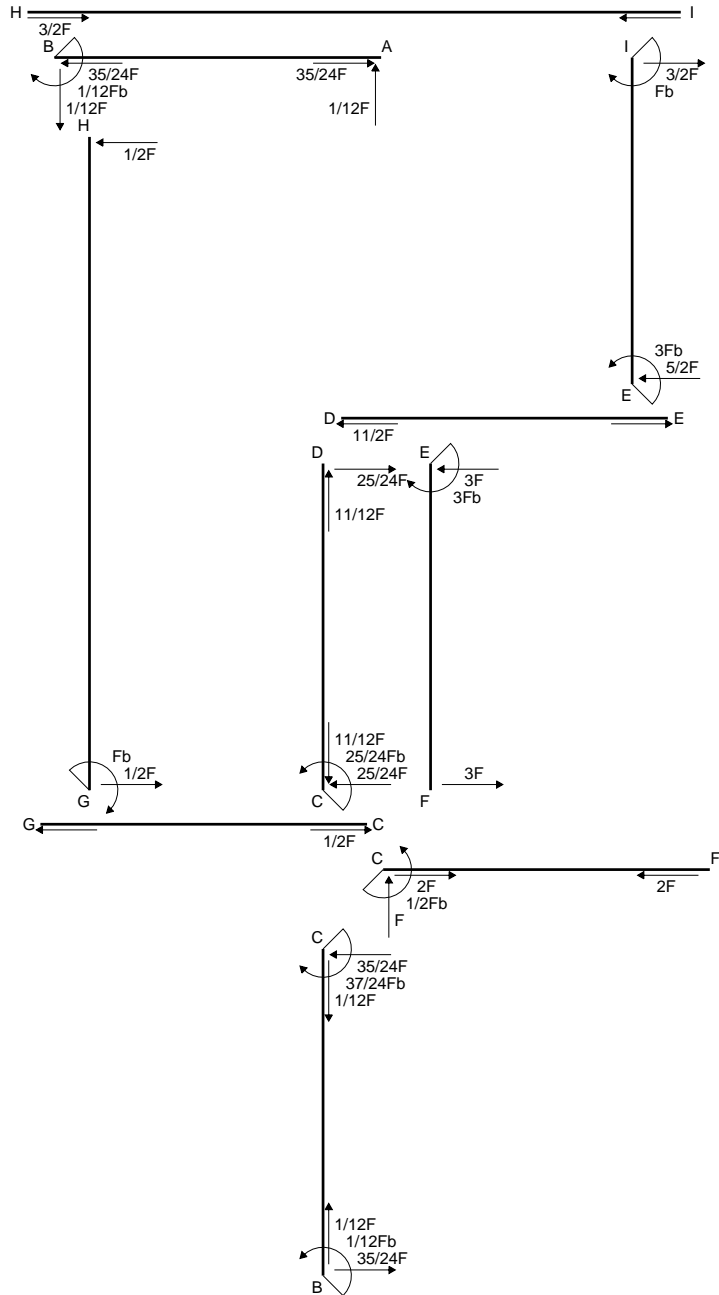
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

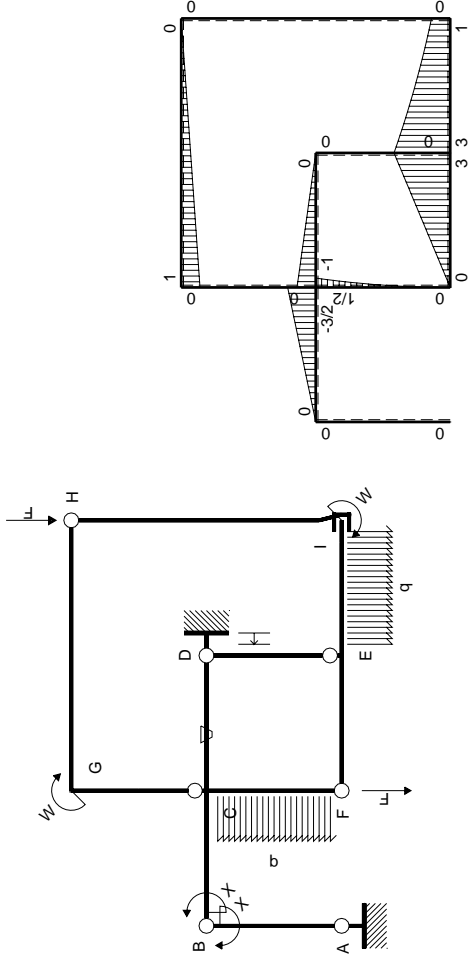
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	$1/2qx^2$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+Fx-1/2qx^2$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

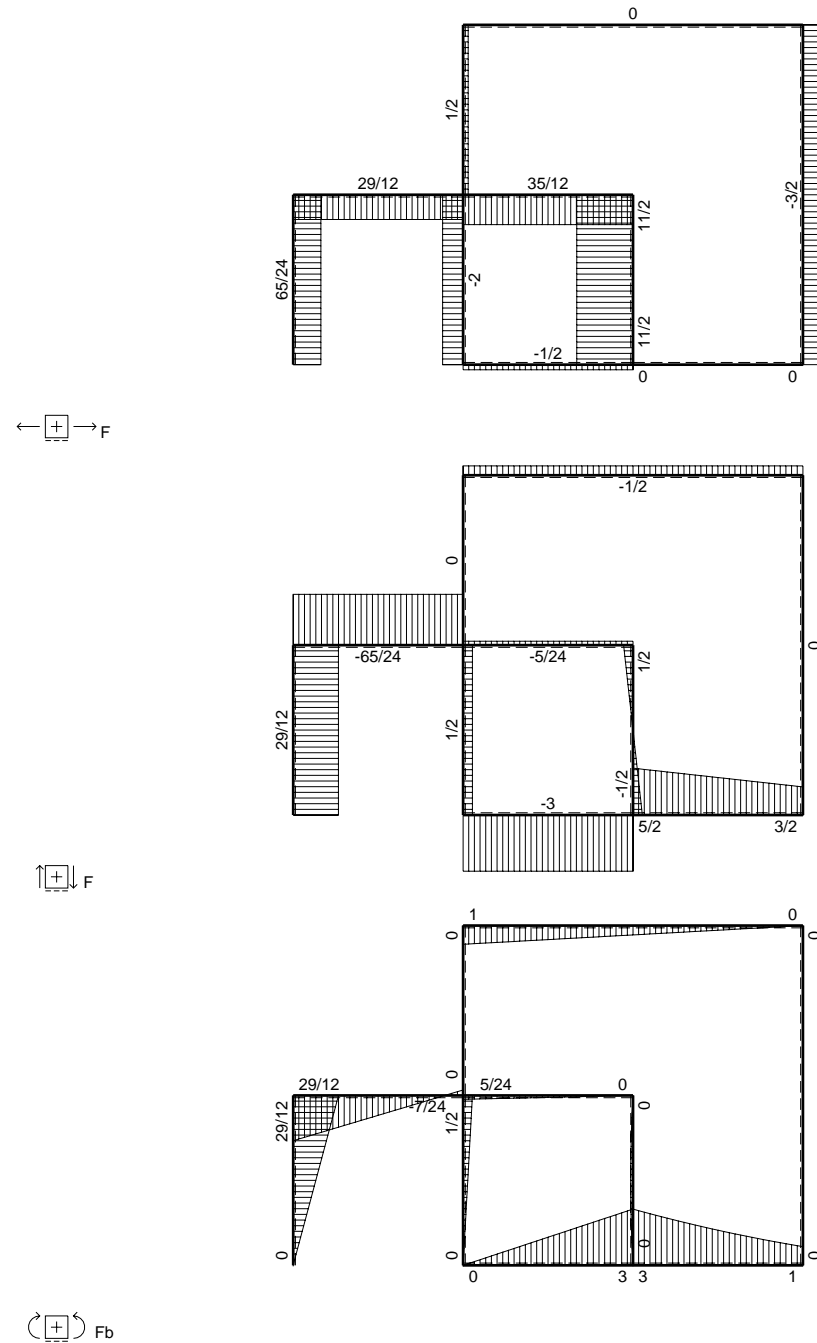
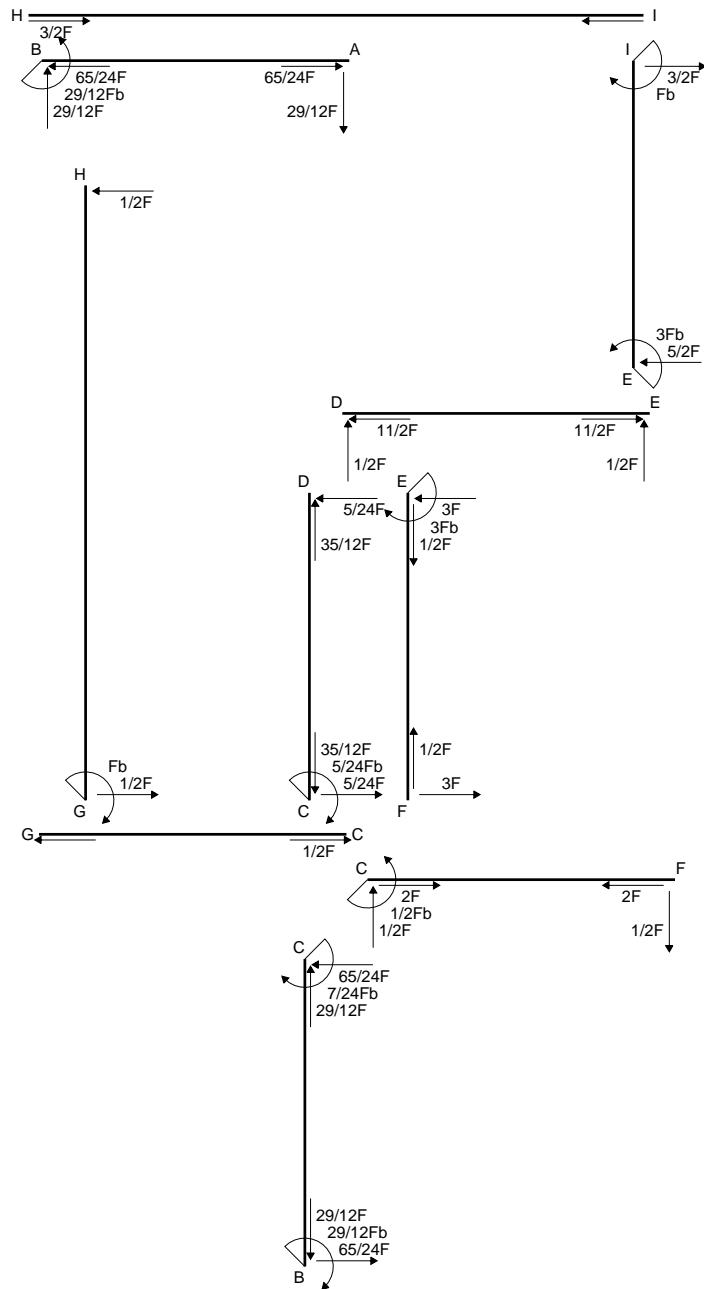
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

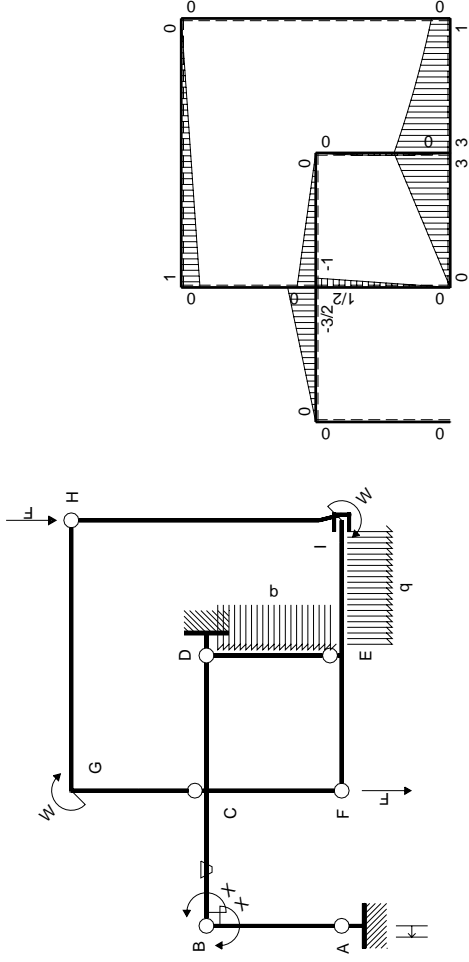
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	$-Fb/EJ$	$3/2Fx-3/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/2+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	Fb/EJ	$3/4Fb-3/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$29/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-29/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/4 b - 1/4 b) Fb 1/EJ + (b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

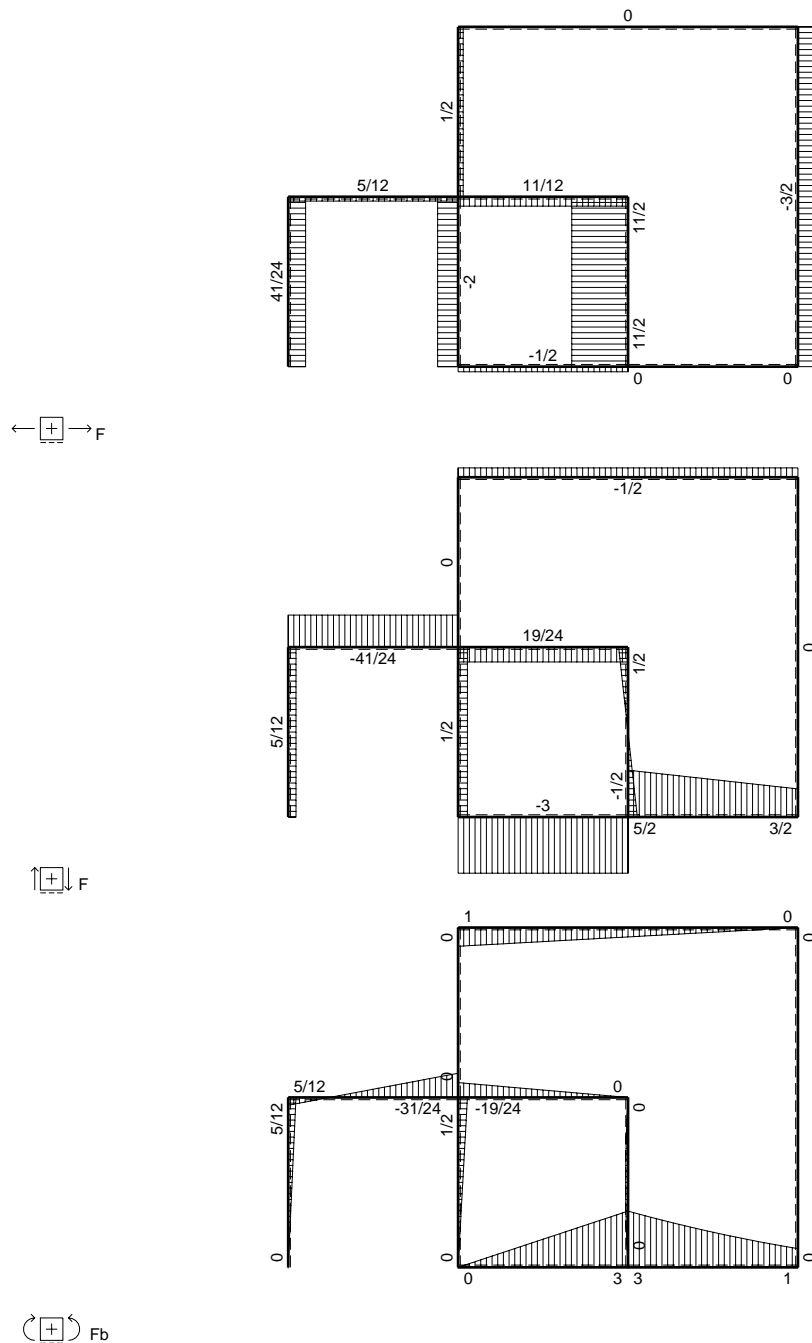
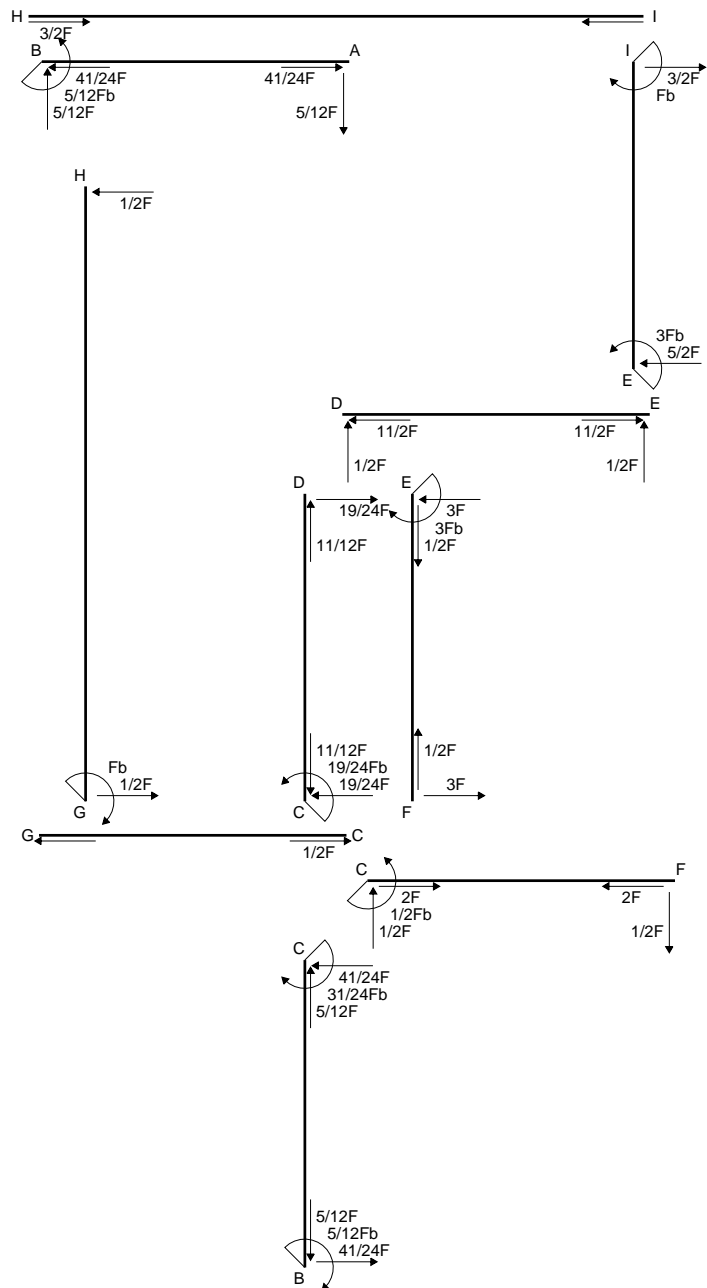
$$= (3/4 b - 1/4 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

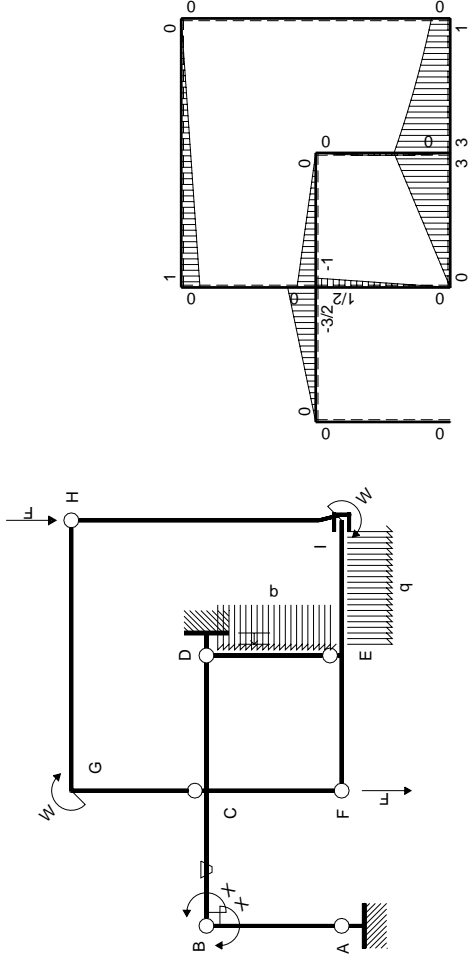
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



⊕ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	$-Fb/EJ$	$3/2Fx-3/4Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/2+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	Fb/EJ	$3/4Fb-3/4Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$5/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-5/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/4 b - 1/4 b) Fb 1/EJ + (b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

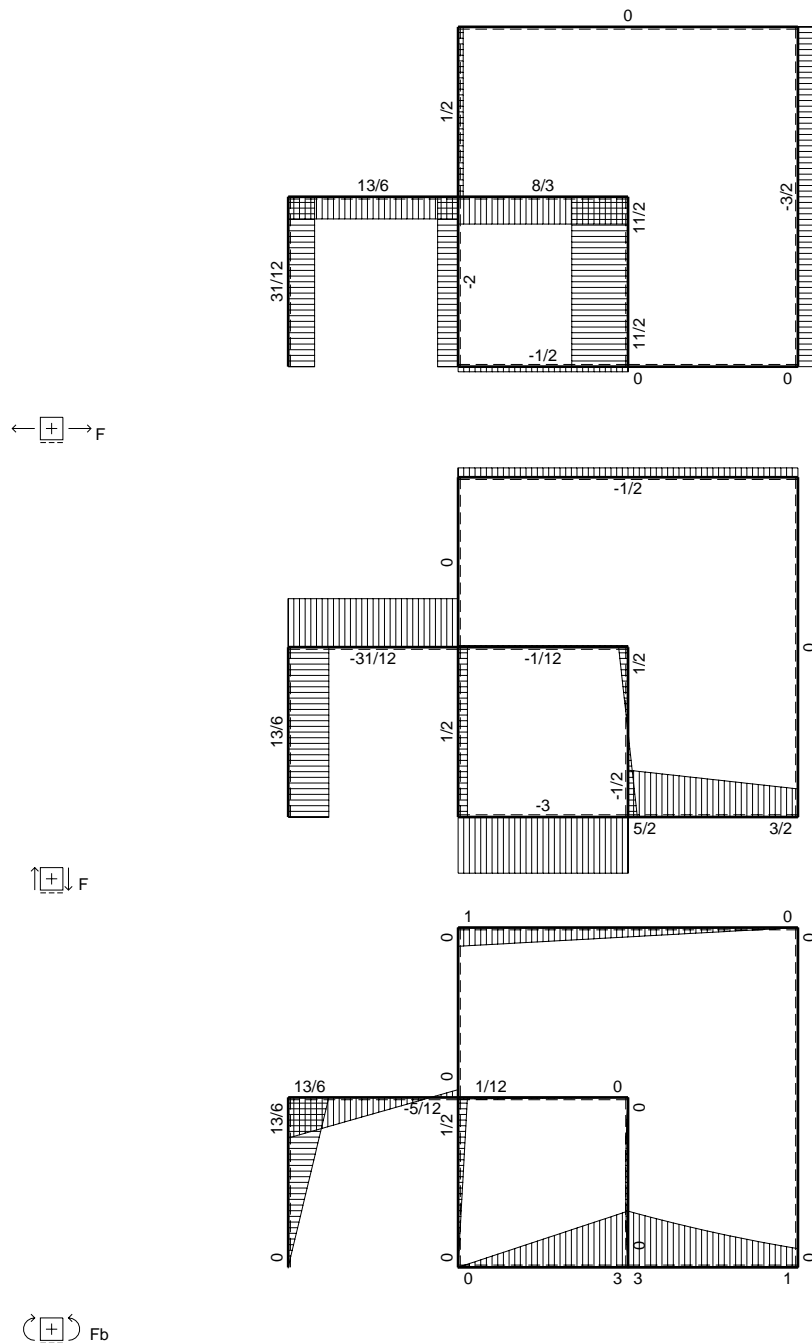
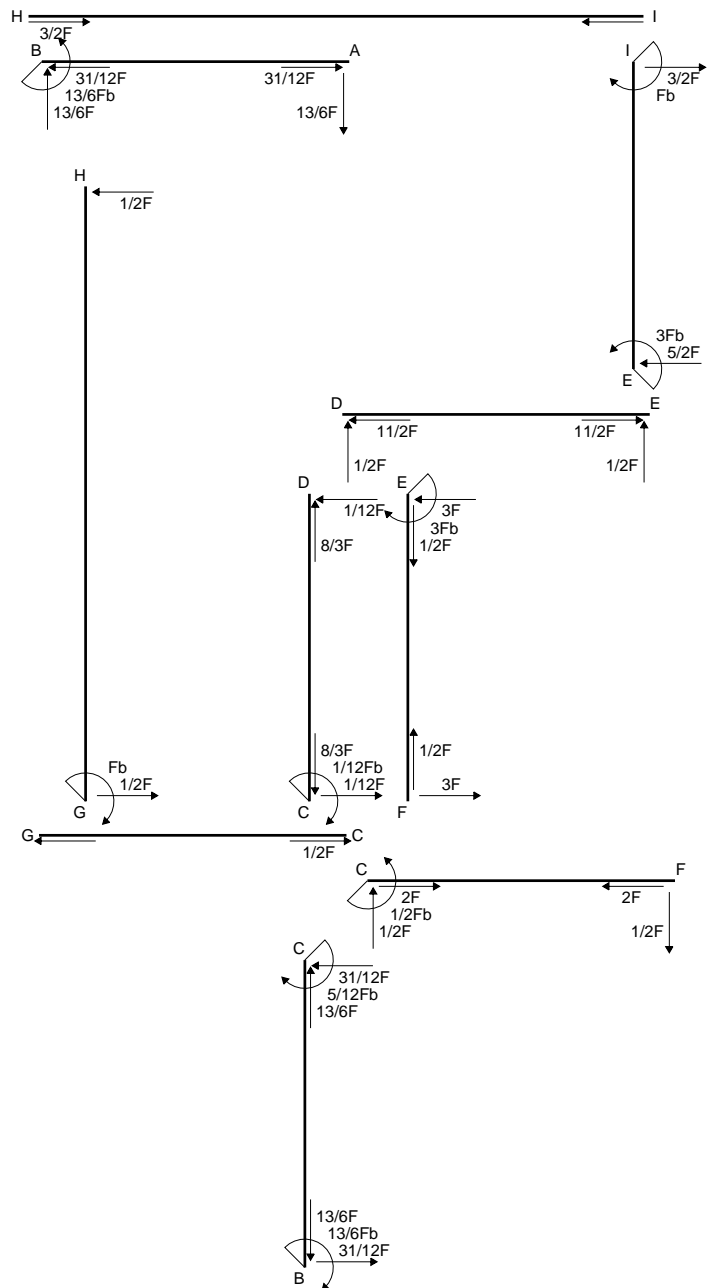
$$= (3/4 b - 1/4 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 5/4 Fb^2/EJ$$

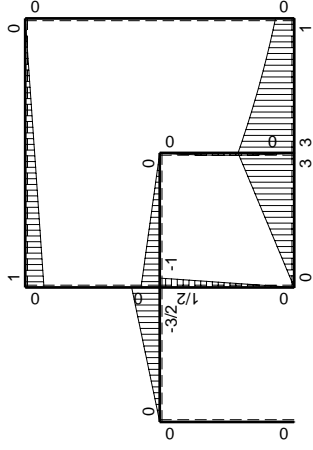
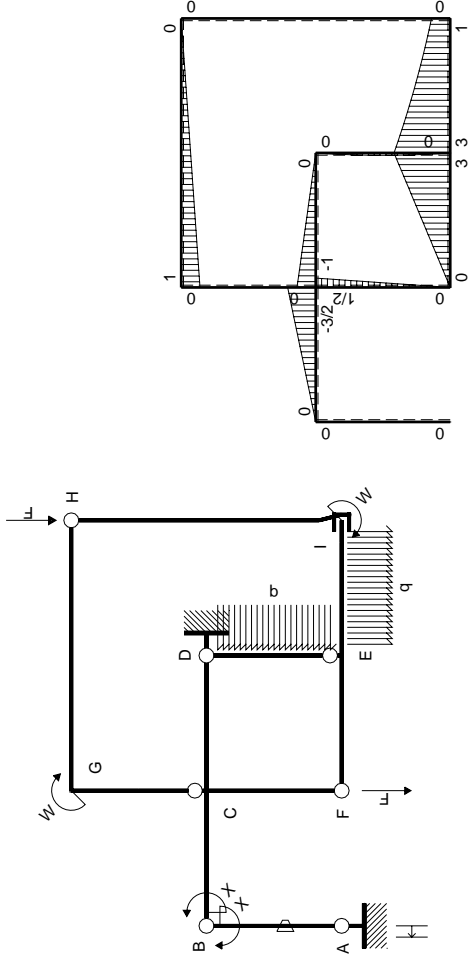
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

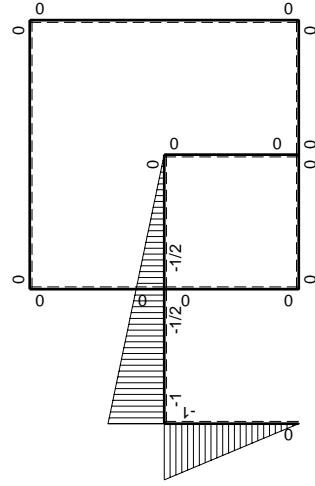
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

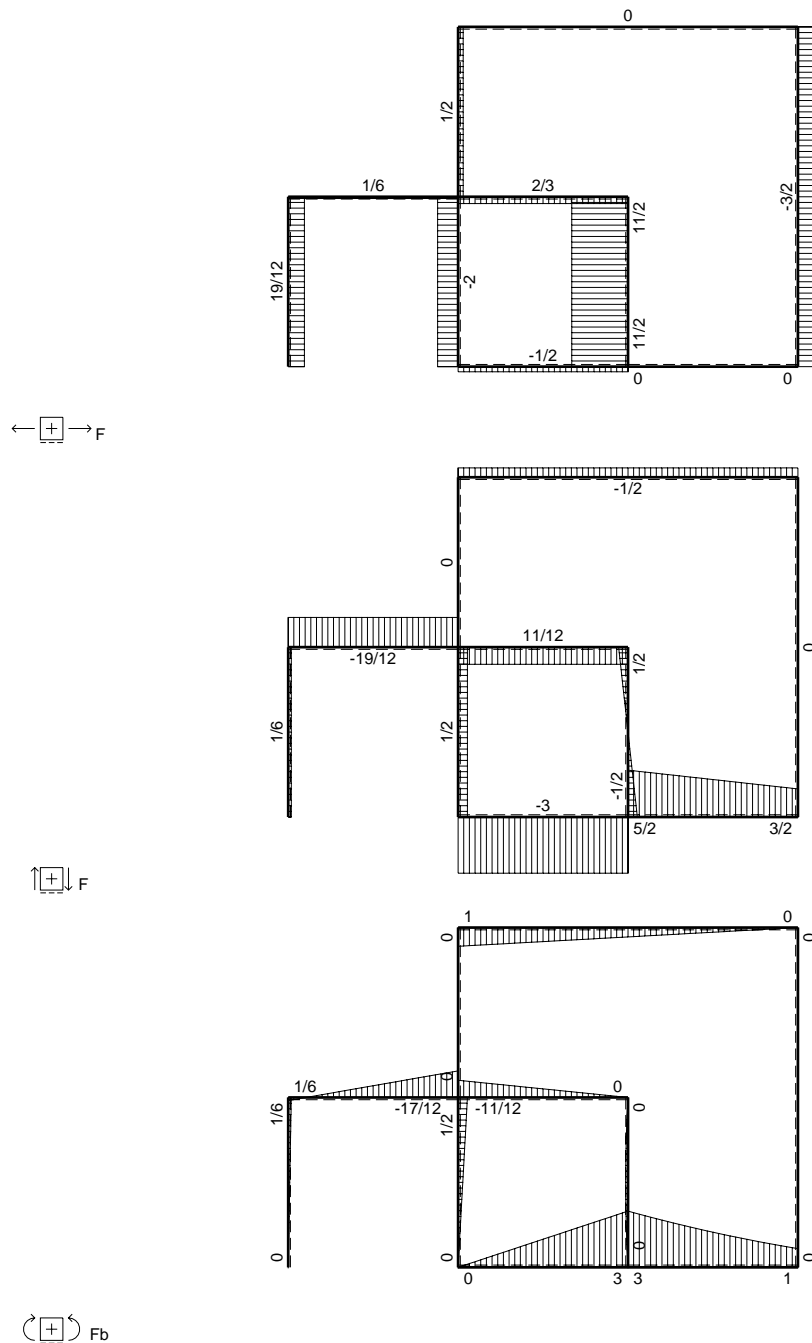
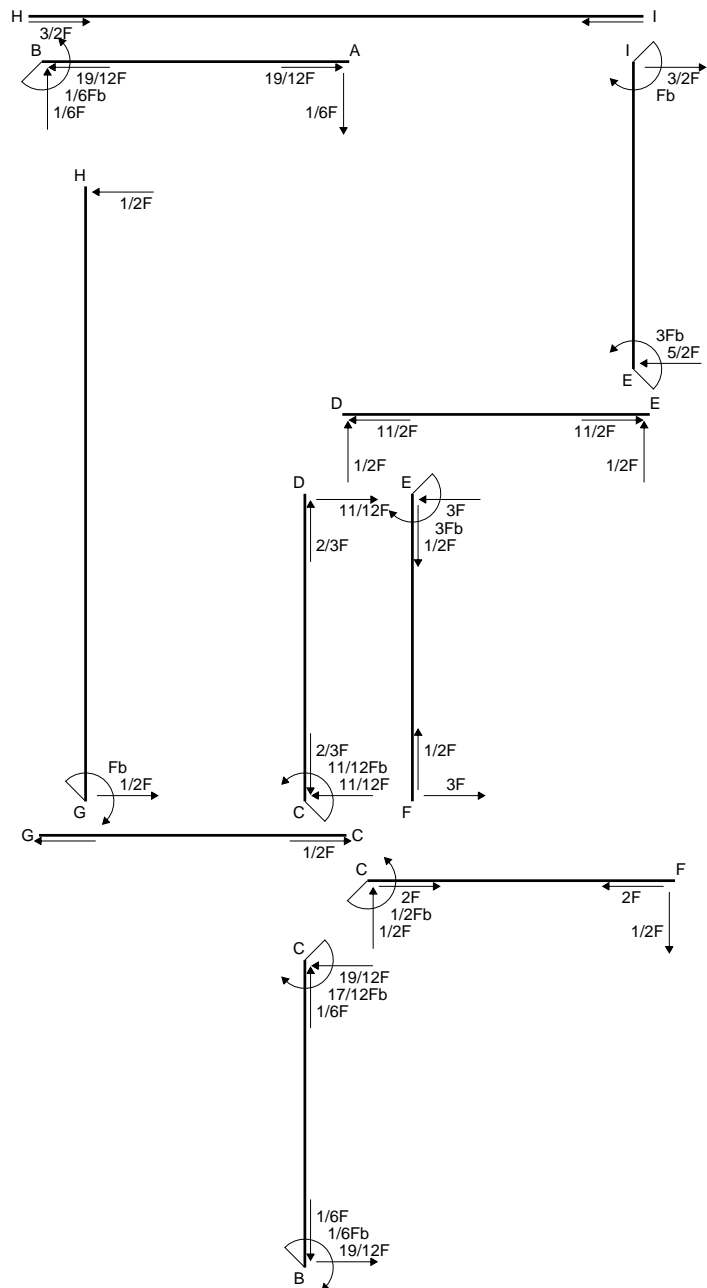
$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

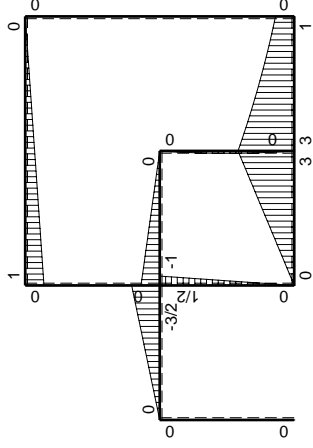
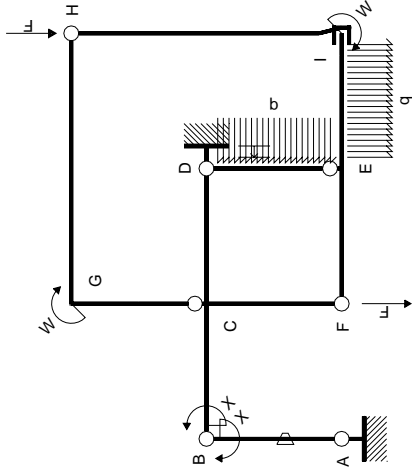
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

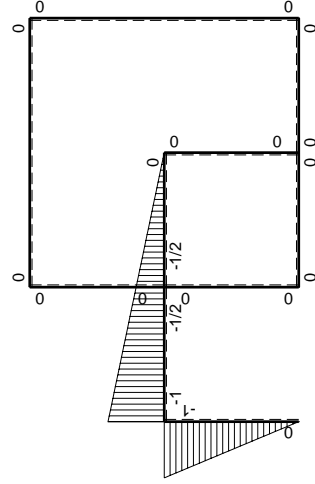
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$1/6Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-1/6Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

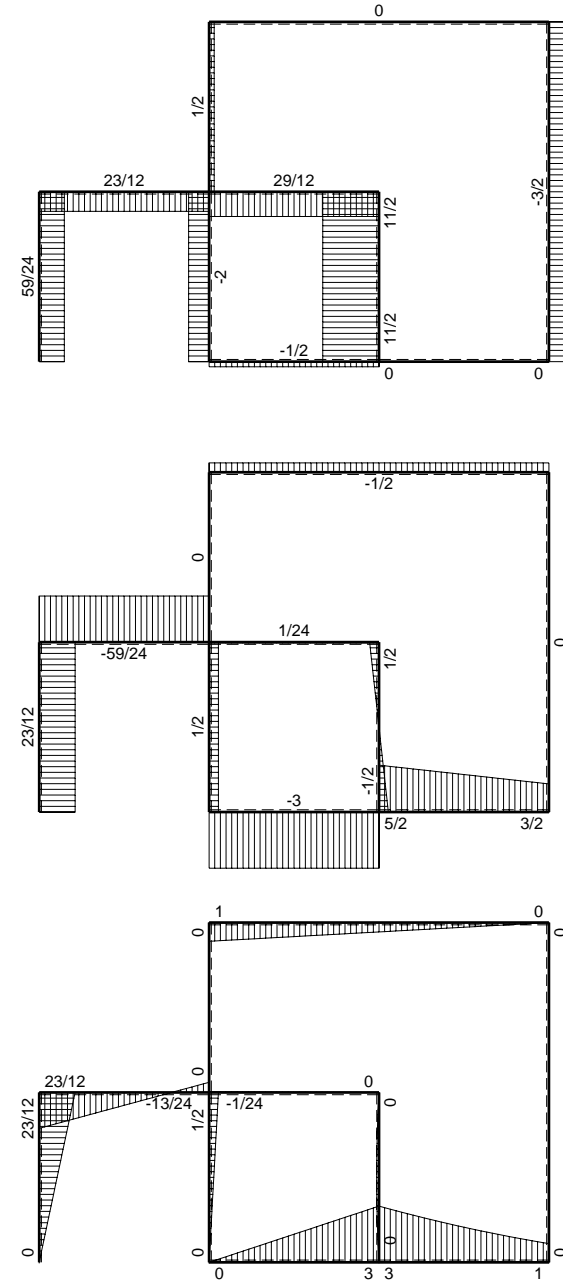
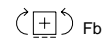
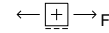
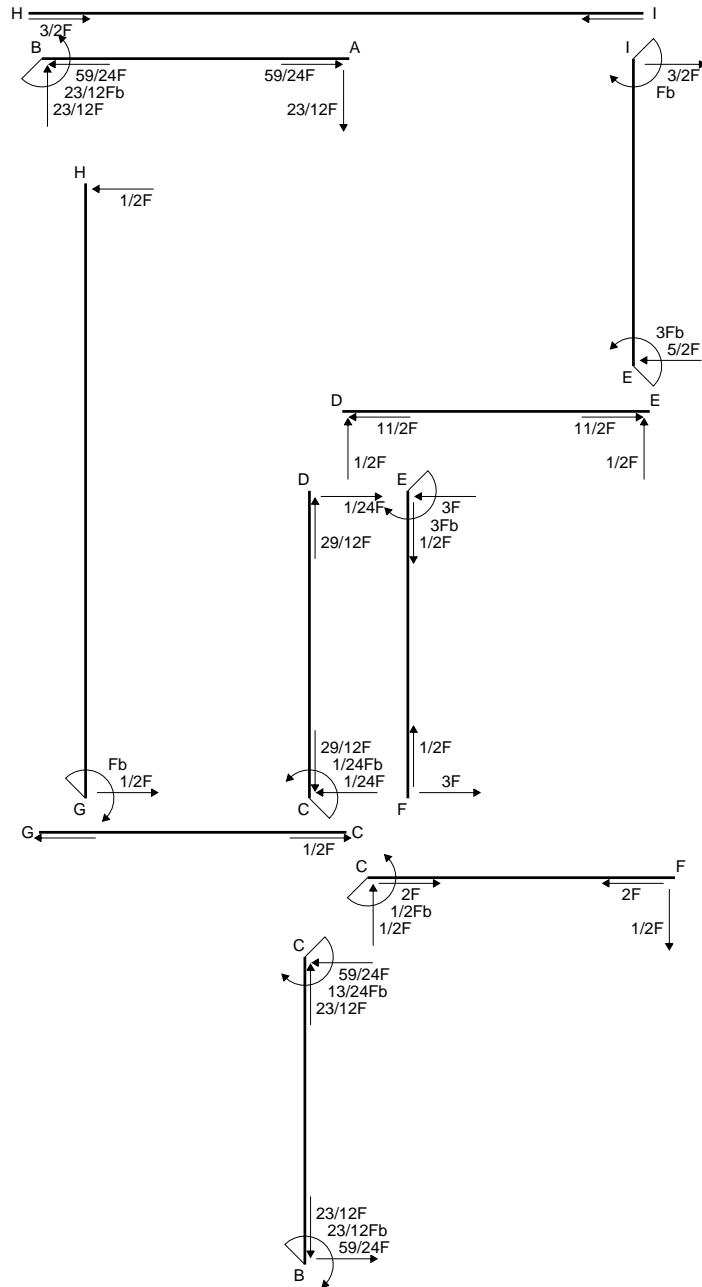
$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

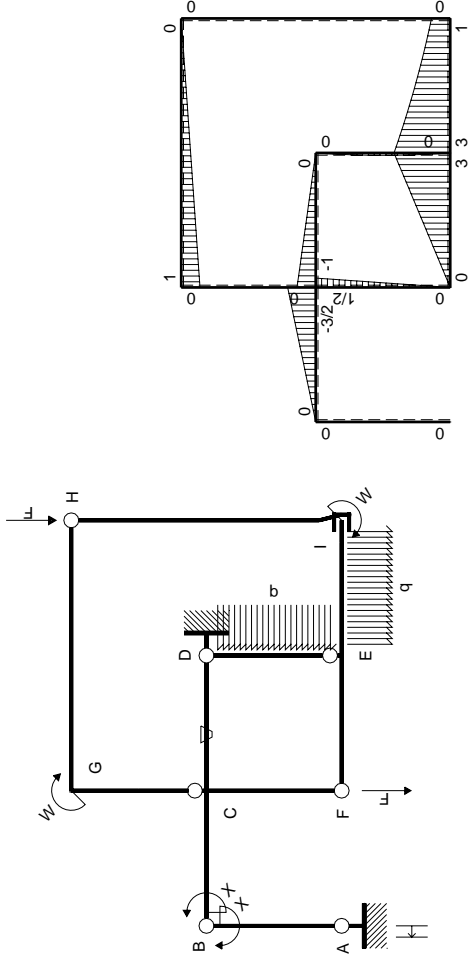
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0
FE b	0	$-3Fx$	0	0	0	0		
FC b	0	$1/2Fx$	0	0	0	0	0+0	0
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$23/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-23/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

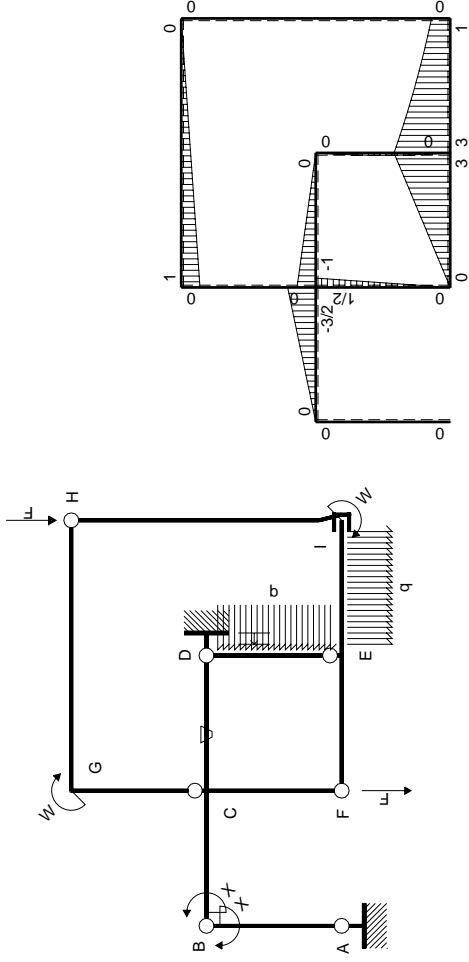
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/2Fx$	0	$3/2Fx-3/4Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/2+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/2Fb-3/2Fx$	0	$3/4Fb-3/4Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
ED b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
EF b	0	$3Fb-3Fx$	0	0	0	0	0+0	0	
FE b	0	$-3Fx$	0	0	0	0			
FC b	0	$1/2Fx$	0	0	0	0	0+0	0	
CF b	0	$-1/2Fb+1/2Fx$	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb-1/2Fx$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
EI b	0	$-3Fb+5/2Fx-1/2qx^2$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/12Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/12Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/2 x/b - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/4 - 3/4 x^2/b^2) Fb 1/EJ dx = [3/4 x - 1/4 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/4 b) Fb 1/EJ = 1/2 Fb^2/EJ$$

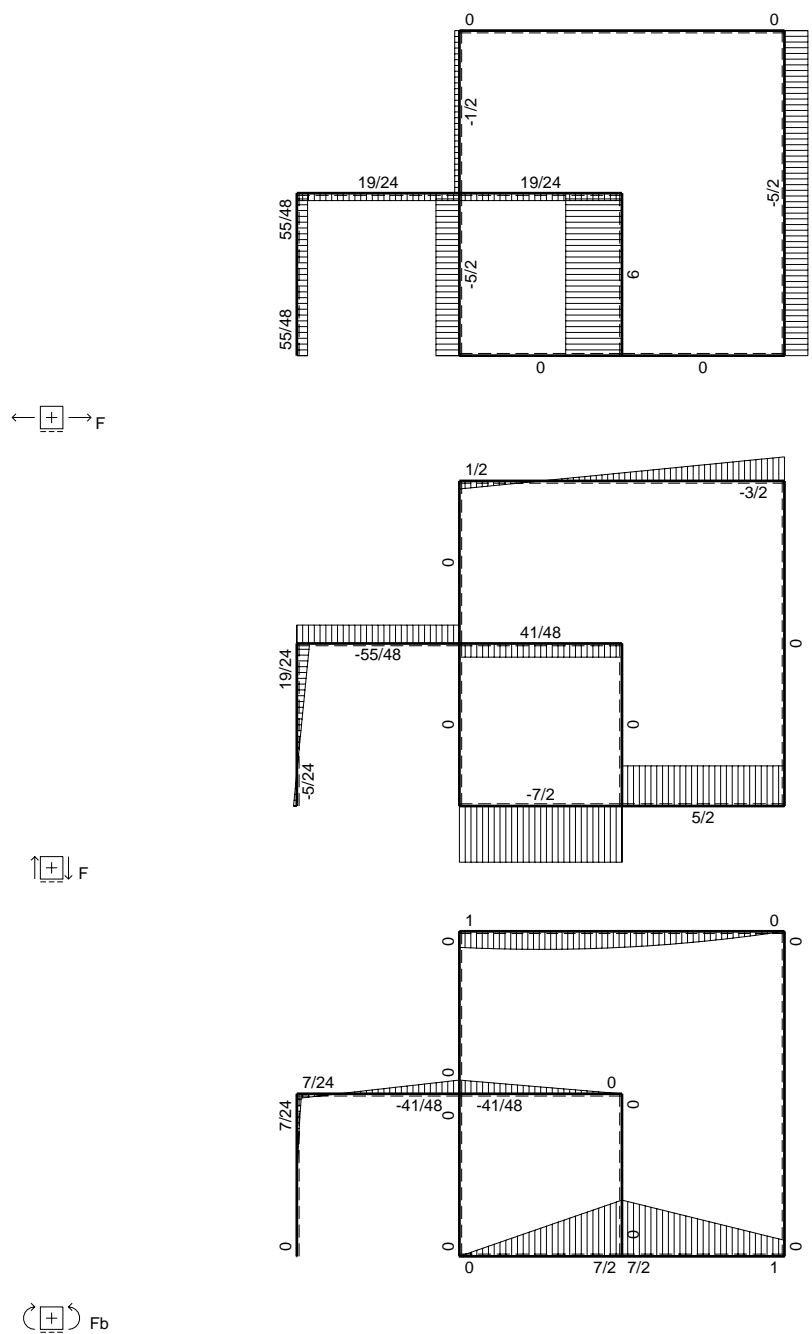
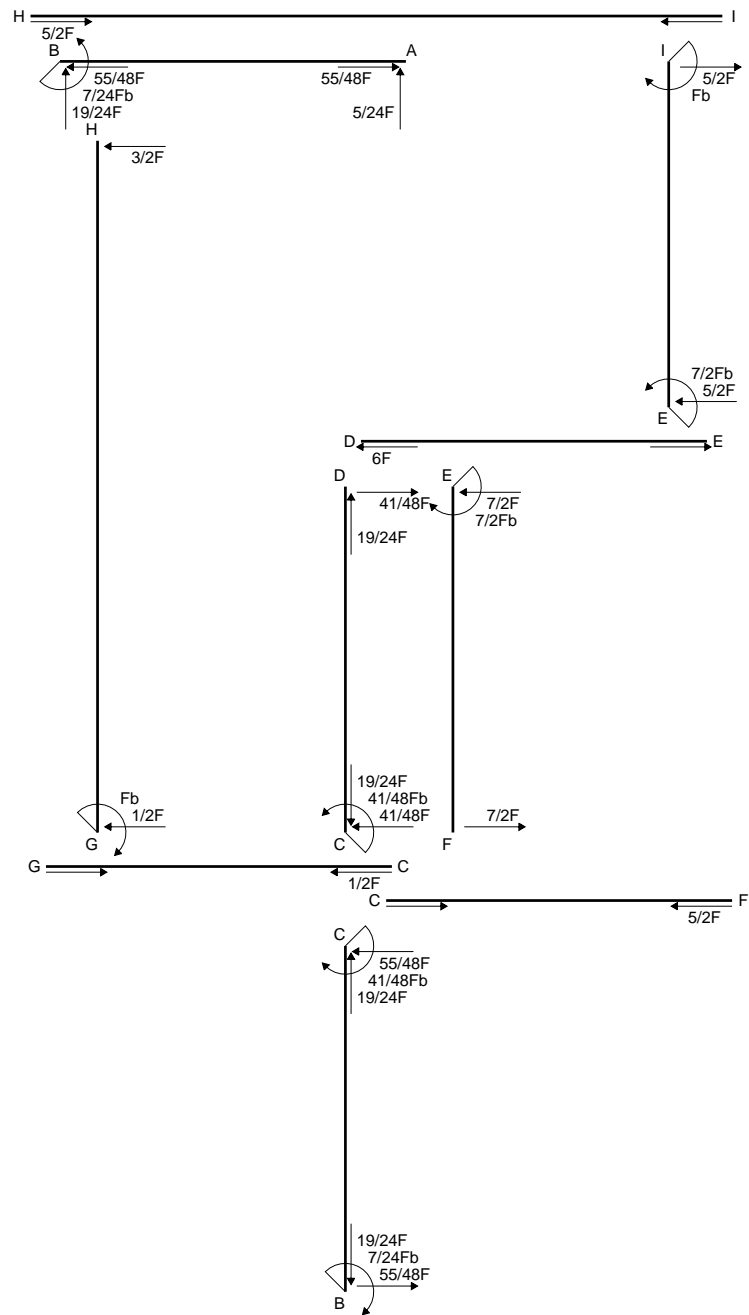
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$



Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0			
ED b	0	0	0	0	0	0	0+0	0	
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0			
FE b	0	$-7/2Fx$	0	0	0	0	0+0	0	
FC b	0	0	0	0	0	0			
CF b	0	0	0	0	0	0	0+0	0	
CG b	0	0	0	0	0	0			
GC b	0	0	0	0	0	0	0+0	0	
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0			
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0	0+0	0	
HI 2b	0	0	0	0	0	0			
IH 2b	0	0	0	0	0	0	0+0	0	
IE b	0	$Fb+5/2Fx$	0	0	0	0			
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0	0+0	0	
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$7/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-7/24Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

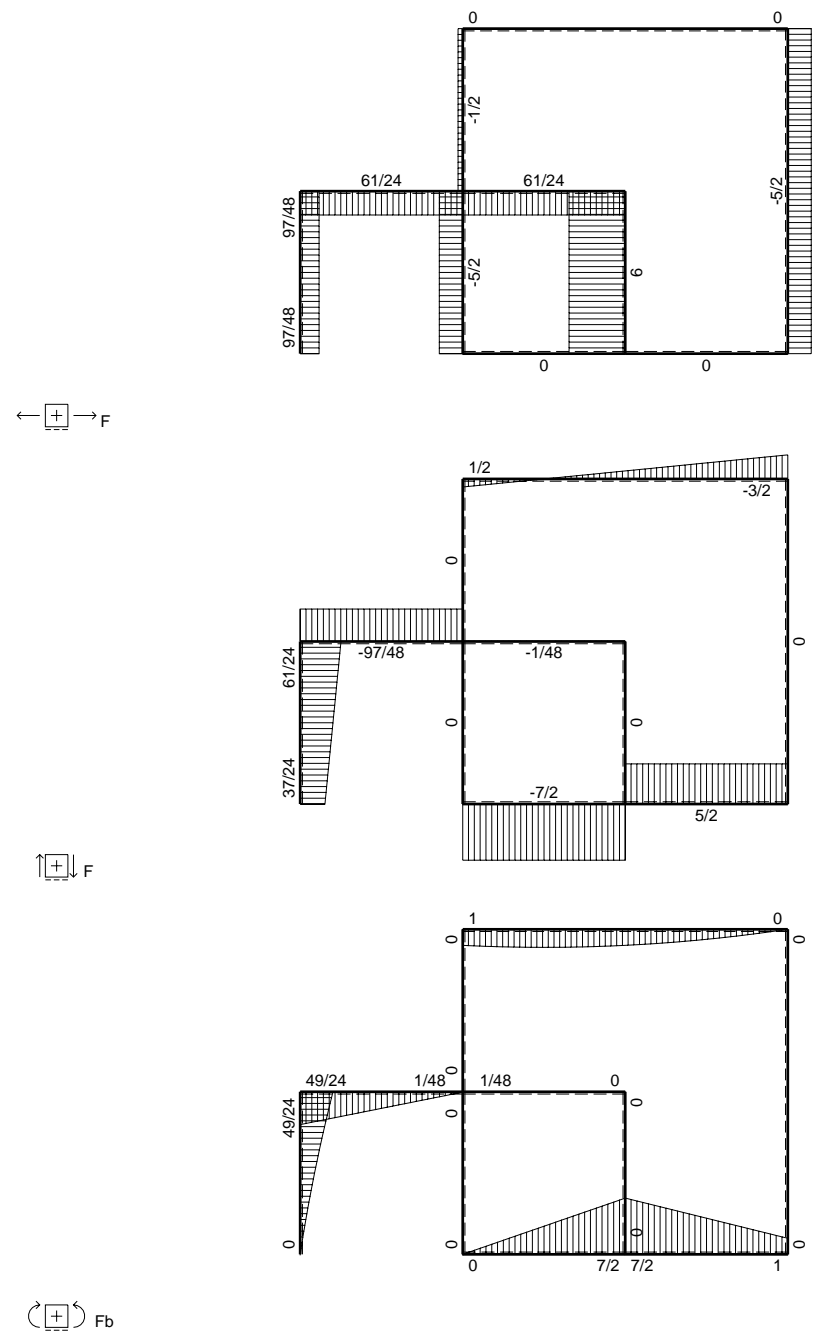
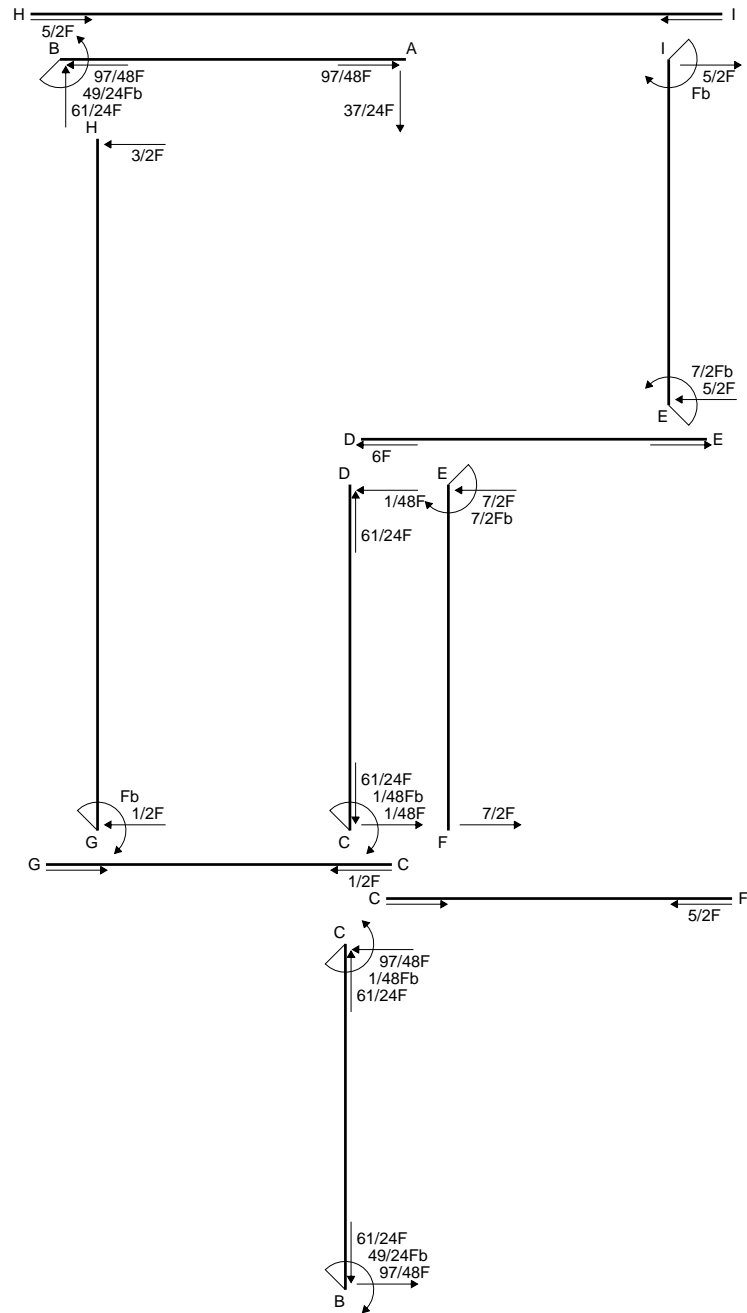
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ		
	totali						$49/24Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-49/24Fb$		

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

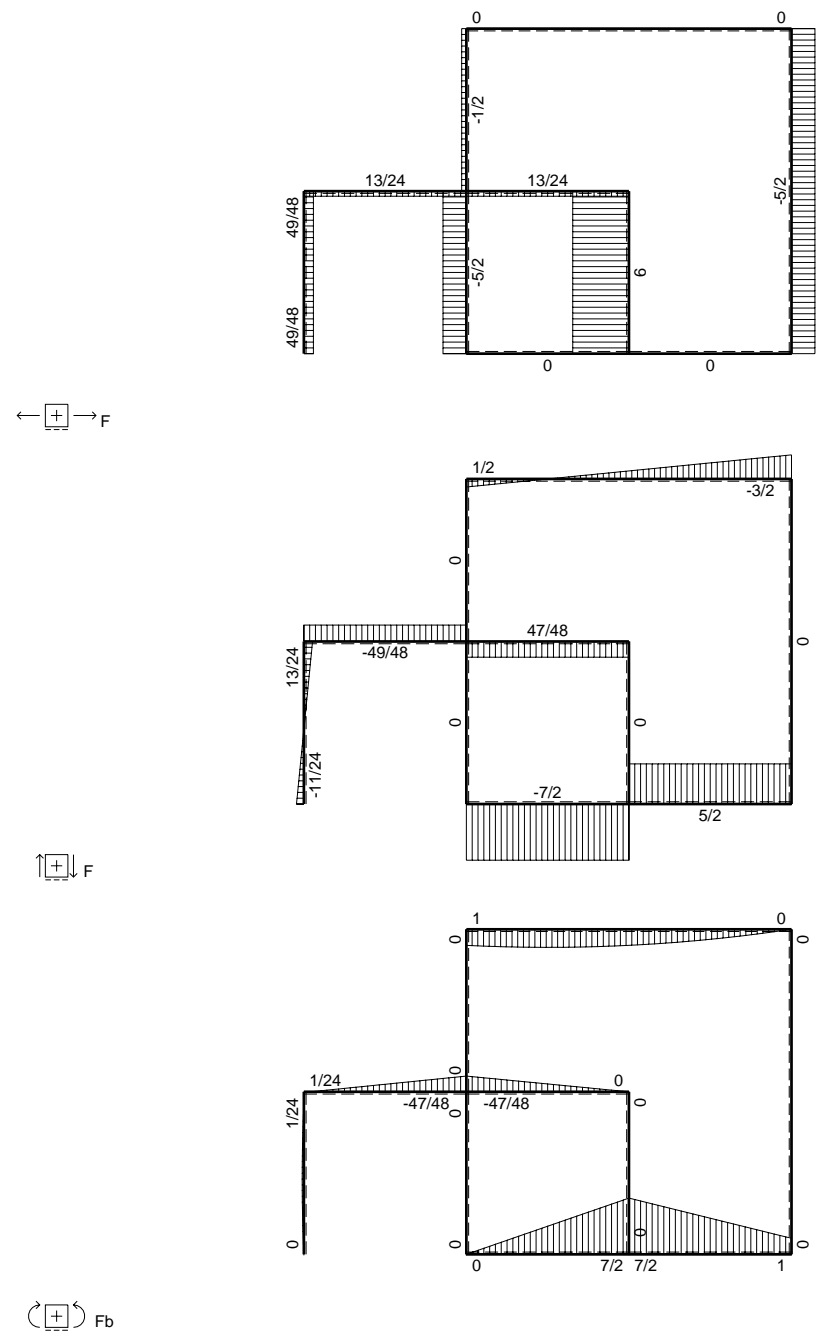
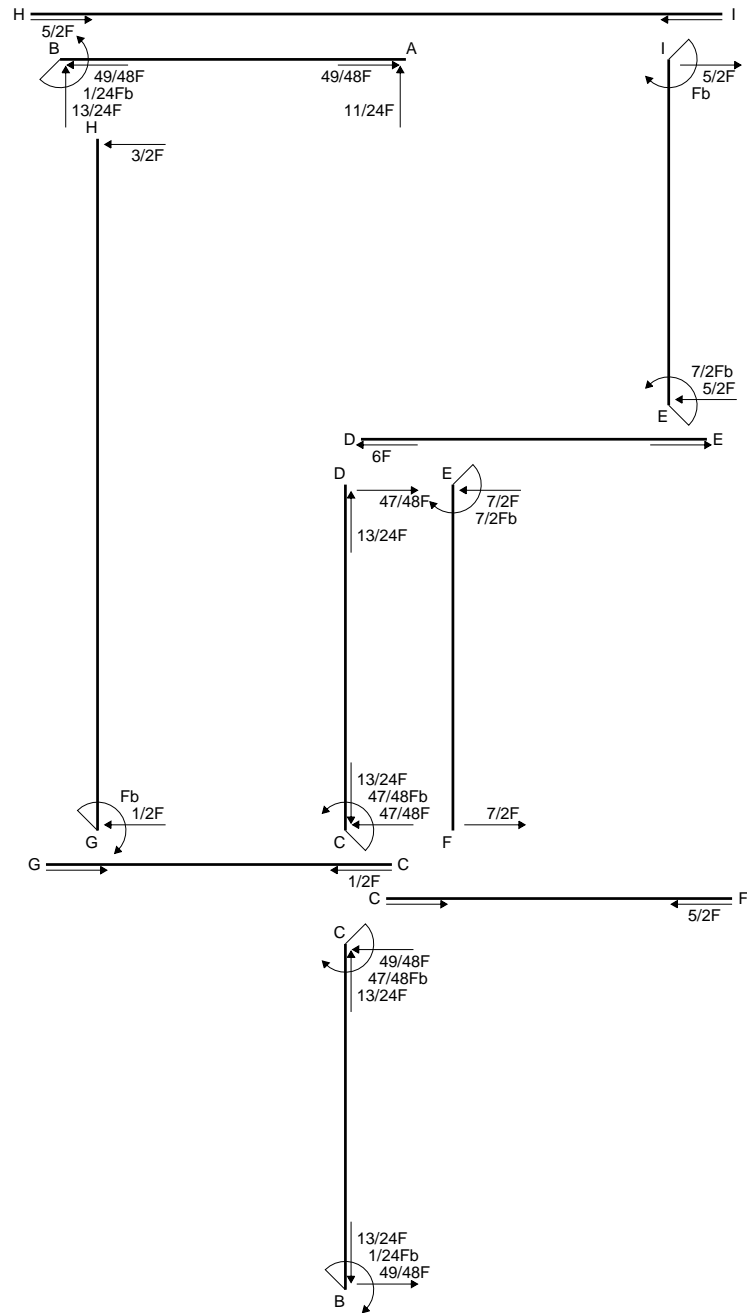
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

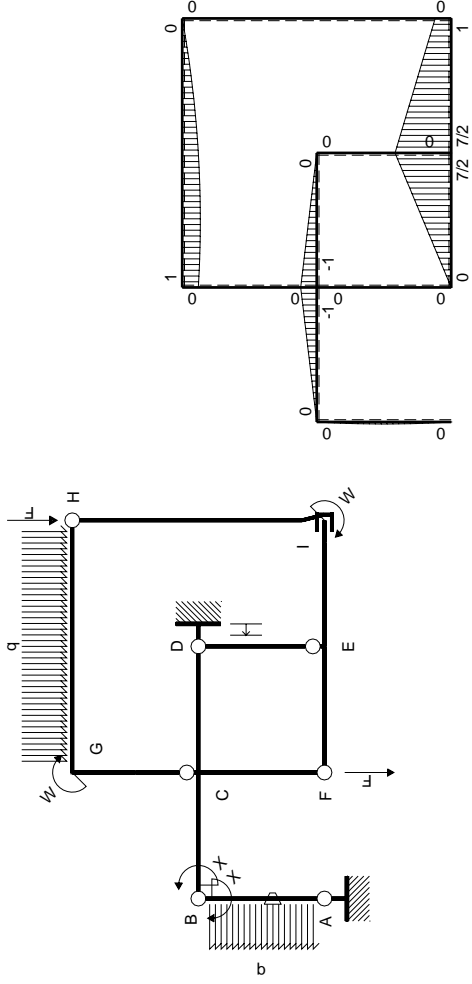
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	$-Fb/EJ$	$1/2Fx^2/b-1/2qx^3/b$	Fx/EJ	x^2/b^2	$(1/24+1/2)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	Fb/EJ	$1/2Fx-Fx^2/b+1/2qx^3/b$	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/24Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (x/b) \theta dx$$

$$= [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ + [1/2 x^2/b]_0^b \theta$$

$$= (1/6 b - 1/8 b) Fb 1/EJ + (1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx + \int_0^b (-1 + x/b) \theta dx$$

$$= [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ + [-x + 1/2 x^2/b]_0^b \theta$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ + (-b + 1/2 b) \theta = 13/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

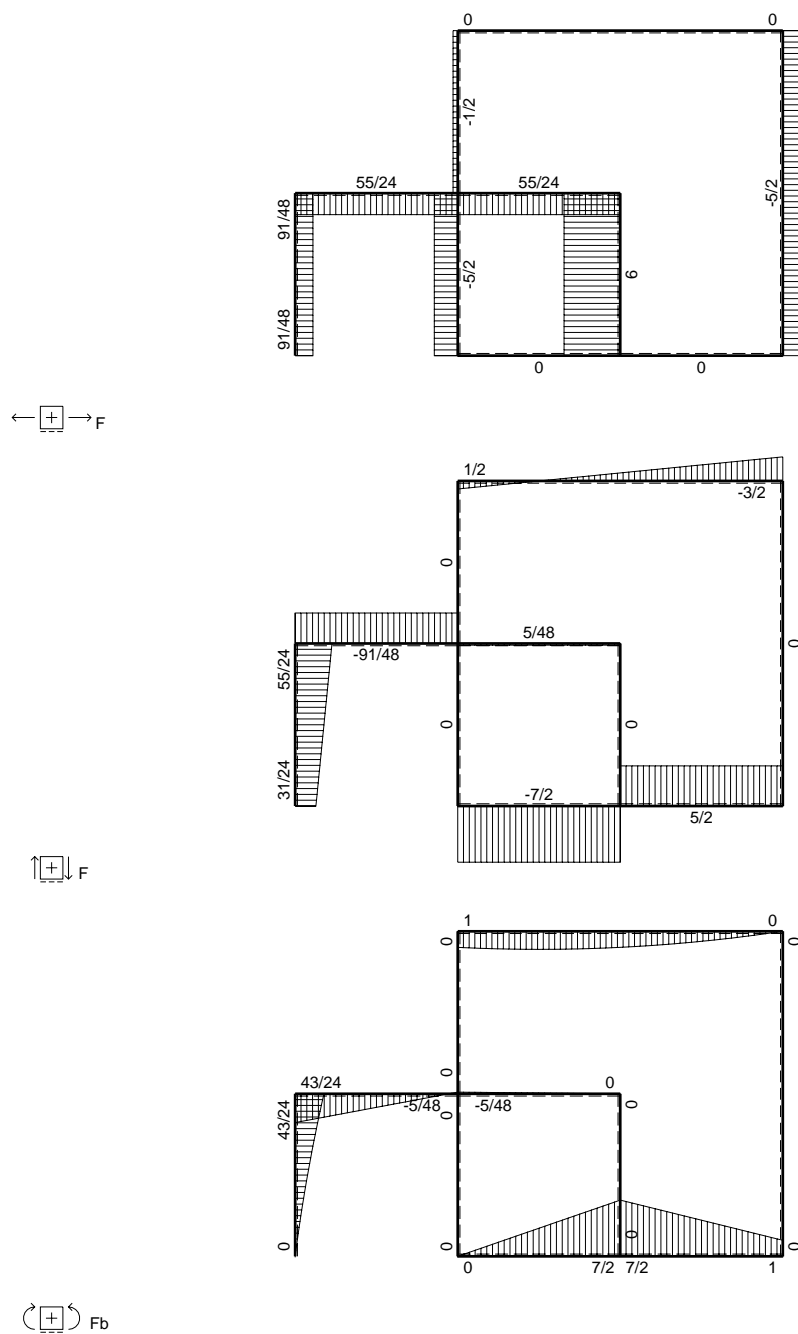
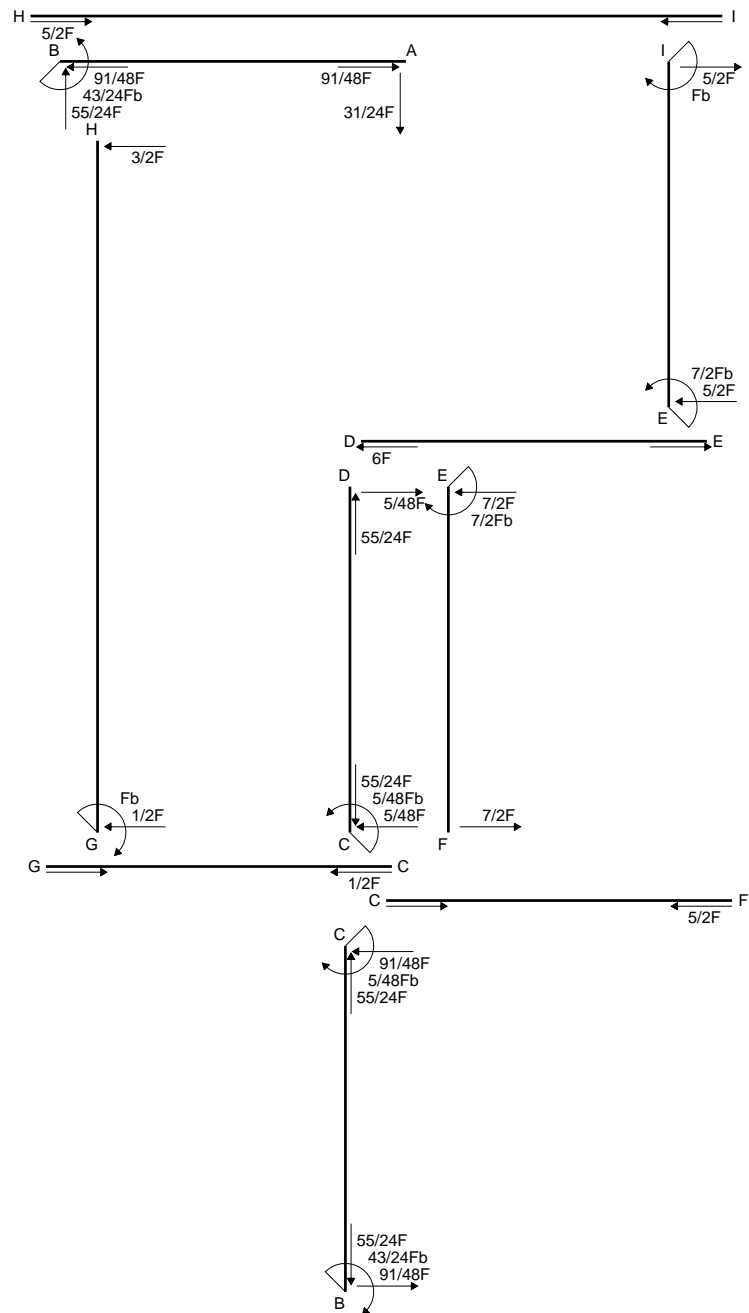
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

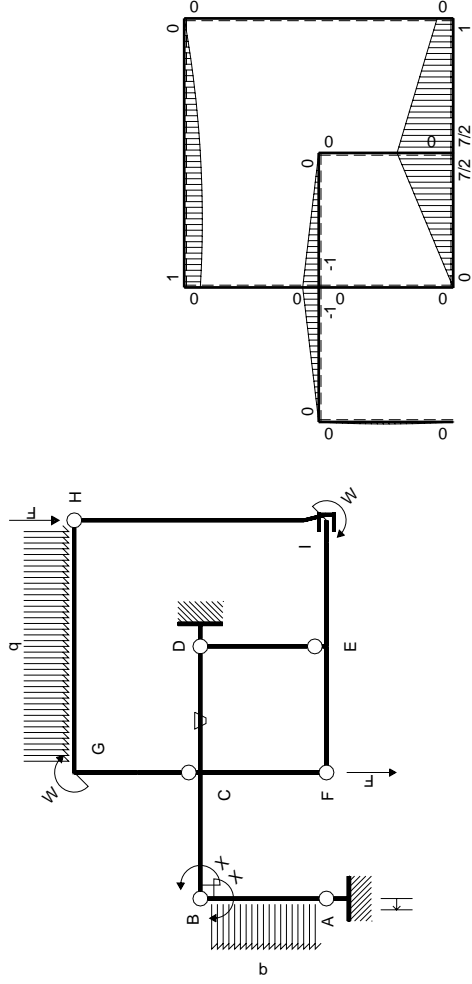
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0
FE b	0	$-7/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	0	0	0	0	0	0+0	0
GC b	0	0	0	0	0	0		
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$43/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-43/24Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

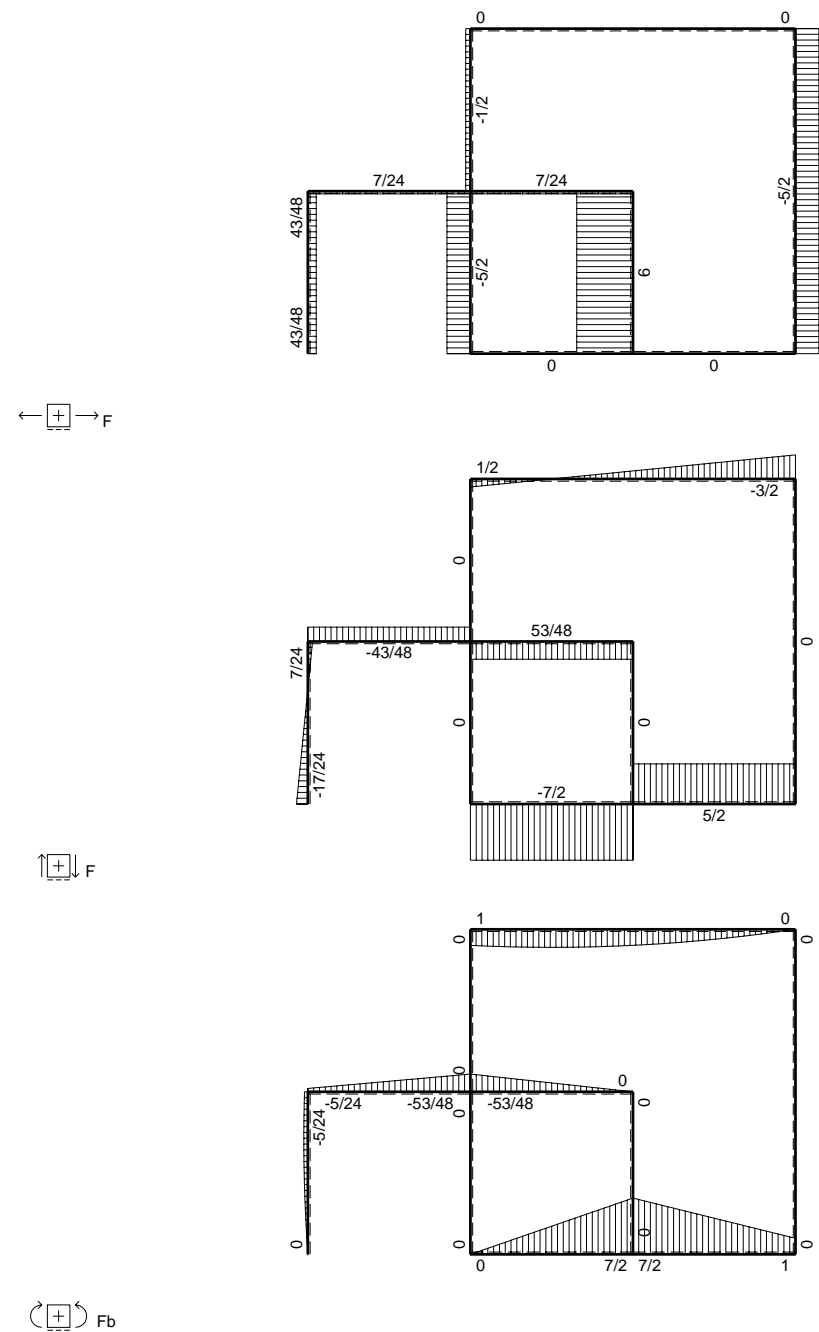
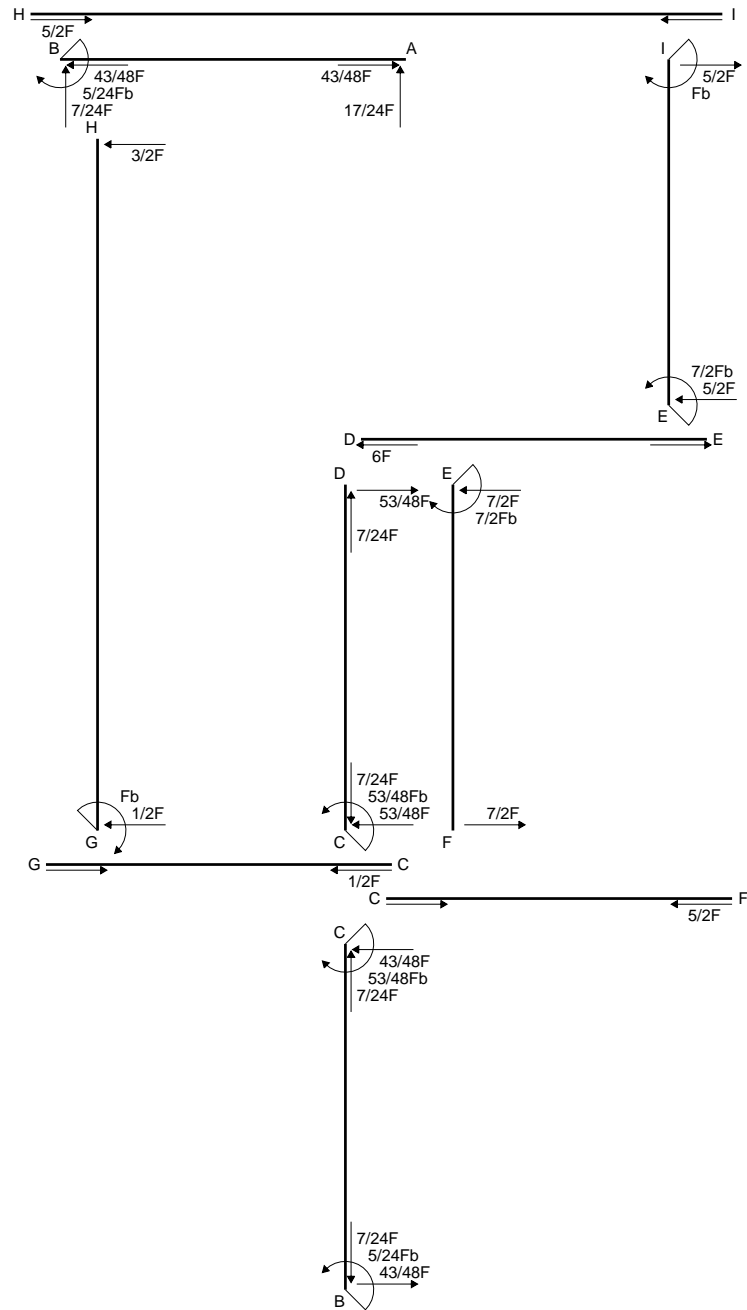
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$



Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	$-1/2Fx+1/2qx^2$	0	$1/2Fx^2/b-1/2qx^3/b$	0	x^2/b^2	$(1/24+0)Fb^2/EJ$	$1/3Xb/EJ$	
BA b	$1-x/b$	$1/2Fx-1/2qx^2$	0	$1/2Fx-Fx^2/b+1/2qx^3/b$	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$7/2Fb-7/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-7/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	0	0	0	0	0	0+0	0	
GC b	0	0	0	0	0	0			
GH 2b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-3/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+5/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-7/2Fb+5/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-5/24Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$5/24Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

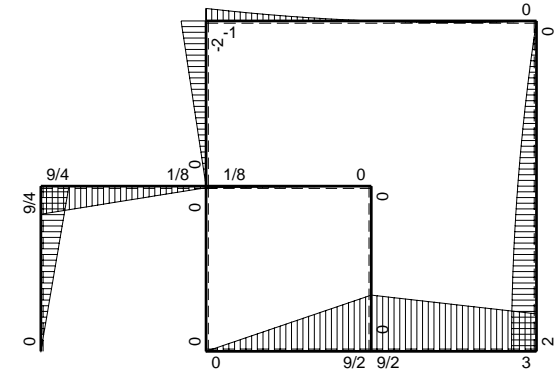
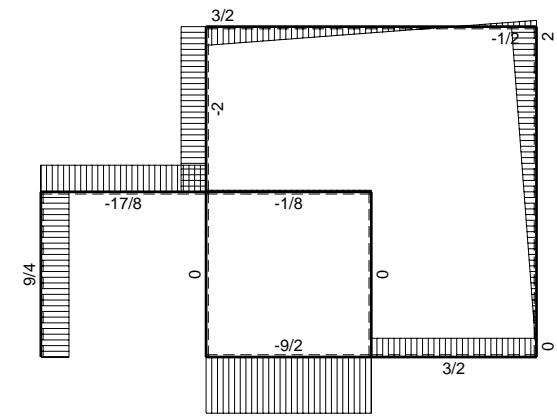
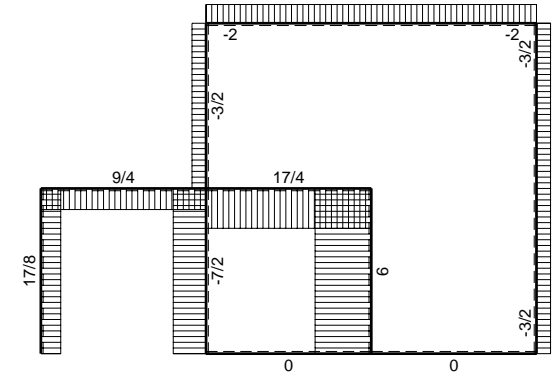
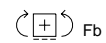
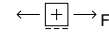
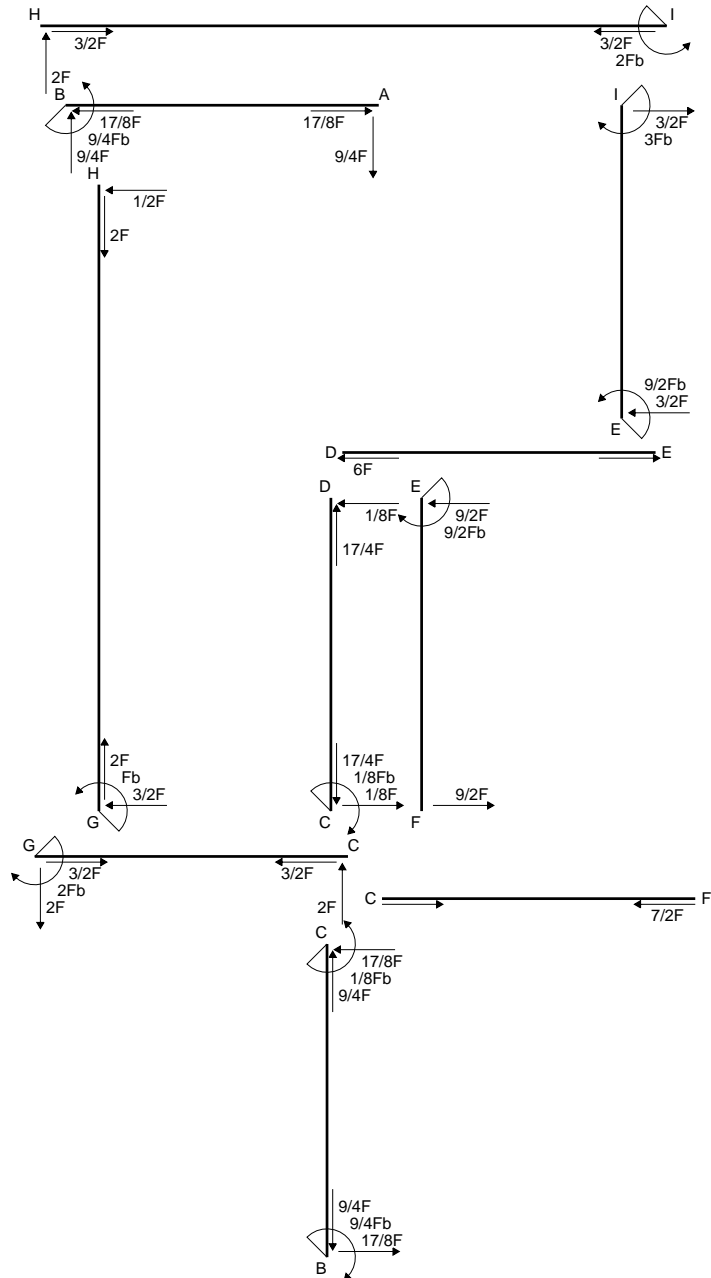
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

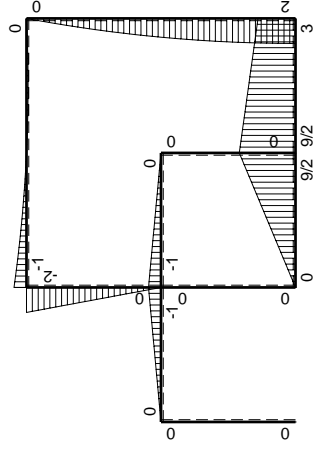
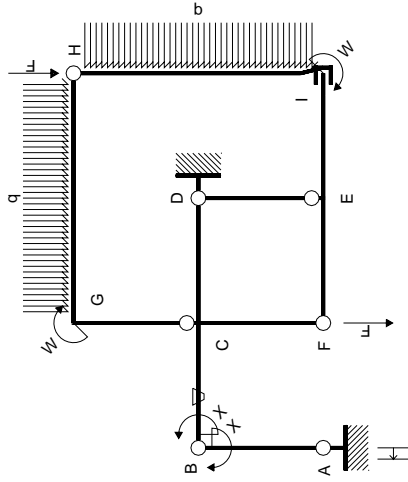
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

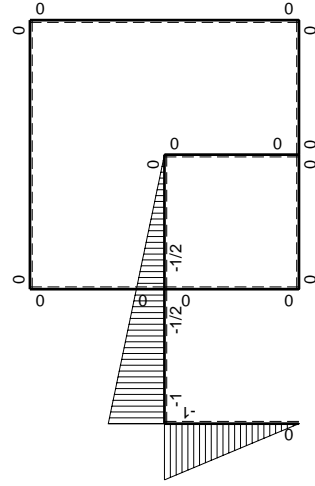
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0
FE b	0	$-9/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$9/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-9/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

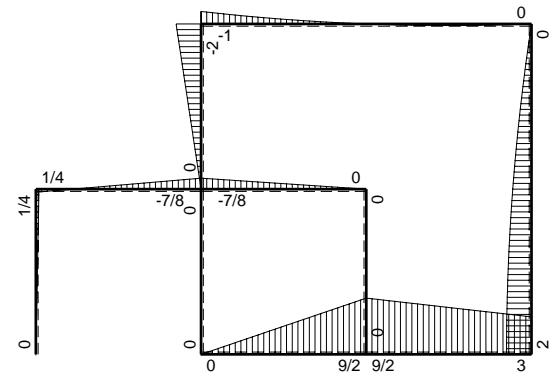
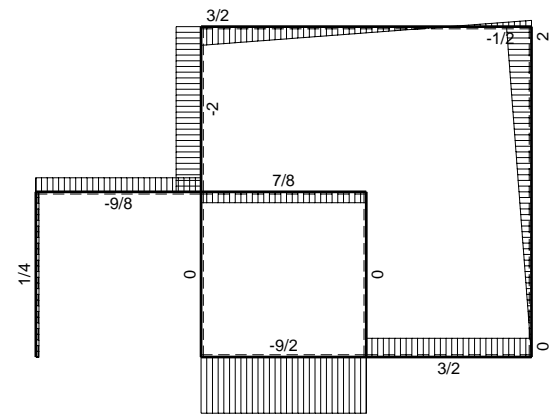
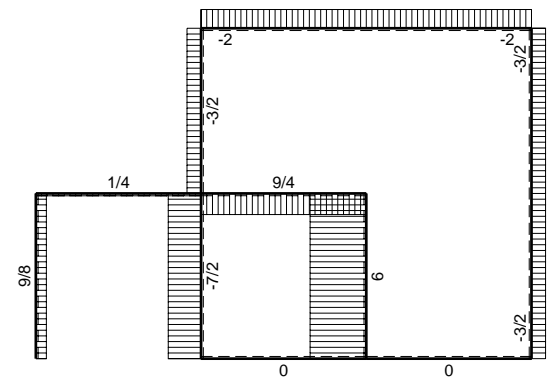
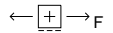
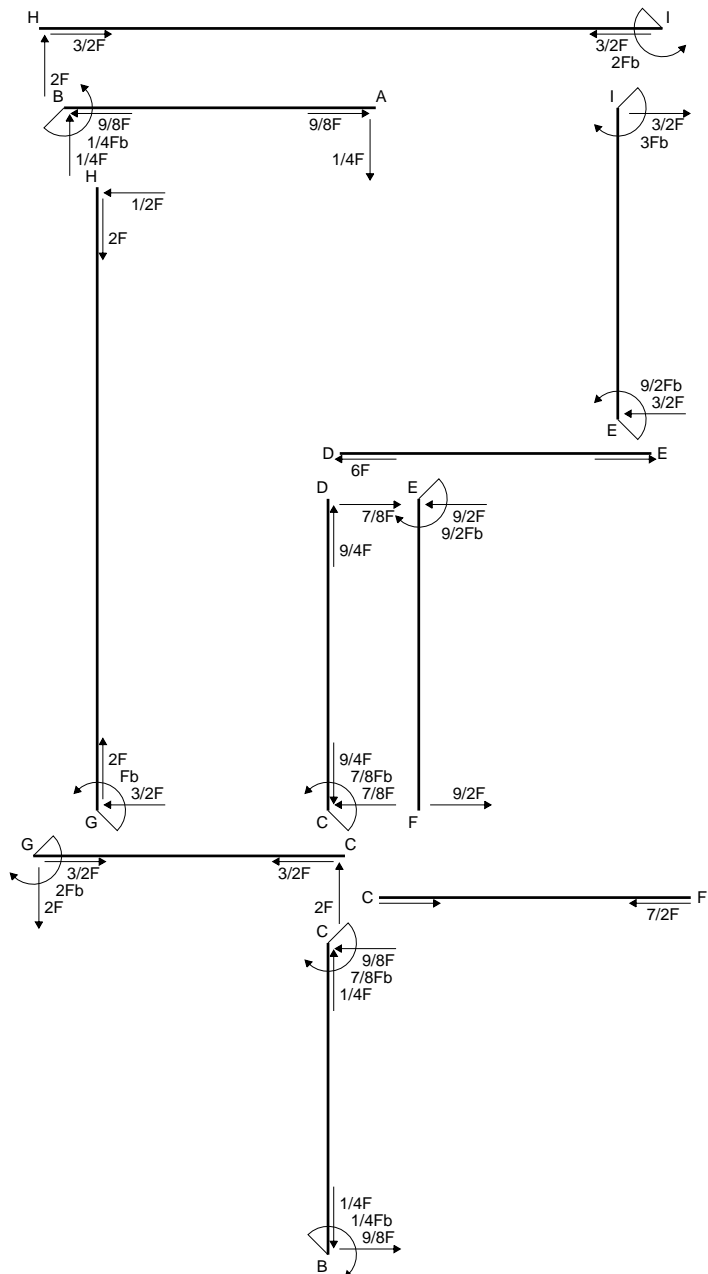
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	$-Fb/EJ$	$Fx-1/2Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/3+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	Fb/EJ	$1/2Fb-1/2Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/6 b) Fb 1/EJ + (b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

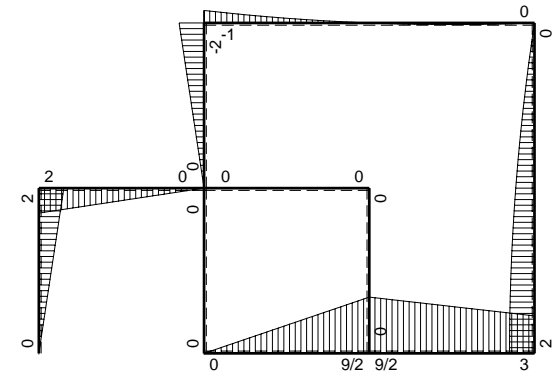
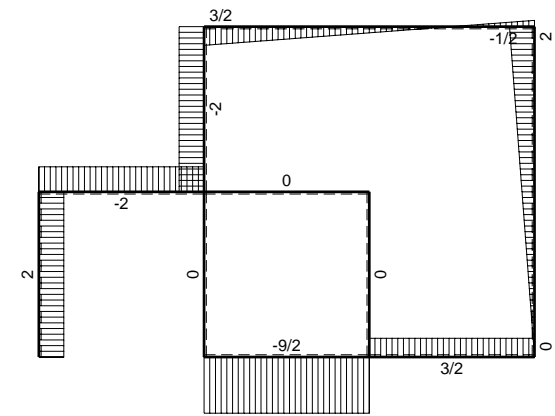
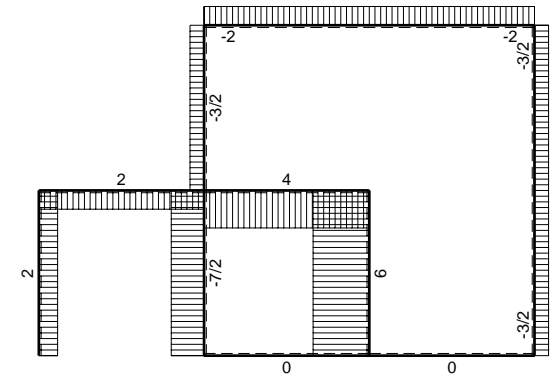
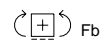
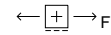
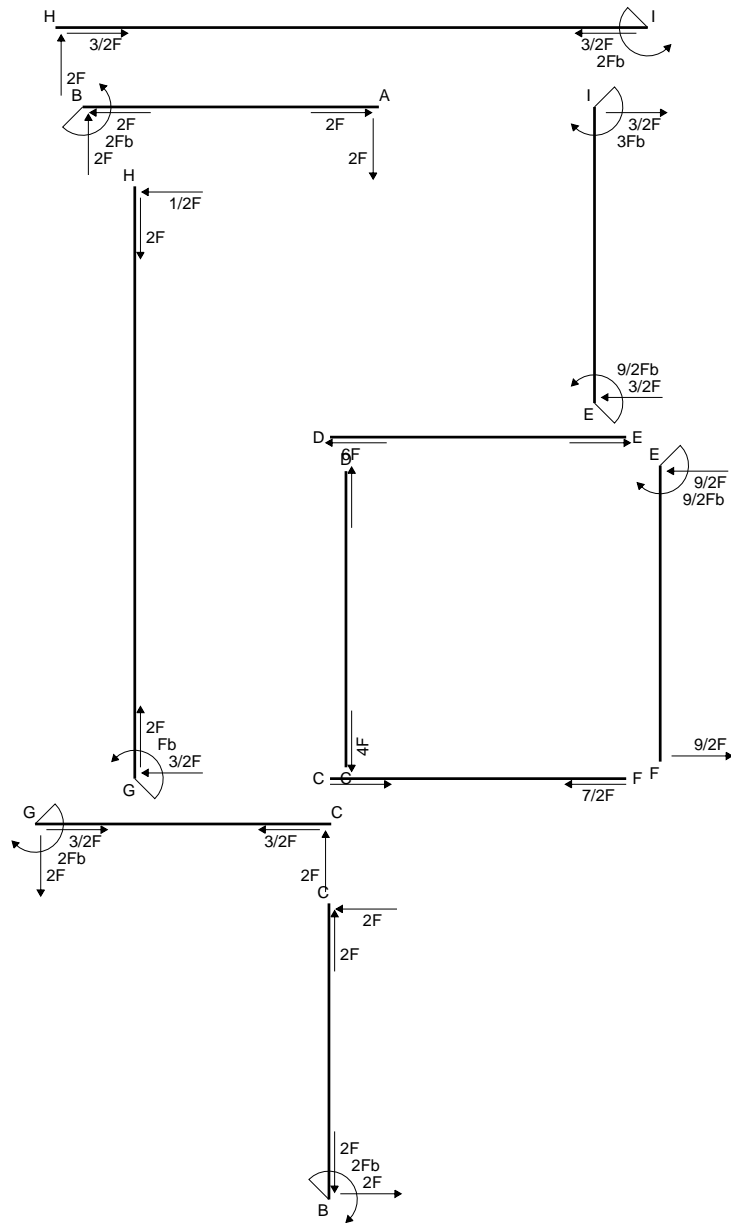
$$= (1/2 b - 1/6 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = 13/12 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0
FE b	0	$-9/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$2Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-2Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

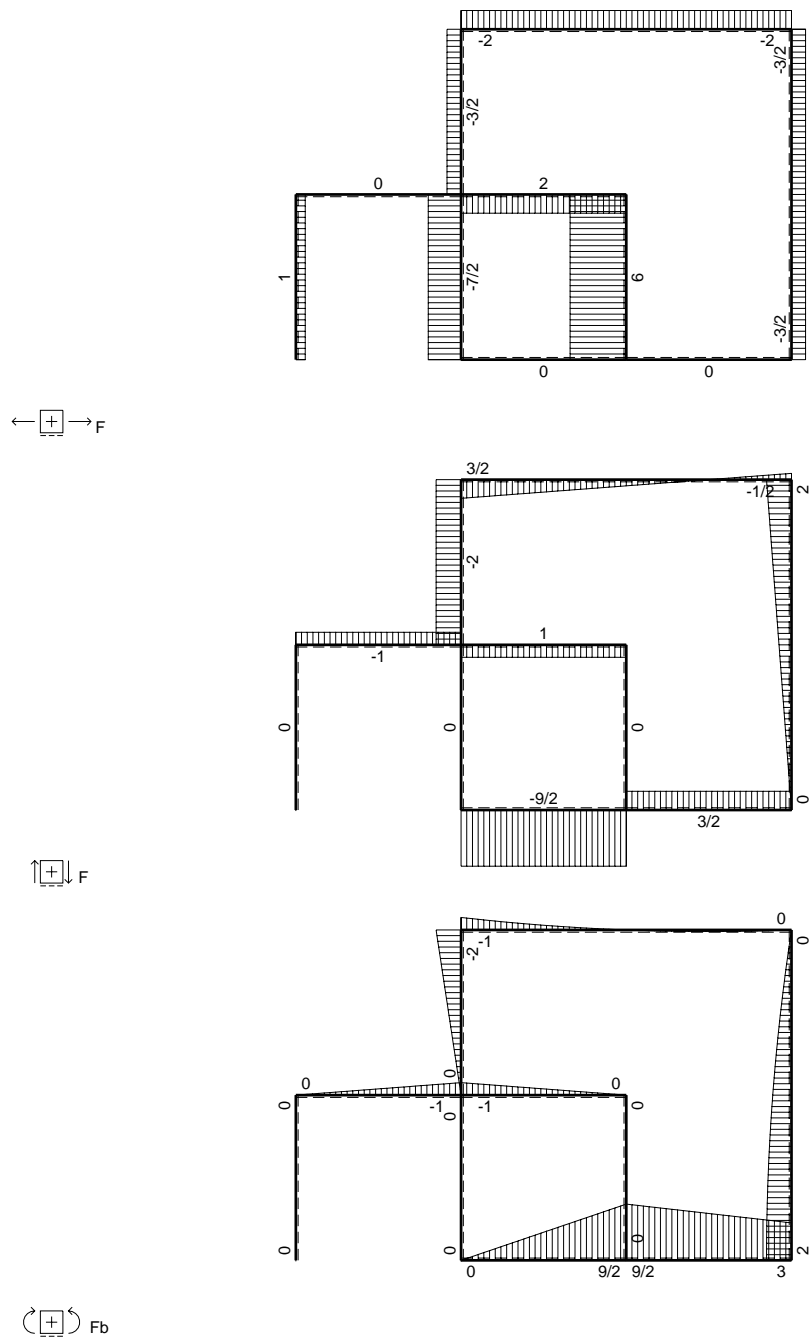
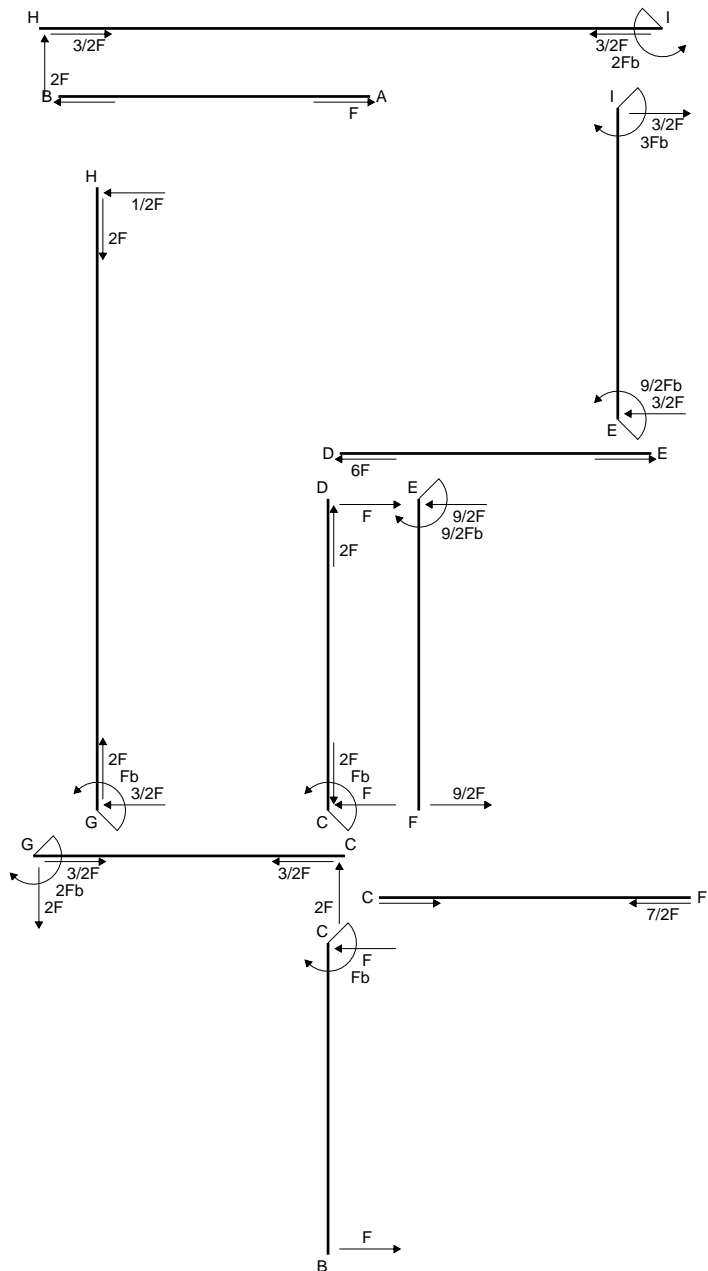
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

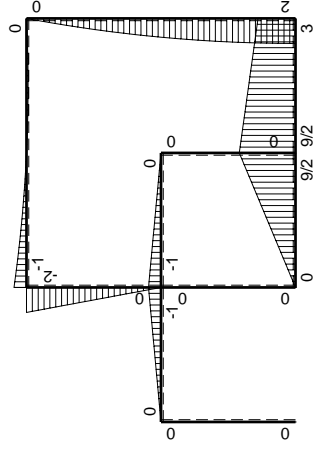
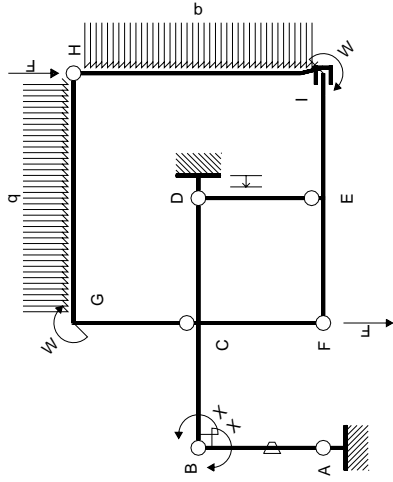
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

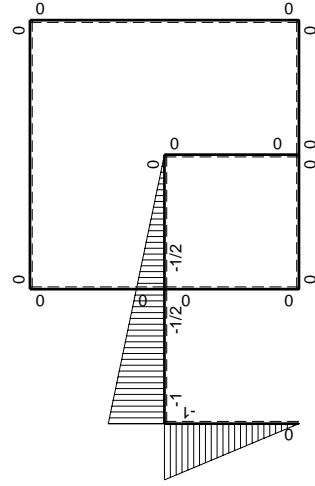
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	0	$1/2Fb-Fx+1/2Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	0	$1/2Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0
FE b	0	$-9/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						0	Xb/EJ
	iperstatica $X=W_{BC}$						0	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

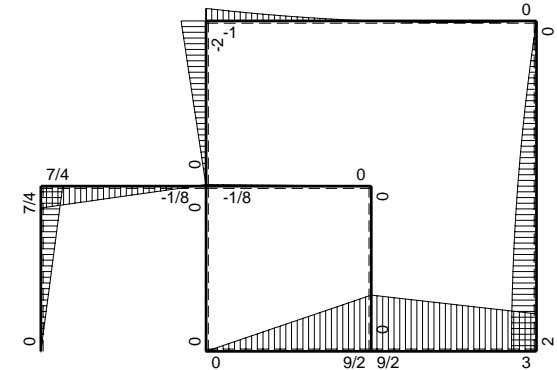
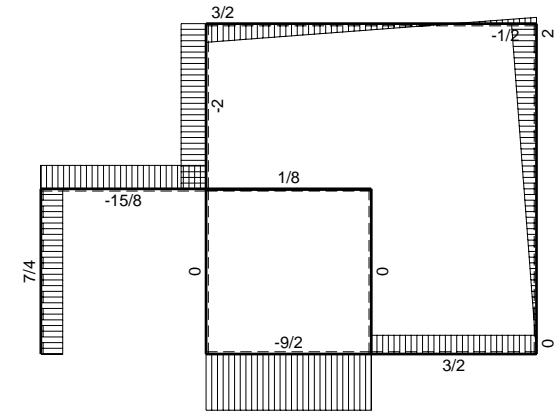
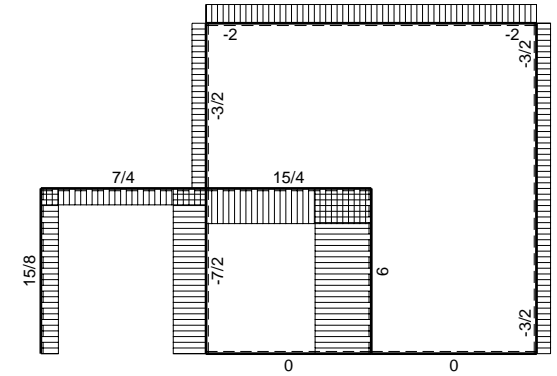
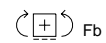
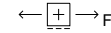
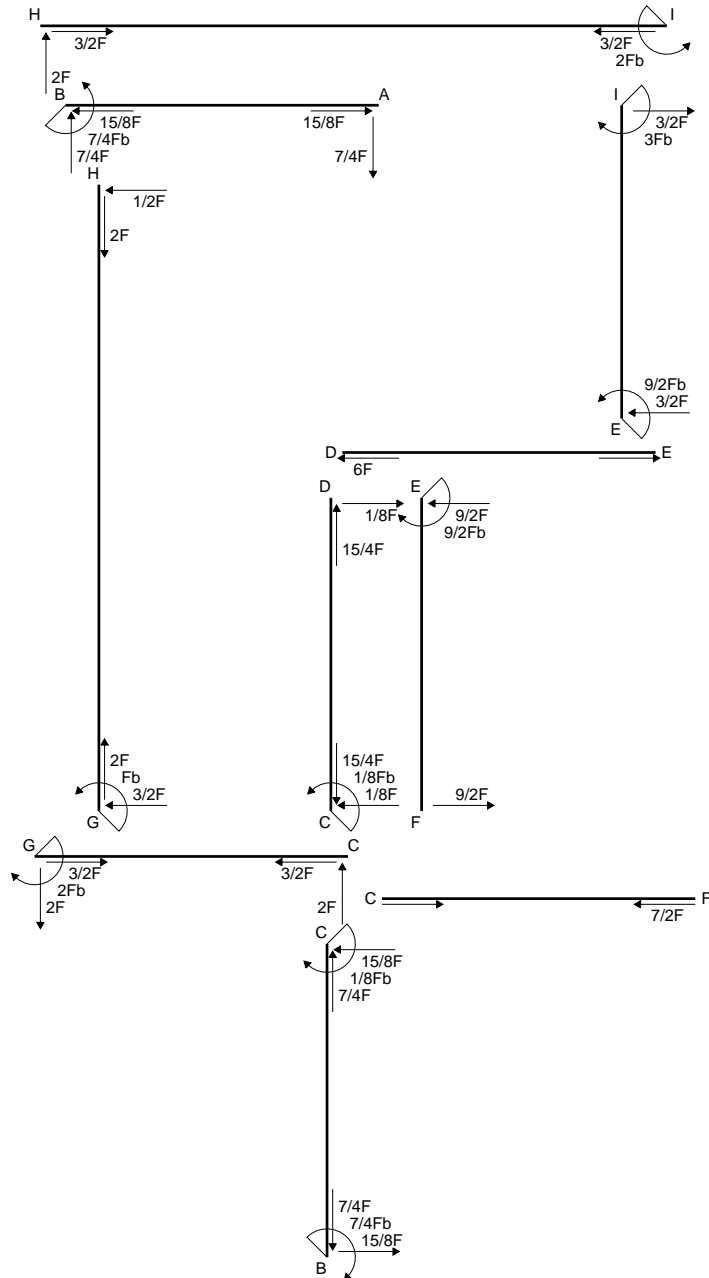
$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

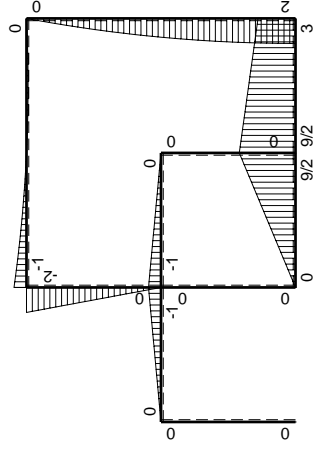
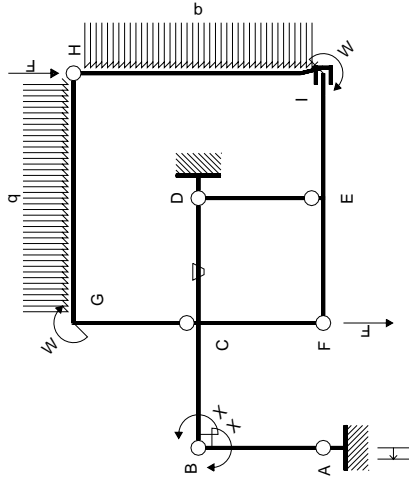
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

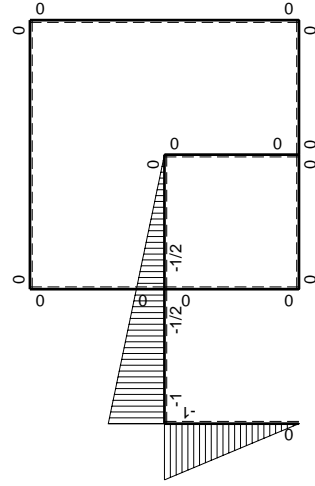
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_X flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0
FE b	0	$-9/2Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-2Fx$	0	0	0	0	0+0	0
GC b	0	$2Fb-2Fx$	0	0	0	0		
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0		
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$7/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-7/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

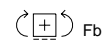
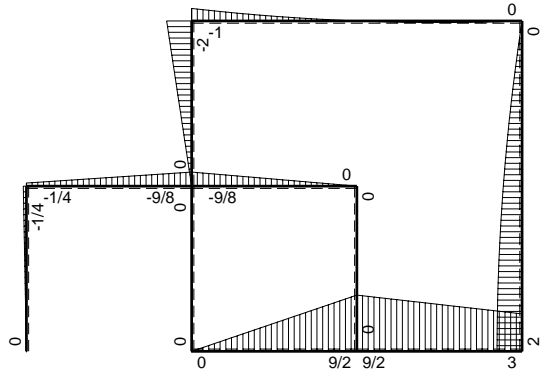
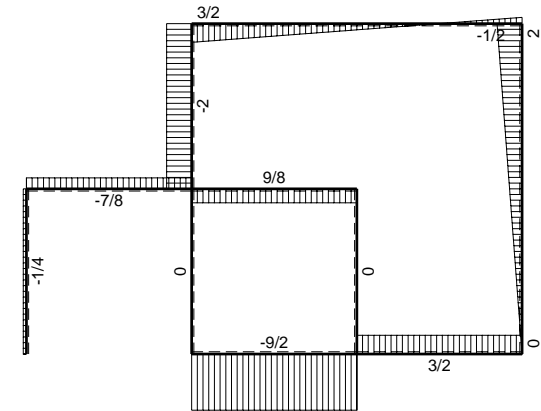
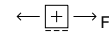
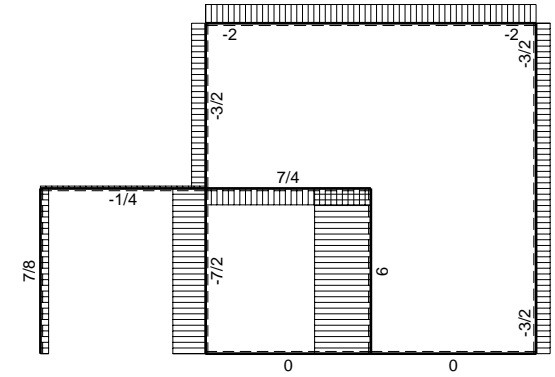
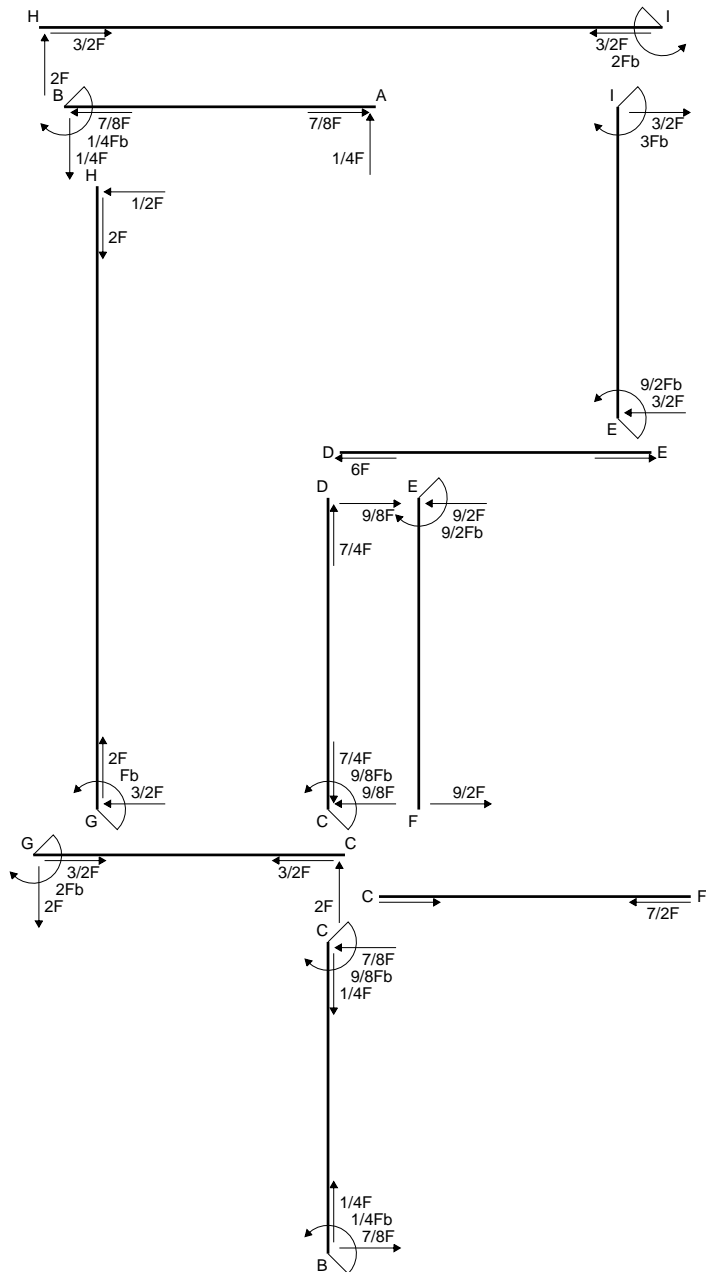
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$



Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-Fx$	0	$Fx-1/2Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/3+0)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$Fb-Fx$	0	$1/2Fb-1/2Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-Fb+Fx$	$-Fb/EJ$	$1/2Fb-Fx+1/2Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/6+1/4)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	Fx	Fb/EJ	$1/2Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$9/2Fb-9/2Fx$	0	0	0	0	0+0	0	
FE b	0	$-9/2Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-2Fx$	0	0	0	0	0+0	0	
GC b	0	$2Fb-2Fx$	0	0	0	0			
GH 2b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-1/2Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	$2Fx-1/2qx^2$	0	0	0	0	0+0	0	
IH 2b	0	$-2Fb+1/2qx^2$	0	0	0	0			
IE b	0	$3Fb+3/2Fx$	0	0	0	0	0+0	0	
EI b	0	$-9/2Fb+3/2Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$-1/4Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$1/4Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (1/2 - 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/6 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

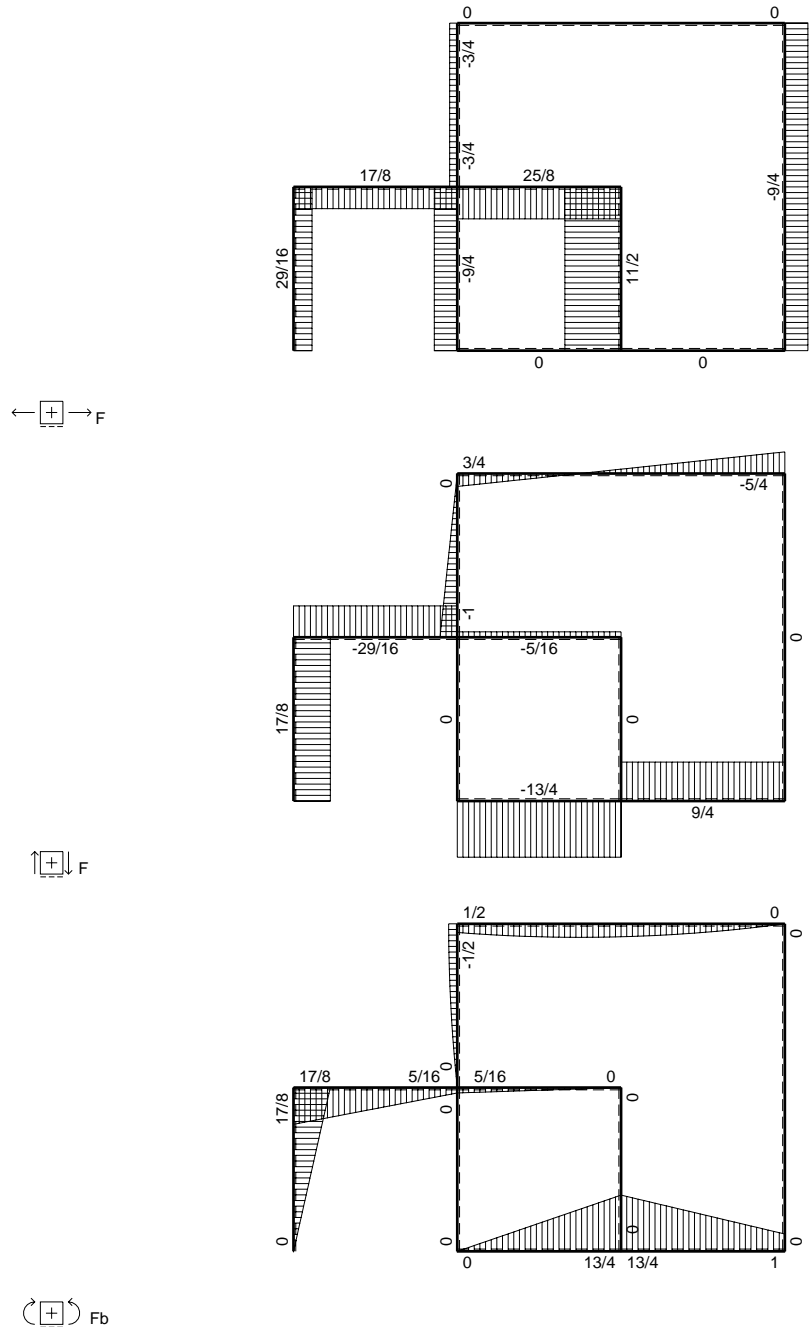
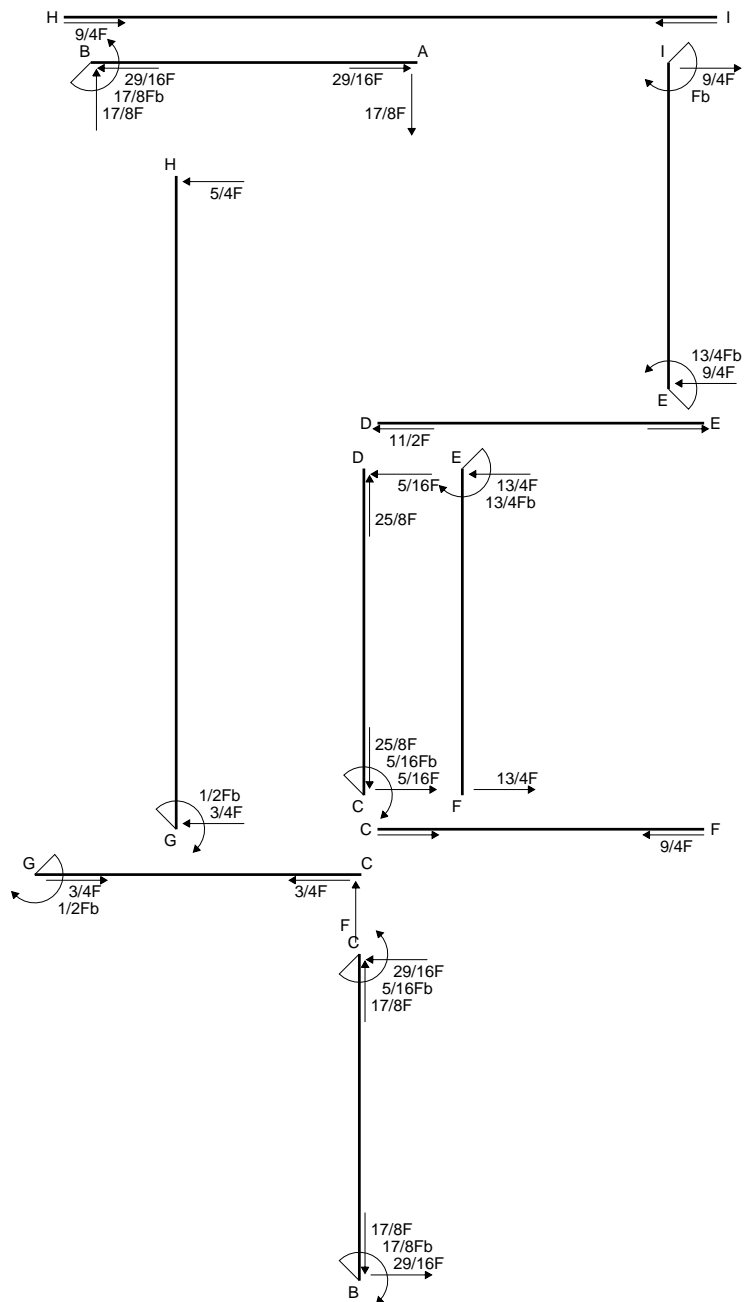
$$L_{CD}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

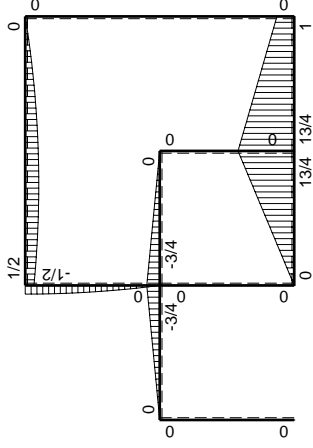
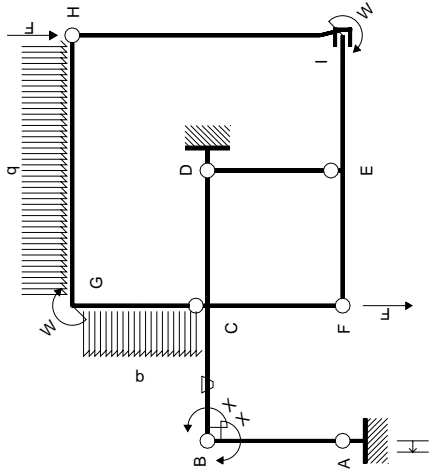
$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 5/12 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/6 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

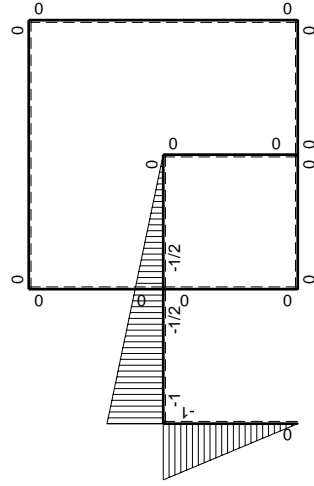
$$= (1/6 b) Fb 1/EJ + (-1/4 b) \theta = 5/12 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0			
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ		
	totali						$17/8Fb^2/EJ$	Xb/EJ	
	iperstatica $X=W_{BC}$						$-17/8Fb$		

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

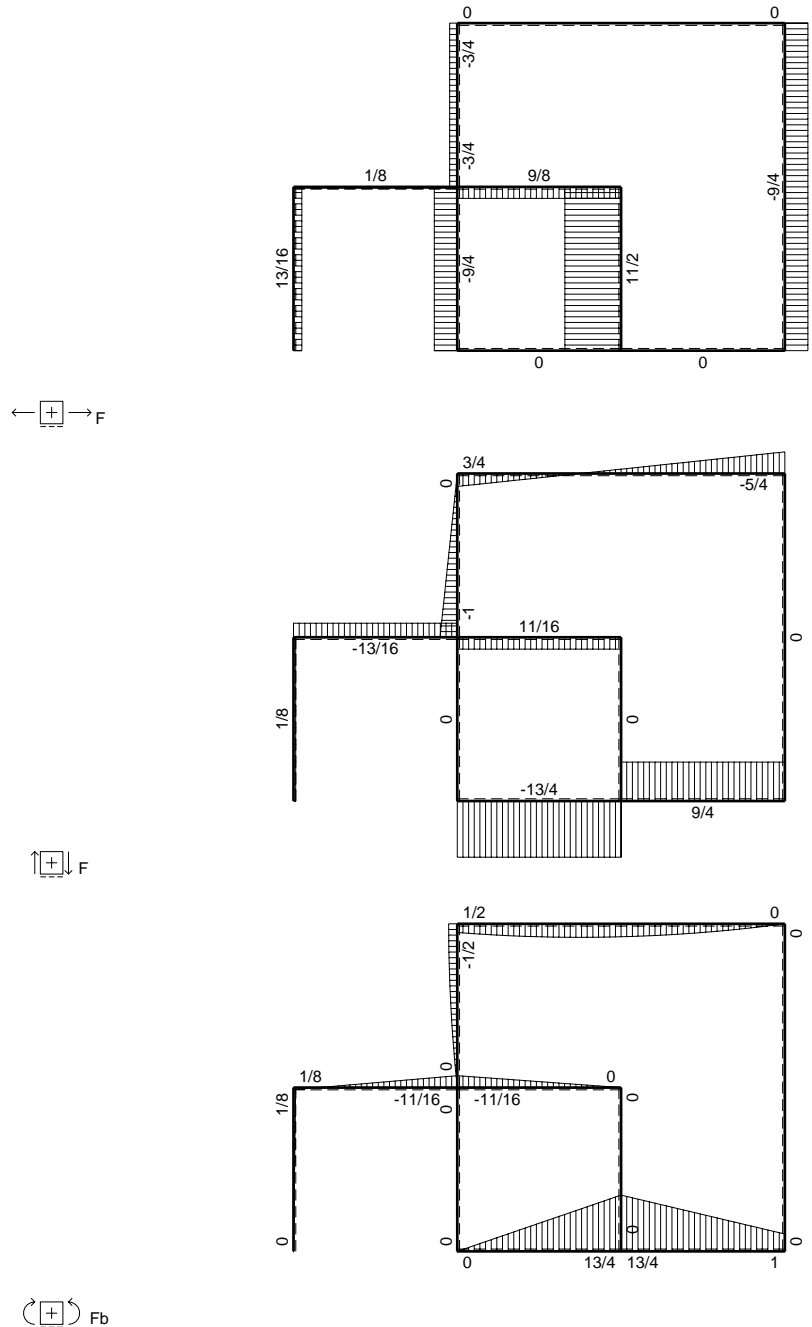
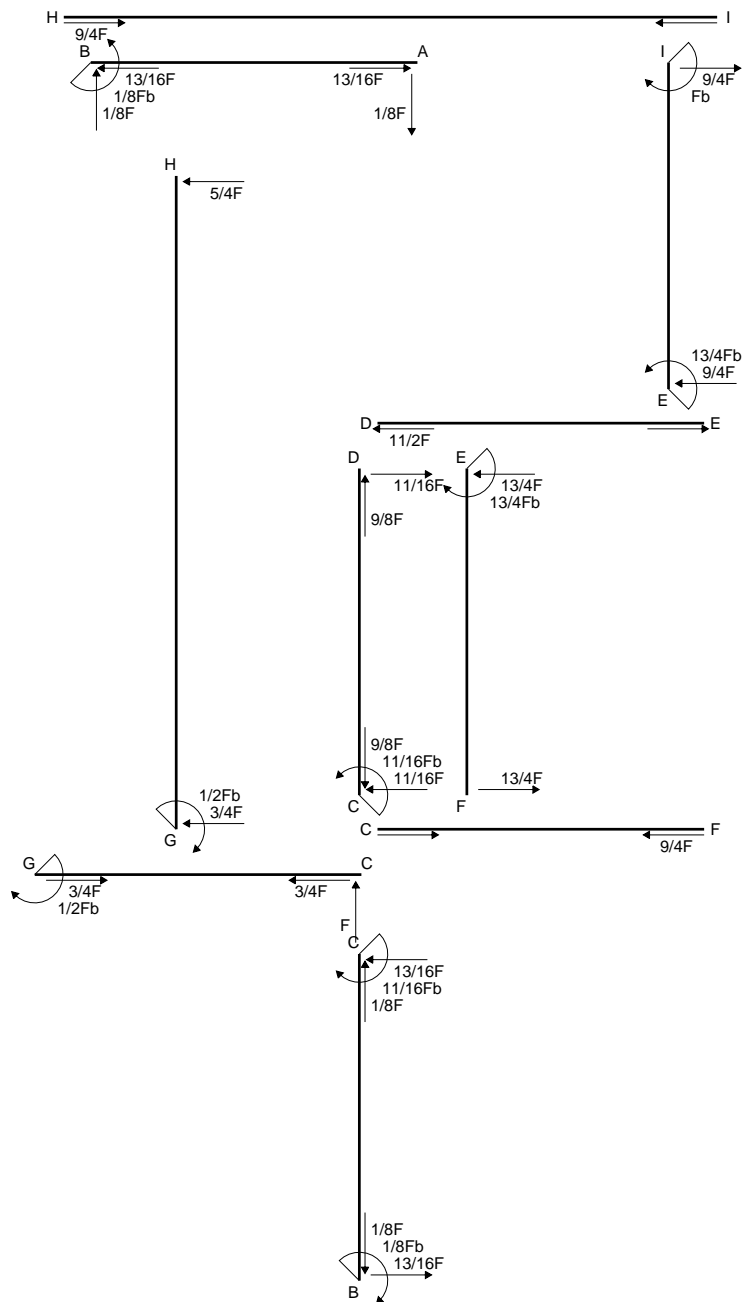
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

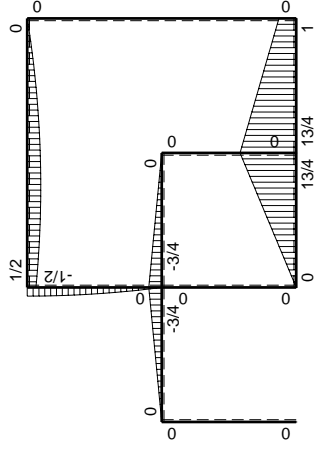
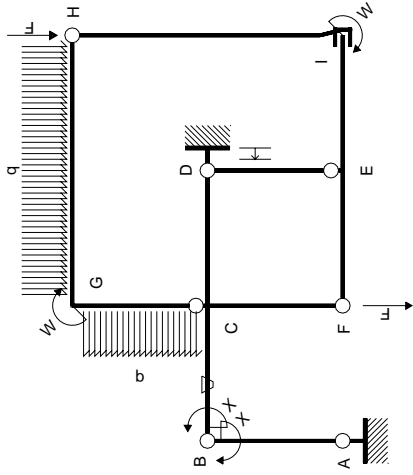
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

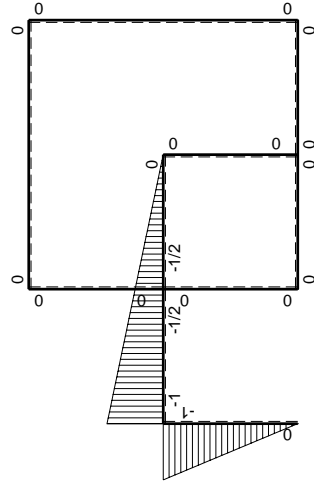
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$	
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$	
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$			
BC b	$-1+1/2x/b$	$-3/4Fx$	$-Fb/EJ$	$3/4Fx-3/8Fx^2/b$	$Fb/EJ-1/2Fx/EJ$	$1-x/b+1/4x^2/b^2$	$(1/4+3/4)Fb^2/EJ$	$7/12Xb/EJ$	
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	Fb/EJ	$3/8Fb-3/8Fx^2/b$	$1/2Fb/EJ+1/2Fx/EJ$	$1/4+1/2x/b+1/4x^2/b^2$			
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$	
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$			
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0			
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0	
FE b	0	$-13/4Fx$	0	0	0	0			
FC b	0	0	0	0	0	0	0+0	0	
CF b	0	0	0	0	0	0			
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0	
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0			
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0	
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0			
HI 2b	0	0	0	0	0	0	0+0	0	
IH 2b	0	0	0	0	0	0			
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0	
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0			
D	cedimento nodo $-H_{1D}u_D$							$-Fb^2/EJ$	
	totali							$1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$							$-1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1 - 1/2 x/b) \theta dx$$

$$= [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ + [x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 1/8 b) Fb 1/EJ + (b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/2 x - 1/4 x^2/b]_0^b \theta$$

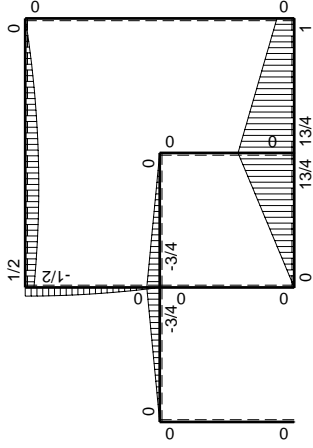
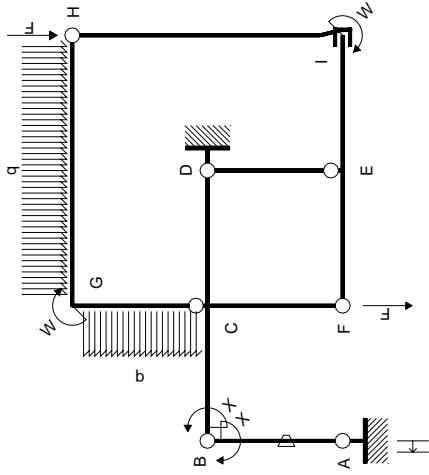
$$= (3/8 b - 1/8 b) Fb 1/EJ + (-1/2 b - 1/4 b) \theta = Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

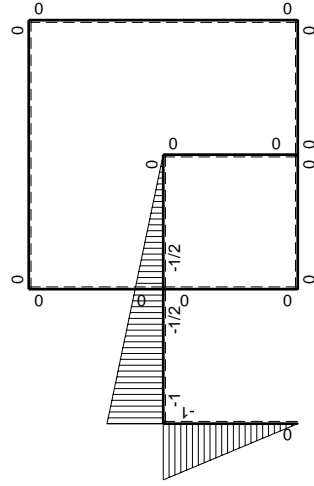
$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$15/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-15/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

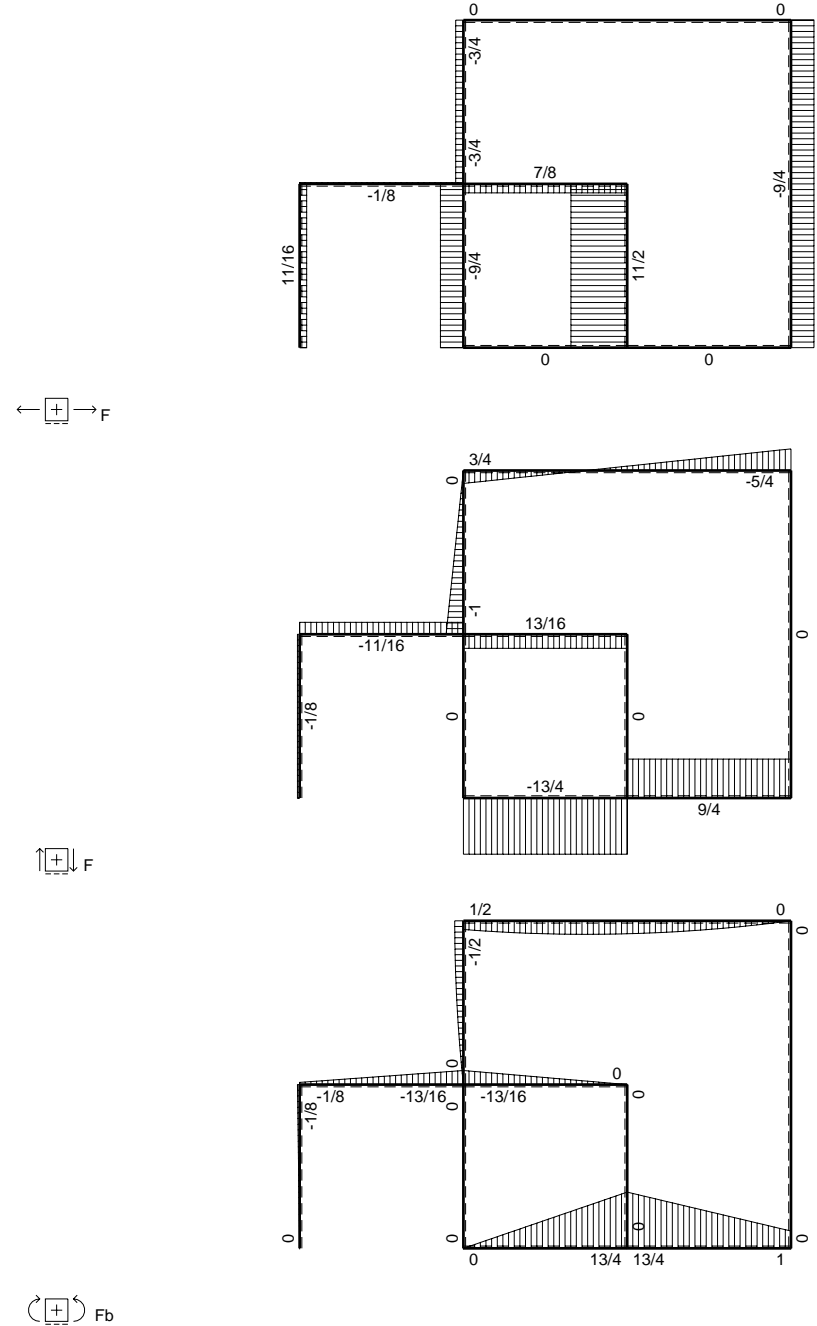
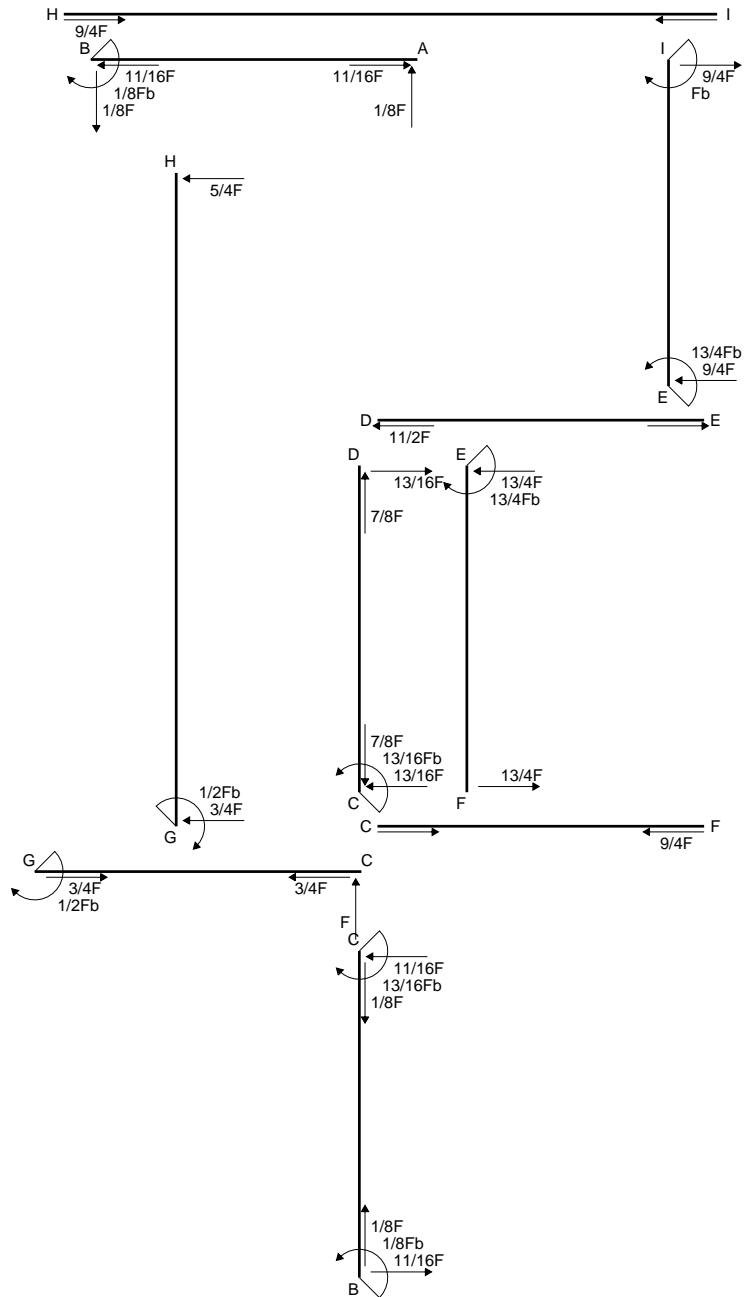
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

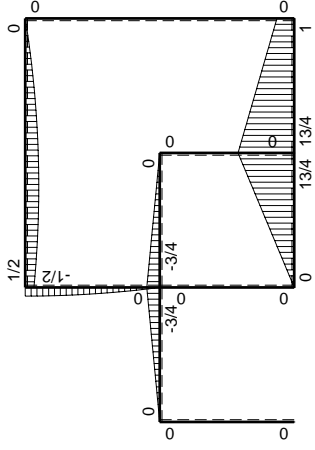
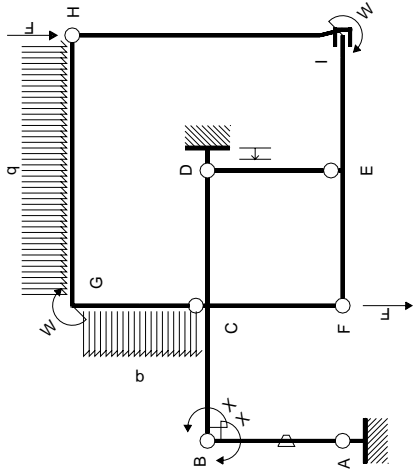
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

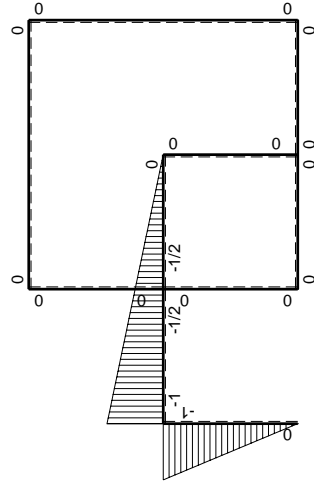
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$-x/b$	0	$-Fb/EJ$	0	Fx/EJ	x^2/b^2	$(0+1/2)Fb^2/EJ$	$1/3Xb/EJ$
BA b	$1-x/b$	0	Fb/EJ	0	$Fb/EJ-Fx/EJ$	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	0	$3/8Fb-3/4Fx+3/8Fx^2/b$	0	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+0)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	0	$3/8Fx^2/b$	0	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0		
D	cedimento nodo $-H_{1D}u_D$						$-Fb^2/EJ$	
	totali						$-1/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$1/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{AB}^{xo} = \int_0^b (x/b) \theta dx = [1/2 x^2/b]_0^b \theta$$

$$= (1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BA}^{xo} = \int_0^b (-1 + x/b) \theta dx = [-x + 1/2 x^2/b]_0^b \theta$$

$$= (-b + 1/2 b) \theta = 1/2 Fb^2/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

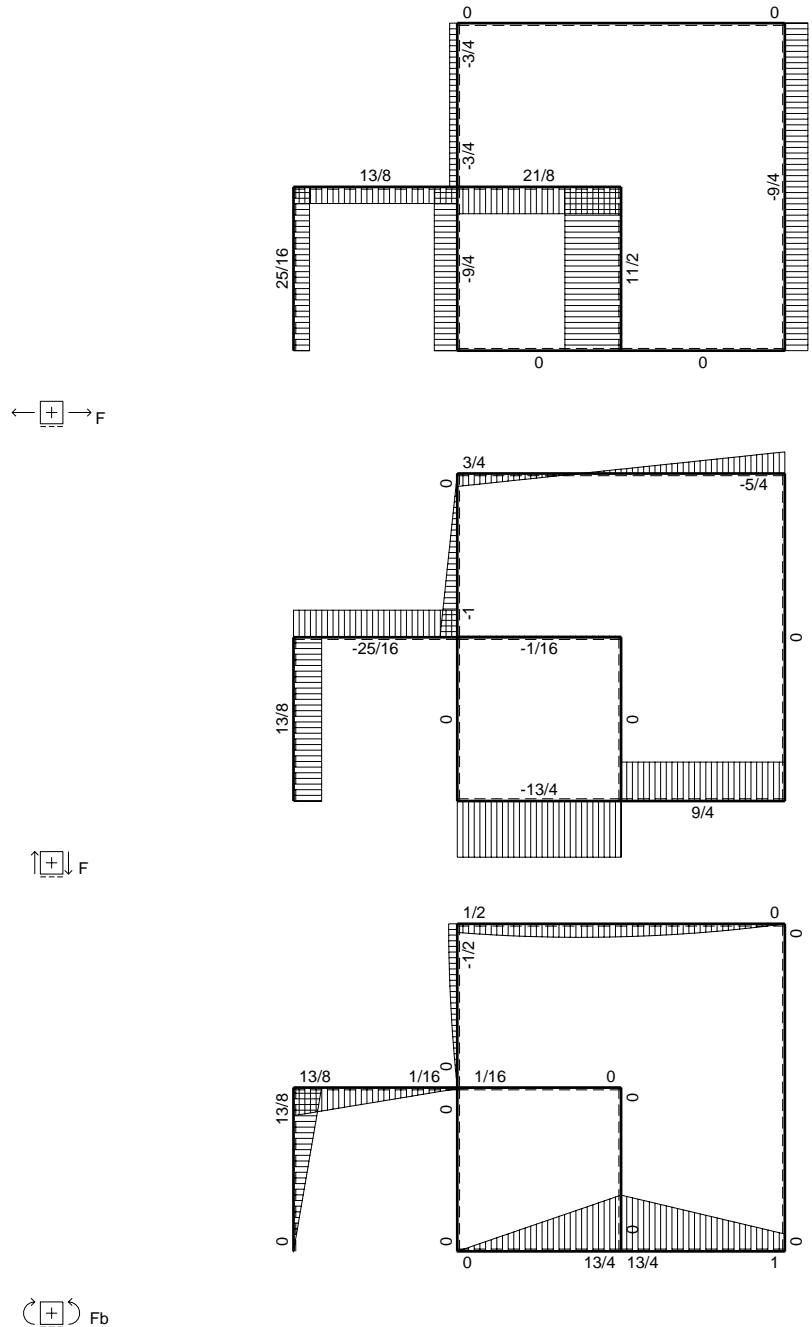
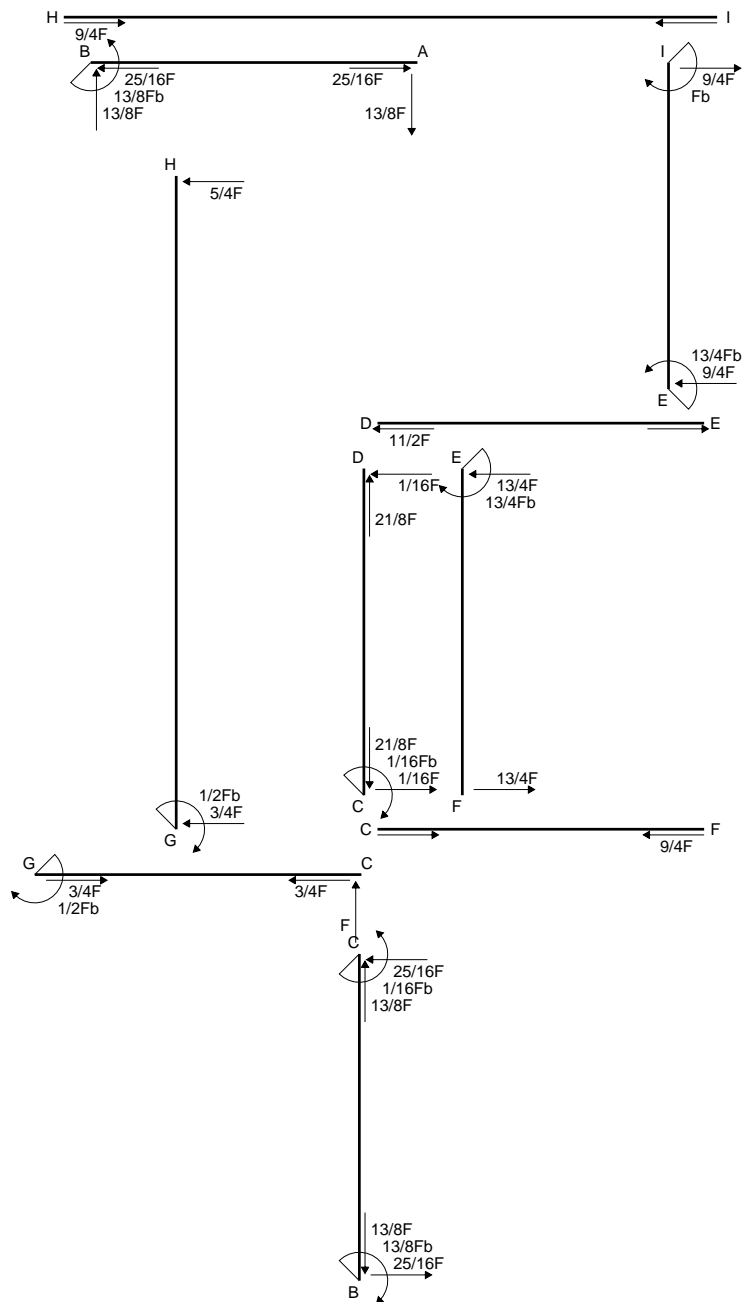
$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

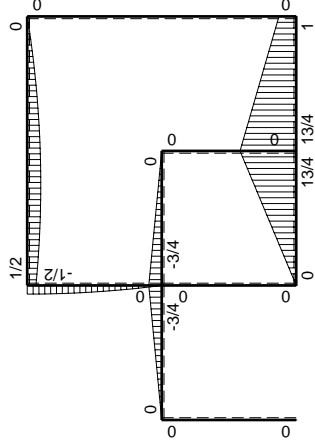
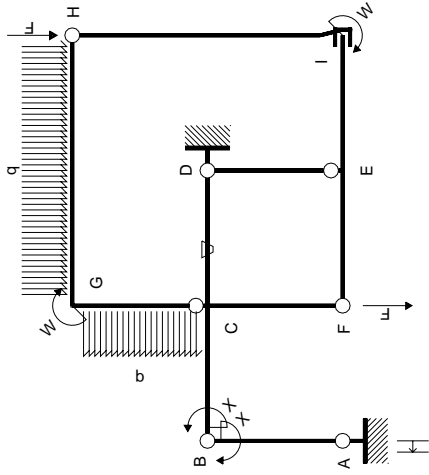
$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx = [1/8 x^3/b^2]_0^b Fb 1/EJ$$

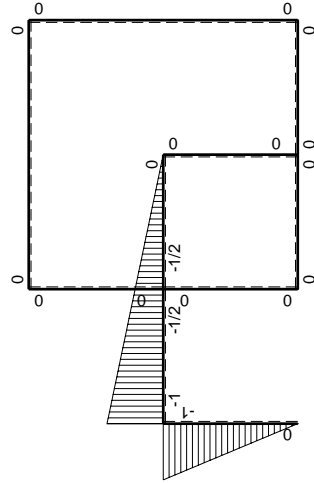
$$= (1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{BC}$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJdx$
AB b	$-x/b$	0	0	0	0	x^2/b^2	0+0	$1/3Xb/EJ$
BA b	$1-x/b$	0	0	0	0	$1-2x/b+x^2/b^2$		
BC b	$-1+1/2x/b$	$-3/4Fx$	0	$3/4Fx-3/8Fx^2/b$	0	$1-x/b+1/4x^2/b^2$	$(1/4+0)Fb^2/EJ$	$7/12Xb/EJ$
CB b	$1/2+1/2x/b$	$3/4Fb-3/4Fx$	0	$3/8Fb-3/8Fx^2/b$	0	$1/4+1/2x/b+1/4x^2/b^2$		
CD b	$-1/2+1/2x/b$	$-3/4Fb+3/4Fx$	$-Fb/EJ$	$3/8Fb-3/4Fx+3/8Fx^2/b$	$1/2Fb/EJ-1/2Fx/EJ$	$1/4-1/2x/b+1/4x^2/b^2$	$(1/8+1/4)Fb^2/EJ$	$1/12Xb/EJ$
DC b	$1/2x/b$	$3/4Fx$	Fb/EJ	$3/8Fx^2/b$	$1/2Fx/EJ$	$1/4x^2/b^2$		
DE b	0	0	0	0	0	0	0+0	0
ED b	0	0	0	0	0	0		
EF b	0	$13/4Fb-13/4Fx$	0	0	0	0	0+0	0
FE b	0	$-13/4Fx$	0	0	0	0		
FC b	0	0	0	0	0	0	0+0	0
CF b	0	0	0	0	0	0		
CG b	0	$-Fx+1/2qx^2$	0	0	0	0	0+0	0
GC b	0	$1/2Fb-1/2qx^2$	0	0	0	0		
GH 2b	0	$1/2Fb+3/4Fx-1/2qx^2$	0	0	0	0	0+0	0
HG 2b	0	$-5/4Fx+1/2qx^2$	0	0	0	0		
HI 2b	0	0	0	0	0	0	0+0	0
IH 2b	0	0	0	0	0	0		
IE b	0	$Fb+9/4Fx$	0	0	0	0	0+0	0
EI b	0	$-13/4Fb+9/4Fx$	0	0	0	0		
A	cedimento nodo $-H_{1A}u_A$						Fb^2/EJ	
	totali						$13/8Fb^2/EJ$	Xb/EJ
	iperstatica $X=W_{BC}$						$-13/8Fb$	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{BC}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) 1/EJ dx = [x - 1/2 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (b - 1/2 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CB}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x + 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) 1/EJ = 7/12 b/EJ$$

$$L_{CD}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) 1/EJ dx = [1/4 x - 1/4 x^2/b + 1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/4 b - 1/4 b + 1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{DC}^{xx} = \int_0^b (1/4 x^2/b^2) 1/EJ dx = [1/12 x^3/b^2]_0^b 1/EJ$$

$$= (1/12 b) 1/EJ = 1/12 b/EJ$$

$$L_{BC}^{xo} = \int_0^b (3/4 x/b - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x^2/b - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CB}^{xo} = \int_0^b (3/8 - 3/8 x^2/b^2) Fb 1/EJ dx = [3/8 x - 1/8 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/8 b - 1/8 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{CD}^{xo} = \int_0^b (3/8 - 3/4 x/b + 3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (1/2 - 1/2 x/b) \theta dx$$

$$= [3/8 x - 3/8 x^2/b + 1/8 x^3/b^2]_0^b Fb 1/EJ + [1/2 x - 1/4 x^2/b]_0^b \theta$$

$$= (3/8 b - 3/8 b + 1/8 b) Fb 1/EJ + (1/2 b - 1/4 b) \theta = 3/8 Fb^2/EJ$$

$$L_{DC}^{xo} = \int_0^b (3/8 x^2/b^2) Fb 1/EJ dx + \int_0^b (-1/2 x/b) \theta dx = [1/8 x^3/b^2]_0^b Fb 1/EJ + [-1/4 x^2/b]_0^b \theta$$

$$= (1/8 b) Fb 1/EJ + (-1/4 b) \theta = 3/8 Fb^2/EJ$$